WMCCAU 2025

10th WORLD MULTIDISCIPLINARY CONGRESS ON CIVIL ENGINEERING, ARCHITECTURE AND URBAN PLANNING

ABSTRACT BOOK

Czech Republic, Ostrava | September 1-5, 2025

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Preface

This volume presents the Abstract Collection of the 10th WMCCAU 2025, showcasing the oral and poster presentations from the World Multidisciplinary Congress on Civil Engineering, Architecture, and Urban Planning, held in Ostrava, Czech Republic, from 1 to 5 September 2025.

The 10th WMCCAU 2025 promotes a multidisciplinary platform that brings together forward-thinking ideas and methods across Civil Engineering, Architecture, Urban Planning, and related disciplines. The congress is designed to encourage the exchange of innovative approaches, current research, and practical solutions, while also inspiring new directions for future development.

A key mission of WMCCAU is to highlight emerging perspectives and demonstrate best practices across a wide spectrum of topics, including Civil Engineering, Architecture, Urban Planning, Accreditation, Archaeological Methods and Theories, Architectural Culture, Architectural Design and Methods, Heritage Conservation, Architectural Historiography, Spatial Architecture, Building Simulations, Planning Education, CAD, Construction Management, Construction Materials, Economics and Politics, Geotechnics, GIS-Based Modelling, Hydromechanics, Coastal Management, Quantitative Methods, Public and Regional Spaces, Risk Mitigation, Social Aspects of Architecture, Structural Engineering, Sustainability in the Built Environment, Theories of Vision, Transportation, Urban Design, Urban Sociology, and Station–City Integration.

The congress serves as a dynamic forum for professionals, researchers, and academics from around the globe to share expertise, debate pressing issues, and foster collaboration. It also provides a valuable opportunity for early-career researchers to present their findings and connect with leaders in the field.

We are deeply grateful for the strong response to this year's call for papers, with nearly 146 abstracts submitted from more than 29 countries. This reflects both the global interest in the 10th WMCCAU 2025 and the importance of working together to address the challenges and opportunities that shape our disciplines today. We hope you find this year's proceedings enriching and enjoyable, and that your time in Ostrava is enhanced by the city's distinctive industrial heritage and cultural landscape.

We look forward to welcoming you again at the next edition of the World Multidisciplinary Congress on Civil Engineering, Architecture, and Urban Planning, the 11th WMCCAU 2026, to be held in Ostrava, Czech Republic, from 31 August to 4 September 2026.

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Abstract Collection 2025

Contents

A CASE STUDY ON ENERGY PLANNING AND RENEWABLE INTEGRATION: DEVELOPING A STRATEGIC FRAMEWORK FOR STEWART COUNTY

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ABSTRACT

This research presents a systematic method for developing an Energy Planning Blueprint for Stewart County, Georgia. The study focuses on energy efficiency, renewable energy integration, and economic improvement. A thorough analysis of current energy consumption, identification of efficiency gaps, and feasibility assessment of renewable energy sources have led to a strategic framework for energy transition. The outcomes include lower energy costs for county facilities and residents, as well as increased interest from renewable energy businesses.

As part of the implementation, the project was applied to an emergency shelter to achieve energy self-sufficiency. This involved integrating renewable energy systems, enhancing energy efficiency measures, and ensuring uninterrupted power supply for critical operations. The findings demonstrate that such interventions can significantly reduce reliance on external energy sources, lower operational costs, and improve resilience in emergency response infrastructure.

Stewart County has historically faced economic and demographic challenges, including population decline, low workforce participation, and a lack of high-paying jobs. The research demonstrates that energy efficiency improvements and renewable energy adoption can contribute to reversing these trends. The study evaluates existing energy sources, environmental impacts, and feasibility of renewable energy investments. The findings support policy recommendations that enable residents and businesses to adopt energy-efficient measures and transition to renewable energy solutions.

The project was conducted in collaboration with Kennesaw State University experts. Major tasks included energy audits of county buildings, development of energy conservation guidelines, and feasibility studies of renewable energy projects. The project also resulted in the creation of an interactive online resource offering energy efficiency recommendations and renewable energy options for stakeholders.

Collaboration with state agencies, renewable energy investors, and research institutions has helped position Stewart County as a leader in sustainable energy initiatives. The study's measurable impacts include reduced energy expenditures, improved air quality, job creation, and overall economic growth. The framework developed in this research can serve as a reference model for other rural communities aiming for a transition to clean and sustainable energy systems.

Corresponding Author: Hussein Abaza

ADAPTABLE HOUSING – ANALYSIS OF EXPANDABLE APARTMENTS IN REINFORCED CONCRETE SKELETON CONSTRUCTION

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ABSTRACT

The issue of adaptable housing has been studied and verified in professional theory and practice for a long time. Currently, this topic is very relevant again, because its application in practice has been able to solve several problems related to social and ecological sustainability. The concept of adaptable housing uses several strategies, in particular flexibility, convertibility, expandability or downsizing. This article publishes partial results of research focused on the analysis of expandable apartments inserted into a reinforced concrete skeleton structure. Given the large number of old, unused buildings, the analysis of a reinforced concrete skeleton structure with a span of 7.8 m x 7.8 m, which was often used in Slovakia, especially in administrative buildings, was chosen for the purposes of publishing the results. Adaptable apartments with the potential for expansion or downsizing are inserted into open structures, which could provide more targeted support to various families who find themselves in need. During the concept design, the results of a survey focused on the requirements of various consumers were applied. The expandability of apartments will allow for higher efficiency of apartment occupancy with the same area and infrastructure. It is also believed that such modifications mean better use of space throughout the entire life cycle of buildings.

Corresponding Author: Jan Baska

ADVANCING CIRCULAR ECONOMY STRATEGIES IN MODULAR ARCHITECTURE THROUGH DESIGN FOR DISASSEMBLY AND REUSE

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ABSTRACT

The current transition to the circular economy of construction is imperatively concerned with diminishing resource depletion, construction waste mitigation, and sustainability. The concept of modularity involves prefabrication of the building elements, accomplishing great efficiency and reduced environmental impact and therefore, creates a perfect ground for transitioning the ideals of the circular economy. The existing research suggested that modular buildings can take advantage of Design for Disassembly (DfD) principles in achieving up to 50% better rates of resource recovery compared to traditional construction methods, including embodied carbon and resource consumption. In addition, the use of material passports and blockchain-enabled tracking systems contributes to greater traceability of building components, ensuring that elements of a building are used at the end of their lifecycle. Through BIM, such designs can be optimized for circularity by enabling precise material quantification and adaptive reuse planning. There are still significant constraints holding up the realization of these benefits, including regulatory constraints, non-standardized modular component options, and financial disincentives relating to material reuse. This study therefore advocates policy intervention, financial incentives, and collaborative frameworks to address these barriers. The research moves forward by discussing some of the issues facing the construction industry and even embracing cutting-edge technological novelties by thinking about moving the industry closer to its transformative journey away from the linear "take-make-dispose" concept and into regenerative politics through circular action by highlighting all the benefits of circular, modular construction. The potential of sustainable architecture would be greatly transformed and promoted with how modular construction is applied, particularly to match circular economy principles which are aiming for a new level of resource efficiency.

Corresponding Author: Belkhiri Kenza

ANALYSIS OF CHANGES IN HEAT CONSUMPTION IN THE DEVELOPING HOUSING ESTATE

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ABSTRACT

Payments for heating apartments, which account for the majority of building maintenance costs, were analysed. Generally, for all apartments in Central Europe payments for heating exceed 50% - 75% and more housing maintenance costs. Based on the analysis of heat consumption over many years, equations describing the heat consumption of residential buildings depending on the ordered power were determined. The model uses approximations obtained in publications. The theoretical value of degree days Do=1282 was determined, at which the buildings do not require heating due to internal heat gains and gains in solar radiation energy. A relationship was determined too showing heat consumption depending on the ordered heat power and the degree days in subsequent years of the building's operation. Calculations were made in accordance with the PN-82/B-02403 standard on the example of a town located in the third climatic zone in Poland, which corresponds to standard conditions of outdoor air temperature -20C and average annual outdoor air temperature of 7.6C. The calculations take into account real temperatures based on historical meteorological measurement data.

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ANALYSIS OF THIN-WALLED TRI-LAYERED ELASTIC-PLASTIC TUBES IN LOADING AND UNLOADING PHASES

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ABSTRACT

Analysis of thin-walled tubes of elastic-plastic behavior is reported here. Various hollow tubes are being increasingly applied in many segments of the quickly developing engineering. Usually, in their numerous practical applications tubes work as pressure vessels. Therefore, the most frequent case of loading on tubes is the pressure. As a result of this, the attention of scientists and engineers around the globe usually is confined to the analysis of the mechanical response of tubes to internal pressure. Most of the studies deal with tubes behaving linear-elastically under loading. If, for instance, even at very low magnitudes of the pressure loading the tubes behave elastic-plastically, the equations for stresses obtained with linear-elastic behavior being assumed do not hold at all. In such situations, the tube response has to be analyzed by applying constitutive laws expressing the stress as a smooth non-linear function of the strain. The tubes analyzed here are tri-layered. The analysis is based on a theoretical formulation which incorporates loading as well as unloading phases of the response of the tubes. Formulas for the stresses in the layers are derived. The length of the tube in the hoop direction and the length of the tube radius are expressed as functions of strains in the phase of loading. A detailed study of the tube response during unloading is carried out. The residual stresses as well as the residual lengths of the tube in the hoop direction and the radius are presented as functions of the residual strains. Diagrams illustrating the functional relations between the characteristics of the tube response and the parameters of the tube geometry and pressure during loading and unloading phases are shown.

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ANALYSIS OF THE POZZOLANIC ACTIVITY POTENCIAL OF HAZELNUT HUSK ASH

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ABSTRACT

Hazelnut husks are considered as a waste and therefore are discarded as fuel, compost or disposed into landfills. When used as fuel, ash is generated which can be used an additive for the construction industry in mortars or cement. Several studies have shown that different organic waste ash have pozzolanic properties and cand be used as additives. This study focuses on the determination of the pozzolanic potential of the ash from hazelnut husks, and the effect of the calcination temperature. For these purposes, a modification of the “Rapid determination of pozzolanic activity method” developed by Dalinaidu in 2007 was employed. The chemical principal of the methodology is based in the loss of the electro conductivity due to the reaction of the pozzolan with calcium hydroxide to form additional cementitious compounds. Because the particle size has an impact on the pozzolanic activity, initially the husk was shredded with a home-made blender and sieved though an ASTM Nº 40 sieved. Afterward the samples where calcinated at three different temperatures: 550º, 650º and 750ºC, crushed with a mortar and passed through the Nº 200 sieved. In this wat the particle size was ensured that was below 75 microns. Calcium hydroxide was employed for the reaction and the electroconductivity was measured though time until it stabilized. For each sample the electroconductivity was measured every 5 minutes until the measurement were stable. For the procedure it was determined that the total time that required was 50 minutes. The result showed that the electroconductivity between 550ºC and 750ºC had an increase from 0,24 mS/cm to 0,41 mS/cm. From the analysis all samples presented pozzolanic activity and the highest activity was observed with the sample that was calcinated at 750ºC. Therefore, hazelnut husk ash presents pozzolanic potential and temperature is a key factor in its potential as an additive in mortars or cement.

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AN OVERVIEW OF TECHNOLOGIES AND TOOLS USING EYE TRACKING IN THE RESEARCH OF ARCHITECTURE AND URBAN SPACES

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ABSTRACT

The use of eye tracking technology in architectural research is innovative and allows for experiments to be conducted in the field of perception of the built environment in various aspects and scales. Designers are interested in improving the quality of proposed solutions in the field of interior design, wayfinding, and perception of the urban environment. The researcher wants to obtain measurable results that can indicate the direction of development of the proposed concepts based on the evaluation of existing solutions as well as those in the design phase. In order to effectively carry out experiments using the described technology, it is necessary to be familiar with the available research tools, techniques for conducting experiments, and the interpretation of results and their implementation in subsequent iterations of experiments or project implementations. Therefore, the author decided to prepare a review article on available technologies and research tools supported by eye tracking technology and its implementation in research in the field of architecture and urban planning. His own experience with attempts to use the tool made available for research in the form of THE EYE TRIBE with proprietary software written by professor Paweł Kasprowski (SUT - Department of Applied Computer Science, Faculty of Automation, Electronics and Computer Science), became a pretext for seeking answers to questions concerning the diversity of eye movement recorders available on the market and their integration with software for processing and interpreting observation data. The questions raised in the article concern the cost of purchasing the system, its ease of use, and the level of integration with popular virtual environment modeling tools used to simulate spaces designed by architects and researchers of built environment perception. The fundamental issue from the researcher's point of view is whether it is possible to design and launch a research station without specialist knowledge in disciplines other than the leading ones (architecture and urban planning). If not, who should be involved in the research team in order to achieve the expected results? The final conclusions include a description of the difficulties associated with the use of the tools described and recommendations on how to organize the process of preparing and conducting experiments/research.

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ANTIBACTERIAL PROPERTIES OF CEMENT PASTES WITH ADDITION OF LITHIUM HYDROXIDE, CUPRIC OXIDE, AND TITANIUM DIOXIDE

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ABSTRACT

In order to provide improved functionalities to concrete, new materials are being studied as antibacterial additions. This could result in a reduction in bacteriological hazards bonded to the surfaces of concrete structures, reducing the requirement for cleaning and chloride use. Therefore, this study evaluates the antibacterial action, and the compressive and flexural strength of cement pastes made with different water/cementitious material ratios (0.35, 0.40, and 0.45) and addition percentages of lithium hydroxide (LiOH), cupric oxide (CuO), and titanium dioxide (TiO2) (1%, 3%, 5%, and 10% by weight) separately on *Escherichia coli*. Antibacterial activity was assessed using inhibition zone measurements, optical density (OD at 600 nm), and colony-forming unit (CFU) counts after exposure to *E. coli*. Mechanical performance was evaluated through flexural and compressive strength testing at 7 and 28 days. Results show that LiOH decreases the pastes' strength while producing the highest antibacterial effect due to its high reactivity and pore-inducing behavior; CuO demonstrated the lowest antibacterial effect due to agglomeration issues but increased strength due to its inert nature and filler effect; and TiO2 had an intermediate antibacterial effect with less strength loss than LiOH, although its antibacterial property was not activated by UV require to its photocatalytic mechanism. Also, it was found notable discrepancies between antibacterial assessment methods, highlighting the need for a multi-technique approach to reliably evaluate antimicrobial performance in cement-based materials. Furthermore, the dispersion of microparticles within the paste significantly influenced both antibacterial efficacy and strength development, suggesting that proper mix design and potential use of dispersion aids are critical for industrial applications. As a result, it was concluded that the three compounds could be used as potential additions to concrete to produce an antibacterial effect. Nevertheless, CuO and TiO2 are highly dependent on the dispersion grade, whereas lithium salts are among the best alternatives due to their soluble potential.

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APPLICATION OF THE DPSIR FRAMEWORK FOR INTEGRATED WATER RESOURCES ANALYSIS IN ZADAR COUNTY, CROATIA

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ABSTRACT

Water resources in Croatia, particularly in coastal regions like Zadar County, face significant challenges due to both natural and human-induced factors. The impacts of climate change, along with rapid tourism development, pose threats not only to freshwater systems such as rivers and aquifers but also to the quality of coastal waters. Sustainable water resource management requires balancing ecological, social, and economic needs, while also ensuring these needs can be met in the future. Therefore, it is essential to quantify and assess the current state of water resources, identify potential impacts, and understand how these may evolve over time. The DPSIR (Driving forces, Pressures, State, Impacts, and Responses) framework offers a comprehensive approach for assessing and managing environmental issues, particularly in the context of water resources. It helps identify the links between potential sources of environmental problems and their consequences. In this paper, the DPSIR methodology is applied to Zadar County, Croatia—a region facing potential water-related and environmental challenges. The analysis covers the driving forces influencing water resources, the pressures on water quality and availability, the current state of various water bodies, and the resulting ecological and socio-economic impacts, as well as the responses from different stakeholders. Population growth and tourism development have been identified as the main driving forces, while increased water consumption and wastewater discharge are the primary pressures. Although the current state of water bodies is generally satisfactory, it is subject to change, which could lead to ecological, social, and economic consequences. This paper explores the complex relationship between human activities and water resource management, providing a foundation for more sustainable water management policies in the region.

Corresponding Author: Tomislav Škara

APPLICATIONS OF INNOVATIVE ELEMENTS OF INDUSTRIALIZATION IN THE FIELD OF CONSTRUCTION INDUSTRY AND WOOD-BASED BUILDINGS

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ABSTRACT

The industrialization of construction has accelerated significantly in recent years thanks to automation, prefabrication, digitalization and sustainable solutions. In the field of timber construction, these innovations are reflected in more efficient and environmentally friendly production and construction processes. Timber construction plays a key role in sustainable construction, as wood is a natural, renewable and carbon-neutral material. In combination with modern technologies and innovations, they become even more environmentally friendly, energy-efficient and durable. The purpose of this manuscript is to point out, within a limited scope, the principles and aspects related to the above-mentioned topics, both in terms of raising awareness of the given topics and also to initiate new research tasks for increasing the performance of the construction industry as such. Because, for example, innovations in the industrialization of timber construction enable faster, more precise and more sustainable construction. The combination of prefabrication, digitalization, automation and smart solutions is creating a new era of wooden buildings that are not only environmentally friendly but also competitive with traditional building materials.

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ASPECTS OF THE INTERNAL ENVIRONMENT OF BUILDINGS IN THE FIELD OF AGRICULTURAL PRE-PRODUCTION

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ABSTRACT

Livestock farming is an important segment of agricultural production that faces challenges in terms of sustainability and effective management. Growing requirements for food production, stricter environmental regulations and economic demands are forcing farmers to look for innovations aimed at long-term stability and profitability of farms. Sustainability in this area includes ecological, economic and social aspects, with an emphasis on minimizing negative environmental impacts, optimizing costs and ensuring animal welfare. Effective breeding management is closely related to the use of modern technologies that enable accurate monitoring of housing conditions and automated operation management. Sensor systems play a key role in monitoring microclimatic conditions, air quality, dust, or light and noise levels. The implementation of smart sensors makes it possible to optimize ventilation, temperature control and improve overall breeding conditions, thus achieving higher productivity and lower operating costs. The article analyzes key aspects of the indoor environment of agricultural buildings and the importance of sensors in the monitoring of housing areas. The benefits of these systems in terms of improving animal health, reducing the ecological burden and managing operations more efficiently are discussed. Research suggests that the use of sensory technologies and IoT solutions in livestock farming represents a necessary step towards sustainable and technologically advanced agriculture.

Corresponding Author: Terézia Pošiváková

ASSESSING CONCRETE STRENGTH: INSIGHTS FROM SCHMIDT REBOUND HAMMER AND ULTRASONIC PULSE VELOCITY TECHNIQUES

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ABSTRACT

Concrete strength assessment is pivotal in ensuring the structural integrity and longevity of various constructions. Non-destructive testing (NDT) methods have emerged as indispensable tools for predicting concrete strength in situ, facilitating timely interventions and quality assurance protocols. Among these methods, the Schmidt rebound hammer (RH) and ultrasonic pulse velocity (UPV) techniques have gained prominence due to their simplicity, cost-effectiveness, and on-site applicability. This study delves into the relevance and efficacy of RH and UPV techniques for predicting concrete strength, focusing on the development of mathematical correlation models between NDT parameters and compressive strength.

The research involves conducting comprehensive experimental investigations on a diverse range of concrete specimens encompassing different mix designs, strength ranges, and ages. Compressive strength, the gold standard for concrete strength determination, was evaluated through destructive testing methods. Concurrently, non-destructive assessments employing RH and UPV were performed on the same specimens. The rebound values from Schmidt Rebound Hammer test and the velocity of ultrasonic pulses were correlated with compressive strengths to establish predictive models. Uni-parametric (RH-Strength and UPV-Strength) correlation models, as well as combined models, were developed to explore the relationship between NDT parameters and concrete compressive strength.

In evaluating concrete strength using the Schmidt rebound hammer test, it was observed that this surface test exhibited less sensitivity to variations in concrete mix design within the same strength range. Instead, its sensitivity primarily stemmed from variations in concrete strength, attributed partly to the density of the cement paste at the surface. Conversely, the Ultrasonic Pulse Velocity test emerged as more relevant for assessing concrete strength, given its ability to investigate concrete depth. However, it displayed lower sensitivity to variations in concrete mix design when dealing with high-strength concretes. Despite these nuances, the proposed correlation models demonstrated reliability and accuracy, evident from the coefficients of correlation obtained. Furthermore, the utilization of combined models facilitated an improvement in prediction accuracy compared to uni-parametric models alone. Notably, it was observed that concrete mix design and the age of concrete exerted significant influence as factors diminishing the precision of concrete strength prediction using non-destructive testing (NDT) methods. These findings underscore the importance of considering such influencing factors and refining model calibration processes to further improve the reliability of NDT-based concrete strength assessments.

RH and UPV techniques offer valuable insights into concrete strength prediction, aiding rapid on-site assessments and quality control during construction projects. While both methods present strengths and limitations, integrating them alongside conventional testing approaches enhances the reliability and efficiency of concrete strength evaluation. The development of correlation models facilitates quantitative predictions of concrete strength based on NDT parameters, advancing the state-of-the-art in non-destructive evaluation of concrete. Further research focusing on refining testing protocols and calibration techniques is warranted to optimize the accuracy and applicability of these techniques in concrete engineering practices.

Corresponding Author: Narmane Fodil

ASSESSING PUBLIC TRANSPORT ACCESSIBILITY THROUGH THE PTQC SYSTEM: THE L'AQUILA CASE STUDY

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ABSTRACT

Assessing public transport accessibility is crucial for effective urban and regional planning. This paper focuses on the Austrian Public Transport Quality Classes (PTQC) system, a standardized assessment method, which is utilized to evaluate accessibility in various geographical contexts. Based on Swiss methodologies, the PTQC system considers several factors, including service frequency, transport hierarchy, and pedestrian access to stops. It categorizes transport areas into seven quality classes (A-G), ranging from high accessibility in well-served urban zones to more basic service in peripheral areas. This study investigates the development, methodology, and application of the PTQC system, emphasizing its importance in spatial planning, infrastructure management, and public transport optimization.

To test its applicability, the PTQC methodology was adapted to the city of L'Aquila, located in central Italy's Apennine region. L'Aquila presents distinct challenges, including its hilly landscape, historic urban structure, and ongoing post-earthquake reconstruction. The analysis involved a comprehensive approach, incorporating data collection, adjustments to classification criteria, and spatial analysis using GIS tools.

The findings reveal significant disparities in public transport accessibility. Only a few key transport corridors leading to the city center met the required quality standards, indicating near-sufficient coverage. In contrast, peripheral areas show a noticeable decline in public transport quality, with longer waiting times and less frequent service. Notably, several districts rebuilt after the earthquake remain inadequately served, creating mobility issues for residents. The study also emphasizes the need to improve intermodality, particularly enhancing connections between low-accessibility residential areas and major transport hubs.

A comparative analysis with an Austrian city revealed a functional gap in public transport within the study area and demonstrated the PTQC system's adaptability to different urban settings. However, the integration of real-time data is critical to refine the accuracy of assessments, especially in areas with fluctuating seasonal transport demand. Ultimately, the PTQC system proves to be an effective tool for urban mobility planning and the optimization of public transport services in diverse territorial contexts.

Corresponding Author: Martin Grabner

ASSESSMENT OF DAMAGE TO CUBIC BUILDINGS IN FLOODED AREAS

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ABSTRACT

Natural disasters can be defined as sudden and destructive phenomena occurring in nature that cause extremely negative impacts on the environment, human life and property. The article discusses a selected type of natural disaster such as flooding, its characteristics and negative impact on building structures. The phenomenon is discussed using the example of the flood that affected southern Poland in September 2024.

The first part of the article presents and characterizes the types of damage to buildings caused by the destructive force of flood waters. Numerous damages to buildings required expert assessment in order to allow the building to be reused or decommissioned.

The next part of the article is a description of the procedures and applicable legal acts related to the process of restoring construction facilities to use or excluding them. It is extremely important that the proper sequence of diagnostic activities is carried out to ensure the safety and effectiveness of construction work in damaged buildings. The course of action in such cases is discussed using the example of buildings damaged by the September 2024 flood in southern Poland (Fig. 1).

It concludes with a summary, along with the formulation of conclusions in the context of potential future activities that should be carried out in order to effectively assess the technical condition of the building and make recommendations for the continued exploitation of building structures.

Fig. 1. Activities of Polish soldiers during the fight against the effects of the flood: a) removal of a damaged temporary bridge structure; b) assessment of the technical condition of a building damaged as a result of the flood

Corresponding Author: Kamil Sobczyk

ASSESSMENT OF THE BEHAVIOR OF A FLEXIBLE PAVEMENT UNDER LOAD BASED ON STRAINS MEASUREMENTS WITH FIBER OPTIC SENSORS IN IN-SITU CONDITIONS

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ABSTRACT

Road pavements are made of layers of various materials. In the case of a flexible pavement, it is a system of layers consisting of: a mineral-asphalt mixture (the upper part of the pavement), a sub-base made of an unbound mixture (the layer below the mineral-asphalt mixture) and lower layers of the pavement and the improved/unimproved subgrade. The load on the pavement causes stresses and strains in its layers. The values of strains and stresses determine its fatigue life. When designing a road pavement, the values of strains are calculated theoretically, e.g. using software based on constitutive models. The development of measurement technologies allows for an increasingly better assessment of the pavement behavior in real conditions. In particular, recent years have brought great progress in the use of fiber optic sensors to measure strains during the operation of the surface layers. The paper presents the results of tests of a flexible pavement using DOFS (Distributed Optical Fiber Sensors). The tests were carried out on a test section specially prepared for the needs of the research project.

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A SYSTEMATIC REVIEW OF THE 15-MINUTE CITY CONCEPT: INDICATORS FOR URBAN LIVEABILITY AND SUSTAINABILITY

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ABSTRACT

Urban transformation and urban preservation are often seen as contradicting goals. Currently, there is no agreed-upon strategy on how to transform historic parts of the city while maintaining their heritage values. Many cities today are characterised by modern 20th-century heritage, yet it poses a challenge to their liveability and to the adoption of less car-dependent lifestyles. The concept of 15-minute cities can be used to improve urban liveability, which may positively affect the experience and functionality of modern historic urban landscapes (HUL). A review of the existing literature on the 15-minute city concept was carried out with the aim of identifying its key indicators and proposing possible new ones. This research primarily explores how the 15-minute city concept can be applied holistically and efficiently in modern heritage. Following the PRISMA guidelines, 20 articles published after the introduction of the concept and meeting the inclusion criteria in the Scopus and Web of Science (WoS) databases were reviewed. Selected examples and case studies are analysed to contextualise these variables and explore how they can be reflected in modern historic urban landscapes. As a result, the following variables are proposed as central to the 15-minute city approach: mobility, time, distance, speed, functions, spatial characteristics, ownership type, price/performance affordability, and human-centred factors, each with their associated indicators. The results are expected to give insights into how to operationalise the concept of 15-minute cities in modern sites of historic urban landscapes, in order to improve liveability while simultaneously preserving its values. This research contributes to the Sustainable Development Goals (SDGs) by promoting walkable, climate-resilient neighbourhoods. In particular, it aligns with SDG Target 11.4, which focuses on cultural and natural heritage.

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BEYOND ENERGY SAVİNGS: THE ROLE OF GREEN ROOFS İN PUBLİC BUİLDİNGS FOR CLİMATE RESİLİENCE AND PERİ-URBAN RENEWAL — INSİGHTS FROM HUNGARY

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ABSTRACT

This study investigates the multidimensional impacts of rooftop greening in urban public buildings through integrated energy simulations and urban spatial analysis. Focusing on a school in Szombathely, Hungary, the research employs Energy Plus to quantify energy efficiency improvements while exploring theoretical frameworks for urban-scale benefits. Three core propositions are examined: Rooftop vegetation enhances building energy performance through thermal regulation; Strategic green roof placement enables climate resilience and social comfort improvements; Systematic implementation can create interconnected green networks redefining public space functionality.

Simulation results demonstrate a 22% reduction in annual cooling energy demand, with peak reduction of 23.1% in July during summer months. Heating energy savings average 6% annually, reaching 10.5% in February. Theoretical projections suggest significant improvements in pedestrian thermal comfort zones through municipal-scale implementation.

The study proposes a conceptual framework for transforming isolated green roofs into continuous urban networks. Spatial analysis indicates potential dual benefits: enhanced heat island mitigation through coordinated vegetation placement and increased social interaction opportunities via strategically connected green spaces. This approach advocates redefining rooftops as multifunctional infrastructure addressing climate resilience and social needs.

Methodologically, the research bridges building physics simulation with urban morphology studies, it pioneers an approach that scales localized interventions to urban social experiences. By analyzing how a single school's green roof modifies both its energy profile and surrounding community interactions, we establish a replicable model for converting individual building upgrades into city-wide social space networks. The innovation lies in correlating energy-saving metrics with spatial accessibility parameters to identify "social multiplier nodes" - public buildings whose roof greening can disproportionately enhance neighborhood connectivity. This human-centered methodology empowers planners to prioritize sites where technical improvements concurrently activate underutilized aerial territories as community assets. Importantly, the study demonstrates how standardized building retrofit data can inform place-specific social space design, challenging the conventional dichotomy between energy efficiency projects and public realm development.

The outcomes recast green roofs as social infrastructure catalysts, providing policymakers with evidence that technical interventions in public architecture inherently carry untapped potential for reconfiguring urban relationship networks. This paradigm shift positions roofscapes not merely as energy-saving surfaces, but as deliberate instruments for choreographing social encounters across vertical urban dimensions.

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BLENDED INTENSİVE PROGRAMME (BIP) ERASMUS: SKETCHİNG AND COMMUNİCATİON İN ARCHİTECTURE - TRANSFORMİNG INDUSTRİAL HERİTAGE

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ABSTRACT

This article analyzes the outcomes of the Blended Intensive Programme (BIP) titled "Sketching and Communication in Architecture. Transforming Industrial Heritage which was held at the University of Beira Interior, Covilhã, for 3 weeks, and finished on June 20, 2025. The BIP explored the tension and potential synergy between designing beautiful urban places for social media (termed “Instagrammable”) and preserving the architectural heritage and local identity of industrial sites. The study aims to quantify what degree student-led interventions can contribute to sustainable urban revitalization by integrating contemporary communication strategies with cultural preservation. The methodology employed a blended learning approach, combining online theoretical modules—where students conducted constructive critiques of industrial heritage sites in their hometowns—with in-person sessions in Covilhã. During the in-person phase, students engaged with the local culture and developed hand-drawn proposals (using pencil or pen) to revitalize a street connected to a former factory, now a museum. Evaluations, based on criteria such as relevance of case study, critical thinking, presentation clarity, visual support, and oral communication, were conducted during the final review. Results indicate that students proposed innovative interventions that successfully balanced aesthetic appeal with the preservation of industrial heritage, enhancing the cultural and social value of the urban space. These findings suggest that blending traditional design techniques with modern media strategies can offer viable solutions for urban planners, heritage conservationists, and policymakers seeking to promote local identity in a digital age. The article provides practical insights and a replicable model for integrating social media-driven aesthetics with sustainable heritage preservation.

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BRAND CITY DESIGNS OF THE FUTURE

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ABSTRACT

In recent years, urban areas have engaged in competitive efforts to enhance their visibility in the global landscape and attract increased numbers of tourists and investors. To this end, cities endeavor to showcase their distinct characteristics, advantages, and opportunities. Within this context, the concepts of branding and identity emerge as significant factors, playing a pivotal role in the strategic positioning of cities and their engagement with target audiences.

In this study, how an ideal brand city example can be possible with the technological and global developments predicted to be experienced in the future of 30 years is examined through different design examples.

In this context, within the scope of the Brand City course conducted at Uşak University Faculty of Architecture and Design, 10 students were asked to design an ideal brand city for the year 2050 in a location of their choice. A SWOT analysis was conducted for each city and it was discussed how threats could be dealt with and how opportunities could be utilized. The main purpose of the study is to create a visual identity inventory of each designed brand city in 2050 and to compare the branding strategies of cities with different strengths and weaknesses. In the ideal brand city design process, artificial intelligence was used for city visualizations, logo design and city slogan.

As a result of the study, it was seen that the marketing strategies of the cities are local handicrafts, nature and adventure tourism, gastronomic experiences, historical sites and tourism tours, festivals, sustainability fair and blending urban culture with the envisaged advanced technology.

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BRIDGING THEORY AND PRACTICE: A COMPARATIVE STUDY OF PEDAGOGICAL MODELS IN ARCHITECTURAL EDUCATION

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ABSTRACT

This research focuses on options for making architectural education more practical and relevant to real-world challenges. This research explores the strategies that can be developed to equip future architects with the skills needed to address pressing social, economic, technological, and environmental issues. It argues that architectural pedagogy should move beyond the idealized, theoretical environment of the studio and engage with the real world and its stakeholders from an early stage in the educational process. The paper examines the introduction and implementation of various practical education models across seven architecture schools within a research project consortium, including institutions in Italy, Norway, Croatia, Montenegro and Bosnia and Herzegovina. The research focuses on how practical education is defined in different cultural contexts and what insights can be gained from diverse approaches—varying in scale, complexity, professional engagement, and time spent outside the studio. Using a comparative methodology that includes workshops, site observations, surveys, and interviews, the paper analyses the outcomes of these educational practices. The research also presents a "Practice Typology Matrix" as a framework for assessing various models of practice involvement in architectural education, highlighting the most effective approaches for different contexts. Through this analysis, the paper identifies best practices and strategies for integrating real-world experience into architectural training.

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CARBON FOOTPRINT AT THE NATIONAL UNIVERSITY OF ROSARIO, ARGENTINA. COMPARISON OF 2019 AND 2022 DATA.

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ABSTRACT

Evaluating an institution's or company's carbon footprint to determine its greenhouse gas (GHG) emissions is important for contributing to the global effort to mitigate climate change. It's even more important for a university, because of its primary role in educating students at the highest educational level. In this paper, we present a comparison of the emissions recorded at the National University of Rosario, Argentina, in the years 2019 and 2022. This university is one of the largest in the country, with a built infrastructure of more than 220,682 square meters and more than 115,000 students, professors, and technical and administrative staff. The comparison is made on emissions due to fixed energy (from the use of stationary electricity in buildings for motors, lighting, air conditioning, etc.). Since data from the first year of the GHG assessment in 2019 are not available for mobile energy (mainly due to the different vehicles with internal combustion engines), no comparison is made and no data were collected from other GHG sources or sinks. However, a rough estimate of the contribution of all other emission sources, such as land-use change, agriculture, industry, and waste, shows that they are significantly lower than those considered. We would like to highlight that part of these undetermined sources is offset by the absorption of carbon dioxide (CO2), the main greenhouse gas, by the large number of trees that exist on the University grounds, principally in the Faculty of Agricultural Sciences, located in Zavalla and the Faculty of Veterinary Sciences, situated in Casilda. The comparison between the data for 2019 and 2022 (the latter in parentheses) yields the following result for greenhouse gas emissions (in TnCO2/year) corresponding to category 2 of the IPCC, the Intergovernmental Panel on Climate Change (due to indirect GHG emissions caused by imported energy to generate electricity and to use natural gas, the latter mainly for air conditioning): 3610(3546). This corresponds to a decrease of -1.80%. Since the number of people (chiefly students) increased from around 107,000 in 2019 to around 115,000 in 2022, the GHG emissions per capita [in kgCO2/(year*person)] was 33,7 and 30,8, respectively giving a GHG emission reduction of - 9,42 %. This corresponds to a significant reduction of -3,14 % per year. In the case of IPCC Category 3 (for indirect GHG emissions caused by energy used for transport mainly with cars and buses): 42 TnCO2 in 2022 to determine its contribution concerning the other Category, we obtained a percentage value of 0.99% for the year 2022. Since it is very small, like the other contributions, even when compared to the uncertainty in the GHG calculation (estimated at 10 to 20%), the greatest effort in reducing emissions will be concentrated on imported energy.

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CASE STUDY-BASED ASSESSMENT OF CARBON FOOTPRINT REDUCTION IN CONSTRUCTION MATERIALS USİNG BIM-INTEGRATED LCA AND SENSITIVITY ANALYSIS

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ABSTRACT

Achieving net-zero emissions is a fundamental goal for environmental sustainability and the transition to a circular economy. The construction and mining sectors contribute approximately one-third of global emissions, emphasizing the urgency of adopting effective mitigation strategies. Reducing the carbon footprint and CO_2 emissions in these industries is a critical challenge for promoting sustainable development and optimizing material usage. This study aims to quantify the carbon footprint of major building materials, specifically concrete, steel, and wood, assess potential CO_2 emission reductions, and evaluate their environmental impact. The research integrates Building Information Modeling (BIM), Life Cycle Assessment (LCA), and Sensitivity Analysis (SA) to establish environmental impact benchmarks. A case study approach was employed to analyse the carbon footprint of construction materials. The study utilized LCA to assess the embodied carbon at various life cycle stages (A1 to A3), identifying key contributors to global warming potential, acidification, eutrophication, and ozone depletion. Sensitivity analysis was conducted to evaluate the influence of material selection on overall emissions, while BIM integration facilitated a comprehensive visualization of the environmental impact. The analysis revealed that the embodied carbon from LCA stages A1 to A3 represents the primary contributor to environmental degradation. The study demonstrated a reduction in material-related carbon emissions from 662 kg CO_2e/m² to 506.8 kg CO_2e/m². Additionally, the global warming impact of building materials decreased from 10.57 kg CO_2e/m²/year to 8.45 kg CO_2e/m²/year. The results confirm that material type and quantity selected during the production stage significantly influence the overall embodied carbon. The findings of this study support sustainable decision-making in the construction industry by promoting material substitution strategies that replace high-emission components with low-carbon alternatives. The integration of BIM, LCA, and SA provides a robust framework for reducing environmental impact while fostering the reuse and recycling of construction materials. These insights contribute to advancing circular economy principles in the built environment. The above-mentioned analyses will be related to the possibilities of adapting the material mining heritage for new functions instead of constructing new buildings.

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COMPARATIVE ANALYSIS OF CLASSICAL GEODETIC METHODS AND TERRESTRIAL LASER SCANNING FOR TILT DETERMINATION OF A HIGH METAL LATTICE STRUCTURE

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ABSTRACT

This study aims to evaluate the applicability and accuracy of terrestrial laser scanning (TLS) compared to classical geodetic methods for determining the tilt of a high metal lattice structure. The structure under investigation is a 65.5-meter-high lighting mast characterized by complex spatial geometry and an open lattice design, which presents significant challenges for deformation monitoring using conventional surveying techniques.

Deviations from the vertical axis were assessed through a series of horizontal cross-sections, analyzed using both total station measurements and TLS point cloud data. Classical geodetic measurements involved angle intersections and trigonometric leveling, performed within a local geodetic control network. TLS data were acquired using a Trimble TX6 scanner and processed through a registration process and georeferenced using target spheres.

To evaluate the consistency and accuracy of both methods, graphical comparisons and analyses of the measured values were performed. The results demonstrate a high degree of agreement between the two approaches, with deviations remaining within a few centimeters. These results confirm the potential of TLS as a reliable and efficient method for monitoring structural deformations in high-rise engineering structures with complex geometries.

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COMPARATIVE EVALUATION OF CFRP MODELING APPROACHES FOR THE SIMULATION OF STRENGTHENED HCS

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ABSTRACT

The objective of this study is to assess, through numerical simulation, the effect of CFRP sheet strengthening on the structural behavior of prestressed hollow-core slabs (HCS), using the ABAQUS 6.13 software suite. Extensive research over the past decade has identified externally bonded CFRP as an effective solution for strengthening prestressed concrete elements, including HCS with non-circular voids. The numerical simulation of CFRP-strengthened hollow-core slabs is inherently complex, influenced by factors such as construction methodology, loading scenarios, and nonlinear material properties. Several modeling approaches have been proposed in the literature, each aiming to address specific aspects of these complexities. The retrofitting technique in this study involved applying CFRP sheets to the internal end regions of the slab voids, over a length of 300 mm, using one and two layers, respectively. To simulate the CFRP material, two modeling approaches were examined. The first involved skin reinforcement, which consists of applying a bonded layer to a part's surface and incorporating defined material and structural properties. The second modeling approach involved contact interaction with cohesive behavior, aiming to capture potential debonding effects. The developed finite element models were validated by comparison with test results from an extensive experimental investigation. The Concrete Damage Plasticity (CDP) model was adopted for concrete behavior, while the Mises yield surface was used for modeling isotropic metal plasticity. For the CFRP material, the simulation process included two stages. First, orthotropic elasticity in plane stress (lamina) was defined using ABAQUS 6.13. In the second stage, Hashin's failure criteria for unidirectional fiber composites were applied to evaluate the failure response of the CFRP sheets. Results are presented in terms of the load–deflection relationship, crack patterns, and von Mises stress distribution. In addition, a parametric investigation was carried out to analyze the influence of CFRP strengthening length and thickness on the load-bearing capacity and stiffness of the specimens.

Corresponding Author: Ilinca-Florina Moldovan

COMPARISON OF GNSS, LASER SCANNING, AND TOTAL STATION MEASUREMENT ACCURACY WITH CRITERIA OF DIGITAL TECHNICAL MAP IN CZECHIA

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ABSTRACT

Criteria of the Digital technical mapping (DTM) in Czechia requires horizontal accuracy of 14 cm and elevation accuracy of 12 cm. This study compares GNSS, total station, and mobile laser scanning measurement techniques to evaluate their precision against these legal standards.

GNSS is a fast and effective positioning tool but can be affected by satellite position, signal interference, and environmental factors. To test its accuracy, GNSS measurements were compared to total station data, which was aligned with the national geodetic control network. Independent verification was carried out using mobile laser scanning, which also produced sample outputs for DTM evaluation.

Results show that GNSS achieves reasonable accuracy in favorable conditions but remains sensitive to external influences. The total station provides the highest precision due to stable reference points and controlled measurement techniques. Mobile laser scanning offers rich spatial data but requires extensive processing and may have accuracy challenges in complex terrain. The generated point cloud serves as a reference dataset for terrain modeling in digital technical mapping.

Each method has strengths and limitations. GNSS is useful for rapid data collection, total stations ensure high accuracy, and laser scanning supports detailed spatial documentation. This study helps refine measurement strategies for digital technical mapping while meeting Czech legal accuracy requirements.

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COMPARISON OF THE SEPTEMBER 2024 DANUBE FLOOD WITH HISTORICAL FLOODS IN THE BRATISLAVA–NAGYMAROS SECTION

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ABSTRACT

Each year, we witness the devastating effects of floods in Central Europe and worldwide. In September 2024, a flood wave passed through the Danube in Bratislava with a discharge of approximately 9,600 m³/s. Over the past 20 years, two floods in Bratislava have reached peak discharges exceeding 10,000 m³/s – in August 2002 and June 2013. A comparison of flood waves since 1991 indicates a slight increase in extreme peak discharges in Bratislava and Nagymaros, along with a significant rise in peak water levels of the Danube. The first part of this paper describes the gauging stations along the Danube in Bratislava and Devín. It presents a series of maximum annual discharges (Qmax) from 1876 to 2024, supplemented by historical flood records dating back to 1501. The second part focuses on the statistical analysis of a 149-year dataset (1876–2024) of average and maximum annual discharges from the gauging stations in Bratislava. The third part compares the September 2024 flood with the September flood of 1899. Finally, the paper discusses possible reasons for the rise in water levels in the Bratislava–Budapest section over the past 100 years. The main factors contributing to these trends are as follows: i) In the past, the Danube naturally meandered and regularly flooded adjacent areas, which facilitated greater flood wave transformation and reduced water velocity. ii) Historically, breaches in flood protection levees helped mitigate flood risks in cities. For instance, during the 1787 flood, the Viennese Road (a flood protection levee) was breached in six places over a total length of 600 meters, preventing the flooding of Bratislava. Similar levee breaches occurred around Bratislava in 1897, 1899, 1954, and 1965. iii) The Danube riverbed is gradually silting up, which affects flow dynamics and peak water levels.

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CONCEPTUAL SOLUTION FOR THE REVITALISATION OF PUBLIC SPACES IN SLOVAK TOWNS (CASE STUDY NÁMESTOVO)

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ABSTRACT

The case study Public Space Námestovo provides an expert view on the issue of public spaces in and its hierarchical understanding in relation to further development. Based on extensive analyses, it defines the important location of the main square in central zone, the proposal for its restoration and the optimal connection with the proposed restored structure of its contact public spaces. The concept is supplemented and presents the approach to the design of a selected secondary public space, which draws attention to the need to comprehensively complete the entire analysis of public space in the city and determine the vision of the development of public space in the city as a whole. It is a challenging task, requiring a thorough and creative examination of several intentions in the form of architectural and urban competitions, which will confirm the potential of these areas. An important task in the further development of the city seems to be to deal with a partially free, sparsely built-up area in contact with the embankment of the Orava Reservoir, where an architectural competition has already taken place. The main goal is its continuous connection with the existing, historically established structure of public spaces. We present the difficulty of entering the central zone on examples. They complete the overall picture and open a discussion about the change in the understanding of the transport infrastructure in the city, while presenting the dominance of pedestrian traffic. The task of creating a quality urban space, building its vision and systematically fulfilling it, is professionally demanding and time-consuming, requiring enthusiasm and focused interest of residents and especially the city management.

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CONFLICTS OF BORDER TERRITORIES IN TERMS OF TERRITORIAL PLANNING. THE INTERPLAY BETWEEN EXTREMADURA AND ANDALUSIA

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ABSTRACT

In Spain, one of the origins of territorial imbalances stems from the historical weakness of territorial planning legislation compared to purely urban planning, highlighting the shortcomings of a model that has not enjoyed an adequate comprehensive territorial approach, either in practice or in regulations. Territorial and urban planning powers are ceded to the 17 Spanish regions, but they are influenced by sectoral elements, which are the exclusive jurisdiction of the state if they affect more than one Autonomous Community, as is the case of the maritime-terrestrial public domain, the hydraulic public domain, or the planning of major infrastructure. This further complicates the issue of territorial planning, compounded by the fact that the consolidation of its legislative framework was fraught with numerous difficulties, requiring almost two decades, and, as previously mentioned, was not achieved equally across the regions. Currently, the approach to drafting legislation does not adapt to new demands, socioeconomic changes, or national or European proposals. It would be necessary for legislative proposals regarding territorial and urban planning to keep pace with social evolution, streamlining approval and management processes and providing real solutions to the many problems they entail.

The fact that each Autonomous Community has different legislations, with different names and planning instruments, makes it difficult to achieve complete territorial cohesion and balanced development in Spain as a whole, since challenges that require this scale to achieve a comprehensive view: environmental, social, and cultural aspects, are not addressed. Territories should be resilient to natural or health disasters, while also being safe, accessible, and energy-efficient. To achieve this, planning instruments must guarantee these minimum standards. Specifically, the areas most sensitive to this situation are those located on regional borders, as is the case between Andalusia and Extremadura, which will be discussed. The research will reveal that the territory and its structural elements do not understand administrative boundaries, but are continuous. Ultimately, on both sides of the dividing line, there are two ways of managing and protecting these areas, which creates a conflict where they meet as internal borders.

Therefore, the research is framed within a differentiated territorial-administrative context, both regional and provincial, which leads to unequal efforts when it comes to developing territorial and heritage protection policies, among others. The subject of this paper will be to understand the legislative framework regarding the Land Law, the Territorial Planning Law—and their regional and subregional plans—in order to analyze the existing discrepancies between the legislative framework of the two regions, Extremadura and Andalusia, and to identify their vulnerabilities in the border area in order to address the situation through some improvement proposals.

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CONTROVERSIAL MODERNIST URBAN CONCEPTS ON THE EXAMPLE OF ALIPAŠINO POLJE SETTLEMENT IN SARAJEVO

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ABSTRACT

The strong development of Yugoslavia and its society after World War II was mostly visible in the massive urban development of cities throughout the country. Among tens of other examples, it was the case with the capital of Bosnia and Herzegovina whose population was increased 10 times in the period from 1945 until 1991 when Socialist Yugoslavia disappeared in several destructive wars. Population growth was related to the economic, social and industrial development and it was reflected to the urbanization and modernization of the entire society, but particularly cites and their new parts. Those new settlements were following the principles of modernism in urban planning and architectural approach. One of the biggest new urban areas realized at that time for more than 30,000 inhabitants in Sarajevo was Alipašino polje built in just several years during the second half of the 1970s. Thanks to high rise massive residential blocks and their number it is one of the most dominant and recognizable skylines in the city until present days. Controversial urban and architectural concept of Alipašino polje has provoked nurnerous discussions and opposite opinions about the way and quality of living in those kind of modernist settlements which deserve more scientific elaborations and professionals rooted researches, including experiences and opinions of their inhabitants. Through the analyzes of urban concept and spatial solutions of typical residential units implemented in this part of the city we can search for answers about the quality of those modernist concepts and their adaptability and usability in neo-modem and contemporary practice and what is the level of universal values, as one of the most proclaimed principles of modernist architecture. It is even more important to emphasize that all the flats in Alipašino polje were built as social housing in accordance to predominant policy in construction of collective residential buildings in the Socialist Yugoslavia that proclaimed housing right in the Constitution of the state as one of basic human rights guaranteed to every citizen of the state.

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CREATE AFFORDABLE AND ABUNDANT HOUSING IN URBAN AREAS AND SOLVE PROBLEMS RELATED TO RAPID URBANISATION BY PREDICTING HOUSING CHOICES

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ABSTRACT

Urban areas are the hotspots of migration due to job opportunities, healthcare facilities, higher wages, a better quality of life, and higher educational possibilities. Affordable and available housing is in high demand in urban areas. Unaffordable housing is considered a primary concern in several European states, as it results in homelessness, financial strain, housing insecurity and becomes a social problem preventing younger people from leaving their parents' home (Dubois & Nivakoski,2023). As population and migration rates increase in cities, housing rates rise, and specific problems related to rapid urbanisation also increase. In some cases, people must wait months and even years to obtain housing that suits their needs. This article will analyse how predicting the housing needs of people who will arrive in the city or are already in the town in need of housing will help solve the problem by creating an affordable and abundant housing option. By using regression, the number of people arriving in the future is estimated. Using agent-based modelling, the migrants' housing choices are predicted based on their social, educational, and economic status. This result will aid the government, urban planners, and authorities in planning and creating housing that will be a potential choice for people who will arrive in the city or, as those already living in urban areas, who require affordable housing. This approach holds the promise of preventing the formation of slums and other problems caused by rapid urbanisation, offering a hopeful outlook for the future.

Corresponding Author: Jobin Josh

CREATING SPACES FOR ALL: FROM MAPPING THE BARRIERS TOWARDS ACCESSIBLE TOURISM

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ABSTRACT

In a difficult time, when the coronavirus pandemic forced us to limit our contacts, the idea was born to promote tourism in rural areas where travelling and recreation away from large crowds is possible. This idea gave rise to the CE-Spaces4All project, which aims to open up rural tourism to persons with disabilities by putting together suitable packages of measures and breaking down existing physical and mental barriers. Due to the time and cost-intensive nature of removing physical barriers, the focus is on raising awareness.

The project focuses on persons with mobility impairments, blind people and persons with visual impairments, deaf people and persons with hearing impairment. Barriers were initially recorded in three pilot regions in a total of seven European countries and summarised in a joint database. The exemplary field surveys were carried out by the project teams directly in the pilot regions. Barriers were identified through this so-called mapping, for example in the road network or other municipal infrastructure, in the respective tourist attractions or in accommodation and catering establishments.

This resulted in the Web Accessibility Viewer, which is an online geoportal that indicates tourist and tourism-related facilities in both public space and private areas and their degree of accessibility in three pilot areas in Central Europe: the transborder area of Slovenia, Croatia, and Hungary. In the next step, the areas in which barriers can be removed as part of the project were identified together with the responsible tourism stakeholders in the respective pilot region. Sometimes these are minor structural measures, but often they are just comparatively simple things such as a lack of information. Although people with disabilities use many technological aids to help them cope better with everyday life, obtaining information before travelling is particularly important for people with disabilities because they need to know in advance whether the destinations they are planning to visit are actually usable for them. The awareness of what is important and that it matters is currently often underrepresented among those responsible for tourism and for policy planners.

It is also a task of CE-Spaces4All to anchor this awareness more firmly and establish it as a matter of course in the long term. The paper presents the path to raising awareness using two examples from the sub-pilot regions of Austria and Slovenia, outlining the key points of the planned measures.

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CULTURAL LANDSCAPE IN THE CZECH-SLOVAK CONTEXT: THEORY AND PRACTICE

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ABSTRACT

The term "cultural landscape" is used in the Czech Republic and Slovakia in a wide range of contexts. The historical development of the concept of cultural landscape in the Czechoslovak academic sphere reflects the nature of landscape studies. The ever-expanding concept began to appear in more and more disciplines; in human, urban and regional geography, geology, landscape ecology, and was also studied from an environmental perspective. This thesis focuses on the analysis of the understanding of this term in the Czechoslovak context and its development in professional discussions. The subject is also how this academic understanding currently influences the setting of spatial planning systems in relation to landscape planning.

It seeks to critically evaluate and provoke debate on the notion of cultural landscape and thus contribute to its clarification and rethinking research in contemporary Czechoslovak academic discourse. One of the purposes is also to evaluate the implications of scientific research on cultural landscapes in practice. The aim of the paper is to identify and analyse the main approaches of definitions of cultural landscape within different disciplines and historical periods. To evaluate how this concept has changed over time, what factors have influenced its interpretation and what influences the Czechoslovak scientific environment has had on its formation.

In order to achieve the set objectives, a content analysis of scientific publications and scholarly studies from the Czechoslovak academic environment was carried out. A comparative method was used to compare different theoretical approaches to the concept of cultural landscape and their research methods. Also, an important observer was what research methods were used by different scientific disciplines.

The understanding of the concept of "cultural landscape" in the Czechoslovak context was influenced by a strong geographical tradition, the historical development of the landscape and the legislative frameworks of nature conservation. In the early stages of research, the term focused mainly on the physical-geographical characteristics and uses of the landscape; in later periods, socio-cultural and historical aspects, in various interpretations, came to the fore. A significant milestone was the integration of ecological principles and the concept of sustainable development.

The development of the understanding of the concept of 'cultural landscape' in the Czechoslovak academic environment has undergone significant changes, with its interpretation gradually expanding from a narrowly geographical perspective to multiple conceptions of cultural landscapes. This thesis contributes to a better understanding of the historical development and current perception of cultural landscape in the context of the Czech Republic and Slovakia, as this has a significant impact on legislation and practice.

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DATA-DRİVEN GHG ESTİMATİON FOR LOCAL PUBLİC TRANSPORT FLEETS: PESCARA CİTY CASE STUDY

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ABSTRACT

The transport sector is among the highest contributors to greenhouse gas (GHG) emissions. Consequently, the European Union has established ambitious targets to accelerate the transition to zero-emission mobility, with a specific focus on public transit fleets. Under current directives, urban bus fleets must reduce GHG emissions by 90% by 2030 and achieve full conversion to zero-emission vehicles by 2035. In this context, continuous monitoring of emission trends by public transport operators is crucial to ensure alignment with decarbonization goals. This study presents a pragmatic, data-driven methodology for estimating GHG emissions from local public transport (LPT) fleets. Designed to be both cost-effective and easily replicable, the approach leverages real-world operational data to generate context-specific emission estimates across various vehicle categories. The methodology integrates traffic volume data with detailed fleet characteristics, such as dimensional vehicle class, passenger capacity, energy carrier type, and engine emission standard, sourced from transport operators and national statistical databases. GHG emissions are quantified for CO_2, CH_4, and N_2O, and aggregated into CO_2-equivalent (CO_2e) metrics. Particulate matter emissions ($PM_{2.5}$ and PM_{10}) are also assessed independently. Beyond quantifying energy consumption and GHG emissions, the study introduces a set of unitary performance indices. These incorporate passenger loads and operational parameters, enabling more precise and detailed per-capita assessments of environmental impact. The methodology is applied to a case study in Pescara, a medium-sized city in central Italy, using high-resolution data from the local transit operator TUA S.p.A. A sensitivity analysis on vehicle occupancy rates has assessed the impact on per-capita energy use and emissions, highlighting key environmental performance drivers. Additionally, a strategic scenario analysis has been carried out to evaluate fleet decarbonization pathways toward a zero-emission target by 2035. Owing to its low implementation cost and reliance on readily available data, the proposed method serves as a valuable decision-support tool for public transport operators. It supports both environmental impact assessments and the strategic planning of emission reduction policies, with strong potential for adaptation across diverse urban contexts.

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DEVELOPMENT OF ALKALI-ACTIVATED LUMINESCENT COMPOSITE

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ABSTRACT

Alkali-activated materials are the alternative binders in which latent hydraulic materials or pozzolans are used as the main binder component. Luminescence is a process in which atoms or molecules are excited and emit light. This phenomenon is used in the construction industry, mainly in safety, lighting, and design. These materials are often used as paint or spray as a safety element to mark escape routes, staircases, etc. They are also used for decorative purposes, for example, in luminescent concrete, where the luminescent component is often contained as aggregate.

The experiment was focused on testing the possibility of preparing a luminescent material based on alkali-activated granulated blast furnace slag, where the luminescent pigment is applied as part of the binder component.

The experiment compared the luminescent properties of the created mixture with cement-based materials and subsequently verified the rheological and physical-mechanical properties of the prepared composites.

It was found that a luminescent alkali-activated composite can be prepared, but the influence of the luminescent pigment on the final properties, especially the flexural and compressive strength, where a significant decrease in the monitored parameters was recorded, must be taken into account.

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DEVELOPMENT OF APARTMENT PRICES IN THE CADASTRAL AREAS OF BRNO BETWEEN 2014–2024 WITH REGARD TO OWNERSHIP STRUCTURE

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ABSTRACT

Over the past decade, Brno has witnessed a substantial increase in apartment prices, with values doubling in most of the observed areas. This study analyzes real transaction prices derived from the cadastral register and provides a comprehensive overview of price developments across various parts of Brno. The data is categorized by cadastral areas and subjected to comparative analysis, with particular emphasis on disparities among specific locations including Brno-střed (the city center), Veveří (a prestigious address), Zábrdovice (a less sought-after area), and Lesná (blocks of flats housing estate). Additionally, current sale prices are compared with listed prices from publicly available real estate platforms (Sreality). The price trends exhibit a consistent upward trajectory, characterized by a slight decline during the pandemic, followed by a new increase in property values.

This article further examines three main forms of ownership: private (including units in homeowners' associations), cooperative, and municipal. Another objective is to estimate the proportion of investment apartments based on the registered permanent residence of their owners.

Moreover, the study investigates regional differences in apartment prices and the impact of factors such as infrastructure, public amenities, and the attractiveness of location. Finally, it outlines possible future trends in price development and their implications for housing affordability in Brno.

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DEVELOPMENT OF CERAMIC MATERIALS FROM MINING WASTE FOR THE PRODUCTION OF SUSTAINABLE CONSTRUCTION MATERIALS

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ABSTRACT

The construction industry faces a challenge in adopting sustainable practices that minimize environmental impact. The search for eco-friendly alternatives has led to the development of materials incorporating recycled waste, optimizing natural resource use. For that reason, ceramic materials with recycled mining waste are gaining attention for their ability to improve the physical and mechanical properties of products while managing mining waste. This approach aligns with circular economy principles by promoting material reduction, reuse, and recycling, which in turn reduces CO2 emissions and enhances manufacturing sustainability. Innovations in the ceramic industry can play a key role in transitioning to a more environmentally responsible model. In this research the main goal is understand the properties and environmental benefits through efficient waste management in new construction materials. For that, this study develops new ceramic materials using recycled mining sludge from Panasqueira mine (Portugal) exploring their potential for sustainable production. Especifically, this research evaluated the impact of adding different proportions of mining sludge (10%, 25%, and 50% by weight) on ceramic brick manufacturing and the samples were fired at controlled temperatures of 800, 950, and 1100 °C, allowing the evaluation of the thermal influence on the final properties of the samples. The methodology employed involved multiple stages, and the following methods were employed: the chemical and mineralogical properties of the materials used were analyzed using X-ray fluorescence (XRF) and X-ray diffraction (XRD) techniques to identify their composition. TGA was performed to assess the thermal properties of the materials. Elastic properties and compactness were evaluated by measuring ultrasonic pulse velocities. The mineralogy, texture, and microstructure of the samples were examined using SEM, providing detailed information about the structural and compositional characteristics. The chromatic properties get to study the aesthetic effects of waste incorporation and their use in new and ancient buildings. The results highlighted that the addition of mining sludge did not significantly alter the overall mineralogy. However, XRD and SEM analyses confirmed that sludge acted as a flux, promoting the formation of mineral phases at lower temperatures and increasing the vitreous phase, improving ceramic structure. The addition of sludge, combined with higher firing temperatures, enhanced the mechanical properties, as evidenced by increased ultrasonic pulse velocities, indicating greater internal cohesion and strength. Color changes were influenced by waste proportions and firing conditions, with higher temperatures (1100°C) producing the most significant variations compared to control samples. The main conclusions confirm that using mining sludge in ceramic manufacturing offered environmental and economic benefits, including reduced clay extraction and water consumption (by 22% to 50%). This led to a more sustainable process, aligning with the industry's goal to lower the carbon footprint. The addition of mining sludge in ceramic brick production improves production sustainability, reducing the use of raw materials, saving energy, and recycling industrial waste. These findings demonstrate the potential of this new ceramic material as an eco-friendly solution for the construction industry. This research is part of the project PCI2024-153488 funded by MICIU/AEI/ 10.13039/501100011033 and ERDF/EU.

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DOMINANT LOADING IN 5- TO 30-STORY REINFORCED CONCRETE FRAME BUILDINGS AND ITS INFLUENCE ON STRUCTURAL MEMBER SIZING

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ABSTRACT

In this work, reinforced concrete frame buildings (frame structures), with 5 to 30 floors were analyzed in order to determine how the dominant design load shift with increasing building height, The study focuses on the identification of the number of floors where the controlling variable load moves with the gravity-inducted (own and live) load on lateral forces (wind and seismic forces) and examines the implications of this shift on the dimensioning of structural elements. Using computer models in software ETABS/TOWER and applying EUROCODE standards (EN 1991 for permanent and EN 1992 for concrete design), a series of buildings with only a central reinforced concrete core (surrounding elevator shafts and staircases) and without additional shear walls was evaluated under combined load scenarios. The analysis identifies a critical building height (within 5- to 30-storey range) where loads begin to govern design, replacing gravity loads as the primary driver for column sizing and reinforcement requirements. The results show that below this threshold height, column design is determined by vertical loads, with cross-sectional requirements increasing towards the lower floors due to accumulated gravity loads. Above the threshold, in taller buildings, lateral displacement and stability requirements dominate the design. This change loads to a significant increase in the required column dimensions and reinforcement – especially in the lower floors – to meet the strength and stiffness criteria. The transition in dominant loading significantly affects the distribution of internal forces and the amount of reinforcement required along the height of the building. These findings highlight the importance of recognizing the height at which lateral loads become critical in the design process, as they implicitly affect material utilization and structural efficiency in frame structures of medium and high-rise buildings.

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DURABILITY AND NATURAL FIBRE CONTENT OPTIMIZATION IN HIGH-PERFORMANCE CONCRETE

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ABSTRACT

Natural fibers have emerged, in the fiber-reinforced concrete, as a compelling solution due to their cost-effectiveness and minimal carbon footprint, gathering considerable attention in concrete technology. The present research investigated the influence of various kinds of natural fibers on high-performance concrete (HPC). Three different fibers, jute fibers (JFs), banana fibers (BFs), and coconut fibers (CFs), were introduced into HPC at varying volume fractions (ranging from 0% to 0.75%). Their performance in HPC was thoroughly compared with polypropylene fibers (PPFs). Notably, the research revealed that workability decreased as the natural fiber content increased, with JFs exhibiting a more pronounced impact on workability than other natural fibers. When it came to compressive strength, JFs delivered slightly enhanced results in comparison to both synthetic PPFs and other natural fibers. In indirect tensile strength (ITS) and modulus of rupture (MOR) tests, PPFs and JFs outperformed BFs and CFs. The optimal volume fraction for achieving maximum ITS and MOR was 0.60% by volume. BFs, JFs, and CFs demonstrated notable enhancements in ITS and MOR compared to the reference HPC at this volume. Higher volume fractions of natural fibers (>0.75%) negatively affect the permeability, capillary resistance, freeze-thaw resistance, and performance under elevated temperatures of HPC. Despite these drawbacks, modified samples still outperformed the reference mix. To counteract the negative impacts of natural fibers, this study recommends using micro-silica and an admixture as practical solutions for preserving HPC integrity while leveraging the benefits of natural fibers.

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DYNAMIC ANALYSIS OF A FREESTANDING SUPPORT STRUCTURE FOR PHOTOVOLTAIC PANELS UNDER SEISMIC EXCITATION

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ABSTRACT

The article presents a comprehensive dynamic analysis of a support structure designed for a photovoltaic (PV) panel system. The primary objective of the study was to construct a highly accurate numerical model of the structure and to analyze its dynamic response to seismic loading. With the increasing emphasis on sustainable energy and the rising costs of conventional electricity, solar power plants are becoming increasingly widespread, not only among industrial and commercial users but also in the residential sector. The growing demand for clean energy has led to the development of larger PV installations that often exceed the capacity of typical rooftop areas. As a result, there is a growing need to install these systems on specialized, freestanding steel support structures. The analyzed structure is intended for a residential single-family building and supports PV panels with a total capacity of 9.6 kWh. The installation consists of four steel cantilever frames, each spaced 4 meters apart, resulting in a total length of 12 meters. These frames are interconnected with steel purlins to which the photovoltaic panels are mounted. The modular configuration and exposed nature of such installations make their dynamic behavior—especially under seismic excitation—an important subject of engineering analysis. The first phase of the study focused on characterizing the mechanical properties of an individual PV panel. Using a laser vibrometer, the free vibration frequencies of the panel were measured, allowing the identification of its stiffness modulus. In the second phase, a full numerical model of the supporting structure was developed. This model was verified through an in-situ experimental modal analysis, ensuring its accuracy and reliability for dynamic simulations.

After successful validation, the numerical model was subjected to kinematic excitation in the form of a seismic shock. The dynamic response of the structure was analyzed in terms of displacement, acceleration, and internal stress distribution. The results confirmed that the structure demonstrates adequate resistance to low-intensity seismic events. However, it was also observed that in specific critical zones—particularly at the connections between the PV panels and the supporting frame—stress concentrations may reach significant levels. Under high-intensity seismic excitation, these areas could become prone to damage, indicating the need for design improvements or reinforcement in future installations.

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DYNAMIC BIM-BASED SIMULATION FOR OPTIMIZING VENTILATED FACADES: ENHANCING ARCHITECTURAL DESIGN FOR ENERGY EFFICIENCY

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ABSTRACT

1/ Introduction - The trend of recent years is the use of a building information model (BIM) in the early design stages. This procedure positively affects the entire life cycle of a building, especially its construction and operation, during which the largest percentage of financial and energy resources are spent. The consumption rate of these resources is directly influenced by the architectural design of the building, from shape solutions to structural and material characteristics of passive systems. One of them is a multilayered external envelope with a ventilated gap, which reduces heat gains during the summer and better accumulates heat from solar radiation during the winter. The fact is that the internal climate in the gap is different from the external environment and is influenced mainly by the external temperature, air flow speed, sunlight intensity, material on the external and internal facade and shading from surrounding buildings.

2/ Objectives - The aim of the work is to develop a simulation tool that will lead to a more efficient design of the shape of the building envelope with a ventilated gap. The tool will simulate the impact of solar radiation on the facade at a certain day and hour of the year, shading from surrounding buildings and materials on the external surface and their influence on the temperature course in the ventilated gap. This simulation will run dynamically on the background of the architectural design and will support the decision-making process. This could subsequently lead to savings in the total energy consumed for heating and cooling the building.

3/ Methods

a/ provide climatic input data – publicly available databases are used, compiled according to methodologies corresponding to international standards.

b/ provide model information data - a BIM model with varying degrees of detail of geometric and non-geometric information can be used for the simulation

c/ design a computational model - the model will calculate the phenomena taking place in the ventilated gap on the building envelope based on the input parameters, the phenomena that are neglected in the calculation are the phase shift of temperature due to the surface material and the unstable external environment.

d/ design an evaluation system - so that the output is understandable and further usable, a system for comparing individual variants of building designs is proposed, which evaluates the average and long-term values that are most reflected in resource consumption

4/ Results - Generally known rules for designing multi-layered facades (such as large facade areas facing south for positive heat gains in winter and small areas facing west and east for negative heat gains in summer) are confirmed, however, the proposed simulation applies these general rules to the real design process and compares architectural design variants dynamically and naturally supports the design of this technical system.

5/ Conclusion – The set objectives were achieved using a precisely defined procedure. For successful application in design processes, the validation of the proposed simulation based on experimental data is required.

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DYNAMIC IMPACT SCALES (SWD-I AND SWD-II): A SIMPLIFIED METHOD FOR ASSESSING BUILDING VIBRATIONS

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ABSTRACT

Vibrations caused by construction activities, transportation, and industrial sources can adversely affect buildings, especially those constructed from masonry or large prefabricated elements. In order to ensure structural safety and environmental protection, it is necessary to assess the impact of such vibrations in both the design and diagnostic stages. While full dynamic analysis provides accurate results, it is often impractical for routine assessments due to the complexity of modeling, lack of vibration data, or the urgency of the evaluation process. In response to this need, simplified procedures have been developed in the Polish engineering practice in the form of Dynamic Impact Scales SWD-I and SWD-II.

The SWD-I and SWD-II scales offer an approximate yet practical method for evaluating vibration-induced structural damage in buildings, based on empirical classification into five vibration zones ranging from "imperceptible" to "structural failure." The classification is derived from the measured peak values of ground acceleration and frequency, and the structural characteristics of the building. The SWD-I scale applies to compact, regular-shaped masonry or panel buildings of up to two storeys, while SWD-II is designed for more general low-rise buildings of up to five storeys, with certain limitations on height-to-width ratios. Both scales are based on engineering judgement and are aligned with the framework of the Polish standard PN-B-02170:2016.

This paper presents a detailed description of both scales, including the criteria for their use, methodology for assigning buildings to the correct zone, and proper sensor placement to capture representative vibration input. A comparative example is provided to demonstrate how a real-world vibration scenario (induced by a nearby compressor) can be evaluated using the SWD-II scale. The case illustrates that even a relatively small source can lead to measurable vibrations that may affect building integrity depending on the frequency content and local amplification effects.

The results confirm that SWD scales can serve as reliable screening tools for preliminary assessment of structural vulnerability to environmental vibrations. Although not a substitute for detailed numerical modeling in complex or high-risk cases, the SWD approach provides a valuable, cost-effective method for engineers, designers, and decision-makers engaged in environmental impact assessments or construction planning. In addition, the scales can be used to support regulatory compliance and community communication in vibration-sensitive areas.

The use of SWD-I and SWD-II scales fills a methodological gap by offering an intermediate level of assessment between qualitative expert judgement and full-scale structural simulations. This contribution aims to bring these effective tools to a broader international audience and encourage their adaptation or further development in the context of local regulatory frameworks and engineering standards.

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EFFECT OF DEXTRIN LU-1400-3 ON WORKABILITY AND STRENGTH OF A FLY-ASH–LIMESTONE CEMENTITIOUS COMPOSITE

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ABSTRACT

This paper examines the influence of the dextrin-based admixture LU-1400-3 on the workability and compressive strength of a low-clinker cementitious composite containing 20 % fly ash and 20 % limestone powder at a constant water-to-cement ratio of 0.51. Workability was assessed with the flow-table method (EN 12350-5); compressive strength was determined on 150 mm cubes after 7 and 28 days of curing.

Adding LU-1400-3 increased the initial flow diameter by 34 %—from 160 mm to 215 mm—and limited workability loss after 60 min to 16 % (180 mm). The 28-day compressive strength rose by 7 %, from 56.2 MPa to 60.0 MPa. Scanning-electron microscopy coupled with EDS revealed a denser hydrate network in the dextrin-modified matrix, supporting the mechanical findings.

These results demonstrate that a single, low dosage of LU-1400-3 can effectively replace a conventional plasticiser while simultaneously enhancing both fresh-state rheology and hardened-state performance of fly-ash–limestone cement composites.

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ENERGY CONSUMPTION INDICATORS IN RESIDENTIAL BUILDINGS IN NORTH-EASTERN POLAND

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ABSTRACT

Thermal energy consumption in selected buildings in three residential estates in a city in northeastern Poland was analysed based on recorded data from 2010 to 2021. Multifamily buildings of varying construction technology, floor area, and number of stories were examined. 47 residential buildings were analysed, some of which contained commercial premises related to services for the estate's residents. These buildings meet current thermal protection standards, have unheated basements, and the top floors are generally heated and occupied. Outside air temperature was considered based on archived meteorological data and standard climate data. Electricity and gas consumption in this city was also analysed for selected apartments occupied by one adult, two adults, and a family of four, based on actual consumption. The aim of this article is to obtain better energy consumption estimates in the event of metering device failures, as well as to better forecast energy consumption based on the size of residential buildings and the number of occupants than is possible based on building design data. The findings may be useful in estimating lump sum fees that consider actual energy consumption in the form of heat, electricity, or gas combustion, as well as in planning residential renewable energy sources. The analysis of buildings' thermal energy consumption is particularly interesting because in recent years, there have been no occurred values of calculated outside air temperatures for winter. The calculations consider real outside air temperatures based on historical meteorological measurement data.

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ENVIRONMENTAL DIALOGUES BETWEEN CROWN WALLS AND THE SEA

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ABSTRACT

Maritime works have a clear purpose, to reflect or dissipate the high wave energies of seas and oceans to create safe areas of shelter. This involves a large number of natural or artificial materials, both for the submerged and the visible works. In this article we analyze some of the structures that make up these works: blocks, caissons and crown walls, from an environmental and landscape point of view, through a historical study of shapes and colors, as well as their aesthetic and visual integration into the landscape.Both national and international cases are analyzed, of structures of mass concrete or reinforced concrete, with launchings or in flat wall, recessed and in continuation of the monolith, proposing forms in balance, rhythmicity and sustainable. Examples such as Malaga or Tazacorte, with supports similar to Gothic cathedrals or impressive slenderness as in Escombreras, where fibers are used in the external wall, are some of the most notable examples. It concludes with a series of recommendations for the design and execution of these maritime works.

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RESEARCH ON PEDESTRİAN ACCESSİBİLİTY İN LARGE-SCALE RAİLWAY PASSENGER HUB AREAS

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ABSTRACT

The concept of "integration of railway station and city" evolved from the TOD (Transit-Oriented Development) concept has become the future trend of the development of China's railway passenger transport hubs. Its core objective is to promote the transformation of the space within the hub station area from a "transit space" to a "destination space". Under this concept, the pedestrian system within the station area is regarded as the core link and key element connecting the hub station and the city. In this study, by constructing an accessibility evaluation model, combining data surveys and using the area ratio method, the walkability of 18 railway passenger transport hubs in four major urban agglomerations in China is evaluated, and the influencing factors causing the differences in their walkability are analyzed. The results show that there is a strong correlation between the walkability of the hub and factors such as the size of the hub, the density of the road network, express/elevated passenger drop-off lanes, pedestrian facilities, and internal transfer circulation lines. Among them, following the traffic-dominated spatial development model has become the main reason for the phenomenon of separation between the station and the city. Finally, the article puts forward measures and suggestions on how to improve the walkability of China's railway passenger transport hubs, and further strengthen the integrated development between the hubs and the city.

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EVALUATION OF WIND AND SEISMIC LOAD MODELLING IN HIGH-RISE CONCRETE STRUCTURES: A LITERATURE REVIEW

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ABSTRACT

The dynamic interaction between high-rise structures and environmental actions-particularly wind and seismic loads-has remained a fundamental challenge in structural engineering for decades. This literature review critically examines the evaluation of modeling approaches, design standards, and analytical tools related to lateral load prediction and structural response in reinforced concrete high-rise buildings from 2000 to 2025.

Drawing on over two decades of peer reviewed publications, Eurocode developments, and advancements in computer-aided structural analysis, the study traces the conceptual and practical shifts in how wind and seismic forces are understood static models toword performance-based and dynamic analysis using tools such as SAP2000, ETABS and TOWER.

Key developments covered include the refinement of wind tunnel simulation data, probabilistic seismic hazard assessments, coupling of soil-structure interaction model, and the integration of damping mechanisms into design. The review also evaluates how modern guidelines (e.g., EN 1998, EN 1991-1-4, ASCE 7) have evolved in response to empirical findings and catastrophic events (e.g., earthquakes in Turkey, Chile, Japan; extreme windstorms in Europe and Asia).

This paper concludes by identifying future research directions, including the role of AI-assisted optimization, climate-adaptive design, and the integration of resilience-based frameworks for urban high-rise development.

The review serves as a comprehensive resource for researchers and practicing engineers seeking to understand the trajectory of structural design methodologies for tall buildings in the face of increasing environmental uncertainty.

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EVALUATING THE IMPLEMENTATION OF LOCAL CONTENT POLICIES IN SAUDI ARABIAN CONSTRUCTION PROJECTS

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ABSTRACT

The implementation of local content policies in Saudi Arabian construction projects is a key strategy for economic diversification, workforce development, and industrial self-sufficiency under Vision 2030. This study evaluates the awareness, adoption, challenges, and impact of local content policies among government officials, consultants, and contractors using quantitative analysis of survey data from 82 respondents. Findings indicate that while 85% of stakeholders are aware of local content policies, only 15% of firms source more than 50% of their materials locally, with high costs, regulatory constraints, and supply chain inefficiencies being the most significant barriers. Chi-square tests and cross-tabulation analysis reveal a strong correlation between experience levels and local content adoption, with more experienced professionals demonstrating higher engagement in local procurement and workforce development. Despite these challenges, local content policies have shown positive economic and employment impacts, particularly in job creation and project efficiency. The study recommends regulatory reforms, targeted training programs, financial incentives, and enhanced stakeholder collaboration to increase local participation in the construction industry. Strengthening policy enforcement, supply chain networks, and workforce capabilities will be essential to achieving Saudi Arabia's long-term localization goals and maximizing the benefits of local content integration.

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EVALUATING THE SHIELDING EFFICIENCY OF CARBON FIBER-REINFORCED MORTARS USING METAHEURISTIC ALGORITHMS

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ABSTRACT

Recent research on carbon fiber-reinforced mortars for electromagnetic interference (EMI) shielding has primarily depended on experimental methods to analyze the relationship between shielding effectiveness (SE) and design parameters. However, these experiments demand substantial resources. Machine learning (ML) models provide a more efficient and cost-effective alternative for predicting outcomes and assessing different scenarios. This study introduces an innovative approach by leveraging hybrid models, which surpass both standalone and ensemble ML models in accuracy. Specifically, support vector regression (SVR) was integrated with three optimization algorithms—firefly algorithm (FFA), particle swarm optimization (PSO), and grey wolf optimization (GWO)—to develop hybrid models for SE estimation. Traditional ML methods, such as random forest (RF) and decision tree (DT), were also applied for comparison. A dataset comprising 346 experimental records from existing literature was used to assess model performance. Among the hybrid models, SVR-PSO exhibited the highest predictive accuracy, achieving a coefficient of determination (R^2) of 0.994, outperforming SVR-FFA (0.964) and SVR-GWO (0.929). Interpretability analysis identified aspect ratio (AR) as the most critical factor, revealing that SE increases significantly with fiber content (FC) up to 0.7%, after which it plateaus, with SE and AR showing a linear correlation. Additionally, a user-friendly interface was developed to enable instant SE predictions for carbon fiber-reinforced mortars based on key input parameters.

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EVALUATION OF VOLUMES AND TONNAGE OF BLAST FURNACE SLAG STOCKPILES IN PC LADCE, A.S. USING GIS APPLICATIONS

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ABSTRACT

Blast furnace slag is a byproduct of metallurgy, generated during the production of crude iron in blast furnaces. This material is often deposited in stockpiles, where it is essential to monitor its volume and weight for efficient utilization and environmental management. Accurate determination of the volume and tonnage of slag stockpiles enables optimized handling of this secondary material while minimizing environmental impacts. Modern methods of spatial data collection and analysis, such as GNSS (Global Navigation Satellite System) and GIS (Geographic Information Systems), provide effective tools for this purpose.

This study focuses on evaluating the volumes and weight of two blast furnace slag stockpiles in PC Ladce, a.s. using GNSS measurements and GIS applications, specifically ArcMap and ArcScene. The measurements were conducted using the direct method of a GNSS point network with the S999 device. The collected data were subsequently processed into a triangulated and raster-based terrain model. Based on these models, the stockpile volumes and total slag weight were calculated using a bulk density of 1.14 t/m³. The results of this analysis highlight the significance of utilizing modern geodetic technologies for industrial management.

GIS and GNSS methods enable more accurate quantification of stored materials and provide reliable data for industrial managers and environmental agencies. In addition to quantifying the volume and weight of the stockpiles, this study also generated visualization models and contour maps, aiding in better result interpretation and more efficient planning for future slag management.

The findings of this study demonstrate that the use of GNSS and GIS is a reliable approach for accurately determining the volume and weight of blast furnace slag stockpiles, allowing for improved control over this material and its further processing.

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EXPERIMENTAL INVESTIGATION ON AXIAL RESPONSE OF COMPOSITE WOOD-COLD-FORMED-STEEL FIXED ENDED STUDS

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ABSTRACT

Compared to hot-rolled steel sections, cold-formed steel sections are more susceptible to instabilities. Under compressive loading, several global, distortional, and local buckling instability modes are expected to manifest. This paper summarizes results of an experimental program carried out at the National Center of Applied Research on Earthquake Engineering Laboratory (CGS) in ALGERIA to investigate the behavior up to failure of composite wood cold formed steel stud under cyclic axial loading, in which a wood core is incorporated inside the cold formed steel C stud subjected to axial cyclic loading which was compared with simple cold formed steel C stud. Eight full scale columns with both ends fixed were tested, four cold formed steel C stud (600s200-68) and four with the same C sections reinforced with wood. Two monotonic axial concentric loading tests (one compression and one tension) and two cyclic axial loading tests with different loading rate were performed on both cold-formed steel (CFS) columns and Wood CFS columns. The cyclic loading protocol was adapted from FEMA 461 with initial displacement obtained from the monotonic tests. The results showed that the local deformations (local buckling) were less noticeable for the wood CFS columns. It was also observed that, the degradation of resistance, rigidity and the total hysteretic energy dissipated were more important for composite columns.

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EXPLORING THE EXPERIENCES OF PEOPLE WITH DISABILITIES IN POST-DISASTER SHELTERING

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ABSTRACT

Disasters adversely impact society on social, psychological, mental, and spiritual levels. One of the most urgent needs in the aftermath of a disaster is shelter. This includes tents, which serve as emergency shelters; containers, which function as temporary shelters; and permanent housing provided during the reconstruction phase. The temporary sheltering process presents diverse experiences for individuals affected by disasters. For persons with disabilities, this process requires particular attention in terms of design and implementation, as it directly affects their ability to access basic needs and maintain well-being.

The February 6, 2023 Kahramanmaraş earthquakes in Türkiye underscored the critical importance of inclusive sheltering practices, highlighting the need to re-evaluate existing approaches concerning individuals with disabilities. This study focuses on the experiences of persons with disabilities, a particularly vulnerable group, during the temporary sheltering phase. Initially, national and international post-disaster shelter guidelines and documents addressing the needs of individuals with disabilities were reviewed. This review was supported by systematic data collection at both the national and international levels.

Subsequently, the temporary sheltering experiences of persons with disabilities following the Kahramanmaraş earthquakes were analyzed. The findings include an evaluation of the temporary shelter units provided in the disaster's aftermath, assessed from the perspective of individuals with disabilities, along with recommendations proposed by the researcher. Among these, it is emphasized that shelter designs must be revised to accommodate various disability types (e.g., visual, physical, cognitive, auditory). Additionally, the accessibility and usability of social activity areas—such as those found in container cities—should be re-examined. The data indicate that disaster preparedness planning must give specific consideration to the needs of individuals with disabilities to ensure inclusive and equitable shelter solutions.

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FACTORS OF BIOPHILIC INTERIOR ARCHITECTURE AND DESIGN, REGARDING NATURAL LIGHTING IN THE ROMANIAN PRE-SCHOOL EDUCATIONAL SYSTEM

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ABSTRACT

Natural lighting is among the main characteristics of educational spaces, influencing children`s learning capacity, concentration and wellbeing on high levels. The article studies the benefits of natural lightning as well as the architectural features of Romanian pre-schools that lead to optimal illumination within the classroom. The discussion has two directions, as the lightning that enters through the glazed surfaces, as well as the quality of outside landscapes seen by children through the window.

Interior architecture in educational spaces, particularly kindergartens in Romania, plays a crucial role in shaping children's cognitive, emotional, and social development. This study explores influencing factors that define effective interior design in early childhood education environments; respectivelly the natural lighting regarding the shape and sizes, window sill height in classrooms and other adiacent spaces used by children. By analyzing these elements, through the following methodologies: empirical observations, site visits, discussions with children and representatives (teachers, parents and others), the research highlights best practices and innovative solutions for optimizing pre-school natural lighting; ultimately supporting a holistic and engaging educational experience; from studied examples around the world and especially European Union, case studies from Timis County; the aim is to discover how to better design such crucial spaces for children`s future education.

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FROM LOCAL TRADITIONS TO GREEN INNOVATIONS: CONSTRUCTION MATERIALS AND SUSTAINABILITY TRENDS IN THE VISEGRÁD FOUR

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ABSTRACT

Introduction:
Construction materials reflect not only technological progress but also cultural heritage and environmental adaptation. In Central Europe, the Visegrád Four countries (Czechia, Hungary, Poland, and Slovakia) offer a unique case study in the transition from traditional materials such as timber, adobe, and stone to modern, eco-conscious solutions. Understanding this evolution is essential to evaluate how these countries are responding to climate challenges and EU sustainability goals.

Objectives:
The aim of this study is to compare the historical and contemporary use of construction materials in the Visegrád Four, and to assess how these choices align with current sustainability practices, including energy efficiency, circular construction, and renewable energy integration.

Methods:
This research is based on qualitative comparative analysis of secondary data, national construction strategies, and case examples of public and private sector projects across the V4 region. Materials were classified chronologically—traditional, modernist/socialist era, and contemporary—highlighting shifts in usage, technological innovation, and ecological performance. Tables and charts were developed to illustrate patterns and trends.

Results:
The findings show that while traditional materials like timber and brick remain prevalent in rural and heritage contexts, there is a growing adoption of sustainable materials such as cross-laminated timber (CLT), recycled concrete, and prefabricated panels. Czechia and Poland show advanced engagement in green certifications (e.g., BREEAM, LEED), solar integration, and smart glazing systems, while Slovakia and Hungary exhibit a slower, but visible transition. Challenges persist in the form of economic disparities, fragmented policy implementation, and social perception of older building types.

Conclusion:
The Visegrád Four countries are gradually transitioning toward greener construction practices, balancing historical identity with modern innovation. Material choices play a central role in this shift. Accelerating the adoption of circular and low-carbon materials can strengthen regional compliance with EU directives and contribute to more resilient, energy-efficient architecture. This comparative insight underlines the need for coordinated sustainability strategies tailored to each country's material legacy and socio-economic context.

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FUNCTIONALLY GRADED SHAFTS UNDER TORSION: AN ANALYTICAL APPROACH FOR INVESTIGATION OF DAMPING

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ABSTRACT

The question for the damping energy in functionally graded viscoplastic shafts loaded in cyclic torsion is addressed in the present paper. In particular, a circular shaft is researched analytically here. It should be specified that the prior damping studies deal mainly with rectangular beams loaded in cyclic bending. However, circular shafts also are widely applied in various load-bearing constructions in the current engineering. Therefore, there is a need of researching damping in circular shafts under cyclic torsion. The shafts researched here are functionally graded. The necessity of studying functionally graded structures is conditioned by quickly increasing use of functionally graded materials and structures in a variety of engineering applications. Studying of damping problem has meaning for guarantying the safety and reliability of structures. Both ends of the shaft analyzed in the present paper are rigidly fixed. The torsion is induced by a moment applied near the mid-span. The damping analysis uses a Ramberg-Osgood type of stress-strain-time relationship. The material parameters of the stress-strain-time relationship are distributed continuously along the cross-section radius. The unit damping energy parameters and their variations along the radius of the shaft cross-section are explored. The damping energy in the shaft is found-out by integrating of unit damping energy. The solution derived offers very good possibilities for obtaining numerical results with purpose of clarifying how the damping energy is influenced by different factors such as distribution of material parameters along the radius of the cross-section, geometry of the functionally graded shaft, and parameters of the external loading.

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GEOTECHNICAL ASSESSMENT OF CLAY MATERIALS EXHIBITING DOUBLE POROSITY TYPE

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ABSTRACT

Introduction:

The mechanical behavior of clay materials with double porosity, particularly those derived from coal mining dumps, presents significant geotechnical challenges. These materials are widely encountered in North Bohemia, where historical coal extraction has led to the formation of embankments composed of altered claystone. Their use in construction requires thorough understanding due to risks such as instability, excessive deformation, or even static liquefaction.

Objectives:

This study aimed to assess the mechanical behavior of dump clay materials—specifically from the S2 (clean clay) and S3 (coal-contaminated clay) samples—by examining their deformation, compressibility, and shear strength properties. The goal was to evaluate their suitability as foundation soils and to identify potential failure mechanisms under various stress conditions.

Methods:

A comprehensive series of laboratory tests was conducted, including oedometer and consolidated undrained triaxial (CU) tests, on both intact and remolded samples. Supplementary characterization involved particle size distribution, plasticity index assessment, and scanning electron microscopy (SEM). The liquefaction potential was evaluated using the Liquefaction Potential Index (LPI). Samples were prepared to simulate both saturated and dry-to-saturated conditions to explore the influence of suction, compaction, and material composition.

Results:

The findings reveal that both clean and coal-contaminated samples fall into the CL group (low plasticity clays), showing moderate to low clay activity due to the presence of kaolinite. The triaxial tests indicated a significant strength drop post-peak under high confining pressures, suggesting static liquefaction tendencies. S3 samples exhibited greater compressibility and lower virtual preconsolidation stresses compared to S2. The LPI increased with confining pressure, reaching 0.47 for remolded S3 at 350 kPa. The critical state line and isotropic state line appeared to converge at high stress levels, indicating potential particle crushing and structural collapse.

Conclusion:

The study confirms that clay materials from mine dumps, particularly those contaminated with coal, pose a high risk of deformation and instability when subjected to stress. The existence of double porosity and weak inter-particle bonding leads to potential static liquefaction and structural collapse. These findings highlight the necessity of cautious geotechnical design when considering such materials for foundational applications. Understanding their behavior is essential for the safe construction of infrastructure on reclaimed or dump sites.

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HOW TO PRECISELY MONITOR THE SHAPE OF THE BOTTOM OF HYDROPOWER PLANT RESERVOIRS USING HYDROACOUSTIC AND SATELLITE TECHNIQUES?

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ABSTRACT

Hydrological processes in the reservoirs of hydropower plants often cause erosion of the bottom and changes in its shape. This can affect the safety of hydropower structures and their surroundings. In order to control the safety of power plants and the surrounding area, regular, precise bathymetric surveys of bottom shape changes should be carried out. The main task of the study was to find a methodology to precisely monitor the shape of the bottom of hydroelectric power plant reservoirs using hydroacoustic and satellite techniques.

During the technical and economic operation of hydroelectric power plants, the water flow is not stable across the entire width of the river. In addition, different water flows through the dam change the water level behind the dams. This causes an engineering problem in the form of potholes on the river bed in some areas and the deposition of material from bottom erosion in others. It also generates technical and methodological problems in terms of performing precise bathymetric measurements of the shape of the bottom of these reservoirs.

The solution is precise geodetic/bathymetric mobile mapping of the riverbed carried out using integrated GNSS (Global Navigation Satellite System) and SBES (Single Beam Echo Sounder). The RTK/OTF GNSS (Global Navigation Satellite System) satellite positioning system using phase observations and the support of the local, GBAS system (Ground Based Augmentation System) allows determining the position of the bathymetric boat with an accuracy of 1 cm. A properly configured and calibrated depth measurement system SBES (Single Beam EchoSounder) also allows to measure the distance from the transducer to the bottom with an accuracy of 1-2 cm. Both measurement systems work on a moving boat and on a flowing and changing river water level.

For this reason, it is necessary to continuously monitor the vertical position of the survey platform. A robotic total station, GNSS RTK and readings from local water gauges are used to estimate sub-centimeter level changes and reduce final depth readings during hydroacoustic surveys. The result of these high-precision measurements is bottom shape monitoring at the 5-cm accuracy level.

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HYDROGEOENVIRONMENTAL STUDIES FOR THE ATTEMPT TO REVIVE AN OLD MEDICAL SPA - TERMAS DA TOUCA – FUNDÃO (PORTUGAL)

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ABSTRACT

This article presents a case study of the essentially hydrogeological nature, serving as an example of a place where a thriving medical spa once operated in the last century, but which, due to various setbacks, closed down, leaving the site almost unpopulated and in ruins. The location of these Thermal Baths is charming in terms of landscape. Because it is served by a deep sulphurous aquifer system, which has water with an extensive and deep underground path, with several thousand years old, it provides the place with unique conditions for the revival of a quality thermal health resort. Thus, after an introduction about the importance of the subject, historical note, and objective, the methodology of the work is presented. The results are presented below, consisting of the geomorphological, geological and hydrogeological framework of Termas da Touca, followed by a detailed presentation of the hydrogeological and other elements associated with the quality of the resource, to optimize the flow rate of a borehole, with water samples collected for microbiological and physical-chemical analysis, for legalization of the resource as natural mineral water for thermalism, by current regulations. The difficulties encountered in the process are explained, which are essentially a consequence of the site's high vulnerability to potential contamination and the poor quality of the current abstraction, preventing the objective from being achieved. It is understood that the solution will involve neutralizing the existing groundwater abstraction and boreholes, as well as installing an adequate drainage system for surface rainwater and groundwater, and finally constructing a new, relatively deep hole to obtain the resource at a depth where the aquifer system is not susceptible to the contamination.

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IMPACT OF CEMENT KILN DUST ON THE CHARACTERISTICS OF ALKALI-ACTIVATED CONCRETE

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ABSTRACT

The influence of cement kiln dust (CK) on alkali-activated concrete is investigated in this work. AAC was produced with the use of alkali activator solutions. The application of an alkaline solution of Na2SiO3 and NaOH depends on the activation of pumice dust (PD) and the beginning of the alkali reaction process in the geopolymer paste. Using varying weight ratios between 0% and 30%, CK was employed as a partial replacement for PD. It also used CK in different weight percentages-0%, 5%, 10%, 20%, and 30%-as a partial substitute for PD. Workability, compressive strength, porosity, unit weight, and water absorption guided an analysis of AAC's characteristics. The findings indicated that slump flow dropped as CK rates rose. Furthermore, the geopolymer concrete using 30% CK demonstrated a notable 23% improvement in compressive strength at the 90-day test age. Moreover, the samples of geopolymers concrete showed a significant 20% water absorption decrease.

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IMPACT OF LAND USE ALONG THE LINE ON PASSENGER FLOW OF REGIONAL (SUBURBAN) RAILWAYS

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ABSTRACT

With the acceleration of regional integration, the trend of Chinese megacities evolving into metropolitan areas and urban agglomerations has become increasingly evident. Traditional transportation modes primarily designed for intra-city travel struggle to meet commuting demands between urban cores and surrounding towns. International experience demonstrates that regional (suburban) railways are crucial for addressing such demands and supporting the integration of metropolitan areas. Consequently, both central and local governments in China have prioritized the development of suburban railways, leading to an unprecedented wave of planning and construction in multiple megacities. However, operational lines often face challenges such as lower-than-expected passenger volumes, low commuting ratios, and severe financial losses.This study selects 16 operational suburban railway ilnes in Beijing, Shanghai, Guangzhou, and international cities (Tokyo, Paris, London, New York) as research subjects. Utilizing quantitative and qualitative analysis methods, it explores key factors influencing passenger flow characteristics of suburban railways. The independent variables include the proportion of construction land, population density, land use functions, distance from the nearest station to the core urban center, and regional total population. Passenger flow intensity of suburban railways serves as the dependent variable. Pearson correlation analysis evaluates relationships between variables, followed by ordinary least squares (OLS) regression to construct interaction models.

Finally, the study analyzes the impact of existing territorial spatial planning patterns (e.g., urban layout) and land use characteristics along railway lines on passenger flow and operational feasibility through case studies. The findings aim to provide insights for coordinating suburban railway planning with metropolitan spatial strategies in China.

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IMPORTANCE OF INTANGIBLE VALUES IN THE POST-WAR REHABILITATION OF ARCHITECTURAL HERITAGE

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ABSTRACT

The destruction of architectural heritage in war conflicts is devastating for the entire civilization and this is precisely the reason for a large number of discussions even today in the 21st century. A society affected by the war destruction identifies itself with a destroyed heritage. Rehabilitation seeks to restore heritage and compensate for losses by giving importance to the process of creating and implementing renewal projects. In these processes, community involvement is of great importance. During wartime events, heritage and society suffer the most. The aim of the work is to present the post-war rehabilitation project as a complex process that includes not only the treated heritage building but also the community to which it belongs, taking into account physical and equally important metaphysical values. Traditional craft skills and historic building materials can restore lost physical structures. The primary concept of rehabilitation is expanding due to the changes caused by different degrees of violent degradation and but also due to inadequate interventions which, in most cases, were unintentionally committed in order to normalize life after the war as quickly as possible. Arguments for the rehabilitation of architectural heritage must also be found in the local community. The places where the heritage complexes were located are of great importance to the community and most of the time, even though there is nothing left, they are still perceived as a space and a place of great importance. Community participation in the rehabilitation process is also a process of reconciliation within the community. The degradation of metaphysical values leaves far greater consequences for the community than the degradation of physical characteristics due to which community loses the sense of belonging, the sense of security, but also its identity. Ultimately, we can say that the rehabilitation of the metaphysical aspect of architectural heritage is a far more complex and uncertain process than any other. With a well-established methodology for the restoration and protection of architectural heritage, we know in advance the results that will follow when it comes to the physical structure. The return of metaphysical values is uncertain, even after the end of the rehabilitation project. Reactions to the object, interaction with it and its understanding by the community take a lot longer, and more serious analyses and final results require the passage of time. The relationship between metaphysical and physical renewal is inherent, and their connection is cause-and-effect, and metaphysical experience arises through the interaction of the body and mind with the objects of architectural heritage.

Corresponding Author: Ida Hodzic Adrovic

IMPROVING ARCHITECTURAL WORKFLOW: A GRASSHOPPER-BASED APPROACH TO CONVERT RHINO MODELS INTO NATIVE REVIT ELEMENTS

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ABSTRACT

The Architecture, Engineering, and Construction (AEC) industry has significantly advanced with the development of Building Information Modeling (BIM) software. However, AEC companies continue to face challenges related to interoperability and collaboration due to the heterogeneous nature of software tools. Various alternatives, such as Industry Foundation Classes (IFC), have been employed to address these issues, but their effectiveness remains limited. In current practice, many architecture firms use Rhino 3D for design, while BIM software such as Revit or Archicad is required for documentation and data management. This workflow presents significant limitations in data exchange, as Revit and Archicad often struggle to interpret Rhino models, importing them as direct shape that cannot be modified natively. This paper introduces a Grasshopper script designed to automate the creation of Revit elements such as walls, floors, windows, and doors from Rhino models using Rhino.Inside.Revit (RIR). While RIR allows the direct conversion of Rhino elements into Revit shapes, the proposed script enhances this process by generating native Revit elements from Rhino Brep geometry. The script functions in two key steps: first, it analyses the boundaries of wall elements in Rhino to automatically create Revit levels; second, it examines the boundaries of architectural components (walls, floors, windows, and doors) in Rhino to generate corresponding Revit family types and accurately place these elements in Revit at the exact coordinates from Rhino 3D using RIR nodes. This workflow improves architectural design efficiency and enables architects to maintain better control over their designs by leveraging BIM capabilities such as quantity take-offs and data management. Additionally, the script can function as a live synchronization tool, automatically updating any modifications made to Rhino elements within the Revit environment. Despite its effectiveness, the script has limitations when handling complex architectural geometries, such as double-curved surfaces. Addressing these challenges will be a focus of future research..

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IN-DEPTH ANALYSIS OF FACTORS INFLUENCING THE CONSTRUCTION PROJECTS SUCCESS – A REVIEW STUDY

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ABSTRACT

The construction industry is critically influenced by factors affecting projects duration, such as labor productivity, material management, design changes, cash flow and weather conditions. Understanding these elements is vital for effective projects planning and management, given their significant impacts on costs and resource allocation.

This literature review aims to systematically analyze the existing body of research to identify and evaluate the factors that influence construction projects duration, thereby providing a comprehensive understanding useful for project managers and stakeholders in minimizing delays and optimizing performance.

A thorough review over 88 published articles from diverse geographical contexts was conducted. Studies were selected based on their relevance to construction time estimation, focusing on key themes, including labor dynamics, material management, design changes and technological impacts.

The review highlights labor productivity as a primary determinate of project duration, with poor supervision leading to time overruns. Additionally, the integration of modern technology and IT systems enhances resource management, leading to timelier projects completions. Changes in design and inadequate cash flow are significant disruptors, contributing to project delays and cost overruns. Weather conditions and climate changes also directly impact construction timeline.

The findings underscore the complexing of managing construction projects timelines in different environments. Enhanced planning, supervision and the adoption of modern technologies by very important in reducing project duration and improving efficiency. These insights provide a foundation for developing strategies that address the unique challenges of construction project management.

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INDOOR ENVIRONMENTAL QUALITY OF SELECTED FLOORING MATERIALS

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ABSTRACT

This study examines the impact of different flooring materials on indoor environmental quality (IEQ) through a comparative analysis of "in situ" measurements. The objective was to evaluate the concentration of total volatile organic compounds (TVOCs), air acceptability, and odor intensity for selected flooring surface materials, including wooden flooring, floating flooring, and carpet. The results demonstrated that the highest TVOC concentrations were consistently observed with carpet. However, the lowest air acceptability was recorded for wooden flooring. Notably, when wooden flooring was combined with other materials, improved sorption efficiency resulted in more favorable air acceptability outcomes than the standalone materials. Sensory evaluation of material combinations under "in situ" conditions yielded superior results compared to chamber tests, indicating that real indoor environments may attenuate the perceived impact of chemical emissions. Over a 36-hour monitoring period, TVOC concentrations from "in situ" measurements exhibited a decreasing trend, whereas chamber test concentrations stabilized at higher levels after approximately 18 hours. After 36 hours, TVOC levels from "in situ" measurements were lower than those from chamber tests for both standalone and combined flooring materials. Floating flooring demonstrated the lowest TVOC emissions and the most favorable air acceptability and odor intensity, suggesting that it provides an optimal balance between chemical emissions and sensory comfort. The findings highlight the significance of conducting "in situ" evaluations alongside chamber tests to accurately assess the impact of building materials on indoor environmental quality, as real-world environmental factors such as ventilation, humidity, and material interactions play a critical role in modulating chemical and sensory responses.

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INDUSTRIAL VERNACULAR HERITAGE AND TOURISM - TIDE MILLS IN FARO, PORTUGAL

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ABSTRACT

Faro being a seaside city, the tide mills are part of its rich heritage. Located on the shores of the Ria Formosa, between mainland and sea, these mills have a potential tourist and cultural interest that is still unexploited.

Taking part in the predominantly Mediterranean climate of Faro, along with tourism being one of the major engines of the region's economy, proposals to create pedestrian routes are generally welcome.

Thus, the objective of this article is to draw attention to a type of heritage that is at high risk of disappearing, developing a pedestrian path in the city of Faro, so that by integrating this heritage into a tourism and sustainable activity, it can be protected and disclosed.

This research was based on bibliographic, webgraphic and field surveys. Throughout the development of the research for this work, the locations of several tide mills were identified, most of them in ruins, some disappeared completely only knowing their approximate location, or their function was changed, making use, in this case, of the existing infrastructures.

In the Algarve, the region of which Faro is the capital, and in the city itself, the vernacular heritage is systematically ignored, either by ignorance or, for being a "minor" heritage, it is simply insignificant to the eyes of experts and to the general population, who do little to protect it. However, tide mills are part of the collective memory of the region and the city of Faro in particular, so it is important to draw attention to these heritage elements and, in this case, tourism can be a driving force.

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INFLUENCE OF THE COMPOSITE ACTION FOR EBFS WITH LONG DISSIPATIVE LINKS

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ABSTRACT

Steel frame structures are widely used in various types of constructions. With much longer experience and tradition in practice, the Moment Resisting Frames (MRF) and Concentrically Braced Frames (CBF) were the predominant lateral load resisting systems for many decades, thanks to their architectural versatility and high ductility (MRF) or high lateral stiffness (CBF), respectively. On the other hand, the much newer Eccentrically Braced Frame EBF system, may be a viable alternative, thanks to an appropriate combination of stiffness and ductility. In this study, we investigated the effect of composite action between the link beam and the concrete slab on the monotonic and cyclic response of EBFs with long links. The results indicated an increase of initial stiffness and yield resistance of the system, but a small impact on the ductility. Also, the simple detachment of the concrete slab from the beam by the lack of shear studs does not fully eliminate the composite action in links, which may affect both the local and global behavior.

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INFRASTRUCTURE, DURABILITY AND SUSTAINABILITY IN ONE CONCEPT

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ABSTRACT

In this paper, the increase of the concrete structure durability is investigated through the implementation of restoration techniques aimed at achieving this goal through the use of specific advanced systems.

Over time, concrete infrastructures are often subjected to the action of dynamic loads of variable amplitude that can establish different stress configurations. To this scope, a special fibre-reinforced cementitious mortar has been developed. This product has been subjected to small and large-scale dynamic bending tests and it has shown high fatigue properties.

Concrete infrastructures can also be affected by different degradation phenomena that can occur depending on environmental exposure conditions. The most frequent phenomena certainly include carbonation and chloride attack. In this regard, this article shares Mapei's experience with the use of elastic cementitious mortar, emphasising the high level of protection offered both in terms of protection against carbonation and against the ingress of chlorides.

To this scope, numerous laboratory tests performed on these types of membranes are shared, as well as the tests performed on samples taken from existing structures, 18 years after application, for an in-depth evaluation of the durability increase over time.

Finally, a small focus on a new range of Mapei products is carried out. The Mapei Zero product range has been the object of an important research and development work to reduce the carbon footprint of these materials underlining an increasing attention to environmental sustainability.

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INTEGRATED CHARACTERIZATION USING SCPTU, CPTU, AND DYNAMIC PENETRATION TESTS FOR GEOTECHNICAL SUSTAINABILITY

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ABSTRACT

The present study focuses on the geotechnical characterization of a rock mass in Covilhã (Portugal) using in situ testing techniques. The research aims to enhance the understanding of subsurface conditions by integrating multiple geotechnical investigation methods, including the seismic piezocone penetration test with pore pressure measurements (SCPTu), without seismic (CPTu), dynamic penetration tests (DPM and DPSH). These tests provide critical data on soil mechanical resistance, internal structure, and deformation properties, supporting more accurate foundation and infrastructure design decisions. The results indicate that the studied soil primarily consists of sand to silty sand with high and increasing OCR and relative density, showing a trend towards cementation. The SCPTu test proved highly effective in assessing initial stiffness and computing deformation moduli, significantly contributing to geotechnical engineering applications. Additionally, DPM and DPSH have provided complementary data, allowing for a more comprehensive evaluation of subsurface variability. The integration of these methods enhanced the reliability of soil classification, ensuring robust datasets for geotechnical analysis and infrastructure development. This research aligns with the themes of in-situ testing for geotechnical development. The findings emphasize the importance of multidisciplinary approaches in advancing infrastructure resilience and sustainability through accurate subsurface characterization. The combination of SCPTu, CPTu, and dynamic penetration tests supports the development of safer and more efficient geotechnical engineering solutions, reinforcing the role of geotechnics in modern civil engineering challenges.

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INTEGRATING AUDITORY PERCEPTION INTO ARCHITECTURAL EDUCATION AND DESIGN

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ABSTRACT

This study extends the scope of architecture beyond visual perception by exploring the parallelism between visual and auditory experiences. It aims to examine the potential outcomes of integrating auditory elements into the design process. Investigating the relationship between auditory stimuli and architecture within the context of design language, the study adopts an experimental approach to explore various dimensions, such as the interaction between sound and architectural thinking and its influence on design processes. Through two- and three-dimensional abstractions of auditory compositions—processed as non-visual design inputs—the study seeks to enhance students' creative thinking capacities. In this context, it examines how variations in auditory tones and stylistic changes influence basic design exercises and architectural reflections. The research consists of an experimental study involving 14 students from the Department of Interior Architecture and Environmental Design, Faculty of Fine Arts, at Selcuk University. Over several weeks, students were exposed to two distinct auditory environments—one characterized by harmony and balance, the other by intensity and dynamism—and tasked with creating designs based on rhythm and structure. To strengthen the study and obtain more objective data, an additional phase was introduced, where the same participants were assigned a different design task—furniture design—following the same methodological approach. This allowed for a comparative analysis of how auditory influences extended across different design contexts. To analyze the relationship between auditory input and basic design, as well as its impact on architectural form, the collected data were systematically structured. The findings indicate that in two separate experiments conducted with the same participants, individuals produced softer lines and forms when exposed to more harmonious stimuli, whereas they preferred sharper, more rigid lines and forms when engaging with high-intensity auditory input.

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INTEGRATING GROUND PENETRATING RADAR AND INFRARED THERMOGRAPHY FOR EXAMINATION OF HISTORICAL OBJECTS

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ABSTRACT

The preservation and protection of historic buildings require non-destructive and highly precise methods to evaluate their condition and structural integrity. Ground-penetrating radar (GPR) and infrared thermography (IRT) have emerged as complementary techniques for the examination of cultural heritage materials and structures. This study explores the integration of GPR and IRT to improve the detection of subsurface defects, hidden features and material composition in historic building structures.

GPR is widely used in archaeological and heritage studies due to its ability to penetrate various materials and provide high-resolution images of internal structures. By transmitting electromagnetic waves into an object and analysing the reflected signals, GPR can identify voids, delaminations and hidden layers without physical intervention. However, its effectiveness can be limited by material properties and surface roughness, requiring the incorporation of additional diagnostic methods. IRT captures surface temperature variations to reveal underlying structural anomalies. Through active and passive thermographic approaches, IRT can identify moisture accumulation, thermal bridging and internal restorations. Combined with GPR, IRT enhances the interpretation of subsurface findings by providing thermal insights that help to differentiate materials and identify environmental deterioration patterns.

This study examines the integrated application of GPR and IRT through case studies that demonstrate their effectiveness in assessing the condition of historic buildings. The investigations were carried out on historic buildings located in Gdansk, Poland. The aim of the study was to present the practical aspects of the application of both techniques in detecting and imaging subsurface defects, hidden structural elements, and material degradation. The study also emphasis the capabilities and limitations of both methods, demonstrating their complementary nature. By combining high-resolution subsurface imaging with thermal analysis, a comprehensive assessment of structural integrity, material composition and degradation mechanisms was achieved. The results highlight the potential of GPR-IRT integration as a powerful, non-invasive tool for the conservation and long-term preservation of historical structures.

Corresponding Author: Tomasz Ciborowski

INTEGRATING MULTIMODAL LARGE LANGUAGE MODELS WITH POINT CLOUDS FOR URBAN VEHICLE DETECTION

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ABSTRACT

Road infrastructure assessment plays a vital role in urban planning, traffic management, and the development of autonomous systems. Recent advances in Multimodal Large Language Models (MLLMs) have shown promising capabilities for zero-shot object detection and classification in complex visual scenes. However, these models are primarily limited to 2D image analysis, lacking the spatial awareness required for precise geometric understanding in real-world environments. Meanwhile, conventional 3D object detection methods using point clouds face challenges in handling diverse, dynamic, and unstructured road environments. This work introduces a hybrid approach that combines the zero-shot visual reasoning capabilities of MLLMs with the geometric precision of 3D LiDAR point clouds collected from Mobile Mapping Systems (MMS). Specifically, the proposed pipeline uses an MLLM (Google Gemini 2.0 flash) to detect vehicles in road scene images based on natural language prompts, generating 2D bounding boxes without the need for task-specific training. These 2D detections are then projected into 3D space using calibration parameters from the KITTI-360 dataset, enabling localization and clustering of corresponding LiDAR points. Finally, 3D bounding boxes are generated, and temporal merging is performed to remove redundant detections across consecutive frames. Experiments on two sequences of the KITTI-360 dataset demonstrate that this fusion approach enables flexible and scalable vehicle detection in complex urban environments. The findings highlight the potential of integrating language-driven perception with spatially grounded 3D reasoning, offering a promising direction for automated road asset monitoring and maintenance strategies.

Corresponding Author: Horia Ameen

INTEGRATION OF GREEN ROOFS AND FACADES AS A CLIMATE CHANGE ADAPTATION STRATEGY: ENVIRONMENTAL, ENERGY, AND MICROCLIMATIC ASPECTS

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ABSTRACT

The study examines the integration of green roofs and facades as an effective strategy for mitigating the adverse effects of climate change in urban environments. Urban areas face growing challenges due to the urban heat island effect, increased stormwater runoff, deteriorating air quality, and rising energy consumption. Green roofs and facades offer a sustainable solution by enhancing building performance and improving the surrounding microclimate through the natural benefits of vegetation. The research evaluates the technical and environmental advantages of vegetative roof and facade systems using detailed case studies and simulation models. Key findings demonstrate that green roofs and facades improve thermal insulation by reducing heat transfer through the building envelope, leading to lower indoor temperatures in summer and reduced heat loss in winter, which decreases the need for heating and cooling and results in lower energy consumption and greenhouse gas emissions. These systems also mitigate the urban heat island effect by absorbing solar radiation and cooling the surrounding air through evapotranspiration. Improved stormwater management is another benefit, as green roofs retain rainwater and slow runoff, reducing pressure on drainage systems and lowering the risk of flooding. Enhanced air quality is achieved through the capture of particulate matter and the absorption of pollutants such as carbon dioxide (CO_2) and nitrogen oxides (NO_x). The study identifies key design parameters influencing performance, including substrate composition, plant selection, irrigation methods, and structural load capacity. A comparative analysis of extensive and intensive green roofs shows that extensive roofs, with shallow substrates and low-maintenance plants, offer adaptability and low maintenance but lower insulation, while intensive roofs, with deeper substrates and diverse plantings, provide higher insulation and greater biodiversity but require more upkeep. Green facades, especially those using hydroponic modular systems, have proven effective in reducing noise and air pollution while improving the building's microclimate. The study concludes that integrating green roofs and facades represents a scalable and sustainable solution for enhancing urban resilience to climate change, offering significant environmental, economic, and social benefits.

Corresponding Author: Michal Kraus

INTERACTION OF THE TUNNEL CASING AND THE NEWLY BUILT WING OF THE RAILWAY STATION FACILITY

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ABSTRACT

Railway construction is an important element of the construction economy in modern transportation solutions. In many countries, the railway is also the basis of the transportation system. Hence, problems that appear at the interface of general construction facilities and solutions used in railway construction are an important element of the level of construction work in general.

The subject of this paper is the analysis of the structural behaviour during construction works carried out in the vicinity of the station building, i.e. the construction of a passage tunnel to the railway platforms and the renovation of the railway track directly adjacent to the building. The foundation of a railway station buiding is built in complex subsoil conditions. The designer proposed the construction of jet-grouting columns, which are the support of the structure and at the same time a part of the railway tunnel casing.

Unfortunately, cracks have been observed in the newly built wing of the facility and subsequent stages of the project implementation have been at risk both in terms of schedule and safety reasons. After analysing the documentation and a site visit, the authors referred to the method of implementation of the individual components of the facility.

The aim of the study is to answer the question to what extent the contractor's deviation from the design study may affect the behaviour of the newly constructed wing of the railway station building. FEM model has been built based on the geotechnical documentation. After performing FEM calculations, it confirmed the assumptions regarding the correctness of the soil reinforcement of the ground under the facility.

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INVESTIGATION OF SELECTED PHYSICOCHEMICAL INDICATORS OF SURFACE WATER QUALITY IN THE UNDISTURBED VARÍNKA STREAM, SLOVAKIA

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ABSTRACT

Physicochemical indicators of water quality play a crucial role in influencing biological processes in surface waters. In the context of climate change, changes in river hydrological regimes also affect water quality. This study aims to evaluate long-term data on dissolved oxygen (DO), water temperature (Tw), acidity (pH) and conductivity (EC) in the undisturbed Varínka stream in the northern part of Slovakia, covering the period from 1972 to 2017. The study focuses on identifying significant changes in physicochemical indicators of water quality and analyzing monthly and annual trends. The results reveal significant increasing trends in acidity and conductivity values in the Varínka stream. The next section examines regression relationships between selected indicators and models them. Cross-correlation between individual indicators showed that most do not follow a linear pattern, but some correlation coefficients (between water temperature and dissolved oxygen) were significantly different from zero. An autoregressive model was tested to model the selected water quality indicators, enabling the identification of risks associated with changing values. This model's predictive ability allows for early identification of potential threats and supports the implementation of cost-effective measures to protect water resources. The study concludes that the SARIMA model can effectively simulate changes in water temperature, dissolved oxygen, and conductivity, providing valuable information for water management and conservation strategies.

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KEYPOINTS AND INFLUENCING FACTORS OF BIOPHILIC INTERIOR ARCHITECTURE AND DESIGN IN THE ROMANIAN PRE-SCHOOL EDUCATIONAL SYSTEM

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ABSTRACT

Considering the development of small children education in a highly creative and dynamic world, this article aims to unveil the benefits of child-friendly design and architecture in the Educational System world of Kindergartens in Romania, Timis County. Starting with theoretical information regarding biophilic design, ergonomic design, color theory, gamification and learning through play with the help of design, the study analyzes best practices to extract a set of guidelines adequate to the public Romanian educational system.

Interior architecture in educational spaces, particularly kindergartens in Romania, plays a crucial role in shaping children's cognitive, emotional, and social development. This study explores the key points and influencing factors that define effective interior design in early childhood education environments; the integration of interactive and flexible spaces enhances creativity and adaptability in educational activities. By analyzing these elements, through the following methodologies: empirical observations, site visits, discussions with children(teachers, parents and others) , the research highlights best practices and innovative solutions for optimizing pre-school interiors; ultimately supporting a comprehensive(holistic) and engaging educational experience; from studied examples around the world and especially European Union, case studies from Timis County and attentievly selected activities specially curated for small children, were we will test their attention span through design and architecture; the aim is to discover how to better design such crucial spaces for our childrens future education.

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INTEGRATİNG FOOD SOVEREİGNTY İNTO URBAN PLANNİNG: A SOCİAL JUSTİCE PERSPECTİVE

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ABSTRACT

As a result of population growth, globalization, wars, natural disasters and the climate crisis that has become more evident, it is seen that the problems related to food have reached a point that cannot be ignored. Until now, food problems have mostly been studied in fields such as food engineering, agricultural engineering and medicine. Studies in the field of planning, on the other hand, have mostly been limited to rural areas, and this problem has been discussed much less through urban areas and urbanization paradigms.

Considering the current urbanization rates and planning paradigms, discussing the food problem through urban areas and producing solutions in these areas by the planning discipline can develop systemic solutions. Accordingly, the aim of this study is to filter the food literature through the planning framework and explore alternative solution areas.

In accordance with the purpose of the study, some concepts have been examined hierarchically within the framework of urbanization and planning, while others have been excluded. The conceptual flow has followed both a chronological order and a deductive method in which one concept points to another concept. Therefore, the study follows a descriptive research method and looks for practical clues. As an auxiliary source, bibliometric analysis has been a quantitative method frequently used in the methodology. The concept sets that emerged from the bibliometric analysis were guided by the role of planning to examine the qualitative and structural dimension of the food problem.

The role of the planning discipline in the conceptual flow centered on food safety, food security and food sovereignty has been examined, and food sovereignty, with which the relationship is more strongly established, has been scrutinized. Food sovereignty has come to the fore with the social justice dimension of planning and has been seen as more potential in producing planning policies.

In the concluding section, a comparative conceptual analysis of the three concepts is made through the approach, main objectives, fields of action, key institutions, food-related policies, actors and concerns. The relationship between food sovereignty, which is seen to have stronger ties to planning, and the instrumental and qualitative dimensions of planning is revealed. Even the marginalization criticisms against food sovereignty have been seen to have a certain scope in planning. It is inevitable that qualitative and empirical studies will accelerate against the current and potential food crises in the current economic system, which is prone to crises. Although there is a lack of food issues in the literature, which has so far been associated with the rural dimension of planning, it is expected that food sovereignty, as a new area of discussion in planning, will also be discussed in urban areas, which host a large part of the population, and point to solution areas.

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MINIMAL INTERVENTION IN ADAPTIVE REUSE: THE SEARCH FOR THE MINIMUM THROUGH CURRENT EUROPEAN CASE STUDIES (2015-2025)

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ABSTRACT

This article examines the scope and form of the minimal intervention concept required for the adaptive reuse of objects and spaces within the context of 21st-century architecture, focusing on European case studies from the last decade. By its nature, minimal intervention has the potential to reduce the environmental impact of construction, support material recycling and upcycling processes, and ultimately address current architectural challenges in Europe and globally. The paper presents the diversity in the perception and application of the concept of "minimum" and "almost nothing" in architecture throughout history. This ranges from the pragmatic approach to minimum as cost optimization during crisis periods, through the understanding of minimalism as an architectural movement associated with Mies Van der Rohe's quote "less is more," to Burckhardt's considerations of preserving existing architecture without intervention. Based on the analysis and comparison of three European case studies, the article describes what constitutes the "minimum" for each, throughout their entire lifecycle. For the case study of the theatre play Electric Angel (Elektrický anjel), situated in an old boiler room in Bratislava, the minimum was achieved by maximizing the utilization of the character, condition, and genius loci of the old boiler room, into which only a minimal, self-supporting, reversible structure defining a makeshift stage was inserted. The installation Offset XYZ was first installed in the former industrial cold storage facility in Berlin. It wasn't fixed to the space's walls, floor, or ceiling. Almost nothing was needed to temporarily transform the cold storage into an art gallery, just the presence of the artwork and a power source for its operation. The Theatre of the useFULL, presented at the 16th Venice Architecture Biennale, featured a pavilion with integrated projection within an old manufacturing hall. The intervention was constructed from materials and furniture pieces selected by the architects in collaboration with local initiatives dedicated to supporting homeless people. After the Biennale, the temporary theatre was disassembled, and all elements were donated to the very initiatives that needed them. Almost nothing from The Theatre of the useFULL remained unused, and it was designed with this principle from its inception. The analyses suggest that minimal interventions represent a multifaceted approach, offering relevant and responsible solutions that address contemporary architectural demands such as sustainability, economic efficiency, recycling and upcycling, the elimination of new construction, and the overall minimization of materials, costs, and energy for execution. Minimal intervention emerges as a viable alternative to complex structural changes often associated with adaptive reuse projects.

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MONITORING THE STRUCTURAL STABILITY OF THE CHURCH OF ST. MICHAEL THE ARCHANGEL IN VEĽKÉ ROVNÉ USING TERRESTRIAL LASER SCANNING

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ABSTRACT

The Church of St. Michael the Archangel in Veľké Rovné, built between 1753 and 1755, is a historically significant structure requiring continuous monitoring due to its age and structural changes over time. The preservation of such historical monuments necessitates accurate and non-invasive measurement techniques. This study employs terrestrial laser scanning (TLS) to assess the geometry of its load-bearing elements, detect potential deformations, and provide essential data for conservation planning.

The methodology involved high-precision TLS using Leica ScanStation C10 and P50 scanners, capturing data from 48 scan positions to ensure complete coverage of both the interior and exterior. The collected point cloud data were processed using Leica Cyclone software, allowing precise registration and analysis. In addition to TLS, other geodetic techniques were employed: precise leveling with a Leica LS15 digital level to detect height displacements and the spatial polar method using a Trimble VX total station to monitor the structural integrity of the church's vaults and supporting elements. The combination of these methods provided a comprehensive dataset for evaluating potential deformations.

Results indicated visible cracks in the vaults and roof framework, highlighting the need for continuous structural monitoring. The study also established 11 benchmark points for future height measurements, ensuring long-term observation of settlement patterns. The 3D point cloud model allowed for detailed structural analysis and provided critical insights into the church's condition. Despite the advantages of TLS, limitations were noted in capturing roof structures due to unfavorable lighting conditions, which affected texturing accuracy.

The findings confirm that TLS is an effective and precise tool for monitoring historical buildings, offering high-accuracy data for structural assessment, damage detection, and conservation planning. The generated point cloud dataset serves as a valuable reference for future monitoring and comparison, supporting engineers and conservationists in determining optimal stabilization and restoration measures for the church.

Corresponding Author: Milan Mikoláš

MONITORING THE VIBRATION OF SCREENING FRAMES USED IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

This paper discusses the operational monitoring of a vibratory machine that is used to sort construction debris separated from construction wastes. At reconstruction and demolition works in the construction industry, vibratory sorters are used to sort construction debris, using vibratory motors to vibrate the vibratory screens. Sorting screens are supported by springs to dampen vibrations generated by vibration motors, which are transmitted to the vibratory sorter frame.

The paper outlines a procedure to optimally select the stiffness of rubber springs depending on the total weight of vibrating masses and the own frequency of the vibratory sorter. The sensor measurement has been used to determine the relationship between the compressive forces acting on rubber springs (which are digital inputs) and their elastic deformation. The characteristics of rubber springs generated by laboratory measurements are a valuable asset in the selection of the actual springs that are installed in vibratory sorters used in the construction industry. The contribution can be justified by the fact that the spring stiffnesses specified in manufacturers' catalogues are often different from the actual stiffness values.

Based on the monitoring and analysis of the measured velocity values, i.e. the vibration signals transmitted to the frame of the vibration machines, the optimum operating mode of the vibration machines can be diagnosed and detected in a very efficient and disassembly-free way and thus any emerging fault can be identified.

The main objective of the measurements performed on the vibration sorter model has been to detect the magnitude of the effective vibration velocity values in the required time period using sensors, thus enabling monitoring, data collection and storage for the purpose of autonomous operation of vibration machines. The ability to sense and analyse the magnitude of vibrations transmitted to the frame of vibratory machines, allows to increase the safety and reliability of the operation of vibratory machines used in the construction industry. The mitigation of risks of accidents during maintenance, even during work activities, of vibratory machines and ensuring their trouble-free operation without the need for human presence due to the use of automation and sensor monitoring has been an important aspect.

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MULTI-CRITERIA DECISION FRAMEWORK FOR TREES-CERTIFIED GREEN BUILDINGS

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ABSTRACT

Construction buildings have a significant and continuously increasing impact on the global environment as they consume a lot of resources, energy and contribute a large share of carbon emissions. Green buildings have become a key approach to improve building performance while minimising environmental issues. There are various available green certification schemes, for example LEED, BREEAM, CASBEE, TREES, and Green Mark. However, the cost of green building varies mainly depending on building location. TREES (Thailand Rating of Energy and Environmental Sustainability) is a national green building certification that provides a framework for assessing building performance and built environment sustainability. Despite its advantages, various studies show that green buildings can cost up to 2-4 times more than conventional building constructions. This cost barrier can cause investors and developers to hesitate when considering green construction initiatives. Therefore, green building selection requires a careful trade-off between sustainability and cost. This research uses a mixed - methods approach, integrating the Analytical Hierarchy Process (AHP) with a stochastic cost assessment model to enhance decision-making in TREES-certified building projects. Different levels of TREES-certified buildings are compared, where AHP ranks alternatives based on sustainability criteria, and Monte Carlo simulations assess lifecycle cost variations. The finding indicated that highly sustainable buildings rate higher in AHP but also show larger cost variation due to the use of advanced green technologies, such as photovoltaic, smart metre etc. In contrast, buildings with moderate sustainability ratings and more stable costs may offer a better balance between investment and environmental benefits. This study provides a quantitative decision-making framework aims to help green building developers, investors, and policymakers that minimise financial risks while optimising sustainability.

Corresponding Author: Warangkana Juangjandee

MULTIFUNCTIONAL EVALUATION OF URBAN GREEN INFRASTRUCTURE FOR COMBATING CLIMATE CHANGE: A CASE OF SANCAKTEPE DISTRICT IN ISTANBUL METROPOLITAN CITY

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ABSTRACT

Urban areas worldwide are increasingly facing environmental challenges due to rapid urbanization and climate change. Phenomena such as urban heat islands (UHI), carbon emissions, and biodiversity loss significantly impact human health and urban livability. In response, Urban Green Infrastructure (UGI) has emerged as a key strategy, linking environmental sustainability with spatial planning to promote climate resilience and sustainable development. This study evaluates the multifunctional effectiveness of UGI in mitigating climate-related impacts in Sancaktepe, a rapidly urbanizing district in Istanbul that has developed informally over environmentally sensitive land. Despite these pressures, Sancaktepe demonstrates substantial UGI potential, as indicated by data from the Istanbul Green Area Management System (YAYSIS). The evaluation focuses on four main functions: UHI mitigation, biodiversity enhancement, ecological corridor potential, and carbon sequestration. Land Surface Temperature (LST) was used to assess UHI mitigation capacity, and results show that natural vegetative zones maintain significantly lower surface temperatures than plantation areas, emphasizing the cooling effect of mature green systems. Biodiversity assessment revealed that the district includes 224 plant taxa and 10 endemic species, primarily concentrated in the Ömerli Basin and Aydos Forest. These preserved regions also support six distinct habitat types and reflect the district's high ecological value. Carbon sequestration analysis indicates that plantation efforts across Sancaktepe's settlement areas contribute approximately 2,139,610 tons of carbon storage, although natural vegetation areas exhibit greater per-area sequestration capacity. A composite Urban Green Infrastructure Performance Index (UGI-PI) was developed to spatially synthesize these indicators using three parameters: Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), and Normalized Difference Built-up Index (NDBI). Each indicator was normalized, and the resulting index was classified into five performance categories using equal interval classification. The UGI-PI map reveals significant spatial variation: northern and eastern areas (including the Ömerli and Aydos zones) score very high in terms of UGI effectiveness, while central and southern urban neighborhoods score low due to high built-up intensity, reduced vegetation cover, and elevated surface temperatures. These low-performing areas are less effective under current conditions but may benefit from targeted small-scale interventions such as tree planting, vertical greening, and pocket parks. The integration of UGI-PI enhances the research by providing a spatial decision-support tool that identifies both conservation-priority zones and vulnerable areas requiring improvement. This framework not only evaluates the current performance of UGI systems but also contributes to strategic climate adaptation planning. The findings reinforce the need to protect natural vegetative zones while implementing targeted urban greening strategies in climate-stressed districts like Sancaktepe.

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MULTI-LEVEL CLIMATE GOVERNANCE FOR URBAN HEAT ISLAND MITIGATION IN TACNA, ATACAMA DESERT, SOUTHERN PERU: AN INTEGRATED APPROACH BASED ON THE SDGS

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ABSTRACT

This study aims to analyze the phenomenon of Urban Heat Islands (UHIs) in the city of Tacna, in the northern region of the Atacama Desert, southern Peru, through an integrated approach that combines biophysical, institutional, and social dimensions aligned with Sustainable Development Goal 11 (SDG 11) on sustainable cities and communities. The research employed a mixed-methods strategy, incorporating high-resolution thermal imagery analysis and 25 semi-structured interviews with local government, academia, and civil society stakeholders. The findings reveal an average increase of 1.8 °C in Tacna's urban temperature over the past two decades, with temperature differences reaching up to 6 °C between densely built-up areas and peri-urban ecological corridors. Additionally, there is significant institutional fragmentation; various municipal departments have overlapping responsibilities but lack coordinated strategies to address UHIs. Moreover, climate injustice was observed, as informal settlements exhibit surface temperatures up to 4.7 °C higher than formal urban areas, exacerbating social and environmental inequalities. The study concludes that effective UHI mitigation in arid urban contexts requires: (1) integrated policies linking green infrastructure and social inclusion, (2) institutional strengthening with technical and community legitimacy, and (3) polycentric governance for adaptive planning. The lessons drawn from Tacna's case offer valuable insights into other intermediate cities facing similar climate-related challenges.

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NATURAL STRATEGIES FOR SUPPORTING HEATING AND COOLING IN NEARLY ZERO-ENERGY RESIDENTIAL BUILDINGS

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ABSTRACT

This paper presents natural design and technical strategies to support heating and cooling in nearly zero-energy residential buildings. The study is based on a literature review and the author's experience, focusing on solutions that can be used in temperate climate, especially in Poland and Central Europe. The aim is to identify natural strategies which reduce the demand for non-renewable energy while maintaining indoor thermal comfort throughout the year.

During the heating season, natural strategies are aimed at obtaining heat energy from renewable sources, mainly solar radiation, its effective distribution inside the building and reducing heat dissipation to the outside. Solutions such as the southern orientation of the day zones, increased share of glazing on the sunny side, compact shape of the building, the use of thermal mass, as well as underground and roof heat storage were discussed. An important aspect is the appropriate functional zoning of rooms and the use of buffer zones on the north side.

During the cooling season, natural strategies are designed to reduce heat gain and support natural cooling processes, including night-time ventilation, evaporative cooling, and shading the building from solar radiation. Technical solutions were presented, such as: the use of deciduous vegetation on the south side, green roofs and facades, the use of colors of external partitions with high albedo and shading systems (eaves, awnings, blinds), as well as ground heat exchangers. It is important to provide a balance between the access of daylight and the need to reduce overheating in summer.

The application of these strategies in the design of nearly zero-energy residential buildings leads to a significant reduction in final and primary energy consumption, a reduction in CO_2 emissions and a reduction in operating costs. Their effectiveness depends on early consideration in the design process and adaptation to local climatic and urban conditions. The article indicates the need to perform dynamic energy analyses and simulations as a basic tool for optimizing natural strategies supporting heating and cooling.

Keywords: nearly zero-energy buildings, NZEB, residential buildings, natural heating, natural cooling, energy efficiency.

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NEW IDENTITY OF POST-SOCIALIST CITIES-CASE STUDY SARAJEVO-MARIJIN DVOR

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ABSTRACT

Urban identity refers to a collection of traits that distinguish a given city or community, both in terms of its architectural and geographical features as well as in relation to social, cultural, and historical elements. Therefore, it is the general impression and experience of the city as perceived by its citizens, based on its unique traits, traditions, social customs, and daily existence.

The paper analyses how architectural heritage, urban infrastructure and socio-political dynamics influence evolving identity of post-socialist cities. The processes that shape the identity of the cities are multilayered and dependent on complex inherited historical, cultural, socio-political elements. Through case studies from various geographic contexts, focusing on Sarajevo's area of Marijin Dvor as well as other cities in the region, paper analyses how architectural heritage, urban infrastructure, and socio-political dynamics influence the evolving identity of these cities under the neo-liberal influences. Ultimately the paper underlines the understanding of the post-socialist city identities under the influences of the global trends.

Based on literature research as an essential first step the paper gives various perspectives and ideas regarding the identity of space and place using analysis and valuation techniques. Understanding the area's history and context is facilitated by analyzing spatial forms, typologies, and identities from the past and present. Comparative studies of a number of post-socialist cities in the region provide a clearer understanding of the motivations and strategies by which they create new identities. The outcome of this research suggests that the identity of the post-socialist cities will continue to evolve detached from the context, influenced by the ongoing global socio-economic trends that will reflect themselves spatially and redefine the urban landscape.

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NON-CLASSICAL OPERATIONAL CALCULUS IN THE ANALYSIS OF THE BEHAVIOR OF GEOSYNTHETICS IN RAILWAY ENGINEERING STRUCTURES

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ABSTRACT

One of the basic tasks of communication structures is to safely carry loads and then transfer them to the ground. In the case of railway surfaces, in addition to static loads, dynamic loads are of particular importance. In the discussed case, this involves adopting an appropriate model to describe the behavior of geosynthetics in railway engineering structures.

When analyzing the cooperation of geosynthetics with elements of an engineering structure (e.g. subgrade, subsoil, pipeline), we can treat them, for example, as elastic membranes or coatings placed on various types of substrate.

A physical model will be built, followed by a mathematical model using non-classical operational calculus. The mentioned operational calculus is not based, as is the case with the classical operator calculus, on integral transformations (Laplace, Fourier, etc.). Therefore, it is freed from many limiting assumptions required in the case of classical operational calculus. The non-classical operational calculus is based on three linear operations S, T, s and two linear spaces L^0, L^1. This allows us to create continuous and discrete models.

In the mathematical description of the behavior of geosynthetics in railway engineering structures in the continuous domain, the Laplace operator $\triangle = \nabla^2$ and the d'Alembert operator $\square$ are used. The d'Alembert operator is treated as an operation S, for which operations T, s are selected and the location of points P from the geosynthetic at time t is determined.

Assuming S as an operation defined in the space of multi-point sequences allows us to analyze the formulated problem in the discrete domain. Such approach to the analyzed problem allows us to determine the location of P points from the geosynthetic at time t using analytical, numerical or hybrid methods.

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NUMERICAL MODELING APPROACH FOR PROGRESSIVE COLLAPSE ANALYSIS OF INFILLED RC FRAMES

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ABSTRACT

Most design codes treat masonry infill walls as non-structural elements, and in the analysis of steel or reinforced concrete (RC) frame structures, their presence is often neglected. However, numerous studies have shown that infill walls significantly influence the strength, stiffness and ductility of the structure. Therefore, it is crucial to consider the contribution of infill walls to the building's behavior.

Accurate modeling of the infill walls requires knowledge of the mechanical properties of masonry, various interacting parameters, and the contact conditions along the interface between the infill and the surrounding frame. Two primary techniques used in the analysis of infilled frame structures are macro-modeling and micro-modeling. Micro-modeling utilizes Finite Element (FE) software to represent the masonry panel as composed of many elements that simulate the bricks and mortar. In contrast, macro-modeling treats the masonry panel as a few elements, typically modeled as one or more compressive diagonal struts. Both techniques aim to capture the nonlinear behavior of the materials.

The objective of this study is to assess the influence of the infill walls on the progressive collapse resistance of RC framed structures. To achieve this, an RC frame experimentally tested by Li et al. (2016) is modeled in Abaqus/Explicit software in two configurations: bare frame (without infill walls) and infilled frame (with infill walls). The frame consists of four bays and two stories, and progressive collapse is triggered by the failure of the middle column from the first story. This failure is simulated through a step-by-step unloading process in a displacement-controlled manner.

To evaluate the progressive collapse behavior of the two numerical models, nonlinear explicit dynamic analysis is adopted to simulate the quasi-static loading scheme. The Concrete Damaged Plasticity (CDP) model is used for both concrete and masonry, with the compressive stress-strain relationship following the Kent-Scott-Park constitutive model. The steel reinforcement bars material properties are specified based on a bilinear stress-strain relationship. Tie-type connections are employed to model the interaction between the RC frame and masonry elements, while general contact is used to simulate the interaction between masonry elements.

The resistance force (applied vertical load) versus the vertical displacement of the middle column is monitored up to a displacement of 500 mm. The progressive collapse behavior of the frame is divided into four stages. The numerical results obtained for both models show good agreement with the experimental ones. It was found that during the first deformation phase (when adjacent and exterior columns moved outward), the infilled frame model resisted a vertical force approximately 4.8 times greater than the bare frame model. In conclusion, completely neglecting the infill walls in the progressive collapse analysis of RC framed structures leads to unrealistic results.

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NUMERICAL SIMULATIONS ON CLOSE RANGE BLASTS AGAINST LIGHT STEEL BASED BUILDING FACADE

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ABSTRACT

External explosions, either accidental or intentional, pose a serious threat to the communities but also a challenge to the structural engineers. Such threats include detonation of high energy explosives (e.g., improvised explosive devices), which can cause structural failures (local damage of structural/nonstructural members or even global failures) and serious injuries or deaths. This risk can be minimized by increasing the standoff distance, but also through structural conception and design, e.g., avoiding brittle materials especially on the facades, adopting specialized construction techniques and detailing. The study investigates the capacity of light steel building facades to resist the effects of close-range explosions and main parameters affecting the ultimate strength and deformation capacity. Pressure-impulse P-I curves are derived from numerical analyses performed with Etabs finite element based structural analysis and design program. Numerical models are calibrated against benchmark tests obtained in a full-scale experimental program.

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OPTIMIZED SMART GRID DESIGN WITH INTEGRATED HYDROGEN STORAGE FOR SUSTAINABLE ENERGY IN URBAN AREAS

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ABSTRACT

The increasing demand for efficient and sustainable energy solutions has accelerated the development of smart grid systems by integrating different types of advanced energy storage technologies. Among various available solutions hydrogen storage is emerging as a key solution for addressing the variability of renewable energy sources while enhancing grid stability and energy efficiency.

This research study investigates the design and optimization of smart grid systems with integrated hydrogen storage. The goal is to improve energy efficiency, enhance system resilience, and support the transition to near-zero energy buildings (NZEBs).

The proposed system combines hydrogen storage with battery energy storage systems (BESS) to mitigate fluctuations in solar and wind power generation. A cloud-based monitoring and control system enables real-time data access, predictive maintenance, and optimal energy dispatch. The study also evaluates the environmental impact, energy efficiency, and economic feasibility.

Results indicate that properly designed smart grid systems with hydrogen storage significantly enhance energy sustainability and reliability. The integration of hydrogen as a long-term storage solution reduces dependence on fossil fuels, accelerates NZEB development, and supports carbon neutrality goals.

Hydrogen storage plays a crucial role in advancing renewable energy systems. The research provides insights into its potential as a key enabler in smart grid infrastructures, contributing to a more sustainable and resilient energy future.

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OPTIMIZING URBAN RAIL TRANSIT POLICIES VIA PASSENGER FLOW IMPACT MODELING

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ABSTRACT

China's current rail transit planning and management policies are mainly based on specific city macro indicators to control the construction and development of rail transit, but in recent years, some cities have serious problems of rail transit passenger flow shortage.In order to explore the influence pattern and evolution of macro indicators on passenger flow, this study selects 2019 and 2023 as the comparison time period, and adopts the ridge regression model to construct the urban rail transit passenger flow impact model for the cities that have already operated rail transit.The results show that: the existing policies of Gross Domestic Product and general budget revenue from local finances have a continuous and significant impact on the total volume and intensity of urban rail transit passenger flow, and the influence of the urban resident population size index on the passenger flow characteristics is gradually decreasing; outside of the policy, the share of urban tertiary output and the density of resident population in urban area will have a significant impact on the characteristics of the passenger flow, and the trend of the impact is gradually increasing; the passenger flow of the Type I large city intensity has a strong correlation with tourist reception. As a result, this study proposes optimization suggestions for urban rail transit planning, construction and management policies to promote the healthy operation and development of urban rail transit.

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PARAMETRIC STUDY METHOD OF ILLUMINANCE AND AIR FLOW IN BUILDING ARCHITECTURAL DESIGN PHASE

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ABSTRACT

Today, the production of sustainable buildings has become one of the main objectives of the construction industry. This direction aims to meet the increasing demand for construction while minimizing harmful impacts on the environment, thus contributing to sustainable development (Ding, 2008; Hendriks, 2001; Hussin et al., 2013; Medineckienė et al., 2010). The indoor environment of sustainable buildings, influenced by various parameters such as lighting, air quality, thermal comfort, and materials used (Jia et al., 2021; Ma et al., 2021; Sarbu & Sebarchievici, 2013) is of paramount importance. This environment requires in-depth research to effectively meet the needs of occupants, thereby ensuring their comfort and well-being. The quantity of light and the natural ventilation flow are therefore essential elements to consider in the architectural design process of buildings. This study explores a computational approach using a workflow between Revit, Dynamo, et Python to assess illuminance levels and airflow efficiency in a small house. To achieve this, our research is divided into three phases: firstly, creation of 3D model in Revit; secondly, and extraction of geometrical and environmental data and thirdly, computation of radiation-based illuminance calculations and estimation of natural airflow rates based on simplified Bernoulli equations using Dynamo and Python. The results of this research provide actionable insights into illuminance exposure and ventilation rates for each room, enabling data-driven decision-making for architects during the design process. This approach establishes a workflow that eliminates the need for external simulation software by leveraging BIM's built-in calculation tools. The results demonstrate the method's effectiveness in analyzing early design stages.

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PLACE ATTACHMENT ON CITY SQUARE SPACES IN CHIANG MAI OLD CITY IN SOCIAL MEDIA ERA

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ABSTRACT

This study examines the place attachment as conveyed through social media, specifically focusing on significant square spaces in Chiang Mai, Thailand. Analyzing social media posts related to the Three Kings Monument Square, Tha-Pare Gate Square and Chiang Mai Gate Square through Instagram application. —evaluating seven factors: demographics, frequency of visits, importance of place (IM), meaning of place (ME), functions and social activities (FU), knowledge of place, and insights from photographic analysis. The study utilized multiple-choice questionnaires, in-depth interviews, and Photo Elicitation Interviews (PEI). A total of seventy-five participants were recruited on-site, including residents of Chiang Mai Old City, aged over twenty, with a balanced representation of genders. The data collection involved interviews lasting over twenty minutes each, during which participants were prompted to share their perceptions and memories related to the photographs they had taken and gave captions in a social media platform.

Findings indicate that individuals tend to feel a stronger attachment to familiar places; however, there is a general lack of awareness regarding the historical importance of these sites. Instead, the attachment of places in social media appears to be more significantly affected by the practical uses of the spaces and the daily activities taking place there. The study concludes that social media is an insightful tool for understanding the changing identities of urban spaces, which are predominantly shaped by public perception and usage rather than historical context that interplay between social, cultural, and economic dimensions of place. The findings reveal that participants generally exhibit a neutral understanding of the places they feel attached to, with greater knowledge correlating to stronger connections, particularly among residents. However, limited historical awareness among short residency participants raises concerns about the potential loss of heritage value within the local community, the findings underscore the importance of functionality and memory in fostering place attachment in both physical and virtual contexts. This research contributes to understanding the dynamic relationship between urban spaces and digital platforms, offering insights for urban planning, heritage preservation, and the integration of social media in promoting place identity.

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POLYSACCHARIDE-BASED BIODEGRADABLE COATINGS ENRICHED WITH PLANT EXTRACTS

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ABSTRACT

Biodegradable materials based on natural polymers are increasingly explored as sustain-able alternatives to synthetic plastics in response to environmental concerns and regulatory frameworks such as the EU Single-Use Plastics Directive. This study investigates the development of chitosan–alginate-based active coatings enriched with natural plant ex-tracts (basil, thyme, oregano), applied using a fine droplet mist deposition method (DesiGate). The study demonstrated that the resulting films exhibit good flexibility, moderate mechanical strength, and bioactivity. However, their barrier and thermal resistance remain lower compared to PET films. The properties of the developed materials are comparable to other biopolymer films such as PLA or PHB, with their greatest advantages being biodegradability and potential use in sustainable food packaging. Future research should focus on improving moisture resistance (e.g., through chemical cross-linking), enhancing mechanical properties using nanofillers (e.g., nanocellulose, graphene), as well as developing multilayer structures and conducting stability tests under industrial conditions. The films were characterized for moisture content, water vapor permeability, thermal stability (DSC, TGA), and mechanical properties. The addition of plant extracts improved flexibility and slightly enhanced thermal stability, with ChA+B achieving the best mechanical strength (6.5 MPa) and elongation at break (70%). Although the films demonstrated lower water vapor barrier properties compared to PET (≈50 g/m²/24 h vs. 3 g/m²/24 h) and reduced thermal resistance, they showed potential for use as inner coatings in food packaging systems. The results confirm that combining chitosan–alginate matrices with bioactive extracts can yield functionally adequate films while supporting environmental objectives. Further improvements in water resistance and mechanical performance could be achieved through crosslinking and nanofiller incorporation. This work supports the integration of natural biopolymers in food packaging applications, with potential scalability for industry, aligning with sustainability and circular economy strategies.

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PRECISE SURVEYING ACTIVITIES USING EASILY ACCESSIBLE GEODETIC TOOLS AND METHODS

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ABSTRACT

The publication draws attention to the possibilities of using some generally available geodetic tools and methods - classical and modern, for carrying out precise setting out works, during the construction process. Accordingly, the required accuracy of construction activities and the available geodetic equipment. In this case, a specific type of engineering facilities has been considered, with requirements for precision in fixing the structural elements - in plan, height and orientation of the construction axes.

In this regard, the necessary accuracy for carrying out the setting-out work has been investigated. By applying geodetic linear resections and the orthogonal method, in combination with the use of navigation receivers - GNSS /Global Navigation Satellite Systems/, as well as coordinate-oriented satellite images.

A method for preliminary assessment of accuracy is presented, when using specific geodetic methods and instruments, regarding construction tolerances. A reasoned conclusion is reached about the appropriateness of the chosen methods in the implementation of similar engineering and geodetic tasks - from the point of view of efficiency, logistical and economic factors.

The proposed approach is supported by practical results from geodetic works on completed construction sites from the author's professional practice.

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PROCESSES OF URBANIZATION IN MICROREGIONS OF SLOVAKIA

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ABSTRACT

The aim of this research is to analyze the processes of suburbanization in the microregions of Slovakia and their impact on the transformation of traditional rural structures, including changes in local identity. The study examines the dynamics of demographic, economic, and social changes that directly influence the urbanization of rural areas. The methods used combine an analytical approach to geographic data, field observations and surveys, and cultural-social and ethnographic information.

Through case studies, we reveal how suburbanization trends and their impact on local infrastructure guide the emergence of a new community identity. The results highlight the diversification of functions within rural municipalities, showing that suburban trends create new social and economic opportunities while also presenting challenges related to sustainable development and the preservation of cultural identity.

The research emphasizes the need for strategic regional planning that integrates urbanization dynamics and identity transformation into the rural landscape, thereby supporting balanced development in the microregions of Slovakia.

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PROGRESSIVE COLLAPSE RESISTANCE OF STEEL AND COMPOSITE FRAMES UNDER LOCALISED FIRE SCENARIOS NEAR AN INTERNAL COLUMN

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ABSTRACT

Localised damages to key structural members may originate from different causes, including localised fires. However, as far as the affected area remains small and damage is contained, the risk is reduced. If the structure does not have the capacity to bridge over the damaged components, progressive collapse may be initiated, with serious consequences for the life of the occupants and the associated costs of losses. Even some common structural properties, like redundancy and ductility, bring significant benefits as they can provide alternate load paths, they can be affected when working under elevated temperatures, and thus structural integrity can be at risk.

This paper investigates the effect of elevated temperature on the progressive collapse resistance of two-way frames with steel and composite steel-concrete floors. Several scenarios are considered, including the loss of an internal columns with or without adjacent joints. Numerical models are calibrated against relevant test data. The results shown that even the fire protection is an effective way in increasing the resistance of structural components under elevated temperatures, the failure may propagate due to the attainment of the capacity in the surrounding elements and connections that are still at ambient temperature. Also, the interaction between concrete slabs and steel beams may provide additional capacity to arrest the progressive collapse.

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PYROLISIS KINETICS OF EUROPEAN HAZELNUT HUSK GOWN IN CHILE

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ABSTRACT

This study focuses in determining the pyrolysis kinetics for the husk of the Corylus avellana grown in Chile as a first step for determining the energy and chemical potential, and as an alternative of the disposal method of this biowaste in Chile. Thermogravimetric analysis (TGA) was performed on hazelnut husk sample at heating rates of 10, 20, 30, and 40 °C/min under nitrogen atmosphere (50 mL/min). The results were analyzed using three different kinetic models to determine the activation energy (Ea) and pre-exponential factor (A): the isoconversional methods of Kissinger-Akahira-Sonose (KAS), Ozawa-Flynn-Wall (OFW), and the Coats-Redfern method. The TGA results revealed a multi-stage pyrolysis process, beginning with dehydration and followed by the decomposition of hemicellulose and cellulose, culminating the formation of char (lignin content). The analysis demonstrated a clear dependence of the decomposition rate on heating rate, with faster heating rates resulting in higher peak temperatures. This effect is attributed to variations in heat transfer efficiency within the biomass particles. Applying the KAS and OFW isoconversional methods yielded an average activation energies of 121 kJ/mol and 126 kJ/mol. The Coats-Redfen method provided the corresponding pre-exponential factors. A detailed analysis of the activation energy and pre-exponential factor as a function of conversion degree was performed, revealing a non-linear relationship and providing insights into the reaction mechanism of the hazelnut husk. A comparative analysis with existing literature on the pyrolysis of similar biomass showed good agreement between the results obtained in this study and previously published data. Understanding the thermal behavior of the hazelnut husk offers a key information for the design and optimization of bioenergy and bio-chemical processes utilizing this underutilized resource.

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RAILWAY TRANSPORT INFRASTRUCTURE ON THE EASTERN FLANK OF NATO AND OF ROMANIA

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ABSTRACT

The paper presents the Romanian perspective for the international and national context of the railway transport infrastructure on the Eastern Flank of North – Atlantic Treaty Organization – NATO in the context of an overlap with the border of European Union and also, the new Schengen border. Major connections and junction points on the railway transport infrastructure near the border are studied. The research is the base for a developing map that aims to analysis the major points of railway transport infrastructure, the entire research is made by civilians with open-source information. The results will ensure a general view of the railway transport infrastructure in national and international context. A country at the edge of the European Union, a Schengen border and not least, the first line of the NATO border has a great responsibility, presents numerous risks and needs to be sustained due to the new resettlement of influence spheres in the world and in the European continent.

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RURAL SANITATION IN CHILE: DIAGNOSIS, INVESTMENT AND CHALLENGES TOWARDS SUSTAINABILITY

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ABSTRACT

Chile faces an important backwardness in rural sanitation, made evident by the low coverage of wastewater treatment plants (around 13% of communities have sewage or treatment). The rest of the population discharges their wastewater into septic tanks or technologies that meet Decree N°236/26 and, to a lesser degree, utilizes cesspools. This gap, compared to urban areas (coverage close to 99.98%), causes social, environmental and public health impacts.

In the context of implementing Law N° 20.998 of Rural Sanitation Services (SSR), which has been in force since November 2020, the State must guarantee access to sanitation and provide infrastructure in rural areas. This investigation assesses the current situation in said areas and estimates the necessary investment to close the gap, serving as an input to formulate public policy. We applied a methodology based on the analysis of the updated database Public Works Ministry's SSR, with the objective of identifying deficits in the countries three macrozones (North, Center and South) and evaluating the investment in diverse technologies – both conventional and unconventional -. The results show a significant backwardness: only 27% functions without significant problems and close to 73% of rural wastewater treatment plants show operational and infrastructure failures; 30% of this latter segment is in a critical state and requires urgent interventions. Among the most common deficiencies, the standouts include lack of maintenance, lack of essential equipment, rainwater infiltration, unforeseen population growth, deficient engineering design, difficulties to operate complex systems and economic problems the rural sanitation services have in sustaining operations. These gaps include coverage, quality and sustainability of solutions, requiring a comprehensive approach that takes into account local reality and the selection of adequate technology.

The impact of said limitations is shown in environmental pollution, sanitary risks and limitations on communities to administer their services and market their products. Faced with this problem, we present several strategies for a solution. In the first place, it is recommended to increase investment in infrastructure, assigning priority to the replacement or rehabilitation of critical infrastructure, after a previous evaluation of geographic, climatic and density characteristics. It is also proposed to strengthen the operation of SSRs via training and the professionalization of operators, technical assistance and continuous monitoring, in addition to updating regulations to favor the adoption of adequate technologies. Lastly, it is emphasized that there is a need to promote innovative and sustainable solutions, such as systems that are based on nature and renewable, that reduce costs and improve performance. Meeting these measures, in harmony with Chile's climatic commitments and the ODS 6, Will make it possible to sustainably close the gap in rural sanitation, improving the quality of life of the communities and protecting the environment.

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SAVING ENERGY THROUGH TRANSPARENT SHUTTERS – PRESENTATION AND DISKUSSION OF A DO IT YOURSELF IDEA

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ABSTRACT

In Europe, the majority of heating energy is required for existing residential buildings: on the one hand, most of these buildings are well over 25 years old, and on the other, they regularly have an uninsulated or very poorly insulated building envelope. Most of the energy lost in winter is lost through the façade because it makes up the largest part of the envelope. Enormous increases in energy prices, particularly in Germany, are forcing the owners of such buildings to economise, i.e. to lower interior temperatures. This is only sensible and possible to a limited extent, which is why extensive energetic refurbishment measures are now needed even more than in 2021 or before. In view of Germany's current economic difficulties (particularly due to many insolvencies and inflation), this poses a challenge for many private owners of detached and terraced houses. The following text therefore presents a do-it-yourself idea that can be implemented at low cost to address this problem. Although transparent window shutters are only a selective measure for existing residential buildings, they are an improvement that can be implemented primarily as a cost-effective interim solution until extensive energy refurbishment is carried out. This idea is based on the historical form of the so-called front window. It avoids the physical problems of many other DIY solutions. In combination with recycled products, the consumption of resources can also be minimised for the idea presented here.

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SHAPING AND APPLICATION OF NATURE BASED SOLUTIONS IN ARCHITECTURE AND CONSTRUCTION

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ABSTRACT

The contemporary urban environment is undergoing rapid transformation due to global climate challenges and the increasing demand for improved energy efficiency, reduced material consumption, and enhanced user comfort. Architecture and construction—fields deeply intertwined with resource management and environmental quality—must adopt innovative and sustainable design strategies. One of the most promising approaches is bionics (biomimetics), an interdisciplinary field that draws on principles from biological systems to inform design practices. Nature has long served as a source of architectural inspiration—from the symbolic and organic forms of Art Nouveau to contemporary projects enabled by digital technologies that allow for precise modeling of biological structures. However, modern biomimetics extends beyond aesthetics. It encompasses function, structure, and adaptive processes, integrating insights from biology, engineering, materials science, computer science, and architecture to develop nature-inspired systems that are more efficient, durable, and sustainable. Key technologies in this domain include parametric and generative design, environmental simulation, digital fabrication, and smart materials, all of which enable the creation of structures that respond dynamically to external stimuli. Additionally, the growing trend of biophilic design—often combined with biomimetics—contributes to the development of spaces that are not only energy-efficient but also promote the psychophysical well-being of users. This article aims to present the current state of knowledge regarding the application of bionic solutions in architecture and construction. Selected case studies are discussed to illustrate how biomimetic strategies have achieved high environmental, aesthetic, and functional performance. The article presents examples of rod structures based on minimal forms, as well as structures with topology inspired by nature and parametrically generated. It also explores specific architectural implementations and identifies challenges and future directions for this rapidly evolving field.

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SINGLE STOREY STEEL FRAME STRUCTURE IN 3D – SENSITIVITY STUDY UTILIZING FEM SIMULATIONS

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ABSTRACT

This paper presents a sensitivity study of a single-story steel frame structure. A basic sensitivity study of linear (Pearson) correlations was conducted to examine the relationships between input parameters and the frame's ultimate resistance. This study provides a basic insight into a problematic of how variations in key input parameters influence the ultimate resistance of the structure across different slenderness levels (various frame heights, keeping the same cross-sections).

The input parameters considered in the analysis are treated stochastically and include two material properties (elastic modulus and yield stress) along with four parameters defining the initial geometrical imperfections of the frame: global sway and local bow imperfections in two orthogonal directions. These imperfections affect the structural behavior and stability of steel frames, making their probabilistic assessment crucial.

To determine the ultimate resistance based on stochastic data, a combination of the First Order Reliability Method (FORM), the finite element method (FEM), and geometrically and materially nonlinear imperfect analyses (GMNIA) is employed. The FORM-based resistance values are then compared with two deterministic estimates of ultimate resistance obtained following the European standard for steel structure design (EC3). The first deterministic estimate directly utilizes FEM, while the second is based on EC3 buckling provisions, where the critical length is determined using prior eigenvalue buckling analysis of the frame structure.

The findings of this study provide valuable insights into the sensitivity of the selected steel frame and demonstrate how probabilistic methods can complement conventional deterministic design approaches. By incorporating both stochastic and deterministic analyses, the research highlights the influence of uncertain parameters on the structural response and enhances the understanding of steel frame behavior under varying conditions. The comparison between probabilistic and deterministic resistance estimates also reinforces the accuracy and reliability of stochastic approaches, which may offer a more refined alternative to traditional design methods.

The basic sensitivity study of linear correlations identifies key relationships between input variables and structural resistance, helping to better interpret the influence of different parameters on the overall stability of the frame. These results contribute to improving structural safety assessments and refining design methodologies for steel frames, particularly in cases where uncertainties play a significant role in performance evaluation.

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SMART BUILDING IN RELATION TO FACILITY MANAGEMENT – OVERCOMING BARRIERS TO DIGITALIZATION

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ABSTRACT

The development of digital technologies can significantly contribute to improving building management and maintenance processes, bringing revolutionary changes in the field of facility management. The digitization of recorded data allows for more efficient management of operational and maintenance processes throughout the entire life cycle of a building, which leads to cost reduction, optimization of workflows and extension of the service life of technical equipment. A key tool in this transformation is the concept of a digital twin, which allows the creation of accurate virtual models of buildings not only for new projects, but also for existing buildings. These digital models provide comprehensive information about building elements, technical equipment and operational parameters, which supports more effective decision-making in the field of management and maintenance. However, with the development of digitalization, there is also a need to identify and address potential risks associated with the implementation of these technologies. The main challenges include cybersecurity, personal data protection, system interoperability and the need to standardize digital solutions. For the successful implementation of a digital twin, not only technological security is essential, but also legislative and organizational readiness of entities managing buildings. Digitalization in building management and maintenance thus represents a significant step towards smarter, more efficient and more sustainable real estate management, while its full potential can be utilized through properly designed strategies and technological solutions.

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STUDY ON THE BEHAVIOR OF STEEL BEAM TO STEEL COLUMN CONNECTIONS WITH EXTENDED END PLATE

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ABSTRACT

The main objective of this study is to evaluate the behavior of a typical steel beam-to-column connection with an extended end plate, isolated from a previously tested composite beam-to-steel column experimental configuration. This paper presents both analytical and numerical investigations focused on assessing the strength and stiffness of such connections. The analytical approach is based on the Component Method, while the numerical simulations were performed using Consteel and IDEA StatiCa, two finite element software tools developed for the analysis of steel structures. In Consteel, stiffness and capacity are evaluated using the Component Method, whereas IDEA StatiCa employs the Component-Based Finite Element Method (CBFEM). The results highlight the column web in shear and the end plate in tension as the most critical components. A parametric study was carried out to evaluate the influence of end plate thickness and the use of additional stiffeners on the connection's stiffness and load bearing capacity. Both analytical and numerical results confirm the semi-rigid behavior of the connection and its ability to transfer negative bending moments. This study is part of a broader research project on the performance of semi-rigid steel and composite connections, where the interaction between the steel beam and reinforced concrete slab is considered partial. The next phase includes the calibration of nonlinear models in Abaqus and an experimental program focusing on steel and composite beam-to-column connections. The research is driven by the limited guidance offered by current design codes regarding the behavior of semi-rigid connections between steel columns and composite beams with partial interaction.

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STUDYING OF A FUNCTIONALLY GRADED PRESSURE VESSEL HVING NON-LINEAR VISCOELASTIC BEHAVIOUR

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ABSTRACT

In this study, a functionally graded pressure vessel having form of a sphere is analyzed. It should be noted that pressure vessels are commonly used for keeping fluids in many industries and technical facilities. Enhancing the efficiency and safety of the pressure vessels is a permanent task for the scientists and specialists engaged in the research, design, manufacturing and exploitation of these vessels. Using of modern materials represents an important step in the way towards modernization and raising the economic efficiency of the pressure vessels. Among the various engineering materials which have been developed in the recent decades, the functionally graded materials show up with their excellent properties. The high achievements in the development of technologies of these materials in many countries in the world offer exceptional opportunities for making not only component parts of various devices, facilities and constructions but also for making of whole products. The response of the functionally graded vessel studied here is non-linear viscoelastic. The analysis aims mainly to help for determining and understanding the relations between the vessel response and the parameters of the vessel viscoelastic model. The vessel response (i.e., the stresses in the vessel wall) is investigated. An approach that deals with equilibrium of an infinitesimal element of the vessel wall is detailed and applied for obtaining the stresses. Some typical results yielded by this approach are used for building-up diagrams of the relations between the vessel response and the model parameters.

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SUSTAINABLE DESIGN FOR MENTAL HEALTH: A FRAMEWORK OF SPATIAL INDICATORS FOR UNIVERSITY CAMPUSES

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ABSTRACT

Introduction

The mental health crisis among university students is gradually increasing, from psychological fatigue, burnout, and anxiety to suicide, forcing universities to integrate a mental health focus in sustainable campus planning. Mental health can be influenced, either alleviated or exacerbated, by the academic environment. Campus Sustainability Assessment Tools (CSATs) provided various indicators, but few include spatial indicators related to mental health. To bridge this gap, it is essential to understand the influence of spatial aspects on students' psychological well-being. Identifying environmental stressors and spatial qualities and translating them into indicators that can be consistently defined and evaluated.

Objectives

This study aims to address the gap in CSATs regarding students' mental health and to develop spatial indicators for universities to embed mental health. The goal is to propose spatial indicators that allow universities to evaluate and measure the relationship between the built campus environment and mental health.

Methods

A comparative analysis was conducted on ten CSAT frameworks and two related frameworks, including the Global Reporting Initiative (GRI) and the Circular Economy (CE), with a focus on identifying and evaluating existing assessments. In parallel, a review was conducted to analyze key psychological stressors and interventions in the academic environment for university students' mental health. This included formulating spatial indicators that describe, quantify, and assess the relationship to psychological outcomes.

Results

Findings show that existing CSATs prioritize curriculum and teaching approaches, and research includes scholarship, social network, and operational. However, only the Sustainability Tool for Auditing Universities' Curricula in Higher Education (STAUNCH) and Sustainability Tracking, Assessment & Rating System (STARS) explicitly reference mental health. Apart from STAUNCH and UI GreenMetric, which include indicators of biodiversity and green space ratio, respectively, nearly all frameworks focus on non-physical, conceptual metrics. The identification of spatial indicators is linked to specific design attributes—such as natural light, spatial openness, and access to nature—with reduced stress and enhanced emotional well-being. Key findings related to the study's spatial indicators propose a three-part indicator set:

1. Psycho-spatial indicators (e.g., light, acoustic, and visual comfort, finishing material, accessibility, air quality, layout)
2. Socio-spatial indicators (e.g., communal area, visibility, accessibility, safety, interconnection)
3. Restorative spatial indicators (e.g., naturalness, spatiality, safety and security, privacy-public balance)

Conclusion

Universities must focus on preserving students' mental health by improving their physical environments, especially because supporting and fostering mental health is no longer optional. Understanding the tangible ways in which space impacts mental health enables universities to define clear, measurable criteria for improvement. These findings offer a practical foundation for evaluating existing environments and guiding future design interventions. A three-part indicator set will be developed and applied through a mixed-method case study approach, implemented in two existing campuses, and it will be examined in depth via on-site observations, structured interviews, and student surveys to capture both measurable data and lived experiences. The framework aims to articulate the connection between spatial design and mental health and to establish a methodology for identifying, defining, and assessing these indicators across different university settings.

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SUSTAINABLE CONCRETE MIXTURE WITH RECYCLED AGGREGATE

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ABSTRACT

The use of recycled aggregate in concrete mixtures represents a significant step toward sustainability in the construction industry. This study focuses on the characteristics and mechanical properties of concrete mixtures in which natural aggregate is replaced with recycled material obtained from construction debris. The main advantages of this approach include the conservation of non-renewable natural resources, the reduction of construction waste, contribution to the circular economy, and the reduction of the carbon footprint.

The research analyzes two variations of concrete mixtures with recycled aggregate—the first replacing only the coarse fraction up to 50%, and the second with a full 100% replacement of both coarse and fine fractions. The study compares compressive strength, bulk density, and modulus of elasticity, with results indicating that a higher proportion of recycled aggregate leads to lower strength and elasticity values. Laboratory tests demonstrated a gradual increase in strength over time, with the maximum achievable strength classes being C30/37 for a 50% replacement and C20/25 for a 100% replacement. Concrete mixtures with recycled aggregate are particularly suitable for sub-base layers, foundations, and infill structures. However, their application is limited in heavily loaded or chemically aggressive environments.

The findings of this study suggest that recycled aggregate has the potential to become a viable alternative to natural materials in specific applications. To further expand its usability, additional testing is required, particularly regarding freeze-thaw resistance and chemical durability. The research supports the role of recycled aggregates in sustainable construction while highlighting areas for further development.

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SYNERGY OF CROSS-BORDER REGIONS IN THE CONTEXT OF SUSTAINABILITY

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ABSTRACT

The synergy of cross-border regions is based on several aspects: economic, social, cultural-historical, and transport-related. At borderlands, there is an interweaving of cultures and national identities, which contributes to the diversity and distinctiveness of these areas. This represents a potential that, especially in regions outside the main hubs of economic development, can significantly enhance their attractiveness and, consequently, support their economic and social advancement.

This paper highlights the cultural, natural, and social potential of the region "Upper Záhorie" and its valorisation for the development of sustainable tourism, strengthened by robust cross-border linkages. The research is grounded in current trends in sustainable tourism development, based on successful strategies for revitalising regions located outside of economic centres. One of the globally recognised positive influences is the trend of reinforcing regional characteristics through local agriculture and gastronomy, the revival of crafts and traditional production. This forms one of the cornerstones of so-called "slow tourism," which is based on active leisure and discovery outside of busy tourist hubs. The region under study possesses favourable conditions for the development of such a model.

The contribution presents the outcomes of ongoing research focused on evaluating the potential of cultural heritage in the region (with emphasis on industrial, craft, and gastronomic traditions that are characteristic for the area). The identification of potential centres for the revival of traditional production and craftsmanship forms a basis for restoring the *genius loci* of the area and for shaping a distinctive interpretative route.

The support of these activities depends on the improvement of accessibility to these areas through the formation of adequate connections and high-quality public spaces.

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TECHNOLOGICAL AND ORGANIZATIONAL SOLUTIONS OF THE CONSTRUCTION PROCESS OF TEMPORARY BRIDGES IN EMERGENCY SITUATIONS

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ABSTRACT

The article describes the procedure for using the Engineering Troops of the Armed Forces of the Republic of Poland in eliminating the effects of the natural disaster that hit south-western Poland in September 2024. In the emergency management system, the Voivode may apply to the Minister of National Defence to allocate subunits or units of the Polish Army to, among other things, perform tasks related to the repair and reconstruction of technical infrastructure, or participate in ensuring the passability of transportation routes.

Shortly after the flood wave passed, Operation Phoenix was launched, bringing together different types of troops for one purpose - to help civilians deal with the effects of the natural disaster. Even before the above-mentioned operation, the Engineer Troops Task Force was established (later included in Operation Phoenix), which coordinated the use of engineer troops for various tasks. The flooding destroyed many engineering structures, which were replaced with temporary bridges, thus enabling the reconstruction of flooded buildings and damaged critical infrastructure.

Temporary bridges constructed by the engineering troops are DMS-65 panel truss bridge structures. The authors have presented in detail the characteristics and application of panel bridges, providing examples of their use from different parts of the world. Using Glucholazy as an example, they have described the operation of the bridge construction team separated from the engineering unit, the method and manner of assembling DMS-65 panel bridges and the schedule of the construction process. The applied structural solutions of the abutments, as well as the span part of the bridge structure, were described in detail.

Using the example of the Czech concept of Reach-Back and Operation Phoenix (the actions of the Task Group of the Engineering Forces), the differences in the actions of troops from different countries in the reconstruction of transportation infrastructure damaged by floods were shown. It was found that panel truss structures are extremely important for the rapid restoration of transportation routes, but existing structures, either on the equipment of the Polish Army or in the strategic reserves, do not meet the requirements set forth in the technical conditions to which such facilities should conform.

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THE APPROXIMATE ASSESSMENT OF THE IMPACT OF MINING VIBRATIONS ON BUILDINGS

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ABSTRACT

Mining operations, whether underground or surface-based, can lead to a negative phenomenon known as mining tremors. These anthropogenic tremors arise from activities involved in mineral extraction. They can occur in various mining basins, such as the Legnica-Glogow Copper District (LGOM), the Upper Silesian Coal Basin (GZW), and the Lublin Coal Basin (LZW). The causes of these tremors include the displacement of rock layers due to mining activities, sudden relaxation of rock mass, and the release of energy resulting from the abrupt release of stress in the Earth's crust. Mining tremors can be categorized based on their energy levels: weak-energy, high-energy, and regional tremors. These tremors can have detrimental effects on the surface, buildings, and the people residing within those structures. It is important to note that surface vibrations from mining operations are fundamentally different from those caused by natural earthquakes, although the research methods for both phenomena are similar. The intensity of surface vibrations originating from mining activities is assessed using numerical analyses of structural models, employing the Finite Element Method, or through approximate methods that utilize specific scales. In the analysed mining areas of GZW and LGOM, the Mining Intensity Scales (GSIS-2017), developed by the Central Mining Institute, are employed to evaluate the intensity of surface vibrations. The Higher Mining Office has assessed the efficacy of these scales, which have been implemented in the GZW and LGOM regions. Additionally, the Dynamic Impact Scales (SWD), proposed and integrated into Polish standards, can also be used to gauge the impact of these vibrations. The SWD scales were created based on numerical analyses, and their effectiveness was validated by in situ research results. This article provides insights into these scales and presents examples of analyses regarding the impact of surface vibrations on buildings. Evaluations of the harmful effects of vibrations on structures indicated consistency between the findings based on the GSIS-2017 and SWD scales.

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THE ARCHITECTURE OF EXISTING HOTEL COMPLEXES AS A BASE OF URBAN DEVELOPMENT IN NEUM

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ABSTRACT

The development of tourism in Neum, Bosnia and Herzegovina's only coastal town, represents a complex process that began during Yugoslavia's socialist era, marked by various social, architectural, and ecological challenges. During the 1960's, alongside accelerated urbanization, transportation infrastructure, and secondary housing, Neum experienced a transformation from a local community to a remarkable tourist destination. Architecture of that period, marked by modernist principles, was not just functional, but reflected a wide socialist ideology- promoting collective welfare, harmony with natural surroundings, and inclusivity. However, the expansion of tourism in Neum also brought problems, such as illegal construction, the destruction of landscape, and spatial segregation. The aim of this research is to analyze how the elements of socialist modernist architecture can be used as a base for the further development of hotel complexes in Neum. Modernist architecture from the socialist period provides various important lessons for today's urban planning. It's basic principles- simplicity, functionality, and the adaptation to the natural terrain, offer a relevant frame for the contemporary development of tourism. In this context, this research focuses on the integration of those principles into contemporary architecture, with the aim of creating sustainable, functional, and aesthetically pleasing hotels that satisfy the needs of tourists, while keeping the local identity. With the use of primary and secondary sources, the analysis includes the study of current hotels in Neum, their architectural characteristics, and urban organization. Special attention is paid to challenges, such as unplanned construction, degradation of the coast, and the unequal development of different parts of the municipality. Through this analysis, concrete models for the further development of hotels are suggested, which include the incorporation of modernist principles, but with a combination of new approaches.

Corresponding Author: Adnan Zoranić

THE ASSESSMENT OF THE BACKCASTING TECHNIQUE'S ROLE IN THAI REGENERATIVE DESIGN PRACTICE AS A BUILT ENVIRONMENT DESIGN TOOL

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ABSTRACT

Thai Regenerative Design Practice serves as a tool in the built environment design and planning process, specifically tailored to the Thai socio-environmental context. This practice integrates the principles of regenerative design, the Thai Rating of Energy and Environmental Sustainability (TREES), and the backcasting technique to address existing gaps in regenerative design practices, enhancing efficiency in design and planning strategies for comprehensive sustainability.

Existing studies indicate that regenerative design principles and TREES share ideological and procedural similarities, guiding genuinely sustainable design. Meanwhile, the backcasting technique is primarily utilised to establish desirable goals within strategic planning processes. Fundamentally, backcasting involves creating a normative vision of the future and then designing pathways back to the present to determine the steps necessary to achieve these goals. This approach ensures that present-day decisions facilitate long-term sustainable change. However, in Thailand, the backcasting technique has not yet been applied within the built environment design and planning process. This study regards it as an opportunity and seeks to evaluate the effectiveness of the backcasting technique as a fundamental component of the Thai Regenerative Design Practice, examining its role in enhancing the credibility of this approach. The research methodology involved a three-day workshop on built environment design for Nong Bua, Chiang Mai, Thailand, with the participation of 17 stakeholders. Data collection was conducted through observation, surveys, and interviews.

The results indicate that participants expressed satisfaction with the workshop facilitated by the Thai Regenerative Design Practice, which, according to the empirical evidence, presented as a built environment design and planning initiative for the case study area. Based on a five-point Likert scale, the findings indicate that Thai Regenerative Design Practice and its components received ratings within the "very satisfied" range. Overall, the Thai Regenerative Design Practice scored 4.80, while the regenerative design principle, TREES, and the backcasting technique received scores of 4.46, 4.23, and 4.42, respectively. Additionally, participants highlighted the significance of the backcasting technique in verifying a project's comprehensiveness. They noted that this technique effectively refines discussions, narrowing broad conversations into key focal points, and can be applied in future built environment development charrettes. In conclusion, the findings suggest that the backcasting technique contributes to developing a normative and accurate design planning strategy. However, its role within Thai Regenerative Design Practice requires further validation through repeated applications in future studies to ensure its most comprehensive and effective implementation.

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THE CHANGING ROLE OF HOTELS: HOTELS AS SAFE SPACES IN NEIGHBORHOODS

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ABSTRACT

The hospitality industry has undergone a transformation, shifting from its traditional role as provider of overnight accommodation to multifunctional service hubs. With this change, hotels' potential to contribute to healthy, livable, and resilient neighborhoods and urban quarters has increased widely. This development is driven by the erosion of urban infrastructure and social services, such as the decline in local shopping infrastructure for daily needs, the lack of care services, the closure of public swimming pools and libraries, and the decease of pubs with a corresponding increase in loneliness among the German population, to name just a few examples. At the same time, society's need for places to stay, meet and exchange ideas across social milieus is increasing. Since 2008 the research project FutureHotel Innovation Network has examined trends and developments in the hospitality industry and most recently focused on the changing role of hotels, particularly in the context of urban resilience and social sustainability. Empirical findings from a survey of 4,880 respondents reveal that hotels increasingly function as nodes of security, inclusion, and emergency support in urban environments.

Research identifies three primary ways in which hotels act as safe spaces:

First, hotels serve as urban sanctuaries, providing secure and accessible spaces for diverse stakeholders extending from guests to employees, business partners, and local communities. This positions hotels as integrated elements of the urban fabric. Empirical data shows that public access to safe and quiet environments is increasingly valued, particularly for individuals facing urban stressors such as noise, heat, or personal distress. Hotels function as non-discriminatory, accessible spaces that foster social cohesion and psychological well-being.

Second, hotels demonstrate high adaptability in crisis situations, acting as temporary shelters during natural disasters, extreme weather events, or social unrest. Their existing infrastructure, professional staff, and round-the-clock availability enable hotels to respond swiftly to urgent community needs. Case studies highlight that hotels have been utilized as emergency shelters, vaccination centers, and safe havens for vulnerable populations. This suggests an underutilized potential for hotels to be formally integrated into urban resilience planning, particularly in cities facing climate-related or social instability challenges.

Third, hotels are emerging as providers of essential services in urban and rural settings, particularly in areas with inadequate public infrastructure. Survey findings indicate that public restrooms, secure gathering spaces, and temporary refuge areas are among the most in-demand services that hotels could offer beyond their core hospitality function. Innovative business models are already experimenting with hybrid hospitality concepts, where hotels provide workspaces, wellness services, and communal facilities to both guests and non-guests. These multi-functional roles position hotels as critical service hubs in urban ecosystems, fostering livable and resilient communities.

The primary purpose of this article is to shine light on the mechanisms by which hotels function as safe spaces for urban environments. Ultimately, the role of hotels as safe spaces redefines their importance for neighborhoods, highlighting their potential to foster resilience and social cohesion in increasingly complex cities.

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THE IMPACT OF NEW RAİL STATİONS ON RAİL COMMUTER GROWTH AND LAND DEVELOPMENT

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ABSTRACT

In the early stage of new urban rail lines opening, the increase in passenger flow (PF) is a key factor supporting the sustainable planning, construction, and management in Chinese cities. However, the initial passenger flow density (PFD) of some urban rail systems fails to meet the requirements of the State Council's Document No. 52, which calls for an average of 0.7 thousand PFD per day. One of the important reasons for the difficulty in increasing rail PFD is the weak aggregation of commuting populations around urban rail stations on the outskirt areas of cities, leading to slow increase or stagnation of PF. Previous studies are relatively limited on the spatial-temporal interaction between land use, population growth, and newly built rail stations and lines on the urban periphery, making it difficult to effectively support urban rail planning and PF growth for rail lines on the outskirt areas. This study analyzes the growth of commuter populations before and after the opening of rail stations in Shenzhen, China. By combining multi-year LBS commuting data, POI data, and rail station construction data, this study developed a Difference-in-Differences model to assess commuter population changes with respect to rail and land use changes. The results indicate that, compared to before the stations were opened, the new stations on the outskirts of Shenzhen between 2017 and 2022 have brought an 8.4% increase in commuter population. The commuter population and land intensity before station opening affect the population growth after station opening. Mixed and high-density land use, such as educational, cultural, residential, corporate, and transportation facilities, helps to concentrate the commuter population around rail stations. The proposed research framework and result help clarify the rail performance evaluation challenges faced in metropolitan planning in Chinese cities, supporting local governments and rail operators in achieving sustainable rail development.

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THE DIGITAL FOOTPRINT OF LE CORBUSIER'S SARABHAI HOUSE, IN AHMEDABAD

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ABSTRACT

Le Corbusier is well known for having exercised strict control over the visual representation of his architectural work. Although he rarely took photographs himself—favouring instead the practice of drawing, which allowed him to selectively interpret and record reality—he worked with a number of professional photographers to document his completed projects. The images that appeared in architectural magazines or in his published Œuvre complète were carefully curated and, in many cases, repeatedly used in different contexts to leave a lasting and strategic impression on his audience. This editorial control resulted in an uneven visual legacy: while some of his buildings have been extensively documented and analysed, others have remained relatively obscure and underrepresented. The Sarabhai House (1951–54), located in Ahmedabad, falls into the latter category. Despite its architectural significance, it has received limited attention in the canonical publications and visual archives curated by or around Le Corbusier. Importantly, this selective visibility occurred long before the era of mass communication and digital media, and wide circulation of architectural imagery. In contrast, today's digital landscape offers a dramatic shift. There is now an overwhelming abundance of images available online, particularly on social media platforms, where photographs are often shared without proper context, source attribution, or critical analysis. However, this visual excess does not necessarily lead to greater insight or deeper understanding. The ubiquity of digital imagery may, in fact, obscure more than it reveals. In this context, this paper aims to investigate the digital footprint of Le Corbusier's Sarabhai House by examining the photographs posted and shared across popular social media platforms. Through this analysis, the study seeks to identify patterns in representation, key points of visual interest, noticeable omissions, and recurring themes. Ultimately, the goal is to assess whether this new wave of digital dissemination helps bring the Sarabhai House out of its undeserved obscurity or merely reproduces a fragmented and superficial understanding of its architectural value.

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THE EFFECTS OF SUBGRADE SOIL STABILIZATION ON PAVEMENT STRUCTURAL DESIGN

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ABSTRACT

This research work presents the effect of subgrade soil stabilization on pavement structural design through improving the engineering properties of weak subgrade soil by using Portland cement material. Soil samples were collected from three locations. Portland Cement material is selected in this study to stabilize the subgrade soils tack in consideration soil type and plasticity index. The California Bearing Ratio (CBR) test was performed on the laboratory-moulded stabilized and un-stabilized specimens in order to evaluate and compare the bearing capacity (is the capacity of soil to support the loads that are applied to the ground above) for each sample and the value of CBR before and after being stabilized. The soil and stabilizer (cement) were mixed with different percentages of cement to determine the optimum moisture content. Total of 45 CBR tests were performed taking into consideration 1- day and 7- day curing time to stabilize soil with cement. Outperforming results were observed for the increased added percentage of cement and in term the CBR value. Five percent cement was found to be the optimal mixing ratio and it demonstrated cost effective design. The results showed that the soil CBR values increased by approximately 60-70% at day 7 for this ratio. Furthermore, pavement design was conducted for un-stabilized and stabilized soils and the cost savings achieved from the stabilization was presented. The data showed that pavement design for stabilized soils achieved approximately 20-25% cost savings when compared with un-stabilized soils.

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THE EFFECT OF SYNTHETIC WAX AND AGING ON THE REHEOLOGICA PROPERTIES OF POLYMER MODIFIED ASPHALT BINDER

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ABSTRACT

The intensive development of transport and especially the increase in the number of trucks with a general traffic structure makes it necessary to use polymer-modified asphalts binder in the production of asphalt mixtures. They are characterized by high physical and mechanical parameters and can meet the requirements that are imposed on them. However, as a result of technological ageing during the production of the asphalt mixture and operational ageing, the binder parameters are reduced. In order to slow down this process, various types of additives are used, which act as ageing inhibitors. These types of materials include low-viscose additives, which include Fisher-Tropsch synthetic wax. At the same time, such additives affect the reduction of technological temperatures of the production and incorporation of the asphalt mixture, which is very beneficial in terms of environmental protection. There are reductions in greenhouse gas emissions and the energy consumption of the production of the asphalt mixture is reduced. The synthetic wax F-T was used in the tests, which was dosed to the PMB 45/80-65 polymer asphalt binder in the amount of 0.0%, 1.5%, 2.5% and 3.5%. Then the binder was subjected to technological ageing (short-term ageing) and operational ageing (long-term ageing). In the first stage of the tests, the penetration at 25°C, softening temperature and critical temperatures during the low-temperature parameter testing were determined. In the second stage, the following rheological characteristics were tested in the range of linear and non-linear viscoelasticity: complex viscosity η* and zero shear η0, dynamic modulus |G*|, phase shift angle δ and MSCR parameters. Based on the analysis of the test results, it was found that the synthetic wax reduced the susceptibility of the polymer asphalt at medium and high operating temperatures and affected the reduction of its ageing rate while increasing the elastic part of the dynamic modulus. Synthetic wax increased the zero shear viscosity level of the binder, which will have a beneficial effect on reducing the deformation rate of the asphalt mixture and ensure the required operational durability of the surface.

Corresponding Author: Marek Iwański

THE EVOLUTION OF ARCHITECTURAL SPACE IN THE CASTLES OF THE MUREȘ VALLEY, TRANSYLVANIA, ROMANIA, IN THE 20TH CENTURY: TRANSFORMATIONS AND CONSERVATION CHALLENGES LETTERS

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ABSTRACT

The Mureș Valley, historically significant for its economic and strategic role, has been home to numerous noble residences—castles and mansions—since the 16th century. These estates, reflecting a blend of architecture and nature, followed the architectural trends of Central and Western Europe. However, the 20th century brought significant transformations, particularly after the establishment of the communist regime in Romania, which led to the nationalization of many noble residences. Castles were repurposed for public functions, such as hospitals, schools, and administrative buildings, resulting in major architectural alterations, with a shift toward Soviet-influenced design that eroded the historical identity of these sites. This paper investigates the architectural transformations and conservation challenges faced by the noble residences in the Mureș Valley during the 20th century, focusing on two case studies: Urmanczy Castle in Toplița and Teleki Castle in Gornești. The primary objectives are to explore the evolution of architectural spaces in these castles, examine the effects of political and socio-economic changes, and evaluate their potential for conservation and restoration. A multidisciplinary approach was employed, involving on-site investigations, archival research, and comparative analysis with similar European cases. The findings highlight significant alterations in the castles' architectural integrity due to nationalization and urbanization. Urmanczy Castle, Toplița: Originally designed in the Art Nouveau style, Urmanczy Castle dominated the town centre until 1956, when Toplița was reclassified as an urban locality. Following nationalisation, the castle was repurposed as a hospital, leading to significant structural modifications, including the partitioning of the central reception hall into smaller rooms; the addition of a new level to one of the towers, disrupting the original volumetric composition; and a reduction of the castle park, diminishing the historical relationship between architecture and landscape. These interventions, typical of mid-20th-century functionalist adaptations, have made full restoration of the original spatial composition nearly impossible. Teleki Castle, Gornești: Teleki Castle, a representative Baroque residence, was nationalised and repurposed as a TBC sanatorium. Unlike Urmanczy Castle, its architectural fabric remained largely intact, and the castle park was preserved. However, communist urbanisation policies impacted the surrounding landscape, leading to the construction of apartment blocks in the castle's immediate vicinity, disrupting its historical setting. Functional changes that affected interior spatial configurations were largely reversible. Today, restoration efforts aim to recover the castle's original 18th-century architectural character and reintegrate it into the cultural and tourist circuit. The research underscores the impact of political and urban transformations on the architectural spaces of the Mureș Valley's noble residences. While Urmanczy Castle faces limitations in restoration due to irreversible changes, Teleki Castle offers greater potential for conservation, highlighting the importance of sustainable heritage management. These findings emphasize the need for integrating historical architectural research with modern conservation practices to safeguard the cultural and historical value of these sites.

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THE FUTURE OF NEARLY ZERO ENERGY BUILDINGS (NZEBS) IN A WARMING CLIMATE: BALANCING HEATING, COOLING, AND RENEWABLE ENERGY STRATEGIES

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ABSTRACT

As climate change accelerates, nearly zero-energy buildings (NZEBs) are emerging as a cornerstone of sustainable development. Rising global temperatures and shifting weather patterns necessitate innovative approaches to balancing heating and cooling demands while maximizing the integration of renewable energy sources.

The study explores the future of NZEBs in the context of a warming climate, assessing the impact of global and regional climate change on building energy needs and adaptation strategies. It highlights cutting-edge technologies such as dynamic insulation, smart building envelopes, advanced energy management systems, and integrated HVAC solutions. Special emphasis is placed on modern passive cooling techniques, energy storage innovations, and the utilization of local renewable energy sources, including photovoltaics and geothermal systems.

Additionally, the study examines the evolution of energy policies and building standards that facilitate NZEB development in the face of rising temperatures. Key challenges, including the increasing demand for cooling, the urban heat island effect, and the role of smart building management systems (BEMS) in optimizing energy performance, are critically analyzed.

Findings indicate that a holistic approach to the design and operation of NZEBs enhances energy efficiency while maintaining indoor comfort under changing climatic conditions.

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THE IMPACT OF BUS AND TRAM SPEED ON BUILDINGS AND RESIDENTIAL COMFORT

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ABSTRACT

Bus and tram traffic in urban environments generates mechanical vibrations that can threaten both the structural integrity of buildings and the well-being of residents. The intensity of these effects is determined by many factors, including the quality of roads or tracks, the type of vehicles used, the distance of buildings to vibration sources and the speed of their travel. The question is: Can speed really have a decisive influence on the generation of ceiling vibrations in relation to the comfort of it's residents? The operation of buses and trams can cause significant discomfort, especially in residential areas located in the immediate vicinity of roads and tram tracks. Such disturbances can negatively affect the quality of life, causing sleep disorders, increasing stress levels and reducing concentration or productivity. The presented work shows the results of experimental studies in buildings, in relation to vibration comfort in buildings in the aspect of the speed of passing trams and buses.

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THE IMPACT OF PHOTOVOLTAIC CELL TEMPERATURE ON THE EFFICIENCY OF ELECTRICITY GENERATION

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ABSTRACT

Photovoltaic panels, like other semiconductor devices, are highly sensitive to operating temperature. In real-world conditions, PV cells are exposed to a wide range of ambient temperatures, influenced by seasonal variations. In Poland, these temperatures typically range from –20°C to 70°C. Research shows that both solar irradiance and ambient temperature significantly affect the efficiency and performance of photovoltaic modules. An increase in cell temperature reduces the open-circuit voltage and slightly increases the short-circuit current, which ultimately lowers the power output and current efficiency. Beyond 25°C, the saturation current of the PV cell rises sharply, further decreasing the open-circuit voltage. Different PV cell types vary in their efficiency losses under high temperatures due to differences in quality and design.

Various cooling techniques have been developed to enhance PV performance. These include: (1) applying a continuous thin water film on the panel's surface to reduce reflection losses and cool the cell, (2) water spraying above the panels to absorb heat, and (3) hybrid systems combining PV panels with solar collectors to utilize excess heat for domestic hot water production.

The study aimed to determine efficiency gains from lowering PV cell temperature. Laboratory experiments were conducted using a test setup featuring polyethylene (PE) and PE-Xc multilayer coil pipes for heat extraction. Results showed that PE-Xc pipes, due to their aluminum layer, were more effective in heat removal. Continuous water flow (overflow system) achieved the largest temperature drops with shorter measurement cycles (15 minutes compared to 48 minutes for periodic systems).

Although the experimental setup did not represent specific PV models or standard test conditions (STC, NOCT), the study estimated that reducing cell temperature by 25.3°C could increase the power output of polycrystalline PV modules by approximately 11.9% when operating at 25°C.

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THE IMPORTANCE OF CLIMATE CHANGE FOR SETTLEMENT FORMATION AND BIOCLIMATIC DESIGN

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ABSTRACT

Green-blue infrastructure, innovative technical solutions in terms of building infrastructure, but also policy interventions significantly influence economic, social and environmental factors in urban areas. Efficient management and reduction of CO2 emissions are essential for and maintain the quality of life in cities with growing populations. This paper examines how natural conditions and climate change have influenced the development of settlements and what significant adaptation measures have been applied in cities during historical development in terms of the sustainability of settlements.

The article also focuses on the importance of implementing adaptation strategies in urban planning to mitigate the impacts of climate change today. In particular, attention is paid to bioclimatic design and its benefits within certified eco-neighbourhoods in an environmental, social and economic context. The article does not aim to exhaust the vast subject matter. On the contrary, through an analysis of history and examples from the present, it is to point out the possibilities for further professional reflection on the subject.

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THE INFLUENCE OF NANO-SILICA ON THE MECHANICAL PERFORMANCE OF POLYPROPYLENE FIBER-REINFORCED GEOPOLYMER CONCRETE

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ABSTRACT

Advancements in high-performance cementitious materials, particularly high-strength concrete, necessitate comprehensive research to assess their structural applicability and long-term performance. This study investigates the effects of nano-silica (NS) and polypropylene fibers (PPFs) on the fresh and mechanical properties of high-strength geopolymer concrete (HS-GPC). A total of nine concrete mixtures were prepared using three PPF dosages (1%, 2%, and 3% by volume) and three NS contents (5%, 10%, and 15% by weight of binder). The experimental program included the evaluation of workability, compressive strength, modulus of elasticity, and splitting tensile strength after 28 days of ambient curing. The results indicated that the incorporation of both NS and PPFs substantially enhanced the mechanical performance of HS-GPC. The optimal mixture, containing 2% PPFs and 10% NS, exhibited the highest compressive strength (134 MPa), modulus of elasticity (32 GPa), and splitting tensile strength (16 MPa). These findings underscore the potential of synergistically using nano-silica and polypropylene fibers to produce high-performance geopolymer concretes, offering a sustainable and viable alternative to conventional Portland cement-based systems.

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THE POTENTIAL TO MITIGATE THE EFFECTS OF CLIMATE CHANGE ON SELECTED EXAMPLES OF HOUSING ESTATES IN POZNAN, WARSAW AND BRNO

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ABSTRACT

Motives: A resilient city is one that anticipates, plans, and acts to prepare for and respond to unexpected crises. The adverse effects of climate change are most noticeable, among others, in multi-family residential areas. The article presents examples of housing estates with various possibilities of mitigating the effects of climate change in Poznan, Warsaw and Brno in terms of compensating for the effects of climate change.

Aim: The aim of the study was to analyze the possibilities and potential to mitigate the effects of climate change of urban systems on selected examples of housing estates in Poznan, Warsaw and Brno. They were characterized in terms of important features, that provided a basis for developing green growth indicators. The second aim of the article was to assess the standards of urbanized space and greenery in areas of collective housing in terms of determining the resilience of these structures to climate change, and to evaluate and select the statistical tools.

Methods: The studied examples of housing estates were ranked using the linear ordering method and the case study method. Analyses were based on the results of empirical studies (calculations of sixteen parameters and urban indicators). The study also used statistical tools (correlation matrix, PCA, multiple regression model).

Results: The results indicate that the examples of housing developments from the mid- to late 20th century selected for analysis present more favorable values of urban indicators and are characterized by a significantly higher proportion of green areas. The development of residential settlements presents a less compact urban structure and high landscape values.

Conclusion: In conclusion, it should be emphasized that the possibilities of adaptation to climate change discussed on selected examples of housing estates in Poznan, Warsaw and Brno of the 20th and 21st centuries show significant differences resulting primarily from the periods of implementation of the estates. Structures of housing estates from earlier periods of implementation are characterized by more favorable conditions and coefficients that raise the potential for mitigation to climate change. The methods used illustrate well the analyzed parameters when evaluating urban structures.

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THE PRIMITIVE ASSESSMENT OF THE WOODEN CHURCH IN TOPLA: A STUDY BASED ON THE COMPREHENSIVE SURVEY AND ANALYSIS

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ABSTRACT

Wooden ecclesiastical architecture, although often overshadowed by Europe's dominant traditions of stone and brick construction, constitutes a vital and distinctive aspect of the cultural heritage across the Carpathian region. This is especially true for western Romania's Banat area, where local communities historically relied on abundant timber resources and developed sophisticated carpentry techniques adapted to their religious and environmental needs. This study focuses on the wooden church of Topla, originally constructed in 1746 in the village of Remetea Luncă (Timiș County), the church embodies centuries-old craftsmanship and vernacular architectural principles characteristic of the Banat region. Its subsequent relocations—first in 1807 to Topla village, and finally in 1987 to the open-air Banat Village Museum in Timișoara—reflect changing sociocultural circumstances and evolving priorities in heritage preservation. Despite its modest size, the church exemplifies sophisticated regional carpentry techniques and vernacular architectural traditions. Prior to its near-total destruction by fire in March 2025, a series of detailed pre-fire surveys—including measured drawings, photogrammetry, and trace analysis—were conducted, followed by post-fire documentation to assess damage and recover architectural data. The research reveals insights into the church's construction methods, historical modifications, and design logic, highlighting an asymmetrical floor plan resulting from 20th-century expansions and adaptations. Analysis of dimensional data suggests that the church's design does not conform to clear geometric or traditional measurement systems commonly found in the region, though sectional proportions demonstrate a coherent proportional logic based on façade width. This mixed-methods investigation integrates archival review and comparative study, contributing new empirical evidence toward understanding wooden church construction in Banat. The findings provide a critical foundation for future reconstruction and conservation efforts, while emphasizing the importance of preserving lesser-studied wooden ecclesiastical heritage beyond the internationally renowned Maramureș and Moldavian churches. This study aims to enrich the broader discourse on vernacular wooden architecture in Eastern Europe and to inform sustainable heritage management strategies.

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THE PROBLEM OF LEAKS IN WATER SUPPLY SYSTEMS - METHODS FOR THEIR DETECTION AND ELIMINATION

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ABSTRACT

Each water distribution company is affected by the problem of water leakage at the stage of its distribution. Currently, water suppliers detect water leaks when the leak is significant, visible to the naked eye on the ground. Often minor damage with a small leak is not detected for days, months or even years. It results in the creation of wetlands and sometimes small spills and reservoirs. Pipe damage occurs slowly and often remains hidden for a very long period of time. The smallest, hidden leaks can cause unexpectedly high water losses. Therefore, it is very important to detect leaks as early as possible so that it is possible to effectively eliminate water losses and the resulting damage. The aim of the research is to develop a system supporting the detection of the smallest uncontrolled leaks in water distribution systems by using the latest technical achievements.

Currently, electro-acoustic sensors are the best solution to detect leaks quickly. This solution requires the installation of a dense network of devices throughout the water supply system. This solution is very expensive and water companies use it only experimentally on small selected parts of the network.

The proposed system (application combining GNSS and EO products) could be a platform supporting regional and national water distribution companies struggling with uncontrolled or even unknown leaks of drinking water from the network.

The proposed prototype of the platform could become a supporting tool for detection of leaks in the water supply system by identifying, characterizing and analyzing changes in the environment. It should facilitate the location of failures by analyzing complex relationships occurring in the environment, collecting, verifying and supplementing maps of water supply networks with changes occurring over time.

Corresponding Author: Urszula Filipkowska

THE PROPERTIES OF ASPHALT BINDER MODIFIED WITH WMA ADDITIVES

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ABSTRACT

Asphalt binder is very important in ensuring the durability of asphalt surfaces. Unfortunately, as an organic material, it is subject to the ageing process. During its transport from petrochemical plants and the production of asphalt mixture, it is exposed to high temperatures. The process of asphalt oxidation takes place, as a result of which its viscoelastic properties are reduced. This stage of ageing is called technological ageing (short-term ageing). However, during the operation of the asphalt surface, it is subject to the action of atmospheric factors such as wind, water and solar radiation. Operational ageing takes place (long-term ageing), the asphalt binder becomes more rigid. As a result of asphalt binder ageing, the operational durability of the road surface is reduced. In order to limit this negative process, various types of ageing inhibitors are used for asphalt binders, which can be chemical and mineral materials or natural and synthetic oils. In the tests, two WMA (Warm Mix Asphalt) additives were used in order to limit the ageing of asphalt binder - synthetic wax and tall oil amidoplamine, which were added to the asphalt binder at the same time. Synthetic wax was used in the amount of 1.0% w/w, 1.5% w/w, 2.0% w/w and 2.5% w/w and tall oil amidopolamine in the amount of 0.2% w/w, 0.4% w/w and 0.6% w/w in relation to the amount of asphalt binder. The influence of technological and operational ageing on the change of physic-mechanical and rheological properties of the asphalt binder composition with both WMA additives and chemical changes occurring in the binder were studied by determining chemical index's. Based on the analysis of the obtained research results, the optimum content of WMA additives in asphalt binder was determined and the effect of their synergy was demonstrated, which ensures the limitation of the influence of short-term and long-term ageing on the asphalt binder properties. Therefore, the required durability of the asphalt surface will be ensured in the long term of operation.

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THE PROPOSED METHOD FOR DETERMINING STIFFNESS OF MULTI-STOREY MASONRY SHEAR WALLS IN FRAME BUILDINGS

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ABSTRACT

he structure in frame buildings is stiffened with masonry infill walls. Such walls have a structural role and provide the stable geometry of the structure. It is characteristic for infill walls that they cannot take vertical loads from beams and horizontal members. The main objective of this paper is to develop the coherent procedure for determining stiffness in compliance with current design standards. This paper presents the original bar method to determine internal forces in units in the multi-storey and multi-bay frame with masonry infill. The used relationships determined geometrical parameters of the compressed strut. The division into “slender” and “rigid” frames was introduced. The “slender” frames included frames with stiffness only at individual storeys, and the “rigid” frames included frames with masonry infill at each storey. It was proposed to extend the requirements for portal frames with additional requirements concerning the position of hinges in horizontal members of the frame. Stiffness determination and load distribution are the same as in the method used for walls in load-bearing structures and (one-storey) frame buildings. Elastic supports with stiffness determined from the solutions obtained for equivalent subsystems are introduced into horizontal planes of the storeys. The discussed method can determine internal forces in the walls in a safe manner.

Corresponding Author: Radosław Jasiński

THE PROPOSED METHOD FOR DETERMINING STIFFNESS OF SHEAR WALLS WEAKENED BY OPENINGS IN BUILDINGS WITH LOAD-BEARING WALL STRUCTURES

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ABSTRACT

Openings in masonry shear walls can cause many problems during load distribution. Forces in walls are distributed proportionally to stiffness including a potential rotation of the building, which is determined by the RC point. Stiffness of wall units can be determined with traditional methods used in the mechanics of constructions and the theory of elasticity. However, in the presence of openings the wall should be considered as material susceptible to tensile forces. The fundamental objective of this paper is to describe issues concerning the design process of masonry shear walls in buildings with conventional load-bearing wall structures and to demonstrate the procedure for determining stiffness of wall units with openings. Two methods for determining stiffness are proposed in this paper. Method I presents the relationships to determine stiffness of a wall unit regardless of the configuration of openings in the wall units. Method II describes the simplified relationships to determine stiffness of a wall unit with openings arranged in rows. The presented methods can be also put in practice to distribute load in simple-shape buildings.

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THE RELATIONSHIP BETWEEN RESIDENTIAL AND NATURAL ENVIRONMENTS IN METROPOLITAN REGIONS

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ABSTRACT

The harmonious relationship between landscape and settlement is one of the important factors of sustainability, especially in the context of the climate crisis, but also in the context of social changes. The hinterland of large cities is characterized by a trend of suburbanization, which affects the way it is used, as well as its character. A special position in this context is represented by metropolitan cross-border regions. The issue of optimizing their mutual connections, as well as harmonizing the relationship between their settlement and landscape structures, has been receiving attention for several decades. Within this context, metropolitan suburban areas were perceived as stereotypical in the past. On the contrary, their heterogeneous character is increasingly evident today, both in terms of the application of diverse forms of housing, storage-production and recreational functions, and the way of land use. It is a kind of interweaving of urban, rural and landscape elements and forms.

The paper presents the results of research aimed at evaluating the potential and optimizing the relationship between landscape and settlement in the border area of Slovakia and Austria. It is a territory that is shaped by characteristic natural phenomena – the Danube river landscape, intersected by the massif of the beginning Carpathian arc, and the cultural landscape, shaped over millennia. The territory is simultaneously under the pressure of strong suburbanization conditioned by the attractiveness and economic power of the two capitals of Vienna and Bratislava, as well as their own growth towards the countryside. The research is therefore focused on the analysis of the relationship between settlement and the dominant natural phenomenon – the Danube landscape on the one hand, and on the analysis of the relationship between settlement and agricultural landscape. The paper presents the problems, as well as the potentials of interaction between natural and settlement structures in the given area. At the same time, it points out appropriate conceptual solutions and regulatory tools for their symbiosis and mutual enrichment.

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THE REVITALIZATION OF SOME OLD PROJECTS FOR THE CREATION OF NEW WATERWAYS IN ROMANIA

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ABSTRACT

The article presents some aspects regarding the updating of some older studies for the navigation on the Arges river, a tributary of the Danube river in Southern Romania. The new waterways are planned to connect Bucharest, the capital city of the country with Danube river. The initial project was conceived in the 1980s, but was abandoned immediately after the 1990s. More than 30 years after its abandonment, the complex hydraulic development scheme was proposed to be updated, in order to provide a series of water uses that will ensure the sustainable development of the area: Navigation; the new waterways will be part of the VII Pan European Corridor, the main river infrastructure artery of the European Union; Production of electricity from renewable sources in the planned HPPs of the hydraulic facilities; Flood protection of 11 localities, lifeline and industrial facilities etc; Aquaculture; Irrigation; Tourism, leisure etc. Extended studies and investigations were performed for the assessment of the health status of the existing works and the safety conditions to be fulfilled by the the re-designed structures as well as a large number of scenarios using hydraulic computations and models. The paper shows how the updated project was modernized and improved to comply with the current European requirements for environmental protection, biodiversity, energy, sustainable development etc.

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THE URBAN SQUARE AS THE ORIGIN OF BULLFIGHTING ARCHITECTURE IN SPAIN AND SPANISH AMERICA: KEY CASE STUDIES

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ABSTRACT

The main squares of many towns typically feature specific architectural characteristics and dimensions that distinguish them from other, less relevant public spaces. These large, quadrangular spaces, were intended to host various civic and festive functions and festive activities, including celebrations, markets, and spectacles such as bullfighting. Their evolution, from medieval plazas to main Squares and eventually to bullrings, reflects the changing social and cultural needs of communities. Each type of bullring has played an important role in urban life, adapting to architectural and urban transformations throughout the history of cities.

Bullrings have undergone a remarkable evolution since their origins. Initially, bullfighting events took place in castle parade grounds or town squares. However, from the 18th century onward, a radical shift occurred, leading to the construction to dedicated bullrings. These new structures adopted various shapes -square, hexagonal, and eventually circular- and were initially made of wood.

In the Americas, the Ordinances of Discovery and Population of 1573 play a key role in establishing a standardised urban model in the Spanish colonies. These regulations aimed not only to organise the urban space but also to facilitate the celebration of public events, such as markets, processions, and equestrian festivals, which included bullfighting shows.

The Main Squares, originally conceived as multifunctional spaces, gradually evolved to accommodate bullfighting spectacles, ultimately giving rise to bullrings.

This study will analyse the morphological and functional transition from Main Squares to Bullrings, highlighting their impact on urban and cultural development. The future of bullrings depends on their ability to adapt to cultural and social changes, while maintaining their architectural and heritage value. Their continuity will rely on their capacity to reinvent themselves and respond to the needs of today's society.

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THE URBAN TRANSITIONS TROUGH DANCE AND MOVEMENT: INNOVATIVE CONCEPTS OF URBAN INTERVENTIONS IN TERMS OF PHYSICAL ACTIVITY

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ABSTRACT

In contemporary urban revitalization processes, the role of physical activity and movement is increasingly recognized as a factor stimulating spatial development. This applies not only to forms of mobility and the development of walkability concepts, but also to the use of urban space as a stimulator for integrative physical activities. At the same time, there is a growing importance of urban interventions based on informal, artistic, and flexible actions developed in cooperation with local communities. In the case of shared physical activity, local traditions, cultural values, and collective memory may be particularly significant for tactical urban practices.

This article adopts the thesis that diverse forms of movement present in contemporary urban space (e.g., dance, yoga, active walking) as expressions of social and cultural identity can serve as effective tools for activating local communities. Moreover, they may contribute to the revitalization and symbolic reclaiming of urban spaces, including heritage sites.

The aim of the article is to highlight the potential of movement as a form of social and cultural expression to strengthen social integration and local identity. The research methodology applied to the above issues consisted of two stages. The first stage involved an analysis of examples of urban actions engaging residents in physical activity. The outcome was the identification of key components of these actions that are essential in the process of reclaiming urban space for local communities.

In the second stage, participatory research was conducted to analyze the potential of historical urban districts in terms of using their features as a factor stimulating physical activity. The target group of this research were older residents of the cities of Gliwice and Barcelona, where innovative Urban Health Paths (UHP) were implemented. The concept of UHP is based on the idea of uban therapy—integrating movement, mental focus, and group activities that draw on the characteristics of local architecture.

Moreover, the UHP structure also incorporates design qualities from the Active Design strategy: memorable places, defined space, urban furniture, visibility, and richness of place. The research results made it possible to develop guidelines identifying the key components for implementing such solutions in new locations. These include:

- in the area of spatial features: flexibility of the solution, clear designation of exercise points, aspects of accessibility in urban space,
- in the area of building a relationship between the participant and the environment: stimulation of short-term memory, integration of movement with surroundings, sensory stimulation, and concentration training.

Furthermore, the implementation of this project serves as an example of an engaging urban strategy that supports physical activity and mental health among older adults. At the same time, it contributes to active ageing programs and efforts aimed at building resilient local communities.

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THE USE OF POLYUREA IN THE RENOVATION OF SEWAGE PUMPING STATIONS - A CASE STUDY FROM KOŚCIAN

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ABSTRACT

The article describes the process and results of renovating the sewage pumping station chamber in Koscian using polyurea spray technology. The goal of the work was to protect the reinforced concrete structure from further degradation resulting from an aggressive chemical and moisture environment. Photo documentation and pH testing confirmed the presence of adverse operating conditions, justifying the application of a protective coating. A pull-off adhesion test was also conducted; its results confirmed the coating's high quality. Applying polyurea enabled the quick and effective restoration of the tightness and durability of the pumping station's structural surfaces.

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TOWARDS HARMONIOUS RESTORATION: BALANCING ENERGY PERFORMANCE AND CULTURAL VALUES IN VERNACULAR DWELLINGS

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ABSTRACT

Vernacular architecture is a significant part of cultural heritage but faces increasing pressure from current demands for improved building energy performance. Legislative frameworks and renovation programs often prioritize technical criteria over cultural-historical preservation, leading to irreversible alterations or even demolition. This study aims to identify and categorize the key values that should be considered in the harmonious restoration of vernacular architecture. The research focuses on selected buildings in the Červený Kameň microregion, analyzing their architectural substance, historical value, and relationship to energy performance.

The study employs a multi-method approach, combining field research, historical analysis, and homeowner interviews to assess the impact of contemporary interventions. Findings indicate that the building envelope plays a crucial role in both preserving architectural identity and influencing thermal performance. Key features such as proportions (wall thickness, the ratio of solid to open surfaces, roof pitch) and structural tectonics (typical materials and construction systems) are often altered in attempts to improve energy efficiency, affecting both the visual and functional character of the buildings.

Historical and field analysis shows that renovation practices frequently disregard traditional construction logic, resulting in loss of authenticity and even reduced long-term sustainability. Interviews with homeowners highlight financial constraints, unclear regulations, and a lack of expertise as key challenges. The study proposes a framework for assessing vernacular architecture, offering practical guidance for owners, architects, and policymakers to support culturally respectful and sustainable restoration.

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TOWARDS SUSTAINABLE BUILT ENVIRONMENTS: SCIENTOMETRIC INSIGHTS ON GLOBAL BARRIERS TO CIRCULAR CONSTRUCTION

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ABSTRACT

The construction sector is a key driver of economic growth and environmental sustainability; however, it remains one of the largest consumers of natural resources and a significant contributor to waste generation. As urbanization accelerates, resource depletion and environmental concerns highlight the urgent need for sustainable solutions. Circular construction (CC) offers a promising approach by promoting resource efficiency, waste reduction, and material reuse. Despite its potential, the transition to CC faces persistent challenges, including entrenched project-based practices, fragmented supply chains, regulatory barriers, and stakeholder resistance. This study systematically investigates these barriers and outlines future directions for overcoming challenges to CC (C2CC). By analyzing global contributions, it identifies influential countries, key journals, leading scholars, and emerging keyword trends within C2CC literature. Using a scientometric approach, this research assesses existing knowledge on C2CC, drawing from the Web of Science (WoS) database, which provides extensive coverage of relevant academic studies. A bibliometric analysis of 199 articles published between 2000 and 2024 was conducted using VOSviewer software to visualize research trends and thematic clusters. Findings reveal six major C2CC themes, emphasizing the critical role of government policies, industry collaboration, innovative material use, circular design principles, digital technologies, and financial incentives. Addressing these challenges requires integrated efforts from policymakers, industry professionals, and researchers. This study contributes to the academic and practical discourse on CC by mapping research trends and highlighting areas for further exploration. The results offer valuable insights for fostering a more sustainable and resource-efficient construction sector.

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TYPOLOGIES OF THIRD WORKPLACES: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Digitalization and changing work structures have made office and knowledge work increasingly flexible in terms of location. As a result, alternative workspaces—so-called Third Workplaces—are emerging beyond traditional offices and home offices. These spaces, including coworking spaces, makerspaces, cafés, libraries, and public spaces, provide flexible environments that meet the growing demand for hybrid and remote work models. While the concept of Third Workplaces originates from Oldenburg's notion of Third Places (Oldenburg, 1989), it has evolved into a distinct category of multifunctional spaces that integrate professional work, social interaction, and community engagement (Mimoun & Gruen, 2021).

A systematic literature review was conducted to capture the current state of research on Third Workplaces. An initial pool of 76 articles, sourced from databases such as ScienceDirect and Scopus, was screened by title and abstract. From these, 35 key articles (published between 2014 and 2025) were selected and systematically categorized using an Excel matrix, enabling thematic classification based on typologies, usage patterns, and geographical distribution.

The analysis distinguishes between formal and informal Third Workplaces. Formal Third Workplaces—such as coworking spaces, innovation hubs, makerspaces, and incubators—are typically designed for work and are often situated in urban centers, contributing to economic growth and innovation. In contrast, informal Third Workplaces—including cafés, libraries, and other public spaces—are marked by their multifunctionality, accessibility, and adaptability. These informal spaces align more closely with Oldenburg's vision of open, barrier-free environments and are increasingly recognized for their sustainable potential in fostering vibrant and creative urban settings. Additionally, the study identifies key typologies based on business models, accessibility, and spatial characteristics, providing a nuanced understanding of these emerging work environments.

In conclusion, Third Workplaces are central to the future of work, delivering positive effects on creativity, innovation and collaboration for individuals, urban planners, decision-makers, and businesses alike. However, for their strategic implementation into urban environments, a comprehensive analysis of existing spatial typologies is essential as a fundament for further research.

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URBAN DEVELOPMENT OF NEUM - ANALYSIS OF THE CURRENT STATE AND STUDY FOR THE FUTURE

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ABSTRACT

The article explores the urban development of Neum, Bosnia and Herzegovina's only coastal town, focusing on its strategic role and potential for growth. The research aims to analyze the factors shaping Neum's urban landscape. It examines the current state of urbanity, identifies crucial issues for future development, and provides solutions and proposals for urban projects based on relevant literature as well as taking inspiration from the case studies of the most successfully developed settlements in Makarska Riviera, Croatia. Neum can be used as an example of decades of poor planning and development that diminished the natural charm of its' landscape and coast. This paper further elaborates on the issues and possibilities in the urban development of Neum. Due to its attractive location, rich ecosystem, and sea access which have resulted in it being a popular tourist town, Neum is under increasing pressure of interested developers. Promoting adequate urban planning would result in inclusiveness, protection of the local ecosystem and general socio-economic improvement. This paper demonstrates the benefit of proper urban development and coastal/environmental protection, by showcasing settlements used as case studies and the development decisions and rules which shaped these settlements. Additional analysis of contemporary development trends in the region, most of which are having negative effects on cities, is used to better understand the current state of Neum. After identifying crucial issues the city is facing at the moment, proposals are presented to mitigate these issues and reverse course before the urban form of Neum is further damaged. Finally, principles are introduced which aim to create a succinct guide to be used in future policymaking and development of Neum.

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USE OF BACILLUS SUBTILIS AND BACILLUS LICHENIFORMIS TO PREVENT EXTERNAL SULFATE ATTACK

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ABSTRACT

The use of bacteria in concrete has emerged as a promising biotechnological approach to enhance material performance and durability. This study investigates the effect of two bacterial strains, *Bacillus subtilis* and *Bacillus licheniformis*, on the resistance of cement pastes and mortars to external sulfate attack (ESA). *B. subtilis* was selected for its calcium-precipitating ability, potentially sealing microcracks and reducing permeability, while *B. licheniformis* was evaluated for its potential sulfate-reducing pathway, which could chemically mitigate the ingress and reactivity of sulfates. An experimental matrix was developed to assess the influence of bacterial concentration (10^5 to 10^7 cells/mL) and water-to-cement ratios (0.3 and 0.5) on key durability indicators, including compressive strength, expansion due to sulfate exposure, permeability (via surface electrical resistivity), and mineralogical changes analyzed by XRD and SEM. Specimens were cured in water and in sodium sulfate (Na_2SO_4) solution to simulate ESA conditions. Results showed that bacterial incorporation improved early-age compressive strength, with increases up to 24% for *B. subtilis* and 34% for *B. licheniformis* at 28 days. However, at later ages, high bacterial dosages could reduce strength due to microstructural porosity induced by excessive calcium carbonate precipitation. Notably, *B. licheniformis* significantly reduced expansion under ESA conditions by up to 80%, correlating with lower formation of ettringite and gypsum. In contrast, *B. subtilis* increased expansion and sulfate-related phases, suggesting a possible adverse interaction between calcium carbonate and external sulfates. XRD and SEM analyses confirmed these trends, showing increased sulfate-related phases in *B. subtilis* mixtures, and a suppression of such phases in those containing *B. licheniformis*. While both strains improved mechanical performance under certain conditions, only *B. licheniformis* demonstrated a consistent mitigation effect on ESA-induced damage, likely through its assimilatory sulfate reduction (ASR) pathway. So, this study highlights the potential of bio-concretes as a sustainable strategy for enhancing concrete durability in aggressive environments. The findings suggest that *B. licheniformis* may serve as a dual-function agent—improving mechanical properties while mitigating sulfate-induced deterioration. Future research should focus on the long-term viability of the bacterial mechanisms and the scalability of their integration in concrete production.

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USE OF DRONE LIDAR SCANNING FOR VOLUME ESTIMATION OF STOCKPILES ACCUMULATED IN POST-FLOTATION SEDIMENTATION PONDS – A CASE STUDY OF BUKOWNO (SOUTHERN POLAND)

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ABSTRACT

This study evaluates the use of drone-mounted LiDAR scanning to estimate the volume of post-flotation tailings accumulated in sedimentation ponds located in Bukowno, southern Poland. The survey was conducted using a DJI Matrice 350 RTK UAV equipped with the Zenmuse L2 LiDAR sensor, supported by high-accuracy GNSS measurements using the Topcon HiPer XR receiver. The main goal was to generate a high-resolution 3D model of the tailings storage area and assess the geometric accuracy of horizontal and vertical geodetic coordinates using control points and statistical validation. Post-processing of LiDAR data was performed using DJI Terra, followed by spatial and statistical analyses in QGIS and RStudio. Statistical evaluation included descriptive statistics, Tukey's outlier detection, and the Shapiro–Wilk test to verify the normality of error distributions. The horizontal accuracy was assessed using 10 control points, while the vertical accuracy relied on 46 measured control points. The analysis confirmed the high accuracy of the generated model, with average absolute elevation error not exceeding 1.7 cm and horizontal deviations ranging from 1.7 cm (Δx) to 3.6 cm (Δy). The volume of deposited tailings above the reference elevation of 320.00 m a.s.l. was calculated to be 37.49 million m³ over an area of 137.9 hectares. The Eastern pond was further divided into operational subsections to support functional assessment and monitoring strategies.

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USE OF SAFETY GUARANTEES OF TRAIN PROTECTION IN THE SAFETY OF AUTONOMOUS TRAIN DRIVING

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ABSTRACT

Autonomous train operation (defined by the on-board part of the ATO - Automatic Train Operation) is a key innovation in rail transport, bringing increased efficiency and safety. Ensuring ATO safety is a key challenge that can be addressed by integration with the European Train Control System (ETCS). This paper focuses on using ETCS safety mechanisms to ensure the safety of autonomous train control. The following paper analyses the possibility of taking over the ETCS safety guarantees into the ATO. It focuses on the different types of data provided by the ETCS, including static train data, dynamic data (movement authority, speed profile, gradient, localization, ETCS modes and traction) and information about the braking capabilities of the train. The key question is whether this information can be relied upon to implement autonomous control without additional redundant mechanisms. According to the RAMS (Reliability, Availability, Maintainability, and Safety) analysis, existing safety features can be adopted if the risks corresponding to the subsystem are sufficiently reduced and there is a secure link between the ATO and the ETCS systems. The specific physical interconnection via Ethernet plays an important role here. This link is described directly in the European Railway Agency specifications. Twelve packets of information are transmitted through this link. The aim is to verify whether it is possible to take over the safety guarantees of the ETCS for the ATO and to find the interface requirements between these systems. The main requirements of the ATO functions that process the ETCS information are to stop safely at a defined location, to keep to the schedule within the conditions specified by the ETCS, to optimize the speed for efficient traction energy consumption and to start the station check-in sequence only after all safety conditions have been met. The methodology includes the analysis of the common interface between the ATO and the ETCS and applying RAMS procedures to identify and mitigate risks. The following paper describes that the ETCS provides robust safety barriers during standard train operation at GoA 1 (Grade of Automation), allowing the ATO system to rely on its safety features and focus on the additional risks associated with autonomous control at higher GoA levels. However, the key factor is to ensure a secure connection between the ATO and the ETCS in accordance with the applicable standards. This paper should contribute to a better understanding of the links between the ATO and the ETCS. It also provides important information for the further development of autonomous railway systems.

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USING BIM AND MATHEMATICAL OPTIMISATION FOR LOCATING AND SIZING WINDOWS TO ENHANCE NATURAL VENTILATION IN HOT CLIMATES

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ABSTRACT

This study proposes an integrated framework, based on Building Information Modelling (BIM) and mixed integer programming (MIP) to locate windows for enhancing the natural ventilation of buildings in hot climates. BIM is used to conduct a solar heat simulation analysis. The mathematical optimisation model is developed based on a multi-objective MIP format, which optimises the location and sizing of windows in building such that heat gain is minimised while natural ventilation is maximised. Other variables accounted for include the orientation of the building, along with the wind speeds in the region within which the building is placed. Two objective functions are formulated, namely maximising wind ventilation and minimising the solar heat gain through openings to reduce cooling loads in hot climates. The multi-objective optimisation model is solved using the ε-constraint method. A trade-off exits between maximising natural ventilation and decreasing solar heat gain through windows on the building's envelope; as a result, the proposed mathematical optimisation model is multi-objective in nature. A realistic case example is solved to demonstrate the applicability of the proposed method. Nondominated solutions highlighting optimum solar heat gain and wind ventilation capacity were generated via a Pareto frontier. In addition, the sensitivity analysis conducted indicates that a 275-fold increase in analysis points is required to generate an optimum solution at 0.5 m gird size, though this leads to excessive and computational cost.

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VARIABLES WITH INCIDENCE IN THE GENERATION OF MICRODUMPS IN CHILE, COMPARATIVE STUDY BETWEEN LAS CONDES AND EL BOSQUE MUNICIPALITIES

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ABSTRACT

The existence of microdumps is an important problem worldwide and Chile is not an exception to this reality. There is a total of approximately 3,492 illegal final disposal sites for waste at the national level, classified as microdumps (sites under 1 Ha.). In Chile illegal dumps are on the rise and the Metropolitan Region (RM) is the city with the highest percentage. This study analyses the most important variables that explain this phenomenon comparing two municipalities of the RM, Las Condes and El Bosque, that differ, especially in socioeconomic status. The IPS (Indice de Prioridad Social/Social Priority Index) evaluates municipalities every year using three indicators: income, education and health. Las Condes is one of the municipalities with the best socioeconomic situation in the RM, at position Nº51 of 52, in the category of “no social priority”, unlike the municipality of El Bosque, at position Nº8 of the ranking, in the category of “mid to high social priority” according to IPS 2022 and in 2021 the same municipality reached position Nº7 entering the category of “high social priority”. The Municipality of Las Condes has 10 microdumps with a density of 0.227/Km2 and has 6.66 m$/inhabitant for solid waste management, while the municipality of El Bosque has 48 microdumps with a density of 3.71/Km2, with most of these located in areas of greater social vulnerability and it only has 2.80 m$/inhabitant (42%) to perform the same function. The study concludes that the factors with the highest incidence in the generation of microdumps include social vulnerability of inhabitants, municipal resources for solid waste management, and the level of employment and education of the municipality’s inhabitants.

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VERIFICATION OF THE ADAPTABILITY LEVEL OF ADMINISTRATIVE BUILDINGS IN BRATISLAVA

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ABSTRACT

Bratislava's real estate sector, which encompasses both administrative and residential properties, faces significant challenges. A notable housing shortage characterizes the residential sector, while the administrative sector is experiencing a growing surplus of vacant office spaces. In the post-pandemic era, evolving workplace requirements and the global energy crisis have increased demand for high-quality buildings—a standard many older office buildings fail to meet. The initial part of this study provides an overview of the development of administrative buildings in Bratislava since the late 1990s.

Empirical evidence from other cities and current trends suggest that converting office buildings into residential units is a viable solution. This research analyses the adaptability potential of Bratislava's administrative buildings for residential transformation.

The study was conducted in two phases. In the first phase, a sample of twelve office buildings in Bratislava was analysed using the Conversion Meter (CM) method developed by Geraedts and Van der Voordt (2000), which we adapted to local legislation for research purposes. Based on the first three steps of the CM method—preliminary screening through NO-GO criteria, location assessment, and building condition analysis—eight buildings are in the category 'ideal for transformation' and four in the category 'transformable'. Further analysis compared results across the sample of buildings to identify common factors hindering the transformation process. These aspects were examined due to their potential to impact the intended transformation negatively.

In the second phase, Research by Design, case studies were developed to analyse possible layouts of floor plans of various sizes regarding the dimensions of the structural systems of the given buildings. Additionally, the necessity of considering the local requirement for ensuring individual access to the exterior from each unit was addressed.

Early identification of aspects against the adaptability of existing administrative buildings in Bratislava, presents an opportunity for both private and public sectors to proactively address these barriers, thereby facilitating transformations and supporting the current trend for sustainable urban development.

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VISUAL ABSTRACTION AS KEY COMPETENCE FOR CRITICAL THINKING

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ABSTRACT

Abstraction is a fundamental intellectual competence that enables the human mind to analyse and comprehend concepts in order to creatively develop new solutions. The ability to translate abstract spatial concepts into equally abstract sculptural artefacts, which is acquired in the context of architectural design and needs to be practised throughout life, can also be transferred to contexts outside of architectural practice. With this main objective in mind, intellectual hypotheses from the humanities, for example from archaeology, can also be represented visually without abandoning their scientific content. The way often practised in the games and film industry of subverting such content with lifelike fantasy worlds is not without alternative. On the contrary, by means of abstraction, the critical thinking of science can also be transferred to the artistic artefact. The methods used to achieve this goal will be presented using samples of visualisations of a number of important heritage sites, developed in close collaboration with major cultural institutions such as the German Archaeological Institute (DAI), Cologne Cathedral administration or Bern Minster Foundation. Essentially, the scientific hypothesis is translated through the two skills adopted from traditional architecture: modelling and photography. Firstly, genuinely new, abstract forms are designed. In the second step, these are projected as if the abstract forms were built architecture. This essential second step can therefore be termed virtual photography. In conclusion, artistic creativity promotes competencies and skills to cope with the uncertainties of the 21st century by practising imagination and critical thinking conceptually and visually through art, as effectively taught in our architectural courses.

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WATER - A KEY ELEMENT FOR MICROCLIMATE

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ABSTRACT

Water is an integral part of microclimate regulation in urbanised environments and plays a key role in mitigating the heat island effect. Water management measures have been actively applied throughout human history. Their level and effectiveness continues to evolve today under the influence of climate change. However, despite these efforts, there is still need for improvement and learning from examples of good practice.

This article focuses on specific solutions in urban and bioclimatic design that use water features to optimise microclimatic conditions. Key approaches include, for example, the introduction of water features such as fountains, rain gardens and retention basins that cool and humidify the environment through evaporation. Linking vegetation with water features helps to regulate temperatures, especially in the hot summer months, and promotes the ecological balance of cities. Case study analyses show that effective stormwater management, the use of permeable surfaces and bioclimatic design can make a significant contribution to improving the thermal comfort of inhabitants. The main results highlight the importance of a holistic approach to urban planning, in which water serves as an essential element for urban adaptation to climate change.

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WATER DELIVERY SAFETY AND INFRASTRUCTURE RELIABILITY: INTEGRATING FAILURE DATA AND GIS IN THE PLANNING OF WATER SUPPLY SYSTEM MAINTENANCE

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ABSTRACT

In recent years, Geographical Information Systems (GIS) and their associated databases have become essential tools in the management of water supply infrastructure. Their application in water utilities extends beyond public health protection and now plays a pivotal role in network operation, maintenance planning, and risk analysis. This study focuses on the integration of GIS tools, operational data, and failure records in the risk-based management of water distribution systems, with particular attention to minimizing disruptions in water supply to consumers. A fundamental requirement for reliable operation of a water supply system is detailed knowledge of its network structure, operating conditions, technical status, and historical data on system failures. Modern GIS platforms, especially when integrated with other digital tools such as SCADA systems, hydraulic models, and monitoring software, provide a robust framework for this. One of the most valuable GIS functionalities for both water suppliers and consumers is the systematic registration of failures in the water distribution network. Failure logs, compiled over several years, offer critical insights into the causes, frequency, and seasonality of breakdowns. These datasets serve as the foundation for assessing infrastructure reliability and planning targeted maintenance interventions. This study presents an example of failure analysis conducted on a selected water supply network in Poland. The analysis highlights dominant failure causes and their temporal distribution. Using GIS-based numerical maps and failure databases, spatial distribution and intensity of pipe damage were evaluated. This facilitated the identification of high-risk areas and pipelines with elevated failure rates, which pose the greatest threat to continuous water supply. Risk mapping based on failure frequency and infrastructure condition supports decision-making in the allocation of repair resources and scheduling of rehabilitation works. This approach not only improves the effectiveness of maintenance teams but also reduces the risk of service interruptions. Moreover, the methodology is aligned with broader European policies such as the INSPIRE Directive, which promotes harmonized spatial data infrastructures as a basis for environmental and risk assessments. In an era where informatization drives operational efficiency, GIS and related information systems offer unmatched potential in the risk assessment and management of water distribution infrastructure. Their ability to process and visualize complex datasets transforms raw operational data into actionable intelligence. The outcome is a proactive maintenance strategy that enhances the resilience and security of water supply systems, ultimately ensuring uninterrupted service delivery to consumers.

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XR-ENABLED VISUALISATION OF AI-DETECTED JETTIES, QUAYS, AND SHORELINE VEGETATION IN INLAND RESERVOIRS

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ABSTRACT

Rapid assessment of hydraulic assets and surrounding riparian zones requires continuous spatial observation and effective communication of complex data. This study integrates high-resolution UAV photogrammetry with a lightweight AI model to perform semantic segmentation of shoreline features, specifically focusing on jetties, quay walls, and shoreline vegetation.

Classified geometries are integrated into an extended-reality application. In augmented-reality mode, detected structures and their associated condition attributes are anchored to geographic locations on site, which supports field inspections. Additionally, a complementary virtual-reality environment offers an interactive walkthrough of the shoreline, incorporating maintenance records and Building Information Modelling (BIM) layers. This integration aids in design reviews and rehabilitation planning.

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