

# 7<sup>th</sup> WMCAUS 2022

7<sup>th</sup>

WORLD MULTIDISCIPLINARY  
CIVIL ENGINEERING - ARCHITECTURE - URBAN PLANNING  
SYMPOSIUM

## ABSTRACT BOOK

Eco-friendly Symposium - WMCAUS

5-9 September, 2022 - Prague (Czech Republic)



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## Preface

This is the Abstract Collection of 7<sup>th</sup> WMCAUS 2022 and consists of the abstracts of oral and poster presentations in the “7<sup>th</sup> World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium” in the city of romance Prague (Czech Republic) during 5-9 September 2022. The World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS) aims to provide a forum for discussion of the latest findings and technologies in different fields of Civil Engineering, Architecture and Urban Planning, to give opportunities for future collaborations, to be a platform for sharing knowledge and experiences in the fields of Civil Engineering, Architecture and Urban Planning, to lead for providing a forum for early career researchers for presentation of their work and discussion of their ideas with experts in different fields of Civil Engineering, Architecture and City and Urban Planning such as; Construction Management and Engineering, Construction Materials, Geotechnics, Hydromechanics, Structural Engineering, Building Performance Simulations, Transportation, Architectural Space, Social Sciences and Architecture, Architectural Culture, Theories of Vision and Visuality, Architectural Design and Methods, Architectural Historiography, Architectural Heritage and Conservation of Historical structures, Sustainability in the Built Environment, Urban Planning, Public Space, Urban Design, Theories and Methods, Regional Planning, Archaeological Method and Theories, Sustainable Urban Development, Urban Sociology, Economics and Politics, Risk Management and Mitigation Planning, GIS-Based Modelling for Mitigation Planning, Computer Aided Design, Mathematical and Statistical Methods, Integrated Coastal Zone Planning and, Management, Accreditation of Civil Engineering, City and Regional Planning Education.

The main mission of the "7<sup>th</sup> World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium - WMCAUS" is to lead to contribute in multidisciplinary studies related with Civil Engineering, Architecture, City and Urban Planning and to improve interactions between people within these fields. As another mission it will provide a forum for this diverse range of studies which report very latest results and document emerging understanding of the related systems and our place in it.

We would like to express our sincere gratitude to almost 400 submissions to WMCAUS 2022 from 50+ different countries all over the world for their interests and contributions in WMCAUS 2022. We wish you enjoy the 7<sup>th</sup> World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium – WMCAUS 2022 and have a pleasant stay in the city of romance Prague.

We hope to see you again during next event “8<sup>th</sup> World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium - WMCAUS 2023” which will be held in Prague (Czech Republic).

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05 -09 September, 2022 - Prague (Czech Republic)

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**7<sup>th</sup> WMCAUS 2022**

**05 -09 September, 2022 - Prague (Czech Republic)**

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## APPROACHES ON HOW TO FACE ONLINE EDUCATION IN ARCHITECTURAL STUDIES IN CHILE

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### ABSTRACT

In 2019, in Chile a “social outbreak” took place in 2019 followed by the pandemic due to the Coronavirus. Face-to-face courses had to be transformed to online courses in a few weeks. It is in the first years of the career when the highest potential of desertion in Architecture takes place. For this reason, this research is about Construction courses at the beginning of the career of architecture at the “Universidad Tecnológica Metropolitana”. Many challenges had to be faced, examples of it are: proportion between synchronous and asynchronous activities, how to adapt practical activities like the construction of prototypes done in groups to individual scale models done at home, and to think about the amount and the type of evaluations between many other problems. Also, there are new challenges in comparison to face to face courses like: flexibility in the use of the camera, the time needed for deadlines, decrease of the number of evaluations required as part of the university policies to avoid stress. In parallel professors have been learning new methodologies, how to use different new platforms and software to improve online education. The methodology used is to compare: 1) quality of work done in relation with learning outcomes 2) grades, 3) synchronous assistance, and 4) asynchronous follow-up of courses of “Construction I” and “Construction II” during 4 terms starting in 2020. The purpose of this paper is to know if: it is possible to transform education in a short period of time, is it possible to meet learning outcomes? is it possible to increase the motivation of students in construction courses specifically and in the architecture studies in general?

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05 -09 September, 2022 - Prague (Czech Republic)

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## A SOCIAL AND ECONOMIC CATALYST USING WOOD IN LATIN AMERICAN COUNTRIES

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### ABSTRACT

Cities like Bogotá, Santiago, Buenos Aires, and Sao Paulo are set to become the most densely populated urban regions in the world by the year 2050, and yet, less than 60% of the population will have access to adequate constructions. 2 out of 3 families in Latin America will be forced to live in informal housing because of the lack of high quality and affordable constructions. Being one of the most biodiverse regions in the planet, and having a wide variety of species, Latin America has the potential to become a global leader in terms of sustainable and responsible wood growth while covering the deficit of adequate constructions in the region with the use of modular and prefabricated wood structures. In these countries, wood is easily obtainable, highly affordable, and simple to work with. Today, more than ever, we are under a scenario where wood has the opportunity of becoming an agent of change around social inequality and environmental justice, allowing for a switch towards a healthier and more sustainable way of construction in Latin America. The paper will showcase the state of the art and the environmental benefits of the material by presenting case studies focused on emergency and affordable housing, educational pavilions, and modular prototypes using native wood and “Guadua” a species similar to bamboo. The aim of this paper is to highlight how wood constructions can have a positive environmental, social, and economic impact in Latin American countries by using wood as a catalyst to increase construction standards, generate jobs, and enhance the quality of life in low-income communities around the region.

Corresponding Author: Natalia Caicedo-Llano



**7<sup>th</sup> WMCAUS 2022**

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**RISK OF INVESTMENT PROJECTS OF LARGE WATER CORRIDORS WITH AN IMPACT ON URBANIZED AREAS, CASE STUDY DANUBE-ODRA-ELBE**

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**ABSTRACT**

The article deals with the construction of large water corridor in terms of impact on urban areas. The aim is to show, on the example of the intended construction of the Danube-Odra-Elbe (DOE) water corridor, which runs through the territory of the Czech Republic, possible negative effects, especially with regard to environmental aspects, with the possible prediction of environmental destabilization. The prediction is based on a theoretical view of the potential risk and relevant available data.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SUGGESTED PAVEMENT MAINTENANCE MANAGEMENT SYSTEM FOR SAUDI ARABIA' S ROAD NETWORK**

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### **ABSTRACT**

The highway network in Saudi Arabia passed through extremely rapid growth in the last three decades. The development of a road network to meet the highest standards was one of the main goals of the Ministry of Transport (MOT) officials. The main challenge at this time was to maintain the network to serve the public in safe and acceptable standards of performance. This paper is to highlight the main elements of the suggested pavement maintenance management system for the MOT road network. The aim of the system was to manage maintenance activities within available resources and increase maintenance effectiveness through systematic methods and procedures in data acquiring, recording and evaluation. MOT performs an annual comprehensive pavement automated survey. In the survey detailed information related to roughness, skid number, deflection measurements, and details of two main surface distress rutting and cracking were collected. The developed system consisted of basic elements including identification and coding of road sections, inventory and pavement data collection, pavement evaluation methodology, identification of maintenance activities, determination of maintenance needs, setting maintenance priorities, and identification of future maintenance programs. The developed system integrated with referenced coordinate system and digital maps using geographic information system. The system was implemented on sample data and the results were encouraging.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**CAN FRACTAL GEOMETRY BE CONSIDERED AS A DESCRIPTOR TO EXPRESS BEAUTY AND FUNCTION IN ARCHITECTURE, AN ANALYTICAL STUDY?**

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**ABSTRACT**

Since the year 1975 the term “fractal geometry” has been introduced by the mathematician Benoit Mandelbrot which he mathematically modelled shapes that seems apparently to be chaotic or unorganized. Before that time the Euclidean geometry represented by the (x,y,z) planes and many other math disciplines described almost everything in architecture. This study will introduce fractal geometry as a new concept in mathematics and therefore its influence upon architecture and visual arts. This research will try to answer the question of how can we explain the existence of fractal design practices thousands of years before the discovery of fractal geometry? And does this mean that a fractal models in architecture considered an inherent design principle in producing beautiful architecture? The answer will be explored by analysing some historic examples in parallel with a detailed definition of fractal geometry. As well, an experiment to determine preferences of students of architecture will be done to decide whether a fractal design is satisfying enough in comparison with typical design solutions, the experiment will ask the student to select or arrange a predetermined photo in terms of their maturity in design and beauty among of one is designed with fractal geometric characteristics, and consequently the analysis will try to depict whether a fractal design is preferred or not, or can really be used as a design principle or approach. Then by now this is still ongoing research, in this paper reached results will be introduced in this conference, the obtained results in this research to be presented here might be only a part of the whole comprehensive research outcomes.



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GENERATION OF FLOOR AND TERTIARY RESPONSE SPECTRA OF STRUCTURES UNDER SEISMIC EXCITATIONS AT MULTIPLE SUPPORTS

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### ABSTRACT

A direct spectra-to-spectra method is developed for generating floor response spectra (FRS) for structures under earthquake excitations at multiple supports in terms of ground response spectra (GRS). Only GRS, “t-response spectra” (tRS), and basic modal information of primary structures, which can be readily obtained from modal analyses, are needed. A new combination rule FRMS-CQC is developed using random vibration theory to combine the dynamic part and quasi-static part of FRS. FRMS-CQC can account for the correlations between various components affecting FRS, i.e., the correlation between the responses of oscillators excited by any two vibration modes, the correlation between the response of an oscillator excited by a vibration mode and the response of an oscillator mounted directly on a support, and the correlation between the responses of oscillators mounted on two different supports. In particular, two special cases, i.e., excitations in the same direction at two supports being fully correlated and excitations at two supports being uncorrelated, are considered. The direct method can also be applied to generate tertiary response spectra (TRS) from FRS at multiple supports of secondary structures. Numerical example of a piping system mounted on different buildings, which are subjected to tri-directional seismic excitations at the foundation level, is presented to demonstrate the superiority of the proposed method. It is shown that FRS/TRS determined by time history analysis have large variabilities, particularly at FRS/TRS peaks. The proposed direct method, which avoids the deficiencies of time history methods, is of excellent accuracy, efficiency, and simplicity for generating FRS/TRS of structures under earthquake excitations at multiple supports.

Corresponding Author: Mahesh D. Pandey



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## IMPACT OF BARLEY ASH AS PARTIAL REPLACEMENT OF SAND IN MORTAR

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### ABSTRACT

Research is continuing to improve the properties of mortar by different ways and also to reduce the negative effect on environments. Sand is one of the main contents of mortar and it is highly consumed in concrete and in cement industry. Replacing sand with other material could make changes to the mortar properties and strength. The purpose of this research is to study the effects of using barely ash as a partial replacement of sand in the mortar's mix and to improve the mortar properties. On the other hand, barely ash is considered as non-degradable and a waste material that causes a severe problem to municipalities and industries. So a big advantage could be achieved when using a waste material to enhance the mortar properties and decrease the dependence and demand on sand. Sand is replaced by barely ash with different ratios to make mortar with different w/c ratios. Then the properties of the mortar mix (with barley ash) such as workability, density, soundness and strength are simultaneously studied. The sand is partially replaced by barley ash in different percentages as 0%, 3% , 6% , 9% , 12% and 15% by the weight of used sand. The results show that barley ash has a great effect on mortar properties. As the quantity of barley ash increases the water demand increases too. Likewise, when barley ash increases the bulk density also increases. The presence of barley ash enhances the compressive strength and flexural strength of mortar. This study deeply shows that the barley ash can be effectively used to replace sand and reduce the negative impact on environments.

Corresponding Author: Yasmeen Taleb Obaidat



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**PRELIMINARY STUDY ON THE ENERGY DISSIPATION STRUCTURE WITH DISPLACEMENT  
DEPENDENT DAMPING AND VELOCITY DEPENDENT DAMPING**

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**ABSTRACT**

The high-rise frame structures mainly occur the shear deformation under the action of horizontal load. This deformation has a large interlayer displacement in the lower floor and a relatively small displacement in the upper floor. Therefore, the displacement dependent damper, such as metal dampers, can be installed on the lower floor of the structure, and the velocity dependent damper, such as viscous dampers, can be installed on the upper part of the structure. A high-rise steel structure model is selected as an example. The damping amount of additional metal damping and viscous damping to the example model is calculated by damping-performance-curve method. Then, the damping of metal dampers is added to the lower floor, and the damping of viscous dampers is added to the upper floor. At last, the energy dissipation effect of the structure is compared with the original structure, the structure only with metal dampers and the structure only with viscous dampers. The results show that its seismic response value is between the structure only with metal dampers and the structure only with viscous dampers. The energy dissipation effect of the structure is relatively stable.

Corresponding Author: Ting Zhang



**DO PEOPLE BELIEVE IN “GREEN” ENVIRONMENT: EVIDENCE FROM STUDENTS’ PRO-ENVIRONMENTAL ATTITUDE IN EDUCATIONAL BUILDINGS**

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**ABSTRACT**

A pro-environmental attitude is an individual responsibility to create a sustainable “green” environment. University students’ attitudes, regardless of how dramatic or small, would have an impact on the environment. Therefore, students’ pro-environmental attitude on daily basis (e.g., carrying reusable grocery bags, cycling, walking short distances, recycling waste, and enhancing the knowledge of environmental issues) should be widely investigated. In the Middle East region, although governments have strived over the past ten years to shift towards more sustainable practices, there is a lack of knowledge on how much people in this region believe in the green environment. In addition, it is still not known how much the young generations are responsible in their daily practices towards the natural environment. Hence, this study aims to assess the pro-environmental attitude of university students, since they are expected to be informed and aware about environmental issues. Three universities are in Jordan (i.e., one public and two private) were selected as representative case studies. A well-designed survey and semi-structured interviews were conducted to collect the required data from participants. Undergraduate students (n = 320) from the selected universities have completed an online self-reported attitude frequency questionnaire. The survey covered four aspects of pro-environmental attitude (i.e., energy and water conservation, transportation, waste avoidance, and recycling). The data were collected between Sept 2021 and Nov 2021. Findings of this study showed the level of pro-environmental attitude of the first-year undergraduate students is medium and was significantly lower than students who are in their last year. The self-reported pro-environmental attitude frequencies were moderate (M = 1.9, SD = 0.3, range [1, 5]). In addition, there was a significant difference in the mean score between the four pro-environmental attitude aspects [ $\Delta\mu = 0.2$ , 95% CI = 0.10 to 0.74]. Considerably more work will need to be done to determine the possible approaches to improve university students’ pro-environmental attitude in this region.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## RELIABILITY AND SENSITIVITY ANALYSIS OF SLENDER STEEL MEMBERS UTILIZING NONLINEAR FINITE ELEMENT ANALYSES

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### ABSTRACT

Several recent studies have revealed, that the structural resistance of stainless steel members under compressive loading determined in accordance with the current European standard does not satisfy sufficiently small level of failure probability. It has been observed, that currently utilized flexural buckling curves overestimate the ultimate structural resistance of stainless steel members of certain material grades and cross-sectional geometries. Not negligible differences have been achieved between the estimations based on standards and experimental data, mainly for specific range of member slenderness values. Compared to carbon steel, stainless steel has higher ductility, and in order to properly describe the stress-strain material behaviour, higher numbers of material parameters are required. The subject of this article is to closely investigate the influence of these parameters (material, cross-sectional geometry and also parameters to describe global imperfection) on the ultimate resistance of the members exposed to flexural buckling. Previously validated numerical finite element models of the circular hollow cross-section (CHS) members are created in ANSYS Classic software utilizing parametric APDL macros. Statistical characteristics of all the input parameters along with their mutual correlations are obtained from recent comprehensive statistical research study. The sensitivity analysis is conducted for three different material grades of stainless steel: Austenitic, grade 1.4307, Ferritic 1.4003 and Duplex 1.4462, and for various values of the member slenderness. The purpose of the numerical models is to determine the ultimate limit state of the CHS members exposed to compressive loading utilizing geometrically and materially nonlinear analyses with initial geometrical imperfections. Influence of each input parameter on the model output (ultimate resistance) is investigated, and the results are well documented and discussed. The sensitivity analysis reveals, which of these parameters have the highest influence on the structural resistance, hence are the most significant for the monitored output, considering their statistical distribution and value range. Study also provides data for the subsequent optimization process of the flexural buckling curves, which can be feasibly conducted utilizing the first order reliability method.

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## THE IMPACT OF PAPER SLUDGE WASTE ON PHYSICAL & MECHANICAL PROPERTIES OF CEMENTITIOUS MATERIALS

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### ABSTRACT

The global production of paper is on the rise, thus leading to increasing amounts of waste in different stages of paper manufacture. Paper sludge waste is the most abundant and there is a big potential to reuse it after appropriate processing. This research paper analyses paper sludge waste fired at 900°C temperature for 2 h in terms of mineral composition, particle density and water demand in cement-based mixtures, as well as the effect of paper sludge waste on the density, ultrasonic pulse velocity, compressive strength and mineral composition of cement-based specimens. In the cement paste mixtures 0%, 2.5%, 5%, 7.5% and 10% of cement was replaced with paper sludge waste fired at 900°C temperature for 2 h. The ratio between water and solid substances was 0.35. Gehlenite and calcium oxide were found to prevail in the mineral composition of paper sludge waste, whereas water demand of cement-based mixture incorporating paper sludge waste was 30%. The intensity of XRD curves revealed that a higher content (more than 5%) of paper sludge waste fired at 900°C temperature for 2 h in the mix increases the amount of portlandite and reduces the amounts of cement minerals: alite and belite. An empirical equation was drawn on the grounds of statistical analysis to calculate the compressive strength according paper sludge waste content fired at 900°C temperature for 2 h. The correlation and determination factors more than 0.9 demonstrate that the change of compressive strength in relation to paper sludge waste content can be described by the second-degree polynomial equation and the optimum content of paper sludge waste fired at 900°C temperature for 2 h in the cement matrix is 5%. The highest density and ultrasonic pulse velocity values of cement stone specimens after 28 days of curing were obtained of specimens containing 5% paper sludge waste.

Corresponding Author: Marija Vaičienė



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**PROBABILISTIC ASSESSMENT OF AN IRREGULAR EXISTING RC STRUCTURE: THE EFFECTIVENESS OF THE RETROFITTING INTERVENTION USING FPS**

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**ABSTRACT**

The seismic assessment of existing structures is an issue of high relevance for researchers and practitioners. In general, design codes of the past (e.g., during the '60-'70) have not been conceived for seismic design and they report just limited recommendations for detailing of main members as columns and beams. With the aim to fulfil performance requirements of existing RC structures against seismic action (both concerning serviceability and ultimate limit states) several intervention approaches are available (e.g., active and/or passive control techniques). Over the last years, one of the most diffused technique is the use of passive seismic protection by means friction pendulum system (FPS). The purpose of this investigation is to investigate, with a probabilistic approach, the efficiency of the retrofitting intervention using single concave friction pendulum system (SC-FPS) on an existing RC structure placed in an area subjected to high seismicity. The herein considered existing RC building presents irregular configuration both in plan and in elevation and has been built without appropriate seismic detailing. Several non-linear dynamic analyses have been performed using fiber-modelling approach and adopting multiple seismic records characterized by accelerometric components in three directions. The seismic performance has been evaluated for the structure with and without the retrofitting intervention by SC-FPS highlighting its effectiveness also in the case of irregular buildings.



## THE COMPRESSION FORCE MECHANISM OF THE TOP BELT OF A CONVEYOR BELT

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### ABSTRACT

In core areas of the construction industry, such as e.g., the areas of housing, power engineering and transport, a significant amount of construction minerals is consumed. In the Czech Republic, there are approximately  $20 \cdot 10^9$  tons of verified reserves of construction minerals and about  $55 \cdot 10^6$ - $60 \cdot 10^6$  tons of them are extracted annually. Mined minerals must be first treated (crushed, sorted, etc.) before being used in the production of concretes, mortars and blocks, which places high demands on handling and transporting them. For the vertical technological transport of large quantities of materials in mining, preparation and processing plants, quite often, with very constricted working surfaces, a special belt conveyor design known as "HAC System" or "Sandwich belt conveyor" can be used. This paper presents the structural design of a spring mechanism, the purpose of which is to create a compressing force acting on the top belt of a vertical belt conveyor. The individual grains of transported material, supported by the bottom belt and covered by the top one, are subjected to normal forces induced by compression force. Friction forces are then generated between the contact surfaces of the material grains and both conveyor belts. For the safe operation and trouble-free transport of granular materials, the conveyor idler rollers, attached to the frames of the segment, must be pressed against the surface of the conveyor belt by a force the size of which does not fall below the limit value. The minimum volume of the contact force must ensure that the grains of the material located in the space between the top and bottom belts, travelling in the vertical section of the belt conveyor, do not move backwards from the movement of the conveyor belts due to their own weight. A laboratory testing device to test top belt compression uses two types of compression coil springs, each one with different values of spring stiffness. The theoretically calculated results and laboratory-obtained values of the compressive force for the two types of redesigned coil springs are listed. The obtained results of the experimentally measured compression forces for the given type of spring, generated by vertical movement of the vertically sliding segment called the "Testing equipment of the compression mechanism for the top belt", which is proportional to the height of the cross-section of the belt filling, are presented.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SEISMIC RESPONSE OF VIADUCTS AND BRIDGES ISOLATED WITH FPS

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### ABSTRACT

This study deals with the evaluation of the seismic isolation of bridges equipped with single concave friction pendulum devices, by comparing the case in which the rigid abutment is present (i.e., multi-span continuous deck bridge) or not (i.e., single column bent viaduct). Two multi degree-of-freedom models are considered for the two cases, while the FPS behaviour is modelled including the velocity dependency. Furthermore, the comparison is carried out by varying the modelling parameters (i.e., pier and deck fundamental period, mass ratio and friction coefficient). The uncertainty in the seismic input is also included by subjecting the two systems to a set of different natural ground motions. The equation of motions are solved in non-dimensional form for both the models in order to obtain the maximum non-dimensional displacement of the substructure. This has led to the evaluation of the optimal sliding friction coefficient able to minimize the maximum non-dimensional pier displacement with the aim of studying the differences between the two numerical models.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SYSTEMIC APPROACH TO THE MANAGEMENT OF INFRASTRUCTURE SAFETY: ORGANIZATIONAL ISSUES

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### ABSTRACT

This study deals with the organizational issues within a systemic approach finalized to make the safety management of road infrastructures more sustainable at a territorial scale. In fact, the infrastructure safety is one of the most relevant topics in many states with structural systems built some decades ago. In addition to the inherent structural problems, other issues are worthy to be investigated, such as, social, economic and organizational aspects. In this context, the study describes a systemic approach finalised to involve all the stakeholders, i.e., public or private actors and institutions, in the management process by improving the organizational issues. In detail, regarding an Italian case study, the authors propose to adopt the satellite information to investigate the structural safety problems of the infrastructures at territorial scale. In this way, risk or alert maps are properly defined. Successively, useful suggestions are discussed with the aim to improve the interactions between the different actors for a better management of the safety. The recommendations are able to improve the governance mode and decision process with a wider degree of organization.

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05 -09 September, 2022 - Prague (Czech Republic)

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## **AN INVESTIGATION ON THE SEISMIC BEHAVIOUR OF BRIDGES ISOLATED WITH DCFP DEVICES**

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### **ABSTRACT**

The Seismic isolation of bridges has greatly enhanced during the last decades. The scope of the paper is carrying out an investigation on how the properties of the double concave friction pendulum (DCFP) devices influence the seismic performance of isolated multi-span continuous deck bridges. The numerical simulations are performed conceived an eight-degree-of-freedom model able to reproduce the elastic behavior of the pier, along with the assumption of both rigid abutment and rigid deck; furthermore, according with experimental evidences, a non-linear velocity-dependent behavior has been adopted for the two surfaces of the double concave friction pendulum isolators. The model has been conceived withstand a set of natural records with different characteristics. The work comes out with the statistics related to the relevant response parameters are computed in non-dimensional form with respect to the seismic intensity considering different properties of both DCFP isolators and bridge.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GENESIS AND METHODS OF BUILDING A THEMATIC IDENTITY OF A GREEN PUBLIC SPACE OF THE MUSIC DISTRICT IN BYDGOSZCZ

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### ABSTRACT

Urban, historic public spaces with greenery, through their relationship with architectural surroundings, contribute to the urban structure of a city. They are often one of the most important elements shaping its identity. The coexistence of greenery with downtown buildings, by integrating it into the urban layout, creates not only the desired aesthetic and functional effects, but also contributes to establishing new relationships and social conditions, and is a city-forming factor. City parks are places that symbolize this symbiosis of nature and culture in a city. As green public spaces, they create conditions for leisure, and at the same time are a place of searching for attractive thematic solutions in open space. An example of an area developed in this way is Jan Kochanowski Park and its immediate surroundings, called the Music District in Bydgoszcz. The park was established at the beginning of the 20th century in the area of a newly built housing quarter, created in accordance with the concept of a garden city, popular and implemented at that time. Originally, its free landscape composition was to complete the city's green system, and the residential buildings closing this space created a clear, valuable public space. In the post-war years, this concept was enriched with new architectural realizations. Grand cultural buildings, a building of the Pomeranian Philharmonic and the State Music School Complex were erected around this area. Historic buildings were converted into the Academy of Music and a student dormitory. The park has become a green public space that bound these buildings together. Its area, completed with a gallery of sculptures commemorating famous musicians, thematic installations and events successively created over the years, has become an attractive public space with a distinctive character, clearly referring to the musical tradition of this part of the city. The aim of the article is to show how conscious, consistent actions and the search for innovative solutions, undertaken in the space of Jan Kochanowski Park by, among others, Andrzej Szwalbe, the director of the Pomeranian Philharmonic and its followers, as well as the revitalization carried out in 2014, led to a development of this expressive, filled with music, distinctive part of Bydgoszcz. The Music District, much liked by citizens, determines the prestige of this part of the city, but also serves as a showpiece and distinguishes the entire city. The method of work is based on the analysis of iconographic and cartographic materials, literature analysis and in situ research. On the basis of the collected material, the main conclusions indicate that through the conscious use of urban details and elements of small architecture in the historic, green open space of the city, a complete, satisfactory effect of the ideational assumptions was achieved.

The researched area, formally and functionally coherent green space in Bydgoszcz, in relation to the existing architectural layout, is an example of how, on the basis of the existing spatial and historical conditions, a culturally important, characteristic district of the city was created.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PIASTOWSKI SQUARE IN BYDGOSZCZ AS AN EXAMPLE OF A PUBLIC SPACE THAT KEEPS THE IDENTITY OF A PLACE

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### ABSTRACT

Public spaces, as elements of a city's structure and a reflection of its history, are images of city life and indicate the character of a city. Shaped in accordance with the urban concept and functions, they determine the identity of a city and become city-forming factors. City squares, an example of public places, are a forum showing urban and architectural changes taking place in the city by giving them a specific form and function in a changing reality. Piastowski Square in Bydgoszcz is a space with a given, endogenous and commercial function. For over 150 years, this area, despite changes in the concept of development, has retained its architectural and urban structure and importance for this part of the city. As a place bringing together commercial and service activities of citizens, as well as having features and objects characteristic of the heritage of this place, it has preserved and still maintains the local identity of the urban space. The aim of this article is to trace how the Square changed functionally over the decades but still maintained its original urban layout and to indicate the factors that allowed the character and distinctiveness of this space to be maintained in a dynamically changing reality. The method of work is based on a comparative analysis of selected, similar squares in Poland, iconographic materials and in situ research. The main conclusions indicate that despite the functional and architectural and urban transformations of the Square, from its foundation in the mid-nineteenth century to the present day, it was possible to create a spatially and socially valuable area. The preserved space and function of the square's retail trade and services still have a positive effect and enliven this part of the city's downtown area. From its beginning, the space of the Square is invariably connected with the spatial system of Bydgoszcz through a clear urban layout, communication and greenery. Treated as a peripheral area for years and thus degraded, it is now regaining its importance for the city's identity and is partially revitalized. The task of historical urban public spaces in the global world is to shape urban landscape in such a way that it retains its distinctiveness, reflects local history and individuality also on a local scale. A stable functional program and the contributing architecture allow to preserve the most valuable elements of the city, and renew the valuable urban fabric. The architectural and urban heritage, such as the area of Piastowski Square, skilfully fits in the contemporary needs of the citizens, and at the same time strengthens and creates an interesting, unique shape of the urban space, recommended in many contemporary scientific studies.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SITE SELECTION FOR SANITARY LANDFILL IN DIBRA REGION IN ALBANIA, USING MULTICRITERIA ANALYSIS EVALUATION

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### ABSTRACT

Landfill is a common solution for the final disposal of municipal solid waste (MSW) in Albania. Landfill siting is an extremely difficult task to accomplish because the site selection process depends on different factors and regulations. To ensure that an appropriate site is chosen, a systematic process should be developed and followed. Unsuccessful landfill siting is typically the result of strong public opposition. In this study, 10 candidate sites for an appropriate landfill area in Dibra Region are determined by using the integration multi-criteria evaluation (MCE). From the application of the exclusion criteria provided in the study methodology, it was able to find the best three alternatives. This study, through a methodology that uses multifactorial evaluation of a set of alternatives and based in the Albanian and EU legislation on urban solid waste landfills, makes the classification of three best sites for the construction of a regional landfill in Dibra Region. The methodology for the evaluation of the best option passed through two phases, applying two different groups of criteria: 1. Exclusions criteria - for the reduction of a list of 10 proposals to three preferred alternatives. After applying the exclusion criteria, the following three sites were the most appropriate for the construction of the sanitary landfill in Dibra Region: Alternative 4 - Pesjakë, Maqellarë, Dibër; Alternative 5 - Vojnik, Maqellarë, Dibër; Alternative 6 – Qafë Bualli, Bulqizë. 2. Development criteria – for the selection of the best option among the three favorite alternatives. After the application of the development criteria, the ranking of three above sites resulted as follows: Alternative 6 - Qafë Bualli, Bulqizë; Alternative 4 – Pesjakë, Maqellarë, Dibër; Alternative 5 - Vojnik, Maqellarë, Dibër. The objective of this paper is to present the assessment of the most optimal location for sanitary landfill construction in the Dibra Region based on the data collected for three potential alternatives through the methodology of multi-criteria analysis.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## RELATIONSHIP BETWEEN ARCHITECTURAL DESIGN AND THERMAL COMFORT IN MODERN SMALL LECTURE HALL

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### ABSTRACT

The paper focuses on the relationship between architectural design and thermal comfort in the modern small lecture hall. Thermal comfort in modern small university lecture halls is usually provided by modern ventilation systems or modern air conditioning systems. Reconciliation of architectural design with the requirements of modern ventilation systems or modern air conditioning systems is inevitable to ensure the thermal comfort of students. Detailed analysis is devoted to the process of harmonization of architectural design with thermal comfort in small university lecture hall. Abiding by the optimal parameters of thermal comfort is essential for students in a small university lecture hall. The adherence of these parameters is fundamental for the physical and mental condition of students and directly relates to their performance. Experimental measurements were carried out in the winter season in the modern small lecture hall in Budapest to assess the parameters of thermal comfort. The Testo 480 device was used for the measurements. The measured values of thermal comfort are carefully presented on the charts. The architectural design and ventilation system of the modern small university lecture hall were evaluated based on measured thermal comfort. The conclusion of this paper presents the principles of modern harmonization of the architectural design of the new small lecture hall in relation to the design of the elements of the ventilation system.



## ANALYSIS AND LONG-TERM PREDICTION OF FUTURE DANUBE DISCHARGE AT BRATISLAVA

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### ABSTRACT

While studying the impact of climatic changes on the hydrological regime in the basin, the forecast or at least an estimate of runoff for some future decades (e.g. for water works operating time) seems to be the main problem. A significant runoff decrease was recorded in Slovak Rivers after 1980. Nowadays, hydrologists are interested above all in looking for solutions to this problem. They ask what share of runoff decrease (or increase) is caused by growing air temperature, and what share follows from natural multiannual runoff oscillation. This paper deals with a statistical analysis of cyclicity and trends in discharge time series of the Danube River at Bratislava station and with a stochastic forecast of minimal, maximal and average annual discharge for the next years. In the paper two statistical methods of long-term runoff prediction are presented: classical time series analysis and Harmonic analysis (Fourier and wavelet transform). To the analysis 145-year data series (1876–2020) of maximal, minimal and average annual series of the Danube River at Bratislava were used. All, the stationarity, homogeneity, trend, and periodicity of annual discharge series were studied. To illustrate the results of the Danube discharge prediction Fourier harmonic model and the seasonal integrated mixed model ARIMA(P,D,Q)  $x(p,d,q)_L$  models were used. From trend analysis it follows that minimal discharges are slightly increasing, but the average discharges do not show long-term trend. From analysis of the cyclicity and trends of the discharge time series the following conclusions can be outlined: 1. in the Danube River, the significant multiannual dry periods were: 1881–1887, 1898–1904; 1928–1934; 1946–1953; 1971–1973; 1989–1994, as well as the years 2014–2020. 2. Using spectral analysis, periods of 2.4-; 4.2-; 5-; 7-; 14-; 21 and 28-29- years were identified. It was mainly caused by a natural 27-29 years discharge oscillation cycle. 3. The Fourier harmonic model, as well as integrated mixed model ARIMA (P,D,Q)  $x(p,d,q)_L$  predict a moderate increase of annual Danube discharge at Bratislava station for the next decade.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **THREATS AND DISASTROUS EFFECTS OF FLASH FLOODS FROM VARIOUS GEOGRAPHICAL REGIONS IN SLOVAKIA**

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### **ABSTRACT**

Flash floods are one of the major types of natural hazards. Such type of the floods is a relatively rare event on the local scale however, the climate change together with an increase of land use and deforestation in some areas can reflect in an increase of such type of extreme floods. Even the urban areas are also prone to flooding in short periods of time, and sometimes rainfall (from the same storm) over an urban area may cause faster and stronger floods than in the suburbs or the countryside. With regard to climate changes the increase of the risk of loss of life and material damages may occur in such areas. The main objective of the paper is to describe, investigate, post-event analyse and compare causalities, culminations, courses and consequences of the four summer flash floods on small basins in Slovakia since 1998. The first one occurred in July 1998 on the Malá Svinka stream in east Slovakia; the second two occurred in June 2011 on the Gidra stream and on the Parná stream in the Small Carpathians and the fourth flash flood occurred in July 2014 in the Malá Fatra National Park in Vrátna Valley. Analyses of the every extreme situation play an important role as an information source in determining the culmination and the course of the flash floods in ungauged basins together with information about geology, topography, vegetation and precipitation in the development of hydrological models for flood risk management. The time–space scales of the occurrence of flash floods are small compare to the rain sampling characteristics and discharge measurement networks. Comparison of natural extreme events from different geographical regions and different rainfall events can provide comprehensive information about their regimes, threats and disastrous effects.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## IDENTIFICATION OF THE CLIMATE CHANGE IMPACTS IN TIRANA, ALBANIA, THROUGH ANALYSES OF OBSERVED TEMPERATURE AND RAINFALL DATA

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### ABSTRACT

The Climate Changes (CC) are evident in the observed climate data in Tirana. They affect ecosystems and economic sectors such as agriculture, tourism and energy. The observed and projected changes require a response from the political system and an increase in the population's awareness in order to have an easy adaptation towards them. CC directly affect hydrology, i.e., the water supply system, the Albanian power system totally based on hydropower, groundwater and flooding. CC also affect the agriculture sector through droughts and floods, livestock and forests, ecosystems and human health. The increase in temperature has led to a reduction in the heating season as well as an increase in the cooling season. The purpose of this article is to identify CC in the city of Tirana with measured data of temperatures and precipitation based on the period with consolidated measurements 1961-1989 and comparing with measurements in subsequent years for the periods 1961-2009 and 2002 -2009. Positive anomalies for the Mean, Maximal and Minimal temperature are evident for the Meteorological station of Tirana after 1990, compared to the time period 1961-1989. There is an increase in the number of days with Mean temperature higher than 26°C, an increase in the number of days with Maximal temperature higher than 34°C and a decrease in the number of days with Minimal temperature less than 0°C. The difference in temperature is presented also as "Temperature Duration Curve" taking into account the whole time period, as well as in the reduction of the Heating Degree Days (HDD) for the city of Tirana. In contrary to the temperature increase, the anomalies on the rainfall data show a negative trend during the later time periods, compared to the data of the 1961-1989 time period. Evidenced changes in temperature, HDD, Heating season, Rainfall, etc., are clear evidence of Climate Change in the city of Tirana. The increase of temperature, the extension of the summer season, the temperature above normal during the period July-August, the decrease of precipitation, are not only a subjective human perception but are based on factice data measurements for the city of Tirana.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EVALUATION OF WATER VAPOR DIFFUSION AND CONDENSATION IN PREFABRICATED CONCRETE WALLS IN ALBANIA

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### ABSTRACT

The increase of the required comfort inside the apartments/buildings, except for the well-known problem of low energy performance, appears to show a problem in regard to water vapor condensation in the outside construction walls. According to the 2011 Census, there are 1.012.062 dwellings or 598.267 residential buildings in Albania. The most common exterior wall constructions in Albania are: i) Bricks with holes wall; ii) Full red bricks wall; iii) Full silicate bricks wall; iv) Concrete blocks wall, v) Prefabricated concrete/penobeton wall, and some older constructions like, vi) Clay bricks wall; and vii) Stone walls. Usually, the existing residential buildings' stock in Albania are not thermo-insulated resulting to a high "U-value", bad living comfort and moisture problems. The aim of this work is to study the phenomenon of the water vapor condensation in the Prefabricated concrete walls and to present the thickness of thermo-insulation needed to avoid this phenomenon. In hot climate areas, the water vapor condensation might be negligible, but as the Heating Degree Days (HDD) increase, going toward colder areas, this phenomenon is intensified. The condensation phenomenon is studied for three different cases: i) existing situation without thermo-insulation, ii) Thermo-insulation from the outside of the building, and iii) Thermo-insulation inside the building, considering five different representative areas of Albania with 600, 1200, 1800, 2400 and 3000 HDDs. It was found that Thermo-insulation outside the building avoids the water vapor condensation problem, while it should be carefully applied within the building, adding a water vapor barrier layer as well. As a considerable percentage of population is living in Prefabricated concrete/penobeton multi-apartments, the work highlights the need for revitalization of these buildings, presenting the necessary thermo-insulation thickness to comply with the Albanian regulations in force related to Energy Performance and avoid water vapor condensation as well.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## TRANSPORT OF DANGEROUS GOODS BY RAIL, AND THREATS TO THE SUBSOIL OF THE RAILWAY SURFACE IN THE EVENT OF A DISASTER

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### ABSTRACT

In Poland the mass of dangerous goods (loads) transported by rail in 2020 was 26 151.06 thousand tons. This translated into the performance of 8 899 691.89 thousand ton - km of cargo transportation. In 2020, these figures accounted for 11.72% of the weight of goods transported by rail. For example, according to RID classification, the mass of flammable liquid materials transported by rail (class 3 according to RID) amounted to 16 122.95 thousand tons. This corresponded to the execution of 5 946 161.70 89 thousand ton - km of cargo transportation of class 3 materials according to RID. The situation is similar in other countries. With such a large scale of transport of dangerous goods by rail, there is a high risk of a railway catastrophe with the use of hazardous materials. Among the elements of environment that are affected by the consequences of such catastrophe are the soil and groundwater. With a large disaster range, this can even lead to an ecological disaster in the ground or groundwater. If a disaster does occur, then its consequences should be minimized. It is only possible when we know the properties and course of the phenomena accompanying these railway catastrophes. Mathematical modeling is helpful here. Dynamical systems are used to model many processes. These are the mathematical models of real systems describing the relationship between the so-called input  $\vec{u}$  and output  $\vec{y}$  (response) of the dynamical system. In the case of the railway disasters discussed here they describe, for example, the relationship between the liquid flammable materials released from railway tank (the cause is given as a vector), and the spread of these materials in the ground (effect). Non-classical operational calculus is used for this modeling, which generates generalized dynamical systems, as the phenomenon of the spread of the effects of a catastrophe in the ground is a complex dynamic process. It can be a slow or violent process. In the latter case, the limit behavior of, for example, a signal is used for modeling rectangular signal, leading to special functions or distributions. Establishing appropriate mathematical models for the dispersal of the consequences of the disaster in the ground allows to limit its negative effects. It also allows to prevent its effects from spreading in the ground over "great" distances and depths. The disaster also has a negative impact on the reliability of the subsoil and components working directly with it. For example, there are different types of geosynthetics. Additionally, high temperature has a negative impact on the aforementioned reliability of the subsoil, in the event of a fire accompanying a disaster (the problem of thermal conductivity of the soil). Determination of the function of unreliability, reliability and intensity of damage to the subsoil in the event of a disaster is helpful while identifying the methods for restoring the primary (initial) operating parameters of the subsoil.

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## ASSESSMENT OF SUBSOIL SUBSIDENCE UNDER THE RAILWAY SURFACE WITH THE USE OF FUZZY SETS

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### ABSTRACT

As a result of the ongoing operation of the railway track, the railway track subsides. The main cause of this phenomenon is the subsidence of the track bed itself, and it is often related to the subsidence of the subsoil. In the case of the track bed, it is about its following elements: track, protective layer - its thickness, embankments - their height, excavations - their depth, drainage ditches. In the case of, for example, embankments, the type of soil from which it is made is additionally important. Such settlement leads to: uneven longitudinal railways and track twist. These phenomena have a negative impact on the comfort and safety of driving, and in extreme cases lead to a train derailment. The most disadvantageous among these phenomena is the uneven settlement which can often lead to the derailment of the railway vehicle. It is worth noting that similar problems concern tram lines, which can be treated as special cases of railways. In detail, the size of these settlements is determined by many parameters characterizing the track bed and subsoil as well as dynamic interactions (vibrations) generated by passing rail vehicles. The propagation of these vibrations in the track bed and subsoil can be modeled with the use of dynamic systems with distributed parameters. In engineering practice, it is difficult to measure all these parameters on an ongoing basis. It is a difficult, labor-intensive and costly task. Moreover, the amount of settlement is locally measurable. It can be measured at a given point or at many points. However, it is difficult to answer the question: What is the global settlement like, for example, along the entire section of a railway track or a tram track of L length? The use of "fuzzy" terms such as: low subsidence, medium subsidence, high subsidence may be helpful in solving this problem. From a formal point of view for their determination we use the constructed membership functions  $\mu_{X_i}, i = 1, 2, \dots, n$  and fuzzy sets  $(X_i, \mu_{X_i}), i = 1, 2, \dots, n$  for various parameters influencing the subsidence analyzed here. This was done after earlier elimination of parameters with a lower influence (with a limited influence) on the settlement process. These expressions (membership functions and fuzzy sets) allow the transition, in the case of subsidence, from one fuzzy feature to another (next one). Importantly, the selection of these membership functions  $\mu_{X_i}, i = 1, 2, \dots, n$ , was adopted in such a way that the transition would not be abrupt. Using the created membership functions  $\mu_{X_i}, i = 1, 2, \dots, n$  their linear combination is determined. The coefficients of this combination are selected by the AHP method. The analysis of a predetermined linear combination can be usefully utilized when making decisions in the field of rail engineering. This applies to: speed limitation on a given section of a railway or tram line, decision on strengthening, improvement of a section of a railroad, etc.

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7<sup>th</sup> WMCAUS 2022

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **PROJECT MANAGEMENT AND RISKS OF THE TENDER DOCUMENTATION OF THE CONSTRUCTION PROJECT**

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### **ABSTRACT**

Tendering for construction projects is a complex activity that requires an extensive exchange of important information. In addition to project drawings, the tender documentation includes a number of additional documents, conditions, contracts and other requisites that define the contents and scope of the project. This article aims to analyse the method of tendering for a private investor's multifunctional building project and proposes a variant of a solution employing different methods. Specifically, the methods are Design-Build (DB) and Design-Bid-Build (DBB). The article focuses exclusively on the preparation and the project tendering itself. It does not cover profitability calculations at the pre-investment stage or construction management after the construction contract is signed. The results show noticeable differences between the aforementioned methods. In particular, there are significant differences in terms of the time necessary to prepare the project documentation. The DB method would be more efficient and economical in this respect. Nevertheless, the investor opted for the DBB method in view of potential modifications required by clients and probably also due to a degree of distrust of the DB method, with which it had no prior experience.

Corresponding Author: Ing. Michal Mikulík



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## **FUTURE PUBLIC SPACE - FORESIGHT-BASED IMPLICATIONS AND DESIGN PATTERNS FOR POST-PANDEMIC PLACEMAKING STRATEGIES**

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### **ABSTRACT**

What qualities will the public spaces of tomorrow have? How will inner cities look like after the COVID-19 pandemic, in the face of climate change and increasingly digital environments? The claims to the highstreets and the public spaces as central places of our Society have changed over time. City centers have already been in a comprehensive and long-term transformation, which is currently being accelerated. The question of revitalization and gains in importance of highstreets and public spaces in general can only be solved consequently when an alternative to the status quo is acknowledged which provides new characteristics of vitality and multifunctionality with simultaneous economic efficiency in this domain. Both for smart and for climate-neutral cities the centers play a crucial role within an urban transformation process - be it as a showcase for technological innovations, as social places or creative districts, as a laboratory for new mobility solutions, as marketplaces or places for experience. These futures must be anticipated across several disciplines and actively designed to make them a preferred reality. As part of the "Future Public Space" research project (2019-2021), quantitative surveys were designed and conducted for two target groups: Both municipalities (N=60) and citizens (N=1200) in Germany were asked about their needs and preferences for the inner-city space of the future. The combined aim of the two surveys was to obtain a multi-perspective overview of the status quo and needs in the inner cities. The methodological approach is based on the foresight process of explorative scenario technique, which was transferred to the domain of public space design within the project. For the development of the lead scenario, more than 20 project participants were involved in a participatory process. Over several scenario workshops, critical stakeholders and the elementary key impact factors which affect the transformation of public spaces were identified, described and weighted. Based on this, three consistent scenarios for the year 2030 were developed using cross-impact and consistency analyses (GAUSEMEIER, 1995), which formed the basis for corresponding trajectories and planning requirements in practice. The core content of the scenarios formed a total of 12 future fields, from which guiding design patterns for the inner city of the future as well as concrete recommendations for planning, engineering and public authorities were derived. The applied research has shown that in order to initiate transformation processes for public spaces on local level, new concepts, governance and planning approaches for future place-making strategies have to be established and prototyped.

Corresponding Author: Steffen Braun

**A NEW APPROACH FOR BUCKLING ANALYSIS OF LAMINATED GLASS PANELS**Heinz Wimmer <sup>1,2</sup>, Christian Celigoj <sup>3</sup>, Werner Hochhauser <sup>1</sup><sup>1</sup> University of Applied Sciences Upper Austria, Stelzhamerstr. 23, 4600 Wels, Austria<sup>2</sup> Carinthia University of Applied Sciences, Villacher Str. 1, 9800 Spittal, Austria<sup>3</sup> Graz University of Technology, Kopernikusgasse 24, 8010 Graz, Austria**ABSTRACT**

Due to its high compressive strength glass panels are becoming more and more popular in architecture for primary load-carrying structural elements. The pursuit of the greatest possible transparency makes it necessary to use the glazing as a load bearing element not only for the transmission of lateral forces but also of in-plane forces. Therefore, owing to the high slenderness, stability issues have to be clarified. In the last decade, many research activities have been undertaken to investigate the in-plane load-transfer experimentally and numerically with the purpose to understand the mechanical behavior and to establish a uniform design format. In detail, the following load-bearing elements were examined: column buckling, lateral torsional buckling of glass fins and plate buckling due to non-uniform pressure or shear fields. Following the design procedure as it is common in steel and timber construction, the linear-elastic stability limit plays a central role. While for homogeneous beams and plates the determination of the buckling limit does not offer any difficulties, it is a challenging task for shear-elastic, laminated glass panels. For laminated glass, different glass panels and interlayer have to be taken into account. A common approach is to model the glass panels with shell elements and the interlayer with volume elements. Shell elements and volume elements are either tied together by corresponding coupling equations or modelled with identical nodes on the surface of the interlayer. In the latter case, the shell elements must be provided by an offset. In case of three or more laminated glass panels this should be a very elaborate task. For these cases we propose an alternative, pure structural approach, which generates a simple model which incidentally gives an insight into the deformation behavior of such structures and allows for a clear and simple, user-friendly definition of the boundary conditions. A starting point is formed by the basic equations of the Refined Zigzag Theory (RZT) published by Tessler/Di Sciuva/Gherlone (2010). This approach uses the kinematics of the First Order Shear Deformation Theory (FSDT) as a base line and enhances it by two simple zigzag-terms to allow for the modelling of specific warping effects along the composite cross section. Extensions of the corresponding kinematic equations with the so-called von Karman terms lead to the geometrically non-linear variant. From here the linear buckling equation can be extracted when neglecting the initial deformations. The present approach is based on a finite element formulation presented by Versino (2013) which uses linear shape functions for all seven nodal degrees of freedom with the exception of the transverse deflection where an anisoparametric interpolation is used, which prevent shear locking. Extensive numerical studies have shown very good results in comparison to existing analytical and numerical solutions. The approach proposed is simple and lives up to all the objectives for practicable usage. Another advantage lies in an easy-to-handle and familiar treatment of kinematic boundary conditions. The numerical effort is about 50 to 100 times less than that of a full 3D-FE-Analysis, regardless of the number of glass sheets.

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**HEALTH SUSTAINABILITY PROMOTING LIVABLE ENVIRONMENTS WITHIN RESIDENTIAL COMMUNITIES (EDISON EASTLAKE, PHOENIX & NASR CITY, CAIRO, EGYPT)**

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**ABSTRACT**

The built environment is the human-made physical setting for human activities- where people live, work, learn, and play. Whether rural, urban, or suburban communities, healthy built environments are places that can be intentionally designed to support good health and help people to thrive. Residential communities design is effective strategies for promoting health. As individuals, we make choices that affect our health, but it was estimated in a 2009 Canadian senate Report that 60% of health outcomes can be attributed to the places we live and socio-economic determinants of health. People have better health when they live in communities that are designed to support day-to-day healthy choices, such as being physically active, eating healthy food, and engaging in positive social interactions. Designing, building, and retrofitting communities to be healthy is about making it easy for all residents to move around, be connected with one another, feel safe, and access services they need. There is an unmet and growing market demand to live in complete, compact, and connected communities. Such communities are necessary to meet environmental, economic, and social objectives. Resident and political support for these planning directions should be bolstered when evidence that links progressive community design and land use with positive health outcomes is provided.



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## STRUCTURAL GLASS AND THE FORM OF AN ARCHITECTURAL OBJECT

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### ABSTRACT

The use of glass as a façade structure has been possible for several decades. The resulting façade systems allow for reaching impressive heights and spans. There are also experiments aimed at the use of glass in architectural projects of a non-standard form. In this article, I would like to quote technical solutions that allow to shape an architectural object with the use of structural glass. The work will be partially reviewing, allowing to distinguish the actual existing possibilities of structural glass, paying attention to the achievement of a non-standard form and size of the building. The aim of the article is to create a basis for further research on the subject of structural glass with an emphasis on the possibility of shaping a non-standard form of a building. The research may be of interest to architects as well as glass constructors and technologists. They can inspire the use of structural glass in research and support the use of glass in a building and provide guidance to designers and investors. The phenomenon will be investigated on the basis of buildings constructed over the last two decades. Due to the global nature of the research, no limited research area has been identified.

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## IMAGE USING INTERFERENCE EFFECTS IN THE GLASS FACADE

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### ABSTRACT

The work analyzes issues related to the integration of architecture and art. The phenomenon of visual interference is an important artistic issue that opens the way to new compositional values in architecture. The process of creating visual interference in artistic glass arises in two distant layers of a graphic image placed on a transparent substrate or spatial graphic elements arranged in a specific order. As a result of overlapping graphics layers, the image is densified, creating compositions: lines, circles and polygons. The resulting graphic layouts change with the change of the observer's position. As a result, visually mobile graphic surfaces are created, vividly reacting to the slightest movement of the observer. The aim of the publication is to study the phenomenon of visual interference occurring in architecture on the example of the created model of a glass facade. The research on creating the shape of an image spread over two layers of glass, creating a decent graphic effect of interference visual effects, will be presented. The usefulness of the phenomenon of visual interference will be analyzed and the method of use in the creation of advanced facade systems will be determined. The research will be used in the work on creating an illuminated two-layer facade. The publication will cover the typology, systematics and characteristics of each type of system. An attempt will also be made to create conditions for the design of interference systems, which may constitute design guidelines for graphic designers and designers. The research may be an introduction to the discussion on the use of visual interference in a glass facade, it may be an inspiration for artists and architects, it may interest designers and investors for their application in architecture.

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## **A STUDY OF INTEGRATING LIDAR TECHNOLOGY WITH BUILDING INFORMATION MODELING (BIM) FOR LARGE RENOVATION PROJECTS**

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### **ABSTRACT**

Building Information Modeling (BIM) is a broad term that describes the processes of creating and managing digital information about a built asset. The use of BIM for information management should go beyond the planning, design, and construction phases to extend through the entire lifecycle of the project, including occupancy, maintenance, and end-of-life. A well-developed BIM model can reduce design errors, omissions, and miscomprehension to the largest extent possible. However, the development of accurate BIM models takes time and is costly. And perhaps even more so when undertaking the development of a BIM model for an existing facility. In these instances, the models are normally developed using as-built drawings and manual measurements. Recently, a technological revolution brought with it a new tool, Light Detection and Ranging (LiDAR) technology, to improve and accelerate the topographic techniques of spatial data acquisition to help create accurate BIM models for existing structures. This paper presents a study of the feasibility and cost effectiveness of utilizing LiDAR technology to capture the existing condition of large dormitory buildings to create BIM models for renovation design. This study has identified that a substantial initial investment was necessary to implement LiDAR in the process of renovation design for large buildings, however, given the number of renovation projects a large firm may complete on an annual basis, the anticipated time and cost savings, and increased design quality (to be measured by amount of cost and time growth during construction because of design errors or omissions) the investment is reasonable. Particularly given that a single design error can often cost hundreds of thousands of dollars in cost growth during construction.

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## INVESTIGATION OF THE PRODUCTIVITY AND ACCURACY OF USE OF BOSTON DYNAMICS SPOT IN SUPPORT OF LIDAR SCANNING ON ACTIVE CONSTRUCTION SITES

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### ABSTRACT

With the recent commercial availability of autonomous mobility platforms, construction researchers have focused their attention to the application of advanced robotic tools on jobsites. One such mobility platform is Boston Dynamic's SPOT (SPOT). The software development toolkit (SDK) enabled, quadruped robot has the infrastructure to attach interchangeable payloads including LiDAR (Light Detection And Ranging) scanners. The goal of this research is to conduct a pilot study comparatively analyzing terrestrial LiDAR scans from a human-based tripod scan system and the scans executed by SPOT in both manual and autonomous modes. The research looked at three metrics – quality of scans, productivity savings, and robot accuracy. The result shows that although scan quality is slightly diminished due to the height and shape of the robot, the productivity gains from an autonomous robot could offset the scan quality with additional scans. In addition, in the sample testing, the robot was accurate in returning to a pre-defined location in autonomous mode.

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## INFLUENCE OF TEMPERATURE ON RHEOLOGICAL PROPERTIES OF SCC AND ON LATERAL PRESSURE ON FORMWORKS

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### ABSTRACT

The objectives of the research were to investigate the influence of temperature on rheological properties of SCC in rest and the formwork pressure generated by SCC at various temperatures in relation to its rheological properties. In addition, significance of the impact of the temperature on formwork pressure generated by SCC was assessed and variability range of the SCC pressure on the formwork, depending on temperature variations was determined. SCC rheological properties and later pressure were investigated in temperature range from 10 to 30°C. SCC having two different w/c ratios (0.30 and 0.40) were prepared with target slump flow diameter values ranged from 600 to 750 ± 20 mm. SCC were casted with speed 7 m/h. Lateral pressure was investigated for column 0,2x0,2 m and casting rate 7 m/h. Rheological properties of SCC in motion and rest state were investigated using Vikomat XL rheometer. The dynamic yield stress  $g$  and plastic viscosity  $h$  of the SCC are initially inversely proportional to temperature. Over time, a decrease in the dynamic yield stress  $g$  and plastic viscosity  $h$  was observed at 10°C, while at 20 and 30°C the dynamic yield stress  $g$  increased with small and ambiguous changes in plastic viscosity  $h$ . The effects were more pronounced in case of mixtures with lower w/c ratio. Both temperature and w/c ratio influence static yield stress  $g_s$  of SCC, with a more important factor being the w/c ratio. Static yield stress  $g_s$  of SCC is higher the higher the w/c ratio and the higher the temperature are. Static yield stress  $g_s$  increases in time, but this increase is not linear - is faster initially and slows down with time. Thixotropy factor  $A_T$  depends mainly on w/c ratio - the higher w/c ratio the lower  $A_T$ . Thixotropy factor  $A_T$  decreases with increasing temperature but the effect is insignificant. Thixotropy factor  $A_T$  increases in time, with the increase taking place primarily in the initial period of mixture being at rest. Over longer periods of time the  $A_T$  may decrease. Temperature does not affect  $A_T$  changes in time. The temperature influences the SCC pressure on the formwork. Initially, the pressure of SCC on the formwork is directly proportional to the temperature, because dynamic yield value  $g$  decreases with increasing temperature. However, SCC at higher temperatures faster build-up a structure capable of carrying loads and obtain higher static yield stress  $g_s$ . Thus, SCC pressure on the formwork after 20 min is inversely proportional to the temperature. The formwork pressure after end of SCC placing is reduced faster at higher temperatures, as a result of the faster flowability loss and stiffening. It was confirmed that the lateral formwork pressure is lower for SCC characterized by higher w/c. The SCC with higher w/c undergoes faster build up the structure and gain higher static yield stress  $g_s$ .

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## INFLUENCE OF SCC RHEOLOGICAL PROPERTIES ON EVOLUTION OF FORMWORK PRESSURE AT VARIOUS CASTING RATES

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### ABSTRACT

The objectives of the study were to assess the significance of the impact of the rheological properties of SCC both in dynamic and static state, on the evolution of formwork pressure over time at different casting rates and to determine the variability range of the pressure formwork exerted by SCC causing by these factors. In the research the impact of SCC w/c ratio and casting rate on the evolution of SCC formwork pressure was investigated. SCC having different w/c ratios (0.30 and 0.40) were prepared with target slump flow ranged from 600 to 750. The variability in the SCC slump flow at the given w/c ratio was controlled through the use of various cements and HRWR. Lateral pressure was investigated for column 0,2x0,2 m, column 0,3x0,3 m and wall with a thickness 0,25 m and casting rates 1 and 7 m/h. Rheological properties of SCC in motion and rest state were investigated using Vikomat XL rheometer. It was demonstrated that in the case of SCC, the key importance in terms of formwork pressure is attributed to the ability of structure build-up expressed by static yield value  $g_s$ . As the time after casting is progressing, a structural build-up of SCC takes place and the pressure on the formwork depends on static yield stress  $g_s$  and its increase over time. The influence of dynamic yield value  $g$  is significant only in the initial phase of casting. Although intuitively it seems different, higher plastic viscosity  $h$  or thixotropy factor  $A_T$  do not necessarily have to mean lower pressure on the formwork - on the one hand they conduce to the reduction of pressure, lowering vertical loads (plastic viscosity  $h$ ) or increasing load bearing capacity (thixotropy factor  $A_T$ ), but on the other hand, they delay the structure build-up (and the increase of static yield value  $g_s$ ). The research demonstrate that the second effect is in case of SCC definitely more important. It has been confirmed that the casting rate is also significant for formwork pressure and slower casting rate leads to the reduction in formwork pressure. However, this effect can be viewed as indirect one and should be investigated in relation to the rheological properties of the SCC and its changes over time. With higher casting rate, a specific height of the concrete is achieved in shorter time, i.e. when the static yield  $g_s$  is lower. Therefore, with faster casting rate, the pressure on the formwork is higher. The formwork pressure of SCC at the same casting rate is the lower the higher is the surface module of the formwork. With a smaller surface module of the formwork, the impact of the casting rate on the formwork pressure is lower.

Corresponding Author: Jacek Gołaszewski



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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## FULLY NONLINEAR TIME-DOMAIN DYNAMIC ANALYSIS FOR ESTIMATING 2D SPECTRAL AMPLIFICATION WITH THE DISTANCE FROM THE BASIN EDGE

Bilal Ozaslan <sup>1</sup>, Merve Akbas <sup>1</sup>, Hadi Khanbabazadeh <sup>2</sup>, Murat Emre Hasal <sup>3</sup>, Recep Iyisan <sup>1</sup>

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### ABSTRACT

It is known that local site conditions may cause significant amplification and concentrated damage during ground shaking. The 2D geometry of the basins causes the trapping of the seismic waves at the basin edges. The variation of the seismic amplification at edges is a subject of numerous investigations. Nevertheless, the location and frequency-dependent change of motion along the basin edge are usually neglected. In this study, the variation of spectral amplification with the distance from the basin edge is investigated by using different levels of strong ground motions. The idealized geometry of two real basins in Turkey has been investigated by the fully nonlinear time-domain dynamic analysis. The results show that while the maximum amplification at lateral parts of the basins corresponds to the shorter periods, it approaches the longer periods by increasing the distance from the outcrop. At shallow parts of the basin edges, the corresponding period of the maximum amplifications remains under 0.1 s while it exceeds 1.8 s at central points of the basins. The amplification curve shows generally two distinct peak points with the increase in the distance from the rock outcrop. The effect of the increase in motion intensity is also investigated. The increase in motion intensity generally increases the corresponding period of the maximum spectral amplification at shallow parts of the basins.

Corresponding Author: Merve Akbas

**INVESTIGATION ON THE RELATIONSHIP BETWEEN STIFFNESS OF AGED BITUMINOUS BINDERS AND ASPHALT MIXTURES**

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**ABSTRACT**

Asphalt mixtures are the most widely used material in road construction. Therefore, it is necessary to know the properties of mixtures and their components, as well as changes in the properties that occur during the service life. The requirements for road durability are constantly increasing. Due to the effects during asphalt pavement production and service, there is a gradual degradation of properties. The article is therefore aimed at research on the relationship between the aging of the asphalt mixture and the aging of the bitumen binder, which is closely linked to the service life and durability of the road. Selected asphalt mixtures (AC11 50/70 and AC11 PMB 45/80-75 used in most European countries) and binders were subjected to short-term (production and laying of the mixture) and long-term (service time, approx. 10-15 years) laboratory aging. For the results in the tested asphalt mixtures to be relevant, the same bitumen binders were used as in the binder research. The asphalt stiffness modulus (IT-CY method) was measured in the performed laboratory measurements, which reflects the elasticity and hardness of the asphalts. Laboratory tests of bitumen binders were performed, such as penetration, softening point, and weight loss. Because the penetration measurement test is performed at 25°C, the stiffness modulus measurement tests were also performed at the same temperature. In general, a higher stiffness modulus was measured in AC11 50/70 mixtures. Lower stiffness was measured with the modified AC11 PMB 45/80-75 mixture; the variance in stiffness values caused by measurements at other test temperatures (10, 20 and 30°C) was lower in this mixture. In both the cases of measured asphalts and bituminous binders, the stiffness after short-term (STOA) and long-term (LTOA) laboratory aging of the samples increased. Due to short-term aging, the stiffness modulus values increased by 7.2% (AC11 50/70) and 25% (AC11 PMB), while the binder stiffness increased by 28.6% (50/70) resp. 18.3% (PMB 45/80-75) after RTFOT. For samples exposed to long-term aging, the increase in stiffness was higher compared to short-term aging by 10.3% (AC11 50/70) resp. 40% (AC11 PMB) and the penetration decreased by 25.5% resp. 28.3%. Regarding the high-temperature properties of bitumen, a change of 50/70 binder was recorded, an increase in the softening point by 6.2 °C and 8 °C. When comparing the change in the stiffness of the bitumen binder and the change in the stiffness of the asphalt mixture at 25°C, we can state that the stiffness of the binder changes by one unit, the stiffness modulus of the mixture changes by 381.6 MPa (50/70) and 702.2 MPa (PMB) due to short-term aging and by 587.4 MPa (50/70) and 1402.4 MPa (PMB) due to the effects of long-term aging. The change in stiffness modulus due to aging at 25°C was smaller with AC11 50/70, but the measured values are significantly higher compared to AC11 PMB 45/80-75.

Corresponding Author: Dušan Briľiak



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## RESEARCH OF THE IMPACT OF BUMPS ON VEHICLE SPEEDS

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### ABSTRACT

The paper presents the results of research on the impact of selected types of speed bumps, located in the streets of the city servicing system, on the instantaneous speeds of passenger cars in free flow traffic conditions. The research concerned different speed bumps. All types of speed bumps are shown to be very effective in a traffic calming. The applied parametric tests of a statistical significance showed that, for the sake of mathematical statistics, the differences in the instantaneous speed of vehicles at the speed bumps are significant in relation to the instantaneous speed of vehicles on the inter-junction sections. The instantaneous speeds of passenger cars at speed bumps were over 60% lower in relation to the speeds achieved by drivers of these cars in the inter-junction sections.

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Corresponding Author: Jan Kempa



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## EU AND PORTUGUESE CYCLING STRATEGY FOR SUSTAINABLE URBAN MOBILITY

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### ABSTRACT

Sustainable mobility has become a central topic for reflection and debate when defining active urban policies. In opposition to traditional mobility focused on private car, sustainable urban mobility aims to respond to society's travel needs of comfort, safety, and time with healthy, environmental-friendly, and economical solutions. Soft mobility modes, especially cycling, is an alternative capable of reversing the trend on private car use in urban areas. Cycling has been playing an important role in urban sustainable development in the last decade, being one of the main strategies of urban mobility plans. The present study presents a review of the main EU and Portuguese cycling strategies. The methodological approach includes the collection and analysis of the main EU and Portuguese documents discussing the challenges and options for urban mobility, especially focused on cycling. These strategies aim to promote the use of bicycle on commuting trips and the reduction of greenhouse gas (CO<sup>2</sup>) emissions, contributing to a more sustainable urban environment and healthier communities, main objectives of the EU's cycling strategies. Conclusions point out that it was mainly in the last 10 years that specific plans for the promotion of bicycle and other soft modes use emerged in Portugal, and only in the last 5 years financing conditions were created to support municipalities in this task.

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Corresponding Author: Bertha Santos



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**SOCIAL SUSTAINABILITY ASSESSMENT IN RECENT MASS HOUSING IN THE UNITED ARAB EMIRATES: SHA'AB AL ASHKHAR PROJECT**

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**ABSTRACT**

Sustainable urban development represents a major challenge across the world for both developed and developing countries. In the United Arab Emirates (UAE), sustainable urban development has been increasingly influential on the recent trends in urban planning in general and mass housing in specific. To trace this challenging trend, especially on the social sustainability level that received little attention so far, the research examined the consideration of social sustainability principles in the design of Sha'ab Al Ashkhar, a recent mega mass housing neighbourhood in Al Ain city. To facilitate this investigation, the research first developed a theoretical framework for the relevant principles and indicators of socially sustainable neighbourhoods. In this framework, five main principles and their related indicators were identified as derived from relevant global literature including density, mixed-use, mobility, accessibility, and special connectivity and integration. A qualitative/quantitative research method was applied to assess the social sustainability indicators of Sha'ab Al Ashkhar neighborhood development. The investigation tools mainly included field observations and spatial syntactic analysis of the urban form of the neighbourhood. The findings of the analyses revealed that two principles have been not achieved (mixed-use and special connectivity and integration) out of five principles of social sustainability in Sha'ab Al Ashkhar neighbourhood, while the remaining principles have been partially or poorly achieved. It is believed that the outcome of the research has given a clearer understanding of the achieved level of social sustainability in Al Sha'ab Al Ashkahr neighborhood design, as a very recent mass housing design model. Accordingly, the research recommended a set of valid, reliable, and highly contextual design guidelines that can help achieve social sustainability in mass housing projects in the UAE and maybe other countries in the region.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE REGENERATION OF INFORMAL TERRITORIES: THE CASE OF PANTE MACASSAR IN TIMOR-LESTE

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### ABSTRACT

Territorial planning accommodates situations that arise from the existence of informal settlements. The need to reconvert this reality requires an operational process that allows for a permanent update supported by a long-term vision. In Timor-Leste, the lack of an applicable legal framework requires that intervention in terms of urban management be as disruptive as possible. Since it is challenging to guarantee equity in the proposed treatment, and operational process that applies to Pante-Macassar makes it possible for the reconversion of informal occupation to occur. Territories today are not an easy decision reality for urban redevelopment where infrastructural interventions cannot be accompanied by the public sector or by the owners or occupants of already built areas. The need to regularize road layouts and promote the creation of new accessibilities for the resident community and future economic activities makes it necessary to identify a set of criteria for the evaluation and decision-making process on the type of intervention, as is the case of Bairro Palaban. This article demonstrates the importance of space requalification and access to urban services in the context of the right to City. The discussion of the theory about planned space and the reality of informal space leads to identifying the relevance of the governance model to the resilience of urban spaces and the list of indicators that must be associated. In conclusion this project place in the regional development context highlights the advantages in terms costs and of impacts to the development for the Oecussi population.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INVESTIGATION OF SHADED ATRIUM BUILDING IN HOT AND HUMID CLIMATE

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### ABSTRACT

Reaching the maximum level of the users' comfort in the building is an important role. At the same time, it is vital to have occurred minimum negative environmental effects. Having an atrium as a popular area in the building needs to investigate thermal performance. This paper finds out the effects of the floor height into the internal condition as the liner atrium with optimum shading device during the warm period. This paper illustrated the different results according to the atrium building height as floor numbers including 1, 3, and 5 floors in Famagusta, North Cyprus climate. As finding in all building height simulation models in August is the maximum discomfort condition month and maximum cooling loads as air-conditioning system, because of internal building gained and ventilation gains, (single floor  $Q_z$  between 330 to -330 watts,  $Q_v$ : -2000 to 2000 watts), (three floors  $Q_z$  between 1200, 2200 watts to -1200, -2200 watts,  $Q_v$ : -7000 to 7000 watts), and (five floors  $Q_z$  between 2000, 4500 watts to -2000, -4500 watts,  $Q_v$ : -12000 to 12000 watts) however, the optimum shading device as 35% over the south external facade of atrium applied but the fully air-conditioned is necessary especially from morning to afternoon time. It found that, while the floor height of the total building and atrium height increased, heat transferring massively occurred during morning time especially as passive performance.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## MADONIE SMART VILLAGES: TECHNOLOGICAL SUSTAINABLE DESIGN FOR SICILIAN INNER RURAL AREAS

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### ABSTRACT

The European Union, today, is promoting the enhancement of marginal areas instead of the chaotic cities that, in the last years, have obtained lots of chances for their development. In the Mediterranean area, referring to Sicily, there is the “Madonie District”, an inner rural area, composed by 21 municipalities, that, in the last years, is suffering of depopulation and lack of work despite to its natural and architectural potential. The pandemic situation has pointed out the necessity of a better life quality that could be guarantee with the process related to the creation of smart villages, little collaborating urban centers, not so far away from the biggest cities. The purpose of the research is to enhance these territories with technological sustainable design, in order to enable urbanization and digital innovation and to realize a sustainable program of development. Innovative materials, technological systems and inclusive design aim at obtain a compatible rehabilitation using technologically eco-efficient strategies and functional and innovative solutions. Sustainable strategies are related to *Design for All* approach, monitoring and control protocols and comparing “Madonie District” municipalities with other Italian and European smart villages. Technological innovations and solutions become intelligent, and therefore “smart”, in terms of compatibility with natural and built landscape. The research focuses on improving the connection between these villages where all the built and natural environment take benefits. Smart and sustainable development is based on implementing digitalization and useful services to the weakest areas, improving indoor and outdoor comfort and creating links that contribute to mutual aid companies: a complex of elements coordinated and operating in close union. The challenge and the goal of the research are to revitalize an area that has great potentials, but that it is not yet sufficiently autonomous and it has not yet implemented a smart network system. The collaboration between public and private Institutions leads to the realization of the proposed projects and the creation of guidelines/best practices are useful to create, devise and concretize a program of technological development of the “Madonita” area. This system can help exploiting the endemic resources from architectural, social, circular economy and cultural heritage point of view. The final research protocol and the identification of best practices are useful to create a programme of development and social renewal. Involving stakeholders, clusters, investors and local companies guarantee the survival of rural communities and to prepare them for Renaissance. These actions favour local culture and traditions, combining tradition and technological and digital innovation. Furthermore, the scalability of this research represents a chance for sustainable development and a “modus operandi” that can be implemented and transposed in other similar contexts with the same characteristics.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## OLD TOWN VRATNIK – FUNCTIONAL TRANSFORMATION WITH MODERN ENGINEERING STRUCTURES

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### ABSTRACT

The position of Bosnia in the Balkan Peninsula and the Sarajevo region in its centre has intertwined the influences of diverse ethnic and cultural currents into specific spatial physiognomies of human settlements within certain epochs, in the continuity of about five millennia of their duration. The shifts of turbulent and calm periods have moved the inhabitants of our region from the plains to steep hills to build forts (defensive fortifications), refuges (shelters for the local population) and fortified cities. This turbulent historical context determined the formation of the Old Town Vratnik at the eastern end of the urban core of today's Sarajevo. Although its territory was completed just in the Ottoman period, there are indications that the fort existed there in prehistory, which marked the nucleus of the much later fortified town of Vratnik with five bastions in the walls. Today, the Old Town Vratnik is faced with numerous spatial and functional degradations of the environment, of which the inadequacy of the inherited urban matrix to the intensity of road and stationary traffic stands out, and to which the urban ground floor is maximally subordinated. Such a situation requires functional rearrangements and restructuring, based on both the preservation of heritage and tradition, and the adaptation to modern life trends. This implies that the projection of the final statements of transformation must be guided by an integrated approach in the application of its interdependent methodological procedures: functional, historical and environmental, moreover, because the vision of the concept includes the application of modern engineering "large format". Starting from the thesis that the civilizational obligation of every society is to respect culture, tradition, history and heritage in the transformation of living space, not taking a hermetic stance, but respecting the need for growth and development, the aim of this paper was to find an answer to the question: How to implement a new articulation of the urban ground floor of the Old Town Vratnik by applying modern engineering constructions, while remaining based on preserving the identity of spatial expressions that represent the sedimentation of cultural and historical trends of its long existence? We found that the answer to the question lies in the ambiguity of the transformation process, justified by the results of the analysis of the historical context of the formation and current degradation of the gatehouse, and the provisions of the current Regulatory Plan. It has been shown that the acute problem of urban ground load with traffic flows can be solved by applying modern engineering structures, by building a garage buried in the rock mass according to the principle of NATM excavation. Also, this first level of functional transformation enabled further rationalization of the use of space, by acting on several levels. That is, it created a basis for the conceptualization of strategic principles in the restructuring of content oriented towards improving the quality of life of the local community, but also the implementation of functional transformations at the level of urban details. All these levels must be guided by the procedures of the historical method of redesign, which, based on the design theory of the traditional in architecture and urbanism, is the only one that can properly channel the influences of history and tradition on the objectivity of transformation. Finally, the method of environmental and ecological redesign is unavoidable, which, according to the same principle, and in cooperation with the previous two, forms a unique platform for conceptualizing the approach to the transformation of the Old Town Vratnik. Lastly, our vision of the future status of the city of Vratnik has received guidelines for upgrading the current Regulatory Plan "Vratnik", which we consider an important contribution of this research.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE GREENERY AROUND THE OLD TOWN OF TORUŃ IN AN ALTERNATING PROCESS OF CHANGE

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### ABSTRACT

The prevention of historical values of medieval old-town centre of Toruń has strong basis nowadays, especially after it was inscribed on the UNESCO World Heritage List in 1997. Like many other historic cities, it has experienced a lot of transformations throughout centuries. The old town of Toruń still have an authentic urban structure, but prevention of its neighbourhoods needs relevant considerations how to conduct with this unique tangible cultural heritage. These former outskirts of the city have been maintained as a place for fortifications and other military facilities during a long period. After medieval times, it has experienced many changes until now. Probably most important one was made after the First World War. Fortunately, at that, town authorities decided at that special moment of history to follow widespread idea of creating a green belt the city centre. Of course, it was not so new at that time, because it had been already realised in many towns around the world, for instance in Vienna or Cracow to mention just a few. In case of Toruń, this action served as a kind of a buffer zone connecting the centre with the surrounding suburbs. Besides of a transport avenue, the urban plan assumed mainly greenery places there, which should be rarely completed with new public utility buildings. A modern idea of creating a green belt around the city centre of Toruń, which evolved in the first half of XX-eth century, challenges nowadays' needs today, which provide to discussion on its further development. The public space outside a ring of former city walls' line challenges the increasing investment pressure. Can it be called sustainable development? It becomes difficult after taking a closer look on what has happened during last decades. It seems that also in the discussed public areas there is a strong temptation to use free space to build it.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE 3D PRINTING OF MODELS AS THE METHOD OF INCREASING THE QUALITY IN THE ARCHITECTURAL DESIGN

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### ABSTRACT

Traditional architectural modelling is one of the basic methods of creating in the profession of architect. The ways of making mock-ups representing building objects hasn't significantly changed during centuries until a few last decades. In that time, an enrichment with modern techniques in previous workshop methods has become more and more popular. Contemporary architectural design is at a high level when it comes to the use of computer techniques. There is plenty of sophisticated methods based on a three-dimensional digital mapping of space. In case of an architect's needs, most important is Computer Aided Design, commonly known as CAD. It has evolved into Building Information Modeling, shortly BIM, during last years. Space grids that can be generated in CAD or BIM software may have an additional use. Solids made of a mesh of points is one of it. They can be quite easily imported into the memory of 3D printers or CNC machines. Both of these tools belong to Additive Manufacturing (AM) technology. Rapid prototyping joins different methods, like CAD and 3D Printing, together. It has been already recognized as a means of achievement progressive results in the industry sector. Might it provide to the same results in architectural design? The design process can be additionally varied if the technology of 3D printing by using it in making architectural models. Particularly noteworthy are the possibilities of constructing shapes that would be unattainable on a small scale using traditional methods. Recognizing the pros and cons of 3D printing is an important step before drawing conclusions. The suitability of AM for the production of mock-ups is undeniable. It seems important to use it not only after designing the object, but also during conceptual work.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SPECIFIC PROBLEMS OF THE CULTURAL HERITAGE ON THE EXAMPLE OF THE ADAPTIVE REUSE ARCHITECTURE DESIGN OF THE MANOR HOUSE IN SICIENKO**

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### **ABSTRACT**

The architectural design is one of important parts of a building process. It is true also in case of historic objects' restorations. There is plenty of problems that have to be considered during historical building's adaption. They are connected to different disciplines like architecture, interior design, construction and probably most important in this matter – conservation and restoration. This last one puts an emphasis on preventing cultural values, especially in Mediterranean cultural circle. Main of them are authenticity, integrity, utility and also scientific, historical and emotional values. Conservational rules can be useful while creating concepts of adaptation any historic objects. They indicate, among others, on a diligence for historic matter. The Manor House in Sicienko, a village near Bydgoszcz, is a representative example of an adaptive reuse design. The object comes from the end of XIX-eth century. It has been significantly depleted in recent years. But there is new owner of the house since the second half of 2021. The Rural Commune of Sicienko, that owns the object now, decided to act comprehensively. An adaptive reuse architecture design competition has been announced in November 2021. Seven pairs of students of architecture were participants of it. Their conceptions were based on the existing documents, including a building inventory. The contest results were announced on February 24<sup>th</sup> 2022 during a special conference in Kruszyn, nearby Sicienko. The competition works indicate an advancement of approaches. There can be found a respect for history together with interesting visions of an interference with the objects' substance. Modern proposals of the revitalisation of the house's surrounding are also worth mentioning.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## METHODOLOGY FOR ASSESSING THE AESTHETIC AND VISUAL ATTRACTIVENESS OF UNDERWATER LANDSCAPES IN THE ASPECT OF PLANNING LAKE COASTAL ZONES FOR TOURISM PURPOSES

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### ABSTRACT

The development and planning of lakeshore zones is closely linked to types of tourism and recreational activities. Tourism involving underwater exploration is one of the most dynamically developing types of qualified tourism. The aim of the study is to develop a methodology for assessing the aesthetic and visual attractiveness of underwater landscapes of inland water reservoirs. A methodological framework for assessing the aesthetic and visual value of lake landscapes using direct underwater observation will be presented. A survey of active divers conducted for the purposes of the study allowed for the development of the basics of the bonitation method. A total of 200 expert opinions were obtained. The high level of agreement among respondents (expressed with Kendall's measures) on the most important features affecting the attractiveness of the perceived underwater landscape confirms the need for this type of analysis. On the basis of the results obtained, one can state that it is possible to plan specific development elements in the lakeshore zones. The value of the underwater landscape can be determined on the basis of direct observations at the designated points using the developed bonus method. It is a resultant of the conducted surveys. The most important assessment parameters indicated by the respondents were the shape of the bottom, natural obstacles, submerged anthropogenic objects, animals and vegetation. Pilot underwater surveys were conducted in selected water bodies in the north-eastern part of Poland. The assessment process involved professional divers with many years of experience in assessing landscapes on the Earth's surface. The results confirmed the correctness of development of the assessment method due to high consistency of readings and interpretations among individual members of the measurement group. The presented methodology and obtained results will contribute to the development of underwater research in the aspect of tourist exploration of inland water reservoirs. They are a prelude to designing a specialised base for qualified tourism. On the basis of the obtained results, it is possible to work out a scheme of planning tourist infrastructure on all lakes that are attractive from the point of view of tourist exploration. This can also include designing didactic or scenic paths for amateur divers looking for attractive areas for tourist exploration. In addition, the classification and identification of the most attractive landscapes can contribute to measures aimed at their special protection against the loss of these attractive qualities.

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## MODERN CONCEPTS OF LOW-HEAD SMALL HYDROPOWER PLANT

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### ABSTRACT

Due to the ever-increasing demand for electricity and the high exploitation of water resources, especially in Central and Western Europe, resources with low hydropower potential are increasingly being used. These sites are characterized by a very low head (up to 5 meters) and are often placed in urban areas. Aside from required effective technical-economic design (the goal is to minimize payback period) it is essential to consider the type of surrounding development and design the power plant so that it would not have disruptive impression and minimize the impact on the aesthetic and ecological character of the locality such as noise minimization, suitable design of the fish pass enabling fish migration, etc. This article will discuss the design of the hydropower plant in urban area, which is located in close proximity to the historic city. The first concepts were to place the power plant on the right bank of the river, away from the historic city. A variant with two modern propeller axial-type vertical turbines was designed. These low specific speed long-bladed turbines are much more fish-friendly than conventional Kaplan turbines. The design of powerplant also originally included a new fish ladder enabling fish to migrate upstream and downstream. This variant was the most suitable of all assessed variants, both from the technical-economic point of view (investment versus energy production) and from the point of view of minimizing the disruptive attribute of the site (the power plant would be located on the right bank and except the aerial view the power plant would be practically invisible). The historical survey of the right bank has shown the existence of well-preserved historical architectural elements and therefore, for reasons of monument protection, the location of the power plant on the right bank is not possible. For this reason, a variant proposal for the location of a power plant with a similar installed capacity in the left weir block was proposed. This would be the concept of a classic overspilled power plant with bulb turbines. An even more modern concept corresponds to a submerged, "invisible" hydropower plant with submerged turbine-generator units without any need to build a standard "dry machine room". The strongest aspect of this concept is the invisibility of the power plant, which is an advantage in terms of the absence of disruptive attribute of the character of the site (located in close vicinity of the historic city). Other advantages are keeping high flood capacity of the weir profile with submerged hydropower plant and maintaining the existing fish pass on the left bank. The only disadvantage of this solution is the need to remove the entire left weir block and associated financial demands and technical solution of the construction site in the riverbed. It is important to emphasize that this solution will not disturb the character of the river in the long run.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ENERGY SAVINGS AND RENEWABLE ENERGIES IN THE EXISTING DRINKING WATER SUPPLY SYSTEM

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### ABSTRACT

Drinking water distribution system is the basic infrastructure of urban areas. Reliable supply of drinking water for the population at an affordable price is a crucial function of the state. Therefore, the local municipalities usually own at least a part of the water distribution companies. In recent years, rising energy prices have significantly impacted final water prices. This paper shows specific examples of energy savings in transporting and storing raw and drinking water. At the same time, it deals with the technical possibilities of energy exploitation of residual heads. The pay-back period on investment for installing turbines in existing systems is incomparably shorter than in stand-alone run-off river hydropower plants. In addition, the electricity produced in this way is environmentally very friendly since it uses already existing infrastructure and does not disrupt ecosystems. It allows profitable combination with other renewable micro-energy sources, such as solar panels on the reservoir roof. First of all, we show the suitable operating nodes in the water distribution with the possibility of significant energy savings or, conversely, electricity production. Subsequently, we present our experience with the design and operation of Pelton water turbines on drinking water systems. Attention is focused on new materials for producing crucial turbine parts such as carbon fiber plastics for buckets of a runner. Their use significantly reduces financial investment and possible replacement costs while maintaining strict requirements for the contact of materials with drinking water. The design considers the operational specifics - drinking water transport has the highest priority whereas the production of electricity has lower priority. The economic analysis considers investment requirements, maintenance requirements, and operational costs. The savings gained by proper system management, the sale of the electricity produced, or even a combination (direct use of the electricity produced) can significantly reduce the total energy costs, and thus maintain an acceptable price of drinking water for the end customer.

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**05 -09 September, 2022 - Prague (Czech Republic)**

**World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium**

**ROMANIAN RAILWAY HERITAGE AND UNFINISHED RAILWAY ROUTE IN SOUTH DEVELOPMENT  
REGION**

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**ABSTRACT**

The paper presents the efforts made by the Romanian authorities to develop and create a modern rail system from 100 years ago. At first it is presented a development plan from the years around 1910 and the possible new railway routes at the time, correlated with actual railway system. One of the presented routes started but was stopped because of the First World War, postponed because of the Second World War and finally abandoned by the authorities, still it can be a great and actual route that can be designed and constructed, also connected to the actual IV<sup>th</sup> Romanian Railway Corridor, that is already modernized and the passenger trains can circulate with 160 km/h. Finally, is presented the difficult part of the prospected railway line and the works that are already done with conclusions and recommendations.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**RAILWAY BORDER CONNECTIONS, DOUBLE RAILWAY GAUGE IN ROMANIA DURING UKRAINE  
CRISIS AND DEVELOPMENT POSSIBILITIES**

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**ABSTRACT**

The paper aims to study and present the actual railway routes along the East and North Romanian border and East European Community border, with neighbors Moldova and Ukraine. In the first part of the paper, it is presented the Romanian railway classification according to national standardization regarding interoperability and also, the major opportunities that the actual geopolitical and geographical context can raise and offer to our country with few efforts made by national authorities for passenger and freight trains. The second part of the paper is allocated to the punctual railway connections that existed and exists along the eastern and northern border that can be activated and used as gates and passing points for freight trains that needs to be delivered all over the world from Ukraine and Moldova. Finally, a Romanian Railway Company modernization work for double gauge, wide gauge and normal gauge for trains with Moldova neighbor it is taken into account.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**ANALYSIS OF THE IMPLEMENTATION OF THE RECYCLING PROGRAM BY THE MUNICIPALITY ASSOCIATION MSUR, METROPOLITAN REGION, CHILE**

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**ABSTRACT**

The study analysed the implementation of the municipal recycling program from the municipality association MSUR. This study considers only the first year of the program that corresponded to the year 2020. The segregated recollection involved a total of 10 municipalities from the Metropolitan Region in Chile. The focus of the program was the recollection paper, glass and PET and the subsequent sale of the materials as recycled to different companies. The analysis was centred in the estimating the weight per municipality recollected, the distribution of the material to be recycled and per capita recycled by each municipality. The first month the program recollected 257.962 kg of material and reached a maximum of 561.827 kg, were it stabilized with an average of 543.840 kg and a standard deviation of 15.600 kg. The percentage of population that the program served depended on the number of vehicles dedicated to each municipality which lead to a variation of the coverage between municipalities that varied between 2,3 to 97,7 percent. The amount of material recovered depended on the municipality and was between 0,016 to 0,124 kg/pp/day. Due to the pandemic, it was observed a small decrease in the amount of recyclable material recollected due to the SARS-CoV-2. As initial result of the program, it was observed that the two municipalities with the highest percentage of coverage area and economical income, were part of municipalities with lowest recovery per capita by weight in the program. This result led to the analysis of the composition of the solid waste for these two municipalities and the inhouse method of segregation. From this part of the analysis, it was possible to observed in the field that the Municipalidad de La Reina had overestimated the percentage of coverage area and the community didn't dispose the recyclables adequately for the segregated recollection. In the case of the Municipalidad de Santiago it was observed that it has a well inhouse structured program, but not all the members of the community are participating, and the spectrum of recyclables is very limited and therefore losing an important fraction of elements that can be recycle.

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## APPLICATION STUDY OF NDT TECHNOLOGY IN BRIDGE AND TUNNEL

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### ABSTRACT

With the continuous construction of bridge and tunnel engineering, more and more examples show that the generation of disease will greatly shorten the service life of structure and even cause great harm to the operation safety of structure. Therefore, ensuring disease timely detection and diagnosis and treatment is an important measure to ensure the stability and safety of structure operation. However, traditional detection techniques have disadvantages such as low efficiency, strong subjectivity, and even damage to the structure. Nondestructive testing technology gradually enters people's attention and attracts people's attention with more and more attention. The development status of nondestructive testing technology in bridge engineering and tunnel engineering is summarized. They studied the NDT technology in bridge engineering and tunnel engineering two direction, in bridge engineering, analyzed the current application of various methods advantages and deficiencies, discussed with the continuous development of computer technology, the future NDT detection technology can be combined with various algorithms to achieve NDT detection technology in bridge disease detection. In terms of the tunnel engineering, the lining diseases, as a more common form of the tunnel diseases, will seriously affect the stability and safety of the tunnel operation. Therefore, the detection of the tunnel lining diseases is the most important content of the tunnel disease detection. Based on the common lining diseases, introduced the main types and influencing factors of lining diseases, the existing common nondestructive detection methods are summarized in apparent state detection and internal state detection, analyzed the advantages and disadvantages of image processing and 3D laser scanning, and discussed the development trend of NDT of lining diseases in the future.

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## APPLICATION OF VIDEO MONITORING TECHNOLOGY IN THE FIELD OF SAFETY MONITORING OF BRIDGE AND TUNNEL

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### ABSTRACT

In recent years, with the development of electronic information technology, video monitoring technology has been widely used in the safety monitoring of bridge and tunnel operation, but there are still some problems. Video monitoring technology is an important part of the safety monitoring of bridge and tunnel operation, and the research on this part still needs to be further improved. At present, there are some problems in the video monitoring technology. For example, In the tunnel, the video monitoring technology is often disturbed by the external environment, so the effect is not obvious, and the collected video data clarity is not high, so the cracks can't be monitored in real time. The brand and mode of the monitoring equipment are mixed, so during the bridge life the replacement of the new and old monitoring equipment troubles the integration of the system. This paper systematically reviews the development status of video monitoring technology at home and abroad, and discusses the necessity of the safety monitoring of bridge and tunnel structure operation, and also analyses and studies the application of video monitoring technology in bridge and tunnel operation safety monitoring. Finally, this paper points out that how to improve the accuracy of video monitoring and reduce the operating cost of security monitoring is the current challenge and the future development direction.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## MODERN SOLUTIONS IN UNDERWATER EXPLORATION AS AN INDICATOR OF NEEDS IN LAKE SHORE INFRASTRUCTURE PLANNING

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### ABSTRACT

The tourist activity of certified divers and the increasing number of people willing to learn about this form of qualified tourism makes it necessary to follow the modern solutions used in underwater exploration. Cheaper and more modern diving equipment makes this form of tourism very fashionable and a popular leisure activity. Appropriate management of water reservoirs and technically advanced equipment are conditions for safe and attractive ways of spending time on underwater exploration of lake ecosystems. The aim of this paper is to show the possibilities of using the latest technical solutions for safe underwater navigation. It will present solutions for underwater navigation and devices improving the level of observation of the underwater world and recording individual parameters and features of underwater landscapes. The presented results set directions for the planning and management of lake coastal zones, which are a prerequisite for the dynamic development of this form of qualified tourism. The possibilities of modern underwater navigation equipment will be presented, which allows moving with a precision of up to a few metres. Such high accuracy increases the safety of diving in cold inland waters and enables the determination of tourist exploration routes, identification of measurement points as well as mapping underwater tourist routes. The presented solution is a set consisting of a personal underwater tug DPV (Diver Propulsion Vehicle) and an electronic underwater navigation console (ENC) used for topographic and vertical orientation during diving. It can be used as a piece of equipment during scientific research, but also as a piece of equipment for the recreational diver. Parameters directly observable underwater include depth, direction, speed, etc. The tested set is complemented by an underwater personal tug (DPV) for faster underwater movement, increased range and comfort of diving, saving of breathing medium and stabilisation of ENC, which increases the accuracy of its measurement. Test results confirm the high usefulness and validity of using this type of equipment, especially during scientific research. The application of the tested technology makes it possible to increase the efficiency of the observations (measurements), on the assumed research stations (set every 100 m), from 5 readings per 60 minutes, without the mentioned equipment, to 15 readings per 60 minutes, with the operational depth of up to 10 m. Such a result is possible to obtain, not only due to the possibility of automatic readings of some parameters, but also due to the high speed of movement under water without the necessity for the diver to frequently ascend in order to determine his own position in relation to the set test stands (measurement points). The presented methodology of modern exploration and the obtained results, using the presented set, will contribute to the development of underwater research and will increase the attractiveness of underwater tourism in inland water bodies. This type of solution is being tested for the first time in inland waters. It should be emphasised that the results obtained are of great importance in the planning and spatial management of the lake shore zone bottoms and the accompanying infrastructure for the development of underwater tourism, the channelisation of tourist traffic and the protection of lake ecosystems.

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Corresponding Author: Marta Figurska



## EXPERIMENTAL EVALUATION OF THE POTENTIAL USE OF WASTE RECYCLED CONCRETE FINE AGGREGATES TO PRODUCE SELF-COMPACTING CONCRETE

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### ABSTRACT

The current concern with sustainability in the construction sector has led to the adoption of processes to minimise the impact on the environment. The use of recycled concrete aggregates in self-compacting concrete (SCC), as an alternative to natural aggregates, seems to be a solution with great potential. However, it is common knowledge that the use of recycled aggregates in the production of SCC instead of natural aggregates may cause changes in some of its properties, both in the fresh and hardened state, and that the magnitude of those changes will depend on the percentages of incorporation and the nature of recycled aggregates. When using the mix design methodology proposed by Nepomuceno *et al*, SCC is assumed to be consisted basically of two phases, namely, the liquid phase (mortar phase) and the solid phase (coarse aggregates), being the main SCC properties controlled by the mortar phase. In this perspective, this research work reports the results obtained when testing mortars with flow properties appropriate to produce SCC, when binary and ternary blends of powder materials were used and natural fine aggregates were partially replaced by recycled concrete fine aggregates. The experimental program carried out involved, in a first stage, the production and testing of 11 binary mortar mixtures suitable for the production of SCC, with replacement percentages of natural fine aggregate by recycled concrete fine aggregate varying from 0% (reference mixture) to 50%, in 5% increments. Subsequently, 6 ternary mortar mixtures were produced and tested for the same purpose, with replacement percentages of natural fine aggregate by recycled concrete fine aggregate varying from 0% (reference mixture) to 50%, in 10% increments. Binary mortars included Portland cement type I 42.5R and limestone powder, while ternary mortars included Portland cement type I 42.5R, limestone powder and fly ash. In both cases, the dosages of superplasticizer and mixing water were determined experimentally to obtain the required fresh properties suitable to produce SCC. The results indicate that the 28 days age compressive strength and density of the mortars decrease with the increase in the percentage of incorporation of recycled concrete fine aggregates, regardless of whether they are mortars with binary or ternary blends of powders. In binary mixtures, the mixing water dosage increases with the percentage of incorporation of recycled aggregates, while in ternary mixtures the opposite occurs, at least up to a percentage of 40% of incorporation of recycled aggregates. The superplasticizer dosages, necessary to obtain the appropriate flow properties, were always higher in the ternary mixtures compared to the binary mixtures, even comparing only the reference mixtures. It can be concluded that mortars with the incorporation of recycled concrete fine aggregates constitute a viable material with potential for use in the construction industry, provided that the necessary adjustments to its performance are considered, thus contributing to the sustainability of construction.

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## A CASE STUDY ON MIX DESIGN, LOCAL PRODUCTION AND TESTING OF NORMAL AND HIGH STRENGTH STRUCTURAL LIGHTWEIGHT AGGREGATE CONCRETE

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### ABSTRACT

Structural lightweight aggregate concrete has been used worldwide in buildings, bridges, offshore platforms, among others. The reduction of its own weight allows the construction of structures with large spans and can also offer advantages in the production of structures located in seismic zones or in the prefabrication of structural elements. This research work describes a case study on mix design, production and testing of structural lightweight concrete (LWC) incorporating coarse lightweight expanded clay aggregates (LECA). The LWC was produced under conditions similar to a prefabrication site, where the variables related to transport and placement are not as demanding. The production and testing of LWC was developed in two phases. In the first phase, four different LWC were produced in laboratory conditions with dry density between 1.8 and 2.0 according to NP EN 206-1 and comprising four different compressive strength classes, namely: Series 1 (20 to 25 MPa), Series 2 (40 to 45 MPa), Series 3 (50 to 55 MPa) and Series 4 (60 to 65 MPa). For the production of LWC, the following materials were used: cement CEM II/B-L32.5N, cement CEM I 42.5R, two mineral additions of microsilica, one mineral addition of limestone powder, a superplasticizer, a natural sand, two types of natural coarse aggregates and a lightweight expanded clay aggregate (LECA) with a maximum dimension of 12.7 mm. The mix design was based on Faury reference curve method. In the second phase, the studied LWC were produced in conditions similar to those of a prefabrication site and 26 reinforced concrete beams with rectangular section and with different steel reinforcement rates were concreting. The obtained correlations between water to cementitious materials ( $w/c$ ) and the compressive strength of concrete at 28 days are reported on the present study, together with the correspondent dry densities and standard deviation values. The obtained results allowed to conclude that it is possible to satisfactorily produce high-strength lightweight aggregate structural concrete in a prefabrication site with a homogeneous distribution, without segregation, and with the desired compressive strength and dry density ranges when supported by correlations specifically developed for the selected materials and provided that there is adequate production control.

Corresponding Author: Hugo A. S. Pinto



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**SMART DECLINE FOR SHRINKING CITIES BASED ON THE SYSTEM OF SYSTEMS ENGINEERING:  
CASE STUDY OF THE SENBOKU HOTTOKENAI-NETWORK PROJECT**

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**ABSTRACT**

This study aims to propose a smart decline for old New-Towns with declining populations, focusing on the concept of the System of Systems Engineering. This paper defines smart decline as “design methods intended to satisfy residents’ living needs, even though the population is declining”. The old New-Towns are developed into large-scale suburban residential areas during Japan’s rapid economic growth period from the 1960s to the 1990s. In the old New-Towns, there were many detached houses with gardens for high-income workers. The method of this study contrasts paradigms, models, theories, and cases in binary opposition. As a case study for the smart decline, we analyzed the “Senboku Hottokenai-Network Project,” which has been working in Senboku NT. Senboku-NT is one of the largest Old NTs with 13 neighborhood units in Japan. Because the population is now 130,000 and the aging rate is over 30%, smart decline theory would contribute to maintaining the residents’ living environment for the declining population with the increasing number of older adults. In conclusion, this study summarized the key factors of smart decline using five factors: a. The stakeholder is the collaboration between residents’ associations in the neighborhood, local businesses, the government, NPOs, and universities. They then organized a Network Council, which could work as an environment for social interactions among multiple levels of stakeholders. b. The objective of this study was to provide various community services related to daily life, such as welfare, health, food, and housing. c. The priority is residents’ spirit of *hottokenai* (leave no one behind). d. The process is diverse, and asynchronous processes are conducted autonomously by stakeholders with the *hottokenai* spirit. e. The resources are vacancies in the neighborhood, such as vacant houses and stores that have not been fully utilized at present. The importance of the community-based planning process and vacant resources are the same as that in previous studies of Hollander and colleagues. In addition to resources and processes, this study clarified points related to stakeholders, objectives, purpose, and priorities. One of the unique features of the Senboku Hottokenai-Network Project is the *hottokenai* spirit that enables various stakeholders to collaborate. In collaboration, a factor in the successful progress of the activities is the participation of NPOs and universities, which have no conflicts of interest with residents’ associations, local businesses, and the government. The smart decline theory, which this study proposed, contributes to maintaining residents’ living environments in shrinking cities. We have studied the smart decline theory to a better theory in cooperation with the Senboku Hottokenai Network Project, which is continuously working.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **THE STIGMERIC CITY: REINTERPRETING ECO-UTOPIA MODEL WITH STIGMERIC BEHAVIOUR**

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### **ABSTRACT**

The impact of human society on ecology has reached a great extent, resulting in a series of natural backlashes. This gradually shows us the importance of re-examining the previous ecological utopian concept, such as Paolo Soleri's Arcology. Utopia represents the ultimate pursuit of human for a better social state, but as well as the ultimate embodiment of the limitations of human beings as self-centred design thinking. It is bound to be difficult to adapt to the complex and dynamic of the ecology if we try to realise utopia as the ultimate order or result operating in a perfect state, as previous failed praxis has done. In fact, the emergence of utopia has a greater value in giving us the motivation for optimisation and progress of our human patterns in each era. Meanwhile, there are patterns of intelligence in nature that are well adapted to this complex and dynamic ecology by an optimisable system, which we call stigmergic intelligence. From the self-organisation of the swarm and flocks to the formation of the social structure of the ant colonies, from the growth of plants to the epidermal tissue of organisms. Natural species place themselves into ecology in a rather miraculous way. Besides, the development of new digital tools allows us to study the phenomenology and reprogram these intelligences. This paper tries to go further and learn from stigmergic intelligent model to form a new system, which can optimise urban ecological issues from a new perspective. Presenting an innovative computer-aided approach based on stigmergic intelligence that aims to handle both miniaturization (the revealing of the human pattern which has the minimal disruption to ecology) and complexity (the optimisation and customisation of human activity content). Study how it works as a layer stack into the urban ecology to reinterpret the utopian model in the digital era.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **HISTORICAL BUILDINGS, SUSTAINABILITY AND RESTORATION: METHODS AND APPROACHES FOR ACHIEVING A SUSTAINABLE AND RESPECTFUL RESTORATION OF MATERIAL**

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### **ABSTRACT**

Respect for sustainability has now become mandatory in the field of general construction as well as architectural restoration, in fact, we try to pursue it through different choices in different areas, one of these is the area of materials and their production. As a result of years of research and formulation with natural methods and materials in the architectural restoration sector, this article shares the results achieved by pursuing the production of mortars with a natural composition, free of additives, consistent with the material nature of the architectural asset and produced avoiding the use of polluting technologies but rather following sustainable procedures, unlike the usual procedures. Case studies will demonstrate how these mortars are efficient and long-lasting, without showing, after years of application, the usual degradation caused by additives present in common premixes produced by industrial supply chains. In addition to the materials and production methods, the aim is to underline how the "approach to the work" also contributes to guaranteeing an integral sustainable process that respects the work, therefore the method of analysis of the existing state of affairs that precedes and then guides the ad hoc formulation for the building. The approach followed in several cases has seen an interdisciplinary collaboration that follows a specific process with an initial phase of study and analysis with methods of archaeology of architecture; analysis of the material components of the building, analysis of the state of affairs, to then define, based on the information obtained, the most appropriate intervention method and the mortar that best conforms to the context to be implemented with sustainable approaches.

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## SENSITIVITY STUDY OF THE STEEL FOOTBRIDGE RESPONSE TO THE DAMPER PARAMETERS

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### ABSTRACT

The paper presents an optimization study of a Tuned Mass Damper (TMD) located on the structure of a steel footbridge. Lightweight bridge structures are prone to dynamic responses caused by human induced vibrations. In some cases, an TMD may be used to limit this response. The TMD is tuned to only one dominant natural frequency. In static response or when oscillating with another frequency, it only acts as an additional load. Therefore, it is necessary to find a suitable ratio of efficiency and weight of the damper. The effective modal weight of a structure is the weight of the part of the structure that oscillates in a given direction at a certain natural frequency of the structure. The ANSYS software system determines the effective modal weight of the structure with respect to the global behavior of the entire structure, which is needed, for example, in terms of calculating the response of the structure to dynamic loads. However, if we need to determine the modal effective mass of a certain natural shape of the oscillation, in addition to the asymmetrical one, it is necessary to use a different procedure to determine this mass. If we want to obtain the optimal course of the amplitude-frequency dependence, it must be tuned using the stiffness and damping parameters. The stiffness of the vibration damper is affected by the difference between the maxima of the two amplitudes. The damping of TMD affects the shape of the amplitude-frequency response so that with a small damping there is a larger drop between the peaks of the amplitudes and in the case of a damping of the structure, the two maxima merge into one larger one. In the first phase, the damper weight is calculated on the basis of a formula based on a 5% proportion of the oscillating modal mass thus determined. Stiffness and damping are also determined in this way. Subsequently, an optimization calculation of the response of the structure with variable values of vibration damper parameters was performed using the ANSYS and OptiSlang software systems. We are looking for values of vibration damper parameters for which the response value will be the smallest when the structure is loaded. The response is monitored in the form of the amplitude of the deflection of the structure in the middle of the span. The result of the study is the dependence of this value on the variability of individual input parameters of the damper.

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## LEANING COLUMNS IN ARCHITECTURE - STATIC ANALYSIS

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### ABSTRACT

In recent years, the solution of the ground floor of buildings with the use of inclined columns has come to the fore. From the architect's point of view, the use of leaning columns is interesting and elegant. In this paper we deal with inclined reinforced concrete columns located in reinforced concrete building structures. From the point of view of statics, this is a new approach requiring a more demanding calculation. The solution of leaning columns can be practically divided into two groups. In the first group there are columns supporting the perimeter wall of the building, mainly on the first and second floors. The position of these columns is in the plane of the wall they support. Their inclination is only in a given plane. The second group of columns includes columns resting on the lower ceiling slab and supporting the upper reinforced concrete ceiling slab. The slope of these pillars is in space. It is not possible to project the plane through the columns. From the point of view of statics, inclined columns are more demanding constructions. Vertical columns are perceived as classic pressure-loaded bar elements. This case entails a compressive axial force, where relatively small bending moments act in the column head. In most cases, compressive stresses occur in the cross-section of the column. When solving inclined columns supporting the wall, the columns are flush with the supported wall; there is such a redistribution of force flow that tensile forces are created in the walls or parapets of the upper floor. The column itself is stressed by three internal forces: axial force, transverse force and bending moment. The second case of spatially placed leaning columns entails a solution of the beam in the space where all 6 components of internal forces occur in the beam and 6 displacements occur in the end points of the beam. The solution of entire structures even with leaning columns is possible only due to a number of software - static programs. All these programs work on the basis of the finite element method (FEM). After calculating the displacement and the stress state in the individual structural elements, their dimensioning takes place. When dimensioning reinforced concrete bars in space, we use different types of programs to dimension the required amount of reinforcement. Subsequently, individual cross-sections of reinforced concrete columns are assessed. Naturally, all calculations are linked to the standard Eurocode EC norms. In the full version of this article there are numerous photos from the author's archive, where he presents the implementation of leaning columns in practice.



**7<sup>th</sup> WMCAUS 2022**

**05 -09 September, 2022 - Prague (Czech Republic)**

**World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium**

**ORGANIZATIONAL AND TECHNOLOGICAL SOLUTIONS FOR MANAGING THE PROCESSES OF  
REDUCING THE COST OF MONOLITHIC CONSTRUCTION**

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**ABSTRACT**

**Purpose** The study analyzes structural and technical, organizational and technological solutions, the use of which makes it possible to reduce the overall cost of monolithic construction. **Methods** Graphical and mathematical models of reinforced concrete prestressing technology application is considered, as well as the use of rational collapsible formwork systems. **Results** The results are presented as comparison of technical and economic indicators and the economic effect of the following solutions in construction: 1. the use of more modern and technologically advanced prestressed concrete in monolithic construction. 2. the use of a rationally selected formwork system in the construction of residential buildings. 3. application of an alternative method of geodetic quality control of formwork in monolithic housing construction. **Conclusion** The proposed method of formwork alignment using vertical design devices improves the quality of vertical structures concreting.

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05 -09 September, 2022 - Prague (Czech Republic)

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## ECCYCLES METHODOLOGY: THE DIVISION IN ARCHITECTURE DESIGN RESEARCH RECTIFIED

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### ABSTRACT

Despite fairly unanimous agreement on the goals of design research, there had been concerns in the past years over what some theorists described as a division in research interest. This came along with the emergence of two different streams of design research: one that aims at increasing design understanding, and one that focus on improving the design process, changing existing situation. Theorists argued that a failure to change existing situations, is often a result of a failure of understanding existing practices. They suggest that changing the current design situations requires not only knowledge of what exists and what would be desirable, but also how to change the existing situation into the desired. More recently, this position has changed, and the division in design research is now being replaced by new systematic thinking. It suggests that changing the current design situation requires more than what is previously thought; it requires an integrated methodology in which design understanding and design improving are both essential components of new scientific approach aimed to create and validate knowledge systematically. This aim of this paper is to introduce the new systematic approach of design research, based on the ECC methodology suggested by Bashier (2021). It proposes a scientific approach to architecture design practices research that has been developed over several years in the research studio. The paper shows the way in which the evaluation-creation cycles (ECCycles) methodology is structured to addresses the goals of design research, by combining the processes of understanding the linkages between current design practices and the context, with making predictions about the desired ones, systematically.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SOLUTIONS FOR TRAFFIC DECONGESTION IN URBAN AREAS**

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### **ABSTRACT**

In the last period of time, global economic development has also had strong effects on road traffic. In this context, in view of the forecasts confirming that the upward trend in traffic will continue at least at the current level, effective and sustainable measures are needed to be taken into account by extending the area of intervention to large urban agglomerations. The urban analysis of large urban agglomerations should not be limited to their administrative area, but should be extended to neighbourhoods and other administrative areas, in order to be possible to find optimal general solutions for their operation and development of perspective. At the same time, several factors / specialists: traffic engineers, public administration, specialists in urbanism etc., must contribute to the management of urban development, and an essential part is transport (traffic) with direct influence on economic development, social impact, environmental protection. The paper aims to present some solutions that the administrators of local, county and national transport networks, specialists in the field and other parties involved have proposed and partially implemented in the metropolitan area of Timisoara, in the western part of Romania.

Corresponding Author: Ciprian Costescu



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **INTERVENTION MEASURES ON TRANSPORT NETWORKS AFFECTED BY NATURAL DISASTER PHENOMENA**

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### **ABSTRACT**

In the last period of time, global climate change has generated a number of shortcomings and dysfunctions on transport networks, thus causing a number of material damage, and not only, relatively significant. Thus, in certain situations, first aid intervention works are required to ensure the immediate functionality of the transport networks at a suitable level, works that must be performed promptly after the occurrence of undesirable phenomena. Of course, most of the times, the causes of these phenomena are natural, but sometimes, a poor maintenance of the transport networks, an improper operation or even their simultaneous action also contribute to their occurrence. The challenge of these works consists mainly in the short time of realization and establishment of the intervention solutions, because the decisions must be very fast, the solutions must be easy to apply and at the same time to ensure a good behaviour in time, at least temporarily, until finding some sustainable solutions for which additional studies and investigations are needed. The paper aims to present several cases, mainly of loss of stability of some slopes, caused by unwanted natural phenomena on the road transport network in western Romania, with the presentation of the causes of their production and remedial solutions that were adopted to ensure a proper state of viability in subsequent operation.

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## PERFORMANCE OF NON-STRUCTURAL MASONRY REINFORCED WITH WELDED WIRE MESH AND STEEL FIBERS UNDER AXIAL COMPRESSION LOAD

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### ABSTRACT

This paper evaluates the behavior of non-structural masonry built with horizontal hollow clay bricks. The aims are to reduce the structural vulnerability of houses built with this type of blocks in seismic zones of Latin America, especially Colombia and Ecuador. The tested specimens are 50 centimeters wide, approximately 10 centimeters thick and 1 meter high. The repowering methods consist of two types of reinforcement: the first one with a 3:1 ratio mortar coating of sand:cement (S:C) with 2.5 centimeters thick drapery covering the welded wire mesh (WWM) ( $\phi 4\text{mm}/15\text{cm}$ ) adhered to the masonry with plastic anchors on each face of the wall. The second one with the use of steel fibers (SF20) in a dosage of 20kg/m<sup>3</sup> of mortar mix, with an average thickness of 2.5 centimeters and a 3:1 S:C ratio. The experimental program includes the testing of 13 axial compression specimens, 4 walls with WWM reinforcement, 4 walls with SF20 reinforcement, 4 with simple mortar plaster and 1 control wall without any type of reinforcement, only with hollow blocks. Each type of reinforcement has a monotonic quasi-static axial compression test and 3 quasi-static cyclic tests. The results showed that SF20 reinforcement increases compressive strength, controls crack growth, but the failure mode is fragile. On the other hand, the WWM reinforcement shows a lower compressive strength, but a less fragile failure since the cracks are visualized and their size increases as the load increases in the test. This is also evident in the load-deformation curves. A morphological analysis of fracture is made in the ceramic material as the clay block. The WWM reinforcement does contribute to life protection, by holding the collapsed clay block fragments between the mortar diaphragms. In addition, it is observed in the experimental tests that the resistance can be increased by ensuring a continuous anchorage that holds the WWM on both faces of the horizontally drilled blocks. Finally, as a conclusion, the increase of resistance by SF20 reinforcement generates stiffer walls, but it would not guarantee life protection in case of cracking or collapse of masonry walls; on the other hand, WWM does allow greater deformations, in spite of not having a similar resistance as the walls reinforced by SF20.

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7<sup>th</sup> WMCAUS 2022

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EFFECT OF JUTE AND SISAL WASTE FIBERS ON MICROSTRUCTURAL PROPERTIES OF MORTARS: EXPERIMENTAL STUDY

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### ABSTRACT

This study aims to add more experimental results by incorporating natural fibers into building materials in order to ensure the performance of recycled materials like natural fibers in the construction sector. An experimental study focused on the physical and mechanical properties of fiber-reinforced mortars. A reference mortar mixtures (cement mortar and cement lime mortar) were used, and two different types of natural reinforcement microfibers (sisal and jute) were used, with different dosages ranging from 1% to 2%. At 28 days, the effect of each fiber type and dosage on mixture properties such as consistency, compressive and flexural strength, dry shrinkage, and microstructural characteristics of the mortars were investigated. Finally, the presence of fibers decreased the consistency. Analyzing the mechanical properties revealed that the mortar sample containing 2% jute fiber has 50% and 20% higher compressive and flexural strength than the reference sample, respectively. In the case of sisal fibers, the strength improves with 1% doses, and the increasing amount reduces compressive and flexural strength. When compared to sisal and reference samples, the addition of jute fibers improves mortar performance by reducing shrinkage and cracking sensitivity. SEM, MIP, and XRD were used to investigate the microstructure of the mortar samples after 28 days of aging. Incorporating jute fibers has no effect on the microstructure of mortar when compared to the reference, and it also improves the bond between the cement matrix and the fiber, resulting in better mechanical properties. The results also reveal that the addition of jute fibers minimizes cracks and voids. The sisal fibers have poor adhesion properties and pull away from the surface of the cement matrix. Natural fibers, however, behave differently in strong cement mortars than in "soft" lime-based materials. Both cases have advantages, but certain factors, such as adhesion to the mortar matrix and water content of the mixture, must be considered.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARATIVE STUDY OF PIXEL AND OBJECT-BASED IMAGE CLASSIFICATION TECHNIQUES FOR EXTRACTION OF LAND USE/ LAND COVER INFORMATION

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### ABSTRACT

Remote sensing image classification refers to the extraction of information classes from the multi-spectral raster image. Two methods of image classification i.e., pixel-based and object-based classification are popular and widely used. Different algorithms developed are using either of the approaches however, there is no general acceptance of any one method. In the present paper comparative study of one pixel-based image classification method, i.e., supervised classification and object-based method have been presented to ascertain their efficacy for correct image classification and extraction of land use land cover information. Maximum Likelihood Classifier (MLC) has been used for the supervised method (Pixel-based) whereas different algorithms like fuzzy, texture and threshold-based algorithms have been used for object-based image classification. Both the methods are used to classify the multispectral remote sensing data obtained from IRS LISS-III & IV sensors for the extraction of LULC information for Ajmer urban fringe (India) for three different years i.e., 2008, 2013 and 2015. Performance of both methods for extraction of LULC through classification of these images (two medium and one high spatial resolution) have been examined through classification accuracy. Results indicate that the pixel-based supervised classification method is better for the classification of medium resolution images whereas, the object-based method is found to be better for the classification of high spatial resolution images. Object-based methods may be better for the extraction of LULC information using fine spatial resolution having higher heterogeneity land use land cover.

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05 -09 September, 2022 - Prague (Czech Republic)

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**EXPLORING MOATS AND THEIR PLACES OF MEMORY USING MULTI-SOURCE DATA: THE CASE STUDY OF CHANGJIANG DELTA REGION**

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**ABSTRACT**

The city moat was an important part of the city's fortification system in history and used to be one of the most typical landmarks in the city. At present, a large number of moats in the cities around the world still remain complete or partially. As an important cluster of places of memory in the city, the moat waterfront with the surrounding cultural resources has become important space for inheriting the collective memory of residents and reflecting the city's history and culture. The surrounding environment and functions of moats have, however, changed during the urban development, which made the moats unidentifiable in the modern urban settings. Therefore, how to clarify and interpret the connotational cultural value of urban moats with their places of memory is an issue of great practical significance. The paper introduces a methodology to collect, analyse and interpret information to identify the moat waterfront and their surrounding places of memory, to highlight their cultural significance. The first step is to constitute an inventory of the existing moat waterfront inside Changjiang delta region based on ancient text data and multi-temporal satellite photos; Secondly, a dataset of places of memory is constructed based on multi-source data, such as local chronicles, interviews. The last step is to create an interactive story map that contains historical information and cultural resources of each moat using GIS. This paper aimed to illustrate a scheme for a public-oriented visualized dataset, which is used to clearly present the detailed information of the moats, places of memory and their cultural value in the Changjiang Delta Region.

Corresponding Author: Shaoming Lu



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYSIS OF OPERATIONAL ASPECTS, ECONOMIC DEMAND AND PUBLIC SWIMMING POOL MANAGEMENT IN THE CZECH REPUBLIC**

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### **ABSTRACT**

Nowadays, a strong emphasis is put on a healthy lifestyle including sports, relaxation and active spending of free time. Municipalities in the Czech Republic, which act as independent legal entities having the right to manage their property and operate their funds, are often investors in construction of free-time facilities and become providers of the services aimed at the wellbeing of the population. Such facilities can be represented by indoor swimming pools, waterparks and wellness centres which are becoming increasingly popular and represent a trend in the needs of current society. Such an investment certainly results in the development of civic amenities and make both the municipality and the whole region more attractive. The indoor swimming pool construction is a demanding investment involving long preparation for its implementation and a lot of risks, which are significantly associated with technical and economic solutions that can significantly affect the final decision on the project acceptability. The main goal of the article is to provide the assessment of management and economic demandingness of the indoor swimming pools and waterparks operation based on the economic data obtained in the research survey carried out by the authors. The aim of the research is to survey, analyse and assess the management of indoor swimming pools in the Czech Republic. A questionnaire aiming at analysing the economic management of indoor swimming pools was distributed among individual providers or founders asking the respondents to fill in the basic information about the swimming pool, number of visitors, number of employees and data on economic activities for 2017, 2018 and 2019 years. This period was chosen intentionally as they were years not affected by the Covid-19 pandemic which subsequently significantly influences both the number of visitors and the economy. Eight indoor swimming pools operated by cities and municipalities were assessed using the data obtained from the questionnaires and other public sources. It was found out, based on this analysis, that all the assessed facilities struggle with operating costs and it is necessary to subsidize their activities from municipal budgets, often by considerable amounts which have an increasing tendency from year to year in most cases. It can therefore be concluded that the vast majority of public indoor swimming pools are at a loss each year, as not all costs can be covered by entrance fees. Exceptionally, large multinational centres, where entrance fees are many times higher, thrive.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **DEVELOPMENT OF AVERAGE PRICE OF WATER AND SEWERAGE CHARGES IN THE CZECH REPUBLIC AND ITS REGIONS - A CASE STUDY**

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### **ABSTRACT**

Water is perceived as a globally unsustainable resource that is indispensable for the life on Earth. Since the period of socialism, which saw a complete political upheaval in 1989, the price of water supplied and the cost of water disposed of through the sewerage system has increased several times. The impact of the increase in the price of water and sewerage charges was not due to the economic situation of the water companies but to the overall macroeconomic perspective of the state. After 1989, the legal form of the water management companies was changed from the state-owned companies to joint-stock companies. The water supply and sewerage disposal are public services, so the price of the water supply should be acceptable and affordable for customers. At the same time, however, macroeconomic indicators such as inflation have an impact on the price of water supply and sewerage. The authors of the article focused on the year-on-year comparison, determining the annual index of water and sewerage prices without VAT on a longer time axis of 2007-2020. This year-on-year comparison was observed both in the context of the average water and sewerage charges and within the individual regions of the Czech Republic. The year-on-year comparison was determined on the basis of the horizontal analysis method. In the corresponding years, when there was a higher increase in the price of water and sewerage charges, they identified the correlation with macroeconomic indicators such as gross domestic product, inflation, population and others. The correlation results were assessed from the qualified perspective. All data required for this study was obtained from the available websites of the Czech Statistical Office.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STRENGTHENING BUILDING STRUCTURES SUBJECT TO FIRE CONDITIONS ON THE EXAMPLE OF SELECTED CASES

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### ABSTRACT

Diagnostics of structures subjected to exceptional loads (exceptional design situation), such as fire, is a difficult and complex issue. It requires not only appropriate permissions, but also a lot of experience. It is necessary to estimate the parts of the cross-sections that were directly damaged, as well as a static and strength analysis in terms of meeting the ultimate and serviceability limit states determined by PN-EN 1995 [1]. The fire resistance of structural elements, which has traditionally been and is determined in fire tests, has become the subject of design and evaluation using calculation methods with the entry into force of the Eurocodes. As of March 2010, Eurocodes function in the Polish Standards system as the only valid standards in this regard - all previous Polish PN standards have been formally withdrawn from the set of current Polish Standards (however, they are still referred to (as an alternative basis) in the ordinance of the Minister of Infrastructure on technical conditions to be met by buildings and their location [2]). According to the authors, the basis for the assessment of the structure should be the period of its creation and creation, and this should be a determinant of the application of an adequate set of standards. The next stage of work on the damaged structure is the development of the reinforcement design. The paper presents examples of such damage, as well as the degree of danger to the structure, conclusions drawn and formulated in relation to fire-damaged wooden structures based on the presented case studies.

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## LOCK APPROACHES OPTIMIZATION TO IMPROVE WATERWAY TRAFFIC CAPACITY

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### ABSTRACT

The traffic capacity of a waterway on canalized rivers is usually determined by the transit time through the locks. Total transit time of a vessel through a lock is influenced by a number of aspects, including the time taken to open the lock gates, the time taken to fill and empty the lock and the time taken for vessels to enter and exit the lock. This paper deals with the optimization of lock approaches. If the navigation conditions in the lock approach are suitable, it is possible to ensure relatively easy manoeuvrability of vessels and the time interval to enter and exit the lock can be significantly reduced. The navigation conditions in the lock approach are influenced significantly by the flow conditions in the vicinity of the guard wall. The guard wall separates the lower and upper lock approaches from the gated weir and, if not designed appropriately, there can be significant flow velocity which tend to pull vessels toward the guard wall and weir. In addition to flow conditions, pilot experience, engine power and wind speed also affect the manoeuvrability of vessels in the lock approach. This paper presents a procedure to optimize the guard wall by achieving appropriate flow conditions in the lock approach using a mathematical 2D (depth-averaged) model. As a suitable measure, a flow-through multicell (ported) guard wall is proposed, which has flow openings between the cells designed below the draft level to limit the transverse flow velocity per vessel in the vicinity of the guard wall. The presented optimization procedure was verified on the case study of the Modrany lock in Prague (Czech Republic). The Modrany barrage was built in 1979-1987 on the Vltava River and at high flows the manoeuvrability of ships is considerably reduced with a decrease in the capacity of the waterway. The application of the proposed procedure led to the extension of the multicell guard wall with the application of flow-through openings. This solution made it possible to ensure significantly better flow conditions in the upper lock approach and was subsequently also verified in a physical model in the hydraulic laboratory. The implementation of this measure in situ is currently under preparation. The described technical solution has minimal impact on the architectural character of the lock and can therefore be used to increase the capacity of the historic locks on the Elbe-Vltava Waterway in the Czech Republic. The research was conducted as part of project no. DG18P02OVV004 entitled "Documentation and presentation of technical cultural heritage along the Elbe-Vltava Waterway" within a support programme for applied research and experimental development of national and cultural identity, funded by the Ministry of Culture of the Czech Republic.



## OPTIMIZATION OF THE LOW-HEAD HYDROPOWER INTAKE STRUCTURE

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### ABSTRACT

Barrages on watercourses are usually designed as multi-purpose structures that were built to navigate rivers for water transport, protect the area from flooding, enable water withdrawals and utilize the hydropower potential. In the layout of the low head barrage a run-of-river hydropower plants (HPPs) are usually designed. The efficiency of operation of HPPs is significantly affected by the barrage layout and by the velocity conditions in the intake structure. The efficiency of HPPs can be adversely affected by inappropriate hydrodynamic design of the individual elements, which include the coarse screens and the submerged wall as protection against coarse debris, the sill at the entry to the intake structure to exclude the bed material, the intake channel and the fine screens. If these elements are not properly designed, high pressure losses are generated, leading to a reduction in the efficiency of the HPP. In addition to pressure losses in the intake structure, the homogeneity of the velocity field in the inlet profile upstream of the turbines has been shown to affect the efficiency of the HPP. In the case of an inhomogeneous velocity field, flow disturbances occur which have a demonstrable impact on the efficiency of the turbines. Nowadays, the method of physical and mathematical modelling is often used for the hydraulic design of the suitable shape of the intake structure as well as other HPP elements. The present paper describes the use of 3D mathematical modelling for the optimisation of the intake structure of a low head HPP with respect to the homogeneity of the velocity field in the control profile upstream of the turbine inlet. There are a number of objective criteria for evaluating the homogeneity of the velocity field, which have been validated by measurements on real HPPs. The procedure is verified for the case of the HPP intake of the planned Děčín barrage on the Elbe River. Optimal velocity conditions were ensured by the use of guide pillars in the profile of coarse screens and entry sill. The resulting optimized shape was verified using the physical model. Currently, there are many HPPs at existing barrages with unsatisfactory hydraulic conditions in the intake area. The described technical solution for the application of guide pillars in the intake has minimal impacts on the architectural character of the barrage and can therefore be used to increase the efficiency of historic hydropower plants with high cultural value. The research was conducted as part of project no. DG18P02OVV004 entitled "Documentation and presentation of technical cultural heritage along the Elbe-Vltava Waterway" within a support programme for applied research and experimental development of national and cultural identity, funded by the Ministry of Culture of the Czech Republic.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EFFICIENCY OF ENERGY DISSIPATION DURING FILLING OF THE NAVIGATION LOCK

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### ABSTRACT

As part of the research focusing on the optimization of the lock filling, the minimization of the longitudinal force during the direct filling of the lock was tested. The longitudinal force was minimized by modifying the geometry of the stilling basin under the Tainter gate using CFD models. Four geometries of the stilling basin were tested using the geometry of the Děčín Lock. These CFD models were verified using data measured on a physical model. By modifying the geometry of the stilling basin, it is possible to reduce the longitudinal force caused by the momentum decrease in longitudinal direction of the chamber and the force caused by the impact of the filling jet against the bow of the ship. Research has shown that by optimizing the upper head and the stilling basin, the monitored forces can be reduced by up to 15 times. Although direct filling is designed for navigation locks with a low head (up to 3 m), this design of the lock head can be used for locks with a head above 5 m. It is possible to eliminate longitudinal force during direct filling of the lock without structural modifications, making it possible to increase the capacity of historic locks on the Elbe-Vltava Waterway (Czech Republic) without impacting the architectural character of the locks. The research was conducted as part of project no. DG18P02OVV004 entitled "Documentation and presentation of technical cultural heritage along the Elbe-Vltava Waterway" within a support programme for applied research and experimental development of national and cultural identity, funded by the Ministry of Culture of the Czech Republic.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **HYBRID MODEL OF THE LOCK FILLING/EMPTYING SYSTEM**

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### **ABSTRACT**

The paper describes the hybrid modelling of the design of the lock filling and emptying (F/E) system. It is a method of hybrid modelling, which combines physical and numerical modelling methods of flow. Hybrid modelling is mainly used to solve the hydraulic flow of a water complex in hydraulic structures. Optimizing and rebuilding the physical model is laborious and does not show all the results. The use of a numerical model allows to optimize only a part of the structure with using measurements on a physical model. The main advantages of hybrid modelling are the high reliability of results and the possibility of interpreting results that are not visible on the physical model. Within the project preparation of the Děčín lock, extensive research was carried out on the physical model of the lock. The aim of the research was to optimize the F/E system of the lock of long culverts. Based on the measurements on the physical model, an optimization of the filling system was necessary. Subsequently, the F/E system was optimized to reduce hydraulic losses using a CFD model. The optimized F/E system is up to 12% more efficient than the project preparation design. The hybrid modelling method can be used to increase the capacity of existing historic locks on the Elbe-Vltava Waterway (Czech Republic) without impacting the architectural character of the locks. The research was conducted as part of project no. DG18P02OVV004 entitled "Documentation and presentation of technical cultural heritage along the Elbe-Vltava Waterway" within a support programme for applied research and experimental development of national and cultural identity, funded by the Ministry of Culture of the Czech Republic.



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CORRECTED SIMPLE MODELLING OF TRI-LINEAR TRUE STRESS-TRUE STRAIN RELATIONSHIP FOR STRUCTURAL STEEL

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### ABSTRACT

Stress-strain model is an important component in the non-linear finite element analysis for civil steel structures. Although the detailed stress-strain relationship can be obtained from material tensile tests, this study aims to propose easy and simple modelling of the stress-strain relationship. The inspection certificate of an actual steel material can be usually obtained easy; however, it provides stresses of yield point and tensile strength and elongation only. The authors proposed an easy and simple tri-linear true stress-true strain model be adopted for a rough evaluation, not for a severe accurate evaluation. However, the model gives in the previous study higher stress from tensile strength to fracture point. Bridgman had clarified the difference between the equivalent stress and normal stress in the necked region due to multiaxial stress. This study focuses on the difference between the stresses, corrected the stress-strain model according to the difference, and checks the validity of the corrected model. To obtain the relationship between material mechanical properties, the results of the material tensile tests were corrected by the survey of previous research papers and reports. The relationships were obtained by regression analysis of the results of the survey. And, a material tensile test of structural steel was conducted to obtain an actual stress-strain relationship. The tri-linear true stress-true strain relationship was modelled based on the stresses of yield point and tensile strength from the tensile test and complemented values such as stress at fracture point and strains, which were obtained by the regression lines. The finite element analysis of the material tensile test was conducted to check the validity of the proposed model. From the analysis, the result of the previously proposed stress-strain model was a good fit until tensile strength, but the result of the stress between tensile strength and fracture point was higher than the model. Adopting the Bridgman correction to the proposed model, the stress of the model between tensile strength and fracture point was reduced. The reduction intends to reflect the multiaxial stress state to the model. The result of the analysis used the corrected proposed model was a good fit for the stress-strain model. And, the model was compared with the traditional n-th power hardening laws such as Hollomon, Ludwik, and Swift equations. The stress around the fracture point of the model was given higher than those of the n-th power hardening laws. Using the proposed corrected modelling, the tri-linear true stress-true strain relationship can be easily modelled stresses of yield point and tensile strength obtained from the inspection certificate of a steel plate.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EVOLUTION OF THE NATURAL STONE FACADE CLADDING SYSTEM

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### ABSTRACT

Natural stone has been used as a material for the cladding of façades throughout history for its aesthetic qualities and its constructive characteristics, which make it a very suitable material for this use. However, the way in which it is used has changed markedly in recent decades. The objective of the research is to study the evolution of this construction system from the claddings attached to the support, through the first ventilated façades fixed with mechanical anchors, to the current systems in which a substructure composed of metal profiles is used to transmit the loads to the structure of the building. This innovative solution provides numerous constructive, hygrothermal and environmental advantages, as well as enabling the designer greater compositional freedom. In addition, there are other aspects that favour the use of this solution compared to those previously used, such as improved efficiency and reliability, greater ease to achieve the flatness of the façade, greater protection of the insulation and the possibility of increasing its thickness or the possibility of replacing slabs independently. This study aims to analyze the implementation of the current ventilated façade system for natural stone cladding, focusing on its behavior and configuration compared to the previous ones. In order to facilitate understanding several examples of real cases are incorporated. The results of the research indicate that the origin of the ventilated system can be interpreted as a response to the behavioral and constructive problems generated by adhered claddings, highlighting several defining aspects for its formation: separation of the cladding from the support and disappearance of the mortar layer; separation of the slabs from each other so that they work independently; increased regulatory requirements in terms of thermal and comfort requirements; and technification of the anchoring systems. In conclusion, it can be highlighted that the system has evolved to adapt to new construction requirements, regulatory and architectural demands. The evolution of natural stone ventilated facades allows the planner to innovate from the points of view of materiality and technology, which makes it a leading system that combines functionality and aesthetics.

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## THE APPLICATION OF NEW TRANSPORT-ENGINEERING APPROACHES IN THE DEVELOPMENT OF PUBLIC SPACE

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### ABSTRACT

The article presents two significant localities in Prague, Czech Republic, where new complex approaches of urban and transport engineering in public space will be applied. The paper will present important urban planning measures and specific proposals for the solution and incorporation of transport into public spaces, which will lead to the calming of the automotive transport and also its fluidity will be maintained. Furthermore the requirement for public transport, bicycle transport and above all to necessary pedestrian relations will be reflected. Integral part of the basic preparation is the economic and transport-engineering analysis, which generally fits into urban planning in given localities. Results of these analyses would be projected to prepared plans and actual projects from praxis. The text of the article would be focused mainly on the localities in the phase of project studies in Prague, specifically in Vyton and Hlavka bridge. The Vyton area is a busy set of intersections and tram transport and adjoining public transport stops, as well as important transfer and pedestrian connections. The reconstruction of the railway bridge is being prepared in this territory and the construction of new railway station with transfer relation to tram transport and ferry is also related to it. There should be also a pedestrian zone, which will contribute to the urban character of the area and safer connections for pedestrian destinations and transfer relations. Within the project, it was necessary to address not only all the present means of transport – automotive, trams, railway, bicycle, ferry and pedestrian movement, but also static transport that has an impact on the character of the district. The second locality, which was dealt with from the economic and transportation point of view was northern forecourt of Hlavka bridge, which is significant traffic intersection. At the same moment, there is an important public transport hub with transfer relation between underground line C and the trams. Apart from the maintaining the transport function of this node, the challenge of the urban approach is to deal with pedestrian connections and bicycle transport in two height levels, which means elevation in very cramped conditions. In the future there should be built a new building of Philharmonic, which will completely change the transport functioning of the area. These new heavy relations would be essential to resolve with the complex point on view and with wider impacts to the closest surrounding of local roads, but even to the through road of the city from north to south and contrariwise according to the traffic requirements. The goal and focus of this article is to present issue of two significant localities from several points of view – from economic to transport-engineering and urban applications within public space, which has fundamental impact on the inhabitants of not only given areas, but also of wider territorial and transport effects in development of public spaces and transport constructions in Prague.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## VERIFYING THE SHEAR LOAD CAPACITY OF HORIZONTALLY REINFORCED MASONRY WALLS BY THE $V_{Rd}-N_{Ed}$ INTERACTION DIAGRAM

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### ABSTRACT

The article is a continuation of the problem of checking the load-bearing capacity of stiffening walls using the  $V_{Rd}-N_{Ed}$  interaction diagram, which was started at the WMCAUS 2021 conference. The article deals with the problem of reinforced masonry walls. Reinforcement in masonry structures is to increase the resistance to cracking and improve the load-bearing capacity. Reinforcement in masonry structures can be placed vertically and horizontally, vertically or only horizontally. The wall bearing capacity  $V_{Rd}$  depends not only on the geometrical and mechanical characteristics of the amount of reinforcement, but also on the acting loads. The paper presents the rules for checking the bearing capacity of reinforced masonry walls loaded horizontally and vertically using the provisions of the EN 1996-1-1: 2010 standard and the Eurocode 6 draft (prEN 1996-1-1: 2017). According to the provisions of the standards, three methods of reinforcement can be distinguished: the V method, when only vertical reinforcement is present, the VH method, when there is vertical and horizontal reinforcement, and the H method, when only horizontal reinforcement is used. In each method, we can additionally distinguish cases a, b and c, which differ in the course of normal stresses in the crack. The article focuses only on the H method. Sample interaction charts of a horizontally reinforced wall cross-section are presented and which factors significantly affect the load-bearing capacity of a horizontally reinforced masonry wall are discussed.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## LOAD-BEARING CAPACITY OF MASONRY WALLS INFILLED FRAME

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### ABSTRACT

The walls inlling frame play a non-structural and structural role. The non-structural role is to provide a visual, acoustic and fire barrier. On the other hand, the structural role of inlling walls comes down to fulfilling the role of stiffening and protection against external influences. The paper presents a proposal of an algorithm for the design of stiffening masonry walls according to the European design standards EN 1996-1-1: 2010 and the project Eurocode 6 (prEN 1996-1-1: 2017). At the outset, the provisions of various design standards in force in Canada and the USA are presented. Due to the lack of applicable European standards for determining the strength characteristics (wall resistance to diagonal compression and diagonal tension), an algorithm for checking the shear capacity was proposed. It was assumed that the shear limit state can be checked assuming that the compressed diagonal has a variable width resulting from the change of the width of the compression zone and with the diagonal of a constant width. Using the provisions of the standards: EN 1996-1-1: 2010 and prEN 1996-1-1: 2017 and CSA S304.1-04:2004, the ultimate limit state conditions for both design methods were formulated.

**THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE INFLUENCE OF THE HEIGHT OF VERTICAL PIERS ON THE TOTAL STIFFNESS OF MASONRY STIFFENING WALLS**Krzysztof Grzyb <sup>1</sup>, Radosław Jasiński <sup>2</sup><sup>1</sup> Silesian University of Technology, Department of Building Structures, Akademicka 5, 44-100 Gliwice, Poland<sup>2</sup> Silesian University of Technology, Department of Building Structures and Laboratory of Civil Engineering Faculty, Akademicka 5, 44-100 Gliwice, Poland**ABSTRACT**

Properly designed stiffening walls should reduce displacements (eccentricities) and safe transfer of horizontal shear forces to the foundation. The load may be caused by the action of wind on structures or the uneven subsidence of the ground. Although the stiffening elements ensure the geometric constancy of entire buildings, there is still no clear-cut regulation allowing the distribution of loads between the individual stiffening parts. In the literature, it is most often recommended to determine the values of shear forces and bending moments in proportion to the structure's stiffness - however, there are no clear guidelines for its determination. The total stiffness method (presented by the authors at the WMCAUS 2021 conference) estimates the stiffness of solid stiffening walls and walls with openings. The wall stiffness is calculated as the reciprocal of the total wall displacement under the action of a horizontal load. The equivalent stiffness is the sum of the stiffnesses of the masonry fragments. The necessity to divide the wall into components is most often due to the presence of window or door openings. There are horizontal lintel strips and vertical stiffening fragments in the plane of each wall. The shear wall can be calculated in two static schemes - fixed on both sides or cantilever. In calculations, the height of the vertical wall fragments is most often taken as the total height of the pillar based on the building geometry. Such an assumption would be valid only in the linear-elastic range of the building's behaviour. However, the cracking stresses in the masonry structure account for about 30% of the value of failure stresses. Cracks and damage to the wall, which may appear even at low stresses, cause a rapid decrease in the structure's stiffness. Experimental studies confirm that cracks and damages increase width before the building is destroyed under a horizontal load and cover an increasingly more extensive wall area. The actual height of the vertical pillars, and thus the total stiffness of the shear wall, is different than in the calculations that do not take into account the effect of the reduced stiffness. The paper proposes an experimental determination of the height of vertical inter-hole pillars in the stage before cracking the central part of the wall. Based on the author's research on a single walls and small building (low rise) with an uncomplicated shape, the actual height of the vertical fragments of the stiffening walls was analyzed. The test walls and building consisted of autoclaved aerated concrete (AAC) masonry units. The analyzes were devoted to monotonically loaded masonry structures. A hydraulic actuator applied the horizontal load at the level of the slab. The reduction of the height of vertical piers assumed in the calculations was based on the analysis of the walls cracking morphology and patterns.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INCREASE IN CRACK RESISTANCE OF BENDING REINFORCED-CONCRETE ELEMENTS BY LOCAL DISPERSAL REINFORCEMENT OF THE TENSILE ZONE

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### ABSTRACT

Reinforced-concrete is used for the production of a wide range of constructions, including the structures which resist bending (beams, slabs, crossbars, etc.) as the most popular ones. Concrete is known to be well resistant to compressive stress, while its tensile strength is 10 to 15 times less than its compression strength. In this regard, common world practice proposals provide for the application of layered arrangement of concretes with different strength in height of the cross section for the efficient use of the mechanical characteristics of the materials. Such concrete layers can be arranged depending on the purpose and conditions of the performance of the structures: in some cases, it is expedient to use concrete of greater strength in the compressed zone, in others - in the tensile zone (for example, if it is necessary to have constructions with increased cracking resistance). It is proposed to arrange a layer of concrete with dispersal reinforcement by means of steel fiber in the tensile zone in order to increase the crack resistance of ordinary bending reinforced-concrete elements. The stress-strain state of the cross section of bending elements has been substantiated, thus the force equilibrium formulas which perform in the cross section have been obtained as well as the formula for determining the moment of crack formation of the bending element. A numerical designed experiment has been performed, which has confirmed the possibility of using dispersal reinforcement in the tensile zone in order to increase its cracking resistance, which can be raised by a factor of four.

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## CHANGING THE POSITION OF THE NEUTRAL LINE OF BEAMS MADE OF GLUED WOOD IN CONDITIONS OF OBLIQUE BENDING

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### ABSTRACT

The practice of designing building structures in particular wooden shows that bending is one of the most common types of stress-strain state. The straight bend of the beams of glued wood is well-studied and represented today by scientific investigations. The purpose of this work is to study the motion of a neutral line of beams made of glued wood for the effects of one-time loads under oblique bend. In this paper experimental studies of glued wooden beams for oblique bend at different angles of inclination are carried out. The results of experimental and theoretical studies of glued beams, in particular the position of a neutral line in the conditions of oblique bend under the action of one-time loads are presented. In order to compare the experimental values of the position of the neutral line with the theoretical in the conditions of the oblique bend, the calculation of the beam was performed using the finite element method. The graphs of changing the position of the neutral line at different levels of load of glued beams are presented. The neutral line of glued beams during the increase in load changes its position in the direction of increasing the area of the compressed section of the section. Theoretical calculations by the formulas of the resistance of the materials show that the neutral line does not depend on the value of the external load and occupies a stable position according to a certain angle of inclination whereas in the real conditions, due to the elastic and plastic properties of the wood and the increase of the load, the neutral line for the oblique flexion changes its position.

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## THE PARADOX OF THE BEAUTIFUL OR THE ART PARADOX

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### ABSTRACT

The paradox is inherent in many works of art of the twentieth century. Particularly clear, the paradox in art showed its essence in the beginning of the 21st century, when distorted reality, problems of meaning, unusual attitude to reality broke down the stereotypes of life established by centuries and could express their essence through an enigma. The paradox always attracted to itself with its non-standard and protest nature. The protest in each era manifested itself in different axonometric projections of human being. Art is a shadow of reality that the artist throws at the object of description according to the angle of his talent. Interest in paradox in works of art testifies to the corresponding psycho-emotional state of society, it reflects reality in its artistic colors, as well as clearly demonstrates the specificity of perception of reality, the way of demonstrating the spiritual world and the level of comprehension of being. The purpose of this study is to trace the influence of art as a manipulative factor in the presentation of reality and the influence of the subjective creative view of an artist on the change of aesthetic categories that have formed in society as classical. The thesis that architecture reflects the general function of culture in soothing and restoring spiritual peace for modern post-industrial society is not sufficient to satisfy the emotional perception of space. To achieve the multidimensionality of the viewer's interpretations required of contemporary art, architecture resorts to a manipulative method of reflecting the reality of the spatial environment.

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## FINITE ELEMENT MODELLING OF A CAPACITIVE STRESS SENSOR

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### ABSTRACT

Safety, functionality, durability, and robustness are the main features that buildings and infrastructures must guarantee over time, despite being progressively subjected to aggressive environmental conditions and the aging of materials. One of the most effective methods to check the efficiency and safety of structures is Structural Health Monitoring (SHM), which allows the measurement of the stress state inside solid bodies made with building materials like concrete or masonry. In most cases, the strains on the external surfaces of the structure are evaluated using strain gauges or optical fibres while internal stresses are commonly measured using flat jacks. Two new types of stress (force) sensors to be embedded inside concrete or masonry have been conceived and patented in recent years: a ceramic sensor, based on piezoelectric principles, and a capacitive one. This work aims at studying the capacitive sensor through finite element simulations, with the scope of evaluating the best internal geometry able to guarantee the reliability of the measurements. In fact, such sensor is subjected to sustained loads over a long time, considering slow phenomena, like concrete (or mortar) shrinkage and creep. The simulations highlighted the capability of the sensor to withstand typical loads of buildings under serviceability conditions and the almost neglectable effect of the rheological phenomena of the concrete or mortar on the sensor measurements. The optimal internal configurations for the reliability of the measurements have been identified.

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## **STRUCTURAL HEALTH MONITORING OF A PRESTRESSED CONCRETE GIRDER BRIDGE DECK USING CLINOMETERS**

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### **ABSTRACT**

In recent years it has become clear that many structures belonging to Western Countries infrastructural heritage require accurate monitoring, to highlight any safety deficiencies aiming to achieve a better programmed and more efficient maintenance. Structural Health Monitoring (SHM) can be divided into two approaches: static and dynamic. Static SHM is based on the measurement of displacements and rotations and/or strains regardless of the dynamic behaviour of the structure. One of the most diffused techniques used in structural monitoring is the measurement of angles (rotations) using clinometers. Signal processing techniques can improve the instruments' accuracy reducing signal noise. This paper presents a survey of a SHM experience on a span of a highway viaduct using clinometric sensors. The data coming from the instruments are processed by means of an algorithm written in Python. The output of the sensors are processed with the aim of cleaning the signal from different forms of noise. The purpose of the monitoring installation is the detection of a possible damage occurring to the bridge beams. In order to appreciate the effect of such damage on rotations very precise measure are needed. The instantaneous rotations due to the by traffic are too quick to allow the needed precision and therefore are treated like noise and removed from the signal. The instantaneous thermal variations on the sensor due to ambient temperature and electric power dissipation, and the daily temperature variations of the bridge itself are also searched in order to clean the signal from their effect.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**IMPLEMENTATION OF PRACTICE-BASED METHODOLOGIES INTO ARCHITECTURAL EDUCATION:  
CASE STUDY - UNIVERSITY OF SARAJEVO – FACULTY OF ARCHITECTURE**

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**ABSTRACT**

In architecture education worldwide, there is an old but perpetual debate on how to integrate practical learning in the academic program. In recent times, introduction of problem-based and project-based learning (PBL) has been highly praised approach because it empowers the students to deal with real-life problems. Like many other higher education institutions which strive to improve their curricula, the Faculty of Architecture University of Sarajevo examines various modalities of integration of practice into formal education. The curriculum has evolved from a predominantly theoretical framework and working with abstract assignments to recognizing and adequately responding to up-to-date topics and real social problems. However, there is a noticeable institutional inertia that impedes the timely response of the academic community to urgent challenges and changes in society. In an effort to eliminate the identified shortcomings and improve the education process, the Faculty of Architecture University of Sarajevo, has undertaken a number of activities in cooperation with partner institutions in Bosnia and Herzegovina and the EU, resulting with critical assessment of the status quo and developing guidelines for future actions. Following the implementation of the international research project "HERD" 2013-2016, energy efficiency and sustainability topics have been incorporated in several courses. As a result of the capacity building of the teaching staff and their continuous training, the project "Typology of residential buildings in BiH" was successfully implemented. The long-term outcomes of this project are of national relevance, as it assists the government in creating strategies for implementing energy efficiency in the housing sector, while the research results can be easily utilized both by the individuals and society as a whole. Examples of cooperation with the industry also serve as an illustration of possible ways to improve the quality of education and raise the competencies of the students. The aim of this paper is to present the importance and modalities of incorporating the practical component into the process of architecture education and actualization of global topics in the local context. It is also necessary to point out the shortcomings in the existing academic procedures on different levels, and the need of valorisation of extracurricular activities. The previously gained experience and examples of good practice should support all stakeholders involved in the educational process: from academia, the industry and the professionals, to the wider community. Such shared endeavours can significantly contribute to a better learning environment and application of acquired knowledge and skills.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## APPLICATION OF WOOD-STEEL HYBRID SYSTEMS – STRUCTURAL CONCEPTUAL DESIGN IN URBAN TRANSFORMATIONS

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### ABSTRACT

This paper deals with the problem of load-bearing capacity and deformability of wood-steel hybrid systems, depending on the selected system constellation, and the possibility of increasing system efficiency and in real conditions by applying pre-stress, in accordance with modern principles of structural conceptual design. The subject of the research is the behaviour of pre-stressed glued laminated beams with external polygonal ropes, different researched constellations, i.e. strut type hybrid systems, in real conditions. The paper is practically divided into three methodological units: theoretical and numerical analysis, and examples of practical applications, and on the theoretical basis of urban transformations of historical units. Theoretical assumptions, as well as the current and own approach to the analysis of parameters, set the theoretical basis for the analysis of these systems and the possibility of applying numerical methods in practice. Parametric analysis of the hybrid system obtained practical expressions and diagrams for use in practice, needed to determine suitable constellations of strut type hybrid system by different geometric characteristics and pre-stressed hybrid system, and for different percentages of wooden girder moisture. In order to compare these systems, the same assumptions were used for the calculation, namely: plane behaviour of the system, and to determine the effective pre-stressing, the condition of annulment of vertical deflection in characteristic cross-sections was used, i.e. achieving the effect of vertical immobility of the struts, from which the measure of pre-stressing of the deformable system was obtained. A hybrid system with a wooden girder, which has bending stiffness, is often used in construction, and the main disadvantage of such a system is the expressed deformability in real operating conditions. The basic thesis of this paper is that by external pre-stressing of glued laminated girder achieves less deformability and increases bearing capacity, while saving base material in real conditions, and is confirmed by our own parametric analysis and laboratory testing of pre-stressed hybrid systems of different constellations. The attached parametric analysis diagrams provide a sufficiently accurate orientation for finding the correct constellations of wood-steel hybrid systems and the possibility of estimating the efficiency of hybrids in real conditions, as well as the necessary pre-stressing applications. The derived expressions of the approximate procedure and the expressions for finding the effective pre-stressing force, assuming the linear behaviour of the system, give sufficiently accurate results for the design of pre-stressed hybrid systems in practice. Also, with this or similar methodology it is possible to qualitatively investigate hybrid systems with different combinations of materials. The presented conceptual solutions for the integration of hybrid systems and modern materials in specific localities represent a contribution to the development of a methodological approach to the transformation of historical urban units.

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## WIND FLOW CFD SIMULATION OVER THE BUILDING ROOFTOP

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### ABSTRACT

This paper focuses on the wind flow over the building flat roofs which values can be used for determination of the energy potential for the small wind power plants. The wind flow is analysed on the roof of the office building in the scientific centre and detailed 3D Computation Fluid Dynamics (CFD) models of the air flow over the real terrain profile with the office building were created. High attention is paid to input boundary conditions namely to the wind velocity, wind direction and to the roughness of the surfaces. Also, because the main factor that influences the accuracy and computational expenses of the CFD simulations is the size of the computational domain, the computation model of the terrain and space was optimized to preserve maximum accuracy according to contour map of the terrain. The attention was also paid to minimization of resulting wind flow deformation. There are used data from the long-term measurement from meteorological station of the building rooftop. In this paper are compared resulting wind flow fields from two variants of the office building surroundings. Model A contains replacement of the buildings from the surrounding scientific grounds in the considered zone by coefficient of roughness according to Davenport-Wieringa and model B includes real shape of the surrounding buildings as bodies. The resulting computed wind flow above the rooftop of the building is in both cases verified by the outdoor measurement of the wind velocity. The resulting findings, especially processed images of the wind flow fields, can be used to optimizing of the wind power plant location on the building rooftop and contribute to the expansion of the microgrids and energy self-sufficiency of the buildings.

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## INTERCULTURAL IMPACT OF CZECH ARCHITECTS ON ARCHITECTURAL DISCOURSE AND EDUCATION IN BOSNIA AND HERZEGOVINA

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### ABSTRACT

Intercultural impact on architectural discourse and education is currently very evident and beneficial, as we are instantly engaged and intertwined in this contemporary globalized world. However, beginnings of these intercultural exchanges in previous centuries have had profound effects on European culture and cityscapes, and sometimes intensely influences its outcomes even today. One such encounter is presented in this research, a respectful and meaningful meeting of cultures that resulted in unique architectural style and educational paradigm. Austro-Hungarian occupation, followed by the formal annexation of Bosnia and Herzegovina (1878.-1918.) is a period of profound social changes, after centuries of feudal order, best reflected in architecture and education. Among others, Czech architects have arrived with the new Monarchy to live and work, and each left a personal, stylistically different mark to the architectural mosaic of the country. At the beginning of their careers, they encountered an oriental culture, that they wanted to transform and adapt to Central European spirit and lifestyle. Karel Pařík, as author of numerous structures, stayed mostly within the domain of interpretations of eclecticism, while Karel Panek and František Blažek make a step towards new fresh fin-de-siècle style. Synonym for Art Nouveau movement is Alphonse Mucha, who by painting murals in pavilion of Bosnia and Herzegovina for 1900 Exposition Universelle in Paris, got international attention to country's Slavic roots and their new European identity. Deep impact is left by Jan Kotěra, an architect that designed a building, a sort of a prelude of early modernism in Sarajevo. Architect Josip Pospíšil, has immersed himself deeply into the essence of ottoman vernacular building, and became one of the pioneers in creating a unique merged Bosnian style. He will be followed by many protagonists of very recognizable Sarajevo School of Architecture in the second half of the 20<sup>th</sup> century. Besides successful careers, most of these architects take an active role in cultural, social and specially in educational development of Bosnia and Herzegovina. This paper explores this link, initiated by Technical High school in 1889, with Czech architects as lecturers. After the First world war some of these students continue their education on Czech High Technical school in Prague. This is a core group of four individuals that established the first Technical University in 1949 with Architecture and Civil Engineering as key departments. The paper explores this multicultural link and emancipation role of the Czech architects on formation and profiling of specific architectural language and education at Faculty of Architecture in Sarajevo.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DEVELOPMENT AND CHALLENGES OF THE ELBE-VLTAVA WATERWAY IN THE 21<sup>st</sup> CENTURY

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### ABSTRACT

As part of the National and Cultural Identity Programme administered by the Ministry of Culture of the Czech Republic, the project "Documentation and Presentation of Technical Cultural Heritage on the Elbe-Vltava Waterway (EVW)" has been underway since the year 2018. The project systematically surveys the historical development of EVW navigability since the beginning of the 19<sup>th</sup> century. The paper focuses on reconstructions and refurbishments that have been realized in the 21<sup>st</sup> century and discuss the future challenges of this unique waterway. Technical modifications in the infrastructure of the waterway are compartmentalized into four main categories. Firstly, they are the modernization of the technologies of locks and hydroelectric power plants built more than 80 years ago. The second category encompasses the construction of new hydropower plants in localities where the energy potential has not yet been used. The installed capacity at the EVW has increased by more than 30 MW of renewable energy during the last 20 years. The third category contains improving parameters and capacity of the waterway. That covers modifications of the fairway and increases underpass heights under bridges. The last group contains the constructions of new recreational berths, which complement the existing infrastructure on the waterway and opens up the opportunity for more intensive recreational use. Concerning further expected development, other investment projects to increase the potential use of the Elbe-Vltava waterway are preparing. The presented future projects at EVW represent a unique social challenge and help to fulfil the meaning and purposes of sustainable transport infrastructure built for more than 150 years.

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## THEORETICAL PREDICTIONS OF BENDING AND SHEAR CAPACITY OF CONTINUOUSLY SUPPORTED BEAMS REINFORCED WITH LONGITUDINAL GFRP REINFORCEMENTS

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### ABSTRACT

The use of Fiber Reinforced Polymer (FRP) bars as an alternative to steel reinforcements in concrete structures has significantly increased over recent decades. One of the reasons is the high corrodibility of steel, which leads to the degradation of concrete structures. Continuous concrete beams are extensively used elements in structures such as parking garages and overpasses, which are exposed to extreme weather conditions and the application of de-icing salts. Therefore, the use of FRP bars in these types of structures has become a feasible alternative to overcome steel-corrosion problems. This paper presents an analytical study of the bending behaviour of continuously supported beams reinforced with locally accessible longitudinal Glass Fiber-Reinforced Polymer (GFRP) bars. The section analysis of GFRP reinforced concrete (RC) is based on the section analysis of concrete reinforced with conventional steel with application of special assumptions for GFRP RC. Due to the linear-elastic behaviour up to the failure of the FRP materials, the ability of GFRP reinforcement to redistribute loads and moments in continuous beams is questionable. As the reinforcement configuration plays an important role in the moment redistribution precise theoretical prediction of the bending and shear capacity is crucial.

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## INFLUENCE OF RECYCLED AGGREGATE CONCRETE ON RESISTANCE OF COMPRESSION MEMBERS

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### ABSTRACT

Volume of waste is rising worldwide at an alarming rate. Large part of it (approximately 30%) is generated by construction industry. Recycling construction and demolition waste (CDW) have many environmental benefits – we can avoid vast landfilling of usable materials and furthermore we can reduce the extraction of the raw resources. CDW consists of heterogeneous mix of materials in which the largest portion (approximately 70%) is concrete which is also the main subject of our study. In this article we present main aspects that need to be considered while designing elements from recycled concrete. We summarize changes in properties of this type of concrete and look at the state of art in this area. Numerous studies have been performed to investigate various characteristic of recycled aggregate concrete (RAC). In general RAC exhibit lesser performance compared to concrete manufactured with natural aggregate (NA). Focus of most studies is aimed on mechanical and durability properties of RAC and the major portion of tests is concentrating on small scale samples. We want to contribute to understanding of RAC with our experimental program. We plan to make full scale columns using RAC. Cross section of proposed columns will be 150 mm x 240 mm and planned height is at 3,8 m. It will be reinforced with 4 reinforcement bars with a diameter of 14 mm and stirrups  $\varnothing 6$  at a mutual distance of 150 mm. Load will act on eccentricity of 40 mm from the centre line considering smaller dimension of the cross section of column. There will be various replacement levels tested – 30, 60, 100%. This will be compared with columns made using concrete entirely with NA.

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## PARAMETRIC STUDY ON STRENGTHENING SLENDER REINFORCED-CONCRETE COLUMNS

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### ABSTRACT

Columns are subtle vertical load-bearing members, designed with a high degree of utilization of their design resistance. They are efficiently used especially in buildings, where it is a requirement to create free dispositions. Their disadvantage is that they have only a small reserve in resistance, so it is often necessary to proceed to their renovation or strengthening. The requirement for strengthening may be based on the need for repair of a structural failure, to repair mistakes during design or construction, but also on the need for an increase in the resistance of existing structure resulting from a change in its load. There are several methods to choose from, when the strengthening of a column is needed. Traditional methods include enlargement the original cross-section with the addition of concrete or structural steel members. These solutions increase the compression as well as the bending resistance of the column, but there is a significant increase in the cross-section area of the column. Newer methods use progressive materials that allow the required strengthening to be achieved with lower or almost zero cross-sectional enlargement. These methods include the application of FRP composites, but also the use of FRC or ferrocement. Mostly CFRP (Carbon Fibre Reinforced Polymer) strips and sheets are used for strengthening. The strips can be installed by NSMR or EBR method. They serve as additional tensile reinforcement. Sheets can also be bonded in the longitudinal direction as an additional tensile reinforcement, but more often they are applied in the transverse direction in the form of stirrups or helices, thus creating a wrap around the column. When column is then loaded with an axial force, the sheets prevent transverse deformation, a spatial state of stress occurs, which leads to an increase in the compressive strength of concrete. In addition to CFRP sheets, FRC or ferrocement can also be used for wrapping. This article deals with slender columns strengthening. The simple parametric study compares the influence on column resistance by the change of following parameters: concrete compressive strength, amount of reinforcement in the cross section, and amount of reinforcement added to the cross section surface, the results are presented by means of interaction diagrams of the column cross-section and the interaction diagrams of the column taking into account second order effects. The comparison shows that for slender columns a more significant increase in the resistance of the column is achieved by adding longitudinal reinforcement. The increase in the strength of the concrete (achieved by wrapping) has only a minimal effect on the resistance increase of the column.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## REVALUATION OF CONSTRUCTION PROJECTS USING STATISTICAL DATA

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### ABSTRACT

The decisive parameter of every project is its price and its adequacy to the expected benefits. The investor decides whether to implement the project or withdraw from it based on its calculation. He makes a so-called investment decision. The planned goal of the project and its duration are relatively constant parameters. The most expensive part of a construction project is the construction work implementation. The price is determined by the budget, that is, by valuing the bill of quantities of individual structures and works. Many months or years can pass between the moment of the construction appreciation and its actual implementation, especially for large projects. The current price of resources used at the time of implementation is affected by the fluctuation of the price level, especially of building materials and built-in products. Therefore, the final price of the construction project may differ significantly from the budget price. A suitable tool for the correct determination of the price of the construction structure and works implemented is the adjustment of the budget price by multiplying it by a coefficient that reflects the price level development - the so-called price index. The use of a reliable source of indices ensures that the investor does not overpay for the project (the price is not excessive) and that the contractor does not lose money (makes the expected profit). In the Czech Republic, the Czech Statistical Office calculates and publishes quarterly price indices for construction structures and works. The contracting parties (the client and the contractor) may agree on the exact conditions for the use of price indices in the construction contract. This concerns in particular their structure according to the classification used and the determination of the time interval between the budget calculation and the invoicing for the work carried out. The article describes the methodology of surveying construction work prices and calculating price indices by the CZSO and the structure and periodicity of their publications. Furthermore, a method of using price indices to update billing prices is proposed. The development of the prices in the last few years is shown in the examples of specific construction structures. The paper is extended by the results of a questionnaire survey in construction companies aimed at finding out whether and how they use construction price indices.

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## ANALYSIS OF DAMAGE CAUSED BY A NATURAL DISASTER WITHIN MUNICIPALITY

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### ABSTRACT

This article deals with the analysis of damage caused by a natural disaster in the municipality of Hrušky in South Moravia in the Czech Republic. In June 2021, a strong storm swept through South Moravia, resulting in a tornado, leaving behind a devastated landscape and destroyed real estate. The article focuses on a detailed analysis of the damage to the most affected buildings owned by the municipality of Hrušky - namely the main buildings of the Kindergarten and Primary School. The analysis presented in this article is processed as a support to the representatives of the municipality with fast and high-quality mapping, detection and summarization of damage. The main output is a list of construction works, which shall serve as a basis for the financial quantification of damage to individual buildings. Further use of processed material is in the process of the municipality application for the state subsidy programmes. Last but not least, the output of the analysis is intended to be used to create documentation for the management of the renewal of the municipality, such as the financial plan, schedule, matrix of responsibilities and structural plan. The analysis shall thus significantly contribute to the effective and transparent repair management of the municipality property. The analysis presented in this article consists of three consecutive steps: identifying the most affected buildings in the municipality ownership, collecting data, its analysis and compiling the analysis results - a list of works necessary for the restoration of the affected buildings. Qualitative approaches to data collection and evaluation were used, specifically in-depth interviews related to the issue. The mayor and the representatives of the municipality and the representatives of construction companies conducting local investigations on the examined constructions were involved in in-depth interviews. Project documentation provided by the Hrušky municipal office and information from local surveys represented an additional basis for the analysis. The research described in the article aims to contribute to a faster return towards the normal life of the municipality.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**HYBRID HOUSING AT THE INTERFERENCE BETWEEN THE URBAN AND THE RURAL IN ROMANIA -  
THE POLITICAL AND ECONOMIC INFLUENCE ON HOUSING FORMS AND LIFESTYLES**

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**ABSTRACT**

Hybridization has become a popular topic in the contemporary culture research, and the process of globalization has contributed to the emergence of heterogeneous processes that have led to the manifestation of hybridization in all fields. In this article, we will look at a hybrid type of housing situated at the interference between the urban and the rural, which appeared since the twentieth century in Romania and that we filtered through the urban models defined by Françoise Choay. These models, inspired on the one hand by the belief in progress (the progressive model), and on the other by the nostalgia for the past (the culturalist model), are identifiable in the way cities and villages have developed in Romania in the last century. Even before the First World War, there was a concern and an intention to align housing policies in Romania with the European trends influenced by the emergence of garden cities, which came as a solution to the chaotic and unhygienic development of cities caused by the increasing industrial production. The culturalist approach of the housing development lasted until World War II, when the communist regime came with new housing policies that led to housing production in the sense of the progressive model. The communist period was characterized primarily by a policy of industrialization of the country, which led to a strong urban dynamic and a movement of migration from the village to the city. The forced relocation of the peasants in the city determined a ruralisation of the city by the way in which the living space was appropriated by the new inhabitants. Paradoxically, the city was ruralized, while at the ideological level the urbanization of villages was required. Post-communist and contemporary housing questions the validity of these classical urban models, the possible alignment of concepts like sustainable development or low-tech city with their principles or the need to define new ones. The characteristics of housing promoted by each period (type, size, location, construction materials) translate a paradigm shift of social transformations, environmental conditions, and residential areas, and analysing the housing stock dynamics in different historical periods in urban and rural areas at different administrative-territorial scales allow the identification of housing production mechanisms. The production of housing determines certain architectural forms, which, in turn, influence the lifestyle of the inhabitants, and these new lifestyles end up having an impact on the production of housing. Hybridization is visible both in terms of architectural form and lifestyle and the challenge is to determine the productive discrepancies of these three layers: production (politics and economics), architectural form and lifestyle.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ECLECTISM AND IDENTITY. CULTURAL LANDMARK ARCHITECTURE IN BUKOWINA IN 19<sup>th</sup> AND 20<sup>th</sup> CENTURY

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### ABSTRACT

Bukowina was the most eastern province of the Austro-Hungarian Empire. This territory was part of Austria between 1774 and 1918. The transition to Austrian rule marked the beginning of a modernization process and synchronization with Western civilization for the entire province. The whole region is experiencing rapid population growth, especially through massive immigration. Ukrainians, Romanians, Germans, Jews, Poles, Armenians, etc. will make Bukowina a multiethnic and multi-faith province, but especially a multicultural one. This aspect can be best observed in Czernowitz, the former capital of Bukowina. During the two centuries of the empire, these ethnic communities underwent a similar process of development from the dominance of religious identity to the development of a clear national identity. Since the middle of the 19th century, the national communities of the city have been intensively building a network of cultural and educational institutions, which included private national schools, orphanages and scholarships; singing, educational, student, sports and shooting public organizations; magazine editors; financial institutions, etc. The most active of the ethnic communities built so-called "National Houses". In Czernowitz during that period are built: Український Народний Дім / Ukrainian People's House; Palatul Național Român / National Romanian Palas; Dom Polski / Polish House; Jüdisches Haus / Jewish House; Deutsches Haus / German House. All these buildings are still present today and are inscribed on the list of historical monuments of local importance. This article is dedicated to buildings that at the end of the 19th century and beginning of the 20th century represented the centers of cultural and educational organizations and activities of different ethnic groups in Czernowitz and the whole of Bukowina.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## REGIONAL URBANISM IN SOUTHWEST LOUISIANA

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### ABSTRACT

Several small towns situated throughout southwest Louisiana developed a clear urban form influenced by their rich cultural mix of French and Acadian, native American, and Creole populations. Southwest Louisiana also has an incredible landscape filled with bayous and wetlands within a sub tropical climate. The colonial French, who settled first along the Louisiana rivers and bayous, instituted clear land divisions known as the French Long Lot. Spanish settlers, who were secretly ceded Louisiana by the French at the end of the French and Indian War, developed clear administrative centers driven by the Law of the Indies 1573. President Thomas Jefferson purchased the land area known as Louisiana from Napoleon in 1803, thereby enabling colonial Americans to institute the national grid and marked out the remaining land in the western part of the state. The impact and invention of the railroad and the expansion of the 4<sup>th</sup> Intercontinental Railroad in the 1880's completed Louisiana's urban pattern. Settlements of Catholic parishes as administrative centers combined with the hot and humid climate forced the architecture to react to the area's environmental conditions. The paper will explore how the rich mix of cultural, political, and environmental factors contributed to the urban and architectural landscape that exists in present day southwest Louisiana.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INFLUENCE OF POLYMER PARTICLES DISPERSION ON SELECTED BITUMEN PROPERTIES

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### ABSTRACT

In recent years, the increased in traffic load has led to more frequent use of polymer-modified bitumens in road surfaces. The available bitumen are usually modified with a styrene-butadiene-styrene copolymer. Such bitumens are characterized by a number of favorable parameters compared to traditional road bitumens. However, in order to protect the environment, there is a need for looking for a new types of polymers from different sources. A good solution could be a utilizing some plastomers available on the market. The article compares the microstructure of two bitumens such as: PMB 45/80-55 and PMB 45/80-65 with processed plastomer modified bitumens. The basic properties of polymer modified bitumens, such as: softening point, penetration, and Fraass breaking point were discussed. The bitumen microstructure was analyzed. In article a changes in particles distribution surface was investigated. For this purposes the epifluorescence microscope observations were carried out. The very important part of studies was performing qualitative analysis using statistical methods. On the basis of obtained statistical inferring was found that particle distribution od plastomer modified bitumens was similar to SBS modified bitumen. Ins cases the level od homogeneity of plastomer modified bitumens bas better than in case SBS usage. Considering set of samples it was worth to note that the increase in particles area brought about a little drop in viscosity at 135deg.C. The bigger particles decreased Fraass temperature and increased bitumen penetration grade. However in case of softening point temperature the particles size had a marginal influence.

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## MASONRY ELEMENTS STRENGTHENED WITH FRM: MODELLING IN "OOFEM" BY USING MULTI-LAYERED ELEMENTS

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### ABSTRACT

Historic masonry characterizes large part of the building heritage in Europe and worldwide but may suffer for structural weaknesses related to material deterioration, long-term fatigue, over-time modifications, accidental actions, seismic vulnerability... For the structural refurbishment of these building assets, the use of fiber-based composites has widely spread within the last twenty years as strengthening strategy for masonry. In particular, the coupling of fiber-based meshes or textiles with mortar plasters (the so-called Fiber Reinforced Mortar technique) gained great relevance due to effectiveness, easiness of installation, material compatibility, durability and reversibility. The development of design methods for this new technique requires, beside a robust experimental database, also reliable and optimized numerical strategies for the performance estimations. In this context, the paper introduces a simplified finite-element modelling approach, based on multi-layered elements, for the assessment of the structural performances of masonry assemblages strengthened with Fibre Reinforced Mortar (FRM). In particular, the free, open source, finite element code OOFEM is adopted to perform non-linear static analyses of masonry samples subjected to in-plane or out-of-plane actions. Brick elements provided with multi-layered cross sections are adopted for the simulations, with layers oriented along the sample thickness: the inner layer for the masonry and a couple of outer layers for the plaster and for the fiber-based reinforcement. The layered elements are based on the geometrical hypothesis that cross sections remain planar after deformation; mid surface is assumed located at average thickness position and normal and momentum forces are computed with regard to it. The Gauss integration rule is used for setting up integration points in each layer, which number can be specified independently for each layer. The materials mechanical parameters for each layer are set in accordance to the results of experimental characterization tests available in the literature. The reliability of the simulations is assessed through comparison with previous experimental outcomes concerning tests on FRM strengthened masonry elements, namely, diagonal compression tests, in-plane three-point bending tests and out-of-plane four-point bending tests. The model is feasible to reproduce the typical failure modes of masonry elements for both in-plane actions (diagonal cracking and in-plane bending failure) and out-of-plane actions (out-of-plane bending failure) also at advanced damage levels and thus can represent a useful and optimized tool to investigate on wider samples, such as entire walls with openings, even under combined in- and out-of-plane loading.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INVESTIGATION OF COMPLEX FLOW THROUGH SPILLWAY-OUTLET STRUCTURE

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### ABSTRACT

The design process and the assessment of the combined hydraulic structure on the dry retention reservoir for its hydraulic functionality are usually quite hard. Hydraulic functions of the combined hydraulic object influence each other during the various flow conditions and manipulations with the release objects. The combined hydraulic structure consisting of the fishway, two bottom outlets, and the spillway enables the variability of partial object's placing. Appropriate variation of sub-objects arrangement can be considered in terms of its hydraulic function and in parallel with some or all the sub-objects. The other suitable assessment of the arrangement variation is the effect of water flow at the end of the combined hydraulic structure, in a stilling basin, and the downstream river channel during each manipulation with the release objects. If the water downstream of the structure affects the river channel, its bed and banks, the velocity field evaluation is a suitable method for assessment. Stilling basin and the downstream channel are placed asymmetrically, so the effect on the downstream channel is one-sided. Therefore, the flume is highly stressed, and thus the maintenance costs increase. Also, the environmental function of the watercourse is disrupted. The goal of the research on the physical model was to check the hydraulic function of each combined object's part. The individual parts were placed symmetrically and asymmetrically. Different flow rates and various object settings were performed, and the riverbed and bank stress were evaluated.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE ANALYSIS OF CAUSES OF DIFFERENTIAL DEFLECTION OF A BUILDING

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### ABSTRACT

Deflection of buildings from vertical in mining areas is usually attributed to ground deformation caused by mining activities. However, when deflection of the building is disproportionately large compared to design deflections of the mining area, there are other causes than mining activities which are responsible for the observed damages. Identification of these causes is significant in relation to the mine liabilities, and mainly to the determination of safety use of a building and adequate procedure for damage. This paper describes an analysis of causes of differential deflection of the tenement on Podgórna Street in Bytom, Poland. Deflection causes were identified on the basis of analysed data concerning the impact of mining activities, conditions of a building foundation, and lateral measurements of the building deformations. The next part focuses on numerical calculations of a spatial model of the building, which were used to deduct the safe use and further procedure for the building. The building deflection was resolved into two components of uniform and differential deflection upon the analysis of the lateral measurement results. The uniform deflection to 10.2 mm/m to the north is seen as rotation of the body of the building. It is caused by inclination of the mining area. The second component – differential deflection of 17.7 mm/m to the north is caused by differential settlement of foundations. Deformations of the building underwent abrupt changes and were directly connected with its upward extension. The computational analysis conducted for the building shows that the currently observed deformation of the building has no significant impact on the stress state of the most deflected north wall of the building. As the building deflection is kept unchanged since the mining effects are no longer manifested, the building is considered to find a new balance position. However, ground under the northern part of the building did not meet requirements for building land. The building state can change as a result of local load, hydration, etc. Therefore, it is recommended to stabilise ground under the northern part of the building.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **CHANGES IN DEFLECTIONS AND DISPLACEMENTS OF THE RAILWAY BRIDGE ELEMENTS DURING MINING ACTIVITIES PERFORMED UNDERNEATH THE BRIDGE**

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### **ABSTRACT**

The majority of mining activities affect buildings with a load-bearing wall structure. This type of structure is typical for many residential and public buildings. The mechanism of transferring ground deformation is well known and used to develop effective protection methods. Additionally, considerable experience is used to identify possible damages of buildings with a load-bearing wall structure caused by expected ground deformations. The direction of such buildings deflection generally coincides with the direction of changes of the mining area slope. This rule is not applicable to bridges. Changes in deflection and displacements of bridge elements depend on the applied structural solutions, the relative position of the bridge components and the real structural arrangement. This paper describes the railway bridge response to mining activities performed underneath it. The relative displacement of the bridge supports was basically caused by the structure position to embankments and a lack of free movement of bearings. The measured relative displacement of the supports was over three times greater than the relative displacement of points on the surface representing the supports, and displacements of bearings exceeded the allowable values. This difference was due to a lack of unlimited strains of the supports caused by the response transferred from the embankment to the support. While the mining area deformations were becoming visible, bearings intended to be fixed were subjected to a few times greater linear displacements than the bearings used as slide blocks. It was a consequence of constraining displacements on the sliding support by adding timber structure between the superstructure and the backwall. The railway traffic was stopped on the bridge as the observations revealed that bearing displacements and buckling of railroad rails exceeded the limit values.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SPANNING HETEROGENOUS URBAN CONDITIONS - CASE STUDY: CITY OF ZENICA

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### ABSTRACT

Transformation of urban environments is a complex process that should always be an upgrade of urban conditions, linked with socio-economic factors. Such a process demands participatory, open approach that is not available in most transitional societies and can in some cases lead to negative gentrification process. The urban tissue discussed in this paper is a part of an industrial city, mostly built in modernist style of architecture as well as its urban matrix. It does contain some historic heterogeneous areas that were once important parts of the city centre, but its role has been degraded over time. This is not only about a case study, but rather a model for situations that many cities encounter in their quest to revitalize within similar urban condition. The city of Zenica has a strong industrial/modernist image that shapes the image with all positive aspects (functionality, quality of public spaces and architecture) and negative (lack of urban continuity form such as „traditional “streetscapes). The questions posed here would be to explore different urban regeneration scenarios and possible interventions within proposals that can range from upholding and enhancing the existing character with more subtle or invasive approaches, or creating a kind of a new hybrid urban and architectural typology that will emphasize all elements of iconic cityscape to the character of the specific site. A set of key parameters is introduced to objectively asses different models presented and assessed through quantitative and qualitative attributes. This approach to urban rehabilitation of mixed (modern and partly historic) transitory urban tissue, with must be done with the awareness of the stratification/layers and capacity of a place. Adaptive reuse and constant upgrade of the existing structures is a shift from an architectural makeover into responsible intervention scenario that serves to improve above all the dwelling conditions and uphold adequate space use. Urban rehabilitation that deals with stratification looks at the city as a living organism - with its hidden substructures that support life and visible manifestation of built tissue.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**CONTEMPORARY DISCOURSE OF REGIONALISM – BETWEEN SENSE AND SENSIBILITY- CASE STUDIES: TWO HOUSES IN BOSNIA AND HERZEGOVINA**

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**ABSTRACT**

The evolution and progress in practical and theoretical framework of architecture can never leave out the influence of regionalist / typological narratives in contemporary architecture. This approach is firmly rooted in local vernacular conscience, as well as being a very rational and time-tested concept. For contemporary practice it has proven to be inexhaustible resource for inspiration and sustainable building. The discourse has come a long way since its inception after the modernist movement, and continues to be relevant due to relentless globalization. Even though regionalism has various wide-ranging manifestations, this paper will be focused on the arguments for an open and positive contemporary approach that embraces in full the advantages of technical and architectural innovations. This type of contemporary regionalist discourse, creates structures that inherently are born with character, evoke emotion and connection. The use of regionalist elements is very balanced, strategic and more abstract than ever before, utilizing concept of modesty and social responsibility. Practical part of the argument will be presented through two relevant case studies: one from a warm Mediterranean landscape and one from the north mountainous region that show the advantages of regionalist / typological approach as well as its progressive theoretical framework. The house in warmer climate is designed as a series of open, semi open and closed spatial sequences, where each single element of space is treated differently, following its function and importance which is an interpretation of traditional layouts for contemporary needs. The house in the north challenges the status quo of contemporariness, by being an extraordinary response to its immediate and wider context through inherently ordinary, modest means, with instinctive sensibility for the environment. Methodology will show predominantly qualitative, as well as quantitative measurable parameters that combined will uphold the argument of numerous advantages of this approach must be an integral part of the future architectural landscape. Even though regionalist / typological issues arise many times over, now they are becoming a matter much beyond pro-place or contextual narrative, but as concept that is more flexible and (pro)reactive in our pursuit for a socially, environmentally responsible building - ultimately ethical quest in architecture.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**SYNCRETISM IN REGIONALIST MODERN ARCHITECTURE OF BOSNIA AND HERZEGOVINA - MODELS OF SYNCRETIC PROCESSES AND FORMATIONS ON THE EXAMPLE OF THE WORKERS' HOUSE BY JURAJ NEIDHART**

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**ABSTRACT**

Occurrence of the regional modernism in Bosnia and Herzegovina has so far been defined in architectural theory as a synthetic, ie as a complete, stable and conclusive resolution. However, given that many incoherent practices were present in the process of creation and then harmonized within architectural programs, as well that there is further visibility of constitutive elements, which acted in a very coordinated and dialogical way in completed resolutions of regionalism, paper outlines the premise of the *syncretic nature* of one part of this architectural expression. Arguing on the basis of theories on the syncretism of cultural and social processes, and borrowing from religious and anthropological studies, this work examines the syncretism of the creative practice of modern regionalism in Bosnia and Herzegovina, using as a sample the typological set of workers' houses of architect Juraj Neidhart, designed and built between 1939 and the 1960s. Their relevance as a case study is reflected in successful tendency to dynamically connect ideological and political discourse of unified Bosnian identity with the very heterogeneous demands of collectivist and individual logics. According with the claim that syncretism can be both a process and a resolution, the analysis differs dialectically in this sense. The first part of the paper, following the *theory of syncretic models*, puts the process of realization of workers' housing units in relation to the described models, and concludes with the found that incoherent logics appear in three basic styles - as *domestication, negation and care*. In the second part, the contact of the formal constitutive elements of the workers' house, ie one of its most expressive syntagms - that of doxat-divanhana (rectangular protrusion-courtyard gallery), is comparatively questioned. Such a syntagm is not contact of traditional and modern, but traditional-traditional, and thus falls within what Kamastra called "syncretism within" where elements of pure structure very often continue to exist within the system, even though they have really lost their original meaning. Results of this research, confirming syncretism both in the process and in the structure of sample, only touch a surface of a complex phenomenology of syncretic architecture which is not nominally related to religious practices. However, at the same time, by characterizing it as syncretic, they pave the way for the key potential of this heritage. Namely, syncretic, unlike synthetic formation, is not a completed process, a legacy of a period, attitude and authority, but a source that is further reproduceable and creates potentially new resolutions. Today's resolution will give way to tomorrow's, which will take a special position towards the historical-political moment. Incoherent combinations of constitutive elements are open and temporal and can respond with positive practice to the still present politics of difference, within the political system that today, in post-socialist society, once again insists on separate ideological spaces. Also, this analysis can be instrumental in critique of concepts that seek to present themselves as too stable, homogeneous and "pure" in terms of understanding cultural identities in which architectural practice is integrated.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CHANGING THE AUTHENTICITY AND INTEGRITY – SARAJEVO CARSI BETWEEN 1878-1918

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### ABSTRACT

The Sarajevo Carsi is the traditional commercial core of Ottoman provenance, which in the shift of civilizational spheres (Ottoman Empire / East - Dual Monarchy / West) went through the most intensive process of disintegration and redefining of its value. The main goal of this paper is to review the influence of the Austro-Hungarian era on the value of Carsi, through the inclusion of the notions of authenticity and integrity as defined within UNESCO doctrine, so far omitted from the theoretical basis of the current protection process. Such an analysis is crucial to understand the significance of the Carsi and of the spatial limits within its value is fully and truthfully expressed today. Indirectly, the debate on integrity and authenticity includes the conceptual methodology and conclusions of recent postcolonial studies on the relationship between the center of power (Dual Monarchy) and the periphery (native society) in the construction of urban identity. Resistance and acceptance of the colonial paradigm and modernization, as one of its key factors, by the native population, is an issue that arises in this study and whose consideration may require a radical change in the definition of Carsi's value. The results of the present study indicate the need to expand the current boundaries of this historical area, in order to ensure the full representation of the characteristics and processes that convey the value of Carsi, in accordance with the essence of integrity. Also, the results of the study underline the pretext about the coexistence of diverse ethnic and confessional groups, expressed in the current definition of Carsi's value. The value of Carsia expressed within the extended boundaries of integrity, more strongly transcends national discourses that are arising again in post-conflict society, underlined in tendency to affiliate symbolic forms of Carsia to one, single confessional/national community.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SIMULATING VACUUM PRELOADING TECHNIQUE WITH FEM**

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### **ABSTRACT**

In geotechnical engineering, ground improvement means treatment of the subsoil underlying the fill to improve the bearing capacity of the subsoil to decrease the settlement. Heretofore, a wide range of various kinds of techniques has been introduced to improve the properties of weak soils and all come with some advantages and disadvantages. In this paper, a commercial FEM program, Plaxis 3D V20 has been used to simulate one of the most economical and effective techniques called Preloading. In the case of existence of soft soil layers or soils with low permeability in the geological profile and due to consolidation settlement, the treatment often takes a long period of time. Under those circumstances, pre-fabricated vertical drains can be employed together with the application of the surcharge to shorten the duration of the process. At the beginning of this research, an as-built road embankment that is located on the R2 highway in Slovakia is simulated and result of the numerical model is compared with the inclinometer measurements installed in the field. Furthermore, compression surcharge load equal to 1.2 times higher than the pressure of the actual structure in combination with a group of prefabricated vertical drains are considered to shorten the drainage path and consequently decrease the consolidation time rate. When the consolidation is over, the surcharge will be removed and replaced with the actual embankment fill. In the end, the results of the time-dependent analysis including graphs of vertical deformation, effective stress, and excess pore pressure versus time are plotted, and efficiency of the technique is discussed.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DEFORMATION MODULUS OF GRAVELS INVESTIGATED BY DYNAMIC PENETRATION AND OEDOMETRIC TEST

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### ABSTRACT

In Slovakia, dynamic penetration is a widely used field test for soil investigation. The test is relatively simple and is recommended to be used mainly in coarse-grained soils because of the smaller friction. The results of the test are used to determine soil profile and to predict or estimate soil properties. The estimation of soil properties by dynamic penetration is quite beneficial especially in cases where it is difficult to extract representative undisturbed soil sample. In coarse-grained soils the test is used for determination of relative density, angle of shear strength, or deformation modulus ( $E_{def}$ ). In this article we assess the deformation modulus of fluvial poor-graded gravels from dynamic penetration and oedometric test. First, the deformation modulus was determined from the results of a heavy dynamic penetration carried out near Bratislava. A Slovak correlation derived by various authors was used for the assessment of  $E_{def}$ . In most cases, these correlations only consider the soil class or its composition as a determining factor and do not include the soil genesis, which also influences the determination of soil properties. Therefore, in the second part of the research, the deformation modulus was investigated in the laboratory, where a series of large-scale oedometric tests were performed. The test consisted of two loading cycles during which the deformation modulus was measured. Subsequently, the results obtained from the heavy dynamic penetration test were statistically processed, and the characteristic value was derived. In the end, the measured results from the field and laboratory tests were analyzed and compared.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SUSTAINABLE URBAN PLANNING OF BLUE - GREEN INFRASTRUCTURE WITH THE STRUCTURAL SUBSTRATE WITH A BIOCHAR COMPONENT**

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### **ABSTRACT**

Application of the structural substrate for urban vegetation might be used as a sustainable urban planning tool for compensation of insufficient rooting volume, negative microclimatic, and soil properties in dense urban structures. The aim of this work is to evaluate the use and possibilities of the structural substrate with biochar components in Slovak conditions. Planting of woody plants (trees and shrubs) in exterior containers were chosen for an initial experiment to simulate difficult conditions of the urban environment (such as the occurrence of urban heat islands, substrate overheating, high evaporation, salination, insufficient rooting space). The research involved planting a control sample using a standard planting procedure in a substrate intended for container plantings and subsequently a structural substrate. The use of the structural substrate in the conditions of Slovakia has not yet been implemented. The structural substrate model consists of a mixture of gravel aggregate (75%), a classic substrate (12,5%), and a biochar component (12,5%). The choice of vegetation material considered the conditions of the reference area and there was chosen one representative of tree vegetation and one representative of shrub vegetation. *Carpinus betulus* 'Fastigiata' from climate 5b, was selected as a representative of tree vegetation. *Photinia × fraseri* was chosen as a representative of evergreen shrubs from the shrub form 6a. The choice of the reference area was limited by several conditions typical of the urban environment, namely close contact with the traffic road, exposed microclimatic conditions, and insufficient rooting space. The location in the town of Piešťany was chosen, near the traffic communication in positions with direct sunlight throughout the day. Piešťany is included in the map outputs of the climate division in zone 6b, which corresponds to -20.5 to -17.8 ° C. Measurements and data collection take place throughout the year, starting with planting. Quantitative and qualitative parameters of vegetation were recorded: bio-indicative properties of vegetation (soil moisture, soil reaction, exposure of vegetation to sunlight) and weather conditions. The second type of the monitoring was focused on dendrometric data such as increments during the vegetation season and the root systems with the priority of determining the growth potential. The implementation evaluates the growth potential of vegetation resisting the unfavourable conditions of the urban environment with a modern method of growing in a structural substrate using a biochar component, in comparison with the classic type of substrate used. The use of modern technological elements in the urban planning environment is a tool for reducing the impacts of climate change and supporting sustainable urban development.

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05 -09 September, 2022 - Prague (Czech Republic)

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## **CRITERIA OF EVALUATION IN THE CONTEXT OF PROFESSIONAL ETHICS – TALK WITH STUDENTS OF ARCHITECTURE**

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### **ABSTRACT**

The ethics of the architect profession and related perception of the achievements of colleagues during modernization, seen from the position of an academic teacher, teaching within the subject of ethical standards. A significant problem is the preparation of students to the process of making independent choices. The article presents issues related to dealing with clients and fellow creators and the need to make reasonable, balanced decisions in the face of specific existing market situations. The author describes and attempts, together with young adepts of architectural art, to diagnose the current state of behavior towards colleagues. Important, due to these boundaries, is the phenomenon of receptions of the rules of professional ethics by successive generations. Another problem worth considering in terms of ethics is the still anachronistic system of public competition, in which the lowest cost of contrast is decisive. Under such conditions, it is almost impossible to consider ethical attitudes. An important problem is the lack of access to architectural competitions (called open), but in fact closed to a large crowd of young artists. This affects the respect for the achievements of the previous generation of architects.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ŁÓDŹ UNITY MIRACLE IN THE FACE OF GAINING INDEPENDENCE

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### ABSTRACT

The city of Łódź, portrayed in Władysław Reymont's (Nobel Prize winner) *Ziemia obiecana* (The Promised Land) was developing rapidly, not only during the steam engine era period. Architects worked intensively as well, although more harmoniously. The architecture of this major industrial centre, elevated (for the first time in its history) to the rank of the regional city, started to gain a large city centre character – mostly in public area space. New buildings (which a regional city should have) started to appear – culture, education, health care, recreation and infrastructure. The rules of the dominant European modernism (at that time) were used in the construction of living space – tenements, apartment buildings, building complexes, villas or detached houses. Designers of these buildings, architects educated in Dresden, St. Petersburg, Paris, Lviv or Warsaw, investors – Municipality, housing cooperatives or the original owners (various nationality), due to creative cooperation, they constructed buildings, which enrich the city even today. Therefore, let us learn from them the rules of shaping space!



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**LABORATORY RESEARCH ON THE EFFECT OF WATER FOAMING TECHNOLOGY ON BASIC PROPERTIES AND FOAMABILITY OF PAVING GRADE BITUMEN 50/70 AND POLYMER MODIFIED BITUMENS (45/80-55, 45/80-80)**

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**ABSTRACT**

Currently, efforts are being made to use ecological and eco-friendly technologies in road construction aimed at reducing CO<sub>2</sub> and other compounds emissions to the atmosphere. It can be achieved by using various additives lowering technological temperatures of asphalt mixtures or by using appropriate technologies. One of the technologies for reducing the production temperature of asphalt mixtures is the technology of foaming the binder with water. This technology enables the production of mixtures using warm mixed asphalt. The aim of the research was to evaluate the properties of 50/70 paving grade bitumen and polymer modified bitumens: 45/80-55, 45/80-80 intended to produced warm mix asphalt. These binders were subjected to standard tests: penetration at 25°C, softening point, Fraass breaking point and dynamic viscosity in different temperatures: 90°C, 110°C and 135°C. These parameters were evaluated both before and after foaming process by adding water. In addition, tests of the foamability of these binders were performed in terms of amount of foaming water and the temperature of the bitumen binder. The important role of the binder temperature in the foaming process results, first of all, from the strong relationship between the temperature and viscosity of asphalt binders, as well as from the need to evaporate the foaming water by transferring thermal energy. Therefore, the experimental plans for the foaming tests of the analyzed bitumen binders were implemented, taking into account the assessment of the influence of the binder temperature and the amount of foaming water on the maximum expansion ratio  $ER_m$  and half-life  $T_{1/2}$  values. The analyzed amounts of foaming water ranged from 1% to 3%, while the temperature range of the binder during foaming was from 140°C to 170°C for 50/70 road bitumen and 155°C to 185°C for polymer modified binders (45/80-55,45/80-80). Optimization was performed to determine the optimal foaming water content for each type of bitumen binder. The analysis of the results showed that the optimal foaming water content was in the range of 1.6%-2.0%, while for polymer modified bitumens it was found to be in the 1.8% to 2.4% range.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EVALUATION OF AIR VOID CONTENT IN ASPHALT CONCRETE WITH USING WATER DISPLACEMENT METHODS AND COMPUTED TOMOGRAPHY

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### ABSTRACT

Air void content is one of the key parameters determining such properties of asphalt mixtures as resistance to permanent deformation, resistance to moisture damage, stiffness, resistance to fatigue and resistance to cracking. Adequate levels of air void content in pavement layers are prerequisite for obtaining durable and long-lasting pavements. In the asphalt mix design, laboratory testing is used to evaluate the properties of the formulations and to assure the quality of the paved material. Laboratory testing usually involves relatively small samples with unfavourable dimension to nominal maximum aggregate size ratios. Compaction in laboratory conditions also introduce edge effects which are due to small mold dimensions and non-uniform, rapidly changing temperature distribution during compaction. Non-uniform air-void distribution may directly impact the results of the performance tests carried out on laboratory samples and contribute to inadequate characterization of the pavement material. These effects are typically, to some degree, combated using adequately large samples and sample trimming. The density of asphalt mixtures can be evaluated using a variety of well established methods, including those involving the water displacement principle (saturated-surface dry method, paraffin and parafilm method, vacuum sealing method), nuclear density gauge and non-nuclear density gauge. Some of these methods are more suited for laboratory use, while others (nuclear and non-nuclear density gauge methods) are intended for field evaluation of compacted later density. The common characteristic of all mentioned methods is the fact that they provide a bulk result, without the possibility of providing the spatial distribution of the air voids in the samples without planned and intended cutting involved. Such prospect arises from the use of the computed tomography technique, in which the scanned samples and obtained data regarding the distribution of air voids can be evaluated non-destructively. The paper concerns the evaluation of the distribution of air voids in laboratory produced samples of asphalt concrete using the water displacement method and computed tomography.

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## COMPARISON OF ELECTRICAL CONDUCTIVITY OF CEMENT COMPOSITE MATERIALS

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### ABSTRACT

Comparison of electrical conductivity of cement composite materials Literature research and analysis was performed on the electrical resistance of cement composite materials, as well as on various functional aggregates that can conduct electric current. The aim of the research is to determine the electrical resistance and compressive strength of different cement composite materials with fibers, as well as to compare obtained results. An experiment was performed to create different compositions of cement composite materials were made with fibers and other electrically conductive components. Conductive cement-based compositions exhibiting both good electrical conductivity and mechanical strength have been obtained by ensuring proper dispersion of conductive phase within the composition. According to the research, there is provided an electrically conductive cement-based composition comprising: a cement binder, a conductive phase consisting of one or more of the following: conductive fibers (carbon or steel fibers), graphite, metal powder, Single-Walled Carbon Nanotubes. The electrical resistance and temperature changes during the application of voltage were measured in the laboratory for the samples from each composition, as well as the compressive strength of the manufactured cement composite material was determined. Exemplary compositions obtained according to the research have a 28-day curing resistivity of 0-30 Om and 28-day compressive strength of 12–60 MPa the content of the ingredients depends on the preparation receipt.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **HOTEL REFURBISHMENT AND BUILDING INFORMATION MODELLING (BIM)**

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### **ABSTRACT**

Research on Building Information Modelling (BIM) focused on the design and construction stages of engineering projects. Fewer studies investigated the use of BIM in refurbishment projects. The aim of this research is to examine the process of hotel refurbishment in an operational environment and how this can be enhanced in BIM environments. The research approach is qualitative however quantitative data were used to complement the qualitative data. Questionnaires were completed by industry professionals in the UK. Themes were identified across hotel refurbishments in varying properties. The findings suggest that a close integration between the construction team and hotel operation is paramount to achieving a successful hotel refurbishment process, and highlight the role of the project manager in facilitating communication across stakeholders. This reflects the essence of working in interdisciplinary collaborative BIM environments however BIM is not widely implemented in many refurbishment projects. The research contributes by proposing procedures for undertaking refurbishment in operational hotels.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **INSIGHTS INTO PUBLIC TRANSIT USE IN BERLIN – THE ROLE OF AUTONOMY AND PUBLIC TRANSIT PRIVACY**

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### **ABSTRACT**

The role of public transit (PT) is increasingly important in large cities from the perspective of transport planning as the population in urban areas worldwide is growing continuously. A well-developed PT, working as a mass transport mode, is needed to satisfy peoples' mobility requirements. Hence, the aim of this study was to investigate factors influencing people to use or not to use PT in Berlin (Germany) in order to derive measures for a more attractive PT. In contrast to other studies we aimed at a holistic approach considering sociodemographic, spatial-structural as well as psychological characteristics of individuals as in travel behavior research those are regarded as three main influencing dimensions on one's travel behavior. The research used data that was collected in Berlin applying the innovative survey design of a travel skeleton. Hereby, a total of 600 respondents provided information on their everyday travel behavior and their attitudes towards PT. Based on a factor analysis with varimax rotation autonomy and public transit privacy were extracted from the psychological item set as latent variables. Especially in times of a pandemic, it was of great interest to look at privacy and how acceptance was before the pandemic. Together with sociodemographic and spatial-structural characteristics the latent variables were integrated in an ordered hybrid choice model. This approach allowed to analyze the interrelations between the sociodemographic characteristics, attitudes and PT use. It further gave us the possibility to further differentiate between direct effects of an individual's characteristics and indirect effects via the latent variables on PT use. We found that particularly autonomy strongly affects the use of PT while public transit privacy plays a minor role in Berlin. However, both variables were highly significant and helped to explain 31% of the unexplained variance in the 'base' ordered probit model. Regarding direct effects, the ordered hybrid choice model revealed that women as well as people living in less urban areas use PT more often e.g. for commuting. They can be considered as captive riders due to the reduced accessibility of Berlin's urban core by car (e.g. lacking parking facilities). As a main indirect influence through latent variables our model showed that while young people use PT even more frequently due to their perceived autonomy, for elder people the unperceived autonomy leads to an additional reduction in PT use. In addition, even if men feel less restricted in their privacy when using PT, privacy doubles the already existing negative direct effect and makes men use PT less frequently.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## MULTI-STEP DATA MINING TO PREDICT PAVEMENT CONDITION INDEX (PCI) THROUGH AN OPTIMIZED NEURAL NETWORK (ONN) MODEL

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### ABSTRACT

Departments of Transportation (DOTs) across the United States allot huge amount of the budget each year to assess the roadway network conditions and program interventions such as maintenance, resurfacing, rehabilitation and reconstruction. The development of efficient maintenance and rehabilitation (M&R) plans requires powerful prediction models for pavement deterioration. Regrettably, the calibration of trustworthy models is arduous, since, generally, the pavement condition data currently available are limited and imperfect. In this study, a multi-step experimental data mining approach through optimized neural networks (ONN) is presented in order to predict pavement condition index (PCI). A case study of experimental measurement of PCI was carried for three different types of pavements including Portland Cement Concrete (PCC), Hot Mix Asphalt (HMA) and Composite Pavement (CP). The approach was developed to handle the real world data which can be imperfect in terms of data quality and number of variables. For this purpose, data preparation was implemented and performance criteria were considered as Means Absolute Percentage Error (MAPE), Root Mean Square Error (RMSE), and  $R^2$ . Then, the best training algorithms in terms of efficiency and accuracy were selected. After that, the best neural network (NN) architecture was selected base on the performance criteria. Data refinement was then implemented based on optimal NN architecture obtained in order to reduce the prediction error. Finally, the optimal NN prediction model was developed through NN optimal architecture and the refined data. The results showed that by using ONN approach, the prediction error can be reduced to half compared to primary NN model. It was found that the ONN approach can be an efficient tool in pavement research to predict PCI and its performance outweighs the common NN models.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **A PAIRING RIDESHARING MODEL TO REDUCE CONGESTION IN LARGE URBAN AREAS**

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### **ABSTRACT**

Modern world is facing difficult times with regard to newly developed concepts like livability and sustainability. Increasingly, growing urban areas are dealing with an escalation of traffic congestion and all its consequences in terms of overall delay experienced by travelers. Ridesharing is intuitively a practical solution to improve the congestion issues in our modern cities. The largely unused capacity of the private vehicles would be utilized in place of other vehicles to satisfy the mobility needs of individual passengers. A large scale proper implementation of it would be one of the effective methods to satisfy the mobility need of travelers and reduce congestion effects. This research utilizes the available large dataset of taxi data from the City of Chicago. Taxi demand is analysed and spatio-temporal distributions are developed to perform simulation analyses intended to investigate the effects on the transportation network assuming a percentage of the demand is willing to be served in a ridesharing mode. Service level constraints are considered to ensure acceptable quality for travelers in terms of added journey time and waiting time. We are considering the pairing model, consisting on assuming only pairs of compatible passengers are combined. The goal is to maximize the total mileage saving and therefore reduce the total driving time on the road network. The main finding of this study include quantification of the mileage saving as a function of: 1) The participation of the passengers in the ridesharing mode; 2) The service level guaranteed to participating customers, in terms of maximum waiting time and additional riding time. The findings provide convincing tools and detailed information for planners and policy makers to consider incentives for the transformation of traditional taxi services to ridesharing service, improving traffic congestion conditions.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SUSTAINABILITY AND DURABILITY OF COMPRESSED STABILIZED EARTH BRICK: AN OVERVIEW

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### ABSTRACT

Human society and the environment are complex systems that have always coexisted and interacted. Thus, we have, for example, in ancient Peru, on the coast with a warm climate, the city of Chan Chan with earth-based constructions and in the mountains with a cold climate, the city of Machu Picchu with stone-based constructions, in both cases, their societies built structures fully integrated with nature, that is, with bioclimatic architecture, different for each climate and ecologically aware. After the industrial revolution, this type of construction has been gradually lost, with the mass production of fired clay bricks and concrete blocks. Population growth and the migration of people to urban areas have increased the demand for construction materials, we can corroborate this with the growth of our cities. However, what causes concern is that man, in the last century, has become increasingly dependent on non-renewable resources and that cities are currently designed and built without taking into account environmental impacts. The construction industry is one of the largest consumers of energy and raw materials that has considerable environmental impacts in its production, being responsible for almost a third of all carbon emissions. Faced with this problem, it is essential to select new materials that consume fewer natural resources in their production to reduce greenhouse gas emissions, in line with environmental problems related to air pollution and global warming. Sustainable construction is a response to the growing awareness of the negative impact of buildings in our societies on the environment. But this change has started very slowly because it requires changes in habits in our society towards the use of materials with less embodied energy compatible with the local climatic context. For this reason, this article aims to promote the use of unfired pressed stabilized earth bricks (CSEB), highlighting recent advances in the sustainability and durability of this type of brick. Regarding sustainability, which is its greatest strength, comparative studies will be reviewed through life cycle assessment (LCA) of three materials: CSEB, conventional fired clay bricks, and concrete blocks. Regarding durability, which is its greatest weakness, the advances in the addition of organic compounds and the improvement in the tests that measure its susceptibility to water will be reviewed.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## RESEARCH ON THE INFLUENCE OF THE TECHNIQUE OF STRENGTHENING WITH THE FRCM SYSTEM ON THE COMPRESSIVE STRENGTH OF CLAY BRICK WALLS

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### ABSTRACT

This paper describes results from studies on effects of the technique of superficial strengthening with FRCM system on compressive strength of clay brick walls. The research program included three series of walls without any strengthening, strengthened at one or both sides. A total of 9 models were tested in accordance with the requirements of PN-EN 1052-1: 2002. The models were made using clay masonry units, class 35 and lime-trass mortar class M5. Models were reinforced on one and two sides with the FRCM system, using the mineral cement matrix PBO-MX GOLD MASONRY and the PBO-MESH GOLD 22/22 mesh. A significant increase in the level of cracking stress, modulus of elasticity, compressive strength was observed in models with reinforcement compared to the models without reinforcement. Walls reinforced on one side achieved better results compared to walls reinforced on both sides.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARISON OF INFLUENCE OF SUPERFICIAL STRENGTHENING WITH THE FRCM SYSTEM ON SCHEAR CAPACITY OF MASONRY WALLS MADE OF CLAY BRICK

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### ABSTRACT

This article presents the results of research on the effect of superficial strengthening with the FRCM system on the shear strength of clay brick samples. The main purpose of the research was to determine, in accordance with the PN-EN 1052-3 standard, the initial and the characteristic shear strength of the wall. The intermediate goals were to observe behaviour, cracking pattern, method of destruction of research elements. The research program included three series of 6 models each, consisting of elements without any strengthening, strengthened at one or both sides. The models were made using clay masonry units, class 35 and lime-trass mortar class M5. Models were strengthened on one and two sides with the FRCM system, using the mineral cement matrix PBO-MX GOLD MASONRY and the PBO-MESH GOLD 22/22 mesh. During the test, in addition to recording the load, the displacements between the masonry elements were measured using the Aramis system and LVDT sensors. Both in the case of strengthened at one or both sides models, a significant increase in shear strength was noted and a ductile method of sample destruction compared to models without strengthening.

Corresponding Author: Wojciech Mazur



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## NEW APPROACH ON URBAN PLANNING TO PROMOTE PEDESTRIAN MOBILITY IN LISBON

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### ABSTRACT

The urbanization increase connected with the aging population set new problems for the planning of new cities and the urban management of old cities. It is therefore necessary to seek and develop innovative approaches, proposing solutions that encourage walkability and reduce the use of motorized transport, in line with the actions towards Sustainable Cities and Communities (SDG11). The opening of passages to the interior of the blocks and the connection between the streets that limit these blocks is one of these proposals inspired by the graphs theory and in the particular cases of some cities (e.g. Prague, Milan, Paris, Juíz de Fora, etc.). Also when promoting the rehabilitation of a building or the construction of a new building that will replace it, the new architectural project design can include this opening/passage/gallery. When the demolition of a building is decided and the construction of another is promoted, the building that replaces the previous one may have a multiplicity of characteristics that promote walkability in the city, or at least does not reduce walkability (Vieira, 2018; Vieira & Ribeiro, 2019). It is intended to develop the study to other neighbourhoods of Lisbon (old city) with diversified urban fabrics, following the research work carried out in Ribeiro et al. (2021). Graph Theory, Space Syntax and Data Analysis methods and technics are used to simulate the increase in pedestrian mobility in those neighbourhoods. Each simulation is analysed by itself and as a whole. Comparing all simulations and discussing the results, will show those passages improve significantly the pedestrian mobility.

Corresponding Author: Jorge T. Ribeiro



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ALTERNATIVE SUPPLEMENTARY CEMENTITIOUS MATERIALS IN ULTRA-HIGH-PERFORMANCE CONCRETE

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### ABSTRACT

Silica fume, a supplementary cementitious material, is used in ultra-high performance concrete (UHPC) as a critical supplementary cementitious material. However, silica fume is considerably more expensive than cement and other SCMs. For the past several years, efforts have been made to replace much of the silica fume with class F fly ash that is substantially less expensive than silica fume. However, future availability of fly ash has become uncertain because the energy industry has been investing in renewable energy production and removing coal burning generating stations from operation. Consequently, there is a growing need to find new, cost effective and environmentally friendly alternatives for fly ash. This study assessed the use of different supplementary cementitious materials including a natural pozzolan, metakaolin, and ground granulated blast-furnace slag (GGBFS) as potential replacements for fly ash in UHPC mixtures by conducting compressive and flexural strengths tests for several UHPC mixtures. Additionally, surface resistivity, rapid chloride ion permeability, freeze-thaw, and drying shrinkage tests were conducted on promising mixtures with compressive strengths greater than 120 MPa. Results indicated that the compressive and flexural strengths of the non-proprietary UHPC mixtures decreased with increased natural pozzolan content. Specimens with natural pozzolan contents greater than 25% had 28-day compressive strength less than 120 MPa, indicating that they cannot be classified as UHPC. Additionally, specimens containing the natural pozzolan had greater shrinkage than mixtures without natural pozzolan. However, the maximum shrinkage was 571  $\mu$ strain, which is acceptable in many UHPC applications. Surface resistivity results showed that chloride ion permeability of specimens with natural pozzolan can be classified as moderate. Although initial results confirmed that these three supplementary cementitious materials can generally be reliable replacement alternatives (at least partially) for fly ash in terms of compressive and flexural strengths, chloride ion penetration resistivity, frost resistance, and drying shrinkage, more tests will be conducted to evaluate the performance of these supplementary cementitious materials in non-proprietary UHPC mixtures.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STUDY ON THE EFFECT OF MAINTENANCE-FREE GREEN WINDOW SYSTEM ON INDOOR AIR QUALITY

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### ABSTRACT

The global haze problem is becoming increasingly prominent, and indoor air pollution is becoming more and more serious, resulting in an increase in the number of patients with "sick building syndrome" living in closed rooms. Under the bad indoor and outdoor air environment, scholars from various countries have actively explored the use of indoor plants to purify the air. Windows are not only a channel for the exchange of air between indoors and outdoors, they are also a channel for outdoor pollution to enter the house. By integrating plants with windows and using trace irrigation technology, the author designed and built a maintenance-free plant window device - Green Window System (GWS). This paper introduces the detailed structure, irrigation technology and plant screening of the GWS. 9 experiments were set up to compare the absorption capacity of indoor and outdoor particulate between the GWS and the same amount of indoor plants under the same conditions. The study found that under indoor air circulation conditions, the GWS adsorbed 1.3% and 1.71% more PM<sub>2.5</sub> and PM<sub>10</sub> respectively than ordinary plants. Under indoor and outdoor ventilation conditions on a hazy day, the PM<sub>2.5</sub> and PM<sub>10</sub> in the room with the GWS were 26.53% and 40.18% lower respectively than in an ordinary room, indicating that the GWS is more effective in adsorbing PM<sub>2.5</sub> and PM<sub>10</sub>, and proving that the GWS is more effective in purifying PM<sub>10</sub> than PM<sub>2.5</sub>. The green window system saves space in the room and enhances the photosynthetic efficiency of the plants. The GWS creates closed airtight ducts and a more humid environment that facilitates the adsorption of plants and the settling of particles.

Corresponding Author: Shenglin Bao



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05 -09 September, 2022 - Prague (Czech Republic)

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## **MODULAR AND CONVENTIONAL CONSTRUCTION COMPARISON: A SUSTAINABLE PERSPECTIVE**

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### **ABSTRACT**

The construction industry is considered as one of the most significant contributors to global environmental and energy challenges including climate change, air pollution, and depletion of natural resources. There appears to be a lack of focus in the construction sector in promoting sustainable practices. Several new strategies have been developed over the last decade in the hope of making the industry more sustainable. Modular construction is a promising prospect, using prefabricated and more sustainable material, that represents an opportunity to make the industry greener. The objective of this research is to conduct a comprehensive comparison between modular and conventional construction systems regarding sustainability issues. This paper presents both qualitative and quantitative results gained from questionnaires and interviews, conducted to assess how modular systems may be compared with the traditional construction. Respondents were building industry professionals including architects, project managers, and civil engineers. Results show that the overall awareness of modular construction is high, however its implementation in projects remains surprisingly low. The main perceived advantages of modular construction are speed of construction and environmental benefits, while the primary barriers to its implementation appear to be the lack of technology available and inexperienced workforce. The overall likeliness of adopting modular construction in the next decade appears to be promising, given respondents' awareness of the multitude of benefits of modular construction over traditional systems.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INVESTIGATING THE ECONOMIC HEIGHT OF COMMERCIAL BUILDINGS: CASE STUDY OF SYDNEY, AUSTRALIA

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### ABSTRACT

This research provides a framework for determining the economic height of commercial developments in the City of Sydney, that is, the height at which the return on investment for the project is maximised. This is determined as a trade-off between the rent attracted per unit of floor space alongside the costs of operations and development, all of which have a dependency on building height. Such a framework would allow for project height feasibility to be ascertained at the extreme early design stage, allowing the total delivery time to be reduced if the project is deemed feasible or minimising financial losses if the project is determined to be infeasible. Factoring in the extraordinarily high prices of land in Sydney, an economic height of 65 – 75 storeys was hypothesised. With the results of the case study revealing an economic height of 60 storeys, it is anticipated that the mean economic height of developments in the City of Sydney within a range of approximately two standard deviations would be between 55 – 70 storeys. The economic height of the case study development was likely lower than the hypothesised range because of the (1) unexpectedly great construction costs specific to Sydney and the (2) relatively small land footprint of 2500m<sup>2</sup> for the hypothetical case study, with economic height becoming more sensitive to these inflated construction expenses.

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## **FACTORS AFFECTING THE ADOPTION OF INDUSTRIALIZED CONSTRUCTION FROM THE DECISION MAKERS' PERCEPTION**

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### **ABSTRACT**

Although its various advantages compared to traditional practices, the adoption of industrialised construction (IC) solutions is lagged in many regions of the world. A particular area where IC could be especially useful is for boosting construction productivity as several authors point out, which concerns not only the Architecture-Engineering-Construction (AEC) industry. For its adoption, structural, contextual and behavioural reasons affect decision-makers. In this context, two factors of communication and collaboration between different the participants arise as two key factors especially in early stages of a project. This paper aims to provide further analysis in the relation of collaboration and communication among decision-makers and the adoption of IC. This research considers a two-steps study by conducting a literature review and survey research. The literature review analyses the up-to-date research on the area, while the survey research will determine the perception of scholars through a series of closed and open questions. Then, the results of both steps are compared. It was found that behavioural and structural factors play a relevant role for decision-makers. communication and collaboration seem to be necessary and should be encouraged for decision-makers for expecting optimal results. Also, the practitioners' perception indicates that the use of collaborative approaches may produce better outcomes than the traditional practices. Creation of consensus and the time to reach it, transparency, and lowering frustration are desirable characteristics of a decision-making process in early stages, whose can affect the willingness to use IC or not. Such findings align with lean construction collaborative approaches. This study provides further knowledge about the affectation and willingness of practitioners for the adoption of IC alternatives and collaborative approaches in early stages. Results show that communication and collaboration may play a relevant role and, thus, shall be considered and encouraged by managerial roles in early stages.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **IMPROVEMENT OF THE BEARING CAPACITY ON THE SAFETY LANES/AREAS ADJACENT TO AIRPORT RUNWAYS**

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### **ABSTRACT**

One of the most important infrastructure elements concerning the safety of air navigation is the existence, configuration and characteristics of the safety belts and areas at the end of the takeoff/landing runways (RESA) in an airport. These technical characteristics are stipulated and explained by the norms and regulations concerning the operation of airports and the safety of air traffic. The paper presents the authors' research aiming at determining the characteristics of the soils beneath the runways of an airport from Romania by realizing in situ and laboratory investigations. Thus, during the first stage of the research, the authors determined the characteristics of the soil in the location: grading, plasticity, consistency index, stratification of the ground through geotechnical drilling and sounding; bearing capacity of the ground through light dynamic penetrations (PDU) and by determining the C.B.R. index (Californian Bearing Ratio). Several technical solutions have been proposed to improve the bearing capacity to reach the C.B.R. (C.B.R. = 15...20%) according to the standards stipulated by the Romanian Civil Aeronautic Regulations RACR-AD-PETA. The studies have been directed towards two alternative solutions to improve the bearing capacity, namely: mechanical stabilization of local soil with different proportions of gravel, and stabilization with special hydraulic binders.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ELEMENTS CONCERNING THE IMPLEMENTATION OF CYCLE TRACKS WITHIN AN URBAN MOBILITY PLAN**

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### **ABSTRACT**

Large urban centers generally face issues such as traffic congestion, air, and phonic pollution, and also road accidents. The air and phonic pollution are harmful for the health and the environment. An explosive increase in vehicle and bicycle traffic has occurred in recent years, and the lack of the possibility of increasing the traffic capacity of existing streets leads to major problems concerning the safety of traffic on the main streets in Romanian cities. Cycling is a popular and sustainable means of transport in many countries in the European Union. The strategic goal for the traffic infrastructure consists in integrating the Romanian road transport infrastructure in the European transport system, as well as smoothing the traffic flow and improving the traffic safety in all modes of transport. To promote the sustainable development, public authorities need to take the necessary measures to mitigate the harmful impact of transportation and health risks, in order to improve the management of natural resources, especially their consumption, as well as to fight social exclusion and poverty, both in Europe and worldwide. They also need to take steps to fight climate change and mitigate its effects. Starting from the theoretical and practical experience acquired by the team of authors in the field of designing and expert assessing cycle tracks, the paper draws a series of conclusions concerning their implementation and promotion in close link with the policy stipulated by the national resilience plan, which comes to support the development of cycling infrastructure.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DETERMINATION OF RESISTANCE OF SEALED JOINT TO COMPRESSION STRESS

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### ABSTRACT

Mankind has been dealing with the issue of sealing since the very beginning of construction. Sealed joints are exposed to several external influences, whether physical or mechanical. These effects also include compressive stresses on the sealed joint. If we know that the structure in which the sealed joint will be placed will be exposed to compressive stress, we should choose a suitable sealant regarding this fact. A sealant suitable for sealing joints subjected to compressive stress should have sufficient flexibility after it has hardened. If the sealed joint is not flexible enough, its pressure load can significantly damage the sealed joint, and thus damage the entire structure. This article deals specifically with the sealing of problematic material. Aquapanel cement board is selected as a problematic material for the purposes of the presented research. The tested sealants are selected based on the manufacturer's recommendations on the suitability of these sealants for sealing cementitious materials. Furthermore, primers are used, which are again selected according to the manufacturer's recommendations. Test samples are made from selected materials, which are further conditioned according to a predetermined schedule. Then these samples are tested according to the European standard. Specifically, the resistance of a sealed joint subjected to compressive stress is tested. After exposing the test specimens to this stress, the sealed joints and their possible failure or deterioration are evaluated. The test results are recorded and further evaluated. Based on the evaluation of these results, it is possible to recommend all tested sealants for sealing cementitious materials, except acrylic sealant. The sealed joint made of acrylic sealant shows significant cracks in this test. These cracks are caused by the insufficient flexibility of this type of sealant and thanks to them the sealed joint is considerably degraded.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## NANOTUBE SUSPENSIONS WITH CONCRETE ADMIXTURES

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### ABSTRACT

For the cementitious nanocomposites which contain carbon nanotubes a proper dispersion of nanofiller is an important factor which determines final properties of the composite. Large, singular concentration of the carbon nanofiller might negate all the additional properties that the carbon nanotubes provide, mainly electrical and thermal conductivity as well as material's strength. The carbon nanotubes are usually added in a form of water suspension therefore their uniform dispersion in the aqueous solution is the first and most important step in achieving a proper dispersion in the cementitious matrix. Typically used methods for achieving uniform dispersion of the nanotubes in water utilise the usage of ultrasonication and surfactants. The surfactants are usually specific chemical substances, however commercially used concrete admixtures can also be used. The paper aims at assessing the usability of commercially available concrete admixtures along with sonication in making homogenous suspension of carbon nanotubes in water. The suspensions have been prepared with fixed amount of nanotubes and water and examined via visual inspection. The results show, that the ability to create a homogenous suspension of carbon nanotubes is largely connected with basic chemical composition of the admixture. Depending on the chemical composition of the admixture, the suspensions showed different levels of flocculation from almost uniform dispersion up to large, easily observed flocs. This kind of behaviour excludes those admixtures from usage in cementitious composites as it will not allow for uniform placement of carbon nanotubes in the cementitious matrix therefore not creating homogenous properties within the composite.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EFFECTS OF WMA ADDITIVE AND POLYETHYLENE WAX MODIFIER ON THE PROPERTIES OF ASPHALT BINDERS

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### ABSTRACT

Typically, the lowered processing temperatures of warm mix asphalt lead to decreased ageing of the asphalt binder (due to less intense oxidation) and therefore is known to hinder the high temperature performance of these types of asphalt mixtures in early service life. Therefore, a use of an additive for improving these characteristics of asphalt binders intended for warm mix asphalt is evaluated. The aim of the study was to assess the effects of the use of two additives on the properties of 50/70 paving grade bitumen and 45/80-55 polymer-modified asphalt binder. The first of the analyzed additives is in a liquid warm mix additive based on organosilanes permitting a reduction of production and compaction temperatures due to improved aggregate coating and wettability and increased mixture workability. The second evaluated additive provided in solid form, based on polyethylene wax increases the high temperature performance of the asphalt mixture. The scope of laboratory tests covers the determination of the asphalt binders with variable amounts of both additives dosed separately as well as simultaneously to both asphalt binders. Basic research was performed, such as: penetration at 25°C, softening point, Fraass breaking point, dynamic viscosity and high temperature performance evaluated using dynamic shear rheometer before and after short term ageing in the rotating thin film oven. The obtained results of the investigation have shown little effects of the WMA additive on the measured properties, while the polypropylene wax significantly affected them, by stiffening the binders. The simultaneous use of both additives resulted in significant interactions of their effects resulting in improved binder performance.

Corresponding Author: Joanna Bartos



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SENSITIVITY ANALYSIS OF LIMIT STATES IN CIVIL ENGINEERING: FROM MODEL OUTPUT TO RELIABILITY ASSESSMENT**

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### **ABSTRACT**

Sensitivity analysis is a tool for measuring how the conclusion drawn from a model depends on changes in the parameters that enter it. Research on probabilistic reliability analysis in civil engineering shows that simply focusing on the model output is not sufficient. In stochastic models, the correlation between input and output, output variance analysis and other methods oriented only to model output are not directly related to the probability of failure, which is one of the main objectives of reliability analysis of building structures. The presented article provides a brief history on the development of sensitivity analysis methods, starting with methods oriented to model outputs and ending with the global sensitivity analysis of reliability oriented to the probability of failure or design quantiles. Recently developed state-of-the-art global sensitivity analysis methods, which are oriented to the failure probability, are presented. The article studies the influence of alternative sensitivity measures on the results of global sensitivity analysis. In the next part of the article, a case study examining the influence of loading, material and geometric characteristics on the probability of failure of a steel bar with a thin-walled closed cross-section subjected to torsion is presented. Sensitivity analysis is performed using two sensitivity measures that measure changes in the probability of failure due to changes in input variables. Methods for the numerical estimation of the probability of failure are discussed in the context of the numerical requirements of global sensitivity analysis algorithms. Both sensitivity measures study the variability of the binary function failure vs success and thus are directly related to changes in reliability due to variability of the input variables. The first sensitivity measure is based on contrast, the second on entropy. There are large differences between the proportion of first-order and higher-order sensitivity indices. Although the results of the sensitivity analysis are not the same, both sensitivity measures give similar values of total sensitivity indices and infer the same sensitivity ranking of the input variables. The studies show that alternative sensitivity measures are useful tools for the global sensitivity analysis of reliability and research should therefore be continued.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INVESTIGATING STREET CONNECTIVITY OF SUPERBLOCKS WITH EQUAL STREET CONSTRUCTION COST

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### ABSTRACT

Superblock neighbourhood planning has been evolving and growing through the past years in rapidly urbanizing countries such as United Arab Emirates (UAE). Superblocks in the UAE take the shape of large tracts of land—approximately 900x 600 m—bounded by arterial roads and developed following the principles of the Neighborhood Planning Unit. Promoting walkability in superblocks, has become a priority for the UAE government, noting that walking is a key variable in planning for more sustainable neighborhoods. However, despite recent research on walkability and street connectivity in superblock neighborhoods of the UAE, not much research has focused on connectivity in relation to road construction costs. This paper addresses this question by jointly studying connectivity and cost-efficiency in three different superblock neighborhoods of Abu Dhabi, the capital of the UAE. Specifically, the study evaluates road construction costs of these three neighborhoods, and the connectivity that their road networks provide to their residents. Connectivity is measured from each plot in the superblock, to each of its corners, noting that it is at the superblock corners that residents can cross over to adjacent superblocks. Testing access to the corners thus, addresses the need to think of superblocks not as potential pockets of walkability, but as components of a city building strategy. Connectivity analysis calculated three distinct but related connectivity metrics: route distance, route directness, and route diversity. The results show that despite having similar road construction costs, neighborhoods only have similar distance and directness to the corners, while differences are found in route diversity. The findings suggest that these methods can effectively support future development, assisting in the selection of different designs based on optimizing connectivity and street construction cost. The paper concludes with a discussion about the ability of these results to inform urban development policy.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SILICA FUME AS A SURROGATE FILLER IN ASPHALT CONCRETE MIXTURES: LABORATORY INVESTIGATION AND A MACHINE LEARNING-BASED PREDICTION

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### ABSTRACT

Transport infrastructure is a key asset in the global development of a society. Its improvement, both from the technologies and materials point of view, is a precondition to achieve sustainable and resilient progress. Under these conditions, it is necessary to investigate the feasibility of using waste materials (also called marginal materials) into a pavement mix composition in order to accomplish two main goals: adding useful life to a material that otherwise would be just a waste and saving on virgin materials supply. The presented paper aims at investigating the feasibility of using industrial waste silica fume (SF) as a surrogate filler instead of Ordinary Portland Cement (OPC). Mixtures were produced with different percentages of SF and OPC and their performance was investigated by using the results of Marshall and Indirect Tensile Strength (ITS) tests. Laboratory testing requires not only highly qualified technicians but also multiple samples in order to define functional relationships between the variables involved. In this regard, soft-computing techniques can be useful in reducing this workload and the resulting costs by identifying the aforementioned relationships by means of artificial intelligence. Therefore, the experimental data collected have been processed using Shallow Neural Networks (SNNs) that provided predictive models of the mixtures' mechanical and volumetric parameters. Resampling and synthetic data generation techniques successfully addressed the difficulties caused by the relatively small dataset size. Results showed that the use of SF resulted in mixture performance comparable to that achieved by mixtures produced using OPC, occasionally even better. In addition, the proposed neural model performed remarkably well and thus could be used in the asphalt mixture optimization without the need for additional laboratory tests.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARATIVE STUDY OF PHYSICO-MECHANICAL PROPERTIES OF POLYPROPYLENE FIBRE-REINFORCED GYPSUM COMPOSITES

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### ABSTRACT

Nowadays, the growing demand of plastic is leading to an uncontrolled waste production that threatens the Planet's health. Over 8 million tonnes of plastic debris go into the ocean annually because of poor end-life management. Single-use products represent one of the main sources of plastic pollution, due to its low recycling rate related to its large production. Among them, personal hygiene disposable products (e.g., non-degradable wet wipes) represent a hazardous concern to marine ecosystem because of their dumping into the sea, dragged away by wastewater currents. Classified as non-woven textiles, non-degradable wet wipes are made from polymeric fibres, mainly polypropylene (PP), that complicate their degradation in contact with water. The incorrect disposal society makes of this waste causes devastating blockages in sewerage network, with alarming environmental and economic consequences. In this sense, alternative solutions to promote the recycling of this waste are needed in support of governmental regulations. Thus, from construction sector and committed to the Circular Economy's objectives set by the European Green Deal, the present work evaluates the feasibility of using PP waste fibres from disposable wet-wipes, as alternative to commercial PP reinforcement fibres, to produce eco-friendly reinforced gypsum-based products. Two types of reinforced-gypsum composites were prepared by adding commercial polypropylene (PPF) and waste polypropylene (PPWF) fibres, respectively. Different addition levels of fibre (2, 2.5, 3 and 3.5% by weight of gypsum) were selected to develop each group of gypsum blends. Then, composites were subjected to an experimental campaign based on dry density, mechanical behaviour (flexural and compressive strength) and deformability pre-failure, following the guidelines established by standards and comparing the results with the control material. The results showed a slight decrease of density as the percentage of PPWF rose, when compared to reference gypsum. Despite of the fact that lower values of mechanical strength were got by composites containing PPWF compared to those reinforced by PPF, a significant improvement of flexural strength (up to ~19.5%) was reached by mixtures with 2.5wt% PPWF content, in relation to control material. On the other hand, a decrease on compressive strength of composites with PPWF addition was observed, unlike the performance showed by gypsums with PPF content up to 2.5 wt% (~4.5% increase). However, all the data were over the minimum strength values established by standard. Furthermore, greater plastic deformation was developed by fibre-reinforced gypsum before to reach the failure point, in comparison with control gypsum which presented a brittle failure. Finally, it could be inferred the effectiveness of commercial PPF to enhance the mechanical properties of gypsum composites, just as the feasibility of using recycled WPPF as eco-friendly replacement to obtain gypsums for construction applications with both mechanical and environmental improvements, so promoting circular economy development.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## TIME-DEPENDENT RELIABILITY ANALYSIS OF STAINLESS STEEL MEMBERS AND BRIDGES

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### ABSTRACT

Stainless steel is used in bridge construction due to its high corrosion resistance and attractive metallic surface. The use of stainless steel is advantageous in aggressive corrosive environments or structures with high demand for long service life with minimal maintenance requirements. The disadvantages include higher material cost and a smaller selection of industrially produced profiles compared to carbon steel. When designing, it is also necessary to take into account the different behaviour of stainless steel. An economical design must also take into account the degradation of reliability over time due to fatigue. The article deals with the methodology of time-dependent reliability analysis, where the partial reliability index is used as a measure of reliability. The approach of probabilistic assessment is applicable to steel bridges where fatigue defects from cyclic loading are the main types of failure. The case study shows that the fastest decline in the reliability of the load-bearing steel structure is observed at the beginning of the operating period. On the other hand, inspections aimed at identifying fatigue cracks and possible repairs to the load-bearing structure should be carried out, especially in the second half of the operation period of the bridge. This article discusses the use of stainless steel in connection with methods for verifying the reliability of steel structures. Stainless steel is viewed as a new material whose fatigue characteristics are not known from long-term observations of real structures. The advantages of using modern materials are also discussed in the context of verified fatigue assessment procedures, which are based on validated design procedures developed for carbon steel load-bearing elements. The article also mentions other probabilistic methods of reliability verification, which are practised to verify the reliability of load-bearing building structures.



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## A NUMERICAL ANALYSIS FOR ESTIMATING CO<sub>2</sub> EMISSIONS IN SINGLE-LANE AND DOUBLE-LANE ROUNDABOUT SYSTEMS

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### ABSTRACT

Carbon Dioxide (CO<sub>2</sub>) caused by human activity is the highest contributor to global warming whose concentrations in atmosphere as for other long-lived greenhouse gas are responsible of climate changes. Environmental protection should therefore cover energy savings and reduced emissions through the use of innovative solutions and clean technologies to deal with the challenges connected to a greener future, at sustainable costs. Although road transport is a resource for each individual user, it influences CO<sub>2</sub> production every year and need to be decarbonized. In this regard, many initiatives have been already taken at European level to promote the transition towards a low-emission mobility and to reduce CO<sub>2</sub> emissions from vehicles. Thus, emission monitoring from mobile source is still an open field of research. New methods and technologies can now be used to detect the main variables that influence the emissive phenomenon and its evolution over time. In this regard, mobile crowdsensing is a spreading logic that employs sensing data from mobile devices of drivers to serve various goals. When applied to emissions from mobile sources, the novel aspect is that vehicle trajectory data collected in the field from mobile source can be sent to a data platform that process and convert them into digital information on pollutant emissions, and return them to the community of users equipped with their smartphones to collectively share information and to derive some conclusions on the emissive impact associated with the travelled trajectories as inspiration to optimize their conditions of mobility. To assess the contribution of roundabout systems to the emission phenomenon, having regard to the increasingly widespread and frequent use of roundabouts in rural and urban settings for the variety of operational and safety benefits that they provide, this paper has been aimed to perform a numerical analysis to model and to simulate CO<sub>2</sub> emissions from vehicles under different traffic conditions. For this purpose, a cellular automata model and an emission model have been coupled in MATLAB and then employed to understand the mechanism of CO<sub>2</sub> emissions in single-lane and double-lane roundabout systems. First results of this study have highlighted the role of changes in kinematic parameters of vehicles (both in the entry or exit approaches, and in the circulatory roadway) in the variation of CO<sub>2</sub> emission rates, and the dependence of emission variation patterns of CO<sub>2</sub> on the entry and exit of vehicles from the roundabout systems under examinations. The implementation of these model allowed to estimate the emission rate of CO<sub>2</sub> in different parts of roundabouts to evaluate the users' behaviour under different traffic conditions and to assess how traffic patterns can modify gas emissions. In this view, the research aligns with the goal of modelling CO<sub>2</sub> emissions from mobile sources to produce useful information that can be returned to users of a digital community to learn about the problem of common interest.

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## THE RESOURCE ASSESMENT DURING PROJECT IMPLEMENTATON INFLUENCED BY LOW QUALITY OF PERFORMED ACTIVITIES

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### ABSTRACT

The project manager has to solve during implementation of the project very often the problem of the time delay. The time is one of the key project parameter a therefore it is necessary to pay attention to this problem. The reason for the delay is, in many projects, the low quality of the finished activities and consequently the necessity the rework of same activities. If the project has to be finished on time, the solution is add the resources, e.g. workers and machines, with the aim to increase the capacity used for activity performing. Consequently, the financial resources are increased. The described problem can be investigated by means of dynamic model where it is possible to observe the changes in the finished activities and reworked activities. The processing rate depends on the capacity of the resources. In the developed model there are workers. The number of workers can be influenced by hiring new workers. At the same time the workers can leave the company. The costs are derived from amount of the human resources. It is possible to see in the model the dependency between quality of the performed activities and number of needed workers to stabilize the situation. The example of the project with the calculation of the human and financial resources is presented.



## PRESERVATION ASSESSMENT METHOD FOR OLĘDER VILLAGES IN FLOOD RISK AREAS

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### ABSTRACT

The paper presents the author's own method to assess the possibilities for preserving Olęder villages (from the Polish word "Olęder" meaning a settler of Dutch and/or German descent in Poland; Ger. Holländer or Hauländer) in areas at risk of flooding. Specific research resulted in a method that provides a clear answer as to whether rural areas with preserved landscape features can continue to exist and grow in spite of periodic episodes of flooding. The methodology which was developed was then verified at two research sites comprising Olęder villages in river valleys. To preserve the landscape of Olęder villages in flood-prone areas, account needs to be taken of the functional and spatial pattern, landscape features and hydraulic conditions of high water flows. The preservability of this landscape can be determined using an appropriate hierarchical multi-criteria assessment system. The methodological research was based, among other things, on the results obtained for the Olęder villages in the Pyzdry Forest (*Puszcza Pyzdrska*). The research focused on villages founded under the Olęder law from 1746 to 1864. Some of the research relating to the risk and hazards of flooding was conducted in river valleys where the research sites were located. The author's assessment method has a sequential structure and is divided into five consecutive stages. What makes the model different is that it is based on village development alternatives available in the decision-making process. The solution which is adopted refers to the planning process. The model each time includes up to 18 alternatives for planning solutions, the possibility of introducing anthropogenic landforms and computer simulations of flood wave transformation with a two-dimensional model. Using methods of multi-criteria analysis, it was possible to specify the most significant criteria for the author's assessment model which the author believes can provide the basis for the decision support system in spatial planning. The method that was developed makes it possible to determine whether villages that are being assessed can maintain their original functional character or, in line with flood protection guidelines, there should be no further development in these areas. In addition, the methodology also shows what the maximum possible extent of village growth will be (extensive, sustainable or intensive).



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## OLĘDER VILLAGES: THE ARCHITECTURE, SPATIAL ASPECTS AND FLOOD RESILIENCE

Joanna Kubiak

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### ABSTRACT

This paper discusses certain characteristic features of Olęder settlements (from the Polish word “Olęder” meaning a settler of Dutch and/or German descent in Poland; Ger. Holländer or Hauländer) using the example of Olęder villages in the Pызdry Forest (*Puszcza Pызdrska*), Wielkopolska region, Poland. What is specific about the area is that, compared with other Olęder areas in the Wielkopolska region, there are well-preserved layouts and a significant number of original buildings erected with traditional techniques. The landscape of Olęder villages in Polish territories evolved gradually from patterns transferred from the area of today's Netherlands and northern Germany. In contrast to the indigenous settlements and cultures, Olęder villages have a different layout, architecture, as well as drainage and flood protection systems. The large numbers and concentration in river valleys shows the importance of those settlements and the specific influence they had on the landscape transformation in these areas. With time, the traditional Olęder settlements and architecture were transformed, and were subject to the process of natural destruction after the cultural and historical continuity of the land was interrupted in 1945 (which included displacement of the residents). With the current residents' lack of attention to preserving the heritage, these areas are being transformed according to new patterns. The purpose of this article is to show the results of a comprehensive field research of 58 historic settlements (67 present-day villages), including surveys of historical sites, as well as to present historical studies and an analysis of cartographic and planning material. The development of settlements from the mid-17th century to 1839 was examined and two types of Olęder village layouts were identified: wetland linear village (*rzędówka bagienna*, Ger. *Marschhufendorf*) and unstructured layout village. The local bog iron architecture, also known as “iron houses” is unique not only for Olęder settlements, but also globally. As a result of the research, characteristic features of the Olęder villages in the Pызdry Forest were identified, such as their layout, pattern, land transformation, and features that strengthened their resilience to flooding. Identifying these features enabled the author to come up with a specific preservation assessment method for Olęder villages in flood risk areas. Such assessment will be discussed in a separate paper.



## FLOOD RISK TO OŁĘDER VILLAGES BASED ON THE EXAMPLE OF THE PYZDRSKA FOREST AREA

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### ABSTRACT

This paper presents various aspects of the flood risk to the Ołęder villages (from the Polish word “Ołęder” meaning a settler of Dutch and/or German descent in Poland; Ger. Holländer or Hauländer) in the Pyzdry Forest. There are several aspects of this matter discussed in the paper. First, the paper identifies the flood risk within the Pyzdry Forest. For this purpose, official documents and studies related to flood hazard and flood risk available from the ISOK (Information Technology System for National Protection) were examined. As a result of the research, Ołęder villages were broken down and described according to the presence and degree of the risk of flooding and their existing flood protection. At the same time, it was found that there are currently two distinct approaches to flood protection. The first approach is to erect protective structures such as e.g. flood embankments – to keep the flood away from people. The other approach, which has emerged in recent years and is written into both the Polish Water Law Act and the EU's Floods Directive, recommends moving developments to areas that are not at risk of flooding. However, both of these approaches may, in the author's opinion, contribute to irreversible loss of heritage and cultural identity of river valley areas, with villages being more sensitive to adverse consequences than cities or larger urban areas. Secondly, the paper identifies the characteristic features of the Ołęder villages that made them more resilient to flooding. The long tradition of planning these villages was not only based on observations of nature, but also on landscape transformation with artificial landforms and specific layouts of homesteads. Ołęder settlers drew on the building traditions originating mainly from the areas of the present-day Netherlands and northern Germany. Their experience of dealing with floods at home was transferred successfully to Poland and partly changed the then existing landscape in river valleys. The process of identifying these features involved a site visit during which local residents were interviewed. This way it was possible to find the original features of land transformation in the Ołęder villages that were examined. The site visit was verified against topographic maps from archives and LIDAR maps. Artificial dwelling mounds (referred to as “terps”) were considered the most important and characteristic feature. These were the mounds on which homesteads were traditionally built in Ołęder villages. Therefore, the paper examined the effectiveness of terps in terms of higher flood protection and their effect on the nearby hydraulic flow parameters. Two research sites (two terps) were selected following the field surveys. The terps were inventoried and photographs were taken. Additionally, bathymetric data were also added. Hydrodynamic modelling of flood transformation confirmed the effectiveness of terps in terms of higher flood protection and their effect on the nearby hydraulic flow parameters.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GLOBAL SENSITIVITY ANALYSIS OF STEEL BEAM RESISTANCE USING FINITE ELEMENT SIMULATIONS

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### ABSTRACT

The article presents the analysis of the effects of random initial imperfections on the static resistance of a hot-rolled steel beam with an IPE cross-section. The IPE-beam is loaded by bending moment about the major principal axis and thus the resistance is subjected to the effects of lateral-torsional buckling. The resistance of the hot-rolled steel beam is examined by global sensitivity analysis. The geometrical and material imperfections were considered as random variables for the evaluation of the variability of the resistance. The resistance is evaluated using SHELL finite elements and geometrical and material non-linear computational methods of the ANSYS software. Sensitivity analysis studies how resistance as a model output is affected by initial imperfections and residual stresses. The Latin Hypercube Sampling method was used for the evaluation of the variance of the model output. The presented case study determines the sensitivity order of imperfections according to their effects on resistance. The sensitivity order is determined using estimates of the first-order sensitivity indices and total indices. The great importance of the amplitude of the initial curvature of the beam axis is confirmed for the beam with intermediate slenderness, which is studied in the presented case study. The second influential variable is the flange thickness. These imperfections influence the resistance and thereby reliability. In contrast, input random variables with the unit pascal (yield strength, Young's modulus and residual stress) do not collectively have such an influence as the amplitude of the initial curvature. The height of the cross-section, the width of the flange and the thickness of the web are input random variables that do not have a large influence on the resistance. These variables can be considered deterministic without a significant effect on the variance of resistance. Reducing the number of input random variables is important for optimizing the computational cost of nonlinear computer models with high computational costs. The information obtained can be used to optimally create a stochastic model with the subsequent assessment of the load-bearing capacity and reliability.

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**UTILIZATION OF AUTOMOTIVE WASTE IN PAVEMENT STRUCTURES TO REDUCE TRAFFIC NOISE**

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**ABSTRACT**

A characteristic feature of the present is the development of infrastructure, especially in the sphere of road transport. Constantly increasing traffic loads and changing climatic conditions are decisive factors for the appropriate selection of materials for the design of the pavement structure. Emphasis is laid on the materials fulfilling the required deformation and strength characteristics. However, economic and environmental aspects are now also coming to the fore. Technologies with reduced greenhouse gas production, lower energy consumption and the utilisation of waste materials are being promoted. The utilization of secondary raw materials is still an important issue. It has been a topic of intense interest to the professional technical community for several decades abroad and in Slovakia. Waste is generally produced by an enormous increase in consumption or as a residual product from particular materials and goods. The article presents the possibilities of recovering waste from the automotive industry, specifically old tyres, in road structures. The authors demonstrate the reuse of these wastes as a binder in the structural layers of roadways. The application of crushed rubber creates the preconditions for devulcanisation. That will improve the rheological properties of the binder and ensure its better dissolution in the asphalt. Such road pavements then significantly improve their surroundings, compared to standard technologies. In Slovakia, there are four experimental sections with an abrasive layer with the additive of CRM (Crumb Rubber Modifier). Attention was paid to the assessment of the condition of the road surface, measurement of noise levels in the vicinity of roads, quantification, and valuation of the cost of implementing a pavement structure with CRM. Currently, road traffic noise is a social problem affecting the health of people living near roads. After ten years of operation of the life cycle of the pavement, a visual inspection was conducted to assess the condition of the pavement surface. Based on the analysis of the inspection results, we conclude that no permanent deformations have formed on the experimental section. It is important to note that more than 12 million vehicles moved on the section over the period. The surface texture of the asphalt layer is in good condition despite exploitation by heavy, medium and light vehicles. In terms of noise, their acoustic performance was verified according to STN EN ISO Acoustics. Measurement of the influence of road surfaces on traffic noise. Part 1: Statistical Pass-By method (ISO 11819-1:1997). The output of the noise level measurements is the SPBI (Statistical Pass-by Index) calculated from the sound pressure levels. Comparison with a road section with an asphaltic concrete pavement surface demonstrated a reduction of approximately 3 dB in the SPBI value. It should be mentioned that a 3 dB reduction in noise has the same impact as a halving of traffic volume. The price of modified asphalts for the asphalt layer is 10-15% higher in Slovakia than for asphalt mixtures. Based on the presented results, we can say that in the long term time perspective, pavements with CRM are economically and especially environmentally more advantageous.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARISON OF THE ENERGY DEMAND WITH THE ENVELOPE LIMITATION OF THE PERFORMANCE NORMATIVE OF BRAZIL AND SPAIN

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### ABSTRACT

Buildings consume 42.6% of the electricity generated in Brazil, and the residential sector is responsible for 21,4% of that amount, in other words, almost a quarter of the electricity generated. Add to this fact, the housing deficit was almost 6 million in 2019 in the country. The purpose of this article is to analyze the results of the heating and cooling demand of a building designed in an H shape, for the city of Passo Fundo, Rio Grande do Sul, in the south of Brazil, from the point of view of the Brazilian (NBR) and Spanish (CTE) performance constructive legislation. The main objective is to verify and analyze the existing differences and potentials in the comparison between the regulations, evaluating the thermal envelope of a typical social housing building. The method used to obtain results was a computer simulation, using EnergyPlus software as an energy calculation engine and Sketchup 2017 for the modeling, with the Euclid plugin, which directly sends data to the energy simulation program. The building was simulated with climate data from the city of Passo Fundo, belonging to the Brazilian Bioclimatic Zone 2, and was compared to the transmittance level required for the D1 climate of Spain, as required by the CTE. Finally, it is possible to evidence that there is a decrease in the building's energy demand as thermal insulation is incorporated into the walls and roof, to reach the strictest standard requirement levels. This article intends to show the potential for improvement in Brazilian regulations and the path to be followed concerning energy improvement in buildings.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SUSTAINABLE URBAN MOBILITY IN SMART SUSTAINABLE CITIES: CASES FROM LATIN AMERICA

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### ABSTRACT

Urban mobility, understood as the ability to move people and cargo in the built space, is an object of great importance in the sustainability and resilience of cities. The rapid growth of cities, when occurred without proper planning, can contribute to urban sprawl, increasing the distances of daily displacement of the population and, often, stimulating the use of automobiles to the detriment of public transport and active commuting, such as walking and cycling. In order to promote more sustainable urban mobility, cities need to promote transportation modes that optimize space and energy, such as public transport, the use of bicycles and walking, to replace car use, in line with the concept of smart sustainable cities. In this paper, some strategies to foster a more sustainable urban mobility, such as the Transit Oriented Development are presented, and their role in the development of smart sustainable cities is discussed, through the presentation of cases studies of two Latin American cities (Curitiba - Brazil and Medellin - Colombia). Thus, the main objective of this paper is to present and discuss strategies to develop more sustainable cities regarding urban mobility. In the case of Curitiba, it is highlighted the comprehensive approach of urban planning directed to improve population accessibility to the transit system, with the creation of the so-called Structural Axes that became the backbone for the urban development of the city. In Medellin's case, the innovations on public transport to serve informal settlements are presented, such as the MetroCable, that was designed inspired on the monocable cable-car system used in ski-resorts; and the Escalator of Comuna 13 which consists of six mechanical escalators installed on a steep hillside, allowing the community inhabitants to reach the top of the hill. Both initiatives presents aspects that foster more sustainable means of urban transportation and can potentially be adapted to other latin american cities.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## URBAN GREEN SPACES AS TOOLS TO FOSTER QUALITY OF LIFE IN SMART SUSTAINABLE CITIES

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### ABSTRACT

The quality of the urban public space is decisive in the quality of life and health of the population, being of great relevance in the attractiveness of a city. Being the place of use and access common to all citizens, used for commuting, leisure activities and social interaction, collective activities, commercial exchanges and various types of human relationships, public spaces are vital for urban life. In addition to factors related to social life, the existence of green public spaces, such as squares, parks, green corridors, play a significant role in the population's physical activity levels, in addition to environmental gains such as the reduction of urban heat islands. However, the underestimation of the benefits related to the presence of green open spaces in urban contexts have made green spaces vulnerable to urban growth, especially when it happens by urban sprawl. Urban green spaces can be a substantial part of the development of Smart Sustainable Cities and, thus, there is a urgent need to consider an integrative approach to improve it, considering its whole range of scales. In this paper, definitions of some urban green spaces typologies, such as urban parks, green corridors and pocket parks are presented. Furthermore, a discussion is made regarding the importance in the context of the smart sustainable cities, using the method of case studies to present the cases of two latin american cities (Passo Fundo – Brazil and Medellin – Colombia) that created high quality urban green spaces. In Passo Fundo, the revitalization of the *Parque da Gare* (Gare Park) and, in Medellin, the creation of the *Corredores Verdes* (Green Corridors). In these case analysis, the Smart Sustainable Cities dimensions that are impacted by the creation of these green spaces are highlighted.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## A MACHINE LEARNING APPROACH FOR THE PREDICTION OF ASPHALT CONCRETES VOLUMETRIC PROPERTIES AND PERFORMANCE

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### ABSTRACT

In recent years, many researchers in the field of pavement engineering have worked with the aim of developing a model capable of predicting the mechanical behavior of a mixture starting from its composition's parameters. This has been done following two different approaches. The first involved the use of advanced constitutive laws based on the materials mechanics; the second, instead of being physically based, was data-driven. The present work belongs to this second context and aims to present, implement and apply a strategy to develop the optimal model for solving an assigned predictive problem. Specifically, a Machine Learning approach, a Feedforward Backpropagation Shallow Neural Network, was investigated. The objective was to correlate stiffness modulus, air voids and voids in the mineral aggregate to the mixture main composition's parameters identified in: bitumen content, particle size and a categorical variable distinguishing the bitumen type and production site. Since the maximum aggregate size is 10 mm, the sieves considered were of 10, 6.3, 2, 0.5 and 0.063-mm diameters. The present study focused on 92 variants of asphalt concretes for very thin road pavement wearing layers produced both in plant and in laboratory. Despite the wide variation ranges of each parameter considered, the optimal model returns fully satisfactory performance. The overall Pearson correlation coefficient is equal to 0.9490, also by virtue of the innovative algorithms implemented as k-fold Cross-Validation (CV) and Bayesian Optimization (BO). These algorithms have allowed on the one hand the improvement of the model's predictive performance making them more reliable and, on the other hand, the optimization of hyperparameters and architecture. The methodology developed can become an important reference in this field since it is independent from the specific predictive application. In this sense, it can help other researchers in the fine-tuning of neural models in the field of pavement engineering.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EVOLUTION AND CONSERVATION OF ROAD NETWORK PATTERNS IN PORT TOWNS OF LIAONING PROVINCE

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### ABSTRACT

Dalian, Lushun, Dandong and Yingkou are port towns in Liaoning province in China that have developed significantly in the modern era, each with its own unique urban form and pattern. All four cities still have ports in use today, and there are commonalities in their historical development. Road network, known as the 'skeleton of a city', is the primary element of urban planning and an important testimony to the urban history. The study of urban form cannot get rid of the interpretation of road network form. However, the protection of historical and cultural heritage in Liaoning province focuses on the protection of historical blocks and single buildings, while the inheritance and protection of road network have been neglected. As a result, this valuable road network is gradually disappearing due to the rapid expansion of cities. Therefore, how to find out the road network inherited by the city, clarify its morphological characteristics, explore its causes, and preserve its form as much as possible is an important topic. The article begins with a review of the urban form development of four port towns in three stages: the modern urban germination period, the urban planning period and the urban expansion period. Subsequently, the paper focuses on the interpretation of their road network pattern, external traffic pattern and typical block pattern. And then the morphological characteristics of road network in four towns are compared. The four towns have made different historical choices between the tessellated, centripetal and free-form road network types. Their locations of external traffic are also different. However, typical regional road networks show commonness because of similar historical background. Then, the causes of the road network form are analysed in three aspects: geographical factors, cultural factors and economic factors. Finally, according to the current situation and the trend of the times, the protection methods of integral protection, serial protection and selective protection are put forward. The article emphasizes the importance and historical value of the road network form, which plays the role of skeleton in the urban form, and puts forward a new angle of protecting for the historical heritage of port towns

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INFLUENCE OF TRUCK MILEAGE ON CARGO SECURING

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### ABSTRACT

The paper deals with the influence of truck mileage on the choice of fastening system (on cargo securing). As part of the transport experiment, the values of shocks (acceleration coefficients) on the T-815-7 truck with different mileage are measured. The basic hypothesis is that a truck of the same age, but with a higher mileage, will generate higher shocks (higher values of the acceleration coefficients). The essential method is statistical analysis, which enable to find statistically significant differences between the measured data sets (tested vehicles). The comparison also includes normatively set limits according to EN 12195-1:2010, which shows that there is also a higher number of extreme values (outliners) for vehicle with a higher mileage. The benefit of the paper is to take into account the "mileage" (worse technical condition) of the vehicle when choosing a fastening system and mitigating the risks relating insufficient cargo securing.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CONVENTIONAL ANALYSIS OF CONTINUOUS BEAMS: VISUALIZATIONS AND DERIVED METHODS

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### ABSTRACT

Building structures are conventionally studied via compatibility or equilibrium analysis. There are usually numerous unknowns in approaches, redundants and nodal movements, which are addressed by resolving linear equation systems via procedures from the realm of Applied Mathematics. A research line at the School of Architecture in Donostia-San Sebastián suggests various strategies for reducing calculations in these analyses. One consists of finding ways of resolving systems by combining images of possible mechanical behaviours of the models during balancing. The images must qualitatively reflect the numerical operations of new numerical methods to be determined, and may be obtained on the basis of others that visualise the operations of the current methods from Applied Mathematics used to solve these equation systems. To date, operations for some procedures have been imagined using Cross' philosophy, and used as the basis for proposing others. This paper presents other findings in regard to the analysis of continuous beams: a. Some visualizations of Gauss', Cholesky's, Crout's, Cramer's operations in resolving systems derived from compatibility analyses. B. Two analysis procedures based on the above visualizations. One is a compatibility method and the other is neither a compatibility method nor equilibrium one, and does not require systems of equations to be resolved. It does not seem to be more effective than current methods, but it proves that it is possible to analyse models in other ways. Both are described qualitatively.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**CONTRIBUTION TO THE KNOWLEDGE OF THE GEOHYDRAULIC MODEL OF THE SULPHUREOUS  
SPRING OF PONTE DO FUMO - TABUAÇO (PORTUGAL)**

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**ABSTRACT**

The sulphureous spring of Ponte do Fumo is a small natural source of groundwater, whose use for medicinal purposes in rheumatic and dermatological diseases is very old, losing the beginning of its use in time. In the 70's of the last century, it was still used in very vernacular installations, however today it is totally abandoned. Because this type of special water resource, has a long and extensive geohydraulic circuit, that spring today continues to maintain its small flow and its unique chemical characteristics, which are very evident in the place, not only because of its bad smell of eggs rotten, such as by the biojelly (white cream) that develops next to it. On the other hand, this type of resource, if captured at depth, has the potential to obtain adequate flow to build a health unit, of the medical spa type, as well as allowing geothermal uses, as these waters at depth tend to be hot. It is therefore very important that studies are carried out on site, which would make it possible to lead to such a situation. Thus, in this paper, after a brief introduction on the importance of sulphureous water for society, and elementary aspects on geohydraulic models, the methodology of work is presented and as results, the hydrogeoenvironmental elements of the study area, geomorphological, geological and hydrogeological aspects, as well as the conceptual geohydraulic model of sulphureous water are presented. Finally, as conclusions, some notes on the best areas for prospection and research are presented, as well as the order of magnitude of the potential flow to be explored.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## REHABILITATION OF WATERMILLS FOR RURAL TOURISM HOUSING - THE CASE OF SANFINS IN VALPAÇOS (PORTUGAL)

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### ABSTRACT

Molinological activity in Portugal at a given time in its history was fundamental for the progress of populations. Several types of mills were used, namely, watermills, associated with streams and rivers, constituting an authentic cereal flour industry, since several products were made from them, namely the wheat bread, rye, maize, and other cereals. Society evolved, technology changed, and these mills were abandoned and are now vernacular constructions, in many cases in complete ruin. The watermills are located on the banks of watercourses, often in a very high-quality natural and landscape environment, favourable to ecological tourism, rural tourism, and other low-impact related activities. It is in this context that we understand that this vernacular heritage should not be lost, and so we present this case study, with a proposal for the rehabilitation of a set of 14 mills on the Torto river in Sanfins, municipality of Valpaços in northern Portugal, for a rural tourism ecopark. Thus, the present paper, after a geographic framing and the presentation of the local natural characteristics, presents a brief summary of the molinological heritage and its importance, and then presents some conceptual aspects that led to present proposal. This constitutes a park with the integration of the mills of greater proximity, including an accommodation sector, a museum-mill, a games area, a parking area, a picnic park, among others. Thus, this paper, after a geographical framework and a Some architectural design elements of some structures are presented, namely exemplifying a mill-housing, where all aspects are developed in order to constitute a fully feasible project, designating it if this dwelling as “my grandfather's mill”. Finally, some final notes are presented, emphasizing that the present proposal is a solution, resulting from academic work, whose fundamental objective is to present the problem that is important from the scientific and historical point of view, but it is also intended to attract an investor, whether state or private, so that by carrying out this project, it is not only honouring a people, an era and a culture, but also contributing to the local and regional economy, with the full functioning of a set of tourist accommodation housing, and other related activities that are useful to society.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

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## TERRITORY OCCUPATION IN THE PERIMETER PROTECTION AREA OF THE SÃO PEDRO DO SUL MEDICAL SPA - THE SITUATION OF THE NEW AQUATIC LEISURE EQUIPMENT OF THE HOTEL DO PARQUE (PORTUGAL)

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### ABSTRACT

The São Pedro do Sul medical spa is one of the driving forces behind the development of the region. All the activity of the medical spa is based on the hydromineral resource available: natural mineral water, which is a groundwater of the sulphureous type and hot. For the entire medical spa process to work normally, there is a strict notion that the natural mineral water exploited in the abstractions cannot, in any way, change its physical-chemical quality. At the same time, in the proximity of the medical spa there is continuous urbanistic pressure, especially for new equipment, such as the desire to build new hotels, or improve existing ones, with the inclusion of new aqualudic spaces, among others. This activity associated with territory occupation, in the proximity of natural mineral water abstractions, can potentially interfere with local groundwater, and even potentiate the contamination of the hydromineral resource. It is in this context that this paper is carried out. Thus, in this work, after an item "introduction", relatively very developed, with the presentation of the importance of the subject and the legislative framework, a concrete case is presented, which is the intention to build new outdoor pools, to be associated with the current Hotel do Parque. The various legal bureaucratic procedures associated with technical-scientific aspects are presented, and it should be noted that the new intention (construction of new pools) had a favourable technical report but imposing some changes to the project and fundamentally requiring the installation of special piezometers, to monitor the quality of groundwater in the proximity of the future pools, over time. In the following, the morphological, geological and hydrogeological aspects are summarized, and in some detail, elements of the design/construction of the piezometers are presented, as well as the results of the quality of the groundwater intersected with them. Finally, the main conclusions and recommendations to be considered in the future are mentioned.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **IMPLEMENTATION OF AUTOMATION AND ROBOTIZATION ELEMENTS IN THE PRODUCTION OF WOOD BUILDINGS**

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### **ABSTRACT**

Advances in automation and robotics in construction also affect wood-based constructions. To some extent, scale and complexity, this transformation will be as fundamental to humanity as no other technological change in the past. In the context of sustainable and efficient construction, traditional material bases such as wood are becoming increasingly prevalent and implemented in modern design processes and design solutions. The great potential of this building material is achieved due to developments in production as well as the actual construction of timber buildings. Especially through prefabricated and solid wood products, which are also cross-glued laminated timber products, modern timber construction represents an interesting and sustainable construction technology. The aim of this paper is to define the basic aspects of industrial building industry in the context of new trends and to introduce the possibilities of implementation of elements of industry 4.0 in the field of wood-based construction.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYSIS PROCESSES OF SELECTED WOODEN BUILDINGS**

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### **ABSTRACT**

Possible ways of production and construction of wooden buildings are diverse. At the beginning of the planning process, the main question for the investor is the choice of construction technology and materials for its construction. With this investment decision, it is not enough to take into account only economic criteria, such as construction, operation and maintenance costs, or financing costs. It is also the construction-physical, technical and ecological criteria that affect the overall success of the building. During construction, the funds made available to investors are tied for a long period. When planning, the issue of costs when choosing a construction method and building material is very important. Comparison of construction methods in terms of construction speed and costs on the basis of already implemented wooden constructions is possible only to a limited extent, because constructions differ in terms of its local construction conditions, architecture, construction, use, properties of building elements and building costs. Only consideration of the same building allows for a realistic comparison and subsequent meaningful investment decision. Within this work, such a comparison is performed on a wooden family house. Here, a distinction is made between the construction of piece elements and prefabricated parts. Qualitative comparison of construction methods presupposes the same or comparable functions and its components.

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## THE YOUNGEST CITY IN CZECHOSLOVAKIA

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### ABSTRACT

The post-war atmosphere in Czechoslovakia, the rejection of economic aid from the West and the preference for an orientation towards the East foreshadowed the development of construction and architecture, which was particularly evident in the economically developed border areas of the country, for example in the industrial region of Ostrava. The concentration of coal mines and steel mills was an ideal place to build new towns for the newly arriving heavy industry workers. The newly built satellite estates of Ostrava attracted modern and healthy housing ideal for daily relaxation and entertainments. The proximity of the water reservoirs Žermanice and Těrlícko in the foothills of the Beskydy Mountains offered suitable facilities for recreation. Havířov was one of the satellites, which was declared an independent town in 1955 due to its larger size. The name of the town Havířov was chosen in a national competition and can simply be translated as the town of the havirians (coal miners). Havířov was indeed the youngest town. Both in the year of its foundation and in the average age of its inhabitants. The town developed along the original imperial road connecting two duchies – Opava and Těšín. Along this historical axis we can trace the development of buildings and the change of architectural styles throughout the second half of the 20th century. The growth of Havířov into a city of nearly 100,000 people was reflected not only in the need for new housing, but also in the need for public amenities – schools, community centres, department stores and railway and bus stations. The significance of the town and the whole region is written into the architectural form of the settlement. Here we can encounter architecture from post-war functionalism through Stalinist socialist realism, Brussels modernism to Husák's prefabricated normalization. Havířov was one of the protégé cities of the past communist regime, whose planned construction was determined by the state's public interest in the development of the Ostrava-Karviná region. Social changes in the form of the Velvet Revolution in 1989 and the loss of demand for heavy industry came as a shock to the region, which it has been struggling to cope with for three decades.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STANDARDIZED TEMPORARY STRUCTURES AS A GENERATOR OF TEMPORARY URBANISM DEVELOPMENT IN SARAJEVO

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### ABSTRACT

Advantages of using temporary structures in emergencies were most emphasized during the Covid-19 pandemic, where the need for fast construction and low-cost buildings became the primary requirement. In addition to emergency use, temporary facilities can significantly contribute to the positive transformations of city districts and improve the cultural and social life of residents. However, the government in Sarajevo never proposed solutions involving temporary structures in emergencies, although there was a considerable need for their application in the last two years. With its linear organization of the city, precious historical heritage, unregulated illegal construction, and poor concept of urbanization, Sarajevo is an extraordinarily complex area for any new interventions and transformations. Therefore, applying temporary structures in such a complex urban matrix could be easily interpreted as positive or negative transformations. Unfortunately, the current use of temporary structures has been reduced to the organization of various temporary sales pavilions that most often degrade the city's image and represent negative examples of the transformation of urban zones. For this reason, one of the aims of this paper is to investigate unified, standardized temporary structures that could be used in both previously mentioned situations. These aspirations led us to the following research question: "Which kind of standardized temporary structure could positively contribute to the activation of urban zones and improve the living standards of Sarajevo citizens, but also be used in case of emergency?" The following types of temporary structures were analyzed in this paper: tent constructions, prefabricated modular containers, transport containers, prefabricated wooden buildings, and deployable bar structures. The analyses were conducted according to criteria divided into two groups. Temporary structures were compared according to the first group of criteria, and these analyses resulted in the selection of prefabricated modular containers and deployable bar structures for further analysis. This paper expands criteria established by authors who have previously researched these structures with new parameters, such as system adaptability, local stability of elements, aesthetics, impact on the urban image, system mobility, etcetera. Analyses results point to deployable bar structures as most suitable for the application as a standardized structure. Further analysis was conducted to create guidelines for location selection in Sarajevo and set up the framework for analyzing both advantages and disadvantages of temporary structure applications at these locations. An analysis led us to conclude that applying temporary structures could significantly improve temporary urbanism in Sarajevo and living standards in inactive urban areas further from the town center. Furthermore, we have concluded that temporary camps should be located closer to the town center in emergency cases due to specific infrastructure needs, and this paper assesses some of the potential locations that are not investigated before. Conducted analysis in this paper has proven advantages in using deployable temporary structures, but these structures are in different development stages, and it is essential to update analysis results with structure developments.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SEDIMENT REDISTRIBUTION AT A RIVER MOUTH: THE CASE OF LIGNANO SABBIAADORO

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### ABSTRACT

Italian natural coastline is almost 7500 km long, with over 60% of low-lying coastal areas, 70% of which is represented by sandy coasts for a total length of about 3200 km. Italian beaches are an invaluable resource, both from an economic and an environmental point of view. Currently, a large portion of Italian coasts undergoes erosion processes, mainly concentrated along the sandy beaches which are usually more vulnerable to the combined action of waves and currents. In the light of the previous considerations, a situation of generalized erosion of a sandy shoreline can signify a problem both from an environmental and an economic point of view. To preserve the present condition of sandy coasts, coastal protection structures are often required also in combination with periodic nourishment, which aim to locally restore the beach. In order to better plan and manage nourishment interventions, an in-depth understanding of the dynamics of coastal sediments is very useful, facilitating, for example, the identification of optimal borrow sources, from which the sediments should be taken. Where coasts are in a dynamic equilibrium condition, the beaches are usually eroded by storm surges during winter season, they are re-supplied through sediments carried into the sea by the rivers and finally reshaped by less intense and more frequent wind waves. In the study of sediment transport, one of the most important factors is certainly the bottom shear stress, which influences both the pick-up of the grains and their deposition as soon as the stress decreases under a limit value. During floods, the river flow often produces bottom shear stresses able to stir up the sediments and to carry them along its course towards the sea. At the mouth, with the development of the turbulent jet, velocity of the current tends to considerably reduce and consequently also the shear stress decreases. Therefore, sediments are usually deposited at the edges of the mouth jet, forming the mouth bar with a typical rounded shape, similar to the shape of the jet. Later, sediments are re-suspended by the combined action of tidal currents and wind wave motion, and redistributed along the coast or carried offshore. The present study focuses on the Italian coast of the Northern Adriatic Sea, where the Tagliamento river carries its sediments toward the beaches of the tourist resorts of Lignano Sabbiadoro on the East and Bibione on the West. In particular, we have tried to understand how the sediments transported by the river are redistributed along the 8 km long beach of Lignano Sabbiadoro, in order to optimize the beach nourishment work. In the light of this, a morphodynamic – spectral coupled model has been applied to the last reach of the Tagliamento river and a portion of the Northern Adriatic Sea surrounding the coast of Lignano Sabbiadoro. The main aim is a deeper understanding of the sediment motion along the coast as the result of the combined effect of river flow, tides and Bora and Sirocco winds, that prevail in this area with very different intensities and directions.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DEPOSITIONAL AND EROSION EFFECTS OVER MEDIUM OR SHORT TERMS: THE CASE OF LIGNANO BEACH AND INLET MORPHOLOGIES

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### ABSTRACT

The evolution of a tidal inlet and its associated morphologies is the result of the complex non-linear interaction among different factors: tidal level fluctuations, the corresponding tidal currents and the nearshore propagation of wind waves generated on deeper waters. The wave motion adds hydrodynamic forcings that induce long-shore currents within the surf zone. The corresponding sediment transport necessarily involves the tidal inlet, in particular during more intense but less frequent sea storms, while the oscillating and repeated tidal motion reshapes the material deposited near the inlet. The wave motion is a dominant process on the dynamic balance of coastal environments, as the current is important in river processes and tides are the driving force for a lagoon. The morphological evolution of tidal inlets is not characterized by the prevalence of a single phenomenon, but it is the result of simultaneous presence of both riverine and maritime hydraulics mechanisms. In this sense, lagoons are identified as highly dynamic and very complex transitional environments. Each hydrodynamic component acts with different time scales: tides repeat periodically every 12-24 hours and constantly reshape the bottom profile over time. Less intense but more frequent wave components also act in the medium-long term. On the other hand, an intense sea storm can last only a few hours or days, but it can have important effects also in the long-term period. In order to study a possible morphological evolution of a lagoon inlet and the surrounding morphologies, it is necessary to understand which events combination should be considered, and the most determinant components in the sediment transport and therefore in the depositional or erosive trend must be evaluated. The Marano and Grado lagoon has been taken as a case study. It is located in the North Adriatic Sea, between the river mouths of the Tagliamento to the West and Isonzo to the East, and it spreads over an area of about 160 km<sup>2</sup>. The connection with the open sea occurs by means of six tidal inlets; the Lignano inlet in particular, the westernmost one, has undergone substantial changes in recent decades, and the adjacent beach is subjected to annual consistent dredging and nourishment operations. An attempt has been made to define the average year in terms of wind speed, direction and associated tide, by means of the analysis of the data measured by local anemometric and tide stations over the past 20 years. Afterwards, the morphodynamic effects on the Lignano inlet and nearby morphologies induced by an average year and some significant sea storms have been compared, by means of a 2DH shallow water hydro-morphodynamic numerical modeling. In particular, the sediment erosion and deposition on the Lignano beach and ebb tidal delta terminal lobe have been evaluated. Two main purposes have been taken into account in this work. First, an insight into the relative weight of different forcings on the medium-long-term evolution of the inlet and its nearby morphologies. Secondly, the comparison of the relative importance between an average year and a single significant sea storm.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **MONITORING OF ARCHITECTURAL DESIGN AIMED AT IMPROVING THE SOCIAL IMPACT AND MANAGEMENT OF MIGRATION EMERGENCIES**

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### **ABSTRACT**

In the coming decades, the countries bordering the Mediterranean will increasingly face issues related to emergencies arising from massive migration flows, economic problems and environmental emergencies. Therefore, it seems necessary a programmatic organization of innovative aid interventions aimed at responding to the needs of survival and sustainable development. The contribution presents a monitoring system of architectural interventions aimed at resolving emergencies within the Mediterranean basin through the creation of a digital control tool, which is embodied in a matrix of Logical Framework Approach (LFA), an expedient able to identify general objectives, specific goals and actions necessary to help a community in an emergency phase. With respect to the actions pursued so far, it is noted that architectural/technological design is not directly involved in the planning/management of intervention for disadvantaged communities. Starting from the assumption that the "law to asylum" should be universally extended, new technological models of digital monitoring of reception and shelter interventions have been prefigured, thanks also to the study of the state of the art of innovative solutions and international reference designs. The development of a digital monitoring system of relief interventions in an emergency area, whether it be an area affected by a natural disaster or a shelter for immigrants, becomes a necessary methodological approach to trigger social renewal. Through monitoring and control, thanks to a matrix filing (LFA), more and more effective and innovative project interventions were obtained. The methodology adopted can be summarized in the following main points: a. Insight into the main international aid interventions within the Mediterranean basin; b. identification of a digital monitoring and intervention tool that meets the requirements of the Logical Framework Approach (LFA) matrix tools; c. Application of the LFA matrix to a pilot project; d. Definition of innovative technological solutions to implement the material and construction quality of the emergency architectures, in compliance with current regulations and energy classification protocols (activehouse, leed etc). The aims of the research can be synthetically traced in raising awareness at European level of the problem concerning the phenomenon of migration and related attention to the architecture of emergencies and sharing a homogeneous digital monitoring tool for all those projects in favor of disadvantaged communities in the Mediterranean basin, which can lay the groundwork for effective planning of incisive and cutting-edge measures.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ACQUISITION AND ANALYSIS OF DATA OF A HISTORICALLY SIGNIFICANT BUILDING USING DIGITAL PHOTOGRAMMETRY

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### ABSTRACT

The aim of the paper is to bring new knowledge from ongoing specific university research. As part of this project, optical data collected locally and historically significant states of the chapel in Horní Nivy were collected using aerial and ground digital photogrammetry. The obtained data were subsequently analyzed for the needs of creating a virtual model. Data was generated from individual photographs as a point cloud. With regard to the parameters of the object, the data were captured partly from the ground using a camera and partly from the air using a camera mounted on a drone. By combining the exterior and interior model and removing unwanted points (noise), a model - a digital twin building - was developed. The created model serves as a basis for the processing of construction technical and construction historical research.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ANALYSIS OF THE EFFECTS OF EVACUATION CHOICE AND WAITING TIME IN QUEUES ON EVACUATION CROWDS IN UNDERGROUND STREETS DURING A DISASTER

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### ABSTRACT

Underground malls, which have become increasingly large and complex in recent years, have become important pedestrian spaces that attract an unspecified number of visitors. Therefore, it is necessary for underground malls to properly secure such urban functions, while at the same time promoting disaster prevention and mitigation measures against large-scale earthquakes and the resulting tsunamis. In order to evacuate many visitors safely in the event of a disaster, it is effective to predict their evacuation behavior in advance and to remedy any evacuation problems. However, it is not realistic to set up a disaster situation in a large-scale underground mall and conduct experiments in which visitors are actually asked to take evacuation actions. A multi-agent system is effective for understanding evacuation behavior. In this study, a multi-agent simulation model that takes into account the behavioral characteristics of individual visitors and their interaction in an underground shopping mall is constructed, and simulations are performed. The results obtained from the simulation are then analyzed. In order to construct a multi-agent simulation model that reproduces evacuation from the underground mall, the results obtained from the questionnaire survey are reflected in the simulation. In addition to these, we will compare two different models, one for visitors' choice of evacuation destination and the other for the time they can wait in a queue, and analyze and report the impact of each factor on crowd evacuation. By conducting this study, it will be possible to provide information that will contribute to future disaster preparedness planning and evacuation drills.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PROCESS MODELING METHODS IN CIVIL ENGINEERING

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### ABSTRACT

The civil engineering domain is going through changes that require the handling of increasingly complex processes. Still, more often the processes can no longer be handled intuitively without explicit description. Even the process description in a textual form very often no longer provides information of sufficient quality to deal with the process. For that reason, the process modeling methods that use graphical notations are more widely used also in the civil engineering domain. Using such process modeling methods brings many advantages. These advantages include that the knowledge of the process is easier to transfer, identified activities of the process can be easier to measure, it is easier to define data that are required or produced by activities, or possible decisions in the process are explicitly shown. The wider use of process modeling methods within the civil engineering domain began with the implementation of building information modeling principles in the civil engineering domain, especially in the AECO industry. The need to design the entire process of collecting, storing, transmitting, and processing BIM data requires to design and describe the entire BIM process. This paper presents an overview of commonly used process modeling methods and their applications in the civil engineering domain. The most commonly used standard for process modeling worldwide is Business Process Model and Notation and this standard is also commonly used in the civil engineering domain. It can be expected that in connection with the development of the civil engineering domain towards the usage of digital twins and modeling of the built environment, processes will be more complex and will require more sophisticated process modeling methods.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**REQUIREMENTS ON THE DATA STRUCTURE FOR STORING DATA FROM MEASUREMENTS OF THE DATA ACQUISITION PROCESSES FOR CREATION OF 3D DIGITAL MODEL OF BUILDING USING PHOTOGRAMMETRY**

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**ABSTRACT**

Photogrammetry is one of the optical methods that can be used to create a 3D digital model. It is becoming popular for the creation of 3D models of existing buildings as an effective method. Equipment for data acquisition for photogrammetry is significantly cheaper than equipment for 3D laser scanning. However, the process of data acquisition for photogrammetry can be a time-consuming process that may be necessary to measure for many reasons. Among these reasons belong the cost estimation or potential process optimization. The process of data acquisition for the creation of 3D models of an existing building using photogrammetry can be decomposed into many particular activities. Some of the activities are obvious, such as taking photos using a camera or taking photos using a drone, and some of the activities are less obvious and become evident after the analysis that requires observation of more instances of the data acquisition process. Each particular activity of the data acquisition process requires time resources, and it can be expected that the amount of time required can be influenced by many aspects. These can be characteristics of the building of which the 3D model will be created, the experience of the person who performs the activity, weather conditions, etc. To reveal the influences on the time resource requirements for the particular activities of the data acquisition process, several instances of the process activities must be measured and the data of these measurements must be stored for further analyses. To store measured data about particular activities of the data acquisition process, the data structure must be designed. This data structure must be able to store the measured required time for particular data acquisition activities and also the aspects that may influence the time resource requirements for particular data acquisition activities. The paper describes the requirements on this data structure.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## USING OF STATE APPROACH IN PROCESS MODELLING IN CIVIL ENGINEERING

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### ABSTRACT

Process modelling has become an integral part of the field of civil engineering, especially due to the need to ensure a formal framework for the field. Due to the huge financial flows within the AECO industry and the importance of the industry, it is not possible to carry out individual processes on an ad hoc basis, but it is necessary to have them properly mapped - and this is exactly what the process models are for. Traditional modelling methodologies and tools are used for process modelling, especially BPMN. Despite the fact that this is a sophisticated and robust methodology, it turns out that it is not always appropriate, especially in cases where the use of the behavioral approach itself, i.e., the approach that perceives the process as a sequence of activities, fails. These are, for example, situations where we are not able to precisely define the sequence of individual activities. The behavioral approach also does not consider in-process measurement or continuous improvement, because it does not monitor any parameters, but only describes follow-up activities. It is therefore necessary to consider a different approach which would perceive the process other than as a simple sequence of actions and activities. One of the possible approaches is the state approach, which perceives the process as a transition between the initial and final state, or between individual intermediate states. This approach has been developed by the authors for several years, the application in the AECO industry is a logical application of the approach, which could mean its significant expansion, especially if the condition of improving software support for this approach to modelling is met. The state approach in the AECO industry has the potential to bring the possibility of effective process management, even those that pose a problem for behaviorally oriented methodologies. At the same time, it is possible to count on a tool that will enable the measurement and evaluation of processes, both individually and within statistical processing. This work provides basic considerations on how the state process can be incorporated into the AECO industry.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## SHIFTING FROM DEMOLITION TO DISASSEMBLY: A HYBRID TIMBER-STEEL MULTISTORY RESIDENTIAL BUILDING FOR CIRCULAR DESIGN

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### ABSTRACT

The construction sector plays a significant role in the high energy consumption, waste generation and carbon emissions. To reduce these emissions, we must begin by changing the way we design, plan, and build our environment. This research study revolves around the idea of applying circular design principles to the built environment, whereby buildings are conceived as recyclable and reusable banks of materials. We focused on applications within the Turkish context, because building sector is responsible for more than 35% of the country's total final energy consumption. The selected building is an 9-story RC building located in Izmir, redesigned with CLT floors and GLT columns and beams offering the possibility of a design strongly resembling the original architecture. The lateral-force resisting system is based on specially concentrically braced frames, and the architectural implications of choosing this system are discussed. Fire design was considered to provide practical guidelines for the design of timber buildings in Turkey. Evaluation parameters include easiness of construction, price, potential for disassembly, mass, and carbon footprint. Each apartment was designed different size for different users' demand and adaptable for different future scenarios, in line with the idea of flexible spaces. From the lessons learned from the design process, the relevance of considering the carbon footprint in combination with the design decisions seems to be the key to introduce circular projects in places like Turkey. This is because not all decisions are based on achieving the lower embodied carbon factor, but on those that increase the potential for disassembly, throughout the life-span of the building.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STRUCTURAL-PARAMETRIC SPATIAL TRANSFORMATIONS OF CITIES - REGIONAL CENTERS OF THE WESTERN REGION OF UKRAINE IN THE POST-SOVIET PERIOD

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### ABSTRACT

The purpose of this study is to analyze, identify trends and assess spatial transformations in selected cities. A model of five-dimensional space is used, which includes dimensions "man - conditions - functions - geometry - time". Based on the model of five-dimensional urban space and the interaction of dimensions, a system of architectural, engineering, social, environmental, economic and aesthetic indicators was identified. The characteristics and analysis of structural and parametric transformations in selected cities of the region of the post-Soviet period were made. Assessment of transformations in cities - regional centers of the region indicates problems, conflicts and inconsistencies in change: lack of coordinated policy within the newly created territorial communities; territorial (uncontrolled urban sprawl, overcrowding, deterioration of the functional structure of territories); ecological (change in the amount of landscaping); exacerbation of transport problems (lag in the development of streets, quality and development of the network); destruction of industry and structure of activity; social (demographic, migration, comfort of community relations, mentality, quality of services); preservation of historic buildings; aesthetic and spatial (change of image, loss of old symbols and acquisition of new ones, structure and composition of spaces); engineering and technical (aging of networks, cleaning and maintenance); city resource management (uncontrolled processes). It is emphasized that there is no single strategy for urban development. There is a particular inconsistency of socio-economic and urban planning documents. The lack of an effective document for the management of urban processes and management "in manual mode" causes unsystematic changes, the destruction of the basic principles of urban development, creates irreparable urban planning errors in their development. Generalization of the results of analysis and evaluation of structural and parametric transformations in cities indicates the growth of disorder in urban life and the growth of its dynamism, there are spaces of different attractiveness in functional, social and aesthetic terms. In general, the changes lead to the deterioration of socio-ecological and economic parameters and architectural and aesthetic characteristics of cities. Comparison of transformations in selected cities - regional centers of the region indicates the phenomenon of fluctuation as an accidental (unreasonable) deviation of a quantity (process or phenomenon) from the average value in individual cities. This phenomenon needs a separate study. Analysis of processes, problems and structural-parametric transformations in the urban space, their assessment should be the basis of a new methodological approach to substantiation of strategic and updating urban planning documents of urban development. There are requirements for developers of urban planning documentation: the organization and development of cities as a system should be focused on increasing the efficiency of time, material resources and human potential; the development of cities on the basis of knowledge of problems and ways to solve them, including world experience, should be associated with the disclosure of their uniqueness.

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05 -09 September, 2022 - Prague (Czech Republic)

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## **SOCIAL IMPACT AND URBAN QUALITY: GRAPHIC REPRESENTATION TOOLS FOR INTERPRETATION AND INTEGRATED DESIGN**

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### **ABSTRACT**

The contribution proposes an ongoing part of a larger work that will be completed in the coming months. The pretext is the update of the evaluation of the social return on investment index carried out in 2015 by the Turin-based Fondazione Sviluppo e Crescita CRT with Politecnico di Torino. In 2021 it will be ten years of activity for Sharing, the first example of social housing in Turin, and so we have decided to give an up-to-date reading of the social return by defining an assessment model that on the one hand makes the process of data collection and analysis more rapid, and on the other includes in the study variables of a broader context, at the scale of the neighbourhood, incorporating parameters and indicators of urban quality and resilience, always read through the filter of social impact. The evaluation model being prepared is intended to be light and simple to apply, while maintaining transparency, representativeness and significance. The objective is twofold: on the one hand to read the evolution of this node within the urban fabric in which it lives. On the other hand, to define an evaluation tool that can operate in the monitoring of different interventions (which will obviously also need to have variables sewn up case by case), but that can also provide elements to identify in advance, ex ante, those social and territorial realities that could support the success of the investment in terms of social impact. This is a field in which social impact must be linked together with local actions and urban infrastructure triggers, involving public and private actors. The survey and the urban project see illustrious references in the research; in particular, significant perceptual approaches will be highlighted through authors, visual approaches linked to the reading of urban space, scenes collected apparently in an extemporaneous manner, in a rush, dense with layers of reading, as well as analytical approaches, which break down the image of the city and operate synthesis at different levels of interpretation. The research group's attention is also focused on the codes of representation, the graphic language that gives access to knowledge and enables the conception and realisation of conscious projects. Urban survey is a lively field of research, sensitive to innovation in methods and tools of investigation. Access to an ever-increasing range of data makes it possible to answer complex questions about the use of urban space and the social impact of its quality.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE ROLE OF HUMAN FACTOR FOR URBAN INFRASTRUCTURES

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### ABSTRACT

There are few studies that relate resilience and the role of urban infrastructures in a pandemic crisis. The main objectives of this paper are to analyse, from a Civil Engineering and actors' perspective the role and behaviour of urban infrastructures for the maintenance of the population's wellbeing in a pandemic crisis. In order to achieve the objectives, a review of the recent literature was carried out. As a result, it is shown that, alongside the technical issue, the human factor is vitally important in the functioning of the entire urban system so that infrastructure does not collapse in a pandemic situation. It is also concluded that, in a situation of a pandemic crisis, the professions that are generally considered to be "inferior", humbler, are precisely those that play a fundamental role.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ALGARVE DRY STONE WALLS – A RESILIENT FORGOTTEN CONSTRUCTED HERITAGE**

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### **ABSTRACT**

Algarve, the southern district of Portugal, is a well-known touristic destination, since the 70s of the XX century. Nevertheless, the regional economical bases are founded upon agriculture and fishery primary sector. Algarve's lithology and geomorphology are very diverse, giving place to different landscapes, being distinguished into three zones, i.e., a narrow beach coastline touching the Atlantic Ocean, followed by a strip of very fertile soils terraces and finally a larger area constituted by smooth hills and mountains. Although agriculture is still an important motor of the region economy, the main producers are located on the fertile terraces and the traditional subsistence agriculture performed on the northern region was practically abandoned, as well as the dry stone walls used to level the slopes and create small terraces. These were used for agriculture, forestry and goat breeding purposes, but also for soil erosion control, as well as to retain and channel the rainwaters into natural or constructed reservoirs, since this is a semi-arid region and there's a shortage of water. With the rural exodus on the 70s and the replacement of the subsistence agriculture for farming production, dry stone walls face abandon, only still standing due to its resilience. However, the lack of maintenance led to vegetation invasion, and consequently to wall tumbling, compromising their function and the human access to deepest forestry areas. The quantity of dry stone walls in Algarve is immense and not only they make part of the constructed heritage, but they also stand up for climate change mitigation and forest fire prevention, thus an important patrimony that must be preserved. The research hereby presented aims, not only to highlight the importance of its maintenance and rehabilitation for the Algarve territory, impacting on cultural, socio-economical, environmental and sustainability indicators, but also to demonstrate the risks associated to the neglect of these structural elements and future implications.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **DESIGN LAB: ONLINE ACTIVITIES FOR AN ARCHITECTURAL DESIGN STUDIO**

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### **ABSTRACT**

The shift to online learning The shift to online learning, caused due to the pandemic has meant several changes for architectural education. This paper discusses the experiences of adopting online activities for a second-year architectural design studio where students were required to demonstrate achievement of various learning outcomes while working on a design project. In a Design Studio, students engage in an iterative process and work up to their final designs by following an established design methodology that includes site analysis, program analysis, massing etc. However, due to the shift to an online format, ephemeral qualities of architecture, such as space, scale and light, which are usually discussed through activities like field trips and studio interactions, need to be explored in a virtual environment. In order to facilitate this exploration, the studio instructors developed three different online activities, with varying dependence on digital tools that students completed as part of their coursework. At the end of the course students also participated in a survey. Students' responses to the activities along with their comments are presented to review the efficacy of these activities. The discussion includes reflections by the studio instructors and is presented with a review of adaptations that studio teaching has undergone for online / blended formats. Findings indicate that the online format allowed easier record and documentation of the design process and facilitated diverse ways of collaboration. There was a greater focus on the activity and using the outcomes of the activity as compared to the traditional student-instructor interaction. The research is expected to be of value to educators and allows one to consider future directions that may develop with regard to architectural design education in both online and face-to-face contexts.

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**IMPACT OF THE SUSTAINABLE CHALLENGES THAT PROMOTE THE USE AND RE-USE OF PETROLEUM-DERIVED POLYMERS IN ARCHITECTURAL AND FURNITURE DESIGN PRODUCTS**

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**ABSTRACT**

All around the world there is a growing interest in the adequate use of sustainable raw materials, a movement that has generated a new range of products for construction and real estate, based on recycling and reuse of polymers derived from petroleum. Although it was presented as a sustainable alternative, its structural, environmental and public health repercussions that may come with its use are not well known. Colombia, and particularly the Campus of the Pontificia Universidad Javeriana-PUJ, are no strangers to the impact caused by the movement of sustainable materials, within the framework of the environmental responsibility we have as a country and as an academic entity. For this reason, a research project was structured, whose goal is to analyze, from an academic perspective, the possible environmental and health impacts of the use and reuse of materials of polymeric origin (derived from petroleum) in Colombia, specifically in the Campus of the PUJ, on an architectural, furniture and structural level, identifying degradation Factors and their possible impact on the environment, related to the life cycle and environmental exposure. As a result, the materials used in the PUJ were first identified, categorized and classified according to their commercial use and characteristics: vinyl leather, plastic wood, polyaluminium, recycled tire rubber pellets, recycled ABS laminates and polyester textiles. A Volatile Organic Compounds measurement chamber prototype was made with materials that do not affect its measurement (nylon and glass) through 3D printing process, with sensor coupling for the measurement of PM 2.5, PM 10, CO<sub>2</sub>, CO and other VOCs. Testing pieces were manufactured from the chosen materials (5mm x 30mm x 90mm approx), for structural testing (compression, traction and bending), as well as exposure to environmental factors such as temperature, ultraviolet light and friction, in addition to microbiological measurements. The preliminary qualitative microbiological results in the plastic wood, showed mostly associations with filamentous fungi. The isolate identified at the morphological level (*Phoma* sp.) is related to fungi that produce plant cell wall degrading enzymes that have the potential to transform some of the components of plastic polymers. Regarding bacteria, the isolated morphotypes are characteristic of those typically found in soil. As for the structural level, the shear and traction tests of three of the materials for architectural use show that the recycled materials have lower resistance indexes (Polyaluminium= 9,508 kPa; Plastic Wood= 6,562 kPa; ABS= 9,028 kPa), compared to virgin materials, behaving as agglomerate-type materials and not as solid structures. Currently, measurements of VOCs continue, as well as measurements for resistance of materials after exposure to environmental conditions. Microbiological analyzes are still continuously being made on the remaining materials. The results obtained will be compiled in the decision-making sheets aimed at professionals in the construction and design sector, contributing not only to the academic fields but also to the scientific knowledge on the impacts caused by the use of these materials classified as sustainable.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EFFECTIVE INFLUENCE OF THE POLYMER POWDER ON THE STIFFNESS REDUCTION OF THE CEMENT-BOUND MIXTURE - CBM

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### ABSTRACT

The aim of the research was to evaluate the influence of polymer modification on the properties of cement-bound mixture (CBM). The article presents the results of research into the influence of polyethylene-co-vinyl acetate (EVA polymer powder) on CBM properties. The material used is a copolymer based on vinyl acetate and ethylene with additives. By mixing RPP and cement together, a new polymer-cement binder can be obtained. The applied polymer-cement binder forms the matrix of the mixture. The planned scope of research was carried out on the basis of a three-level two-factor experiment plan. The amount of Portland cement and polymer powder varied in three levels from 0% to 4% in 2% steps. Eight different mixes were obtained and coded for analysis according to the number of factors controlled. The mineral skeleton is based on a mixture of dolomite and dolomite-limestone aggregates with a grain size of up to 31.5 mm. The influence of the modifier on the stiffness modulus of the cement-bound mixture was assessed. The tests were carried out at two temperatures: 10°C and 25°C. The results of the analysis show a significant influence of the cement and polymer powder content on the value of the stiffness modulus. An increase in the stiffness modulus was observed with the increase in the cement content in the mixture. The use of a polymer modifier leads to a decrease in the CBM's stiffness modulus and greater sensitivity to temperature changes. The confirmation of this observation can be clearly observed by analysing the change of the elastic stiffness modulus at the maximum amount of Portland cement, taking into account the gradual increase in the amount of polymer powder in the CBM composition from 0% to 4%. The increase in the amount of polymer powder in the composition of the bound mixture, regardless of the test temperature, causes a decrease in the elastic stiffness modulus. Such observations lead to the conclusion that the use of polymer modification in cement-bound mixtures leads to greater deformability, which eliminates the possibility of the mixture stiffening.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PRESERVATION OF ARCHITECTURAL CREATION

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### ABSTRACT

The study of architectural surfaces and materials used in conservation and restoration has seen an increase in interest in recent decades, a consequence of reorienting the taste of the public towards buildings with historical, environmental and aesthetic features. even so from the point of view of evolution, the conservation of surfaces has evolved slowly, for economic and technological reasons, little known to restorers. The scientific papers in this field address those topics that almost always answer some especially applicative questions and which tend to clarify details reflecting the nature of the materials and their behavior over time. Manufacturers of restoration materials provide only a part of the information necessary to understand the quality of cleaning, consolidation and protection materials of architectural surfaces. In the field of restoration, manufacturers' indications are quite limited from a practical point of view, even if the places of application, tools and technical conditions for them have been individualised. Further research is needed to provide appropriate solutions to the problems on the ground/'in situ'. But, as a field like this, which attracts the attention of lovers of beauty, of specialists, is still in full development, it is explainable why ambiguities arise, impressions expressed outside the context and unknowingly, but also undeclared economic interests, which can push any effort into ridicule. Therefore, the specialists in the field become more sensitive to the new "cultural" trends and eager to explore any historical information, putting it in connection with the physical evolution of the building, to the detriment of the necessary interdisciplinary studies, which bring concrete clarifications on the conservation state and can indicate the coherent solution of restoration / conservation of the architectural surfaces, both indoors and outdoors.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PREVENTIVE CONSERVATION OF ARCHITECTURAL HERITAGE: PROGRESS AND CURRENT STATUS IN CHINA

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### ABSTRACT

Preventive conservation, which originated from the field of heritage conservation in Europe, is a concept developed from modern conservation theories and practices. In the field of architectural heritage conservation, it aims to ensure that the value and historical information of architectural heritage are authentically and completely preserved to the maximum extent through minimal intervention. After being introduced into Chinese academia in the early 21st century, preventive conservation as a professional theory has gradually become a research hotspot with extensive discussions. Although preventive conservation is a foreign concept, throughout Chinese architectural heritage conservation history, a fact can be discovered: some practices in China from ancient times to the present have reflected the concept of preventive conservation. In ancient China, cyclical maintenance and regular repairs were important traditions of architectural conservation. The Qing court established the annual repair system, and there were also craftsmen engaged in building maintenance in the folk. In modern times, in response to the needs of protection and management, some protected cultural heritage entities in China carried out various forms of work such as monitoring and periodic inspection to conduct practical explorations of preventive conservation. Moreover, drawing on the international experience of preventive conservation, professionals preliminarily discussed the related issues of architectural heritage conservation in China. Based on years of research and efforts, the concept of heritage conservation in China is changing from “rescue conservation mainly” to “emphasis on both rescue conservation and preventive conservation”. This paper gives an overview of preventive conservation of architectural heritage in China, including historical context, theoretical research, policies, and regulations. Furthermore, this paper analyzes the current status of architectural heritage conservation in China in combination with practical projects and conducts in-depth discussions of the existing problems, in order to explore effective methods for preventive conservation of architectural heritage in China.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **MEDIEVAL MONASTIC HERITAGE AND CONTEMPORARY REHABILITATION. THE IDEAL BENEATH THE DESIGN, AN ADAPTATIVE RE-USE CASE**

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### **ABSTRACT**

The 11th century Cistercian Order is a true example of a pan-European medieval institution. The Cistercian Order embodies not only the stylistic messages of the past but also is an inspiration for the work of modern and contemporary architects. The medieval monastic heritage can inspire artists and architects to produce new works like Le Corbusier's Dominican Monastery of La Tourette (France) or John Pawson's reformed Cistercian Trappist Monastery of Novy Dvur (Czech Republic). Le Corbusier was inspired, by his visit to the Carthusian Monastery of Ema (Italy) as well as the Cistercian Monastery of Le Thoronet (France), to design and built La Tourette. The english architect John Pawson wrote the book "Minimum" (Phaidon Press, 1996) and also was influenced, by the intensity and sense of order of the medieval Cistercian Monastery of Le Thoronet and was inspired to design the Trappist Monastery of Novy Dvur. St. Bernard's "Apologia" to Abbot William of St. Thierry was written in 1125, this tract was product of the controversy which arose between the Cistercians and the Cluniacs regarding the interpretation of the Rule of St Benedict. The aesthetics followed by the Cistercians and the aesthetics followed by the Cluniacs at that time were entirely divergent. The Cluniac's opulence was challenged by the Cistercian's "minimalism" and austerity. St. Bernard of Clarivaux established a comprehensive blueprint for the construction of Cistercian monasteries which aimed to translate St. Benedict's Rule into Architecture. This blueprint laid out the various territories of the monastery. Architectural design has consequences which go beyond aesthetics. St. Bernard's building program simply recognized and exploited this. St. Bernard's "Apologia" gave to this blueprint the aesthetic requirements, placing emphasis on the quality of light and proportion, restrained detailing and spatial clarity. This paper aims to discuss the importance of the Medieval Cistercian Architectural legacy as well as the influence which this Order had on Architecture since the beginnings in 1098, with the foundation of the Abbey of Citeaux, until the minimalist rehabilitation in 2004 of an ancient Baroque Farm into a new Reformed Cistercian Trappist Foundation. The relationship between Cistercian Architecture and actuality is deeply linked not only to the subject of how to rehabilitate, but also to the adaptative re-use, the actions and the strategies used, as well which are the methods and instruments applied.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**THE "CUBIST" DWELLINGS OF OLHÃO (PORTUGAL): A CASE STUDY ON DEVELOPING SKILLS IN ARCHITECTURAL REHABILITATION DESIGN THROUGH THE HISTORY OF ARCHITECTURE AND TRADITIONAL CONSTRUCTION TECHNOLOGIES**

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**ABSTRACT**

This paper considers the importance of academic research projects regarding the integrated master's degree in Architecture of the University of Beira Interior (UBI), Covilhã, Portugal. Evolution on architectural programs, due to the Bologna Process, oversaw the link between education and research in the young architect's formation. At UBI, the future architect's 10th semester (which is the final semester) comprises a dissertation which can be practical (a full design) or an academic research project (connecting theory and practice) as well as a full semester of Project design. A significative number of these final dissertations tackle academical research projects regarding the built heritage. These are interventions combining education and research, theory and practice, ideas and designs. The Department of Civil Engineering and Architecture of UBI, its staff and students, have developed a concern regarding built heritage. Dissertation themes have focused on traditional aspects of Portuguese architecture and traditional building technologies. This paper brings to discussion a very specific case study. In fact, this reveals a new trend, and a new academic experience, achieved through the connection to the reality. The dissertation research design was being built while the dissertation was being carried out. The traditional Portuguese architecture of the so called "cubist" dwellings of Olhão in Algarve's region (Portugal), and its traditional building technologies, are the core of the research which conducted to an architectural rehabilitation in Olhão. This kind of research project (linking education and reality) will endow young future architects' specific skills. These skills are mainly about architectural rehabilitation, through with the history of Portuguese architecture, building engineering physics, traditional construction technologies, and local materials. This paper will tackle this research, focusing on objectives, methodologies, and results, which will be presented, and open to discussion, providing a debate on the results and experiences that outcome from the actual concretization through a real case of rehabilitation design of a "cubist" dwelling in Olhão.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**SLATE STONE VILLAGES NETWORK: RESEARCH AND ADAPTATIVE RE-USE REGARDING MARTIM BRANCO'S BUILT HERITAGE (CASTELO BRANCO, PORTUGAL)**

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**ABSTRACT**

Portuguese vernacular and popular architecture, mainly the Slate stone Villages located in Portugal's Interior East are the subject of several case studies. The creation of the Slate stone Villages Program in 2001 enhanced the value of these Villages by structuring the territory with the establishment of a network that uses of what is highlighted in each village, regarding what it has to offer, and what can be done and studied according to new uses, adaptative re-use, inventorying the built heritage or constructing memories upon the immaterial heritage which still can be discovered. The Village of Martim Branco (Castelo Branco, Portugal) is one of these villages which was a case study at the University of Beira Interior in one of the final dissertations in Architecture. Initially a theoretical approach was accomplished regarding the vernacular or popular architecture in Portugal to frame Martim Branco's in this architectural background reference with a proper research methodology, which included among other the individual survey of each building. Then the adaptative re-use was considered and a rehabilitation of a significant number of buildings was considered. Such architectural rehabilitation was intended to accommodate visitors who seek experience the way of life of a quiet village, but full of greatness in customs, traditions and a distinctive set of built heritage examples. This study case culminates in a proposal of architectural rehabilitation which supports tourism (that is essential for the economy of the region and for the connection between villages) fulfilling the objectives of the Slate stone Villages network. This paper is a tribute and a contribution to a better knowledge of the Slate stone Villages and aims to bring to this encounter a fully constructive debate on the Slate stone Villages built heritage.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **EVALUATION OF STRUCTURAL DAMAGE DUE TO LANDSLIDE IN THE PACCHA TOWN AND MITIGATION MEASURES FOR AFFECTED STRUCTURES**

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### **ABSTRACT**

This article is a structural record of the houses of the Paccha head town and the Baguanchi area in the city of Cuenca, Ecuador. Sectors that are classified as high-risk areas by landslides, whose objective is to evaluate the real and current structural situation of the houses, through a visual analysis where all the characteristics of the structural system, the quality and the year of construction can be rescued; in order to find the structural damage index through the structural monitoring methodology established by the company Consultores en Ingeniería y Medio Ambiente CI Ambiental SAS. After the collected data was introduced to a specialized structural software to evaluate the behavior of the structure through a nonlinear static analysis (PUSHOVER) until reaching a performance level of Immediate Occupancy for a general slight damage according to FEMA 356. The creep sequence of each plastic patella was analyzed by establishing mitigation measures for the affected houses. In addition, the characteristics of the structures will be reflected in georeferenced maps in a Geographic Information Systems (GIS) program to obtain a database of the current state of the houses integrating the current landslide risk area, levels established by the "PLAN DE ORDENAMIENTO TERRITORIAL DEL AÑO 2020" of the Paccha town. Finally, a comparison will be made between the landslide risk level established in the existing risk map and the effects caused by this phenomenon on the structures to analyze the behavior of the structures of known characteristics in the different risk levels in each evaluation zone.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## NUMERICAL ANALYSIS OF POINT-SUPPORTED GLASS PANELS SUBJECTED TO STATIC LOADS AND SOFT BODY IMPACT

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### ABSTRACT

The paper reports the results of an extensive numerical campaign, in which two point-supported elements made of laminated glass are investigated with FEM. The first element is a typical, horizontal roof panel 3000×1500 mm<sup>2</sup> supported at six locations and subjected to static, nominal uniformly distributed load. The second element is a free-standing glass balustrade 900×1900 mm<sup>2</sup> mounted to the structure via four point supports subjected to soft body impact. Four types of fixings are investigated: a disk fixing, a countersunk fixing, a bonded disk fixing and a countersunk fixing on a single layer. The main analysis is aimed at the investigation of the influence of different point supports on the stress in glass. In addition, for a selected connector a comparative analysis using two FE software (RFEM, SJ MEPLA) and an analytical method presented in DIN 18008-3 is performed.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **IMPACT OF THE SHAPE OF A (TENSIONED) MEMBRANE CEILING ON THE ACOUSTIC CONDITIONS IN A ROOM**

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### **ABSTRACT**

The phenomenon of reverberation has a significant impact on the acoustics of the interior of a given object. When designing interiors, reverberation time cannot be measured, and therefore computer simulations or theoretical models are used. In the article, the analysis was carried out in a dedicated computer program ODEON. Six rooms with a different shape of the ceiling covered with a membrane were simulated in the program. On this basis, the impact of the shape of the ceiling covered with the membrane on the acoustic properties of the room was determined. The obtained results demonstrate that the shape of the ceiling covered with a material having very high sound absorption coefficient in the room (3) affects reverberation time. The shorter the reverberation time in the room (2) and (3) and the closer the sound source P1 and P2, the higher are the values of the STI index.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **BUILDING INFORMATION MODELING FOR CONSTRUCTION PROJECT MANAGEMENT: A LITERATURE REVIEW**

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### **ABSTRACT**

Over the last decades, Building Information Modeling (BIM) has increased its relevance to construction project management to improve the construction projects' outputs and the integration between stakeholders. BIM is undoubtedly a tool used worldwide and has become practically a standard in construction project management. However, despite the relevance of BIM for construction project management, no literature review has been conducted to unravel this relation. This study introduces a comprehensive understanding of the nexus between BIM and construction project management and its evolution. A screening process resulted in 166 peer-reviewed papers retrieved from Web of Science. Findings demonstrated that the incorporation of BIM in the construction project management literature still being incipient starting in 2010. Overall, this research agenda has been strengthened especially since 2017 driven by China and three traditional developed English-speaking countries (the USA, England, and Australia). The implementation of BIM within the construction project management literature is evolving from traditional drivers of monitoring/control such as schedule to more complex and multidimensional topics such as sustainability, lean construction, and optimization. The network representation revealed five clusters, each related to one or more subject groups defined in the project management body of knowledge. Overall, the most representative subject groups supported by the BIM implementation in construction project management were integration, time, and cost. Interestingly, the most representative process group is implementing/executing revealing the role of BIM as an enhancer of the development of the project's activities, contrasting with the traditional project management literature focused mostly on the planning process group.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CONTRACT RENEGOTIATIONS IN PPPS: EVIDENCE FROM ITALY

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### ABSTRACT

Public-Private Partnership (PPP) has gained participation among the project deliveries because of its life-cycle approach incorporating the design, construction, and long-term operation of public infrastructure. Despite its multiple strengths, PPPs projects are characterized by heterogenous time and cost performances because of the frequent occurrence of missed deadlines and cost overruns. These heterogeneous performances vary among the multiple types of PPP such as Build Operate Transfer (BOT) and Build Lease Transfer (BLT), each, with different contractual characteristics. Contrasting with the diversity of projects and outcomes among PPP projects in Italy, the public sector establishes homogeneous risk' probability and impact for risks that PPP procurers must adopt in their risk management plan. These standardized values contrast with the heterogeneity of performance among different settings within the PPP sample given the different probability of risks occurring in the different types of PPP contracts. The risk assessment phases (i.e. identification and quantification) are both carried out not ex-novo by the technical management of the contracting authority but following the standard models with relative probabilities and impacts calculated on a one-off basis. Specifically, the standard probabilities and impacts employed in Italy are related to a 2009 non-public study based on PPPs between 2000 and 2007, which represents an outdated small sample size. This methodology allows public technical departments to rely on risks that have already been identified, but which are only analyzed qualitatively and, above all, only for construction risk. Moreover, the risk matrix derived from this standardized approach provides stakeholders with a wrong view of project risks. In this study, therefore, the authors uncover the main issues related to the risk management phases in PPPs in Italy and the possible quantification of the risk. This paper aims for analyzing the PPP projects developed in the last three decades in Italy to establish the probability of occurrence of cost overruns derived from renegotiations among multiple types of PPP contracts. Findings revealed the probabilities of occurrence obtained through the analysis of the frequency of renegotiations turn out to be different between a BOT and a BLT, and among different types of infrastructure. The Italian PPP market demonstrated to be prompt to renegotiations. These often negatively characterize the development of a project, both in terms of time and in terms of extra costs. In this research work, "variants" and "suspensions" of works will be understood as renegotiations, as the Italian system frames them in this way. Overall, risk management is still at an immature or unconsolidated stage in PPPs in Italy derived from a great fragmentation of public administrations. A great help comes from the public Dataset; however, due to problems in the data transmission process, many of these are probably lost or even not transmitted to the public sector. This results in the loss of a great opportunity, namely, the analysis of statistically significant time series on which to develop perspectives on the risk of renegotiations.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **MULTIPLE LINEAR REGRESSION MODEL FOR PROJECT'S RISK PROFILE AND DSCR**

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### **ABSTRACT**

Several studies have been conducted in the field of project risk management to understand risk impact and probability. However, the relationship between risk factors and financial variables established by debt providers measuring how project risk impacts debt financing ratios. Of these, the Debt Service Coverage Ratio (DSCR) in particular has been considered. As is well known, a project in Public-Private Partnership (PPP) must present a DSCR greater than or equal to the target DSCR imposed by the financing party. In this study, we want to highlight the components that affect the DSCR such as the risk profile of the concessionaire or the annual cash flows. This study aims to develop a linear model and an analysis of variance to understand how risk profile variables affect the DSCR established by debt providers in PPPs. The research is based on a dataset of ten hospital PPP projects in build, finance, and operating hospital facilities. Multiple regression analysis will be useful to estimate the number of regressors and intercept the most significant ones. The latter is composed of multiple variables related to the complexity of the project. Therefore, the objective of this study is to bring out the most influential regressors (i.e. the variables that most characterize the variation of the DSCR). Linear regression makes explicit the correlations between the risk profile's variable and DSCR. It is wanted to make to understand also, like the link between these variables is strong and to the variation of one of these the indices of indebtedness can vary.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## FACTORS AFFECTING WATER ABSORPTION AND SETTING TIME of SUSTAINABLE MORTAR WITH ALKALI ACTIVATED GGBS/FLY ASH BINDER

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### ABSTRACT

In order to reduce the environmental footprint of the production and use of ordinary Portland cement (OPC), this study evaluated fresh properties of mortar with alkali activated fly ash and ground granulated blast furnace slag (GGBS) as binders. The properties studied include connectivity of pore system, initial/final setting times, and flowability. It was found that the relationship between water absorption and square-root of time of mortar pore system for up to 6 hours of standard base immersion, is linear with high coefficient of correlation, for binders including alkali activated GGBS and blends of fly ash and GGBS. This is similar to the relationship that characterizes mortar with OPC binders. Sorptivity of mortar prepared with alkali activated GGBS binder decreased with increase in solution molarity as well as ratio of sodium silicate/sodium hydroxide. Initial and final setting times are strongly corrected to initial ratio of  $(Ca+Si)/Al$  established at mixing time. Mortar flow, maintained using carboxylic ether superplasticizer was suitable for many professional practice applications. Mortar flow increases with increase in fly ash content from 0% to 50% within the GGBS/fly ash blend. For a particular GGBS/fly ash blend, flow decrease with increase in sodium hydroxide concentration. Setting time of mortar with high GGBS content (greater than 50%) was too short for many practical applications and a suitable retarder is necessary.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DEVELOPING A SAFE AND HEALTHY BUILT ENVIRONMENT WITH EXAMPLES OF INTERDISCIPLINARY STUDENT RESEARCH PROJECTS

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### ABSTRACT

Today's academic education is positively challenging. Students (especially in the upper years) are most likely to engage in the process when the knowledge they need to acquire is shared in a way that brings something new and far from routine. The purpose of this article is to present examples of student research projects carried out using a modern, as for Polish conditions, didactic method called Project Based Learning (PBL). Four interdisciplinary projects carried out at the Silesian University of Technology will be discussed, mainly with the involvement of students and academic teachers from the Faculty of Architecture, Faculty of Civil Engineering and Faculty of Energy and Environmental Engineering. The research tasks carried out were devoted to ergonomic issues, with safety of use and health as the key guiding words. The following will be presented first: No 1. the concept of an obstacle training track for blind and visually impaired people called "adaptive path"; No 2. the idea of a multifunctional temporary inhabitable container, with the possibility of its vertical multiplication, which fits into the economic model of circular economy. Another strand of research within the presented PBLs was devoted to the topic of sustainability and related to issues related to building energy demand, to optimize and provide users with a sustainable thermal balance. Based on the example of typical residential houses in Poland, in project No. 3 the energy and environmental analysis of single-family houses is presented; in No 4 research relating to passive cooling solutions for improving thermal comfort in apartments in multi-family buildings from 1960s will be presented. The projects carried out for several years at the Silesian University of Technology raise interesting and worthwhile ideas and develop valuable research conclusions. Each time they also prove that their added value is, on the one hand, professional, interdisciplinary cooperation, so useful in future professional life, and on the other hand, shaping the so-called soft competencies, where communication, patience, time management and problem solving skills are of great importance.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **INFLUENCE OF POWDERED SCALE AND POWDERED POLYMETALLIC ORES ON SELECTED PROPERTIES OF CEMENT COMPOSITES**

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### **ABSTRACT**

Concrete is one of the basic building materials used in the world. The binding agent in concrete is cement. The technological process of cement production emits carbon dioxide (CO<sub>2</sub>), and the demand for cement is constantly increasing. In order to reduce the emission of harmful emissions, waste raw materials are used as ingredients in cement and concrete. For the common good and to save the environment and our planet, industrial waste should be used as widely as possible. For this reason, research has been undertaken into the influence of scale and polymetallic ore on the properties of mortars. This paper presents the use of these two components as a powder added to cement at 10% and 30% by weight. In order to determine the properties of such a composite, basic tests were carried out on mortars or grouts. Among other things, the consistency of fresh mortars and the flexural and compressive strengths were checked. In general, mortars with powdered materials added at 10% by weight of cement showed a larger flow diameter than the reference mortar, while when 30% by weight of cement was added, the flow diameter was smaller than that of the reference mortar. The compressive strength of mortars with powdered scale at 10% by weight of cement was lower than that of the reference sample, while mortars with powdered polymetallic ore at 10% by weight of cement showed higher compressive strength. In mortars with the addition of waste at 30% by weight of cement, the compressive strength was lower than that of the reference sample.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EFFECTIVENESS OF SOLAR SHADING DEVICES FOR BUILDINGS – CASE STUDY ANALYSIS OF A HOTEL

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### ABSTRACT

This study focus on the contribution of solar shading devices on the energy needs of a hotel located in Portugal. There is no doubt that enhancing the energy performance of buildings is a priority given that buildings contribute a major part of European energy consumption. To reduce the buildings' energy consumption, the use of shading systems in the glazing is a passive solution to be considered especially in Mediterranean climates. In this sense, the proposed study arises from the need to make designers aware of the correct choice and dimensioning of solar shading devices. To carry out this study, several numerical simulations were performed using the *EnergyPlus* software. First, the existing solar shading devise in the building was analysed, and then successive simulations were carried out with different solar shadings (such as shutters and Venetian blinds), in order to understand the impact that each one has on energy needs. Additionally, simulations were made for several orientations and for different U-values and g-values of the glazing. The results obtained show the importance that the orientations of the glazing and type of shadings have on energy demands as well as the advantages and disadvantages of using a low-emissivity glass. For the climate under study, the use of low-emissivity glass resulted in an increase in heating energy needs between 6 and 15% (depending on the solar shading device adopted). Regarding the solar shading devices, it was found that the installation of a Venetian blind on outside of the glazing allowed a reduction of energy needs by up to 45%.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THERMOCHROMIC PAINT SOLUTION FOR BUILDINGS – AN EXPERIMENTAL AND NUMERICAL STUDY

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### ABSTRACT

Buildings represent around 40% of all energy consumption, so reducing their energy demands will be a central piece of any climate strategy. Thermo-chromic exterior paint can be a promising technology for moderating energy consumption in buildings, but it has not been widely investigated. This study investigates the contribution of a thermo-chromic painting system to the energy consumption of a single-family building. The present study is divided into experimental tests and numerical simulations. For the experimental analysis, which allowed to collect many parameters for the numerical model, samples of three types of rendering mortar were produced: two based on white cement and one based on hydrated aerial lime. In order to make the mortar more sustainable, wood waste was used to replace traditional sand. The render samples were painted with ordinary paint and with a thermo-chromic paint (which changes from black to white at temperatures above 30°C). The simulation results indicate that a render with thermo-chromic paint would provide annual energy savings of around 12%, when compared to an ordinary paint. The render-based on white cement with wood waste and finished with the thermo-chromic painting system has the lowest annual energy consumption.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**ASSESSMENT OF THE INFLUENCE OF THE COMPOSITION OF THE HYDRAULIC BINDER ON THE MODULE OF STIFFNESS OF THE SUBBASE MADE OF MINERAL-CEMENT-EMULSION MIXTURE (BE-RCM)**

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**ABSTRACT**

The subject of the research is to evaluate the influence of the composition and quantity of the hydraulic binder on the stiffness modulus of the recycled subbase, made of a mineral-cement-emulsion mixture (BE-RCM). Road subbases made in the technology of deep cold recycling are a proven method for the construction of the construction layer of the road surface. Among the many advantages, it is necessary to indicate the reuse of materials obtained during the demolition of a degraded pavement. There is also a real possibility of reducing the costs and time of reconstructing the road infrastructure. It is extremely important to choose the right hydraulic binder for the recycled mixture. The subbase must be a durable and load-bearing layer. It should be noted that the use of too much binder, in the form of Portland cement, may lead to the stiffening of the layer and the appearance of uncontrolled reflected cracks. Cracks of this type are initiated precisely in the hydraulically bound base layer. Currently, attempts are being made to modify the binder composition to avoid the occurrence of undesirable effects. The paper presents the results of research on the stiffness modulus of the recycled BE-RCM subbase depending on the measurement temperature and the composition of the hydraulic binder. Portland cement I class and a modifier in the form of a redispersible polymer powder with a polymer base (polyethylene-co-vinyl acetate) EVA were used as a binder. The impact analysis was performed using the assumptions of the Box-Behnken experiment plan in which three variables are controlled. The variables in the experiment were the content of: polymer, cement and asphalt emulsion in the mixture. The mentioned ingredients were dosed with a step of 1.5% of the percentage share in the mixture composition. EVA redispersible polymer powder and Portland cement were dosed from 0.5% to 3.5%. In contrast, the pure asphalt that came from the asphalt emulsion added to the mix was 0.0%, 1.5% and 3.0%, respectively. The obtained test results may be an impulse to optimize the binder composition of recycled cold mixes with asphalt emulsion. There is a chance to reduce the Portland cement content in BE-RCM mixes thanks to the use of a polymer modifier. The subbase made in this way has the appropriate parameters and values of the stiffness modules. The introduced polymer allows to reduce the occurrence of uncontrolled cracks in the foundation.

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## APPLICATION OF REMOTE SENSING METHODS FOR MONITORING OF ELECTRICAL POWER LINES

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### ABSTRACT

In Latvia, the distribution of overhead power lines in 0.4 kV and 6-20 kV voltage lines is 64% with the total length of 92 958 km. The proper maintenance of these overhead power lines ensures the continued functionality of public functions. Regular monitoring procedures shall be carried out for power lines to maintain operations in accordance with the appropriate procedures. They include the regular observation of the state of systems, control, analysis and complex of forecasting. The monitoring of the electricity infrastructure plays an important role in the overall oversight and management of the system. Monitoring of the power line helps to detect unwanted changes and prevent defects that are potential causes of accidents on the power line in a timely manner. This contributes to the secure supply of electricity to consumers and helps to reduce the costs of maintaining the power line. In pursuing digital development opportunities, electricity line monitoring is increasingly being pursued by means of a variety of remote research methods. Methods for distance exploration are referred to as methods where the acquisition of data on an object or situation and analysis is carried out by systems forming a contact-free image. The amount of data obtained and their analysis helps to reduce the time of monitoring, to identify the state of the power line infrastructure and to assess the situation of the area near it. The study examined, applied and compared several remote-sensing methods for monitoring power lines. The optimal acquisition of images by creating an orthodox image and a cloud of points resulting from laser scanning was recognised in Latvian conditions. The advantages of these techniques are the possibility of obtaining data on the power line remotely from the air. The methods provide an opportunity to analyse power lines throughout the length and to ensure that defects are detected in difficult areas. As a part of the study, two flight routes were drawn up and sold over the selected power line A-24 in Jelgava and Jelgava county area, Latvia. The total power line is 4.7 km long. An unmanned aircraft with a built-in image retrieval facility and an unmanned aircraft with an installed laser scanner was used during the flight. The resulting flight route data was collected and processed with special computer programs, resulting in visual information on a power line position and the locality situation.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE EVOLUTION OF YINGKOU'S URBAN FORM IN THE PERSPECTIVE OF HISTORICAL INFORMATION TRANSCRIPTION

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### ABSTRACT

The study of urban morphological evolution is an important way to trace the memory of a city and continue the historical lineage. At present, the research on the evolution of urban morphological elements combined with historical and cultural preservation has been carried out more in cities with intact heritage, while obstacles are encountered in cities with fragmented existing remains. Yingkou is an important port town in Northeast China and the first port of foreign trade in modern history. Yingkou has rich historical and cultural resources, but the current stage of inappropriate protection has resulted in serious destruction of the old city fabric and fragmented distribution of historical and cultural relics. In order to further explore the historical characteristics of Yingkou and make up for the lack of research on the evolution of urban morphology of Yingkou. In this paper, on the one hand, we explore the evolution of the overall urban form of Yingkou in each major historical stage: ancient period, modern period and modern period by combing information from historical documents and historical satellite image maps of Yingkou; on the other hand, we translate the historical information of each stage into morphological elements in GIS, extract the urban morphological characteristics of Yingkou from three perspectives: architectural elements, urban elements and landscape elements. And then, we determine the distribution location, value attributes and protection status of cultural resources in Yingkou, and express them in modern standard maps. Finally, combining the results of these two analyses, the article summarizes the patterns and characteristics of the evolution of Yingkou's urban morphology and propose corresponding historical and cultural conservation strategies.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## MONITORING SENSOR TECHNIQUES FOR AN INTEGRATED AND DIGITALIZED DATABASE

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### ABSTRACT

Romanian earthquakes produced severe damage over time to a significant number of old buildings and that is why efforts are being made to obtain data especially on different types of public buildings. On the other hand, European and international experience of the past strong earthquakes during the last decade shows that, in many urban areas, besides many old building, there is a number of modern reinforced concrete buildings that do not meet the requirements of additionally improved codes for seismic resistant design. Structural instrumentation and monitoring are applied regardless of the year of construction in order to get data about the dynamic characteristics and the structural changes, improving on long-term the life cycle management. It is also a reliable solution for performing a semi-automatic rapid analysis after a moderate or severe earthquake. In this context, the digitization process based on a network of sensors and a methodology for data acquisition and processing, graphic images for the time histories of accelerations, velocities and displacements are necessary. The usefulness of digitization is also reflected in the ability to collect and compare data obtained in real time from sensors located in a building (on different floors), or in collecting and comparing data received from an area for which certain value judgments are required. A logical scheme in the context of structural health monitoring and digitization includes sensor selection and placement, data management and security, analytical analysis, sensors inspection and maintenance, a cloud database platform etc. All obtained results are transferable and of special technical and legal importance, the elaborated documents representing the basis for the Technical Book, and the archived data constituting initial records for the following data. Authorities and the owners can monitor the overall behavior of buildings and can plan actions and measures to reduce the effects of disasters.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## REVIEW OF THE LITERATURE ON THE LOCATION OF VIBRATION SENSORS IN CASE OF ANALYSIS OF THE EFFECT OF VIBRATIONS ON HUMANS

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### ABSTRACT

Paraseismic vibrations are a phenomenon that influence on both- the structure of buildings and the comfort of people inside the buildings. Vibrations can cause frustration, loss of productivity, and complaints from occupants in the buildings located close to a vibration source. In order to assess the negative vibrations influence on people, analyzes of this influence are carried out according to different standards. The article presents the differences between the provisions of the standards, focusing mainly on the location of measuring sensors. The article compares three standards (PN-B-02171:2017, BS-6472-1:2008 and ISO 2631-2:1997) which define the location of the measuring sensor in different ways. Due to the maximum vibration amplitudes, the measurement in the middle of the floor would theoretically be the best possible point selected for analysis, but in practice the presence of non-structural elements, e.g. partition walls, machines or equipment may make it impossible to install sensors for measuring vibrations in the central part of the floor. In such cases, the most useful standard from the mentioned is British norm, but the consequences of conducting vibration measurements for the sensor away from the center should be analyzed. The maximum vibration amplitudes obtained in a place distant from the center of the floor may be smaller than those obtained in the central point, therefore the test results may be underestimated. In order to obtain reliable results of the analysis, tests should be carried out to examine the relationship between the location of the measuring sensors and the values of the vibration amplitudes obtained. By examining such a dependence, it would be possible to perform a more precise analysis with greater flexibility in the location of the measurement sensors. The article is a review of the different approaches to the location of the measuring point in the assessment of the human perception of vibration in buildings.



## FIRE RESISTANCE OF CONCRETE COLUMNS WITH BFRP REINFORCEMENT BARS

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### ABSTRACT

Using Fibre Reinforced Polymer bars instead of traditional, steel reinforcement in concrete structural parts may lead to multiple benefits due to their high strength to weight ratio, high corrosion resistance, electric indifference, or ease of recycling. However, their behaviour at even slightly elevated temperatures is problematic, therefore, their fire resistance needs careful consideration. Numerical simulations performed by authors in Abaqus software aim to highlight the influence of key parameters (concrete cover thickness, compressive strength of concrete and diameter of the main bar), which might influence the fire resistance of concrete columns with FRP reinforcement. Concrete Damaged Plasticity model, which is modification of Drucker-Prager plasticity model, was used for concrete. The mesh size for cubic concrete elements was equal to 15 mm, while for truss reinforcement elements it was 50 mm. Simultaneous influence of mechanical and thermal load (radiation) was simulated. No slip between reinforcement bars and concrete was assumed and heat was transferred by radiation. Basalt Fibre Reinforced Polymer bars were chosen for such simulations as a relatively new type of FRP with high ecological impact. Due to lack of experimental data, results available in literature for concrete columns with steel main reinforcement were chosen to validate the model (five elements – S0-S4). Differences between numerically determined and measured temperatures (at the concrete surface of the column and at the surface of the bar) were no higher than 20%, while differences in experimentally determined and numerically estimated fire resistance was no higher than 10%. Therefore, after achieving satisfactory level of compliance, the numerical parametric study was performed on seven elements with BFRP main reinforcement bars (elements B0-B6).

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## MARKET AS AN URBAN ECOLOGICAL ENTRY POINT TO THE CITY CENTER

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### ABSTRACT

The issue of completing the original housing estates in Bratislava is also connected with the urbanization of their main nodes. The urban structure in the Bratislava residential district of Ružinov lacks high-quality urban structuring, the vitality of its main Ružinov axis and the hierarchy of main and secondary nodes. From the junction of the market on Miletičova Street out of the city, there is no legible street line of pedestrians with a ground floor, there are traffic lines with sidewalks, there is no ground floor, there are no more significant squares. The chaotic pole of the current main market town of the city "Miletička Market" is popularly popular, but at the same time it is an unattractive gateway from the east end to the city center. It is a locality with a natural character and manifestations of the periphery. There is a lack of interconnection and functional vitality of pedestrian movement. The transformation of this area on the Ružinov city axis means the strengthening of urban, compositional and ecological principles. The aim of the research was to verify the transformation of an important city hub - Miletičova marketplace on the route Záhradnícka street - Ružinovská. The case studies focused on variant modeling of this locality and the formation of a multifunctional public space. The preservation of the genius loci at the Miletičova market is decided by the footprint of the former slaughterhouse and the footprint of the chimney. The vision of the marketplace as an architecturally completed, ecological entry point into the city was alternatively solved with the parameters of accessibility by a new tram line, with the addition of bicycle transport, pedestrian permeability and complex road transport with static and logistic transport. The blue-green infrastructure of the courtyard was involved in the system of green roofs of the marketplace and additional playgrounds in the field and on the roofs of buildings. The multifunctional character of the area was verified for indoor and open forms of the market, as well as facilities for gastronomy, boutiques, farming, cultural events, as well as opportunities for the presentation of year-round and seasonal events. In this way, the new market structure transforms the node into a place of meeting, trade, rest and relaxation. It creates from the peripheral market the area of a new marketplace, a green oasis, a social, urban, ecological entrance node to the city center.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE PROFESSIONAL CONTEXT OF FIBRE REINFORCED POLYMERS (FRP) IN POLISH CONSTRUCTION INDUSTRY

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### ABSTRACT

All over the world, the composite materials industry is growing up every year. The fastest developing markets are located in China, Brazil and India. Even though the European market is smaller than Asian or North American, but still it is assessed that the production volume is over 1 million tons. In Poland, there are no available precise data about the volume of the Polish market, however, it is estimated over 5% of total European production (which is more than 50 thousand tons). The composite materials are mainly used in construction industry (for structural applications), in transport industry (especially in the automotive and railroad), in aviation and maritime industry, as well as energy, electronics and sports industries. The reason of the research was insufficient knowledge among professionals (architects and construction workers) about the composite materials in general, and about Fibre Reinforced Polymers (FRP) in particular. In the authors' opinion, such a situation results from a poor education in FRP (which was also reported by the Architects Council of Europe), as well as lack of FRP-oriented vocational trainings: IVET (Initial Vocational Education and Training) and CVET (Continuing Vocational Education and Training). The paper presents the specific of the Polish construction market in terms of FRP applications, level of knowledge and practical skills among professional users (architects, civil engineers and construction workers at each stage of the whole construction process of composite designing and applications). The analysis presented in the paper are based on the authors' own investigations, as well as the development of the statistical data. A special emphasis is put on recognition of professional knowledge received during regular education or vocational courses for all of the participants regardless of their role in the process. There was also analysed the educational offer of the trainings on the use of FRP for the construction sector and what were the basic skills provided. Besides, the most important competence requirements (skills and knowledge) for architects, civil engineers and construction workers were pointed in the paper. And finally, the challenges and opportunities in the context of the FRP use and steps required to meet these challenges in the construction sector were analysed. One of the conclusions was that the construction is a fairly conservative field and new materials have to prove their durability. From the national perspective, it is necessary to intensify work on national guidelines for the use of composites, or at least a handbook, extensively discussing the issues of using FRP composites in construction. Some of the international literature sources (such as the fib Bulletin 90) are difficult to access, and for the older staff, the language barrier is not without significance. Also, noteworthy is that the data provided in the paper were based not only on analysis of the statistical sources, but also on interviews with structural designers and contractors (workers and managers).

Corresponding Author: Szymon Dawczyński



**PROFESSIONAL PROFILE MAP AS A TOOL OF IMPROVING THE CONTINUING VOCATIONAL EDUCATION AND TRAINING (CVET) IN THE USE OF COMPOSITE MATERIALS BY ARCHITECTS AND CIVIL ENGINEERS**

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**ABSTRACT**

Composite materials in general, and Fibre Reinforced Polymers in particular, gain growing importance in the construction sector. As some of their specificities help to improve the carbon footprint in construction and enhance the life cycle of buildings, Fibre Reinforced Polymers (FRP) are more and more used. At the same time, the application is often hampered by a lack of qualified labour. This is true both for the planning and for the operational part of the work. Formal educational institutions often cannot react fast enough to new trends and technologies, so that even qualified labour sometimes does not bring the necessary skills and competences. In order to help the construction industry to find the requested competences, a concise overview of knowledge, skills and competences (KSC) related to the use of FRP is needed, which is currently missing. A Professional Profile Map may provide such an overview. The Professional Profile Map presented in the paper, was the basis for the development of the training. It contributed to improve continuing vocational education and training (CVET) by helping stakeholders to identify skill gaps in the use of composite materials and particularly of FRP. It was set up by following recommendations in the EQF context, using the VQTS approach. The authors suggested to use the VQTS model in order to ensure applicability of the Professional Profile Map in different national contexts (in Poland, Spain, Slovenia and Greece). The model used a learning outcomes approach to enhance transparency, instead of focusing on specificities of national VET systems. Work processes were independent from learning context and therefore allow mapping and comparison across borders. Therefore, the Professional Profile Map was based on real-life work processes. In addition, this also enabled mapping qualifications and competence profiles of individual workforce. By introducing a common language, the Professional Profile Map can be applied both in the world of education and in the industry, and it can be used by stakeholders in both fields. It helps educational institutions to take informed decisions about integrating newly emerging KSC into courses and trainings. In the world of work, it facilitates gap analysis: Which KSCs are well covered in the company, which ones are missing and should be acquired either through training of existing staff or by hiring trained and qualified staff? Such analysis helps HR departments in the construction sector to define skills gaps. To define the Professional Profiles, we mostly applied qualitative and explorative methods. The content of the map was based on evidence, through company visits and interviews. Stakeholders were involved in interview, company visits and in consultations. To make the map sustainable, not only the status quo of skills development was considered, but also future trends were questioned too.

Corresponding Author: Szymon Dawczyński



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05 -09 September, 2022 - Prague (Czech Republic)

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## TIME AND MIXING TIME IMPACT ON THE FLEXURAL STRENGTH OF THE FLY ASH ALKALI ACTIVATED MORTAR

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### ABSTRACT

The construction industry is considered as one of the worlds' biggest carbon dioxide emitter and industrial waste producer. This is mainly because of the cement production process which is characterized by high energy consumption. And in Poland, over 70% of the energy is obtained from traditional power plants which use hard coal or brown coal as a main substance in the combustion process (while the average in Europe is 14%). The by-product and mainly waste material which remain after the coal combustion is the fly ash. The solution which on one hand limits the quantity of wastes from the power plants, and on the other hand reduces the cement use in concrete industry, might be the idea of more common application of alkali activated materials (AAM). As it was indicated in the paper, this broad group of modern materials might successfully replace the ordinary Portland cement (OPC) concrete in structural and non-structural applications. However, as the bonding process of AAM is different than the OPC based materials, it is required to know their strength development in time, as well as the factors which influence the strength parameters. The paper presents the results of laboratory investigation on flexural strength of the alkali activated mortar. The main precursor used for preparing the mortar was power plant fly ash containing in its composition silicon and aluminium atoms (which are desirable in terms of alkaline activation), and also carbon and sulphur atoms. The chemical activation of the precursor was done with the use of the mixture of sodium hydroxide and sodium silicate (in ratio 1:1.5). There were prepared two series of the samples – in one of them the mixing time was 2 minutes, and in the other one the mixing time was 5 minutes. After the preparation of cuboidal samples, the mould with the samples was placed for 24 hours in a climate chamber with a constant temperature of 40°C, and then the samples were un moulded and stored in constant conditions (room temperature 20°C) until the day of testing (which was 1 day, 3, 7, 14, and 28 days after the samples preparation). The flexural strength was tested in a professional testing machine in the standard three-point bending test. The value of the failure force was read from the device, and then the bending strength was calculated. The results of the investigation indicate, that the increase of the flexural strength might be observed approximately till the 14<sup>th</sup> day, and then the strength stabilizes. This phenomenon might be useful in structural application, especially when high early strength is required. Also, on the basis of the research it was found that too long mixing time of the precursor and activator can lead to a reduction of the final flexural strength.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**MODERNIZATION OF THE HEAT SUPPLY SYSTEM OF THE UNIVERSITY OF AGRICULTURAL SCIENCES  
AND VETERINARY MEDICINE OF BANAT, FROM TIMISOARA**

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**ABSTRACT**

The current problem of the district heating systems in Romania and especially of the district heating system in Timișoara, which even after the massive investments to replace the existing pipes with pre-insulated pipes so far, have remained unresolved problems. The article proposes an analysis regarding the connection of the University of Agricultural Sciences and Veterinary Medicine of Banat (USAMVB Timișoara), a consumer fed with conventional compounds to ensure the necessary heat. A comparative study was conducted between the direct connection of the current centralization system and modernization solutions that include the use of mixing loops and the integration of renewable energy sources at a thermal point of the final consumer. The results obtained after the simulation indicate a reduction of energy losses of approximately 38% approaching the solution with mixing loop and 70% respectively by using renewable energy sources SRE depending on the temperature regime of the indoor heating installations.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## nZEB AVANT LA LETTRE: AN ARCHITECTS' PERSPECTIVE

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### ABSTRACT

During the past almost two decades, the European Union launched and systematically updated Directives that aim to keep under control the use of energy in buildings. In this context, the "Strategy 20-20-20" (launched in January 2005), aimed to reduce greenhouse gases by 2020 with 20% and on the other hand, to increase the use of renewable energy consumption by 20%, in an effort to ensure the improvement of energy efficiency by 20%. It was followed in 2010 by the Energy Performance of Buildings Directive - that was revised in 2018 - and by the Energy Efficiency Directive in 2012, amended in 2019. Furthermore, in December 2021, the Commission proposed a revision of the Energy Performance of Buildings Directive, that sets new and ambitious targets regarding the buildings - either new or old - that match the provisions and expectation of the European Green Deal. "As of 2021, all new buildings must be nearly zero-energy buildings (NZEB) and since 2019, all new public buildings should be NZEB. When a building is sold or rented, energy performance certificates must be issued and inspection schemes for heating and air conditioning systems must be established" is stated on the Energy page of the site of the European Commission. However, as strange as it may seem, preoccupations for a fair energy management is probably almost as old as mankind as the building is the product with the longest life span: we have millennial buildings that not only stand but are still functioning. It was not a calculation or a direction that designed the buildings, it was the genius of architects. While not denying the political will and the strategies that it brings forth, it must be emphasized that energy efficient buildings were created long before the need to measure the building performance from the point of view of the energy it uses. And, as one of the greatest architects of the XX-th Century said "Architecture is the will of an epoch translated into space" (Ludwig Mies van der Rohe). And this epoch has the technological means of producing energy from alternative resources that can be embedded in building products. Hence, why not use them?! As means not as targets, in order for the building to continue to fulfil the Vitruvian triade: firmitas - utilitas - venustas (structural strength - utility - beauty). The paper is a plea for the prevalence of the architectural concept over rigid quantitative measures of energy efficiency.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## IMPACT OF THE WATER FOAMING PROCESS ON THE PROPERTIES OF BITUMEN MODIFIED WITH WMA ADDITIVES

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### ABSTRACT

The development of environmentally friendly technologies makes it necessary to lower the temperature of production and compaction of asphalt mixtures produced in a traditional way at a temperature of about 170 °C. In addition, the large-scale implementation in road construction of the principle of using materials for road pavement construction layers in a closed cycle, causes that mineral-asphalt mixtures with the use of water-foamed asphalt technology are used on an increasing scale. Therefore, this type of binder should be characterized by high qualitative parameters of foaming. One way to do this is to modify the asphalt prior to foaming with F-T synthetic wax and a surface active agent. In the binder foaming process, cold water and air affect hot asphalt at a temperature of about 160-170 °C. Consequently, oxygen and hydrogen interact with the asphalt. In order to assess the influence of the foaming process on the properties of 50/70 asphalt and 50/70 modified with 2.0% synthetic wax and 0.6% SAA, the properties of the binder were assessed before and after foaming, as well as after foaming and aging (TRFOT, PAV). The following parameters of asphalt foaming were determined: maximum expansion (ER) and half-life ( $t_{1/2}$ ) of asphalt foam. Then, the penetration at 25 ° C, softening point, Fraass temperature, dynamic viscosity at 60 °C, 90 °C and 135 °C were tested. The low temperature stiffness modulus was determined using the Bending Beam Rheometer method. By analyzing the test results, it was found that the asphalt foaming process with water has a significant impact on the tested properties of the modified binder and the level of its aging.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE IMPACT OF ENVIRONMENTAL CONDITIONS ON THE PERFORMANCE OF POLYCRYSTALLINE PHOTOVOLTAIC PANELS

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### ABSTRACT

At national and international level, climate change is a major challenge, and its approach must consider radical changes in the production of energy from renewable sources. To this end, the article proposes an analysis of the impact of climatic conditions on the performance of solar photovoltaic systems. A polycrystalline photovoltaic panel (Solovent SV-L-230) was tested under various specific conditions: dust accumulation, water film, clouds / partial shading effects and solid deposits (dry leaves, grass, straw). The experimental measurements were performed at the Faculty of Constructions in Timisoara using the equipment from the LE laboratory (Electrical Laboratory) of the Specialized Building Services. The results obtained for the photovoltaic panel show that the accumulation of dust reduces the output power by 43% and the efficiency by 57.12%. From the point of view of the impact of the water film on the surface of the panel, there is an improvement in the output power of the panel at least 6.5%, and solid deposits (dry leaves, grass, straw) reduce the output power of the photovoltaic system by about 47 %.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE INTERACTION OF URBAN AND NATURAL SYSTEMS OF MODEL SETTLEMENTS IN DANUBE REGION

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### ABSTRACT

Nature together with anthropogenic intervention is a unique but not always sustainable and harmonious system. Today, fast developing and new-build settlements do not always use the reserves that environmental space brings and often destroy the Ecological stability. In an effort to create a favorable economic environment for the development of industrial facilities, we are forgetting the need to harmonize landscape and urban structures. Each settlement is the result of the synergy of the human hand and Nature. Each settlement has its own rare and individual character, which needs to be understood in a similar way as to understand the strengths and weaknesses of the child for his harmonious growth. Research into the interaction of urban and natural systems of several diverse model settlements will help determine the identity of cities, their carrying capacity, adaptation to climatic conditions, and the image quality of the city. The evaluation of the acquired knowledge by the method of synthesis, induction and SWOT analysis of selected localities will help to determine the potentials and limits of settlement development and will help to form optimal functional-operational relations, thus contributing to sustainable development and tourism as well as improving the quality of life of local residents. The research is focused on small and medium-sized settlements in the Danube region. Most settlements are located in the Slovak Republic, but there are also "twin towns" - cross-border settlements on the opposite banks of the Danube. The Danube, as an important natural phenomenon, determining the size and character of towns is a connecting element, which at the same time always manifests itself differently in the mutual interaction with the seat.

*This research is linked to the international research project Interreg-DANUrB and the ongoing project DANUrB 2.*



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## HEDONIC PRICES AND ECONOMIC EVALUATIONS OF GREEN AREAS AND TRANSPORT INFRASTRUCTURES INCIDENCES ON REAL ESTATE VALUES

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### ABSTRACT

Empirical evidence supports the hypothesis that greater accessibility and the presence of green areas can have a positive impact on property values. However, the capitalization of these benefits varies across different areas studied. Here, a hedonic model referring to a sub-area of the Italian city of Bari is estimated to quantify the impact of public transport accessibility, specifically Bari railway station, on real estate value differentials. The novelty of the paper lies in the use of differential values, deriving from the difference between commercial values and the cadastral values of real estate units, which are an expression of all those elements that do not characterize the properties. Economic influence on the price differential of the presence of fixed share capital in the proximity of the properties being valued is therefore considered. The estimates provided in this paper allow for quantifying the economic contribution of the railway station and green areas, innovating the quantitative methods used so far. It is, therefore, possible to affirm that the infrastructural endowments that significantly characterize the settlement/location areas affect the differentials of the property values. This is since these represent the quality of the services offered, both directly and indirectly, and as such are considered positive in measuring the impact on the final property values. This contribution allows for no more distorted measurements of the real estate values/differentials and is useful for more correct quantification of taxable bases by financial administrations for the taxation of real estate. The methodology proposed in this paper can be replicated in any other geographical area, under the condition of having a good data set. Finally, further research can be developed by assuming other functional forms, apart from the one proposed here of a Box-Cox function, with the use of linear transformations.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**PROPOSALS FOR THE SEPARATION OF INORGANIC COMPONENTS FROM TECHNOLOGICAL WASTEWATER IN ORDER TO REDUCE LANDFILLS**

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**ABSTRACT**

Worldwide, the amount of waste (hazardous and non-hazardous) generated by various processes varies from year to year and the whole planet is facing severe problems regarding pollution, especially water pollution. The article aims to propose a solution to reduce the impact on the environment by separating inorganic components from technological wastewater, recovery of recyclable waste and minimizing the amount of waste destined for storage. Thereby, the article proposes the construction of a plant for the separation of inorganic components from waste that are currently destined for storage. The hydraulic separation installation by centrifugation with hydrocyclone proposed, can contribute to improving the quality of industrial waste management services and recovery of reusable waste (manufacturing waste, slurry and water).

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**OPTIMAL DYNAMIC CHECKPOINT STRATEGY FOR THE FLEXIBLE TRANSIT SYSTEM**Dahye Lee <sup>1</sup>, Luca Quadrifoglio <sup>1</sup>, Kai Yin <sup>2</sup><sup>1</sup> Texas A&M University, 3135 TAMU, College Station, TX 77802, USA<sup>2</sup> Expedia Group, 11920 Alterra Pkwy, Austin, TX 78758**ABSTRACT**

This study explores a dynamic checkpoint strategy for an on-demand flexible transit service called a Mobility Allowance Shuttle Transit with Dynamic Checkpoint (MAST-DC) that clusters customers by spatial and temporal proximities. By introducing a dynamic checkpoint option to customers in their booking process, we allow customers to walk less distance with a slight increment on the fare, which is expected to improve the system's level of service and increase the service provider's profit. Hence, we propose an optimal operational framework to cluster customers to dynamic checkpoints by minimizing their walking distance and to create the shortest vehicle route between checkpoints without violating the promised scheduled running time at two consecutive fixed checkpoints. The analytical model is performed to estimate the number of dynamic checkpoints and customers' average walking distance. An equation derived to compute the expected number of dynamic checkpoints is entangled with the system parameters, including vehicle speed, unit demand, service time, segment width and length, and slack time. This paper also proposes a sequential two-phase heuristic method that cluster first and routing second to find a sequence that satisfies: 1) route that originates and terminates at the fixed checkpoints by minimizing vehicle distance traveled, 2) each cluster centroid visited only once by the same vehicle, and 3) customers' walking distance minimized towards their assigned dynamic checkpoint. First, the sequential heuristic method clusters customers by using the memetic differential evolution (MDE)-based clustering algorithm, one of the state-of-the-art metaheuristic algorithms to solve the minimum sum-of-squares clustering (MSSC) problem. The clustering model is later fused with the second phase, which uses the branch-and-cut method for the traveling salesman problem (TSP) model to find the shortest possible path between identified checkpoints. The parametric analysis of the analytical model has shown that the analytical model to estimate the dynamic number of checkpoints and customer's average walking distance become lower bound and upper bound of the heuristic model, respectively. The parametric simulation experiment is conducted to explore the impact of system parameters on the number of dynamic checkpoints in the analysis region and average walking distance and validate the robustness of the analytical model.

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## EXPERIMENTAL DEVELOPMENT OF 3D PRINTING USING CEMENT COMPOSITES

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### ABSTRACT

The research of 3D printing of cement composites is carried out in cooperation with the Technical University of Liberec, the Klokner Institute of the Czech Technical University in Prague and the company Červenka Consulting s.r.o. The research deals with the use of 3D printing of cement composites in architecture and construction. The research develops original equipment for 3D printing of mixtures with cement-based binders, including the original design of printing mixtures and original software for printing data processing and machine control. The ambition of the project is to develop equipment that can be used for in-situ printing of building elements and to develop such procedures that would enable the implementation of a printed multi-storey building. The print is focused on vertical and horizontal load-bearing structures. The vertical structures will be printed in the final position, the horizontal structures will be printed on the construction site in the form of prefabricated parts, retrofitted by a crane on the pre-printed walls of the building. The shape and static solution of vertical and horizontal elements of the supporting structure is optimized for 3D printing technology with a focus on minimizing material consumption in accordance with current requirements for sustainable construction, saving non-renewable raw materials and energy savings. This leads to the use of thin-walled constructions with a print width of 20 to 50 mm. At the same time, design procedures for these types of structures and implementation of 3D printed elements into non-linear Atena software, designed for advanced modeling of concrete structures and developed by Červenka Consulting s.r.o. At present, a Test-Bed is in operation, intended for testing the print head and development of printing mixtures, with a printing space of 3 x 1 x 1 m. stability and other properties and tuning of design procedures so that in the future they allow safe verification of designed structures in terms of their static function. Part of the research is the study of printing logistics on site and a comprehensive design of the entire system from the mixture to the printed structure.

Corresponding Author: David Citek



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE PLANNING OF GREEN INFRASTRUCTURE USING A THREE-LEVELS APPROACH

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### ABSTRACT

The urbanization process takes place around the Europe, more and more people moving to cities or suburban areas. Therefore, for several years now, global trends in spatial planning have been focused on the development of sustainable green infrastructure in order to reduce the impact of urbanisation on ecological, socio-economic and also aesthetic indicators. Global warming, problems with rainwater management, storms and floods are just some of the reasons why the planning of the green infrastructure has come up to date. In line with other current strategies (EU Biodiversity Strategy, EU Green Infrastructure strategy, Green Deal initiatives, etc.), green infrastructure plans for different types of territories, which include ecological, social and economic issues, are increasingly being developed. Until recently, green infrastructure was only an added value to real estate, and now it has acquired a very different meaning. The green infrastructure planning process has already started in Europe, and various European countries have developed strategies to bring green infrastructure into the urban environment at different scales and in the country as a whole. The principles of green infrastructure planning vary according to the scale to which it is addressed. In the Europe's examples, the green infrastructure is viewed in large-scale regional landscapes, where the green network is made up of natural areas, and in the context of cities, where the creation of green infrastructure is in line with the creation of the green network of the city, creating links between the largest green spaces (parks, squares, urban forests, etc.). However, the correlations and links between the different scales and levels of green infrastructure planning are not widely analysed in the scientific literature. Therefore, the purpose of the article is to define the main principles in the planning of green infrastructure using a three-levels approach. In the approach, each of the levels includes territorial unit of a specific scale, starting with the level of the region, then continuing with the rural and urban areas` level, concluding with the site level. Each lower level is subordinated to the highest, thus forming a single green infrastructure planning system. For each of the levels, the main conditions and planning principles to be considered when planning green infrastructure have been identified. As the pilot object of the study, the territory in Latvia was used, which consists of both rural areas and urban areas. Thus, the article discusses not only the planning of green infrastructure in the context of three levels, but also the different approaches to green infrastructure planning in the rural and urban landscape.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## IMPORTANCE OF RECLAMATION OF POSTINDUSTRIAL AREAS NEAR CITIES

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### ABSTRACT

In 2015, 54.5% of world population are living in cities and it is estimated 60% of the population will be live in cities by 2030. As the population grows, the demand for space, facilities, energy and resources increases. Migration from rural to urban areas will increase due to better lifestyles and economic benefits. Cities with current infrastructure and facilities will not be able to accommodate this increase. With the growth of urban areas, thorough urban planning is necessary. Problems arise due to air and water quality, high energy consumption, water disposal problems resulting in more demand from urban areas. Addressing the problem by building more infrastructure and leisure activities will encroach on forest areas, meadows or other spaces that are natural habitats for many living things and trees, and this can cause an imbalance in the ecology. Urban areas all over the world face these problems. In some parts, people are even building new buildings without taking into account the ecology or how their new construction may negatively affect the ecology. In Rio de Janeiro, huge numbers of people are moving from rural areas to urban areas in search of jobs and better opportunities, resulting in a lot of pressure on amenities and services. Delhi is considered to be the most populous city in the world in 2028 and currently the problems due to overcrowding in the capital are getting into serious problems with housing, waste disposal, public transport, lack of electricity and security. There are many cities located near abandoned post-industrial areas and mining areas which are yet to be reclaimed or not even have any plans to reclamation. Some mining areas cannot be reclaimed totally due to some mining methods underground deep. It will be hard to reclaimed even if it's possible but it will be expensive, there will regular deformations happen. Upper Silesian coal regions which is shared by Poland and Czech Republic. Cities like Katowice which turns black into green, Katowice cultural Zone occupies in the formal coal mine area. The development of post-industrial area which contributes the effect of increasing cities resilience to the effect of climate change also. My presentation will be based on what are the positive impacts of mining reclamation. The location of the reclaimed area is an important aspect. In the Katowice agglomeration, for example, there are a number of tailings dumps located directly in urbanized areas. In contrast, in the Ostrava and Karvina parts, many tailings dumps are located more on the outskirts of towns. In my paper I will compare these different situations and compare the possible impacts that may be associated with the location of the tailings near the residential center.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

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## **ADVANCE SEDIMENT TRANSPORT MODELLING, STUDY CASE BARZAVA RIVER, ROMANIA**

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### **ABSTRACT**

Study case is situated in Caras Severin county. To solve theoretical problems of movement of water in the river Barzava, it requires modelling of water flow in this case. Numerical modelling was performed using the program MIKE11. Advanced computational modules are included for description of flow over hydraulic structures, including possibilities to describe structure operation. The Hydrodynamic (HD) module is the nucleus of the MIKE 11 modelling system and forms the basis for most modules including Flood Forecasting, Advection-Dispersion, Water Quality and Non-cohesive sediment transport modules. The MIKE 11 HD module solves the vertically integrated equations for the conservation of mass and momentum, i.e. the Saint-Venant equations. The input data are: area plan with location of cross sections; cross sections topographical data and roughness of river bed; flood discharge hydrograph. Advanced computational modules are included for description of flow over hydraulic structures, including possibilities to describe structure operation. After simulation with MIKE 11 result the water level in each cross section. The Barzava River is 85 kilometers long. It springs from the Semenic Mountains (at a distance of 5 kilometers upstream from Resita Municipality), passes through the localities: Mun. Resita, Bocsa, Berzovia, crosses the national road Belgrade-Timisoara, about 4 kilometers from Deta crosses the border with Serbia and flows into the river Timis (Serbia) about 30 kilometers from the border. In the area studied or performed hydrological and topographic measurements on the watercourse and the nature of the land, these measurements were the basis for the numerical modelling of the watercourse by the method of finite differences. The main objectives of the paper are the modelling of the water course with the forecast of the evolution of water levels over time as well as the possibility of making flood risk maps.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**MODERNIZATION AND EXTENSION OF THE IRRIGATION SYSTEM - SPP1 - 1700 HA, SAHATENI, ROMANIA**

Hausler - Cozma Dorian, Beilicci Robert, Beilicci Erika

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**ABSTRACT**

Through its rural development policy, the EU aims to help rural areas meet the many economic, social and environmental challenges of the 21st century. This policy forms the second pillar of the common agricultural policy (CAP). EU rural development policy is funded by the European Agricultural Fund for Rural Development (EAFRD), which has a budget of EUR 100 billion for the period 2014-2020. Infrastructure owned and managed by the O.U.A.I. Sahateni, is part of the arrangement of AHC CAMPPIA BUZAULUI and serves the land area related to plot SPP1 on the Cvest 2 canal, Buzau county. The SPP 1 pressurization station supplies water for irrigation with a net surface of 1716 ha. Modernization and refurbishment of the irrigation system infrastructure are necessary to: ensure a much lower specific water consumption than today in the system, reduce electricity costs by reducing energy consumed per thousand cubic meters of pumped water, reduce operating costs. Reducing the risk and uncertainty in agriculture by reducing the incidence of natural phenomena (drought, soil erosion, etc.): due to unpredictable weather conditions from one year to another, a well-developed irrigation system will reduce the risk of obtaining a lower production per hectare in case of drought. Increasing the efficiency of agricultural activity by improving the supply of inputs and better use of the resulting products: eliminating water losses and water use where needed, which will lead to an increase in production per hectare and help increase the profitability of this activity.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**ANALYSIS OF THE POTENTIAL OF RENEWABLE ENERGY IN THE PRODUCTION OF ELECTRICITY,  
HEATING AND COOLING FOR A SMALL COMMUNITY**

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**ABSTRACT**

Solar energy, due to the fact that it is sustainable and environmentally friendly, plays an important role in achieving energy reserves and reducing emissions. Solar technology is complex because it can be used both to generate electricity and to process heat and cooling simultaneously. In the paper we will address, in the introductory part, the history of solar technology referring to the basic principles of how this technology works. We will extend the research to related topics such as heat transfer devices and the use of solar thermal heat for vapor absorption cooling. For the case study we chose an analysis on how to produce electricity, heating and cooling for a small community. The program used for modeling is RETScreen Expert. The paper studies the technical characteristics, economic analysis and environmental impact for a system that produces electricity, heating and cooling.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYZE OF BISTRITA WATERSHED USING REMOTE SENSING**

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### **ABSTRACT**

In recent years, the climate changes have determined the increase of the frequency flooding, and concurrently, negative effects of these weather phenomena were amplified by other factors (the deforestation, needs of the hydro technical works, etc.). The paper present of the catchment Bistrita, from point of view the hydro morphological and morphometric. From this analysis of the river basin to determined the physical-morphological parameters (surface, average slope and land use distribution, etc.), which we will use later in the hydrological modeling part.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## MIXED-AGE PLAYGROUNDS DESIGNED BY CHILDREN

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### ABSTRACT

Children's social play has generally occurred between children of varied ages, and sometimes between individuals of dramatically opposing ages. We should thus monitor social play among mixed-age groups of children if we want to get a deeper understanding of the benefits of children's social play. In this study, we try to examine how playgrounds for mixed-age children affect children's social development. We firmly think that mixed-age playgrounds help both younger and older children, since they foster peer learning. Other critical questions of this study is how a playground influences children's creativity? In addition, how children can design a creative playground for their selves? Light, scenery, music, and even noise and visual pollution all contribute to creative enhancement, therefore we genuinely believe that, along with contributing in the development of communication skills among children of various ages, the designed playground would also aid in the strengthening of their creative thinking skills. We genuinely think that mixed-age play benefits children's development while also injecting vitality into employees' work environments, resulting in increased productivity. Therefore, Karsiyaka Child Protection Agency in Izmir, Turkey, was selected as a case study for this research. At the first step, survey with 111 children and 38 employees was undertaken to determine their preferred playground; and in the second step, a mixed- age playground was designed according to the survey results. We found that same-age play allows youngsters to collaborate fully and equally. Even the competitiveness produced by same-age play may be interpreted as beneficial, as it, can assist inspire performance and prepare children for competitive adult job conditions in a competitive society. Nevertheless, age-mixed play has benefits to same-age play in terms of acquiring skills, culturally relevant information, cultural rituals, nurturance, and leadership. When children are not institutionally separated by age, they opt to engage in a lot of age-mixed and same-age play, gaining experience with both. At the end, according to results, we designed a mixed-age playground for the children and employees in Karsiyaka Child Protection Agency in Izmir, Turkey.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANIMAL PASSAGES AND RULES FOR THEIR DESIGN**

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### **ABSTRACT**

One of the most serious, ecological consequences of the development of road infrastructure is the restriction of the free movement of organisms in the landscape space by creating ecological barriers. As a result of barrier interactions, there are a number of negative environmental effects, most of which result from the permanent division of habitat areas into smaller fragments, with impeded contact between the individuals inhabiting them. The construction of animal passages has for many years been the most important and commonly used method of minimizing the negative impact of roads on wildlife. In Poland, an appropriate number of properly located and designed passages will be decisive for the maintenance and development of large mammal populations with the highest habitat requirements, such as wolves, lynxes, bison and elk. The enormous ecological importance and high costs of construction of passages require that every effort be made to achieve their highest efficiency by selecting the right locations, selecting the optimal parameters, number and density of facilities and their appropriate management. A number of guidelines and recommendations relating to the key elements determining the effectiveness of animal passages were developed on the basis of European "good practices" and the Polish experience to date. However, it is not always possible to avoid design and construction errors that affect the efficiency of animal passages. The article focused on designing aspects of animal passages.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ACTION RESEARCH AND THE ROLE OF PARTICIPATION FROM A DESIGN PERSPECTIVE**

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### **ABSTRACT**

This paper aims to make a review of action research (AR) approach, explore its history developed over the last half century, and analyse its principles and paradigms while focusing on its methodology to reveal the role of participation. Action research with all its features, principles, paradigms and methodologies as mentioned in the previous part, could be a very appropriate and beneficial approach for the research in the design practice. Action research, which is an approach that helps the practitioner for social change, could also help the designer/design researcher who has similar goals, similar way of work, and similar vision in mind for social change. Some practical examples of AR projects are critically analysed to reveal how the approach could be useful for design research/practice. This study reveals that the integration of the practice of design with research paradigm, referred as *research through design* by Archer (1995), can be realized with the use of AR approach, and can be used by the practitioner for social change. Consequently, action research and design practice follow a similar path and have the potential to support and elevate each other for the common purpose of social improvement. Action research and design practice are both situation-based, context-specific, collaborative and participative. They aim practical improvement and social change; and involve problem solving, action, evaluation, reflection and implementation. They create knowledge, improvement and change in and through action. They develop reflections by participatory interpretations, and have non-conclusive, non-absolute and ever emerging solutions. Thus, the paper concludes with two main arguments: (1) the importance of the role of participation in action research and (2) the use of AR in design research / practice being crucial.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## IMPACT OF SEA WATER ON THE STRENGTH OF STEEL ANCHORS

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### ABSTRACT

The aim of the work is to determine the durability of fastenings with construction connectors in aggressive environments. Currently, the research will be carried out experimentally for the own needs of Fastener Manufacturers. The lack of guidelines causes differences in the approach to determining the final pull-out capacities of construction fasteners from concrete substrates under the influence of aggressive environments, in particular sea water. Building fasteners available on global construction markets, in accordance with the Manufacturers' recommendations, are intended for technically diversified applications, resulting from the need for renovation or new structures. The growing demand for construction fasteners provided for in difficult environmental conditions forces the estimation of new load capacity of construction fasteners in aggressive environments. According to the conducted preliminary literature analysis, the topic of the influence of aggressive environments on the durability of fastenings has been conducted for several years. The tests and guidelines refer only to the material knowledge and not to the load-bearing capacity of the fasteners for a specific case combination of action. Therefore, the proposed experimental research, as an innovative approach to determining the load capacity of construction fasteners, will be a significant expansion of the knowledge on the durability of fastenings with construction fasteners under the influence of aggressive environments. The article defines the load capacity for pulling out steel anchors depending on the condition of the concrete substrate, drilled diameter, the typical salinity of seawater. Tests for the purposes of the article was carried out on concrete substrates, strength class C20/25. Three diameters of steel anchors made of stainless steel were selected for testing, as commonly used for fastenings in modern construction.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## TRANSFORMING THE URBAN PUBLIC SPACE THROUGH ART AND DESIGN DURING THE COVID -19 PANDEMIC

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### ABSTRACT

In Turkey, where the urban public space is constantly changing, public space renewal methods are becoming more and more diverse. As a flexible space intervention strategy, the impact of independent art and design initiatives invites design actors and citizens to raise questions about the relationship between design and the city and to think together in this way. This paper first discusses the concepts and types of public art and design interventions and evaluates them through the public space studies carried out in Izmir. Art and design interventions in Izmir include several different approaches. From individual initiatives to collective and even institutional actions, the configurations of art and design practices in the urban public space are diverse. For this reason, the social implications of each practice and the reproduction of the public space are different. In addition to the contribution of independent initiatives to public spaces such as the old city center and abandoned industrial areas, its interaction with the residents of the neighborhood is crucial. The social, commercial and touristic significance of these areas will be evaluated together with the design and art interventions with the neighborhood. In this study, which examines the role and impact of art and initiatives in urban transformation by looking at the Darağaç Collective and NomadMind in Izmir's central district, we benefited from the literature on urban transformation, public space, street art, and artist initiatives. Focusing on the case of these events, this study deals with the role of artistic and designer activities in urban transformation processes during the Covid -19 Pandemic. As an urban precariat, the artists' efforts to survive despite the pandemic, economic and social difficulties, and the changing exhibition methods due to the pandemic conditions have also affected the production of art and design work in the public space. By combining a number of qualitative research techniques, a methodological approach was applied to determine how artistic and design intervention affects residents and their environment. Oral interviews with artists, government officials, residents and business owners, and theoretical approaches and concepts related to the public space were discussed together.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ORGANIZATIONAL ECOLOGICAL EMBEDDEDNESS AND VULNERABILITY OF THE STRUCTURES

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### ABSTRACT

This paper presents a new, comprehensive, system-wide approach in the driving factors of the vulnerability of the structures through two focuses: one refers to the firm's illegal structures, the second relies on their ecological embeddedness. Through the lens of the organizational ecology theory we posit that high levels of vulnerability are not to be considered in an isolated manner rather in a collective that expresses a low level of identification and respect for the territory where the firms are located as well as a low level of institutional and cultural pressure that should lead to respect common safety standards. This preliminary study considers the illegal structures on the part of the firms as a proxy of low level of vulnerability since illegality deals with firm's structures built outside of safety standards. We refer in particular to those located in areas with high risk of natural events therefore worsening the vulnerability of the structure. As for the driving factors we rely on two groups that are distinguished according to their sources. Thus, we consider some territorial driving factors that expresses the culture of the safety inside the boundary of a territory and attributable to agents different from the firms and those driving factors that are intended as micro, directly attributable to the firms in a given territory. The results show that structures with lower levels of safety are positively associated with the institutions weakness in controlling the territory, with high rate of bankruptcy as well as with lower level of corporate social activities. Implications are about the security of the structures notion that cannot be considered a detached technical activity but rather a culture to be shared whose degree of variability depends on the firms' ecological embeddedness.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CRITICAL MOMENT OF BEAMS WITH MONOSYMMETRIC I-SHAPED SECTION

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### ABSTRACT

The set of European Prestandards so-called Structural Eurocodes published in the years 1992- 2000 reflected the actual state of the art and provided powerful tools for practical design. Nevertheless, the experience has shown, that there was room for their improvement. ENV 1993-1-1:1992 for design of steel contained Annex F and ENV 1999-1-1:1998 for aluminium contained Annex H with rules for calculation of critical moment. These Annexes contained identical rules for  $M_{cr}$  calculation, which gave for several cases incorrect results. Authors of current Eurocode EN 1993-1-1:2005 decided to delete this Annex and not to give designers any approximate formulae for  $M_{cr}$  calculation. But authors of EN 1999-1-1:2007 decided to offer to designer improved formulae in Annex I. Historical outline. Comparison of different formulas for elastic critical moment. General evaluation of 3-factors and 3-parameters formulae. Comparison of factors  $C_1, C_2, C_3$  computed by different authors. Formulae used in Eurocodes and in Czech and Slovak codes. Publications containing incorrect rules for calculation of critical moment value of unrestrained beams in bending. Way how to improve incorrect rules. Unifying of different formulae for calculation of critical moment. Advantages and disadvantages of various formulae formulae for critical moment. Overview of computer programs for calculation of critical moments. Numerical examples. Comparing of results of approximate formulae with exact values obtained by computer programs. Calculation of critical moments of beams made of steel, stainless steel, aluminum alloys or timber. Interval validity of approximate formulae.

Proposals for Technical Report CEN/TR 1993-1-103 Eurocode 3 – Design of Steel Structures – Part 1-103: Elastic Critical Buckling of Members.

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## ELASTIC AND PLASTIC RESISTANCE OF THIN- WALLED HVH SECTIONS

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### ABSTRACT

In the present paper a program THINWALLRES is explained to obtain the elastic and plastic resistance of thin-walled HVH sections under many combinations of the internal forces: axial force  $N$ , shear forces  $V_z$  and  $V_y$ , bending moments  $M_y$  and  $M_z$ , bimoment  $B$ , warping torsional moment  $T_w$  and Saint Venant torsional moment  $T_t$ . The program THINWALLRES can at the moment solve various HVH-sections (H – Horizontal upper flange, V – Vertical web, H – Horizontal bottom flange), i.e. I-sections and H-sections that can be monosymmetrical, Channel sections and Z-sections. The background of the theory is briefly explained. The results provided by the program are the elastic normal stresses, shear stresses and von Mises stresses due to any combinations of eight internal forces. The plastic stress distribution under given internal forces, plastic factor and up to ten different interaction diagrams combinations may be obtained with THINWALLRES. The results in the form of diagrams are helpful in the safe and economic design of metal (steel and aluminium) thin-walled members of the Classes 1, 2 and 3.

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## PLASTIC RESISTANCE OF Z-SECTIONS UNDER VARIOUS INTERNAL FORCES

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### ABSTRACT

Z-section belongs to the group of pointsymmetric section with principal axes  $u$  and  $v$  and axes  $y$  and  $z$  parallel to Z-section flanges and parallel to Z-section web respectively. In the paper Z-section with even flanges without edge lips are investigated. The shape of these sections is convenient for use in the slope roofs as purlins. There are plenty of different shapes of cold formed Z-sections produced by many companies. Light gauge cold-formed steel members are commonly used in a range of building types as secondary steelwork and in the primary load-bearing elements in light steel frames. These are of Class 4 sections at which local buckling and distortion may appear. The paper is focused on Z-sections of Class 1 and 2 at which the plastic resistance may be utilised. Roll formed Z-sections may be seen in various steel constructions such as commercial buildings, large storage bins, mezzanine flooring,, racking, residential garage doors, fencing, etc. Some commercial computer programs calculate elastic and plastic cross-sectional characteristics and resistances to the both kind of axes:  $y$  and  $z$  and also to principal axes  $u$  and  $v$ . Unfortunately, some of them are incorrect. Cross-sectional properties of Z-sections of Class 1 and 2 may be taken also from German standard DIN 1027. Again also in this code some of them are incorrect. The paper offers for Z-sections of Class 1 and 2 formulae for calculation of: a) cross-sectional elastic and plastic characteristics, b) elastic and plastic resistances including their maximum values which may be achieved with combination of other internal force. Several numerical examples show details of calculation, comparison with results of other sources and interaction diagrams as well. The presented procedure will be useful for designers in practice, authors of computer programs and participants in educational processes.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE COMMUNICATION OF HERITAGE, ARCHITECTURE AND ENVIRONMENT: REFLECTIONS ON THIS POST-COVIDE PANDEMIC

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### ABSTRACT

This is a contemporary subject, since tourism and the number of visitors to a city have practically disappeared or been suspended due to the current situation in the world. The crisis that has arisen with the emergence of the COVID-19 virus. What the pandemic seems to have highlighted is the way different agents deal with communication issues, namely musicological institutions, is the object of this reflection.

Alongside the usual forms of communication, new ones seem to be emerging, combining a series of new technologies and the growing use of social networks. How will be the future of these spaces, what will make the visitor go to these places, or continue the virtual visits will be something important to discuss. In this context, environmental quality, integrated planning, the use of local materials, the enhancement of place, innovation and creativity may be a way forward, and will be an opportunity for new forces of communication, for rethinking tourism in cities and the role of architecture in this communication that is sustainable and environmentally friendly. The use of new materials, of new digital tools can be a tool that, always bearing in mind that the city is ultimately a human creation, of the zeitgeist and human knowledge, can and must contribute to a greater sustainability in time and space of the agglomerations, resuming good practices and sustaining itself in the reflective practice and the uniqueness of the people. A look at this problem from different points of view, against the backdrop of the Belém area in Lisbon is proposed as a starting point for this theme.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## REFLECTION OF THE OLD CITY - ARCHITECTURE, HERITAGE, AND TOURISM: CIDADE VELHA IN CAPE VERDE

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### ABSTRACT

Since the last decades of the 20th century, tourism in Cape Verde has been one of the fastest growing sectors, attracting greater foreign direct investment. However, this growth can create greater pressure on existing resources, with negative impacts at various levels. There is a clear reflection on the valorisation, preservation, and conservation of patrimony heritage, in which the historical center of Ribeira Grande, Cidade Velha, the bearer of a of a unique history, being the cradle of the Creole nation and the place where the slave trade where the slave trade was born. It had an existence of golden times, almost ephemeral, but knew how to take It had an almost ephemeral golden age but was able to take advantage of it and be efficient at the time. The theme of this work is a think proactively study that relates history to urban design, the image of the city design, the image of the city from various points in it, economics, sociology, and architecture with heritage and tourism. architecture with heritage and tourism. A demonstration of how to revitalize the historic, almost rural place of the Cidade Velha de Ribeira Grande, is suggested, valuing the environment, conserving the cultural, natural, built natural, built, and underwater heritage. In this way we combine a research study on history, landscape, urban endowments, and equipment, to thus give way to a "recycling" of space and World Heritage, without disturbing the environment, making it attractive, and developing its economy in the sector of Sustainable Tourism.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **VARIOUS ASPECTS OF HUMAN SAFETY DURING THE CONSTRUCTION AND USE OF TUNNELS**

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### **ABSTRACT**

The article presents selected scientific and technical problems referring to the construction and use of tunnels to ensure safety. The intensive development of tunnel construction technologies concerns the progress in their design. This progress is of particular importance for subsequent safe use. The priorities in the safe tunnels design procedure refer to the advanced methods and computational models and the awareness of the need of conducting geotechnical research. These tests cannot be limited to the normal activities such as determining the type of soil but must take into account many other aspects such as the optimal foundation depth, environmental impact, vibroacoustic, groundwater interference or the need to inventory existing buildings in the case of tunnel location in the built-up area. Incomplete recognition of the soil properties is the frequent reason for failures and disasters occurring during drilling and subsequent operation of tunnels. Previously performed tests are therefore the basis for minimizing the risk. Fire safety is another aspect of the article. The author presents examples of fire tests in tunnels carried out in recent years. Tunnel fire safety tests, including international projects such as the Eureka 499 "Firetun" and the Memorial Tunnel Fire Ventilation Test Program, were the first to provide reliable information on the nature and course of a tunnel fire. The article also presents the problem of ensuring adequate air quality inside the tunnel and the impact of pollutants resulting from fuel combustion on the human body. This section proposes ways to improve air quality in tunnels. The research includes specialized internal finishing coatings to reduce harmful substances such as NO<sub>x</sub>. The author presents the test results carried out in the Umberto I tunnel in Rome (Italy) before and after using the air-purifying coating/paint. The experiment showed over 20% reduction of NO<sub>x</sub> concentration, which is harmful to humans. The article presents essential subjects of safety in the stages of implementation and use of tunnels. The study refers to research and analyses focused on increasing the safety level.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## OPTIMIZATION OF ENERGY EFFICIENCY WITH REGARD TO THE COMFORT OF USE FOR A HISTORIC BUILDING: CASE STUDY

Małgorzata Fedorczyk-Cisak

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### ABSTRACT

The article presents a new, innovative approach to improving the energy efficiency and comfort of using historic buildings and buildings under conservation protection. Most of the thermal modernization works proposed to improve the energy efficiency of existing buildings cannot be performed in this type of facilities. This is due to the necessity to preserve the cultural heritage, which translates into the priority of maintaining the shape and facade, sometimes the functions of historic buildings. Only in this way is it possible to recreate our historic infrastructure for future generations. Conducting construction works on a construction object entered in the register of monuments requires, prior to the issuance of a building permit decision, obtaining a permit to carry out these works, issued by the conservator of monuments. Therefore, despite measures to improve energy efficiency in the construction sector, all buildings listed in the register of monuments are completely exempt from the obligation to determine their energy performance. However, in many historic buildings, economic activity is carried out or these buildings are intended for permanent or temporary residence. In such cases, improving the energy efficiency and comfort of using historic buildings is very important. The article presents an innovative approach to improving the energy efficiency of historic buildings, taking into account the possibility of using the existing infrastructure that meets the strict requirements of energy efficiency (e.g. passive buildings, nZEB) and activities resulting from conservation restrictions for buildings under conservator's care. An innovative approach to improving the energy efficiency of historic buildings, including energy production in buildings with very good energy efficiency located near a historic building, is presented in the article on the basis of an analysis of the real "district" of two buildings: a historic building and a facility with a very high level of energy efficiency. The presented methodology can be guidelines for the design of thermal modernization of buildings under conservation protection, taking into account the improvement of energy efficiency and comfort of use.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## OPTIMIZATION OF ENERGY EFFICIENCY WITH REGARD TO THE COMFORT OF USE FOR THE EXPERIMENTAL BUILDING NZEB: CASE STUDY

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### ABSTRACT

The article presents an innovative approach to designing buildings with almost zero energy consumption (nZEB), taking into account the comfort of use. The climate and energy policy, preventing the degradation of the natural environment, supporting the protection of natural resources and biodiversity, is one of the major challenges resulting from the provisions adopted by the Member States of the European Union. The exhausting resources of natural energy raw materials and the deterioration of the quality of the natural environment due to the high energy consumption of the sectors of the economy require effective measures. One of the sectors of the economy with the highest energy intensity is construction, which accounts for around 40% of total energy consumption in the Union. EU member states and countries around the world take effective measures to reduce the consumption of energy from non-renewable sources and thus contribute to the increase in the use of energy from renewable sources. The effect of the activities is the reduction of greenhouse gas emissions. The article presents "in situ" research on the optimization of energy efficiency, taking into account the comfort of use of rooms in an experimental building with almost zero energy consumption. The comfort of using the rooms is a collection of many feelings of users. Among other things, the comfort of using the rooms is influenced by thermal comfort, lighting comfort, air quality comfort, vibro-acoustic comfort and the comfort of space ergonomics. This article addresses the aspect of ensuring thermal comfort by controlling various heating and cooling systems. Various comfort levels were adopted during the research. For certain comfort levels, the energy consumption has been measured to achieve them. Conclusions drawn up on the basis of the analyzes presented in the article may constitute guidelines for the design of comfortable, low-energy residential and public buildings.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**INFLUENCE THE ACTUAL DISTRIBUTION OF ISOTHERMS IN THE NZEB BUILDING ENVELOPE  
DEPENDING ON THE INDOOR AND OUTDOOR CLIMATE**

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**ABSTRACT**

The requirements for thermal insulation of external partitions, in particular for low-energy, passive buildings or for the standard of buildings with almost zero energy consumption, are very restrictive. The member states of the European Union have introduced the standard of nearly zero-energy buildings (nZEB). Buildings designed and built to this standard are characterized by a very good insulation of the casing and a very high tightness, limiting heat loss through leaks. It is a new standard for the design and implementation of buildings (nZEB). The article presents the methodology for determining heat losses through partitions of such buildings. On the example of a real building that has been properly measured, the measurement system and the results obtained from the conducted tests are presented. The analyzes and conclusions carried out in the article also show the dependence of heat flow through partitions on internal and external climatic conditions. The innovative methodology and conclusions contained in the article can be the basis for the design of buildings with almost zero energy demand.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ARTIFICIAL NEURAL NETWORKS AND ESTIMATION OF THE ENVIRONMENTAL QUALITY IMPACT ON URBAN REAL ESTATE VALUES

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### ABSTRACT

In recent decades, the uncontrolled expansion and increasingly rapid urbanisation of cities are leading to dramatic consequences, such as the fragmentation of ecological assets, the loss of biodiversity and, more generally, the deterioration of environmental quality. Therefore, it is becoming increasingly urgent to invest in the conservation and restoration of green areas, so that the urban system itself can in turn become a provider of ecosystem services. Such initiatives, besides generating positive environmental and social benefits, can lead to significant increases in the real estate values of the area involved in urban regeneration. The aim of this paper is therefore to characterise an innovative Artificial Intelligence (AI) model to estimate the impact of urban greening on property prices. Specifically, we propose an Artificial Neural Network (ANN) that includes among its inputs also proxy variables of environmental quality. The ANN, besides being still little used to assess the monetary benefits generated by ecosystem services, can set non-linear relationships between inputs and outputs, and returns results more performing than traditional forecasting models. The critical steps of the model concern the choice of input variables and the setting of the ANN. In the second part of the work, an application to a real case study will allow the model to be tested and demonstrate how measures to preserve green areas can have an impact on both the community and urban real estate. In conclusion, the aim is to demonstrate how AI models, also by integrating them with traditional forecasting models, can: on the one hand, provide evaluators with a more rigorous set of information on the performance of real estate; on the other hand, provide a monetary evaluation of environmental externalities, with consequent effects on the whole decision-making process.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **TOWARDS SAFETY AND RISK ASSESSMENT IN RENOVATION OF COMPLEX URBAN HERITAGE**

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### **ABSTRACT**

The contribution sets out the approach of a particular study carried out in the framework of a wider ongoing research for the definition of innovative integrated tools for the management, valorization and transformation of urban complexes of relevant cultural interest. The adaptation to safety requirements must in this case meet the challenge of a coherent integration with the valuable elements of the built heritage. The site of Ivrea, an industrial city of the 20th century, recently inscribed in the UNESCO lists, is an interesting case study, because of the many aspects of its complexity that would require effective guidelines for the planning and coordination of autonomous interventions.



**EFFECT OF SLENDERNESS RATIO AND SPIRAL CFRP CONFIGURATIONS ON THE BEHAVIOUR OF CONFINED CIRCULAR REINFORCED CONCRETE WITH SPIRAL CFRP ROPE**

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**ABSTRACT**

This study aims to investigate the behavior of circular slender reinforced concrete (RC) column strengthened and confined by Carbon fiber reinforced fiber polymers rope (CFRP) taking into account the influence of slenderness ratio, CFRP configuration, and spacing between CFRP rope. Because stiff NSM-CFRP cannot be wrapped around the column, the necessity for flexible near-surface mounted carbon fiber reinforced polymer (NSM-CFRP) material has recently arisen. Twelve round RC columns were tested. These RC columns consisted of with three slenderness ratios (17.3, 23.79, and 28.1) and heights of (80 mm, 1100 mm, and 1300 mm). The results show that when the slenderness ratio increases, the bearing load capacity and axial strain corresponding to the maximum axial stress decrease. The slenderness ratio had the greatest impact on the behavior of the RC column when there was more CFRP rope or when the spacing between CFRP ropes was the lowest. Furthermore, increasing the spacing between CFRP ropes leads to an increase in the load, stiffness, toughness, and ductility of RC columns. Finally, it has been determined that the confinement technique utilizing spiral CFRP rope at 150 mm spacing has the greatest impact on the load-carrying capacity of the RC column. Additionally, confining the RC column with spiral CFRP rope at a 150 mm spacing increased the bearing load capacity of the RC column with the lowest slenderness ratio more than the other slenderness ratios.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE EFFECTS OF VENTILATION ON BIOAEROSOL CONCENTRATIONS AND CONTAINMENT IN LONG-TERM CARE ENVIRONMENTS

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### ABSTRACT

As of February 24, 2022, the U.S. Centres for Medicare and Medicaid Services (CMS) identified a total of 983,312 COVID-19 cases in long-term care (LTC) facilities resulting in 149,985 deaths. At this time, COVID-19 cases in LTC facilities accounted for only 1.2% of 78.8M confirmed U.S. cases yet 15.9% of the 946,109 total U.S. deaths. Although many LTC facilities have implemented measures to isolate infectious residents from the general population, most are not designed for airborne infection control and guidance for retrofitting existing LTC spaces for airborne isolation is limited. The purpose of this study therefore, was to evaluate the effect of ventilation, negative air pressure, airflow barriers and other retrofit measures on bioaerosol concentration and movement within LTC environments. Results from aerosol testing in an actual LTC facility suggest that ventilation rates have a significant effect on the removal of bioaerosols. Increasing ventilation from 1 to 6 air changes per hour (ACH) reduced the time necessary to remove 99% of aerosols from 3 hours to approximately 40 minutes. Significant reductions in aerosol mobility between resident rooms, corridors and common spaces were also observed with respect to negative room pressurization and the use of anterooms.



## ANALYSIS OF THE COOLING EFFECT CRITERIA OF BUILDING STRUCTURE AND ENERGY DEVICE

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### ABSTRACT

Cooling and heating are fundamental physical processes associated with heat transfer in building structures, in technological processes, with phase change of flowing fluids in energetic devices and in other industrial applications. The aim of this paper is to investigate the dependencies of the cooling criteria of a building structure (building envelope) and the energetic device located in the building. The discontinuity of the mentioned thermal processes is conditioned by the variation of the thermal content of the investigated bodies. For technical purposes, in most cases of building structures the heat flux can be monitored in one direction, most often in the x-axis direction. The results of the solution of the first and second order Bessel functions show that the function of interest depends on many variables. A deeper analysis reduces the number of independent variables to three dimensionless ratios - criteria (similarity constants), one of which is the Bi - Biot criterion. This number is considered as an evaluation criterion of the building structure. Generally, the most followed parameter in experimental investigation of phase change parameters in power equipment is the heat transfer expressed by the dimensionless criterion Nu - Nusselt number, with relation to the transfer characteristics. The two proposed dimensionless numbers express the ratio of convective and conductive heat transfer, with no difference in the dimension of each parameter, but they differ in the value of the thermal conductivity coefficient, both in the case of the building structure and in the case of the flowing fluid. In this paper, values in the range of Biot's number  $Bi \gg 1$  and Nusselt's number  $Nu > 3.66$  are considered. In the paper, analytical calculations of non-stationary heat conduction in a building structure with negligible external thermal resistance and Nu calculations according to selected correlation relations of different authors in the process of fluid cooling in a power plant are performed in terms of their suitability, usability, and applicability. The output is finding the functional dependence of both criteria (building object and energy device) and its general application to different building structures and energy devices in terms of cooling effect. The results of the calculations in relation to the dimensionless criteria Bi and Nu are tabulated and expressed graphically.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**EVOLUTION OF ENERGY PRODUCTION FACILITIES IN POLAND: REMAINS OF GAS FACILITIES -  
ANALYSIS AND MODEL FOR HERITAGE CONSERVATION**

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**ABSTRACT**

Thanks to the evolution taking place during the industrial revolution, new types of energy and power source were introduced: gas, electricity and heat. In order to meet the demand, in addition to the production itself, it was necessary to create a municipal technical infrastructure - providing access to new energy sources. Due to the huge supply demand for a new energy source and the price of new technologies, energy production facilities were very often built in the central parts of the agglomeration, which allowed to reduce the costs of building new energy transmission infrastructure. This genesis of the buildings has led to significant changes in urban structures and the way they develop. The growing demand for energy led to the rapid evolution of these buildings during this period. Both the demand for the type of energy and the technologies of its production have changed. Initially, rapid development of the energy sector led to a departure from the earlier methods of supplying gas. Gasworks facilities many times have been rebuilt or demolished due to the lack of demand for the type of energy they produced. When analyzing the remaining gas-related objects in contemporary Poland, there are few of them left. Research will be carried out to determine the state of preservation of the heritage related to the gas industry based on the remains of structures created in large urban cities in Poland. The aim of the study is to analyze the remains of objects related to gas extraction and to create a model of activities limiting their further degradation in order to maintain historical objects that are part of the polish energy technology development history.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**APPROXIMATION PARAMETERS OF MINING TERRAIN SUBSIDENCE INDUCED BY A MULTI-SEAM EXPLOITATION OF HARD COAL DEPOSITS**

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**ABSTRACT**

Underground mining exploitation of hard coal deposits causes vertical displacements of terrain surface and a rise of subsidence trough on it. It's very important to make predictions of mining exploitation influences with a high accuracy. Evaluation of computational models applied in forecasting of exploitation effects is made on the basis of comparing forecasted values of deformation indicators with their average measured values. In this case subsidence of terrain surface caused by an exploitation of the 338/2, 358/1 and 341 hard coal seams have been observed. They on an observational line No. 8 after the end of exploitation in the 338/2, 358/1 coal seams and the 338/2, 358/1, 341 coal seams have been measured. Average values of measured subsidence on the way of approximation have been obtained. Approximation by the use of polynomials has been done. There a polynomial order  $n$  and a sections number  $k$  of approximating function on the basis of minimalization of a value of variability coefficient of random dispersion of observed subsidence  $M_w$  have been chosen.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ASSESSING THE LEVEL OF LIVABILITY IN COMMERCIAL STREETS IN THE GULF. A MIXED METHOD APPLIED IN THE STREETS OF MUSCAT**

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### **ABSTRACT**

The concept of livability had gained tremendous popularity in the west and had been used in practice and planning theory for the last 50 years. Nevertheless, the term is not well defined, and many studies were initiated to understand what makes an urban space livable. Livability as such reflects the quality of living and the wellbeing of people by satisfying all their necessary needs. Jan Gehl a pioneer and promoter of livable spaces, studied people in architecture to understand how walkable, social environments create livable cities (Gehl, 2013; Gehl & Svarre, 2013b, 2013a). He developed criteria to evaluate the livability of spaces and guidelines for the Design and improve the livability of public realm in cities. Cities in the Gulf region lack the livability values, particularly in their recently planned retail streets. Pedestrianizing neighborhoods is fundamental in order to achieve livable, walkable and healthier outdoor environment, because it improves people's socialization. However, pedestrianizing alone, no matter how important, is not sufficient to create a vibrant and livable street or neighborhood. There are other aspects and features that are required in such spaces. The aim of the present study is to investigate the level of livability in commercial streets of Muscat, and define the important design aspects that affect it. Three case studies were selected for this purpose. The methodological approach was of qualitative and quantitative nature. A comprehensive literature review was done to understand the concept and tools that helped in the study of livable streets in neighborhoods. Moreover, questionnaires, behavioral mapping and walkthroughs were also conducted in the select streets to identify the patterns of people's visits in weekends and weekdays. The data analysis revealed that aesthetic appeal, activities and pedestrian friendly streets attract people and promote the use of space, thus enhancing the level of livability in the street. The study contributed also in generating a set of criteria and indicators that assess the level of livability in commercial streets in Muscat and they could be generalized to other cities of the Gulf and in similar geo-cultural contexts

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SURVEY ON GREEN ROOFS IN POLAND**

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### **ABSTRACT**

The aim of this paper is to present the results of a survey on green roofs among potential real estate developers and users, concerning knowledge about, awareness of the benefits of, and interest in green roofs. The survey sample consisted of 151 persons – potential real estate developers and owner-builders from Poland. This is not a large number, but it is significant. The research sample was purposive and statistically insignificant, and the study was an initial part of a larger project. Greenery in urban settings positively affects human quality of life and health, and contact with nature improves well-being and reduces stress. Roofs covered with greenery are also a sign of growing environmental awareness. In Poland, green roofs are usually a feature of public and commercial buildings. The low popularity of this solution in single-family housing has its source in potential owner-builders being unaware of the benefits of the roofs' application, funding opportunities, and benefits in the form of a greater amount of biologically active surfaces. Currently, the technology of covering roofs with greenery is highly developed, and there are many experienced contractors who operate on the Polish market. However, there is a deficiency in knowledge about green roofs among real estate developers and prospective owner-builders, which constitutes a demand barrier. Many people are anxious about using a green roof out of fear of high construction costs and necessary greenery maintenance. This is due to misinformation, as it is possible to use an extensive, low-maintenance roof type. In the case of an intensive roof, the maintenance largely resembles that of a traditional domestic garden. The costs of creating a roof garden are higher than in the case of traditional roofing materials, but a smaller plot could be bought as a result, as a greater amount of biologically active surfaces can be obtained to meet zoning regulations. In Poland, there are currently no legal regulations that obligate or incentivise the use of green roofs. The popularity of this solution is growing, which gives hope for making cities greener. In an era of progressing climate change, building additional green spaces, including those on roofs, is a crucial remedy for the severe consequences of unsustainable urbanisation.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**DESIGNING FOR PUPILS WITH THE AUTISM SPECTRUM DISORDER: CASE STUDY OF THE CAUDWELL INTERNATIONAL CHILDREN'S CENTRE, NEWCASTLE, UNITED KINGDOM**

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**ABSTRACT**

The increasing number of ASD cases requires therapeutic centres and infrastructure in order that efficient and wide-ranging diagnosis can be carried out. One of such objects was established by John Caudwell and Trudi Beswick in Newcastle (UK) as "The Caudwell International Children's Centre'(CICC). The programme of this centre is based on uniting the leading world-renowned experts in the field of ASD diagnosis and therapy, as well as supporting long-term care, improving the education results, and employment of people with ASD. The case study research, which is presented in this publication is to analyse the key perceived architectural elements of the CICC and results in an expert survey of the designed solutions. The acoustics, lighting, finishing materials, colours, ventilation and visual identification were the main criteria of the analysis. As an outcome of the interdisciplinary cooperation, the ASD space-defining data is collected. The result shows, that the architect was not only concerned about technical standards for physically disabled people but also took the neurodiverse pupils into consideration during the design process. Autism is classified as a group of disorders that affects communication, social interactions and stereotypical behavioural patterns. Each affected person consists of different juxtaposition of these mechanisms and causes which are responsible for the developmental difficulties. Sensory sensitivity of people with autism has different aspects. It is not possible to develop a universal pattern that will work in any case. The basic factor involved in the perception of the building is the sensory stimuli. Considering the specificity of autism spectrum disorders and the unusual sensitivity of these people, it is a key element that needs to be implemented in a specialist design in the future.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INFLUENCE OF THE THERMAL INSULATION COATING ON THE IMPROVEMENT OF THERMAL INSULATION OF BUILDING PARTITIONS

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### ABSTRACT

Building partitions (walls, ceilings, floors, windows, doors) with appropriate insulating properties play a fundamental role in energy-saving construction. From 2021, the maximum value of the thermal conductivity coefficient  $U$  [ $W / m^2K$ ] for vertical external walls is  $0.20$  [ $W / m^2K$ ] in Poland. This value can be achieved by using an insulating layer of an appropriate thickness. However, a dozen or so centimeters of the insulating layer reduces the living space inside the building. This is important, especially in the case of multi-family buildings. The problem may be solved by using a thinner material with better insulating properties. Such a material may be a microsphere thermal insulation coating, which has become more and more common recently. In order to verify the impact of insulating microsphere thermal insulation coatings on the building's energy efficiency, comprehensive in situ tests of the thermal properties of such a coating were carried out in the energy efficiency test range at the Building School Complex in Tarnów. The Energy Efficiency Testing Ground was established on the premises of the Building School Complex (ZSB) in Tarnów in 2014 as part of the implementation of the Krakow University of Technology project - Małopolska Laboratory of Energy Efficient Construction (MLBE). The task of the modern laboratory (MLBE) built on the campus of the Cracow University of Technology is to test modern technologies dedicated to energy-efficient buildings in laboratory conditions. The Energy Efficiency Test Site is to provide the opportunity to test modern technologies in natural use conditions. Tests are performed in model buildings, the partitions of which are erected in various technologies selected by scientists from the Cracow University of Technology. A small research building was built on the site, in which "in situ" tests were carried out on the thermal properties of the microsphere thermal insulation coating. Such coatings are more and more often on the market of building materials, and their producers and distributors promise a large impact of coatings on the thermal insulation of buildings and thus reduced heating costs. In situ research was aimed at verifying the data presented by the producers of innovative coatings and analyzing the possibilities of using coatings in buildings in order to increase energy efficiency and comfort of use. The research included a comparative measurement of temperatures inside the building, the walls of which were covered with a microsphere thermal insulation coating. The air temperature difference between the coated zone and the reference zone was  $1.5$  ° C

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## METHODS OF DETERMINING THE THERMAL CONDUCTIVITY OF BUILDING MATERIALS WITH HIGH AND MEDIUM THERMAL RESISTANCE

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### ABSTRACT

The subject of the analysis are methods of determining the thermal conductivity of building materials with high and medium thermal resistance. The thermal conductivity of building materials is determined by the thermal conductivity coefficient  $\lambda$  [W / mK]. There are a number of ways to determine the thermal conductivity  $\lambda$ . The coefficient  $\lambda$  may be determined under the steady state conditions or by the non-stationary (dynamic) method. The test conditions in the steady state conditions are defined by the standards ISO 8301, ISO 8302 and EN ISO 8497. Measurement of the coefficient  $\lambda$  [W / mK] in accordance with the PN-ISO 8301 standard is performed in a plate apparatus with heat flux sensors, while the measurement in accordance with PN-ISO 8302 is carried out with a plate apparatus with a guarded hot plate. The PN-EN ISO 8497 standard defines the test conditions with an apparatus with a guarded and calibrated hot pipe. Under steady-state conditions, the measurement of the coefficient  $\lambda$  is based on the one-dimensional Fourier's law applied to the one-dimensional temperature field. An alternative measurement technique is the non-stationary method, based on the measurement of thermal diffusivity. Thermal diffusivity is a specific material property that characterizes heat conduction in transient conditions. The phenomenon is used that in a certain time range the temperature change is a function of the natural logarithm of time. This value allows you to determine how quickly the material reacts to temperature changes. Thermal diffusivity is defined as the quotient of thermal conductivity and the product of specific heat and density. Alternative methods of determining the thermal conductivity coefficient  $\lambda$  have been developed in various research centers. This applies in particular to the measurement of the thermal conductivity of ultra-thin microsphere thermal insulation coatings. The value of the thermal conductivity coefficient  $\lambda$  obtained with this method for the microsphere thermal insulation coating was 0.001 [W / mK]. At the Małopolska Laboratorium Budownictwa Energoszczędnego (MLBE), the thermal conductivity coefficient  $\lambda$  [W / mK] is determined both under steady state conditions with a plate apparatus and the non-stationary method.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARISON OF A NEARLY ZERO-ENERGY BUILDING (nZEB) WITH A PASSIVE BUILDING: CASE STUDY

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### ABSTRACT

Construction is the sector of the economy with the highest energy consumption rates. The sustainable development policy in the world, based on reducing the consumption of natural resources and improving the quality of the environment, supports all activities increasing energy efficiency. Construction is one of the sectors responsible for the highest consumption of energy resources and emitting very large amounts of harmful substances into the atmosphere. Politicians and social organizations are taking action to prevent a climate disaster related to the activities of the construction sector. Examples of activities include the introduction of building standards with a radically reduced energy demand. Among the many standards of energy-efficient buildings, the most common are buildings in a passive standard and a new mandatory standard - buildings with almost zero energy consumption (nZEB). As these two standards are very often confused, in the article the authors, using the example of a single-family building project, showed parameters that differ between the two compared standards. In the introduction to the main part of the article, the authors presented the most popular building certification systems and conducted an analysis of the market of materials and technologies used in energy-saving construction. The main part of the article is a comparison of the parameter's characteristic for a passive building and a nZEB building. On the basis of the comparison, a single-family building design was created for both standards, together with the energy characteristics. The results of the comparison are presented as final and primary energy consumption values. In addition, the authors analyzed the impact of the selection of a heat source on the energy efficiency of buildings.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## FAST SYNTHESIS OF GAS HYDRATES

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### ABSTRACT

Global demand for energy resources is expected to increase significantly in the coming decades and although the share of renewable energy in the overall balance is steadily growing, the amount of energy generated may still be far from enough to meet the high energy demand. By 2040 more than 76% of energy is predicted to be generated from carbon-based sources (gas, oil and coal). Among these, demand for natural gas will increase at the highest rate (up to 2% per year). However, we should also expect CO<sub>2</sub> emissions to worsen. Nearly 80% of the world's natural gas consumption is met by conventional sources, while unconventional sources such as tight gas, shale gas, and coal bed methane have become increasingly common in recent years. Gas hydrates are a very promising source of natural gas, with an energy resource several times greater than all proven deposits of carbon fuels. Therefore, technologies of gas extraction from natural gas hydrates are currently of great interest to researchers all over the world. In this paper we propose a new fast gas synthesis, such as mine methane, natural gas and CO<sub>2</sub>, which can be used to form gas hydrate blocks and their subsequent storage or transportation. CO<sub>2</sub> hydrate can be safely buried at fuel extraction sites. We also propose a theoretical framework to assess stability of gas hydrates and apply to the development of technologies for gas extraction from natural hydrate deposits. The paper analyses thermodynamic conditions in fast synthesis of hydrates and proposes an optimization criterion for thermodynamic and heat and mass transfer parameters for effective implementation of a new fast synthesis technology.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THERMAL, CHEMICAL AND MINERALOGICAL PROPERTIES OF SOIL BUILDING BLOCKS REINFORCED WITH CEMENT

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### ABSTRACT

This paper represents an experimental study to determine the effect between thermal conductivity of Compressed Earth Block Stabilized (CEBs) by cement and the mineralogical and chemical analyses of soil, all the samples of CEB in the dry state and with different content of cement, the samples made by soil stabilized by Portland Cement. The soil used collected from fez city in Morocco. That determination of the thermal conductivity of CEBs plays an important role when considering its suitability for energy saving insulation. The measurement technique used to determine thermal conductivity is called hot ring method, the thermal conductivity of the tested samples is strongly affected by the quantity of the cement added. The soil of Fez, mainly composed of calcite, quartz and dolomite improved the behaviour of the material by the addition of cement. The findings suggest that to manufacture lightweight samples with high thermal insulation properties, it is advisable to use clays that contain quartz. In addition, quartz has high thermal conductivity.

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## URBAN GREEN INFRASTRUCTURE PLANNING IN PUBLIC COMMENTS. LESSONS FROM PUBLIC CONSULTATION PROCESSES IN ROMANIA

Cristina-Gabriela Mitincu, Constantina-Alina Hossu, Simona-Raluca Grădinaru, Mihai-Răzvan Niță, Ioan-Cristian Iojă

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### ABSTRACT

The potential of urban green infrastructure (UGI), i.e., multipurpose networks of green and blue spaces, to address urban challenges and provide ecological, social and economic benefits makes it an important investment for urban areas. However, its planning is challenging, as it should embody the principles of connectivity, multifunctionality, integration and multi-scale. Furthermore, the transferability of the conceptual understanding of UGI planning principles into practice experiences spatial and context difficulties, which undermines UGI implementation quality and outcomes. Thus, the aim of our study was to systematically assess the public comments made for planning documents dealing with green spaces in urban areas. We selected 159 individual public comments submitted for 13 planning documents from five county's city capitals in Romania and applied an evaluation protocol to investigate whether urban green spaces (UGS) planning practice is built on the theoretical considerations of UGI planning. Our evaluation protocol consists of 37 predefined items, which were classified into four main categories: (i) general aspects about the planning documents, and (ii) the public consultation process, (iii) comments characteristics and the extent they divulge the planning principles on UGI and (iv) comments incorporation into the planning document. This study identifies the strengths and weaknesses of the public consultation process in Romania, as well as the challenges for linking the theoretical considerations of UGI planning with practice. Our results indicate that the theoretical considerations of UGI planning add quite a bit of support for UGS management practice as 47.80% of the public comments mentioned at least one of the principles. The most common principles were multifunctionality (in 34.95% of the comments) and integration (in 28.16% of the comments), while multi-scale and connectivity were rare. Among the most common benefits of the UGS appreciated by the public were aesthetic value, recreation and sports opportunities, microclimate regulation, and enhanced quality of place. Regarding the integration principle, frequent reference was made to the UGS integration with 'gray infrastructure' or into residential areas. Furthermore, we found a relatively low level of public comment incorporation into the approved version of the planning documents. Considering these aspects, we suggest that there is an urgent need to better integrate public concerns into the planning process, as well as to increase public awareness about the theoretical considerations of UGI in order to consolidate UGS management practice.

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## **SIMULATING FUTURE LAND USES TO ANALYZE THE INFLUENCE OF THE LANDSCAPE IN URBAN CHANGE: THE CASE OF INDUSTRIAL HERITAGE NEIGHBORHOODS IN CHILE**

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### **ABSTRACT**

Since the end of the nineties, various researchers have studied the applicability of computer models to predict land-use change. Most of this research focuses in urban growth at a regional scale. Within this field of research, our investigation innovates by studying the applicability of these tools to predict land use changes regarding urban heritage at the scale of the city plot. Using GIS we built previous and current land use maps of an historic neighborhood located in the coastal city of Tome in Chile (years 1992, 2009 and 2019). Then, using the *Dinamica-EGO* land-use simulation and modelling software, we analyzed future scenarios of land use from 2019 to 2029. The methodology involved two phases. Firstly, building static maps of land uses that do not change during model iteration; secondly, identifying key cells linked to specific characteristics of the landscape; and thirdly to analyze how they affected land use change. We compared a baseline scenario with other two scenarios taking into account the influence of these morphological characteristics in increasing or reducing the probability for the preservation or regeneration of the historical land uses. The main results prove that the method is a powerful tool not only to simulate future land uses within historical areas, but also to analyze the impact of different morphological variables in these processes.

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## EVALUATION OF DIFFERENT COMMON GEOSYNTHETIC DESIGN PROCEDURES FOR MATERIALS IN PAVEMENTS

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### ABSTRACT

This paper discusses the pavement design methods used for the applications of geosynthetics. Geosynthetics are used for filtrations, separation, stabilization, drainage and reinforcement of the pavement base course and subgrade layers. Different agencies and organizations use different design approaches for geosynthetics in pavements and there is no unified design methodology that is used nationally. Four design methods were selected for the purpose of this study. These methods are the ones used by California Department of Transportation (Caltrans), New York State Department of Transportation (NYSDOT), US Army Corps of Engineers, and American Association of State Highway and Transportation (AASHTO). The focus is to analyze the design methodologies for drainage and reinforcement. The four methods are used to design a pavement section and the resulting pavement layer thickness and the geosynthetics characteristics were compared. The results for drainage indicated that geotextiles with different Apparent Opening Size (AOS) are obtained by each method with AASHTO method seems to be less conservative to clogging potential. The reinforcing effect is not uniformly recognized by the design methods investigated. Caltrans design method seems to account for the full reinforcing potential of the geogrids for subgrades with R-Value less than 20. NYSDOT does not account for the reinforcing effect of the geosynthetics. The Army Corps identifies a range of pavement thickness over which the reinforcing effect is more pronounced. The proposed modified AASHTO method also specifies a range of pavement thickness for the reinforcing effect of the geosynthetics to be realized although it is a different range from the one identified for the Army Corps of Engineers.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PROCESSING TECHNOLOGY AND APPLICATION METHOD OF 165MPa-UHPC SPECIAL-SHAPED PRESTRESSED PREFABRICATED BEAM

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### ABSTRACT

UHPC (Ultra-High-Performance Concrete) is a cement-based composite material that has received extensive attention in recent years. The compressive strength of UHPC can reach up to 200MPa, and considering other physical and mechanical properties, which make it a new type of composite material with great application prospects in civil engineering. However, due to the limitation of the material forming process, UHPC is seldom applied as a load-bearing structural material in the field of building construction. Shanghai Grand Opera House, which is under construction in Shanghai, China, unprecedentedly applied 165MPa-compressive-strength UHPC prefabricated components as the 15m long cantilever beam load-bearing structure in the core section. The cross section of prefabricated components is unusual in shape, and considering the processability of UHPC, it is necessary to study its prefabrication process and construction method. In this paper, solutions to three key issues are presented. First, a new component mould sealing process is developed, which solves the problem of reserving a large number of connectors at the joints of prefabricated beams, considering large fluidity of UHPC. Second, the mould system of floor slabs on both sides of the special-shaped prefabricated beams is introduced. Third, the on-site construction technology of UHPC prefabricated beams is briefly illustrated. This research and application breaks through the structural barriers that traditional high-strength concrete cannot achieve by using UHPC prefabricated components. Under the premise of construction safety and controllable quality, the solutions to the three key issues ensure the technical feasibility of the actual background engineering construction, and present substantial economic benefits. The technologies and results of this research can be directly applied to guide related projects or similar structures.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **PARAMETRICAL ANALYSIS FOR SYMMETRICAL LOADING OF A SINGLE-SPAN COMPOSITE STRING STEEL STRUCTURE**

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### **ABSTRACT**

The article analyzes the string and composite string bridge behavior and compositional parameters. The derived parameters are calculated and presented by selecting the appropriate limit parameters. The main parameters for suspended structures are the cross-sectional area of the tensile element and the initial sag of the structure. The selection of different component parameters and assigning different prestressing to the string leads to the analysis: which cross-sectional areas meet the defined conditions, what is the effect of prestressing, of the lower cable initial sag and the axial stiffness ratios of the string and the lower cable on the weight of the structure.



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYSIS OF SUCCESS FACTORS AFFECTING THE PUBLIC–PRIVATE PARTNERSHIPS IN THE PUBLIC SERVICES PROJECTS**

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### **ABSTRACT**

The development and economic growth of any country are significantly dependent on the provision of fundamental infrastructure and services for public sector projects. The infrastructure projects include the construction of roads, bridges, railways, etc. while the public services are constructed with the cooperation of both public and private sectors. The public-private partnership (PPP) procurement system has been implemented in different countries for more than three decades, helping these countries, especially the developed ones, to have a higher standard of infrastructure to fulfill their economic objectives. Essentially, there is a close relationship between infrastructure provision and the growth of the economy. However, the less developed countries need to achieve a satisfactory standard of provision of infrastructure to assist their fulfillment of economic development. This study is an attempt to examine the factors affecting the adoption of the PPP procurement system in the fields of services and infrastructure in developing countries in general and Iraq in particular. This aim was accomplished through a survey of construction experts. Based on the literature review and face-to-face interviews, 22 barriers affecting the growth of PPP projects were selected. The survey included engineers, architects, contractors, project managers, and bankers. Out of 180 questionnaire sets distributed, 115 completed sets were returned. The analysis was carried out using “Statistical Package for Social Scientists – SPSS”. The study revealed that corruption in government officials was one of the significant threats. The survey's analysis revealed numerous other factors, including bureaucracy in government departments, insecurity, and political instability.



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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE GREEK STILT HOUSE TYPE AS A FORM OF DIACHRONIC DEWELLING: AN ANSWER TO THE CLIMATE CHANGE

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### ABSTRACT

Stilt houses constitute another yet glamorous mystery of prehistoric “small/big world”. It is about permanent human constructions in water areas (usually lakes or lagoons), that is a civilization which has been created and developed having as a special characteristic the water element. Even though, the first stilt houses have been appeared 8.000 years ago, people live up to now, in such a dwelling type, located on shallow water areas such as seaside, lakes or rivers worldwide. In Greece, the first stilt settlements appeared in the Neolithic era, about 5.000- 3.000 B.C., and only one of them has been excavated. Additionally, the later stilt settlements in Mesologgi lagoon area, are also important. These dwellings’ stilts are not nailed down to the deep sea, but they are knit with bulrush and constitute a floating construction on the water. Nowadays, stilt or floating architecture is linked to the usable land’s deficiency for building structures, which due to residential evolution, economic growth and transportation, belongs to the most important environmental pressures on landscapes worldwide, especially in urbanized areas. According to climate change progress and temperature increase, the sea level rises as ocean ice melts day by day. So, usable land in urban areas will be limited due to the continuous development expansion for residence. Concluding, the stilt house type which appeared in water settlements for the first time, in lakes and lagoons areas in Greece during the Neolithic era, and later in Mesologgi lagoon, is the type of residence, which is going to be used worldwide, as an answer to the climate change and the environmental damage.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INITIAL STUDY ON POROSITY AND PERMEABILITY OF EVAPORITIC ROCK SAMPLES FROM ABU DHABI COASTAL AREA, UNITED ARAB EMIRATES

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### ABSTRACT

This study provides initial information about porosity and permeability of the evaporitic rocks from the coastal area of Abu Dhabi Emirate of the United Arab Emirates (UAE). This rock material may constitute the bedrock for construction sites and foundation of structures. The rock quality may directly affect and may threaten such structures either on or in evaporitic rocks. Moreover, this surface rock facies have vital role as a similar sealing rock material for the subsurface hydrocarbon traps. Therefore, twelve rock block samples were collected from ten different locations and core samples were prepared to investigate the porosity and permeability of evaporitic rocks. Further, petrographic descriptions were obtained using polarized-light microscope, scanning electronic microscope (SEM) and X-ray diffraction (XRD) analyses for some representative samples. The study indicates that the porosity ranges between 1.69 and 7.78 % and the permeability 0.001 and 15 mD, respectively. The porosity and permeability relationship showed an optimum exponential best-fitted trend. As the majority of the samples increase with the increase of effective porosity. Moreover, a permeability at one location was extremely higher than the average. This could be due to heavy fracturing on gypsum samples. The distribution of porosity and permeability were mapped and presented for the study area. As well as, microphotograph (crossed-polarized) of some of the rock samples displayed gypsum crystals with anhydrite inclusions. White megacrystalline gypsum with parallel fractures filled with clay sized carbonates and clay-sized carbonate patches (matrix inclusions). The SEM images of gypsum samples exhibited dissolution cavities in a gypsum crystal filled with small anhydrite and anhedral gypsum crystal decorated by small anhydrite grains. In addition, the XRD pattern of the initial gypsum was qualitatively identified, where the gypsum and anhydrite minerals were recognized by X-ray diffraction technique. The study designated low to moderate porosity and permeability ranges in the study area. In general, the porosity measurements showed that it was increased from south west to the north and north east of the study area. The findings confirm good to intermediate quality of evaporitic rock facies. This study should be considered as initial phase and will be completely achieved with more sampling and analysis to cover all the questionable locations to enhance the results and having a detailed map of the porosity and permeability distribution of the study area. In any case, this initial study will help and provide useful initial information to decision makers in resolving various foundation problems at the construction sites and sealing rock material for the subsurface hydrocarbon traps in Abu Dhabi region.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYSIS OF WATER AND SEWERAGE CHARGE RATE COMPONENTS IN THE REGIONS IN COMPARISON TO THE NATIONAL AVERAGE VALUES**

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### **ABSTRACT**

The issue of water is becoming increasingly important in the world and is currently a much-discussed topic. There is a significant loss of water both due to global warming and the lack of precipitation. Wells and groundwater sources in the Czech Republic are drying up. However, it is not only global warming that contributes to groundwater loss in the Czech Republic. The article focuses on the issue of water and sewerage charge rates in the Czech Republic in the 2007-2020 period. The aim of the article is to show the development of water and sewerage charge rates in the Czech Republic over the last 14 years and to point out the difference in the percentage ratio between the components of water and sewerage charge rates in the regions in comparison to the national average values. The research is based on data collection. A total of 420 samples were processed. The departmental portal of the Ministry of Agriculture eAGRI.cz was chosen as the data source. Basic information and documents of the Ministry of Agriculture can be found on this server. The method of vertical analysis was chosen to evaluate the percentage ratio of the water and sewage charge rate components. It is clear from the analysis carried out that in the observed period the average national ratio of water and sewerage charge rate was 53.15% and 46.85%, i.e., the average price of water charge rate in the Czech Republic is higher than the average price of sewerage charge rate in the monitored period. The Czech Republic is divided into 14 regions. Solely the Pardubice Region has the opposite trend in all monitored years compared to the national average, i.e., the average price of water charge rate is lower than the average price of sewerage charge rate. This fact was also detected in some years of the observed period in the Liberec and South Moravian Regions. The Karlovy Vary Region tend to be the closest to the average national ratio of water and sewage charge rates.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## HIGHER COMPRESSION STRENGTH CONCRETE AS INFILL OF SLENDER STEEL CIRCULAR COLUMNS

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### ABSTRACT

Results presented in this paper are based on the research programme dealing with use of higher strength materials for columns made of steel circular tubes filled with concrete. Benefits of the combination of steel tube and a concrete infill are reflected in convenient load response, better fire resistance and also in constructional solution. Increasing in material strength is consequent upon effort of minimization material consumption and it is also discussed in case of concrete filled steel tubes. The previous results indicated that a use of high strength steel is economically disadvantageous, while a use of higher strength concrete has sense but only to certain degree. In case of an assessment of slender columns at the ultimate limit state (ULS), a buckling resistance decides. In estimation of buckling resistance theoretical value, slenderness of columns plays important role. And slenderness is inversely proportional to concrete compression strength, when calculating according Eurocode 4. Within the research program, experimental analysis of axially compressed circular tubes filled by concrete was conducted for columns created by a combination of these parameters: concrete of cylindrical strength 55 MPa and 80 MPa, steel of strength class S235 and S355 and tubes of diameter 133 mm and 168 mm. There is steel tube thickness 4.5 mm and tube length 3.00 m in every case. First, the paper deals with evaluation the results and their comparison with expected values determined by a standard calculation algorithm. The second part is focused on monitoring the influence of concrete material characteristics on column buckling resistance. The aim of the paper is a verification of theoretical method of determination buckling resistance and an appraisal of efficiency higher strength concrete in these types of composite members. It can be stated based on the result presented in this paper, that buckling resistance of slender column from concrete filled steel tube is influenced more by modulus of elasticity than by concrete compression strength. The use of higher strength concrete is irrelevant if the modulus of elasticity does not increase at the same time.

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## ENHANCEMENT OF PUBLIC REAL ESTATE: ITALIAN PENITENTIARY BUILDINGS

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### ABSTRACT

The purpose of this paper is to consider the possibility of the adaptive reuse of former Italian penitentiary buildings as tourist accommodation. This paper is a practitioner viewpoint paper; therefore, it is not based on any particular methodological approach. It describes the project launched by the Agenzia del Demanio of Italy (State Property Agency) for the transformation and redevelopment of public real estate; it analyzes some international and domestic cases of former prisons' being changed over to tourist accommodation facilities. The paper identifies three methods for adapting former penitentiaries to tourist purposes: Italy has been characterized mostly by the recovery of the islands hosting abandoned prisons as preserved natural areas, while less frequent is the changeover of former penitentiaries located in urban areas, or in historical and cultural sites. The paper seeks to highlight some possibilities of adaptive reuse of former prisons, which seem not to have been fully exploited in Italy. The project by Agenzia del Demanio might be the appropriate tool to this aim, especially if more specifically focused.

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## LEVERAGING CONSTRUCTION EXPERTISE DURING PLANNING & DESIGN IN THE U.S. ARMY CORPS OF ENGINEERS

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### ABSTRACT

The success or failure of most construction projects is often decided long before the project breaks ground. Decisions made in the early stages of project planning and design (P&D) can have a significant impact on the outcome of the project. One of the most fundamental and often overlooked ways to increase the likelihood of project success is to optimally leverage construction expertise early and often during project P&D. The U.S. Army Corps of Engineers (USACE) recognizes the importance of doing this and has issued some guidance to ensure that it is done. This research focused on assessing how well USACE leverages construction expertise during P&D as well as identifying barriers to doing so. This was done through an extensive literature review and mixed-method research consisting of a focus group and a survey questionnaire. The main findings of the research come from analysis of the questionnaire responses. The questionnaire included questions focused on assessing how USACE currently leverages construction expertise during P&D and questions focused on identifying barriers within USACE to leveraging construction expertise during P&D. This research provides a prioritized list of the areas in which USACE could work to improve how it leverages construction expertise during P&D. This research also provides a prioritized list of barriers that USACE could work to remove and thus increase its ability to leverage construction expertise during P&D.

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## RELIABILITY ANALYSIS OF PILE FOUNDATIONS IN SOFT SOILS: A CASE STUDY IN URABÁ (COLOMBIA)

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### ABSTRACT

The main objective of this work is to evaluate the reliability of deep pile foundations in soft soils considering two methodologies, the Allowable Strength Design (ASD), and Load and Resistance Factor Design (LRFD). A case study is located in the municipality of Apartadó in the Urabá zone in the department of Antioquia in Colombia. Three cases with different soil profiles and conditions were considered. Case 1 with soft clay in drained conditions, case 2 with fine-granular soil in drained conditions, and case 3 with fine granular soil in drained condition excluding the first 5 m of the profile due to possible liquefaction phenomena. Reliability was evaluated through the comparison of reliability index and failure probabilities using the First Order Second Moment (FOSM), Point Estimation (MEP), and Monte Carlo methods. In turn, the load capacity results obtained are compared with the results of Pile Driving Analyzer system (PDA) tests to obtain resistance factors RF. When comparing the RF results obtained by cases with the RF used in the LRFD methodology and with the safety factor of 3.00 used in the ASD methodology in Colombia, it can be seen that the average RF are all values higher than those consolidated in the Norma Sismorresistente del 2010 NSR10 (linked to the ASD methodology) and Norma de Puentes del 2014 CCP14 (linked to the LRFD methodology). This indicates that the allowable skin friction resistance and allowable end-bearing resistance by both methodologies could be underestimated and in turn, the ultimate resistance could be reduced by a higher resistance factor, that is, a lower safety factor could be applied, obtaining higher values of admissible resistance.

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**THEORY OF SIX VALUE AGGREGATION PATHS APPLICATION FOR ALTITUDE CHANGES ANALYSIS  
DETERMINED FROM PSINSAR – SURROUNDING OF DUNKIERKA GNSS STATION**

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**ABSTRACT**

The main objective of this paper is to analyse the application of the Theory of Six Value Aggregation Paths for developing a model of elevation changes determined from the PSInSAR. As a test area, the Dunkerque GNSS station surrounding has been used. The data have been analysed by using six value aggregation paths: minimum value increase, maximum value increase, minimum value decrease, maximum value decrease, minimum value difference and maximum value difference paths. The aggregation process allowed to determine new dependencies in data structures and to select areas for the calculation of the average movements of the earth's crust. A plug-in for the QGis software has been developed using the Python language to automatically create network models and conduct empirical analysis in GIS.

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**INVESTIGATION OF THE RELATIONSHIP BETWEEN OBSERVATIONS FROM TIDE GAUGE, SATELLITE  
ALTIMETRY AND BATHYMETRIC ON THE AFRICAN COAST**

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**ABSTRACT**

Global sea level changes and their consequences are leading to intensive development of research on the monitoring and modelling of these fluctuations. The sea surface is variable in time and space, therefore many researchers are currently interested in searching for dependencies and connections with the elements influencing this diversity, e.g. with the seabed topography. The aim of this study is to investigate the correlation between the observations from the point recording of tide gauge, satellite altimetry measurements and bathymetric data. The object of research is the capital city of Gabon - Libreville, located in Central Africa. On their basis, we can conclude that an important problem that may be encountered is combining or comparing models obtained on the basis of different data sets with different accuracy and spatial resolution.

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## THE MOTION-BASED ANALYSIS OF KINETIC SHADING DEVICES ACTIVATED BY SMART MATERIALS

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### ABSTRACT

Due to the global climate change and energy crises, the energy-efficient design of buildings has become more and more crucial in recent years. Particularly in summer, solar radiation and excess heat can penetrate the interior from the transparent components of the facades and adversely affect the building performance and user comfort. The shading devices, by avoiding these, provide the user's visual comfort conditions and reduce energy consumption. Kinetic shading devices, which can respond instantly to changing atmospheric conditions, are more functional in terms of meeting energy efficiency and user comfort requirements compared to fixed shading devices. Movement in kinetic shading devices can be realized both with active systems, in other words, by motorized systems, using external energy, and with passive systems, in other words, by making use of material properties. Although kinetic shading devices using passive systems have not yet gained currency in terms of production and application, when the associated literature is considered, it is clear that the interest in the subject of kinetic shading components activated by smart materials has increased in recent years. However, an analysis of the motion types and actuator design principles used in these studies are limited. This paper, therefore, aims to present an overview of kinetic shading devices activated by smart materials through a literature review, focusing on the use location of the smart materials within shading devices (i.e. the function fulfilled) and the motion types that can be provided by each different smart material. The smart materials that will be examined and discussed in this respect are the shape memory alloys (SMA), shape memory polymers (SMP), thermo bi-metals, bi-layer wood, and bi-material wood. Another goal of the paper is to discuss the potential motion and geometry options for SMAs by examining the systems activated by other smart materials, since SMAs are among the smart materials with high potential to be used as actuators in construction practice. The literature review will focus mainly on journal articles, conference papers, and book chapters indexed within Scopus and Web of Science databases, with a particular attention on those containing implementation/application either as a prototype or as a product. In the paper, firstly, background information will be given on smart materials with a focus on shape-changing materials among them, and shading systems and motion typologies used in architecture. Following the explanation of the study methodology, the findings of the review will be presented and discussed according to the common motions and shading device and/or unit geometries used in each shape-changing material. Additionally, the common motion mechanisms (i.e. actuator design principle) in each shape material and their adaption potential to be used with SMA will be discussed.

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**CHANGES OF FLOW AND THEIR IMPACT ON MASS TRANSPORT PROCESSES IN REAL SEWERS  
AFTER SEVERAL YEARS OPERATION TIME**

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**ABSTRACT**

Sewer pipes are from hydraulic point of view a prismatic stream channel with relatively constant roughness of streambed. But after several years operation time the effect of so-called "dead zones" could occur. These zones are created in real sanitary sewer systems or in combined sewer system as a result of impact of sediments and deposits along the pipes or because of other irregularity appearance. Irregularities of streambed roughness, such as small dunes existing in sand or gravel sediment along the pipe beds or any obstacles can produce re-circulating flows which occur on different scales. All these affect the flow conditions and thus the transport of substances in the flowing water of sewer system. Hydrodynamic dispersion is an important part of mass transport phenomenon. From hydrodynamic point of view, it is de facto the spreading of mass from highly concentrated areas to less concentrated areas in flowing fluid. Mass dispersion with advection is basic motion mechanics of particles transported in water. The main characteristics determining the degree of dispersion phenomenon are dispersion coefficients in relevant directions. The spreading rate is described by the value of this coefficient in the advection – dispersion equation. "Dead zones" significantly modify velocity profiles and affect dispersive mass transport within the sewer by collecting and separating part of the solute from the main current. Subsequently, the solute is slowly released and incorporated back to the main current in the flowing water, creating a significant distortion of the transported mass concentration time course. It might seem that the dispersion process is not so important for the transport of substances or particles in the sewer, but this knowledge could be very useful in case of leakage of hazardous illegal substances and the need to identify their source. Strong influence of "dead zones" raises the question of the adequacy using standard solutions, for modelling the dispersion of pollution or other substances carried by the flowing water in sewers. Paper describes the observed effect of "dead zones", which theoretically should not occur in conditions of sewer system (prismatic channel) and discuss its cause. The dead zones effect becomes evident especially in case of low discharges (dry weather flows). The reasons can be lower sewer construction quality (irregular slopes, sewer settlement due to the ground consolidation), but also obstacles, sediments and deposits in sewer pipes. The effect of dead zones was observed during field experiments, performed in a straight sewer sections under dry weather flow conditions, i.e. with relatively low pipe filling, discharges and velocities. Paper describes also approaches how to consider the dead zones phenomenon in numerical models, simulating waste water quality in sewer networks and shows results of the dead zones parameter estimation.

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## ADAPTABLE HOUSING IN THE CONTEXT OF UNIVERSAL DESIGN AND SOCIAL CARE

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### ABSTRACT

Existing concepts of housing are currently being re-evaluated, often prompted by unfavourable projections on population ageing, issues related to the sustainability of social systems, or challenges related to respect for human rights, which are a frequent impetus for housing research. When considering the design of housing for different users, we have to take into account different life situations, e.g. changes in family life, changes in housing users, but also ageing users or deteriorating health conditions. Housing must also be prepared for the provision of care services or personal assistance. Adaptable forms of housing that take into account the needs of different users are expected to be of undisputed benefit to all. This paper discloses a method for exploring new adaptive housing concepts to enable necessary changes in buildings for housing without difficult structural modifications. In particular, the research is oriented towards tracking changes in family life and the possible need for social services in the home environment. In order to ensure as much independence as possible for older adults or users with a disability, the emphasis in the design of new housing concepts is on adhering to universal design principles, on integrating artificial intelligence technology solutions, or on tightening security features. The adaptability of buildings for housing is also a suitable approach in terms of sustainable architecture, as it saves resources, construction waste and emissions, thereby reducing the environmental impact of the construction industry. The research is carried out in accordance with the current process of transformation of the social services system in Slovakia and in this context it was necessary to focus the research both on the state of the existing housing stock, whether it is ready to provide care in the home environment, as well as on new models of housing that would be able to take into account the individual needs of service users related to disability, illness or ageing. The basis for research were the results of a number of surveys carried out in social service buildings across Slovakia, such as a survey of the capabilities of social service users, an assessment of the risks and shortcomings of existing social service buildings, and a survey of the desires and wishes of recipients of year-round residential services about their own housing. Namely deinstitutionalisation envisages the return of users of large-scale residential facilities to their home environment or their relocation to new housing, so-called 'small group houses'. The final part of the article summarises the results of the research, which have shown that the diversity of service users requires specific approaches in the design of new housing concepts. The findings are illustrated by means of the authors' own concepts and schematic designs of model adaptive housing projects.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **A FRAMEWORK FOR INDOOR TRACKING SYSTEM BASED ON PIR MOTION SENSORS FOR CONSTRUCTION SITES**

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### **ABSTRACT**

One of the biggest challenges in construction sites management nowadays is finding adequate and quick method of tasks completion date forecasting. One of the reasons for such a state is difficulty in data collecting during conducting construction works. Due to hazardous conditions present on most construction sites researches rarely can be carried out on site. Therefore, there is a strong need for simple unmanned systems that could allow data collection on construction sites. The purpose of this research was testing probable sensor- based indoor tracking system yet to be utilized on construction site. Testing procedure consists of 2 major steps: measuring maximum sensors sensitivity (both range and viewing angles) and executing small-scale long-term foot traffic analysis inside office building (Faculty of Civil Engineering). Various components were examined in order to construct optimal foot traffic sensor. Different types of power supplies, microcontrollers and sensors were carefully analysed in order to propose most durable and reliable solution. Top designs were tested in-situ for 2 days each in order to confirm their sureness levels. Foot traffic analysis was conducted in order to assess people's behaviour in office buildings, especially their walking speed. Data was compared with class schedules and other official timetables in order to search for a correlation between pace of movement and scheduled meetings. Proposed sensors proved to be fully functional and appliance in construction sites monitoring and studying is possible. Analysis of obtained data confirmed to be extremely complex, and finding correlations with high confidence levels requires multiple long observations. Even few weeks measurements turned out to provide too few information in order to reach unambiguous conclusions. Moreover, method for bottlenecks in foot traffic detection was proposed.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

### **STUDY CASE: MONASTERY “SAINT JOHN THE NEW FROM SUCEAVA”**

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#### **ABSTRACT**

This paper is part of the doctoral research concerning the places of sites and church towers in the development of urban patterns in the city of Suceava. Studying the hystorical existing plans of the surroundings of the Monastery “Saint John the New from Suceava”, we observed the importance of this religious settlement in the life of the city. Some of the most important hystorical and social events that have to be mentioned are the impropriations that were made during the reign of Alexandru Ioan Cuza and the secularization that was made after the World War II. The impropriation of the monastic fortunes was one of the great reforms adopted by the ruler Alexandru Ioan Cuza for the modernization of the new state, founded in 1859, by uniting Moldavia with Wallachia. Through this administrative reform, adopted in 1863, the properties of churches and monasteries dedicated to foreign places were transferred into the State ownership. The secularization that took place after the World War II was, unlike the one that Cuza made, not only a material one, but also one that referred much more to a removal of Christian practices. In 1952, religious services were regulated, and they were reduced. There were also strict rules for a church to function and be opened for the believers. The sustainability of the Monastery “Saint John the New from Suceava” establishment results mainly from the religious life sustained over time. The built environment has changed, especially reducing the space where the faithfull gather around the church at the main events.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## POSSIBILITIES OF REVITALISATION OF WATER BODIES IN EAST SLOVAK LOWLAND AREA BY EXISTING CHANNEL SYSTEM

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### ABSTRACT

The paper deals with results of continuing research activities of the Department of Hydraulic Engineering, Faculty of Civil Engineering, STU in Bratislava in the field of revitalisation of water bodies (old river branches) in the Medzibodrožie region which belongs to the southern part of the East Slovak Lowland. This problem was solved in the past in frame of INTERREG IIIA Initiative between the Hungary and Slovak Republic. The problem remained, just new aspects for solving the water supply were analysed in the presented paper. The first aspect is to supply old river branches due to gravity using outlet structures on pumping stations Boľ and Pavlovo on the Bodrog and Latorica rivers. This solution is closely connected with high surface water levels in rivers, especially during floods. The second possibility – to our opinion more appropriate – is the revitalisation of river branch system by realisation of the rubber weir on the Latorica River and flooding of existing drainage channel system through outlet structures in the left-hand protection dyke of the Latorica River. The fundamental difference between mentioned methods of revitalisation of water bodies is that the second possibility can be utilized almost all over the year not depending on the flow rate in the Latorica River. Numerical modelling analysis of such a solution has quantified the amount of water supply into the river branch system, its water level regime at different discharges in the Latorica River during the year with respect to interaction with groundwater flow in the surrounding region. The analysis was connected with detailed hydrological, morphological and hydropedological survey.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PAVEMENT ON SUBSTRATE WITH RANDOM CHARACTERISTICS IN A VARIABLE SATURATION STATE

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### ABSTRACT

There are many different types of pavements, one of the most effective and economically advantageous is the chemically stabilized ground subsoil. When designing such a pavement, made of soil admixed with binders, it is necessary to meet the SLS and ULS conditions for it during use. This work is aimed at optimizing the thickness and strength parameters of the pavement. The problem can be solved analytically, using a Fourier series, and numerically. In this case, the analytical solution is exceedingly time-consuming, therefore the FEM program was used. The study uses a three-dimensional model of substrate with random properties of Young's modulus with a pavement made of elastic perfectly plastic material corresponding to the cemented soil upper layer. In the analysed job, the influence of the load was treated as a random variable, the nonhomogeneity of the subsoil layer, and saturation changes were taken into account. Soil saturation has an influence on the matrix suction value. This phenomenon affects the value of the soil Young's modulus. Consideration of changes in saturation makes Young's modulus even more variable. The study simulated changes in substrate saturation related to the phenomena of infiltration and evaporation. The Darcy-Buckingham law was used to describe the flow of liquid through the unsaturated subsoil. The solutions for one realization of the random field are presented, taking into account a wide range of pavement loads and the full characteristics of changes in the saturation of a nonhomogeneous subgrade. The considerations about the reliability of the pavement also were carried out, which is a contribution to further work on this problem.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ECOSYSTEM SERVICES ASSESSMENT IN URBAN PLANNING AND DESIGN AT A NEIGHBOURHOOD SCALE

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### ABSTRACT

Urbanization produces land use and land cover change with a strong negative impact on ecosystem services production linked to the alteration and loss of biological processes and structures of the ecosystems. An important stage could include the design of Natural-based Solutions for improving natural capital in the urban areas and introducing important ecological processes and structures for improving human well-being and creating more liveable cities. Therefore, A new frontier of sustainable cities should focus on urban planning tools and strategies able to integrate ecosystem services assessment in urban planning and design. In this study, we propose a methodology to analyze the impacts of urban planning and design on ecosystem services production at a neighbourhood Scale. The ecosystem services assessment was carried out considering as starting point of land use and land cover of the study area in its current state and after the potential changes in the ecosystem services produced from the evolution of land use and land cover generated by the urban actions planned. The scenario of analysis includes the integrations of Natural-based Solutions in urban planning at a neighbourhood scale. The ecosystem services analysis was focused on considering microclimate and gas regulation as priority ecosystem services able to improve the thermal comfort and reduce carbon dioxide concentration in the new urban scenarios. The case study is located in the municipality of Gallipoli, Southern Italy and it is a peri-urban area characterized by an agroecosystem but planned for an urban expansion. In the current state, the analysis highlights a low ecosystem services production of the agroecosystem characterized mainly by arable land for affecting by *Xylella fastidiosa* bacteria that destroyed important olive trees. So, the integration of Natural-based Solutions such as community gardens, characterized by new olive trees, could be the best scenario to improve the comfort term and reduce the carbon dioxide concentration in the area and increase co-benefits linked to cultural aspects in using these spaces. The ecosystem services assessment carried out highlighted that the ecological design of Natural based Solutions can improve the typology of ecosystem services production of new urban land use and land cover in consideration of the starting points. It was useful to drive the choices of the best land use and land cover scenario of the urban planning. Therefore, the capacity to integrate ecosystem services analysis in urban planning could be a tool of the ecological urban design useful to support the decision-making processes.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## POTENTIAL FOR THE IMPLEMENTATION OF MODULAR APARTMENT BUILDINGS IN SLOVAKIA

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### ABSTRACT

The living standard of a society is often evaluated on the basis of the quality and availability of housing. In housing policy, the role of the state is to ensure stability in the market environment that will allow households to live according to their income as well as to support labour mobility by using an existing housing stock without erratic excessive pressure on housing construction. Almost 95% of flats in Slovakia are in personal ownership of owner-occupants. In terms of the labour mobility and the flexibility of the labour market, the owner-occupied housing is rather detrimental. The solution to this fact can be supported by the construction of new rental housing, not only by the state, but also by the private sector. Although there are various state concepts for the construction of rental housing, so far it is all just in paper form and nothing is happening in reality. There is also some talk about implementation of modular buildings in construction of rental housing. The aim of the research is to evaluate the potential for the construction of modular apartment buildings in Slovakia. This is one of the reactions to the ongoing policy of the state, where the government of the republic committed to the massive construction of rental housing in its government program statement for 2021 - 2024. The main research question is whether there are enough companies in Slovakia that will be able to realize the number of modular apartment buildings, which the state says about in its program statement. The off-site modular construction has several advantages over traditional onsite construction. However, some disadvantages or barriers to the adoption of the modular construction generally or in Slovakia are also mentioned in the study presented. As to potential construction of apartment buildings, comparison of modular and traditional construction methods, from construction cost and construction time point of view was performed. The construction companies and especially modular construction companies from the Slovak construction market were engaged in the comparison. The companies provided the data related to examined economic and technological parameters (cost and time) of construction. More or less expected results of the comparative study are presented in the contribution. Based on the results of the presented study, it can be stated that the potential for modular housing construction in Slovakia exists.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE ROLE OF INDUSTRY 4.0 IN CONSTRUCTION SITE SAFETY AND SMART SOLUTIONS OF SAFETY RISK PREVENTION

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### ABSTRACT

A well-established culture of safety risk prevention in construction can be developed with support of Industry 4.0 implementation. Wider digital transformation trends connected with Industry 4.0, undoubtedly belong to factors that are enabling an improved outlook for smart collective and personal protective equipment of workers. In more economically developed countries, especially wearable technologies have begun to play a role in workers' health and safety protection. These technologies are known as personal protective equipment (PPE) enhanced with built-in smart electronic devices that unlock uncommon opportunities to protect people. In addition to wearable technology, smart solutions for workers' safety in construction include for example red point positioning systems, smart sensors and drones. The presented study deals with implementation of smart technologies to keep workers safe in construction sites in Slovakia. The aim of the study is to identify the most distinguished barriers of use of smart collective and personal protective equipment and to suggest the right steps to overcome these barriers. These proposals are aimed at manufacturers of smart protective equipment, at experts in charge of safety on construction sites and at representatives of construction companies. In order to meet the presented aim, two methods were applied: desk study and interview research method. Three experts from construction sector, two safety managers and one site manager, were involved in guided interview that was focused mainly to their experience with implementation of smart protective equipment in construction sites. As a result, the barriers to adoption of smart occupational safety and health solutions in construction and proposals to overcome the barriers and to expand implementation of intelligent protective equipment preventing accidents in construction are presented in the contribution.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**MILL RACES AS HISTORICAL SOURCES OF HYDROPOWER AND THEIR POTENTIAL TODAY –  
EXAMPLES FROM SLOVAKIA**

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**ABSTRACT**

The energy of rivers and streams in Slovakia has been used for centuries to power the water mills to process many material goods - grain, textiles, lumber, paper, to drive mechanical processes in the mining, and processing of metal products. Mill races and ponds were built to ensure enough flow to power the mills. The use of the energy of water was important for the development of settlements and mill races were an important infrastructural element for towns. Later, in the 19th century, with the technological development of water turbines, the mill races became used also as a source of electricity. Old mills were adapted and the first hydroelectric power plants were built on mill races. Today, the development of small highly efficient turbines and energy storage systems opens the possibilities of the new uses of hydro-energy of the mill races at micro or pico scale. In the research, we reviewed the historical use and also the current use of mill races as sources of hydroelectric power in the towns of eastern regions of Slovakia. However, the results of the research show that in most cases the mill races have not survived to the present day, they were filled or channeled underground and their potential as a source of energy is not used. Only a few examples document the attempts to use their potential today. The extinction of the former mill race channels from towns means losses of social and environmental benefits of green and blue infrastructure, loss of historical and cultural heritage values, and also losses of possibilities to use their hydropower potential even on a micro or pico scale. It is worth thinking about their regeneration in cases where it is still possible.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CONCEPTUAL FRAMEWORK OF WINDCATCHER'S NATURAL VENTILATION FOR AN URBAN THERMAL COMFORT

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### ABSTRACT

Climate changes in recent decades have caused among other risks significant overheating of urban ecosystems from a global perspective. The number of tropical days is constantly increasing in the cities of Central Europe, and experts predict this trend will continue. Increasing energy consumption for cooling buildings and their different heights during the daily and annual cycle requires not only a more extensive application of storage battery systems to ensure current consumption but especially greater involvement of natural and renewable sources for energy production. The current geopolitical situation increases the urgency of this requirement. The usage of clean recycling or renewable energy from the sun, water or wind natural elements is essential for providing environmental sustainability in the cities. Mechanical cooling systems in buildings are the main producers of carbon dioxide emissions, which have negative impacts on the environment and amplify global warming, particularly in a hot climate. Wind natural cooling system, known as windcatcher and exploited for centuries in Iran and other arid climatic areas, offers the opportunity to improve the ambient comfort conditions in buildings whilst reducing the energy consumption of air-conditioning systems. Modern windcatchers' applications show their obvious potential for contemporary architecture in not arid climatic areas as well. Nevertheless, their potential at the level of the urban scale of the group of buildings and public spaces has not been sufficiently explored and documented. The applied research method is descriptive and comparative and provides the conceptual framework of the existing windcatcher's natural ventilation system and its potential for modern architecture; specifies the objectives and approaches for its application in the urban environment in the not arid Central European climatic conditions.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ENERGY-EFFICIENCY IN THE DENSE URBAN CONDITIONS

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### ABSTRACT

Awareness of the climate changes and the problems in the supply of fossil fuels because of the war are also a challenge for the construction sector. The availability of renewable energy sources on site is limited and it is particularly problematic in the densely built-up areas of city centres and historic neighbourhoods – we see this as a challenge. Passive measures, including the passive use of solar energy, are the first step in reducing dependence of our buildings on non-renewable energies. In dense urban environment, the solar envelope methodology makes sense, and the mutual shading of buildings significantly affects thermal comfort in winter as well as in summer. The availability of solar rays influences the use and efficiency of the photovoltaic systems, where several prejudices need to be overcome. Dense urban structure also brings specifics to the use of energy of the environment, whether passively or through heat pumps. In this context, it is important to optimize the use of energy obtained from renewable sources, to offer its storage for later consumption and the possible use in another sector (sector coupling). This interconnection of sectors is related to several "smart" concepts: smart city, smart grid, smart mobility. Our research focuses on the analysis of these interrelationships, on the specifics of the use of RES in dense urban development and on the considerations of the effects of climate change on the urban environment in terms of energy efficiency, human comfort, biodiversity protection and risk minimization. We present the acquired knowledge not only as theoretical considerations, but also through inspiring case studies. Our vision is a sustainable city with an emphasis on our cultural sustainability, preserving the image of the city in changing conditions.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## INNOVATIONS IN THE ARCHITECTURE OF EVANGELICAL CHURCHES DURING THE ERA OF FUNCTIONALISM IN SLOVAKIA

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### ABSTRACT

Typological, constructional, engineering, and especially space and mass architectural innovations laid the foundations of a new direction in the area of sacral architecture besides others. Still within the long 19th century, the influences of subsiding historicism and emerging modernism met the peak of innovative impulses in the era of functionalism. Beginning in the 1930s in Slovakia, then a part of interwar Czechoslovakia, we can observe a reflection of innovations especially in the architecture of Evangelical churches. Their creators introduced remarkable layout and operational solutions that came from the innovation in traditional central and basilic schemes. Evangelicalism brings into architecture the innovation of tradition as well as entirely new spatial concepts, style and use of new constructions, materials, and construction technology including modern technical equipment of sacral spaces. We present the aforementioned innovations in the architecture of Evangelical churches during the era of modernism and functionalism in Slovakia using examples of selected buildings from the south-west of Slovakia – the Evangelical church in Prievoz in Bratislava, the church in Pliešovce, the New Evangelical church in Bratislava and its variations (Pukanec, Veľký Grob, and Ladzany), Evangelical churches in Grinava, Senec, Nesvady, and Trnava. Each of the selected buildings represents a unique approach to creating a sacral space and by means of their creators reflects innovative trends. In this way the contribution maps regional differences in the architecture of the buildings, spatial concepts, or the rate of usage of new construction practices, materials, and technologies in sacral architecture. We also pay adequate attention to the individual architects and builders or building companies that were the main bearers of architectural innovations and new ideas. Architects Michal Milan Harminc, Emil Belluš, Josef Marek and others were ones one important Czechoslovak interwar architectural scene figures. The first two, Harminc and Belluš, are ones of the doyens of Slovak architecture. We qualify their contribution to the formation of sacral architecture of Evangelicals in Slovakia as extraordinary.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GEOMETRICALLY AND MATERIALLY NONLINEAR ANALYSIS OF SELECTED ASPECTS INFLUENCING RESISTANCE OF COLUMN WEBS IN TRANSVERSE COMPRESSION

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### ABSTRACT

Members of double-symmetrical open cross-sections are widely used as columns in steel structures. In many cases columns are subjected not only to axial force but also local transverse force due to effect of beams connected to the columns. It results in compression in the column web which should be verified in the frame of structural design of the column. Current standard for design of joints in steel structures provides basic information for verification of this joint component. The design resistance of column web in compression is given as yielding resistance or, based on relative slenderness of the web, buckling resistance which takes into account stability effects (buckling of the web, crippling of the web) that are considered using reduction factor. The complex behaviour of the column web in compression is affected by number of aspects, e.g. structural solution of the joint (bolted, welded, with or without end plate), level of normal stress resulting from axial force or possible interaction with shear. The paper focuses on selected aspects influencing the resistance of the steel column web in transverse compression and summarizes results of advanced geometrically and materially nonlinear numerical analysis which are compared with results determined using provisions in the actual standards. The numerical analysis was performed using computation system based on finite element method. As it is considered that the resistance of the column webs in transverse compression is influenced also by the geometric properties of the cross-section including geometry of the flange-web transition, both rolled and welded cross-sections with various values of web slenderness were selected for the analysis. Along with evaluation of the results obtained in the frame of the study, suitability of different types of numerical models for investigation of this problem is discussed.

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### CREATIVE CITY - PROMOTING THE CITY NAME

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### ABSTRACT

This is a contemporary subject, since tourism and the number of visitors to a city have practically disappeared or been suspended due to the current situation in the world. The crisis that has arisen with the emergence of the COVID-19 virus. This article shows how some cities have been developing ways to attract people again to their historical centres and cultural or tourist areas. The use of marketing and communication techniques, linked with new digital technologies, has been an essential tool in the dissemination of the memory and the cultural identity of the place. We, also, conducted a small survey about the relevance of using certain online digital platforms while choosing a destination to visit. The survey also inquired about the use of photos and selfies by the interviewees. In recent years, many cities have opted for artistic manifestations that seek to enhance their streets, either through urban art, the most used, or through creative initiatives such as the case of “Águeda”, with Umbrella Sky, a festival that fills the city streets with colourful umbrellas. These initiatives are mainly aimed at attracting visitors while beautifying the city. The use of new materials and of new digital tools can be a tool that, always bearing in mind that the city is ultimately a human creation, of the human knowledge, that can and must contribute to a greater sustainability in time and space of the agglomerations, resuming good practices and sustaining itself in the reflective practice and the uniqueness of the people. The pandemic, and the months of confinement, led to a reflection on how this issue of creativity and marketing of cities can reflect the real needs of the population, how new technologies can be applied to promote the cities, the streets, but above all, how important is a reflective knowledge about the city in which we live, walk, work: how important is creativity sustained on specificities and supported by technology.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ENVIRONMENTAL CERTIFICATION AND ITS IMPACT ON THE OPERATING COSTS OF OFFICE BUILDINGS

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### ABSTRACT

The article deals with the issue of environmental certification of buildings, which was emerged in the 1990s to make it easier to compare buildings and their impact on the environment. The environmental certification of buildings mainly assesses how the building affects its surroundings and the quality of the indoor environment. Environmental certification currently represents a trend that has extended from office buildings to commercial, logistics or hotel facilities. However, a large number of certification tools is currently used all over the world and almost every country uses a different evaluation methodology. Moreover, in some countries, more certification methodologies that compete with each other are used, as is the case in the Czech Republic. This results in a confusing situation in the field of environmental certification which prevents more extensive development of environmentally friendly construction, where the energy efficiency of buildings and their environmental impacts constitute up to a third of the total project evaluation in the preparatory phase. For this reason, the research described in the article compares six environmental certification systems, namely BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), SBToolCZ (Sustainable Building Tool CZ), WELL (Well Building Standard), DGNB (German Sustainable Building Council) and HQE (High Environmental Quality). At the same time, the environmental certification impact on the amount of selected operating costs used for calculating the operating costs per m<sup>2</sup> of useful floor area has been assessed on a model example and then compared. The research assessed the costs of electricity consumption, water and sewage and heating.

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## INSPIRATION FOR LEARNING: RELATIONS BETWEEN PEDAGOGY AND SPACE IN SUSTAINABLE SCHOOLS

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### ABSTRACT

Good architecture speaks for itself. Successful architecture needs no explanation. *Can this goal be applied and tested on future schools built in Romania?* Having more than 80% of the existing school building stock built until the 1970s, our country urgently needs to drive forward after half a century of stagnation. A strategic vision should be embraced, and long-term programs should begin with the scope of constructing new public buildings to host undergraduate education. Architecture for education should keep the dynamic rhythm of its teaching and learning activities. This research paper analyses the connections between pedagogical processes and architectural design decisions. For structural change to happen, we must first understand the mechanisms perpetuated in traditionalist education, comparing them afterwards to authentic learning, motivated by well-trained teachers on three different competence layers: scientific, psycho-pedagogical, and psycho-social. The Romanian Law of National Education defines the purpose of *lifelong learning* as the development of the person and the sustainable development of society. *Nevertheless, what is important for citizens to know and implement in their day-to-day life?* The long-term United Nation's Agenda for 2030 and the European objectives aim to integrate sustainable development into the educational curricula, both for students and teachers, also for all training and certification programs. Together with the forced digitalization of education since March 2020, new perspectives have opened on learning methods that are essential for contemporary schools. Self-centered learning needs flexible spaces and varied furniture, an advanced information technology infrastructure and flexible assessment standards. Network learning requires both study spaces for small groups and spaces for the community. Experiential learning involves mobile laboratories and connections between inside and outside. Collaborative learning requires multiple types of spaces for interactive courses and joint projects. *How could a school motivate students and teachers? By what means could the architecture of a sustainable school have the power to educate?* Nowadays, every debate about post-pandemic architecture must take into consideration key concepts like *resilience* and *sustainability*. These two words incorporate complex meanings and are often overused, becoming buzzwords and not being easy to incorporate by architects or easy to decipher by users. This article explains how sustainable design of educational spaces should be guided by contemporary pedagogical approaches. The school building, the courtyard, the roof, the building site, and the school website, can all offer a range of dynamic methods for teaching architecture, engineering, and environmental sciences. Teachers can act as learning designers, transforming students' experiences into knowledge through guided reflection. Responsive architects can become teachers of sustainability, translating the pedagogical vision into the spatial configuration of the school. A school building will be pragmatically sustainable only if it can encourage learning experiences for multiple intelligences. Successful architecture inspires education to happen by means of its embodied sustainable principles.

**CHEIA – A KEY RESEARCH PROJECT FOR SUSTAINABLE ARCHITECTURAL EDUCATION**Oana Mihăescu <sup>1</sup>, Daniel Armenciu <sup>2</sup><sup>1</sup> "Ion Mincu" University of Architecture and Urban Planning, 57 Maior Ion Coravu St., Ap. 23, 2nd District, 021973, Bucharest, Romania<sup>2</sup> 75 Grigore C. Moisil St., Ap. 7, 2nd District, 023793, Bucharest, Romania**ABSTRACT**

Sustainability is one of the most current topics of our time. Issues regarding environmental protection, depletion of natural resources or carbon footprint reduction are on the international political agenda. The need to implement pragmatic solutions is proving to be increasingly imperative. The purpose of the CHEIA research project was to generate a collaborative core of experts in sustainability, by strategically exploring the impact of cross-disciplinary learning models and the opportunities offered by organizing the 2023 edition of the Solar Decathlon Europe competition in Bucharest. The CHEIA project (acronym for *Holistic Competition, Integrated Academic Expertise*) was conducted in 2021 in the "Ion Mincu" University of Architecture and Urban Planning (UAUIM), Bucharest, Romania. Although there are various global student competitions regarding our built environment, the uniqueness of Solar Decathlon lies in the transformative potential of the experience gained by participating in a holistic *design, build & operate competition* on the professional paths of all students and teachers involved. The 5 Romanian teams participating in the Solar Decathlon editions in the last decade have formed networks of specialists motivated to innovate and generate knowledge. For financial reasons, the Solar Decathlon Europe 2023 was cancelled, unfortunately, in January 2022. However, the one-year efforts of organizing this competition in Bucharest left a valuable mark on Romanian architectural education towards sustainability. This article will focus on two specific objectives of the CHEIA project that should be developed in the following years, without being influenced by the cancellation of the 2023 edition of the Solar Decathlon Europe competition. One objective consisted in identifying opportunities for active involvement of architecture students in creative practical activities towards sustainability. The second objective refers to establishing academic directions for implementing a new master programme in the field of sustainable building design in UAUIM. This extensive study started with an analysis of 15 international master's programs dedicated to the design of sustainable buildings. The main conclusion highlighted the need to use innovative methods of teaching and training in design, with realistic applicability, preparing graduates for the challenges in the practical architectural field. Furthermore, two types of questionnaires were addressed to the two important poles in the teaching process: the faculty and potential students. One survey had the role of verifying the degree of interest of the teaching staff and their training needs in the field of sustainability. This paper will analyse the answers offered by the 48 respondents. The second survey received 128 answers from architects and students in the 5<sup>th</sup> and 6<sup>th</sup> year of study in a short interval of 10 days, having a high degree of relevance for our research topic. Given the major impact of the construction sector on the above mentioned subjects, training professionals is a priority. The long-term goals are experiential learning, cross-disciplinary research, practical application of integrated design principles and consolidation of sustainable attitudes and behaviours. In this context, profile universities have a key role to play in promoting current values by training specialists in the field of sustainable built environment.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## OUTCOMES OF INTERNATIONAL PROJECTS FOR SUSTAINABLE DEVELOPMENT OF RIVERSIDE TERRITORIES IN TRANSITION

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### ABSTRACT

In recent years, under the pressure of phenomena such as spatial and economic shrinkage, as well as the uncontrolled development of tourism, areas situated alongside rivers have been going through a process of transition, affecting the existing societal and territorial structures. This is because the topographical characteristics of riverside territories generate an increased level of attraction for tourists, while also making it difficult for large corridors of economic development to integrate these regions. As expected, the process of transition is not always coherent and, as a result, it does not support territorial resilience. The lack of coherence comes from the fact that the simultaneous processes of contraction and growth follow different patterns and have a divergent impact on the built environment. Therefore, academia, administrations and local stakeholders alike have been struggling to create and implement feasible methodologies to obtain sustainable development at every level of governance. Among these, one can count international projects of cooperation, designed to facilitate the exchange of knowledge and resources, and therefore deliver specific operational tools that vary in scale and output. However, these do not always generate the expected results. Although significant from a quantitative perspective, the quality of the outcomes is difficult to measure. This study, therefore, follows a comparative analysis between three different types of tools defined by international projects: guidelines, action plans and interventions. The results of this analysis can further contribute to future international cooperation projects applications by improving the methodology and the criteria used to evaluate the process as a whole, as well as the outcomes themselves.

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**EVALUATION OF THE PERFORMANCE OF SOIL MIXTURES WITH CONSTRUCTION AND DEMOLITION WASTE (CDW), FOR THE IMPROVEMENT OF SUBGRADES OF LOW VOLUME TRAFFIC ROADS**

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**ABSTRACT**

Although they are of great economic importance to communities, rural roads can generally be considered low volume traffic. This makes its paving difficult to make financially viable. Due to the above, most of these roads are unpaved, which creates difficulties for transit, particularly during rainy seasons. On the other hand, construction and demolition waste (CDW) constitutes an environmental problem in cities and its use in road construction has been identified as an alternative for its final disposal. The purpose of this work is to evaluate an alternative to intervene low-volume roads, using CDW composed of brick, to improve the bearing capacity of the subgrade. Empirical and mechanistic pavement design methods were used to evaluate the performance of the CDW-added subgrade. Properties of the soil and CDW mixtures were used in different proportions and the effect on the thickness of the pavement structure was determined. The results show important reductions in the thickness of the base and subbase layers, obtaining economic and environmental benefits by including increasing percentages of CDW in the subgrade soil.

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## **ACCESSIBILITY OF GREEN SPACES IN THE CITY OF WROCLAW (POLAND) IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT AND ENSURING SOCIAL JUSTICE**

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### **ABSTRACT**

Ensuring the accessibility of green spaces is one of the goals of sustainable development and an condition for ensuring social justice. Green spaces are very important for the mental and physical health of city dwellers and the urban livability. According to the World Health Organization (WHO), one of the accessibility indicators is the proximity of green spaces to the place of residence. It is recommended that every person should be able to enjoy green spaces within walking distance, whereby walking accessibility is of particular importance for elderly people and children, who have limited mobility. The adoption of GIS tools in recent years has allowed for an increase in research on the accessibility of green spaces in cities. Despite this, the accessibility of green spaces in many Central European countries including Poland has not been thoroughly investigated. In order to fill this gap, research was carried out for Wrocław, a large and dynamically developing city in Central Europe. The research was carried out with the use of network analysis in GIS and publicly available data on green areas constituting the planned greenery system of the city. The investigations resulted in the determination of the percentage of the population (including the elderly and children) deprived of access to green spaces and identification of areas where the deficit is the greatest. The results have a practical dimension and provide a framework for changes in the city's development plans. They can also serve as a basis for comparative studies on the accessibility of green spaces in other Central European cities belonging to the same planning family as Polish cities.

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**CASE STUDY OF THE SEISMIC VULNERABILITY OF A HISTORICAL BUILDING IN TIMISOARA,  
ROMANIA**

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**ABSTRACT**

Timisoara is a city located in the western part of Romania, in an area characterised by shallow earthquakes of crustal type, with a design seismic acceleration  $a_g=0.20g$ . The city has a lot of historical buildings in Secession, Art Nouveau and Baroque architectural style, located in Cetate, Iosefin and Fabric districts. The typical buildings are made in brick masonry and lime, with massive perimetral walls and masonry vaults or wooden floors. All of them were built before the existence of any design codes in Romania and many of them are in a poor conservation state, highlighting the necessity of assessing their seismic vulnerability. This paper presents the case study of one of these historical beautiful buildings in Timisoara, study which aims to assess the seismic vulnerability of the building. The vulnerability was determined both with empirical and analytical methodologies. The empirical methodology that was used is based on the vulnerability index procedure that is applied globally, but that was adapted for shallow earthquakes in previous studies by the same authors. The analytical methodology that was used is based on numerical nonlinear analysis made with Tremuri software. After both analyses were performed, the results were compared, illustrating a very good correlation between the two selected methods. The conclusion of the study is that the empirical methodology is appropriate for using it a larger scale, for similar buildings in similar seismic areas. The aim is to evaluate if by calibrating an empirical methodology for a specific area, there can be obtained specific and credible results for a very large number of buildings in a simplified and quick way.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STUDY OF THE STRENGTH OF SOILS STABILIZED WITH QUICKLIME: CASE OF RESIDUAL AND SEDIMENTARY SOILS OF THE NORTHWEST OF COLOMBIA

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### ABSTRACT

Lime-stabilized soils are a viable alternative for optimization in the construction of embankments and retaining structures in reinforced soil. This research aims to evaluate the strength behavior of residual and sedimentary soils from two regions of northwestern Colombia when being stabilized with quicklime. For this purpose, unconfined compression tests were carried out on soil samples with different percentages of quicklime. Two types of soils from two different regions of the country were used, which differ in their lithological and classification characteristics according to the Unified Soil Classification System. Soil 1 corresponds to a residual soil from the Batholith of Antioquia and which is generally classified as silt. The second type of soil is related to marine alluvial deposits, from the Sucre - Córdoba region, and are generally classified as expansive clays. Quicklime percentages of 1%, 2% and 3% were used and the maximum density of the samples was determined by means of the modified Proctor compaction test. To determine the number of tests to be carried out and taking into account the number of variables that influence the test, a mix factorial experiment design was carried out. The results show a similar trend in the two types of soil, which corresponds to the increase in unconfined resistance when increasing the percentage of lime, however, in soil 2 (expansive clays) a greater consumption of lime is identified to achieve high resistance, which is associated with the mineralogy

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## **CULTURAL LANDSCAPES IN BANAT: IDENTIFICATION METHODOLOGY AND TRANSFER OF KNOWLEDGE**

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### **ABSTRACT**

Currently in Romania, there is little discussion about the importance of the cultural landscapes. In the situations where the territory is approached from these perspectives, there is a lack of a clear methodology of inventory and identification. This vague approach on the part of specialists and the general public is to the disadvantage of protecting and enhancing these landscapes, as they are not understood to be of real importance. At the same time, by twinning with the idea of cultural heritage and historical monument, a cultural stigma is added to the cultural landscape. This aspect, coupled with a lack of education in the field and sometimes lack of civic and community spirit, can lead to the loss of irrecoverable values in terms of overlapping layers (geographical, hydrographic, functional, agricultural, urban and territorial development, architectural and heritage), which give specific to certain areas and territories. In this context, the cultural landscapes project in Banat was developed in 2020, organized in the form of three major stages: identification, identity and implementation. The first phase identified the cultural landscapes in the Banat area, by developing a methodology that studies the material component of the landscape; and made a first map of their inventory. The second stage is dedicated to the investigation of the territory in terms of intangible values, which will complete the information of the first stage and will facilitate their transfer to communities. The third stage is dedicated to the transfer of information and tools developed throughout the project to the communities within and within the radius of influence of a cultural landscape. Among the results of this project so far are: the creation of the map of the cultural landscapes in Banat, the realization of the methodology of their investigation and identification; several exhibitions; several connections of the project with other international ones. In parallel, an online platform has been created, which will soon be translated into English, and which will facilitate the transfer of information to specialists, communities and public administrations. The project continues today with an archival study on the entire region of historic Banat, which includes areas in Romania, Serbia and Hungary, what will be the foundation for an international research project.

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## RETHINKING THE CYCLE NETWORK AS AN ENVIRONMENTAL INFRASTRUCTURE

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### ABSTRACT

The topic addressed is the potential interdependence between the cycling network and the management of rainwater. In the mid-Adriatic city of Abruzzo there are two territorial phenomena that have emerged with notable evidence. The first concerns cycling, which in Italy has seen a constant increase, both in terms of territorial diffusion and of turnover related to it. The second concerns urban flooding resulting from extreme atmospheric phenomena, whose frequency too, has in recent years constantly increased. Both phenomena, however, have been addressed in a sectorial way. The cycle paths, as a race to create the largest possible number of them, exclusively intended for the circulation of bicycles. Urban flooding, as a continuous emergency to be answered, time and again, through the Fire Brigade and the Civil Protection. Overcoming this sectoriality is needed. The goal is to imagine the cycle network as an environmental infrastructure that, in addition to supporting the transit of bicycles, is able to contribute to a better collection and management of rainwater as an alternative to the sewer system. In Italy, legislation and sector planning (Biciplan) have never taken this working hypothesis into consideration. Elsewhere, this has taken place: Boston, Melbourne, San Rafael e Copenhagen have transformed water from an agent that generates dangerous conditions, into a strategic resource, making use of the cycle network too, for contributing to a better collection and management of rainwater. Methodologically, the projects and intervention programs of the four cities will be compared with reference to: the network space (reserved for transit) and the materials of which it is made (porous asphalt, underground channels for the flow of water), the space associated with the network, characterized by the Green Stormwater Infrastructures that contribute to drainage, the contexts crossed by the cycle network and the relationships it establishes with the public space. The comparison aims to bring out some useful lines of action for orienting the making of the plan in the mid-Adriatic city of Abruzzo. The new working perspective would be one in which the cycle network becomes the infrastructural part of a larger soil project, capable of triggering processes of ecological regeneration and urban resilience.



## REMOVING THE EFFECTS OF BUILDING DEFLECTIONS- TRADITIONAL AND INNOVATIVE METHODS

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### ABSTRACT

The article presents methods of rectifying buildings used in practice and a method that has not been used so far. The scientific goal of the research is to develop the theoretical basis for the rectification of buildings subject to mining influences based on horizontal displacement. Although the threat to the structure of the object caused by its inclination from the vertical is not great, the use of such structures is very onerous. This leads to the necessity to rectify the objects, and this generates high costs, often reaching the value of the erected objects. As it is commonly known, all participants of the construction process, and also later users, mainly care about the long-term and failure-free operation of buildings. Undoubtedly, damage to parts of the structure, or the deflection of the entire structure from the vertical, sometimes generates considerable defects in the finishing elements, which in turn necessitates additional renovations and repairs. Of course, the correct design of building structures on the impact of underground mining allows us to significantly reduce their subsequent maintenance costs. However, it does not give us a 100% guarantee that such an object will not undergo an undesirable tilting, where it will be necessary to carry out the currently quite expensive straightening process of the building body. The reason for attempting this scientific research is to define the requirements of a new, possibly cheaper system of rectification of building objects, which will be adapted to this process at the design stage. An additional advantage of such a system is the fact that carrying out the rectification process itself will require minimal preparation, and the process itself can be repeated many times. The basic assumption of the idea is to make a double foundation of the building, in which the joint between its two parts is equipped with a sliding layer placed directly on the prepared bottom part of the foundation. The contact surface will be in the shape of a portion of a sphere with the convexity facing downwards. In the event of an inclination of the terrain, accompanied by the inclination of the entire structure, in order to bring the structure to its initial state, it is enough to move the upper part of the foundation horizontally, which will lead to the levelling of the building. This will allow for easy, inconvenient for the users of the building and almost cost-free rectification process at any time in the existence of the building. The straightening process itself will be carried out by moving the upper part of the foundation horizontally with respect to the lower one by means of hydraulic cylinders in a controlled direction and range. These cylinders will be supported and stabilized against vertical resistance related to the lower part of the foundation. However, to avoid uncontrolled displacement of the upper part, it will be wedged against vertical resistance in time between the rectification processes. This type of construction solution can be used for all cubature objects with a regular, non-fragmented foundation plan.



## HYDRAULIC MODELLING OF FLASH FLOODS PRODUCED BY FAILURES OF NATURAL DAMS AS INPUT TO A VULNERABILITY ASSESSMENT IN EXPOSED INFRASTRUCTURE AND HOUSING IN HIGH MOUNTAIN ANDEAN BASINS

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### ABSTRACT

In the month of May 2015, the population of Salgar (southwest of the department of Antioquia) was suddenly covered by the waters and sediments carried by the river La Liboriana, whose source is located on the slopes of Cerro Plateado, in an Andean basin, characterized because of its steep slopes. More than one hundred people lost their lives, and multiple properties and infrastructure in the urban core, as well as in the rural area, suffered significant damage, which subsequently forced the relocation of a good part of the houses in the municipality. This situation highlights the importance of having technical studies that allow the technical personnel to understand the relationship that exists between the generation of flash floods generated by the formation of natural dams that are the consequence of landslides, the mechanism of rupture of this type of dams, the routing of the flood downstream from the dam failure site, and its impact on the populations and infrastructure that are in its path. The process to understand the hydraulic effects of the occurrence of natural dams in steep slopes of Andean basins covers the following phases: a. Hydrological characterization of the rain event under study, b. Obtaining of secondary information on the characteristics of the terrain: digital terrain model (DTM) and orthoimagery of adequate resolution to identify signs of landslides triggered by rain on the lateral boundaries of the main channel, c. Location of the probable site(s) where the natural dam is generated as a product of the landslide(s) triggered by the rain, d. Estimation of the volume of sediments that moves towards the channel, and also, approach to the determination of the geometry of the dam that could be configured as a consequence of the landslide, e. Characterization of the most probable failure mechanism of the natural dam, f. Determination of the different resistance coefficients present in the channel and its walls, based on the land cover map for the study area, g. 2D modelling of the hydraulics resulting from the occurrence of the hydrological event, incorporating in its settings non-systematic information collected in the field, and generating the dam-breaking hydrograph and the routing of the flash flood downstream of the rupture site, and up to the areas affected belonging to the municipality of Salgar. The products of the hydraulic component (mainly - although not uniquely – water elevation associated the hydrological event and the velocity field) constitute inputs for estimating the different degrees of vulnerability that can be reached in exposed infrastructure and housing. The proposed process for estimating vulnerability includes the following phases: a. Definition of boundary conditions for the implementation of the ANSYS computational model, based on the data provided by the 2D model b. Modelling of the impact of the event on a housing scale, c. Analysis of the variation of the impact at the housing scale, for different types of breakage and constitution of the dam material, d. Estimation of vulnerability at the household level, according to Fuchs et. al (2018). Principal results show how the level of water of La Liboriana covers the elements of infrastructure and housing of the urban zone of the Salgar, as well as those of La Margarita peri-urban zone, reaching levels of the non-systematic information related the studied rain event of May 2015, this validating both the hydraulics and the vulnerability methods. The present work constitutes a relevant contribution both for the municipal administrations and for the environmental authorities with a regional scope, since it serves as an input for decision-making regarding the necessary measures to improve the degree of exposure and the level of fragility of the infrastructures and housing present in areas prone to flash floods, and in a more general scope, for the mitigation of risks of this type. However, this kind of approach must be accompanied by economic evaluations, and above all, with complementary work from a social approach, so that an integration of results is achieved that ensures a holistic vision of the problem, and from it, of the alternatives of required intervention.

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## LANDSLIDE SUSCEPTIBILITY MAPPING VARIABILITY BY USING OF FUZZY LOGIC OPERATORS: CASE STUDY OF LA LIBORIANA BASIN (SALGAR, COLOMBIA)

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### ABSTRACT

Landslides and the associated flows are two of the leading causes of loss of life and damage to infrastructure in mountain areas. Landslide susceptibility assessment (LSA) is defined as the spatial probability that a landslide will occur in a specific area, derived from the spatial correlation of conditioning factors and the distribution of registered landslides within the study zone considered. Several qualitative approaches have been used for LSA at large-scale like expert knowledge-based methods and statistical approaches by bivariate or multivariate analysis. Among the qualitative approaches, the Fuzzy Logic (FL) technique is based on subjective judgements about the relative importance of the predictive variables and their several states. Due to landslides are a complex process that involve many uncertainties, FL is used to deal with the uncertainties associated to spatial analysis and modeling, and some degree of knowledge of the relationship between the conditioning factors and slope instability process. The main objective of this study is to evaluate the effect of the application of a combined method of a data-derived model (frequency ratio) and a knowledge-derived model (fuzzy logic operators) on landslide susceptibility mapping in the “La Liboriana” Basin (Salgar-Colombia) located in the north-western zone of the Colombian Andean region as study case. A fuzzy logic membership function was assigned to each of 15 conditioning factors considered (Elevation, Slope, Aspect, Curvature, Landforms, Terrain Ruggedness Index, Drainage Density, Soil Depth, Lithology, Landcover, Normalized Difference Vegetation Index, Stream Power Index, Sediment Transport Index, Topographic Wetness Index, Antecedent Rainfall Index) according to landslide density and frequency ratio values using a landslide inventory of the study zone. The fuzzy landslide susceptibility (FLS) maps were generated using the fuzzy conditioning factors by integration into a geographic information system (GIS) environment, applying the fuzzy operators Sum, OR, AND, Product and Gamma. Finally, the FLS maps were verified by comparing with existing landslide inventory for prediction accuracy validation using ROC (AUC) analysis. Among the fuzzy logic operators, in the case in which the Gamma operator ( $\gamma=0.90$ ) showed the best accuracy (81.2%) while the AND operator showed the worst accuracy (50.4%). The final FLS map can be very useful to support decision-making process at regional-scale land use planning and landslide hazard mitigation, even in a data scarce area of tropical mountainous regions.

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## MONITORING AND CONTROL OF JUST TRANSITION IN MINING REGIONS: RELEVANT TOOLS

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### ABSTRACT

Mining regions are similar in terms of socio-economic evolution and characteristic patterns of spatial development. Their current challenges are determined by seemingly divergent processes, which regardless of their nature produce long-term instability and reduced control over the efficient use of resources. Although they are the main scope for various international support initiatives, these areas suffer from a lack of coordination, cooperation in finding common solutions and limited spatial planning. This is especially noticeable in those areas that have lost their economic importance and relevance in the settlements network, remaining less relevant for the usual control and monitoring tools in strategic planning. Through the just transition, the mining regions are helped to overcome their uncertain status because of the implementation of programs, projects and measures specific to each analysed territory. The territorial administrative units coordinate Just Transition Plans, which are implemented provided that all stakeholders in the affected area, members of the working groups, are involved. These entities have the role of assisting the transition process by ensuring compliance with the sectoral and transversal principles initially established. From the urban planning point of view, this process is partially valid, since the planning is in these territories at a very low level of quality compared to areas of major economic importance. For this reason, the spatial relevance impact assessment tools have a reduced capacity to analyse the progress in meeting their objectives, both quantitatively and qualitatively. This study presents existing tools for analysing spatial planning processes and their impact, providing good practice examples in this area. Applying distinct criteria, specific to each analysed territory, subject to the just transition process, the result is presented in the form of a set of useful guidelines for the stakeholder members in the working groups coordinating the just transition process.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## EDUCATION AND RESEARCH FOR SMALL AND MEDIUM-SIZED CITIES OF THE DANUBE URBAN CORRIDOR

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### ABSTRACT

The Danube region is characterised by largely diverging levels of development in different regions. Particularly small and medium-sized cities (SMCs) in lower regions are facing challenges linked closely to shrinkage processes, ageing population structures, labour shortages, loss of local identity, and a diminishing river industry. Furthermore, their spatial development is characterised by incoherent planning processes, leading to wasting natural resources and environmental problems. In this regard, Danubian SMCs (<https://danubian-smcs.uauiim.ro/>), an Erasmus+ Strategic Partnerships for higher education, was developed to strengthen the transnational dialogue between 7 important universities in the region in the field of built environment and spatial development. DANUBIAN SMCs project tackles the cities challenges in a creative innovative and cross-disciplinary approach, based on knowledge transfer and exchange of experiences between actors and institutions focusing on education based in Central-Western and Lower Danube regions. The project addresses these aims through the collaborative educational approach that emphasises the transfer of knowledge between university partners, between teachers and students of all partners and involves a number of local stakeholders in tackling the common challenges in SMCs of the Danube region. The methodology consists of a set of steps that have as main focus to stimulate all participants to an innovative approach of teaching activities related to declining or peripheral cities within the Danube region. Thus, this paper aims to underline the project contribution to the planning education of small and medium-sized cities from Danubian region from the pedagogical innovation of the consortium. How to explore the way in which elaboration of interdisciplinary teaching material through knowledge methods and task can be transferred to the Danubian local communities is the key question of the paper and highlight a new attitude towards the SMCs sustainable development.

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## HYDRODYNAMIC DIAGNOSIS OF SKIMMING FLOW IN A STEPPED CHANNEL WITH VERTICAL CURVES, BASED ON NUMERICAL MODELING

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### ABSTRACT

Due to the importance of stepped channel for handling surface runoff and its use throughout Colombian surface to transport large volumes of water, it is intended to evaluate quantitatively, through numerical modelling, the properties of the skimming flow in stepped channels of high slope, with vertical curves. For this, it was carried out an initial numerical modelling with CFD (computational fluid dynamics), using Ansys Fluent software, of the skimming flow over a stepped channel, starting from the experimental analysis proposed by [1] and [2], from where the geometric configuration of the spillway was obtained, size of the steps, magnitude of the discharge to be modeled and experimental velocity profiles for the validation of the numerical model. The RNG  $k - \epsilon$  turbulence model was used and also multiphase flow VOF. The results showed a good fit to the experimental data up to the air insertion point. Since the turbulence model used does not have the ability to numerically capture the aeration of the flow, downstream from this, the numerical velocity profiles oversized the velocity, nevertheless, graphically they managed to capture the shape of the profiles. Subsequently, two vertical curves were added at the upstream and downstream ends of the stepped section, defined according to the criteria presented by [4], and adjusting the steps to their geometry from the variation of the ratio between the length of the riser and the tread ( $H/L$ ). Numerical simulation of this new geometry was carried out, in order to perform the hydrodynamic diagnosis comparative between the stepped zone convex, straight and concave of the channel, of the behavior of the longitudinal pressure gradient, and the turbulent kinetic energy dissipation rate  $\epsilon$ , along the tread of the steps. It was found that the dissipation along the tread, is greater in the steps of the concave curve compared to the stepped ramp and the convex curve; likewise the zone of readherence of the flow to the solid bottom, which coincides with the zone where  $\epsilon$  is maximum, downstream of the recirculating vortices, also occupies a larger fraction of the tread length at the concave curve steps. The magnitude variation of the mean flow rate, the static pressure and  $\epsilon$  as a function of the perpendicular distance to the tread of the steps, was also analyzed, It was found that the velocity magnitude profiles describe the behavior of two flows, one of them is associated with the main stream and the other to a lesser extent is related to a recirculating flow that generates friction between the layers and consequently energy losses at these points. It was observed that the pressure is greater in the concave curve, and that the point where the recirculating vortex reaches its greatest height, dissipation is due to friction between the vortex and the main current, and by friction with solid bottom which also contributes to dissipation.

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## **DAM FAILURES DUE TO ANTHROPOGENIC THREATS – KEY ASPECTS OF THE ASSESSMENT OF THE POTENTIAL CONSEQUENCES**

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### **ABSTRACT**

The current development of the security situation around the world is significantly linked to part of the spectrum of anthropogenic sources of threats to dam safety. Even in countries in central Europe, such as Czech Republic, the level of risk of a breach flood wave threat can now be regarded as unacceptable. The situation therefore requires a detailed analysis and enhancement of the applied methods of assessing the impact or consequences of breach flood waves as the currently used methods assume natural origin, such as natural flood or sliding caused by natural phenomena, of the potential dam failure mechanism. Historical experience with the impacts of breach wave floods from large dams is limited and assessment methods usually neglect recent enhancements in the dam safety and overall technological advancements (active dam surveillance, dam safety management systems, utilization of cell phones and effect of social media during in crisis management, etc.). Also the nature of population and buildings at risk differ dramatically around world regions and the method of assessment needs to account for such fundamental local differences. The paper presents historical experience of selected dam failures and the concept of adaptation of the impact assessment of dam breach due to anthropogenic causes applicable in the central Europe region.

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## **VOIDS IN URBAN FABRIC**

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### **ABSTRACT**

An urban regeneration program must mitigate both the architecture's spatial vision and the socio-economical strategies. From an architectural perspective, its implementation must not be scale-dependent, but rather it should be dependent on the overall unity of space. Public spaces, as key elements in expressing the image of a city, can be seen as tools for measuring the overall urban comfort and for enhancing the urban living conditions. Over time, public spaces incorporated and adapted different meanings to its spatial form. In this sense, the purpose of the research is to define the major characteristics for designing resilient public spaces. Therefore, the principal result of the paper points out the link between social dynamics in urban life and the psycho-sensorial impact of space over people's behavior. In this sense, one relevant conclusion depicts the correlation between urban morphology and social dynamics. Furthermore, the study initiates a discussion on urban voids in a city's spatial fabric. Relevant for understanding the importance, and thus defining a mechanism of classifying urban voids in a city's fabric would be the public-private gradient analysis undertaken on void spaces. With this respect, a duality between "my public square" and "my private garden" is being defined. Another breakthrough in the process of spatial investigation would be the analysis of spatial voids through Gestalt analysis, thus correlating the morphological form with social dynamics. In this manner, the road is paved for a more resilient adaptation of spatial voids to different socio-economical ideas. To sum up, by understanding the triad defined by: Spatial design patterns – Contemporary tendencies in architecture – Implications of social dynamics on the act of "deforming and defining" the architectural space, the study concludes its major directions for analyzing and designing voids in a more resilient manner.



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## ANALYSIS AND BENCHMARKING OF SPRINKLER IRRIGATION SYSTEM PERFORMANCE

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### ABSTRACT

This paper presents a newly developed tool for evaluating the hydraulic performance of a pressurised irrigation sprinkler distribution network. These systems are characterised by significant variability in the placement and size of water demand, as sprinklers, e.g., hose reel irrigators, are usually moving from place to place. Moreover, they are devices that take a lot of water in one place. This leads to many possible operating scenarios, and traditional simulation models alone are not capable of tackling this variation in possible operational scenarios. Thus, the paper's authors developed a package (add-in) in the R programming language environment that can help to solve this task. Besides various tools in this package (R functions) allowing users to edit network parameters, run hydraulic simulations, and evaluate results in tables and graphs, specific modules for dealing with operation variability were also developed. The most significant of those is the generator of operating situations, which hydraulic simulation can subsequently evaluate. This means assessing whether the pressures and flows in the irrigation network allow the operation of the irrigators. Regarding the satisfaction of the required pressure in the hydrants, hydraulic situations, where the demand is more concentrated in some parts of the network, will be more problematic, especially if this happens in the end parts of the network. The presented software is intended to warn the irrigation system operator of such situations so that he avoids them, so the operation of an irrigation system works without problems (i.e., with sufficient pressure in the hydrants). The generator of the operation situations and evaluation of hydraulic analysis has been successfully tested on a large irrigation network.

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## STUDY OF COAL DUST AND METHANE HYBRID MIXTURE EXPLOSIONS

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### ABSTRACT

Notwithstanding the significant scientific and technical measures (events) preventing the explosion of methane and coal dust in coal mines, today, the incidents and accidents in mines caused by explosion, still remains the main challenge of security. Annually several hundred miners die or acquire serious trauma from explosion. During of recent decade, more, than 50 serious accidents were occurred in the different countries of the world, which were caused by explosion of methane and coal dust. The specialists indicate, that in nearest future it is expected to increase the threat of explosion of methane and coal dust, that is related to much deeper mining of coal in the coal mines, where the mining-geological, mining-technical terms are much complicated and these coal layers are characterized with higher content of methane. The literature analysis shows, that the properties of explosions caused by methane and coal dust mainly are independently studied, there aren't foreseen the character of their interaction, while methane and coal dust are mixed with each other. Even more is unstudied the impact of coal dust's fraction on explosion ability and flammability of the mixture of methane and coal dust. Besides, the explosion ability and flammability of methane and coal dust mixture varies according the coal from different fields. This is caused by fact, that coal's physical, chemical and material composition is different. The paper presents the results of experimental work in the shock tube, in which was explored in Georgia being Tkhbuli-Shaori coal ore's mines detonation, deflagration and ignition characteristics conditions of coal dust and methane containing mixtures. New explosion research design the shock tube consists of a blast chamber, a tube, a system for dosed supply of coal dust and methane, sensors, registering equipment, and a process control module. blast chamber was carried out during dosed delivery and subsequent initiation of various dispersion coal dust and methane. Indicators of ignition processes, combustion and explosions were controlled using sensors, during which, the excess pressure in the chamber and its distribution over time were determined. In parallel, the process was monitored using high speed video cameras. The article presents the main results of the experiment and the conclusions and recommendations drawn on their basis.

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**SeisRICHerCRO: ESTIMATION OF LOCAL SITE FREQUENCIES USING MICROTREMOR MEASUREMENTS IN EARTHQUAKE PRONE (WITH SIGNIFICANT CULTURAL HERITAGE BUILDINGS) AREAS IN CROATIA**

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**ABSTRACT**

In many seismically active regions there is a large amount of vulnerable infrastructure and it is impossible to adequately protect all vulnerable infrastructure. So, it is important to establish priorities when planning construction retrofitting. A key tool for establishing priorities for construction retrofitting is seismic risk assessment. Seismic risk assessment is especially useful in the case of cultural heritage buildings, which are invaluable. The most seismically active regions in Croatia are the coastal region and the north-western part of Croatia, regions that have numerous cultural heritage sites. Therefore, it is important to estimate seismic risk for cultural heritage sites and to develop procedures for seismic risk assessment. These are the goals of the research project Seismic Risk Assessment of Cultural Heritage Buildings in Croatia (SeisRICHerCRO) funded by the Croatian Science Foundation. The targeted locations of the project are Trakošćan Castle, the Cathedral of St. Jacob in Šibenik and the old city centre of Dubrovnik. The project has many objectives: investigation of seismicity according to the compiled earthquake catalogue, determination of local site characteristics, numerical analysis of local seismic site response, determination of dynamic characteristics of selected buildings, seismic hazard assessment, seismic vulnerability and risk assessment and finally coordination and administration. Here will be presented results of the determination of local site characteristics, specifically microtremor Horizontal-to-Vertical Spectral Ratio (HVSR) results. Microtremor measurements were carried out at all three targeted locations: Trakošćan Castle (approx. 0.1 km<sup>2</sup>, 36 measurements), in the proximity of the Cathedral of St. Jacob in Šibenik (approx. 0.15 km<sup>2</sup>, 108 measurements) and in the old city centre of Dubrovnik (approx. 0.2 km<sup>2</sup>, 115 measurements). Measurements were performed using four Tromino instruments (MoHo, Italy). To reduce the impact of traffic, industry, trees, buildings or any other source of noise that would affect the measurements, locations were carefully picked. Moreover, since Dubrovnik is a famous tourist destination all measurements there were performed at night. Analysis of HVSR microtremor measurements was performed in line with SESAME guidelines (SESAME, 2004), according to the criterion of obtaining the most reliable measurements and clearly expressed maxima. This research presents typical examples of HVSR curves and fundamental soil frequencies at targeted locations. Also, differences and difficulties encountered at targeted locations are discussed.

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**SeisRICHerCRO PROJECT: SEISMICITY OF EARTHQUAKE PRONE REGIONS (TRAKOŠĆAN, ŠIBENIK, AND DUBROVNIK) IN CROATIA**

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**ABSTRACT**

Earthquake catalogs are foundational data products for earthquake science. For the purposes of this project (SeisRICHerCRO), new uniform earthquake catalogs for investigated areas are prepared. An overview of the new catalogs, and the observed selected statistical and structural characteristics, as well as connection with geological features, are presented. Seismic risk assessment of cultural heritage buildings in Croatia (SeisRICHerCRO) is a research project financed by Croatian Science Foundation. The main objective of the project is the thorough research of the most earthquake-prone area in Croatia, intending to develop a readily transferable methodology and practical procedure for assessing the seismic risk of cultural heritage which include seismic risk assessments on an urban scale. In order to properly estimate the seismic hazard of the selected case study areas, and further seismic risk, the ground objective is a detailed seismicity analysis. Croatia is a very seismically active country, mostly in the northwestern and coastal parts. More than 145.000 earthquakes from the period before Christ till the end of 2020 are contained in the Croatian Earthquake Catalog (CEC). There were more than 100 stronger earthquakes, whose computed or estimated magnitude was more than 5. The majority of the earthquakes on Croatian territory are the result of the strain accumulation caused by the rotation of the Adria microplate towards the Eurasian tectonic plate. Additionally, central Croatia is in a contact zone of three big geological units: The Alps, Dinarides (or The Dinaric Alps), and the Pannonian Basin. Two of the strongest earthquakes, that mainly determined a seismic hazard in Croatia, are the Dubrovnik earthquake (April 6<sup>th</sup>, 1667.) with a maximum intensity of IX-X °EMS98, and the Zagreb earthquake (November 9<sup>th</sup>, 1880.) with a maximum intensity of VIII-IX °EMS. Both earthquakes left near cities and villages with great damage. Their historical recordings were used in more detailed and precise reanalysing in this research, and they were included in the newly compiled earthquake catalog. In the presented project, vulnerable buildings of the historical and cultural value of the main focus are Trakošćan Castle in the northwestern part of Croatia, the Cathedral of St. Jacob in Šibenik in the central part of Dalmatia (coastal Croatia), and Dubrovnik old city in the southern part of Dalmatia.

Corresponding Author: Iva Lončar



**SeisRICHerCRO: MAPPING THE LOCAL SITE EFFECTS FROM THE ANALYSIS OF AMBIENT NOISE MEASUREMENTS IN EARTHQUAKE-PRONE (WITH SIGNIFICANT CULTURAL HERITAGE BUILDINGS) AREAS IN CROATIA**

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**ABSTRACT**

The most seismically active regions in Croatia are the coastal region and the north-western part of Croatia, regions that have numerous cultural heritage sites. Therefore, it is important to estimate seismic risk for cultural heritage sites and to develop procedures for seismic risk assessment. These are the goals of the research project Seismic Risk Assessment of Cultural Heritage Buildings in Croatia (SeisRICHerCRO) funded by the Croatian Science Foundation. The targeted locations of the project are Trakošćan Castle, the Cathedral of St. Jacob in Šibenik and the old city centre of Dubrovnik. The project has many objectives: investigation of seismicity according to the compiled earthquake catalogue, determination of local site characteristics, numerical analysis of local seismic site response, determination of dynamic characteristics of selected buildings, seismic hazard assessment, seismic vulnerability and risk assessment and finally coordination and administration. Microtremor measurements were carried out at all three targeted locations: Trakošćan Castle (approx. 0.1 km<sup>2</sup>, 36 measurements), in the proximity of the Cathedral of St. Jacob in Šibenik (approx. 0.15 km<sup>2</sup>, 108 measurements) and in the old city centre of Dubrovnik (approx. 0.2 km<sup>2</sup>, 115 measurements). Based on individual microtremor measurements, maps of fundamental site frequencies were derived. Following the empirical relationship between resonance site frequency, bedrock depth and Vs30 for Croatia, maps of average shear wave velocity in the upper 30 m (Vs30) and bedrock depth (H800- depth of the bedrock formation identified by shear wave velocity  $V_s \geq 800$  m/s) were also derived. Presented maps can help to distinguish potentially dangerous seismic zones in the all three targeted locations: a) soil-structure (building) resonance at fundamental site frequencies, b) Vs30 is important for Eurocode 8 classification, and c) bedrock depths are important for numerical site response analysis for the estimation of site amplification. Comprehensive seismic microzonation maps incorporating seismic site amplification data provide input data for earthquake-resistant designs as well as the construction and reconstruction of important buildings and are also useful for urban planning that utilises spatial master plans

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## **STRUCTURAL AND NON-STRUCTURAL MEASURES FOR FLOOD RISK MANAGEMENT IN URBAN AREAS**

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### **ABSTRACT**

During the past decades, many regions have been affected by floods with devastating effects, causing loss of human life and damage to property and infrastructure. Some cities, which have developed and expanded in floodplains of rivers, and climate change contribute to the increase of probability of occurrence of flooding and its negative impact. According to conducted studies, climate change will increase significantly in the next decade, therefore, it is absolutely necessary to implement sustainable strategies at national level that contain both structural and non-structural measures. Flood risk management aims to reduce the negative consequences associated with floods for human health, the environment, cultural heritage and economic activities. Jiu River is located in the south-west region of Romania and has a length of 260 km and a catchment area of 10,080 square kilometers that represents approx. 4.2% of the country's surface. The total population located in the river basin is 1,46 million inhabitants, of which about 56% live in urban areas, with the largest city Craiova which has a population of approximately 300 000 inhabitants. In 2013 Jiu River was affected by a maximum historical flood, recorded upstream the city of Craiova, causing the flooding of the adjacent areas. In order to prevent significant damage to the hydraulic structures and also the city, a burst was created in order to create a controlled discharge of flow, thus affecting only agriculture land. In order to protect the city against floods and adapt to the current national and international requirements, a project was conducted consisting in the improvement of the hydrotechnical infrastructure in the vicinity of Craiova. This paper is on the subject of the proposed solutions in order to cope with the negative effects of floods and climate change on urban areas with regards to the specific environment conditions.

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## THE EFFICIENCY OF DISSOLVED AIR FLOTATION – A LAB SCALE RESEARCH

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### ABSTRACT

The paper deals with efficiency of dissolved air flotation as technology of water treatment. Described research was made by goal to recognize dissolved air flotation efficiency by the help of turbidity and UV absorbance removal for different conditions. As different conditions are meant the efficiency for different baffle position, different detention time in separation zone and checking results with adding chemicals compared to results without adding chemicals. The research tasks were made on lab scale flotation models. The efficiency was evaluated by comparison turbidity and UV absorbance.

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## THE RESEARCHES RESULTS OF THE SLIT STRIP FOUNDATION BASE OF THE STRESS-STRAIN DISTRIBUTION

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### ABSTRACT

The article presents the results of calculation of stress-strain distribution of slit foundation on the resilient perfectly plastic base. It gives the analysis of the influence of foundation base's shape modification, foundation's embedment, the influence of bond and modulus of deformation on the results of non-linear problem's solution. The data received is compared with traditional calculation results recommended by Russian normative papers and with the results of experimental researches. Results of the executed calculations shows the possibility (to 150 %) of substantial growth of the load transferred by the foundation on the base, due to its embedment increase with other equal conditions. To set of the solid П-type foundations with rectangular walls the reinforcing of the bases it is not required. For the precast foundations the reinforcing can be required; the amount of armature is defined by calculation with use of the resulted data or by additional calculations. The received results can be specified at the collaboration of the foundation slab and a brick wall.

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## **DEVELOPMENT OF A CEMENTITIOUS POZZOLANIC MATERIAL USING CALCINED LOCAL CLAY: MECHANICAL AND DURABILITY PERFORMANCES**

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### **ABSTRACT**

In today's cement-based materials, the usage of different natural and artificial cementitious and pozzolanic materials has become very popular in the concrete industry. These cementitious and Pozzolanic materials are recognized to offer value to mortar/concrete not only in terms of mechanical and durability performance, but also in terms of sustainability, resulting in lower construction sector environmental impacts. The development of locally generated natural pozzolans is critical to the building industry's long-term viability. Locally excavated raw clay from Nizwa city (NZS) in Oman was subject to a series of preparation and treatments including screening, grinding, categorizing, and calcination. Both the raw and calcined clays were first characterized before utilized as a partial substitution for normal Portland cement (PC) in mortar at 10%, 25%, and 35%. The compressive strength and durability properties of the blended mortar were evaluated. The results show that the flow diameter of the blended mixes has dropped slightly. The NZS replacement had no influence on the hardened mortar's density, although it did increase strength at 10% replacement before dropping at higher substitution ratios. In the meantime, when modified mortar is exposed to 5% sulphuric acid, strength losses between 4% and 50% is recorded, with a 1.8% mass increase. Exposure to a combined solution of 5% (sulphate + chloride) resulted in a 2 to 2.5 percent mass loss and a significant increase in strength.

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## NUMERICAL MODELING OF A REINFORCED RAILWAY SUPERSTRUCTURE

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### ABSTRACT

The always increasing patterns of vehicle railway traffic set that the maintenance and rehabilitation of infrastructures among the engineering key tasks for transport infrastructures. Furthermore, the need to guarantee high performance wilts increasing pavement life, has led research and industry to focus a greater attention on the use of pavement reinforcements. Geosynthetics are widely used in the mechanical stabilization of railway infrastructures with a weak subgrade. The use of geosynthetics placed inside the ballast layer or between the foundation layer and the ballast, has demonstrated advantages in reducing displacements and extending the life of the superstructure. This latter aspect appears to be of particular importance in a historical moment in which the economic resources available to railway infrastructure managers are limited; furthermore, reducing maintenance interventions also means limiting environmental pollution and not creating disservices for users. In recent years, numerous kinds of geosynthetic grids have been introduced on the market, which can be used for road and railways pavement reinforcement, extending extend pavement life, guaranteeing high performance and reducing costs of service and maintenance. The use of geosynthetics can produce several benefits, such as drainage, reinforcement, filter, separation and proof. In this paper, the effectiveness of geogrids as reinforcement was investigated. In this study, a two-dimensional finite element model was developed, using ABAQUS software, to investigate the behavior of a non-reinforced system and one reinforced with geosynthetics. The aim of the study was the evaluation of the reinforcement contribution offered by the geogrid in the displacement's reduction under traffic cyclical loads.

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## NUMERICAL INVESTIGATIONS ON SEISMIC RESPONSE OF BUILDING UNDER THE INFLUENCE OF SOIL VERTICAL VARIABILITY OF SHEAR MODULUS

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### ABSTRACT

The scope of this paper is to study the effect of soil vertical variability of shear modulus, using the probabilistic approach, on the dynamic response of building. The random field for shear modulus is generated using simulations of the Monte Carlo method. For the random simulation of the medium, the chosen random variables are defined by their moments of order 1 and 2, which are respectively the mean and the variance supposed valued from in situ samples. Soil state variables in space and time are due to complex geological conditions. Its (soil) properties change from a point to another. Due to the uncertainty associated with its inherent spatial variability, and limited available information, soil properties can be considered as random variables. The shear modulus is considered to have lognormal distribution. This choice is motivated by the fact that this parameter (shear modulus) is positive, and the lognormal distribution enables analysing its large variability. This result indicates that, the increase in the coefficient of variation of the shear modulus induces a decrease in soil amplification and the peak acceleration response spectrum for the one-dimensional case. In addition, it is observed that the decrease in soil amplification has generated an unfavourable response spectrum for buildings.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## HOUSING NEIGHBORHOODS IN THE UNITED ARAB EMIRATES: DIFFERENCES IN PERSPECTIVES BETWEEN FEMALE AND MALE PROFESSIONALS

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### ABSTRACT

Cities are growing and adapting to newer initiatives, increasing the efficiency of their built environment, and providing their citizens with a prosperous future. Several disciplines are particularly associated with the growth and development of cities, including urban planning, architecture, and engineering. Hence, it is inevitable that the future of cities and their citizens is determined by professionals in these disciplines. Amongst the key attributes of cities are housing neighborhoods which are a conglomeration of social, spatial, environmental, and economic factors aimed at accommodating and serving people. In the United Arab Emirates (UAE), housing neighborhoods have various characteristics, inspired by local, regional, or global influences. This research aims to explore differences in opinions between female and male professionals on the UAE's housing neighborhoods. The study targets professionals in the three disciplines of engineering, architecture, and urban planning, and it assesses a set of indicators across three stages of housing, including design, construction and operations and management. The hypothesis claims that there are differences in perspectives between female and male professionals, and data was collected through an online questionnaire with a snowball sample of working professionals in the UAE. Using MANOVA with gender as the independent variable, the research findings highlighted trends of varying perspectives between female and male professionals, particularly at the design stage. In this study, gender-based perceptions of professionals are examined in relation to housing neighborhoods in the UAE. A snowball sample of 64 professionals, including 37 females and 27 males were part of an online survey. 28 variables were generated corresponding to 6 key aspects of housing neighborhoods, including urban planning, landscape, interiors, social sustainability, economic sustainability, and environmental sustainability. Each of the 6 aspects is explored across 3 different stages, including design, construction, and operations and management. The analysis has shown that differences in gender perspectives are mostly present at the design stage, less likely at the construction stage, and almost non-existent at the operations and management stage. This study can be used to present a gender-based theoretical contribution to the discourse of design and construction, in addition to a practical set of factors that reflect the needs and expectations of female professional. The ultimate purpose of this research is to contribute towards more inclusive and sustainable urban environments, especially in the Arab-Gulf region.

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**MECHANICAL PROPERTIES OF CONCRETE WITH CO<sub>2</sub> CURING**Ming-Gin Lee <sup>1</sup>, Yung-Chih Wang <sup>2</sup>, [Wei-Cheng Lin](#) <sup>2</sup><sup>1</sup> Department of Construction Engineering, Chaoyang University of Technology, Taichung 413, Taiwan<sup>2</sup> Department of Civil Engineering, National Central University, Chungli, Taoyuan 320, Taiwan**ABSTRACT**

The purpose of this study was to investigate the effect of CO<sub>2</sub> curing on the mechanical properties of concrete. Three different sample sizes (5 × 10 cm, 10 × 20 cm and 15 × 30 cm cylinders), three CO<sub>2</sub> concentrations (50%, 75%, 100%), three curing pressures (0.2, 0.4, 0.8 MPa), three curing times (1, 3, 6 h), two water-cement ratios (0.41, 0.68) for normal and high-strength concrete, and two test ages (3, 28 days) for this investigation. Before using the CO<sub>2</sub> curing process, the concrete samples reached the initial setting in about 4 hours, and the free water in the samples was gradually removed when dry CO<sub>2</sub> gas was injected. The test results show that the 3-day early compressive strength of ordinary CO<sub>2</sub>-cured concrete is higher than that of water-cured concrete, but the difference between CO<sub>2</sub>-cured high-strength concrete is not obvious. In addition, there is a size effect on the strength of the 5 × 10 cm and 15 × 30 cm cylinders, and the strength conversion coefficient  $k_{s5}$  value obtained from the 28-day compressive strength is greater than 1.18. Compared to conventional water-cured concrete, the modulus of elasticity of carbon dioxide-cured concrete typically increases proportionally to the square root of the 28-day compressive strength. It was observed that there are only minor differences in the four  $E_c$  empirical equations obtained by CO<sub>2</sub> curing from 5 × 10 cm and 10 × 20 cm cylinders, respectively. In terms of freeze-thaw cycles, the compressive strength of general concrete decreased by about 10-30%, while that of carbon-cured concrete decreased by about 0-20%, indicating that carbon-cured concrete has better freeze-thaw resistance. Finally, in the RCPT test, the Coulomb values of carbon-cured concrete and normal concrete are fairly close, which means that their resistance to chloride ions is the same.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPARISON OF TOPOGRAPHICAL GROUND SURVEYING AND SATELLITE-BASED SURVEYING OF A HIGHWAY IN SOHAR UNIVERSITY, OMAN

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### ABSTRACT

Highway earthwork is the most cost-consuming stage of highway pavement construction. The basis of earthwork calculations is the estimation of the topography of the area in study. conventional traditional surveying techniques involve the use of measuring tape, theodolite, and the leveling staff. The ground surveying operation is done manually to obtain the three-space coordinates of the area and consequently, obtain the volumes and cost of earthwork required. Although the traditional surveying techniques provide data of high level of accuracy, the process of ground surveying is a time and effort-consuming process, especially in projects involving main highways. Recently, satellite imagery is becoming more available and accessible, representing a more cost-effective method that may replace the traditional surveying methods. Digital elevation models (DEMs), which are obtained from highly developed instruments, can generate the contour map of the area in study. However, there is a lack of data regarding the accuracy level of the elevations obtained by DEMs. Therefore, the precision of such techniques remains unknown. This study involves a case study on an area in Sohar university campus in sultanate of Oman in which a topographic survey is conducted using traditional ground techniques then results are compared to results of a satellite survey of the same area. The comparison is made to evaluate the accuracy of data obtained and assess the adequacy of DEMs in terms of quality, resolution, and precision. Moreover, a comparison of resulting earthwork costs has been made. The findings of this study will help overcome the challenges and limitations of ground topographic surveys and potentially provide more reliable cost-effective methods of highway earthwork surveying using remote sensing techniques.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## BETWEEN REDEMPTION AND RESILIENCE

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### ABSTRACT

Punishment is the oldest and the most common means of sanctioning crimes, being the main coercion instrument used in all societies, which aims both to isolate the delinquent individual in specialized detention institutions and to re-educate and resocialize him with the help of treatment and social recovery programs. Émile Durkheim argued that the sanctioning of perpetrators has a salutary effect at the community level, by reaffirming the collective conscience, the criminal punishment being applied, therefore, in the name of society. The opinion of the famous French sociologist summarizes the trend of evolution and adjustment of correctional systems, in order to respond to the transformation needs registered internationally. He drew attention to the fact that the intensity and severity of the punishments are even harsher, as societies are less developed and in which the central power has a more absolute character (...) and that, in certain periods, depending on the severity of the committed crimes, custodial sentences tend to become the normal type of repression against criminal individuals. The responsibilities of the penitentiary institutions are considerable. Goffman said the penitentiary was a place where a large number of individuals of similar statuses, separated from the rest of the society for a considerable amount of time and, together, are living a life led by strict limitations, officially regulated by the institution. As imprisonment only represents one part of the act of justice - the execution of the sentence with deprivation of liberty - the study includes an approach to the prison infrastructure based on respect towards the human rights. Starting from the international standards in the field and the regulation of the minimum living standards for deprivation of liberty institutions in the European space, this paper identifies the problems faced by most penitentiary systems, but also the global trends. It addresses the relationship between the architecture of the prison and the criminal ideology of some European states, as well as how these punitive constructions contribute to the rehabilitation and reduction of recidivism. The study, which involves both national and European systems, provides a multicriterial understanding of the existing state of the detention units by selecting criminal systems from some countries in our geographic area with comparable levels of socio-economic development to Romania. Therefore, starting from the main objectives of the criminal system (to protect society, to punish criminal behavior and to prevent new criminal acts) in relation to the fundamental human rights, as well as the degree of success in the rehabilitation of the prisoners, the paperwork explores how the different ideologies related to punishment are reflected in the architecture and the layouts of the prisons and makes an analysis of the trends in the contemporary prison architecture. The study emphasizes a discrepancy between the functional aim of the contemporary penitentiary institution (as described by the rules and by the authorities) and the actual situation identified in many reports of the national and international bodies, finding that, at least in Europe, there are only a few prisons that are changing their approaches in terms of human rights based on their legal framework.

*This paperwork represents a part of a doctoral study named Between redemption and resilience which takes place under the auspices of the Center of Architectural and Urban Studies from Ion Mincu University of Architecture and Urbanism, in Bucharest.*

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE ENVIRONMENTAL DESIGN AND SPACE REQUIREMENTS OF MULTIPLE PURPOSE COMPLEX FOR ELDERLY

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### ABSTRACT

Under the global aging process, the issue of aging is taken seriously. In Taiwan, 14.05% of the population was over 65 as of 2017. The National Development Council in Taiwan in 2019, it is expected that Taiwan will enter a super-aged society in 2025, and that shows the aging problem has caused a great burden on the medical care and economic structure of advanced welfare countries. As the physical and mental functions of the elderly are degraded, and their living circles are gradually as shrinking. The urban environment in Taiwan is different between Europe and United States. The concept of the multiple purpose complex for elderly is to transform the traditional horizontal life service circle into a vertical service axis, and increase the possibility of elderly people participating in social and physical activities, also enhance the social support of the elderly to maintain their physical and mental functions and delay the possibility of related diseases. This research aims to build the factors of environmental and space facilities of a multiple purpose complex for the elderly which improve social support for the elderly and define the idea of local aging and successful aging. A questionnaire survey was used to compare index factors to propose a design of a multiple purpose complex for the elderly in Taiwan and explore the planning factors and their needs. The research goals are as follows: 1. To understand the needs of elderly in Taiwan in the community environment, social connection, quality of life, and environmental factors, 2. Explore the planning factors and needs of the multiple purpose complex for elderly, 3. Draft environmental design indicators of the multiple purpose complex for elderly and, combined with the smart housing design.

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**LES-ENERGY SEED AND HEALTH. FROM SCHOOL TO HOME: TOWARDS A MODEL TO RAISE AWARENESS ABOUT THE BENEFITS AND CO-BENEFITS OF ENERGY RETROFITTING IN THE RESIDENTIAL BUILDINGS**

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**ABSTRACT**

Project LES (*Labor Energetics and Health, from school to home*), co-financed by *Educació científica, cultura científica i divulgació a la recerca* program has the aim to promote education, culture and scientific dissemination to the citizenship or specific group of people that are not specialized in this area. This project is seen as an opportunity to show to future generations that the applied science (experimental workshops) is a decisive strategy to activate the renovation building plan which successfully and comprehensively deals with the climate emergency. The culmination of this project is the sum of results of past research projects in theoretical, descriptive and experimental fields that are previously accomplished avoiding to stay on the Death Valley. As an example, *EnerValor2* project has provided evidence about the limited awareness of society in the face of benefits and co-benefits emanating from energy retrofits at houses, especially in the well-being, health and user productivity realms. Give visibility about science function in our context are the opportunity to present the architecture research as an essential key to mitigate the climate change and improve people's health. The goal of this research is to arrive the major range of people, but the main receptor and driver is students between 8 and 10 years old and then it will be available to seed the energy and environmental conditioning concepts and the interrelations with strategic performance in buildings. The awareness is achieved throughout scientific workshops implemented in primary schools which exhibiting energy and quality air deficiencies and opportunities of their schools and also extrapolated to housing. The success of energy knowledge transmission and awareness in the project is evaluated through the surveys made before and after the workshops, which allow tracing the quantitative and quality stage through the workshops and their energy and health concepts. Reach adult people throughout our children is the main challenge, but also is the main key to obtain a successful final result. The project diffusion and the awareness to society are not only attained to primary students of the two schools selected for the project, but also the entire educational community (students, teachers, families and the whole of society). Due to the experimental material (8 scientific briefcase), it will be available into the administrative educational headquarter and the energy educational contents (instruction manuals of the workshop, quality air measurements values and also energy teaching material) developed during the project will be available in a website. The project seeks to raise awareness regarding benefits about energy efficiency actions at houses and, accordingly, a wider interest to start energy renovations (since actually there is only among 0,4% and 1,2% of buildings renovations) of our residential area that contributes to relieve the climate change. Indeed, the decision to select two schools situated in different socioeconomical districts (vulnerable and middle-income families) permit to provide details and statistics about the different perception about energy benefits in both school's families. This evidence contributes to establish energy path and actions policies to active a massive deep energy residential renovation.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## LABORATORY REMOVAL OF TOXIC METALS FROM WATER USING SELECTED SORBENTS

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### ABSTRACT

Currently there are many substances that pollute drinking water sources, including various metals, metalloids and their compounds. In small quantities, certain metals can be essential for human health, however in large quantities they can cause acute or chronic toxicity. Therefore, it is necessary to remove harmful metals from water. In order to compare selected sorption materials for the removal of harmful metals from water, a laboratory experiment was carried out on filter columns. Columns with an internal diameter of 4.4 cm were filled up to a height of 80 cm with the sorption materials selected for testing - they were GEH, Bayoxide E33 and Filtrasorb F400. At the bottom of the columns there was a drainage layer preventing leakage of sorption materials during filtration. Toxic metals and metalloids - arsenic, nickel and lead, which were added to tap water for the purposes of the experiment were removed from the water by filtration. A suction hose of a pump was inserted into the barrel with model water and the water was pumped from the barrel into the individual columns. The amount of water flowing was regulated on a flow meter, with a maximum flow defined at 20 l/h. During filtration, water samples were taken at 1, 2, 4 and 6 minutes from the start of the experiment. The temperature, pH and turbidity of these samples were determined directly in the laboratory, and then the samples were sent to the laboratory of the Health Institute based in Ostrava to determine the concentrations of individual metals. From the results of the analyses, it was possible to observe that all of the materials lowered concentrations of the metals below the limit value announced by the decree. However, the Filtrasorb F100 material achieved significantly lower efficiency than the other two materials. The materials GEH and Bayoxide E33 achieved a high efficiency of approximately 90%, based on several criteria, the material Bayoxide E33 was evaluated as a more suitable material for the removal of monitored metals.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **FIRE PROTECTION OF HERITAGE BUILDINGS IN ROMANIA: ROMANIAN LEGISLATION, MECHANISMS AND STRATEGIES**

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### **ABSTRACT**

Today, fire safety objectives are expressed in different ways by different authorities and in different countries, but in general there are two main accepted aspects of fire protection for modern buildings: safety of life and protection of property. In the case of historic buildings, the protection of cultural values must be added, either for the buildings or their contents. As far as fire protection legislation is concerned, Romania, as part of the EU, follows the European directives, but there is its own functional mechanism for the control and prevention of emergencies, but it does not deal specifically with buildings of historical value. Fire safety is a fundamental requirement for buildings, regardless of their age. In this context, the issuing of fire safety approvals and authorisations, which certify compliance with the fundamental requirement - fire safety - is an important act of exercising state authority in the field of emergency prevention.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## DFD IN CONSTRUCTION: DISCUSSION TO ADAPT DFMA PRINCIPLES USED IN PRODUCT DESIGN

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### ABSTRACT

Today, when the life of a building is complete, the general practice is to take the valuable parts and send the remaining ones to landfills. This practice; cannot be sustained in any respect since the wastes related to the construction industry have one of the highest percentages of the earth's waste amount, and this industry is responsible for more than one-third of overall carbon emissions. At this point, Design for Disassembly (DFD) in buildings is a promising concept that targets the non-destructive separation of components and materials to recycle, reuse, or relocation at the end of initial use. Even though DFD has been studied in product design areas for a couple of decades and construction since the late 90s, it started to be discussed more with the urging need to create a more sustainable environment. Design for Manufacture and Assembly (DMFA) is another design methodology with similar concerns that are based on the principles of optimization of materials and coordination and aims to cut down part counts, assembly time, and overall costs eventually. Early DFMA studies date back to the 70s in product design to respond to the competitiveness of the production industry. It received attention in the construction industry mainly in recent years. DFD and DFMA emerged in product design in the beginning, and now, the construction industry sees the opportunity to benefit from the know-how gained from studies and practices in other fields. Unfortunately, the fragmented structure of the construction industry challenges these adaptation efforts. Also, the difference in scale makes the principal adaptation between fabrication and construction difficult, and it is an important topic to be discussed. DFMA and DFD have similar essential goals for implementation, such as reducing part counts and time. Besides, both also aim to find the most efficient component design. There are some barriers related to accessing component handling or joining methods, etc. to implement DFD in construction. One could argue applying DFMA principles in DFD could help remove these barriers. No research has focused on implementing the DFMA principles to improve DFD yet. Hence, this study will analyse studies in other fields to create a base for a leading methodology. A literature review will be made for DFMA studies in a subcategory of the product design (i.e., home appliances). It will focus on the case studies to be able to make comparisons among practices. Then, the DFMA principles used in these studies will be discussed to see their adaptability for accepted DFD principles in construction at different scales as a part or total product. There will be some questions tried to be answered, like how the application of these principles could be helpful for different end-of-life scenarios in DFD such as recycling, reuse, and relocation. Likewise, in which stage of the application, which DFMA principle has been used, how this might be useful on DFD in construction, or for example if the principle of reducing the part count by combining two parts always means ease for DFD or not, etc. will be searched.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SAMPLING A SUSTAINABLE APPROACH IN AN ARCHITECTURAL EDUCATIONAL CONTEXT**

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### **ABSTRACT**

In order to develop a sustainable architectural environment, we must first of all research and learn how sustainability can be reached in a specific context and following a specific topic. Thus, architectural education has a vital role in preparing future generation to address such issues and to take them further.

Architectural education must not only be creative, but also innovative and at the forefront of contemporary approaches in order to prepare future generations for demands that are just beginning to shape or to anticipate future needs. Sustainability is a subject under continuous consideration and as it becomes a requirement in the real world, so it should, in this context, be addressed in every project even during university studies. However, it should not become a checklist as it frequently is – introducing sustainable aspect into a project in order to gather enough points. As the educational context allows less conformist approaches through projects that can be creative, imaginative in a way that sometimes puts aside present-day technical capabilities, regulations, finances (being even utopian), it also opens sustainability to exploration. In such approaches lays innovation and one can only open a students' mind, teach him/her how to raise the right questions, encourage him/her to look for less expected answers and solutions, not show him/her how to “do” innovation. Every project is a challenge for an architectural student, as he learns to design spaces while answering to a more or less detailed brief. However, those spaces must not be just that – students must build their way through sets of research and design questions, searching for an architectural solution that meets various criteria in various proportions (given the conceptual vs. buildable today request for example). Sustainability, through its components – economic, environmental, social – should be implemented by fully understanding its extent and taken into consideration when appropriate during the endeavour through the research questions. What I am proposing in this article is a sampling of a train of thought in an architectural educational context, given a specific program and the specific questions it raises. It wishes to both show the depth research should reach in the final years of architectural studies and the possibility of taking into consideration sustainable elements. I am calling it a sample because, unlike a template, it does not impose a list of issues to be addressed or a list of requirements to be respected, but it is rather an open list of issues to be considered in an organic manner, following different routes (subjects of interest, themes, topics) in search of depth and coherence – which I consider to be essential values in architectural education.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GREENERY IN SINGAPORE'S SELECTED HIGH-RISE BUILDINGS

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### ABSTRACT

In the late 2000s, skyscraper greenery has become one of the key elements in the design of urban spaces in Singapore. Due to limitations related to land development and expected population growth in the next several decades, the intensification of land use has increased through the development of tall buildings at high density. As a result, this led to an intensification of competition for the area originally intended for greenery and infrastructure development. Taking into account the limitations of the land available for greening, the logical solution was to introduce greenery in the form of green roofs, terraces, and vertical vegetation. Singapore has favourable conditions for the use of this type of vegetation due to its climate and the significant number of high-rise buildings. It is very beneficial in ecological, social, urban, technical, and economic terms. Currently, there are more than 70 hectares of green roofs, which vary in terms of size, height above the ground and planting patterns. In this paper, the authors present Singapore's representative high-rise buildings with garden roofs and sky terrace systems by analysing the structure, function and urban location of these buildings. The selected buildings are not only Singapore's showcase, but also a model in world architecture for tall buildings with advanced greenery. The growing popularity of such solutions causes a change in the urban landscape, becoming a priority for an increasing number of metropolises around the world.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## PERFORMANCE EVALUATION OF BUCKLING RESTRAINED BRACES IN CHEVRON AND V-TYPE BRACE FRAMES UNDER BLAST LOADING

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### ABSTRACT

Buckling-restrained brace frames (BRBFs) are usually used for seismic design in high seismic regions. They are designed with moment frames and are braced with steel bracing that is encased by concrete and that the concrete is also encased in a thin layer of steel casing. BRBF is an efficient lateral force resisting system used for its high ductility and ability dissipate energy in seismic events. Although BRBFs have been used in the United States as early as 1999, they were not officially adopted in the building code until 2005 and was adopted in the ASCE 7-05. This research investigates the behavior of BRBFs in a building frame system subjected to blast loading, despite being primarily designed to resist lateral forces like earthquake or wind. When considering blast loading one might think of lateral loads similar to seismic or wind force, which BRBF's can be designed to resist. However, there are differences between blast load and conventional lateral force in a building structure. Even though both are dynamic loads but their durations are completely opposite. Earthquake loads can last several seconds and are cyclic while blast loads are usually less than a second and are not cyclic. This research intends to look at BRBFs and evaluate their performances under blast loading despite being designed to resist seismic force. This research will mainly focus on the braces and their effects of the performance of the frame. Effectiveness of a single-bay chevron type and a single-bay V-frame buckling-restrained braced frames with varying steel core areas of the braces have been investigated. This research investigates how increasing thickness of the core brace affect the overall performance of the BRBFs both in Chevron Type and V-Type Frames under blast loads.

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## NO DAD: THE CLASSROOM IN OPEN SPACE

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### ABSTRACT

Facing to the problem of Covid-19 in 2020 and 2021, the continuous lockdown and closure of school made the parents getting mad: the young kids were taking DAD (Didattica A Distanza: distance education), and the parents were obliged to stay at home to make smart work meanwhile to take care with their kids. The co-founders of RECS Architects, Arch.Pier Maria Giordani and Arch.Chen Zhen, also as two desperate "Dad" (father) exhausted with this situation - kids need parents to accompany with during DAD, decided to make the project NO DAD: Create open classroom to against DAD; non need "Dad"(father) for DAD. We believe the project NO DAD can kill four birds with one stone. FIRST: Of course, the open space is safer during the epidemic period and the mask could be also not mandatory. The fear of the virus will be tempered by nature and the tranquility will return to the mind of children. The criticism of this approach is always the same: the climate. We should notice that the temperature cannot be a problem: from Naples downwards, the mild temperature allows you to be outdoors all year round. From Bologna to Naples, it is possible from March to November. Throughout the pre-Alpine belt (Turin - Milan - Brescia - Verona - Treviso) people can stay outdoors in April, May, and June and again in September and October. SECOND: The outdoor teaching would be realized, which encouraged and pushed by Italian government for about ten years, to let little children to embrace the open area, and discover the seasons and the evolution of the natural environment, without fear of atmospheric conditions. THIRD: This push towards the outside could finally put the school, understood as a cultural, sport and social institution, in a position to open to the city by sharing its spaces with it, finally demolish the boundary walls between the world of students and citizens. The space is flexible for both educational and social uses. At the same time, when the school will not be able to count on its own open spaces, the city will lend them, in fact many schools are adjacent to gardens and parks which would thus fulfill the needs of outdoor spaces. FOURTH: In this way a lot of forgotten spaces around the school and park can be requalified and adapted to the useful function, and the intervention cost is much lower than the normal construction or renovation of the school building. We projected five open classroom prototypes to some Italian municipality governments, and this idea was appreciated by some wise political leaders. Thanks to them all the five prototypes (exactly eight open classrooms) have been constructed until now and were proved very useful to the school and the city.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## GROUNDWATER STORAGE CHANGES USING GRACE OBSERVATION

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### ABSTRACT

Groundwater is vital for the global water cycle, but it is being depleted at an alarming rate, especially in arid regions. Researchers are looking into new techniques for monitoring changes in groundwater levels in order to evaluate groundwater storage. Different approaches take into account temporal differences in total water storage (TWS). The Gravity Recovery and Climate Experiment (GRACE) and GRACE Follow-On (GRACE-FO) are two satellite missions that are able to monitor water mass changes in a basin and calculate changes in water levels by measuring water variations. The GRACE satellite system has allowed for significant advances in monitoring changes in groundwater levels over large regions. This paper reviews recent studies that used the GRACE mission to show how improved analysis techniques provide greater accuracy in the estimation of mass changes. Moreover, several studies compared the findings of the different GRACE estimates. The findings of these studies are summarized in this paper in order to validate the results of GRACE estimates. The main findings of the literature review showed that aquifer depletion is widespread in areas such as the Middle East, India, China, the United States, and Australia to estimate the change in groundwater level storage in these areas. The California Central Valley and west Africa regions show the most significant groundwater depletion over the past decade, with rates of  $24.42 \pm 9.3$  km<sup>3</sup>/year and 14 km<sup>3</sup>/year respectively, for the period 2003–2015. The middle east experienced a groundwater depletion of around  $13 \pm 1.5$  km<sup>3</sup>/year from 2002 to 2014. Further investigation will be carried out.

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## DIGITAL TWINS APPLICATIONS IN THE WATER SECTOR

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### ABSTRACT

As cities grow, they consume more resources. This necessitates the need for sustainable and efficient cities. To make informed decisions, advanced tools that use real-time sensor data and predictive modeling are necessary. Digital twins (DTs) are digital replicas of physical objects or systems that can be used to improve decision-making and optimize operations. In the context of civil engineering, DTs could be used to monitor the progress of construction projects in real-time and also used in different fields such as transportation, infrastructure, water, and waste management. The data can be used for various purposes, such as optimizing operations, detecting and diagnosing problems, and planning for future needs. By identifying system issues and responding quickly to emergencies, digital twins can help improve the overall performance of a water system. The advancements of DTs in sensing technology can change how maintenance is performed instead of relying on corrective maintenance, which only addresses an issue once it is detected. This research explores how digital twins can be used in the water sector to improve the efficiency of water networks. The paper presents the techniques, strategies, and applications of digital twins in the water sector. Scientific literature, professional magazines, and marketing material were reviewed to summarize the use of the DTs concept in the water field. The majority of the material used in this research came from Scopus, with additional non-academic sources coming from Google. Most of the literature focused on the use of DTs in the manufacturing sector; with few resources focusing on the water sector. In this paper, a summary of the findings from the literature review is presented for the different use of DTs in the water sector. One of the main challenges in using DTs in the water sector is the lack of data. This is due to the fact that water utilities have traditionally been reluctant to share data. However, there are a number of initiatives that are working to change this, such as the Global Omnium in Spain, Portsmouth Water and Anglian Water in the UK, and Halifax in Canada. Another challenge is the lack of standardization in data formats. This makes it difficult to compare data from different utilities. In addition, data quality is often an issue, as water utilities typically have a large number of sensors and several specialized sectors are involved in the digital twins' model. Each company has its own method of developing a digital twin, which can make it difficult to compare models. Despite these challenges, DTs have the potential to transform the water sector. Utilities that are able to overcome the challenges and make use of DTs will be well-positioned to improve their operations and better meet the needs of their customers. The results of this research will be used to integrate digital twin modeling and simulation approaches in all applications in the water sector.

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## OVERSIZING URBAN AREAS IN LOW-DENSITY REGIONS

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### ABSTRACT

Since the 90s, the experience with the Municipal Master Plans, has been showing ambiguities in the enforcement of criteria regarding the delimitation of urban perimeters. This figure of spatial planning was expected to be an instrument for the consolidation of urban areas, ensuring their urban continuity. However, this goal was not always achieved. One of the problems is the oversizing of urban perimeters, having as a result the spread of new urban developments, the creation of urban voids or the underuse of facilities and infrastructures. In low-density regions, with a population loss, these problems are even more serious, given the weak demand of buildings and urbanizations. In this sense, this study is part of an on going research, and it will be focused on the study of oversizing urban perimeters in seven low-density regions in the Interior of Portugal. All of them having in common a land-use map coming from their Municipal Master Plans which are proposing the oversizing of urban perimeters compared to demographic or urban developing dynamics. The result of over nearly three decades of these spatial planning instruments are fragmented urban areas with low levels of urbanization and building execution. Even though they have all followed particular methodologies in order to identify the proper limits of urban perimeters, in all of them this process has occurred without the verification of the existing infrastructures. The conclusions have shown that in some cases the urban voids with no demand, correspond to 1/3 of the urban perimeters as a whole.

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## STRATEGIES FOR EFFICIENT HANDLING AND ECONOMIC CIRCULARITY FOR CONSTRUCTION AND DEMOLITION WASTE IN INDIA

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### ABSTRACT

The construction materials industry is an enormous economy and is expected to continue to rise in future. The primary construction materials often not being available easily, their shortage has been reported to result in project delays and cost over-run. Over the past few years, India's urban built environment has been expanding to accommodate the increasing urban population and to meet the rising aspirations of upscaling standards of living. In addition to new projects, redevelopment works are also prominent amongst the construction activities being undertaken all across our urban areas. The large-scale construction and demolition waste (C&D waste) is generated inadvertently from on-going construction activities with no major sustainable achievements in place ever since. Circular economy and product design for products or components remanufactured from dismantled and/ or recycled waste would no longer let the C&D waste remain as a threat. Instead, the industry would get geared up to produce high-quality secondary raw materials that can be fed back into production processes. This can reduce the reliance on primary resources for construction materials like stone, sand, etc and also promote the new business models which will focus on waste prevention and 'turning waste into resources' by effectively and efficiently utilizing C&D waste in a sustainable manner. This paper provides state of art overview of C&D waste management and related legislation in India and select countries abroad. Using a conceptual model, an action plan is proposed with focus on strategies, institutional arrangement and economic circularity in managing the C&D waste. The paper discusses different possible approaches for introducing circularity in C&D waste management and promoting circular economy (CE) by use of C&D waste either through direct reuse or by recycling/ repair /refurbishment within the construction industry through the lifecycle of construction projects. Present models for sustainability assesment are primarily based on statistical records of C&D waste quantities and most of these rarely include all three aspects of sustainability (economic, environmental, social). This paper proposes a conceptual model of efficient C&D waste management strategies. A system dynamic model has been developed using the barriers and motivating factors obtained from literature review for implementation of effective C&D waste management for circular economy. The model represents existing knowledge with respect to the components of the CDW system, and the positive or negative relationships between them. The paper highlights the need for an institutional framework and suitable strategies for managing the waste in order to conclude in an action plan for efficient handling of C&D Waste. The paper concludes with a discussion to summarise the future direction and potential policy recommendation for optimizing C&D waste management in India.

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## TYPOLOGICAL STUDY OF TRADITIONAL HOUSES OF SEMNAN CITY

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### ABSTRACT

In Semnan, there are several valuable historic buildings that, despite the diversity and innovative nature of each building, have a standard and unbreakable identity. These houses have organically enriched the historical fabric of Semnan city and played the most critical role in its integration. So far, a comprehensive study has not been done to identify the patterns of building these houses. With their erosion and degradation, their architecture and construction are rapidly being destroyed and forgotten. A multifaceted study of these buildings is essential to recognize the patterns of building homes as the primary focus of development, relying on valuable samples, mostly dating back to Qajar and Pahlavi dynasties. In this research, forty historic houses in Semnan have been studied and analysed in terms of climate, culture, geometry, form, spatial communication, structure, and all architectural elements that are the basis of the formation of the patterns of these houses. It was realized that architectural designs and constructions of these houses had undergone fundamental changes over time, based on changing social conditions and habits of life. Previous architectural patterns have been removed in each period, and new and even inappropriate practices have been replaced. Traditional houses were studied in three specified periods, including before the reign of Naser al-Din Shah Qajar, from the power of Naser al-Din Shah to the early reign of Reza Shah Pahlavi and Mohammad Reza Shah Pahlavi. The houses in each of these periods have their specific patterns. The houses of these three historical periods have a standard image, in which they have a particular identity. By reviewing all the details of historical houses and categorizing them, we will achieve a guideline for providing conservation and restoration projects in the historical context of Semnan, allowing architectural designers and restorers to act with complete insight and understanding of the protection of these buildings. Furthermore, we deliver a methodology that can be applied in any other architectural culture and city.

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## CRITICAL SUCCESS FACTORS FOR THE SUSTAINABLE HOUSING ADOPTION: INTEGRATIVE LITERATURE REVIEW

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### ABSTRACT

Sustainable development has been discussed in several studies involving a wide area of issues such as Life cycle assessment, energy efficiency and new technologies. Despite being a concept that is still evolving, it is understood that environmental, social and economic aspects must be met to achieve sustainability. In civil construction there is an effort to find ways to implement sustainable construction (Green labels and Environmental Product Declarations). However, there is no consensus in the literature on potential drivers and barriers related to the sustainable housing adoption. The Critical Success Factors is a complex decision-making process, influenced by several objectives. One of the limitations is the simplified application of the concept of sustainability due to the difficulty in measuring it within the selection of projects combining quantitative and qualitative criteria. However, the strategic choice of projects can significantly increase the chances of organizations achieving their goals. Despite the relevance of the topic, it is noticed that there is a lack of reviewing research studies on sustainable housing, identifying the main determinants indicators. Thus, what are the main factors that motivate and prevent the adoption of sustainable housing? This research aims to identify the scientific production around the world on sustainable development in housing from a theoretical and empirical point of view. This knowledge can be useful for the promotion of such ventures in the Brazilian context, in addition to supporting decision makers. The procedure consisted in the articles analysis related to the topic, indexed to the databases in the global scientific environment. Through an integrative literature review, after identifying the scientific production indexed to the selected databases, the main articles were initially filtered considering the research problem, by reading the titles and abstracts, 27 articles were threefold analyzed: (i) bibliometric (Network of co-occurrences of keywords, number of publications by year, per country and per continent), (ii) conceptually (research procedure, focuses group and research aim), and (iii) categorically (checklist of the most cited factors in the global literature). The databases were Scopus and Web of Science of Clarivate Analytics of Elsevier, considering the scientific production between 2018 and 2022. The results showed that economic factors, government measures and the consolidated market with specialized professionals in the area are both drivers and barriers to the sustainable housing adoption. Environmental and social factors encourage the practice, however, cultural factors, lack of knowledge on the subject and the building performance risks are negative. Although many studies have focused on the user, most of them focus on the purchase intention, and not on their adoption by financial or governmental assistance measures. Thus, understanding the different perceptions of all incomes allows specific interventions to each one. In addition, the study provides new insights into the sustainable adoption housing and presents suggestions for future research.

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## ORGANIZATIONAL AND TECHNOLOGICAL SOLUTIONS FOR MANAGING THE PROCESSES OF THE CERTIFICATION SYSTEM FOR THE QUALITY OF ASPHALT CONCRETE MIXTURES

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### ABSTRACT

A huge amount of factual material has been accumulated in the field of certification, and theoretical proposals and practical recommendations have been developed. However, this system was not subject to reform for a long time. Therefore, the studies considered in the work on improving the certification system are relevant, have novelty, contribute to the development of the certification system with the introduction of a method that allows predicting the period between repairs of asphalt concrete pavements based on standard indicators. The aim of this study is to assess the regulatory impact of the certification system on the quality of structural layers of asphalt concrete on the basis of existing linear and artificial structures. The object of the study is the current certification system and factors affecting the quality of asphalt concrete mixtures and structural pavement layers from them, and the subject is the regulatory action of the certification system for road building materials, as well as operational and acceptance control during the construction of highways. To be scientific novelty, the followings were proposed: a) a scheme for the formation of a database on objects and their structures for further work in statistical research; b) a scheme of certification of the structural layer or the entire road surface; c) a method for predicting the period between repairs for specific objects based on strengthening the regulatory action of the certification system on the quality of the structure of structural layers. The work was carried out using theoretical research methods that allow characterizing the research model in order to create an image of the scheme being developed with decreasing contradictions and determining its main direction of functioning. The following results were obtained from this study. The necessity of the problem of efficiency criteria and limitations is substantiated to be reduced to a system-target model based on the hierarchy of the structure of the transport system and the corresponding modeling of the reconstructed system of transport support goals, the contradiction between the needs of the practice of improving the certification system for the integrated use of the transport system and the state of the scientific and methodological base for predicting the period between repairs of asphalt concrete pavements. The scientific task of developing methods and models of the economic efficiency of the organization and technology for the construction of access roads with asphalt concrete pavement during the preparatory period of construction is being formed. Conventionally, the directions of development can be divided into four sectors. First – takes into account the accumulated theoretical and practical experience and the established laboratory base. Second – adopted optimized models and shapes of samples of the test material. Third – the availability of research and ease of processing the results with their sufficient reliability. Fourth – a new approach to assessing the quality of road building materials, taking into account their operating conditions in a structure based on optimized laboratory samples with an assessment of the anisotropic and wave characteristics of materials, followed by the formation of a fundamentally new regulatory framework. The conclusions of the study can be given as followings. The problem of assessing the quality and choosing a system of requirements for the technology of preparing any material in order to improve the quality is one of the cardinal tasks of construction. Compliance with technical standards and technological regulations guarantees the quality of materials and constructions. The considered method of substantiating the economic efficiency of calculating the period between repairs of asphalt concrete pavements will provide an opportunity to develop recommendations for its development in the interests of strengthening economic and environmental safety. The results are described by a mathematical model in the form  $y(x)=a \cdot \ln(x)+b$ . The method allows balancing the interests of enterprises and citizens, transport organizations and enterprises with the interests of investors. These interests are often contradictory and even opposite. In similar situations, a system of state regulation is recommended for managing the joint activities of all participants in the functioning of the unified road transport system.

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## **PRACTICAL METHODS OF OBSERVATION OF THE IMPACT OF MINING EXPLOITATION IN THE RIGHT-OF-WAY ON A SELECTED EXAMPLE**

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### **ABSTRACT**

The effects of underground mining on road surfaces are a serious problem. Deformed road surfaces significantly affect the comfort and safety of use. For example, discontinuous deformations characterized by discontinuity of the medium affect the condition of the road structure. Loosening the layers that make up the pavement structure reduces its stiffness and thus reduces the fatigue life of the pavement. Frequent repairs are the result. Therefore, it is important in mining areas to constantly monitor the condition of the facilities, determine the need and scope of surface repair. Various measurement methods can help, mainly geodetic measurement of displacements. Additionally, in order to monitor the condition of the road infrastructure, their operational features are determined, such as the condition of cracks and surfaces, longitudinal evenness or the depth of ruts. Subsoil surveys performed with geophysical methods are often required. In the research, both classical and modern measurement techniques were used to measure the deformation of the road surface in the mining area. The observations were made for a group of points constituting the observation line along the right-of-way. The changes that were observed were linear, discontinuous deformations and pavement undulations. In addition to identifying the geometric changes of the road, the method of assessing changes in pavement stiffness was also used.

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## **INFLUENCE OF TRAM SPEED ON THE LEVEL OF GENERATED VIBRATIONS ON PEOPLE INSIDE BUILDINGS**

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### **ABSTRACT**

For many years, engineers, as well as people not related to the issue of vibration propagation, have believed that in order to reduce the level of vibrations observed on buildings in the vicinity of the tram line, the speed should be reduced and the problem will practically disappear. Road workers and railwaymen are also very eager to use such knowledge. Is this belief reflected in reality? The Laboratory of Structural Mechanics of Faculty of Civil Engineering Cracow University of Technology has been carrying out measurements of communication vibrations for many years. The aim of the research undertaken was to confirm or contradict the above thesis. Having observed this issue for many years and based on the results of research on real objects, we have formulated some conclusions that may arouse interest. Based on the results of experimental tests, the parameter with the greatest impact on the level of generated vibrations is the type of tram, not its speed. Even the mass of the tested trams does not affect directly into the level of vibrations perceived by people inside building. What can be interesting, increasing the tram speed does not necessarily increase the level of vibrations felt by people in buildings in the vicinity of the tram line. Selected results of the research on the impact of tram speed on the vibration level generated in the building located in the neighborhood to the tram line are presented in this paper.



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**FLOOD RISK MANAGEMENT BY USING SAR (SYNTETHIC APERTURE RADAR) REMOTE SENSING IMAGES**

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**ABSTRACT**

This case study discusses the possibility of using satellite data, instead of ground pluviometric measurements, as input data in modeling a hydrological system. One of the biggest problems in the monitoring process is the determination of floodable areas in order to establish and assess damage and risk management. Also, the maps regarding the floods are a real help to the institutions and to those who intervene in rescuing the population. Unlike optical sensors, synthetic aperture (SAR) radar provides valid measurements by covering high-resolution clouds.

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## THE MORPHOMETRIC PARAMETER ANALYSIS OF THE CATCHMENT USING GIS

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### ABSTRACT

Catchment analysis is an efficient method for understanding of how climate variability and catchment characteristics interact to define a hydrological response. This paper analyses the geomorphological and morphometric parameters of the Tarnava Mica river basin using GIS. Târnava Mică River has a length of 196 km and the surface of the river basin of 2071 km<sup>2</sup>. Remote sensing technique is a tool to assess the morphometric parameter of basin hydrology, that it helps to understand the basin hydrology and water resources management.

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## FIRE BEHAVIOUR OF WOOD AND WOOD-BASED COMPOSITE PANELS TOWARDS THE DEVELOPMENT OF FIRE-RESISTANT MULTILAYER SYSTEMS

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### ABSTRACT

The use of sustainable natural resources has been practiced by the construction sector as a means to reduce energy demand and increase the efficiency of buildings. In this sense, wood and wood-based materials are alternative and renewable material sources that can be effectively used in building elements, such as doors and partition walls, which are required to provide adequate thermal, acoustic, and fire resistance performance. Such elements play an important role in the fire compartmentation of buildings. Appropriate selection of materials with a reduced potential of ignition and enhanced fire behaviour may reduce the heat flux, and the passage of hot gases and smoke, thus minimizing fire hazards. In the case of wood products, the combustibility of wood usually limits its use in fire-resistant components. However, the fire performance of wooden assemblies can be improved by using engineered wood products and insulation materials, which can be assembled into multilayer systems. This work investigates the performance of wood and wood-based multilayer panels exposed to ISO 834 standard fire curve to improve the knowledge about their fire resistance in terms of insulation (I) and integrity (E) criteria. The study considers pinewood, OSB (oriented strand board), and moisture-resistant MDF (medium-density fibreboard) of different thicknesses. Rock wool with a thickness of 27 mm was also used as a core material. The multilayer systems have a dimension of 580×580 mm, fixed to a wood frame and mounted to a wall made of refractory bricks and mortar. The composite panels were tested in a small-scale furnace. During each test, temperatures were measured using type k thermocouples attached between layers and to the panel surfaces and wood frame. The specimens were considered to have failed when the insulation and integrity criteria were met according to EN 1361-1. The results showed that a 1-hour insulation resistance was achieved when using 16 mm-thick MDF panels on both sides and rock wool as a core material. Similar assemblies using 6 mm-thick and 10 mm-thick MDF panels reached 30 min., and 40 min., respectively. The specimen with 20 mm-thick pinewood on both sides and rock wool core had an insulation fire resistance of 50 min., but had the highest superficial mass and total thickness amongst tested specimens. Pinewood has been tested as a core material sandwiched between two 10 mm-thick MDF panels, and its insulation resistance was 30 min. The assembly with 15 mm-thick OSB placed between two 10 mm-thick MDF boards had the smallest insulation resistance of around 27 min. The fall-off of the exposed panel and warping of the edges of the panels greatly influenced the integrity behaviour of the samples. The insulation performance was mostly affected by the type of material and its thickness, as well as by the relative position of the layer in the composite assembly. The results provide important data regarding heat transmission effects and integrity issues related to the exposure of wood and wood-based composite multilayer systems under fire.

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## THERMOMECHANICAL BEHAVIOUR OF BONDED JOINTS OF WOOD AND WOOD-BASED PANELS AT ROOM AND ELEVATED TEMPERATURES

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### ABSTRACT

Wood is a natural material traditionally used in the construction industry. In recent decades, developments in scientific research have turned wood into a high-tech construction material. Increased interest in bonded joints in wood construction is due to the advantages of adhesive technology compared to traditional mechanical joining techniques. It is very important to understand the influence of elevated temperatures on adhesives due to their use in multilayer systems such as compartmentation walls and fire-resistant doors, which require adequate mechanical and thermal resistance in fire situations. The purpose of this study is to investigate the mechanical behaviour of different structural adhesives on bonded connections of wood and wood-based panels at room and elevated temperatures through experimental testing. The performance of the adhesives was evaluated at room temperature and at 50 °C, 100 °C, 150 °C, and 200 °C. The resins tested were a polyurethane prepolymer resulting from the reaction between polyols and diphenylmethane diisocyanate (MDI), Flexpur151, and urea resin glue for hot pressing. The tensile shear tests with lap joints were performed using combinations of pinewood-pine wood and MDF-MDF. The experimental tests were done according to EN 205:2016, which allows for determining the tensile shear strength of bonded joints. The failure mode of the tested specimens was classified according to ASTM D5573. The results show that the bonding strength and the displacement of the specimens decrease with the increase of the temperature. The failure mode presents a different result for different temperatures. For example, for the urea resin, the shear resistance of MDF-MDF panels decreases about 50 % when exposed to 100 °C with the failure mode usually occurring on the panel, and 98 % when exposed to 200 °C with the failure mode in the adhesion plane. For the MDI based resin, the shear resistance of MDF-MDF panels decreases about 35 % when exposed to 100 °C with the failure usually occurring on the panel, and 65 % when exposed to 200 °C with the failure mode occurring in the adhesion plane.

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## RESIDENTIAL FAÇADE DEVELOPMENTS IN ABU DHABI: SIMULATION OF SUSTAINABLE KEY CONCEPTS

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### ABSTRACT

Abu Dhabi, the UAE's capital, is experiencing rapid development of residential buildings in terms of quantity and construction style; however, the building façades of these modern units barely reflect the importance of sustainable concepts carried out through traditional houses through urban growth. In such extreme weather conditions as in Abu Dhabi, it is essential to create a pleasant indoor environment in a residential building, while regulating solar gains and reducing energy consumption on mechanical cooling. If not properly addressed in the façade design, the intense heat and glare, air leakage, and lighting loads will affect the performance of the interior spaces of housing units. Throughout the traditional settlements till modern housing developments, the façade design of residential buildings in Abu Dhabi addresses many changes from a design perspective such as materials in use, opening sizes and shapes, and shading elements with additional architectural features from which some resulted in high sustainable performances. This study aims to establish an understanding of sustainable housing façade design key concepts in Abu Dhabi within a structured housing development timeline from traditional settlements to modern residential buildings. The research extended with a case study on recent housing developments in Al Raha Beach area. The study showed that achieving sustainable goals has priority in recent façade designs and various design elements are integrated into the facades to challenge Abu Dhabi's harsh climate conditions. Later in the research, three residential buildings from the case study were selected for solar radiation analysis on the South façade. The simulation was run using Ladybug and Grasshopper software to review the environmental impact of the concepts used in the South façade treatment. This research shows that from traditional to modern façade designs in Abu Dhabi there are several key concepts yet to be developed in order to achieve high sustainable performances in residential units. The case study and the simulation highlight the importance and necessity of sustainable façade design to be applied in response to the climate and orientation for better thermal comfort.

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05 -09 September, 2022 - Prague (Czech Republic)

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## RESISTANCE TO MOISTURE AND FROST OF A COLD FINE-GRADED ASPHALT MIXTURE WITH A COMPOSITE BINDER

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### ABSTRACT

Maintenance works in an asphalt pavement for removing and replacing the wearing course produce large amounts of milled material. Following the sustainably-sourced resource principle, this material is recirculated and, in this case, utilized in new mixtures, chiefly in cold recycled mixes. Since it is derived from surface course rehabilitation, its particle size is up to 10 mm. To ensure the most beneficial parameters of so produced cold mix asphalt, the properties of the binder have to be optimized. The binder used in the tests was composed of CEM I 32.5R, hydrated lime and by-product fines. Various combinations of binder components were tested in this study to obtain the optimal parameters of the recycled mix. Foamed bitumen 70/100 was used. Void characteristics were evaluated, and a particular focus was on the resistance to moisture and frost-induced damage, i.e., ITR, TSR, and  $RW_{WM}$  according to ASSHTO T283. A series of tests enabled the determination of the composite binder composition to ensure proper resistance of a cold recycled fine-graded mixture to moisture and frost.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **TOWARD FUTURE NEARLY ZERO-ENERGY CITIES: THE IMPORTANCE OF ENERGY PERFORMANCE SIMULATION IN URBAN PLANNING AND DESIGN PROCESS**

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### **ABSTRACT**

During the past few years, considerable efforts have taken place to develop responses to climate change in cities, promoting their systemic transformation towards future nearly zero energy development. This challenge is symbiotically related to fostering urban energy transition and improving on-site solar energy generation conditions while reducing energy demand. Recent advances in digital technologies have provided urban planners, architects and engineers with new tools to improve the design of neighbourhoods, public spaces and buildings, integrating energy performance simulation in different phases of projects. In this context, integrating bioclimatic parameters such as solar radiation, air temperature, relative humidity, and wind flows in the urban planning and design process is a determining factor in improving several aspects of the future energy performance of the built environment, in particular, thermal comfort, natural light, heating and cooling demand and energy production by photovoltaics on roofs and facades. This study develops an integrated model that combines 3D modelling (Rhinoceros), environmental performance analysis (ClimateStudio) and computational fluid dynamics (Flow Design), structuring an interactive workflow that aims to support decision-making in the multi-scope perspective of urban planners, architects and politicians. Presenting practical applications to different case studies in Portugal permits validating the developed methodology and drawing together evidence and key finding. Using these digital tools allows urban planners and architects to anticipate energy performance, using the conception phase to optimize a project's core components. Moreover, the visualization and comparison of future urban models permit the involvement of policymakers and other stakeholders in an interactive and participatory process with the co-creation of the final design of the solution.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ELEMENTS OF ECOLOGICAL CONSTRUCTION: SELECTED EXAMPLES**

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### **ABSTRACT**

A warming climate is happening, more and more often extreme climate and phenomena that relate to design, nurtures on the basis of principle on principles. Moreover, legal regulations regulate the principles of providing services. Contemporary building solutions that you will design are building technologies that tend to create zero objects. Subsequent actions, such as immediate actions, in the object creation phase, can be done later. Buildings already (19th century and older) exposed to less restrictive energy standards are a big problem in terms of reducing energy efficiency. The used thermo-modernization materials are the same energy sources. Ensuring the comfort of the users' living at that time. In order to solve the problem related to the optimization of structural elements that will give effect on the date of the problem, reduce the emission reduction process. The purpose of preparation for content creation is to teach technical problems and proposed technical technical elements and to create technical and technical tools for users. Sales analysis technology testing one method: AF technology customer analysts, analysis, analysis, interdisciplinary research community of students and academics, research. Proceedings from the tests of the conducted elements and methods of conduct were successful and resulted in a breakthrough in methods and rules of conduct. Introduction to urban space. That it has the structure of an object, with subdivisions into smaller parts, making use of those prevailing in nature.

Corresponding Author: Anna Gumińska



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## STEREOTYPICAL CUSTOMER TYPES OF CONVENTIONAL AND MODULAR CONSTRUCTION METHODS

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### ABSTRACT

**Problem:** In the course of the structural transformation of the construction industry, the integration of industrialization and digitization has led to the development of construction methods with an increased degree of prefabrication, such as modular construction. Compared to conventional construction, these innovative construction methods are characterized by modified structural and procedural properties and expand the range of construction services. It was unclear on the basis of which construction properties and motivations a customer decides in favour of one of the two construction methods. Currently, the different target groups of the two methods have not yet been analysed, so that target groups often do not correspond to the method. Therefore, there was a need for research in the analysis of customer-specific preferences regarding the choice of the construction method. **Goal:** The aim of the study was to identify the acquisition drivers of conventional construction and modular construction, taking into account their qualitative characteristics. hard and soft customer characteristics with regard to construction preferences were determined in order to derive the target group of the respective method. Thus, customers can approach suitable construction companies with the desired method and suitable customers can also be approached by the respective construction companies. **Methodology:** The study approach starts with a literature review in the field of conventional construction method and the modular construction method as well as the definition of customer in the building industry. In addition to outlining basic characteristics, the focus is on discussing theoretical acquisition drivers of the construction methods. Based on the literature research customer-describing research hypotheses are formulated for each method. In order to validate these research hypotheses, qualitative expert interviews are used in the sense of an explorative study to obtain empirical data. For this purpose, experts from conventional construction companies and experts from companies active in modular construction were interviewed for this study. Finally, stereotypical customer types are derived from the research hypotheses and the additional findings from the expert interviews. **Conclusion:** Through the expert interviews, differences and similarities of customers of the two construction methods could be identified. Furthermore, stereotypical customer types could be characterised for both methods. By evaluating the stereotypical customer needs, the decision-making behaviour of the demand side can be segmented accordingly. The resulting needs-based customer approach contributes to cooperative and successful project management.

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## THE INFLUENCE OF TBM ON A BUILDING IN SOFIA CITY CENTER

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### ABSTRACT

The construction of the third line of Sofia underground railway is of the major priorities of the geotechnical engineers in the Bulgarian capital during the last two years. Since the first and second lines passed under the existing streets and parks, the third line is designed to go under some buildings built in the last century. These buildings have been in the architectural view of the city for years. Such is the case, described in the present article. The railway is designed to pass under a building in the Sofia city center. The building is five story, skeletal, constructed on single and strap foundation. The purpose of the study is to establish if the settlement due to the TBM will adversely affect the structure of the building. The solution is for a single plane task. Data given in the manual of the TBM and the subsoil geotechnical properties are used in order to define the behavior of the soil massif. After the calculations made, the relative settlement of the building is determined to be much smaller ( $1/1662$ ) than the allowable one ( $1/500$ ). Then the maximum relative settlement is calculated to be  $1/1054$ , which is higher than the average settlement for the whole building, but much less than the allowable. The calculations and comparisons were confirmed in practice.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE USE OF RECYCLED AGGREGATES IN LOAD-BEARING CONCRETE STRUCTURES

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### ABSTRACT

Concrete is the most used building material in the world. Its success lies in its versatility and availability, as it is essentially a local material. At present, however, the existence of concrete will be achieved first by the challenge of its arrival, which is its sustainability for the next generations, in connection with the growing population. With the passage of time, there is an increasing deficit of non-renewable resources. It is because of this that most informed people agree with the transition from a linear to a circular economy. Of course, concrete cannot keep up with this significant paradigm shift. What are the most important data to assess the potential for concrete recycling? In Europe, 196 Mt of recycled concrete aggregate (RCA) was produced in 2015, mainly from construction waste from demolitions. Of this amount, approximately 40% was reused in monolithic or precast reinforced concrete. Therefore, according to such simple calculations, there would be a possibility to replace at least 20% of the used natural aggregate with recycled aggregate in the entire production of concrete load-bearing structures. Of course, if we consider concrete load-bearing structures made from internal materials originating from demolitions (including natural or granular materials from subsoil roads), this percentage will increase even more. Some European countries have been using this method of producing recycled concrete for several years. For example, in England, the rate of use of recycled concrete aggregate was already in 2008, about 5% of the total RA production. However, this material is not yet fully used for the design of the load-bearing structures of buildings. So, we can conclude that the concrete industry could recycle significantly, but currently it still does not do so. In general, it can be summarized that this is due to the fact that there is no consensus on whether the use of recycled aggregate results in an increase or decrease in the mechanical properties of concrete, given the diversity of results in each available experiment. The use of recycled concrete in load-bearing structures is therefore a very current topic and its application continues to be of interest to the field of development and research. This paper will deal with the dispersion of the mechanical characteristics of recycled concrete depending on the type of recycled aggregate and the size of the water/cement ratio.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**SEISMIC VULNERABILITY EVALUATION FOR REINFORCED CONCRETE BUILDINGS IN BAGHDAD, IRAQ, WITH DIFFERENT SETBACK IRREGULARITIES**

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**ABSTRACT**

Four six-story reinforced concrete buildings, with different setback configurations and designed for locations in Baghdad, Iraq, were studied in order to assess their seismic vulnerability. The buildings, with masonry infills at the first two stories, categorized as vertically irregular, were dimensioned according to the provisions of the Iraqi Seismic Code, ASCE 7-16 and ACI 318-19. Nonlinear static (pushover) analyses were conducted to compute the capacity curves, then sets of fragility curves were developed in order to estimate the seismic damage probability, in terms of spectral displacements. The target displacement was identified on the pushover curve by utilizing the modified coefficient method in FEMA 440, adopted in ASCE/SEI 41-13, and then the idealized force-displacement curve was established, to obtain the yield point of the models. The pushover curve was developed for three lateral load distributions: the equivalent lateral force distribution, the uniform pattern and the first mode pattern, to take into account various possible actions that may occur during the actual seismic response and to identify the worst case, which will be the one governing the subsequent computations. The setback degree of the studied models was assessed to take into account its influence in increasing the local damage hazard. From the results it could be noticed that, as the irregularity setback level increases, the probability of damage hazard rises and the models exhibit poorer seismic performance. The fragility curves in this study could be used as a preliminary basis in seismic risk scenarios for Baghdad, for vertically irregular buildings with setbacks. However, further processing of these curves is considered necessary, to account for the potential variation of input parameters selected for the nonlinear analysis, damage state thresholds and the assumptions used for the determination of fragility curves for each of the reference damage states.

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**INTRODUCTION OF ARCHITECTURE AND URBAN DESIGN FOR DISASTER RISK REDUCTION  
DATABASE ABOUT THE 2011 GREAT EAST JAPAN EARTHQUAKE AND TSUNAMI**

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**ABSTRACT**

Mankind has experienced repeated disasters in history, learned from them, and developed safer cities more than past through the phase of post-disaster recovery. In order to record and to disseminate such efforts in the field of civil engineering, architecture and urban planning, we commenced construction of Architecture and Urban Design for Disaster Risk Reduction (Archi-DRR) Database (<https://isdmlab.irides.tohoku.ac.jp/english/archi-drr/?sort=id&page=0>) after the 2011 Great East Japan Earthquake and Tsunami. The contents of database are as follows: **A.** Location: Region, Country, Prefecture/Province/State, Municipality, District, **B.** Triggering Disaster Classification; **a.** Primary Item: 1.Wind-related, 2.Water-related, 3.Fire-related, 4.Earth-related), **b.** Secondary Item: 1.Storm and Flood, 2.Extreme Climatic Event, 3.Snow, Freezing, and Lightning, 4.Ground Deformation, 5.Earthquakes, 6.Volcanic Disaster, 7.Tsunami, 8.Explosion, 9.Fire, 10.Leakage, 11.Toxicosis, 12.Structural Collapse, 13.Break Down, 14.Traffic Accident, 15.Environmental Pollution, 16.Human Error/Fatal Accident, 17.Others. **C.** Targeting Disaster Classification (same as above), **D.** Related Disaster, **E.** Spatial Scale Classification, **F.** Purpose in the Systematic Disaster Life Cycle; **a.** Primary Item: 1.Mitigation, 2.Preparedness, 3.Response, 4.Recovery, 5.Prediction and Early Warning, 6.Damage Assessment, 7.Information and Communication, 8.Information Sharing and Education, 9.DRR Base Facility not Constructed in a Post-disaster Recovery Process, 10.Others, **b.** Tertiary Item: 1-1.Environmental Mitigation, 1-2.Structural Mitigation, 1-3.Landuse Mitigation, 3-1.Evacuation, 3-2.Evacuation (Vertical), 3-3.Evacuation (Horizontal) 3-4.Open Space, 3-5.Shelter, 4-1.Sheltering Place, 4-2.Temporary Housing, 4-3.Temporary Complex, 4-4.Permanent Housing, 4-5.Post-disaster Memorial Park 4-6.Post-disaster Memorial/Monument, 4-7.DRR Education Facilities, 4-8.Disaster Remains, 4-9.City Hall, 4-10.Commercial Facilities, 4-11.Industrial Base 4-12.Transportation Facilities, 4-13.Educational/Cultural Facilities, 4-14.Community Base, 4-15.Others. The number of data is 562, mostly focusing on the 2011 Great East Japan Earthquake and Tsunami, as of July 12, 2022. It will be introduced at the conference.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## METHODS FOR INQUIRIES OF TRADITIONAL HOUSES: CASE STUDY FROM THE TRADITIONAL HOUSES OF THE TOBA BATAK, INDONESIA

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### ABSTRACT

The study discussed methods to enquire layout of traditional houses. Long has been, the conventional dwellings safeguard the living patterns of a particular society. They reflect a consensual way of living in a home as an inheritance. These living patterns are intangible and complex, with cumulating anthropological, social, behavioural, and architectural layers. A complexity that is not easily perceived, especially in short-term observations. The methods to read and understand a dwelling pattern from traditional houses by studying their plans are our study's aim for exploration. We propose and experiment with a series of steps to inquire about the dwelling patterns in a culturally specific community. As a case study, we opt to test it in our fieldwork by observing traditional community houses of the Toba Batak in Indonesia. Our study investigates multiple data collection tools from observation and direct inquiries to 3D model analysis to extract the uniqueness and complexity. Our experiment devised activity logs accompanied by house layouts to gather information about a community's habits in using rooms in their home. They are both coded in stages to capture their typical-communal pattern out of an otherwise individual log. The approach succeeded in harnessing data from personal records without imposing our understanding of space and its use as a foreigner to the group. The resulting data from all sources serve as inputs to modelling in the form of justified plan graphs that will generate the patterns. Justified diagrams will then illustrate the configurational characteristic of a traditional house in graphical presentation. In our case study, they are shallow graphs with intricate "branches", highlighting the centeredness of their living arrangement. A character (or pattern) not often found in contemporary houses, where division and seclusion dominate. Further inquiry by calculating depth, relative asymmetry and integration value, based on the space syntax analysis (Hillier, 1984), reveals the numerical characters of the room or zones in their house. The analysis summary illustrates the space hierarchy, mirroring the social structure that drives and animates the whole living milieu. Collective use of multiple tools extract patterns of available houses, particularly in a specific community house, as methods for house research and a basis for future design iteration.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **AUTOMATIC CREATION OF STREET PLANS FOR URBAN PLANNING**

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### **ABSTRACT**

Modern age requires re-evaluation of directives for efficient urban planning both in small towns and cities. For example, in order to mitigate the effect of climate change, cities are being planned more in regard to motorless transport and with more trees and green elements. Cycling lanes are becoming norm in western Europe. In addition, city development must be complex and must reflect different structures and attributes specific to the districts to be able to plan the city as a whole. In cooperation with KAM KV (Office of Town Architecture in Karlovy Vary), we are preparing data model of all streets in the town which includes information about street width, traffic, urbanistic structure, street type etc. In addition, we are developing an algorithm, which is going to automatically create street plan based on the aforementioned data model and its various attributes. The street plan is subsequently used in a public contest for the best company to rebuild the street. So far, these plans had to be drawn manually for each street, which is very time-consuming in case of bigger cities. The algorithm is developed in Python as a QGIS plugin. Pillow library is used for floor plan drawing with dimensions included. The street plan creation process is either fully automatic by selecting desired street with attributes in QGIS, or half-manual by setting/editing these attributes manually. As town halls in different towns face similar problems in the field of urban planning, we believe this proposed solution can be used in many of them too.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SUSTAINABLE URBAN MOBILITY – ITALIAN AND POLISH EXPERIENCES ON RESEARCH AND IMPLEMENTATIONS**

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### **ABSTRACT**

The transformations that have taken place in the social and productive structures of economically advanced countries are to be correlated to a new structure of urban networks and territorial relations, from which it results that a vast series of activities and functions are to be considered no longer subject to localization constraints and thresholds dimensional. From this emerges a wider territorial participation in the development process, which ends up affecting the regional articulation, giving rise to the formation of reticular spatial structures. It comes out the idea of sustainable mobility was than born, which was based on giving a greater role to public transport, pedestrian and bicycle movements, which are much more efficient, thanks to which you can in turn reduce time waste, pollutant emissions and increase safety at urban areas without limiting mobility. In light of these aspects, in this paper we highlight, in parallel, what has been achieved with a view to sustainability in two realities: Brindisi, a city in southern Italy, and Cracow, a Polish city. They are two realities that highlight what has been done and what are the indications coming from the stakeholders. It is possible to move in this direction for future planning and for the adoption of sustainable mobility plans adhering to territorial needs.

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## CAN THE PILE LOAD TEST CURVES BE ESTIMATED?

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### ABSTRACT

Currently, the pile load test is considered to be the most realistic result for testing the bearing capacity of piles, that is why these measurements must be evaluated as efficiently as possible. When designing a pile foundation, the bearing capacity of the piles can be determined most precisely based on the pile load test until failure, but this is an extremely expensive and time-consuming procedure. Among other things, this is why we tried to develop methods for calculating load capacity based on partial test loads or other measurement results. In many cases, it is not possible to produce a complete (load to failure) pile load test curve, because during the pile load test: a. the load steps are increased up to the standard load, b. the load is applied up to a specified settlement, c. they are not able to physically transfer such large loads to the pile, which it would be necessary due to the high load capacity. Getting to know pile load test curves more effectively can be key to developing load capacity calculation methods. The goal of our research is to set up a bearing capacity model that utilizes the trial load data available to us and the extremely valuable database of cone penetration test and exploratory drilling at the same location. The present analysis deals with pile load test curves, using the various measurement results available to us. We conducted our research from two perspectives. First, we examined the fit of the pile load test curves, and then their estimability. In the estimation methods known to us, we found that the calculation of the base resistance with a linear formula is an obstacle to a more accurate fitting of the pile load test curve, so we looked for a new method for fitting this as well. Our method gives more realistic base resistance values than those obtained from previous methods. The difficulty of developing the estimation method is that there is no clearly predictable function in the context of load-settlement, because it depends on many factors. Another difficulty is that the behavior under load consists of different phases, so the relationship between the load-settlement during its first and later phases is not linear. During the tests, it is important to examine the mathematical accuracy of the fits/estimates, where the primary goal was to minimize the deviations and make them easy to use.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **COLLING TOWER MEASUREMENT BY LASER SCANNER AND CLOSE-RANGE PHOTOGRAMMETRY**

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### **ABSTRACT**

Cooling towers with natural draft are mainly used in large power or chemical plants. The shape of cooling tower is rotation hyperboloid in order to gain optimal performance of natural draft. The height of cooling tower is designed by maximum cooling capacity. The smallest cooling tower has 35m (Heerlen – NL 1914) and the biggest tower reaches the height of 200m (Niederaussen – D 1998). Perfect geometry of rotation hyperboloid must be respected as a thin thickness of tower is susceptible to vibration and gusts of wind. This study offers a comparison of measured towers shape and model from blueprints. Data were obtained by laser scanning and close-range photogrammetry. During the measurement the cooling tower was inoperative, so it was possible to measure even inside the cooling tower. Model was processed in Reality Capture software which allows to combine laser scan and photogrammetry data. Final model was used for comparison with mathematical model of rotation hyperboloid, shell thickness analysis and damage detection of outer tower shell. Geometrical analyses processed in Cloud Compare software show the difference of reference model against tested model and the result is difference model. Mathematical model of rotation hyperboloid was represented by mesh, and it was created in Blender software. Texture of outer tower shell was projected by cylindrical formula to map for damage detection. Damages like crack and exposed reinforcement were visible on outer tower shell. Summarization of these damages allows determination cooling tower liveliness. Damage detection analysis was obtained by deep learning by CNN model and OBIA in eCognition software.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ENVIRONMENTAL FACTORS AND PROBLEM BEHAVIORS OF ASD CHILDREN: REDEFINITION, CLASSIFICATION AND ASSOCIATION

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### ABSTRACT

Since the latest revision of the Diagnostic and Statistical of Mental Disorders (DSM-5), the prevalence of people with autism spectrum disorder (ASD) has been steadily increasing over the past 10 years. The problem behavior is a major indicator in the identification of children with ASD, as well as an important component of intervention therapy. Existing research on the problem behavior has long been dominated by scholars from medical disciplines. However, in recent years, research on environmental support and environmental interventions for children with ASD has received attention from design disciplines, such as environment-behavior studies. Due to the inherent differences between disciplines and research objectives, the definition and classification of the problem behavior in environment-behavioral and medical studies are quite different. Therefore, definition and classification of problem behaviors of ASD children become a vital basis for discussing the research scope in design disciplines, as well as for constructing interdisciplinary fields and clarifying the context of interdisciplinary research. The purpose of this study is to redefine ASD children's problem behavior from the perspective of environmental behavior studies. The redefined problem behaviors, along with related environmental factors, was identified and classified based on their characteristics. A matrix incorporating the classified environmental factors and problem behaviors was established as the conceptual framework to investigate potential associations and underlying mechanisms. An explorative study was conducted, examining and quantifying environment-behavior associations, through an interview with clinicians and parents of ASD children. The results suggested that our framework worked well in disentangling nested environment-behavior associations relating to ASD, which shed light on further studies aiming at bridging the gap between design and medical disciplines.

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## ARE THERE BIG DIFFERENCES IN FAMILY ESTIMATES BETWEEN RESIDENTS OF DIFFERENT TYPES OF SETTLEMENTS?

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### ABSTRACT

In recent decades, contradictory phenomena in family and marriage relations have been noticeable in Russian society. This is due, among other things, to the fact that "post-material" values (quality of life, self-expression for individuals) begin to prevail over "materialistic" values (including family). One of the fundamental questions is whether the family (and children) really cease to be a value for modern generations? In this study, attention is paid to how, in general, residents of different territorial settlement structures assess the importance of the family. On the example of survey materials of respondents - residents of a metropolis (the city of Samara), small towns and villages of the Samara region. The materials of the sociological survey "Fathers and children: conflict and cooperation, continuity of generations", conducted in the Samara region (Russia) at the beginning of 2020 under the leadership of L.G. Lebedeva, are used as the factual basis in this work. The survey was conducted on a sample representative by age, gender, as well as by territorial and settlement structure of respondents, the total number of which was 620 people aged 16-69 years. More than two-thirds (67.4%) of respondents in the entire sample admitted that the words: "Family is hope and support" are quite fair. And about a quarter (25.2%) of respondents agree that these words are mostly true. At the same time, the share of confidently positive assessments of the family ("Yes, they are quite fair") among respondents – residents of the megalopolis (Samara city) is significantly less (59.1%), and among respondents – residents of villages is significantly more (78.8%) than among other groups of respondents. Almost two-thirds of respondents (63.5% of the entire sample) fully agree with the thesis that the concept of "happiness" is correctly associated with family and children. And even more than a quarter (27.9%) agree in some ways with this thesis, disagree in some ways. At the same time, the share of confidently positive assessments of the family – that the concept of "happiness" is correctly associated with family and children – among respondents – residents of the megalopolis (Samara city) is significantly less (51.6%), and among respondents – residents of villages is significantly more (78.1%) than among other groups of respondents. More positive trends in relation to the family are manifested among residents of villages and cities of the Samara region, noticeably less positive trends in relation to the family are manifested among residents of the megalopolis (the city of Samara). These differences suggest the need to search for special approaches in socio-economic and socio-cultural policy (including housing construction plans, provision of social infrastructure facilities to the population) when solving demographic problems in relation to residents of different territorial settlement structures. Our sociological data confirm that there is a tendency to decrease the importance of the family, the value of the family and family life. At the same time, sociological data show that the family is recognized as a hope and support in life by the overwhelming majority of respondents – residents of different territorial settlement structures.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## CAUSALITY? CORRELATION? COINCIDENCE?

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### ABSTRACT

For more than two and a half years, our lives have been significantly impacted by the coronavirus pandemic. The related numbers, data and facts have dominated and continue to dominate the news. At the beginning of the crisis, comments from officials from a range of relevant disciplines were in high demand. However, one could hardly count civil engineers among those most involved with SARS-CoV-2 academically. This article raises the question whether there is in fact a specific field within civil engineering that may be connected to the impact of Covid-19, namely radon exposure in interior spaces in certain parts of the world. Radon exposure is particularly high in regions that have seen high mortality rates related to SARS-CoV-2. Examples of these include the Bergamo region in Italy and the Erz Mountains, the Fichtel Mountains or the Bavarian Forest in south-eastern Germany. But is there actually a correlation, or is this merely a coincidence? Is there in fact a causality? If so, constructional measures to protect against the decay products of radon in interior spaces would gain a new significance that goes beyond the realms of current knowledge. This article cannot provide a definitive answer to these questions due to the current patchiness of data in Germany. Nevertheless, this paper will use the data available to demonstrate that there is evidence of a possible correlation or causality between the two, and that this merits further research.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## QUALITY OF LIFE IN THE CITY, CREATION OF SPACES BASED ON URBAN PLANNING STANDARDS

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### ABSTRACT

According to the findings of the latest, sixth IPCC report, cities contribute to climate change, generating around 70% of global CO<sub>2</sub>e emissions, consuming an estimated 60-80% of energy. For the same reason, cities are where the climate fight can be most effective. The ambitious target for European cities is a 55% reduction in emissions by 2030 and total climate neutrality by 2050. With the changing needs of cities in terms of carbon emission, it is necessary to provide residents with a variety of alternative forms of travel - walking, cycling or public transport. It is also important to ensure accessibility to essential urban services. In term of spatial planning, this indicates returning to the district scale, with urban development in the context of enhancing quality of life based largely on pedestrian accessibility to essential services. Such development can be based on urban planning standards for providing districts with functions and public spaces. Standardisation is a method of defining indicators for the number of functions in urban areas, as well as the accessibility parameters of these facilities, ensuring the convenience of the neighbourhood living. At the same time, urban areas are under constant pressure from private investments - due to the commodification of space, which has become a financial instrument. Public resources are shrinking, and the demand for them will increase, due to the need to bring urban areas to a state where they are comfortable for daily life without a car. Standardising the requirements, which provide the districts with functions and public spaces can be an effective tool to guarantee the quality of urban life in the future. Urban standards were analysed at World Urban Forum 11, in a session entitled: *Quality of life in the city, creation of spaces based on urban planning standards*. An analysis of the available urban planning standards - including indicators of quantity, quality, accessibility and quality of access to functions supplementing the urban residential environment - was carried out before the Forum. Documents on the creation of high quality districts with all amenities were analysed. The analyses included standards and methodologies in particular of Polish, British and German origin. The aim of the workshop was to introduce participants to the subject of urban standards and to test the application of standards in urban planning. The international format of the event encouraged a lively discussion on the validity of the application of urban standards and their particular values in different urban contexts. The publication will present the issue of the standardisation of urban space applied to the city shaping process and the conclusions of the workshop work that took place during WUF 11 in Poland.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## ZERO ENERGY FEASIBILITY ANALYSIS FOR LARGE EXISTING OFFICE BUILDINGS

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### ABSTRACT

This article analyzes transformation possibilities of existent office towers into ZEB buildings, determining which critical factors must be considered in order to determine transformation feasibility and their influence. To carry out this radical building transformation, first building geometrical and physical characteristics are considered to determine if minimum required conditions are satisfied. ZEB transformation requires modifying large amount of building elements and systems and a basic list is determined. Specifically modifications focus in facades that used as main energy source using solar double skin walls and comfort systems to reduce losses and increase efficiency. Key technology used are double-skin solar façade on which PV energy production is performed with a of heat exchange are based. Feasibility objective requires a time averaged energy production ratio sufficient to a complete building operation support, providing energy for all systems. For this reason, office buildings, whose highest energy consumption is due to air conditioning systems during working hours, are the most suitable for this transformation. Transformation process involves global energy production rate based solar radiation and climatological data. Once energy production calculation is completed, consumption rates are considered and recalculated applying expected efficiency increases. Final analysis step will determine energy storage requirements. To meet realistically a ZEB objective, it is necessary to include energy storage systems in transformation. Use energy networks as a storage system has initially not considered to avoid future simultaneity and peak conflicts. Required energy production characteristics and storage requirements, which are optimal in the Mediterranean area for office buildings, present limitations for other utilizations and for areas with less insolation or severe weather conditions, although foreseeable increase in thermodynamic efficiency of building systems and PV will make it possible to extend the applicability to many other building uses and less insolation areas. Final part of article include a feasibility analysis of building H on the UPC campus, which was conceived in the late 1950s and finished in 1965, and which currently has low energy performance.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **A REGENERATIVE ACTION AS PRESERVATION MEASURE OF CULTURAL LANDSCAPE: THE RESEARCH OF THE PHOTOVOLTAIC TECHNOLOGY UPON TRANSILVANIA TRADITIONAL ARCHITECTURE**

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### **ABSTRACT**

A small-scale regenerative action on a well-chosen regular residential building sustaining a rural acupuncture intervention with an impact as a revitalization measure of the vernacular cultural landscape. Two villages were chosen from the Romanian mountain area: every village was analyzed with the main case study with all technical parts of calculus and a validating case study from the same cultural landscape area. The validating case study is a published case study in the first locality; in the second village, the validating case study is very similar to the main case study analyzed from the same locality. Both case studies validated the replicability and the value of indigeneity/the ancestral wisdom of one vernacular bioclimatic main case study primordial for the village cultural heritage specificity. Small-scale regenerative actions proposed are changing the roof finishing material with photovoltaic solar roof tiles and a heat pump. The intervention is a revitalization measure of the cultural landscape in the context of evolution by changing the roof finishing material, which supposed many evident reasons, and the results were occasionally undesirable in heritage preservation. It could also be the case of the solar roof tiles, and this follows to evaluate in more humanistic arguments, like philosophical or historical, and technical ones. It would sound like an undesirable dichotomy if technic versus human values were analyzed. Technic and humanistic, through a holistic approach, the technical specialties could also assume that even is not the detailing level requested by any technical design, it is a nondetailed level determined by the large scale of a cultural landscape. The intervention starts with the small-scale, referential building by its indigenous value: the electrical energy produced with photovoltaic solar roof tiles evaluated with PVsyst dedicated software in the preliminary design stage. The buildings were measured or just facsimile drawings after the published referential sources. So one of the vernacular architecture houses studied is not in its original site; there are measurements posted at one moment with or without the initial orientation. Nowadays, the published source's relevance verifies with actual photos or other sources. The supposition for evaluating an orientation is essential for assessing any building integrating photovoltaics technology. An intervention with the change of roof geometry and structure appears desirable in the guides for promoting Romanian rural areas' local specificity, even surprisingly considering the influence of a specific roof geometry in this cultural landscape is essential, and this is one reason that determined the necessity of the research. Assuming the solar roof tiles with photovoltaic technology are expected to become a standard material on traditional buildings, analyzing vernacular buildings with local specificities is crucial for any design's replicability. Often unclassified vernacular heritage is endangered, and the few preserved ones need retrofitting intervention to reduce their inhabitants' energetical poverty to remain functional or gain functionality. The main target is the replicability of an individual case study that could be the base for an urban scale intervention, the future local energy village-scale hub that preserves a cultural landscape. It is the research of a preservation measure, regenerative through the vernacular design's replicability and more if the morphology of historic urban context permits it.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## TERRITORIAL FACTORS AFFECTING STUDENTS' CHOICE OF HIGHER EDUCATION IN THE SCO PARTNER COUNTRY

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### ABSTRACT

The partnership of the SCO countries and the internationalization of higher education, as well as changes in education, new requirements for the infrastructure of universities, territorial and geopolitical factors impose new requirements on the higher education system in Russia when training foreign students. The choice of Russian and, in particular, Yekaterinburg universities is due to a number of following territorial factors such as: urban infrastructure, the development of the city, its convenience for living, proximity to the native country, the availability and convenience of hostels, the desire to continue living in this city. The outstripping pace of technological progress in the digital society imposes new requirements on the infrastructure of the university and the city. It emphasizes the need for a comprehensive study of the architecture and infrastructure of the university and the city influence on the educational process. That is why it seems to be interesting to study the characteristics of various cities and their territorial factors in order to understand the innovative potential of Russian education for foreign citizens from the SCO countries. However, to the best of our knowledge serious researches referring to this topic remain to be revealed. The purpose of our study was to identify the main factors influencing the choice of a university by students from the SCO countries. The study was conducted in the city of Yekaterinburg universities, in 2022. The primary data was collected using questionnaires. Three hundred respondents – students from SCO countries at the age of and above 18 were questioned on the basis of quota sampling. In addition, in-depths interviews with 30 employees of the International department of the universities were conducted in order to identify key issues of the problem. Our research has revealed that the territorial factor of universities becomes a key factor in educational interaction. Availability of a specialized university for studying in Yekaterinburg; a beautiful, attractive, modern city to live in; territorial proximity to the native country and city; the presence of various sightings in the city are the most significant territorial factors in choosing a university for studying in Yekaterinburg. The research has determined architectural features of cities that attract students from the SCO countries. Our study made it possible to develop recommendations for improving the architectural, spatial, and territorial potential of Russian cities and universities.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## TERRITORIAL FACTORS OF CHOOSING A UNIVERSITY IN THE SCO PARTNER COUNTRY

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### ABSTRACT

The partnership of the SCO countries and internationalization of higher education, and education changes, requirements to the infrastructure and territorial factors set new requirements for universities receiving foreign students. The choice of Russian and in particular Yekaterinburg universities is due to a number of territorial factors, which include the urban infrastructure, the development of the city, its convenience for living, proximity to their native country, accessibility and convenience of hostels, the desire to continue to live in this city. That is why it seems interesting to study the features of various cities, their territorial factors for understanding the innovative potential of Russian education for foreign citizens from the SCO countries. The research aimed to identify the main factors influencing the choice of a university for students from SCO countries. Questionnaire-based research covered universities in Yekaterinburg. The overall audience of the project comprised 300 students from SCO countries who are either studying in universities of Yekaterinburg. The qualitative part included 30 in-depth interviews with employees of international departments of universities in Yekaterinburg. The research funding from the Ministry of Science and Higher Education of the Russian Federation (Ural Federal University project within the Priority-2030 Program) is gratefully acknowledged. According to the results, the territorial factors of universities is becoming a key factor of educational interactions. Availability of a specific university for study in Yekaterinburg; beautiful, attractive, modern city to live in; territorial proximity to home country and city; availability of various attractions in the city are the most significant territorial factors of choosing a university for study in Yekaterinburg. The study was able to identify architectural characteristics, develop recommendations to improve the architectural space, territorial factors of Russian universities.

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## A PRELIMINARY REVIEW OF CASE STUDIES: WINDOW VIEW QUALITY IN BUILDING

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### ABSTRACT

During the last half-century, the rise of high-density urban spaces has matched the population growth of the world's community, resulting in all the cities having less natural greenery and structures with less daylight and viewpoints. Access to sunlight and view of the outside is becoming restricted in constructions due to the public's exponential rise and the corresponding increase in quantity in metropolitan areas. It has been observed that a window view quality that offers visual contact with the outside has various benefits for residents. These advantages involve environmental experience, wellness, decreasing discomfort, and stress recovery. Case studies focused on the evaluation of view out and its effects on human physiology, cognitive function, psychological state, and behavior were reviewed with the aims to identify: i) the main elements and aspects influencing the windows view, ii) the methodologies, indices, and procedures used to investigate the quality of view, as well as iii) the impact of window view quality on buildings' commercial value. Results underlined that the idea of window viewing level is random because it depends on a number of elements. These elements can be physical (like observation, environment, weather conditions, location, landscape) or social (such as demography and cultural context). Besides, although, at the moment, there are no design standards for window view quality, the literature review suggested that the kind of building concept impacts objective viewing qualities. For instance, the window view requirements for hospital patient rooms may differ from office spaces. Content, access, and clarity seem to be the three significant aspects of judging the window view quality. In addition, theories and studies suggest that viewing choices can be divided into three categories: the demand for the art form, the need for knowledge about the outside surroundings, and the requirements for relaxation and wellness. The results of this preliminary review on case studies about window view quality in buildings highlight that the complicated structural processes behind window views, as well as the individuals' reactions and perceptions while looking through a window with different visual qualities, have to be thoroughly investigated. Therefore, several opportunities for further investigations are opening up in this field concerning the following aspects: (i) geometrical (number of window views, size of window views, the distance of window views, etc.), (ii) temporal (timing of view, duration of view, etc.) and (iii) psychological (feelings, mood, occupants' satisfaction, emotions, etc.).

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7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **ANALYSIS OF THE RECONSTRUCTION OF A GREEN ROOF ON A MULTIFUNCTIONAL BUILDING IN BRNO**

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### **ABSTRACT**

The article analyzes construction-technological processes during the reconstruction of green roofs on a multifunctional building in Brno. The reason for the reconstruction was the insufficient thickness of the substrate and the absence of a hydroaccumulation layer that would ensure better growth of vegetation. First, the original layers of substrate and vegetation were removed and the existing geotextiles and waterproofing were inspected. Subsequently, a pre-designed new roof composition with a hydroaccumulation layer and a larger layer of substrate for better vegetation growth was installed on the roof. During the reconstruction process, a time-lapse camera was located on the roof, recording the time spent by workers removing the original material, transporting new materials to the roof, and the time of subsequent storage.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

**TOWARDS CLIMATE CHANGE ADAPTED BUILT ENVIRONMENTS - RETROFITTING THE EXISTING BUILDING STOCK OF MULTISTOREY RESIDENTIAL BUILDINGS FROM THE 19<sup>TH</sup> AND EARLY 20<sup>TH</sup> CENTURY IN URBAN AREAS IN GERMANY**

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**ABSTRACT**

As an adequate response to the new environmental conditions expected to arise due to climate change, our cities must be adapted to continue serving as pleasant and liveable spaces for its inhabitants and visitors. Large parts of our existing building stock remain unprepared/inadequate for the anticipated climatic changes. Adjustments are urgently needed. Within this paper a strategy has been elaborated about how retrofitting can significantly contribute to the climate change adaptation of our urban environments, as will be strongly required in the future. The focus of this study is directed to possible climate change related adaptations of multistorey residential buildings from the 19<sup>th</sup> and early 20<sup>th</sup> century in inner city areas of Germany. Building on the general principles of climate responsive and ecological architectural design and construction, it poses the following question: How can our existing buildings be transformed in order to explicitly reduce the impact of climate change on our built environments? Following an evaluation of the new climatic conditions influencing our buildings and looking into current knowledge of sustainable architecture and urban design and construction methods, this paper goes onto propose a set of guidelines for climate change adaptive retrofitting of 19<sup>th</sup> and 20<sup>th</sup> century multistorey residential buildings of inner-city areas of Germany. On one hand these optimization proposals are addressed to respond better to longer heat and dry periods in summer and to more extreme rainfall, snowfall and storms in the winter. On the other hand, these adjustments aim to build a criteria that serve to mitigate adverse effects of climate change, like an improvement of the buildings' energy performance and ecological efficiency. The results of this study demonstrate that the buildings focused on are well suited for retrofitting interventions, which would reduce the impact of climate change and which in parallel would constitute effective measures to strongly improve the buildings' ecological performance in general.



7<sup>th</sup> WMCAUS 2022

05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## **SPECIAL PROCEDURE FOR OPTIMIZING FISH PASSAGES, ON TÂRNAVA MICĂ RIVER AT BASEFLOW TRANSITION**

Cristian Bratanovici, Marie - Alice Ghitescu, Albert Titus Constantin, Gheorghe Lazar, Serban-Vlad Nicoara

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### **ABSTRACT**

This paper presents a special optimization procedure applied on the discrete numerical model of a fish passage. The hydraulic structure complex consists of a based on a technical structure triple bottom threshold and a rehabilitation project triple bottom threshold on the river Târnavă Mică, Bălăușeri area, Mureș County, Romania and the execution of a fish passage with shore protections, made of drywall, placed on a rock prism, as described in documents [2] and [3]. The current study presented in this paper is presenting an optimised approach of the fish passage design. The structure has been represented as a discrete numerical model developed with the HEC-RAS software package version 5.07. Compared to the numerical modelling described in the paper [3], changes were made to the two bottom thresholds (in the entrance area and the exit area of the fish passage) by introducing two additional rectangular control slots, and the nine additional rows of shaped stone and embedded in concrete (in [3], modelled with connection structures), are replaced by spatial elements (3D), possible to be introduced with the version HEC-RAS 6.0 of hydraulic modelling software [4]. A row of spatial elements (3D) module consists of two solid volumes, with a rectangular base (made of shaped stones) and spaced apart, embedded in concrete, with the centre of the local axis (Oy direction) on the longitudinal axis of the passage of fish. Discrete numerical simulation aims at the optimal choice of geometric dimensions for shaped stones to obtain a continuous longitudinal path, where the flow velocities are minimal when transiting the easement flow, respectively, estimating the parameters of transient (non-permanent) hydraulic simultaneity through this structure complex.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## COMPUTER MODELLING OF AN AQUATIC FAUNA COMPLEX CONCRETE PASSAGE AT A RIVER BARRAGE

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### ABSTRACT

The paper presents a 2D computer structure modelling and discharge simulation for an improved aquatic fauna passage consisting on a three compartments stepped concrete channel and considered as a side appurtenant for a small head dam on a river upper course. The water arrangement on the Livezeni–Bumbești mountainous sector of Jiu River [1,2], Hunedoara County, Romania, is mainly designated for hydro-power harnessing. The considered developed river area is situated between the East Jiu and West Jiu Rivers confluence (right south of Petroșani Town) and the confluence with left side Valea Sadului River tributary (towards the Town of Bumbești Jiu), stretching over about 31km in the Jiu Gorges. The further on presented numerical discrete modelling of the flowing phenomenon by the Livezeni Dam side fish ladder aimed to detail and enhance its initial general geometry for the structure elements, based on water velocity development as revealed over the entire 2D domain and with a closer look towards the path narrowing sections. The foreseen structure aims to reduce the barraging environmental impact by offering optimum flow conditions under given water discharging circumstances, meaning even for ensuring the minimum required sanitary/ecological river discharge as split by the main path through the gate dam and the side passage path. The hydraulic simulation looks to establish the side passage discharge development and in the same time to estimate the extreme values of water velocity, especially at narrowing sections. In case there is necessary, the numerical results would point to further geometrical optimisation by adjusting the existing structural details or by considering additional constructive elements in order to fulfil specific requirements (usually with respect to the maximum water velocities) as indicated by in-force regulations.

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05 -09 September, 2022 - Prague (Czech Republic)

World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE IMPACT STUDY OF PROPOSED RIVER WORK ON FLOOD RISK ALONG JIUL DE VEST RIVER REACH

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### ABSTRACT

The paper examines the influence of the proposed river works in order to reduce the flood risk along the West Jiul River. The proposed study objective is in the minor and major riverbed of the West Jiul River and its tributaries, including the Valea de Pești river, in the Valea de Pești reservoir site. The study reach is Balomir - Baleia, respectively section no. 3, the whole project being more complex and developed on 5 calculation sections. In order to reduce the flood risk of the localities within the Uricani ATU, Lupeni, from the West Jiu Valley, Hunedoara County by attenuating the flood waves in the reservoir and regulating the downstream flows, as well as ensuring the capacity of the riverbed to take over and transit the flood flows, works to stop the active erosions in the urban areas bordering the riverbed, to increase the transit capacity of the minor riverbed through local works of renaturation, clearing and arrangement of the riverbed. The way of ensuring the fundamental requirements according to HG846 / 2010 presupposes the accomplishment of the hydrotechnical works that aim to protect the towns and villages at the calculation flow with the probability of exceeding 0.5% for the urban areas with average development, 1% for the rural areas. Depending on the destructive phenomena that were previously registered on the West Jiul River, phenomena that affected the population and the constructions in the riparian localities, works are proposed for the arrangement of the minor riverbeds, for damming or for the elevation of the major riverbed. The analysis of floods along watercourses (flood wave propagation) can be described by a one-dimensional (1D) mathematical model and for the modelling of floods in open areas it is necessary to apply quasi 2D or 2D models. The hydraulic calculations on the West Jiul River, for the Balomir - Baleia study section, (a length of approx. 11 km), were performed with the HEC-RAS software, which reproduces the transit of flood flows in natural regime. and in an arranged regime, highlighting the hydraulic characteristics of the riverbed and the effects of the studied hydrotechnical works. The calculations were performed in both 1D and 2D models. Data from 110 cross-sections were analysed. Mathematical modelling was performed in one- and two-dimensional system for the two flow situations: the current situation and the arranged situation. Following the simulation of the mathematical flow models for the two situations: the current situation and the arranged situation, the results were obtained which highlighted the major decrease of the flood limits for the flows with the insurance of 0.5%. The results obtained were illustrated by cross-sections with the representation of the maximum level obtained, as well as by flood risk maps. Following the analysis of these, it could be concluded that the proposed works achieved the purpose for which they were designed for.

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## INFLUENCE OF JOINT ROTATIONAL STIFFNESS ON THE DESIGN OPTIMIZATION OF GRID SHELLS

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### ABSTRACT

Grid shell structures are spreading in the last two decades thanks to their capacity to cover large span with light solutions. The peculiarity of these structures is to combine aesthetic/functional characteristics with optimal structural performances, which are completely merged since their shape and structural elements are on sight. In this context, structural optimization techniques are more and more popular to support architects and structural designers for the design of competitive constructions, usually in terms of structural weight, stiffness, cost, and accounting for specific requirements. In case of grid-shells, the structural weight and performances are strongly related to their susceptibility to global buckling phenomena, which is mainly related to the global stiffness of the structures. The main aspects that affect the susceptibility to global buckling are rotational stiffness of joints, boundary conditions and presence of imperfections. In this framework, the paper presents design optimization strategies that aims to minimize the weight by taking into accounts the presence of semi-rigid joints, in order to find light solutions safe from global buckling phenomena. In particular, the proposed approach pursues the objective to minimize the weight of the structure by specifically taking into account different levels of rotational stiffness of the joints, and by respecting structural requirements. The approach has been applied to case studies characterized by different boundary conditions, also considering the presence of imperfections. The results of the proposed design strategy highlight the beneficial effect of considering joints with a finite value of rotational stiffness, also if small, in the susceptibility of the grid shell to global buckling phenomena and in the sensitivity to imperfections; further, the boundary conditions also influences the susceptibility of the grid shell to global buckling, in particular the lower the number of restrained sides, the higher the structural weight necessary to assure safety against buckling phenomena. All the conclusions will be supported by results in terms of weight, buckling factor, maximum level of utilization ratio, and maximum displacement of the joints.

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## WOOD USE FOR THE EXECUTION OF RESIDENTIAL CONSTRUCTIONS MADE OF MASONRY AND CAST IN SITUS CONCRETE: MULTIPLE CASE STUDIES OF PARANA-BRAZIL

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### ABSTRACT

The construction industry is the main responsible for the consumption of materials in the world, accounting for 38.6% of the 100.6 billion tons of resources consumed in 2019. Among the primary materials consumed is wood which can be used as the basis of industrialized construction systems or to support artisanal construction systems. In Brazil, most of wood products are consumed temporary and permanent works (roof trusses) in houses made of masonry and casted in situs reinforced concrete, which leads to the consumption of products with low added value. In this context, this research aims to analyse the flow of wood products used for transitional purposes in housing constructions in conventional masonry, identify negative environmental aspects that can be mitigated, and point out strategies for better use of this material resource. Therefore, the research is based on a material flow analysis of wooden products for temporary and permanent works of multiple case studies. These cases are construction sites of typical residential buildings (one-story dwelling, semi-detached dwelling, and townhouse) located in the State of Paraná-Brazil during 2021 and 2022. The results show that wood products are mainly (82.6%) used for temporary works (formworks and falseworks) and permanent works (roof structure) (17.4%). The wood products used for temporary works are rough sawn wood (53.1%), logs (45.0%) and wood panels (1.9%). While the log products are primary used temporary supporting systems are destined for reused in another sites, which can reach 6 times, sawn wood and temporary wood panels are usually discarded at the end of construction works. By the end of their lifetime most of the temporary wood materials are sent to recycling companies, using the biomass as fuel.

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7<sup>th</sup> WMCAUS 2022

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World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium

## THE PRESENCE OF CYANOBACTERIA IN WATER RESERVOIR IN SLOVAKIA AND OPTIONS FOR THEIR REMOVAL

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### ABSTRACT

Health concerns regarding the presence of cyanobacteria cells and related metabolites (cyanotoxins, sapor and odorous substances) in water resources have raised in the last decade. The number of cyanobacteria in water resources is higher than 10000 cells/ml in some of the cases. At the same time, exceeding the value of 20,000 cells/ml of water is a reason for monitoring the quality of drinking water and the value of Microcystin LR in drinking water. The intensive physical and chemical treatment is needed, e.g. coagulation, flocculation, sedimentation, filtration, adsorption (activated carbon), disinfection (ozone, chlorination), eventually the combination of mechanical, physio-chemical and biological treatment methods with the disinfection. Removal of cyanobacteria require the further options to be seek to improve the treatment technology efficiency of drinking water. Ultrafiltration (without coagulation) was investigated within the pilot-plant tests at the WTP Turček during the treatment of surface water originating from water reservoir Turček. Water treatment was focused on cyanobacteria turbidity, color and humic substances (expressed by the COD - chemical oxygen demand parameter) removal from water. Fully automated ultrafiltration equipment with the membrane modul UA-640 (Microdyn-Nadir) was used. The ultrafiltration unit treated the water for 3-4 hours, filtration took place for 30 minutes, then washing with treated water followed for 15 seconds and the entire filtration cycle was repeated several times. On the base of filtration cycles, the effectiveness of membraned technology was evaluated. By the application of membrane technology used, the required quality of treated water has been achieved. The results show 100% cyanobacteria removal efficiency, 38.8% COD<sub>Mn</sub> reduction efficiency, 78.6% turbidity removal efficiency, water colour was reduced by 80.8%. The turbidity value in the treated water ranged from 0.32 to 0.42 NTU. Ultrafiltration membrane processes generally remove viruses and bacteria with an efficiency of 99.99%, There are no published data on the removal of filamentous cyanobacteria in the literature. Based on the results achieved, it clearly follows that this method of treatment is suitable for this type of water and achieving the stricter limits specified in the new Directive of the European Parliament and the Council (EU) 2020/2184 for drinking water.

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## DIFFERENT DISPLAY PATTERNS OF COMMERCIAL SPACE IN CRUISES BASED ON THE SPACE NARRATIVE APPROACH

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### ABSTRACT

Commercial space in cruises as the main place for tourists to consume can directly influence the tourism and consuming experiences. We need to consider how to improve the commercial space in cruises effectively, and how to meet the living needs of tourists. This study selects the Apple Store at Celebrity Summit in new regionalism style, Clothing Store at Disney Fantasy in eclecticism style, and Lego Store at AIDA Prima in modernism style as cases that utilize space syntax and the theory of space narrative to analyse the design elements, spatial configuration and relevant functions and activities of their commercial space. For their various features of spatial design, the study proposes relevant advice, which lay the foundation for the improvement of the spatial quality of commercial space at cruises in the future.

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## INTERACTIVE DESIGN FOR CRUISE PUBLIC SPACES FROM THE PERSPECTIVE OF NARRATIVE IN VIRTUAL SCENE

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### ABSTRACT

Cruising motivation is impacted by tourist experiences, and cruise companies exert considerable effort in constructing cruise travel experiences that could meet and ideally exceed passenger expectations. The public space of the cruise ship centered on the atrium is a nodal public space for cruise leisure experience and the climax of emotional experience. Spatial narrative design refers to triggering the empathy and continuous emotional experience of users, and it plays a significant role in the interior decoration design of cruise ships to strengthen the interest and appeal of the experience of space. With the development of interactive design technology, the spatial narrative is redesigned to support the exchange of information and stories that are transformed and transplanted into virtual and real environments. However, the existing research on interactive design mainly focuses on interactive multimedia technology and forms of expression, and there are few studies on the interaction between users and design solutions. Simultaneously, the existing research mainly expounds on the application of interactive technology in enhancing the narrative effect, but few studies explore the linkage relationship between interactive technology and spatial narrative theory. Therefore, this research takes the cruise's public space as the research object, deconstructs the narrative strategies and elements of the cruise ship public space interior design based on space narrative theory, and constructs a cruise's public space interactive design system based on Unreal Engine5 to collect users' design preferences. Furthermore, this research analyzes the linkage relationship between interactive design technology and narrative art of cruise public space design and further explores the interactive design mechanism of the cruise's public space under the narrative perspective. The results reveal that first, for space narrative design, the interior design of the cruise's public space constructs the narrative theme through the narrative elements of typical narrative images, symbolic styles, shapes, and colors. And the cruise's public space takes the atrium as the center and constructs the narrative grammar and unique spatial experience through the narrative sequence of beginning - development - climax - ending. Second, the interactive design system for cruise's public space is divided into three layers: bottom engine, data layer, and application layer. The underlying engine supports the construction of the cruise ship public space interaction design system through UE5's own character. The data layer contains imported 3D model data of the cruise's public space, material library, furniture library, and lighting special effect library. The application layer contains two parts: Virtual Roaming and Interactive Design. Third, the linkage relationship between the interactive design system and spatial narrative theory for cruise's public space could be concluded as follows: as a virtual space carrier of spatial narrative, the interactive design system can simulate the process of narrative practice through users' experience and interaction in virtual space. Simultaneously, users choose materials, furniture, and lighting effects in the interactive system and then feed back user preferences to designers in real-time to bridge the gap between designers' narrative design and users' narrative practice.

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**ESTIMATION OF THE RESISTANCE OF CONCRETE MIXTURES AFTER 28 DAYS, ACCORDING TO TEMPERATURE HISTOGRAMS AND TESTS AT EARLY AGES, CASE STUDY OF HYDRAULIC CEMENTS COMMERCIALIZED IN THE EQUATORIAL AUSTRO**

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**ABSTRACT**

One of the most important characteristics of concrete is its compressive strength ( $f'c$ ), it has been proven that mixtures made with the same aggregates, w/c ratio and different cementing material, provide different results, finding variations of 3% , 11% and 25% between the effort at 28, 56 and 84 days of one mixture and the other. Worldwide, it is known that there are several methods and ways to calculate the  $f'c$  of a dosage, currently in Ecuador, the efficiency can be known with the compression test of witnesses, which are developed at the age of 28 days. Several countries have adjusted the Maturity Method within their standards as a source of information to know the resistance of a mixture, this method is based on the use of temperature histograms to calculate the maturity index (accumulation of temperature) and its relationship with the resistance reached at a given age, with controlled curing, allowing actions to be taken to improve performance or execution times, such as stripping; reflecting savings based on the magnitude of the work. The objective of this research is to develop concrete strength models at 28 days based on temperature histograms and short-age tests, through experimental research in cylindrical specimens, made with two locally used GU-type cements and previously established aggregates. in the study area, dosing a mixture for a resistance of  $f'c = 240\text{Kg/cm}^2$ , to estimate their resistance in less time. The method presents thus a mathematical model, which exhibits two constants "A" and "B" that, together with the logarithm of the maturity index, allows obtaining resistance approximations of up to 7% at 28 days, about destructive testing in the press. The mathematical model and its constants vary depending on the type of cementitious material. In this study, an analysis is carried out with hydraulic cement Type GU.

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## **PASSIVE BIOCLIMATIC STRATEGY: USE OF SOIL AND GRAVEL AS HIGH DENSITY AND SPECIFIC HEAT ROOFING MATERIALS**

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### **ABSTRACT**

The maximum use of the conditions and resources provided by the environment within the construction processes, together with the reduction of dependence on facilities, in order to achieve a maximum level of comfort in buildings, is a fundamental task in architecture. The correct choice of materials, the proper use of proportions, the use of climatic conditions, lighting, insulation, among others; which are called passive bioclimatic strategies, are used effectively to achieve this. In this context, the study considers the analysis of four typologies of construction systems used in flat roofs: conventional roof system; inverted roof with gravel protection; roof with semi-humid earth covering and green roof with vegetal covering; as alternatives of passive bioclimatic strategies, which allow improving comfort conditions in buildings located in a context of temperate - moderate rainy climate, in Ricaurte, province of Azuay - Ecuador. It is proposed the elaboration of four scale models, one per planned system. In each specimen, the analysis of the thermal conductivity of high-density materials and specific heat will be carried out, based on the measurement of the temperature, both in the roof area, as well as in the interior of each model. The data capture spaces will be carried out under conditions of exposure to the sun and shade, during specific times of the day. The research, supported by bibliographic sources and the compilation of information obtained from the measurements, will seek to agree on the most appropriate levels of temperature utilization, using traditionally adopted bioclimatic materials and with a reduced level of impact on the environment. The results obtained will allow establishing a comparative analysis of each of the cases, to verify the degree of incidence of the materials and their application in roofs, thus determining the most suitable system, which can be used as a passive strategy of bioclimatic design, in the task of achieving the best comfort conditions, reducing to the maximum the sudden changes of temperature, both in the exterior space and in the interior area protected by each type of roof.

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## **PASSIVE THERMAL SYSTEM FOR CAPTURING SOLAR ENERGY IN A HOUSE: TROMBE WALL**

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### **ABSTRACT**

Currently, the effects derived from global warming, force to use more frequently, passive solar systems to capture and accumulate the heat from solar energy, thus avoiding the use of electromechanical devices. On the other hand, it is necessary to guarantee the thermal comfort of living spaces, by saving energy, especially in those places with cold weather. Faced with this reality, in recent years, interest in these systems has grown, among which is the Trombe wall, patented by Edward Morse in 1981. Therefore, the objective of this work is to demonstrate the validity of the use of the Trombe wall, through its application in a house located in a cold climate area, to achieve the highest level of thermal comfort with minimum energy consumption. To do this, exploratory, documentary, field and experimental research is used, since it is based on digital and printed sources, on the collection of climatic data of the chosen site and on experimentation through a scale housing model with trombe wall, to which controlled heat sources were applied, whose results were verified through thermal cameras. As a result of the work carried out, it was possible to demonstrate that, through the use of the Trombre wall, the heat of the sun is received, stored and transmitted to the interior space of the house studied, increasing the temperature from 18.7° to 22° Celsius, thus guaranteeing the comfort of the users. Finally, it is concluded that the Trombe wall does constitute a passive design alternative that allows, through its implementation in bioclimatic housing projects, located in cold climates, to raise the levels of thermal comfort, both in winter and summer, with low energy consumption.

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## EVALUATION OF RADIANT HEATING FLOORS WITH THE USE OF RENEWABLE ENERGIES FOR THE AIR CLIMATE CONTROL OF HOUSES IN THE CAÑAR PROVINCE

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### ABSTRACT

The energy efficiency of buildings is based on the reduction of high energy demands, especially in the face of weather variations that require the supply of climate control, contributing to the excessive use of energy. To achieve energy savings, strategies are devised with criteria of almost zero energy buildings, passive or based on sustainable evaluations, where the current regulations or assessment criteria propose better solutions in terms of sustainability in buildings. In context with the above, the energy flexibility of single-family houses is proposed with the adaptation of heating floors as a methodological contribution in the construction area, through renewable energies, in order to optimize energy consumption, reduce carbon emissions, improve comfort and thermal wellbeing. The research shows the characteristics of a system for the placement of climate control heating floors through performance tests, which relate energy savings with the efficiency of the system to mitigate the high energy consumption. These simulations define the behavior of a house in different conditions through the use of BIM technology to represent the best energy efficiency; this, through a relational experimental research, where data were obtained from the energy savings based on the efficiency of the radiant floor system, to identify the optimal system for the placement of climate control heating floors in single-family houses, depending on the areas delimited in the architectural spaces and the materiality of the modeled system, of three specific points of the province of Cañar-Ecuador. With the MIDUVI social housing typology as the basis for the modeling, the spaces maintain their distribution and 7 circuits of the simulated radiant floor systems are formed. Among the parameters that characterize these systems as they produce greater variation in the reduction of resources or energy demand are the layout, the separation and therefore the length of the pipes. These systems are adapted to the use of a reversible heat pump, air - water, whose higher power according to the heating or cooling conditions will be generated by photovoltaic modules located on the roof of the house.

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## CRANE SKEWING ANALYSIS ACCORDING TO STANDARDS AND ACCORDING TO A DYNAMIC MODEL

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### ABSTRACT

Bridge crane skewing analysis is needed for proper bridge crane design. Hannover dealt with the skewing of the bridge crane on a theoretical and experimental level. The results of his work are now included in the design standards for the design of bridge cranes and crane runway. The Hanover skewing analysis assumes two basic assumptions, and that is the uniform constant speed of the crane and the perfect rigidity of the crane structure. The author of this article created a dynamic model of a bridge crane, which solves the movement of a bridge crane in general as a dynamic task. It includes, among other things, considering the bridge crane as a flexible system and considering the uneven movement of the crane. This article deals with the comparison of both models for a specific selected crane.



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## CONSTRUCTION-TECHNICAL SURVEY CHAPEL IN DOLNÍ NIVY

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### ABSTRACT

The aim of the paper is to inform about the construction and technical survey of the oldest building in the village of Horní Nivy. It is a chapel that has undergone unprofessional construction modifications in the past. These modifications damaged the building in terms of history but also in terms of construction. The chapel shows cracks in the masonry and humidity maps. Construction engineering research shows that all failures are caused by the problem of increased humidity, both ground and surface. The paper also includes an evaluation of the non-destructive and destructive tests performed, as well as a proposal for the rehabilitation and reconstruction of this historically significant building.

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## **WEATHER IMPACTS ON ADDITIONAL ROOFING UNDERLAYS FOR SLOPING ROOFS**

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### **ABSTRACT**

The article focuses on the aging and degradation of polymer foil sheets by analyzing weather impacts on light polymer foil used for additional roofing underlays in sloping roofs. The author relies on tests for specific material properties exposed to various weather conditions. Inspecting effects of different types of weather, he concludes that solar radiation is the most impactful factor on the overall state and degree of material degradation.



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## THERMAL BRIDGES AS A PLACE OF ECONOMIC DAMAGE

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### ABSTRACT

Any errors in the thermal insulation of buildings cause serious energy leaks and can therefore cause great economic damage. In the Czech Republic, attention is paid to thermal bridges from an energy point of view, but the economic point of view is neglected. In this work, we focus on the economic impact of errors in the implementation or project preparation causing thermal bridges and compare the various types of solutions from an economic point of view.

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## USING THERMOGRAPHY FOR DETECTING MOULD GROWTH

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### ABSTRACT

The paper deals with the issue of mould formation in a prefabricated panel building. It is a panel building from the mid-20<sup>th</sup> century with the External Thermal Insulation composite system ETICS applied. To identify the cause of mould formation, diagnostics of the flat was performed with the aim to determine the composition of the envelope. The diagnostics was performed using a cut probe and thermographic testing. Extensive thermal bridges were detected using an IR camera. The identified cause of mould formation was insufficient insulation of the object and improper use of the apartment on the side of the tenants.

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## PERCEPTIONS OF THE SENIOR POPULATION ON MOBILITY AND WALKABILITY IN SMALL-SCALE CITIES

Michal Kraus, Ales Kankovsky, Petra Machova

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### ABSTRACT

Today, cities are exposed to many challenges and are looking for new efficient solutions that will make existing infrastructure lighter, improve public space and promote sustainable modes of transport. The task of contemporary urban planning and municipal engineering is to provide transport infrastructure to citizens that will save time while being pleasant, comfortable, and environmentally friendly. A significant part of urban sustainability and viability lies in reducing the need for transport and creating quality networks of walking routes, cycling routes, and support for public transport. The main goal of the survey is to identify and describe mobility behavior and needs and the associated views and attitudes of the senior population in Small-Scale Cities. Subsequently, detect opportunities for improvement in urban transport. The paper presents the results of a case study of the perception of urbanized public space from the perspective of mobility and transport in the small town of Chotebor in the Czech Republic.

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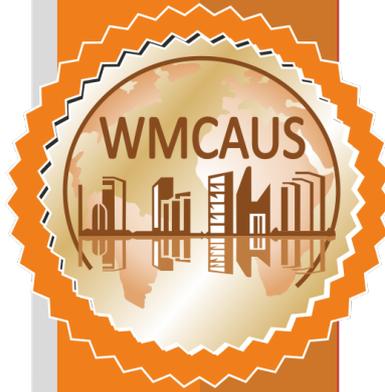
## **ANALYSIS OF INVESTIGATION OF THE LOAD OF PEDESTRIAN ROADS IN CHOTĚBOŘ**

Zuzana Kramářová

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### **ABSTRACT**

In 2019, the TL0200559 project entitled "Safe Cities for Pedestrians and Seniors" was launched. Part of the solution of this project was also a survey and analysis of the use of pedestrian roads in selected cities. The town of Chotěboř was chosen for pilot processing. In the first half of 2019, a questionnaire was compiled for the questionnaire survey. At the same time, a local survey was conducted. In October and early November, data were collected by a questionnaire survey. In the following five months, the digitization of paper forms of the questionnaires took place. Their evaluation was interrupted by ongoing quarantine measures due to SARS-CoV-2 (Covid-19). In 2021, quarantine measures (especially the return of children and students to full-time school attendance) were relaxed to the extent that it was possible to return to the standard scientific research work and analyze and verify the obtained data by re-conducting local surveys. The procedure for compiling the questionnaire for this survey, the course of the actual data collection, and the results of this pilot survey are presented in this paper.



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