



4th INTERNATIONAL BALKANS CONFERENCE ON CHALLENGES OF CIVIL ENGINEERING

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ABSTRACT BOOK

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Assist. Prof. Dr. Erion Luga

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PREFACE

In this volume are included the abstracts of contributed papers presented at the **International Balkans Conference on Challenges of Civil Engineering**, by new academicians, researchers and professor invited as keynote speakers.

4th International Balkans Conference on Challenges of Civil Engineering (BCCCE) is hosted by the Department of Civil Engineering of Epoka University in Tirana, Albania during December 18-19, 2020. This conference was jointly organized by Departments of Civil Engineering of EPOKA University, Institute of Geosciences of Albania, University of Perugia, Polytechnic University of Bari, University of Novi Sad, Ss Cyril and Methodius University, "Gheorghe Asachi" Technical University of Iasi, University of Prishtina,

The conference aimed to provide a platform for civil engineers' technology, management research and education status all over the world. The conference proposed to offer a motivating environment to encourage discussion and exchange of ideas leading to endorsement of Structural and Earthquake Engineering, Construction Management and Technology, Construction Materials, Geotechnical Engineering, Transportation Engineering, Historical and Monumental Buildings, Disaster Risk Management, Impact of Climate Change on Built Environment, Sustainable and Life Cycle Assessment and Innovative Practices in Construction Industry.

The papers were accepted for presentation in the Conference were selected after a peer reviewing process performed by the international Scientific Committee. During the conference, the papers were presented and discussed in four sessions.

We would like to acknowledge and give special appreciation to our keynote speakers, *Prof. Dr. Jorge de Brito*, *Prof. Dr. Arturo Shultz*, and *Assoc. Prof. Dr. Marco Corradi*, for their valuable contribution,

We would like to extend our appreciation to the International Scientific Committee and Local Organizing Committee for the devotion of their precious time, advice, and hard work to prepare for this Conference. *Julinda Keçi* and *Enea Mustafaraj* must be particularly mentioned for their hard work.

On behalf of the organizing committee of the 4th International Conference on Challenges of Civil Engineering (4th BCCCE), we thank all the authors and participants for their contribution in the realization of a successful conference even though in an extraordinary situation created by COVID-19.

Assist. Prof. Dr. Erion Luga
Conference Chair

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Building Pathology: A Systemic Approach

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INTRODUCTION

The study of building pathology focuses on the operation and maintenance stage of a building's life cycle, during which buildings need to be followed periodically. Technical inspections allow estimating different types of degradation through observation. They also allow assessing the performance of the building elements and, thus, of the building. Well-informed decisions on maintenance planning, sudden repairs, local replacements, or overall rehabilitation should only be made considering the data collected in technical building inspections.

Building inspection systems are an important tool as they provide objective information. Inspections should be performed regularly, at predetermined intervals, collecting predefined types of data. A building inspection system should include location information about the degradation phenomena concerning: the building and its surroundings; the building element within the building; the detected defects and their causes within a building element. Furthermore, building inspection systems provide unambiguous designations for all concepts involved in technical inspections, such as defects, causes, diagnosis methods and repair techniques. Building inspection systems may also determine the use of *in situ* or laboratory tests to obtain qualitative or quantitative information, whether on the first inspection or a more detailed one. Information like the area of deteriorated zones, the width of cracks, the temperature of the building element and its moisture content may help to characterize the defects and confirm their causes. Finally, a building inspection system should classify levels of degradation according to a predetermined quantification system. Those levels will influence the determination of the urgency of repair. To sum up, building inspection systems aim at an independent inspection, keeping subjectivity to the minimum.

COMPONENTS OF THE INSPECTION SYSTEM

The authors' research team at Instituto Superior Técnico, University of Lisbon, has defined the structure of an inspection system, presented in Figure 1. Considering the non-structural building envelope of buildings (façades and roofs), two classification lists are highlighted [1]: defects and their causes. The classification list of defects is organized in four categories: defects of physical nature; defects of chemical nature; defects of mechanical nature; and other defects. In total, 38 types of defects are included in the list. The classification list of causes of defects is arranged in five categories: design errors; execution errors; mechanical actions; environmental actions; and use and maintenance errors. The list includes a total of 108 causes of defects. According to the structure of the inspection system (Figure 1), the relationships between the items in these lists are represented in a defects–probable causes correlation matrix [2].

BUILDING DEFECTS

To ease the identification of defects, the use of photographic examples of the listed defects is encouraged [3].

Figure shows three different types of defects from the classification list of defects.

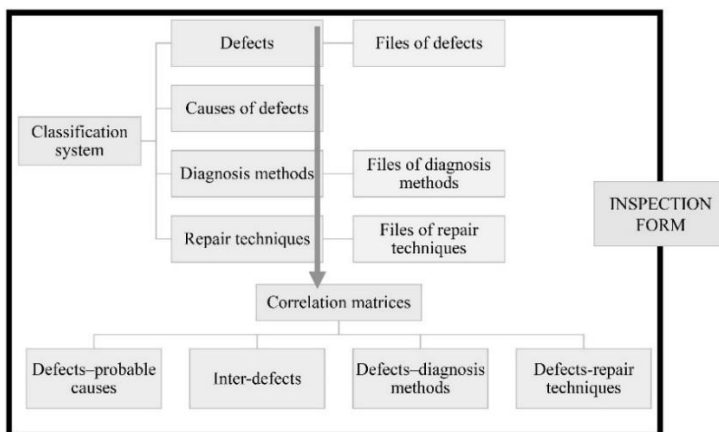


Figure 1. Organogram of the building inspection system developed at Instituto Superior Técnico, University of Lisbon



Figure 2. Examples of three types of defects [1]: a) “A-B1 Biodeterioration/biological growth”; b) “A-B2 Vegetation growth”; c) “A-B3 Efflorescence/cryptoflorescence and carbonation”

FINAL REMARKS

Nevertheless, although having a catalogue of defects may speed up the inspection process, a full diagnosis comprises more steps. After identifying the type of observed defect, its causes should also be determined. The surveyor should also analyze the need for carrying out additional diagnosis methods. Then, according to the findings, the surveyor should be able to recommend a course of action, namely: adjusting the maintenance plan with periodic maintenance works or performing curative or preventive repairs.

Finally, full data should be provided for decision-makers in view of more enlightened decisions.

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Earthquake-resistant cities in Albania: The Seismic Microzonation Studies (SMS) and Limit Condition in Emergency (LCE) integrated approach

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Abstract

In this work, it is intended to highlight the indispensable significance of the seismic micro-zonation studies (SMS) and the Limit Condition in Emergency (LCE) at the level of primary decision-making at urban planning studies and to help resolving a range of problems connected to seismic risk assessment in Albania.

Following the 1979 Montenegro seismic sequence, the Albanian government implemented a 'National Plan for Seismic Prevention', which funded the SMS of some of the biggest cities in Albania. Unfortunately, the seismic risk prevention activities were halted after the renewal of the national codes for design in 1989.

Located next to the most active fault in Albania, the main cities of the country have experienced seventeen (17) seismic events with magnitude from 5.4 to 6.6 in the last 114 years. The last earthquakes that hit Albania on September 21st, 2019 of Mw 5.4 and November 26th, 2019 of Mw 6.2 severely damaged the cities of Durrës, Thumanë, Tirana, Vora, Shijak and the villages around. The main event of the 26th November caused the deaths of 51 persons and the damaging of hundreds of buildings. The degree of damages produced by these earthquakes has been, in some cases, significantly enhanced by the characteristics of the earthquake ground motion affected by the local subsurface soil structure of the cities.

The seismic events of 2019 evidenced the crucial importance of the earthquake risk reduction and mitigation. In the process of creating earthquake-resistant cities, the SMS and the LCE could be the best tools for a better seismic hazard mitigation and prevention in Albania.

Keywords: *seismic microzonation studies, Limit Condition in Emergency, Durrës earthquakes, seismic mitigation, seismic prevention*

Cementitious Grout Method Application on Tunnel Rockbolts and its Effect on Bond and Load Carrying Capacity. A Real-Scale Pull Out Test on Fan River HPP Power Tunnels

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Abstract

This paper presents the investigation of 144 in situ rock bolt pull-out tests conducted during the construction of Fan River hydropower plant's power tunnels. The pull-out tests are performed on 22 and 25mm diameter; 3, 4 and 6m usually full grouted rock bolts installed in different parts of the tunnel with different angles to gravitational direction. The pull-out tests were performed to analyze the bond and load carry capacity of rock bolts based on their installation angle and grouting efficiency. To optimize the rock bolt performance, two different grouting methods have been used.

The results indicate that rock bolts' bond strength declines as the installation angle goes closer to the gravitational direction and majority of the failure cases are due to grouting problems.

Keywords: *Cement grouted rock bolts, pull out test, bond, and load-carrying capacity.*

Experimental Study of Hysteretic Damper for Energy Dissipation Capacity

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Abstract

This paper summarizes the experimental campaign carried out for the development of a new steel energy dissipative devices named Slit Dampers (SDs) designed for earthquake protection of structures. SDs consist in shear steel plates with appropriately shaped cut-out portions of material for allowing maximum spread of plastic deformation along the device and then maximizing the hysteretic dissipative behavior.

A total of eighty-two steel shear plates with different openings and thicknesses are tested to investigate their behavior under cyclic pseudo-static loading. Six types of steel shear plates are studied, including the SD with narrow slits that divide the plate into rectangular links, and the butterfly fuse with a diamond-shaped opening that create butterfly shape links in the plate. Other varying test parameters are loading rate, material strength, and the number of in-parallel damper elements.

It is expected that the proposed model can be successfully used to predict the behavior of dampers in real-world applications.

Evaluation of Seismic Pounding between two Adjacent Reinforced Concrete Buildings from Albanian Practice

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Abstract

Seismic pounding is the colliding action between two adjacent structures that occurs during earthquake vibrations. Due to insufficient separation gap between buildings that own different dynamic characteristics, structural damages to both structural and non-structural elements are magnified during the impact of buildings. Since a country like Albania is considered to have moderate-size seismicity, it is important to provide and check the necessary separation distance to avoid the impact between structures. A parametrical approach is followed up in this study to evaluate the sufficient seismic gap in the middle of two existent Reinforced Concrete (RC) structures. Ten pairs of structural models are analyzed in Sap2000 by using the Equivalent Static Force Method (ESFM). The change of structural parameters such as concrete grade, seismic zone factor and storey height are inspected to study the influence they have in the separation gap between the structures.

At the end, a comparison with a similar study is done and conclusions, as well as recommendations for further studies are generalized.

The alternative stormwater system versus the traditional piped stormwater system

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Abstract

The urbanization process is an issue concerning many branches of urban planners and civil engineering, not only to ensure proper spaces and environment or living places, but moreover to offer a comfortable manner of life, serving to the people by all the types of services needed. Stormwater drainage system is a type of service not directly connected to people daily living activities, such as drinking water, electricity, etc., but directly to their properties and indirectly to their outside activities, such as work, leisure time, etc. Despite of the urbanization process, which is going to be increased in many big cities, the intensity of the rainfall is also going to be increased more and more due to climatic changes.

Nowadays, we are facing more rare rainfalls, but with more and more severity and higher intensity (the less frequent intensities forecasted before are happening more frequently). Then, which of this phenomenon is the most likely to impact on highest levels/volumes of surface runoff, in order to take the proper measures?

In this article, to express better the up-mentioned impact, it is developed a hydraulic model of a city wastewater combined system. The model has been developed based on the city urban plan and in the registered rainfall intensities for this city. During the model construction, there are performed preparatory work in to fronts. The first work has been based on the division of the urban area into storm water catchments, to be also in conformity with the pipelines trace and connection, from the upper and farthest point of each part of the system inside the catchment, to the discharge point into the river. Another issue is the exact value of the runoff coefficient in the respective areas. The runoff coefficient is function of the surface type, the impervious vs. pervious surfaces inside a catchment, the slope of the surface where runoff is created, etc. The next goal of the preparatory work for the

model is to define the IDF curves, for different rainfall intensities' return periods and durations. Upon hydraulic model development, different scenarios are created. The scenarios have taken into the consideration the change of the urban area and its development, vs the same rainfall intensities and the change of rainfall intensities vs the stable and not dynamic urban process.

Keywords: *SUDS, attenuation measures, stormwater system, hydraulic modelling*

Inundation Modeling Using HEC-RAS Software Farka Stream Case Study

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Abstract

This study analysis how water flow corresponding to maximum discharge of $Q=240\text{m}^3/\text{s}$ is distributed along Farka stream. To visualize flow dispersion, two modeling approaches 1-dimensional and 2-dimensional HEC-RAS models are implemented and unsteady flow analysis is simulated. HEC-RAS models and hydraulic analysis are used to analyze water depth planimetry and flow hydrograph of each stream segment. The objective is to develop 1-dimensional and 2-dimensional models, representing possible stream rehabilitation scenario and performing unsteady flow analysis in order to make a comparison of results.

In this study, it is concluded that flow distribution along stream was not the same for 1 and 2-dimensional models. These two modeling approaches, under the same conditions, produces different results and only engineering experience together with project aim can decide which one of them to use while performing flood modeling.

Keywords: *rehabilitation, unsteady flow, hydraulic analysis, flow hydrograph, simulation*

Impact of neotectonic processes of Shkumbin valley, "Xibrake-Librazhd area" on existing and future civil engineering works

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Abstract

The rock type contacts on both sides of Shkumbin river valley indicate that the neotectonic movements from west to east are not uniform. This has been verified through continuous field investigations in both sides of the Shkumbin valley (Xibrake-Librazhd area).

This paper aims to show the results of these field investigations followed by geological and geotechnical assessments on the impact of these neotectonic processes on the civil engineering works.

Based on this verified neotectonic movement as well as the results of the analysis of this study, recommendations will be given that should be taken into account in the maintenance of existing works as well as the construction of future works of national interest (roads, tunnels, residential centers, etc.).

Keywords: *geological investigations, petrographic contact, tectonic movement*

Effect of errors on execution and design of key details in the object

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Abstract

Key details must be given major attention in design and execution of a building. Errors which may lead to increase of damage in case of an earthquake and additional loads, can be of different nature, especially those related to beam-column joints. There should be strict attention to details execution by the supervision engineer and contractor. The contractor and the supervisor should correct the design errors, if such exist. The execution in an improper way can have major consequences. The local ductility on the cross-section of vertical elements and their importance is vital for the building. The severity and extent of such damage shall be illustrated with some examples from a recent earthquake in Albania, as the lead author was invited by the state institutions of Albania to assess the degree of damage to school buildings.

The paper shall discuss observed damage, possible causes in relation to design errors, as well as some solutions that may be employed for the renovation of damaged buildings.

Keywords: Concrete, earthquake, building, design, errors, responsibility

LAND4FLOOD Network as an opportunity to bring together diverse Stakeholders in Fighting Flooding beyond Engineered Solutions

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Abstract

The aim of this presentation is to contribute to the collective awareness about the importance of nature-based solutions (NBS) for combating emerging societal challenges. NBS are seen as an adequate alternative to engineered approaches (which are based on grey infrastructure like dikes, dams, etc) that society has developed to deal with consequences of different natural hazards. For instance, in case of urban flooding, the Natural Water Retention Measures (NWRM) are successful measurements to mitigate flood risks while complementing the existing grey infrastructure. While, NWRM methods regulates the water run-off, they provide other ecosystem services contributing to the well-being of the people of the place. Yet, its implementation needs allocation of vast lands, which generally are private properties. This implicates other issues related to economics, property rights, public participation, and public subsidies.

The new approach based on NBS concept is becoming an attractive realm for professionals and beyond. COST Action CA16209- "Natural Flood Retention on Private Land" is a recent and among the most inclusive international networks that brings together people from different disciplines and backgrounds. According to the official information of the project, LAND4FLOOD aims to address the abovementioned issues and to establish a common knowledge and build communication channels among diverse stakeholders in field. The synergy that is emerging within the activities of the network has the potential to motivate tangible contributions at national level, especially in developing countries, where the awareness about NBS is the weakest.

Keywords: *Land4FLOOD, nature-based solutions, urban flooding, transdisciplinary interventions, CA16209*

Computational Fluid Dynamics Modeling of Submerged Vegetation in Open-Channels

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Abstract

This study examines how the submerged vegetation affects the hydraulic properties of the open-channel flow.

To predict the impacts of vegetation presence, a Computational Fluid-Dynamic (CFD) model has been developed. ANSYS CFX 18.2 is used to analyze vertical velocity distribution and other flow characteristics as resistance to varying densities, length and positioning of solid cylindrical rods representing vegetation.

The main objective is to create a CFD approach to identify, determine and measure the parameters that contribute to additional resistance due to vegetation. The aim is to better understand hydraulics in stream flow with vegetation systems and to suggest a design tool for evaluating the potential effect of vegetation on stream water management and ecology in Albania. In this study, it is found that the model for the three considered cases gave different results for each of the evaluated parameters, so a correlation exists between the development of the flow hydraulic properties and the vegetation configurations. Also, the obtained results showed that vegetation has a great influence on the characteristics of the flow.

Keywords: *CFD, flow resistance, open-channel, submerged vegetation, simulation*

Supplementary cementitious materials and mechanochemistry for sustainable concrete production

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Abstract

Excavation and removal of instable clayey soils before construction works, e.g. in infrastructure, residential or commercial buildings etc., can generate vast amounts of waste clay deposits. Treatment of those clays to achieve suitable supplementary cementitious materials (SCMs) for use in concrete production can extensively contribute to a circular economy. Mechanical activation (MC) by ball milling has shown suitability to be an alternative and sustainable method to process clays and to obtain dehydroxylation at reduced temperatures and without the addition of chemicals. Furthermore, BM can induce amorphization, increased chemical reactivity and improved pozzolanic properties. Amorphization of crystalline phases can be achieved also for poorly reactive materials as air-cooled blast furnace slags (ACBFS), which can be further utilized as a precursor in sodium silicate alkali activated systems.

This study shows how mechanical activation is promoting the reactivity of clay and ACBFS, and their potential to be used as replacement of cement in concrete production. Evaluation of the pozzolanic activity before and after treatment was performed for the treated clay, suggesting increased pozzolanic properties. While alkali activated systems based in mechanically treated ACBFS reached, after 28 days, comparable compressive strength values with the commonly used ground granulated blast furnace slag (GGBFS)

Keywords: *sustainability, SCM, mechanical activation, clay, air-cooled slag.*

Study of Microstructure of Waste Tyre Ash (WTA) Concrete Using the Scanning Electron Microscopy (SEM) and X – ray Diffraction (XRD) Techniques

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Abstract

This paper reports the findings of an investigation into the microstructure of WTA – Concrete. The WTA was obtained by open burning of waste tire slices to a temperature of about 500°C for about five (5) hours at the local open burning sites in Kano. And after allowing to cool, it was sieved through 75 µm BS Sieve and characterized. The ash was subjected to chemical composition analysis using the X-Ray fluorescence (XRF) analytical method using the X –Ray spectrometer machine.

The investigation was carried out on a concrete of 29 N/mm² compressive strength, Water – cement ratio (w/c) of 0.65 and slump range of 10 – 50mm. The microstructure assessment was conducted on the concrete at WTA replacement levels of 0, 5, 10, 15, 20, 25, and 30% of cement weight, respectively to determine the influence of WTA on the microstructure of WTA – Concrete using SEM and XRD techniques.

Both SEM analysis and XRD results of WTA – concrete indicated the occurrence of pozzolanic reaction between WTA and cement and that the WTA has more porous micro-structure than OPC concrete especially at higher WTA concrete.

Experimental study of FRP reinforced concrete beams according to ACI

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Abstract

This paper presents the experimental analysis of the static behavior of twelve simply supported beams reinforced with FRP (Fiber Reinforced Polymers) bars. The design procedures, cracks and deflection parameters were calculated according to American (ACI 440.1R-06) guidelines.

All beams were reinforced with CFRP and GFRP bars with different diameters. The bars came from different manufactures. A total of twelve beams dimensions was 2200 mm x 130 mm x 220 mm and were tested up to failure under four-point bending. The main parameters, deflections and cracks were recorded. The results were used to evaluate SLS stage of RC with FRP bars.

Keywords: GFRP, CFRP, Cracks, Deflections, Beams

An advanced Method of Shear Transmission from Slam to Steel Beam of the Composite Beam Subjected to Combined Negative Bending and High Axial Tension

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Abstract

The performance of the steel-concrete composite beam reduces in the negative bending region due to the formation of the cracks. The high axial tension applied in the steel section leads excessive slip between components and trends to form cracks at early stage, which brings the importance in advance methods in the structural components of the composite beam. These cracks can be controlled by resisting tensile forces and avoiding longitudinal slipping. The application of waveform steel strips with shear connectors as one component of mechanical device may be tallied the requirement in taking sufficient shear and tensile forces on the negative bending region of the composite beam subjected to combined negative bending and axial tension, which had the hypothesis of this research study.

This research was accommodated with validated three-dimensional Finite Element (FE) models of composite beam subjected to combined negative bending and axial tension to predict the behavior in the application of waveform steel strips with shear connectors with various parameters of waveform thickness and height.

The significant performance was predicted in the shear flow forces developed and it is discussed in this paper with caused failure scenarios in the material components.

Keywords: *Steel-concrete composite beam, combined negative bending and axial tension, Shear flow forces, Waveform steel strips with shear connectors, Non-linear 3D FE model, Parametric studies, Performance of the composite beam.*

A case study on flexural behavior of reinforced concrete beams strengthened with CFRP wraps

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Abstract

In this paper are presented the results of an experimental study on flexural behavior of reinforced concrete beams strengthened with Carbon Fiber Reinforced Polymer (CFRP) wraps. Three identical reinforced concrete beams of a section dimensions of 210 mm x 270 mm and span of 2.5 m were built and tested in the laboratory under four-point flexural test. The CFRP technique was applied on a pre-cracked beam, and on an un-cracked beam.

The results were compared with the control specimen parameters. The CFRP system provided a considerable increase in those parameters; 133 - 156 % in terms of load bearing capacity and 128 - 131 % in deformation capacity.

Keywords: *CFRP, strengthening, reinforced concrete beam, four-point flexural test*

Structural assessment of the south-west wing timber roofs of the Loreta in Prague

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Abstract

The Loreto of Prague is a remarkable Baroque historic monument, a place of pilgrimage with a captivating history. Behind the main façade, which is the marvelous work of the famous Dientzenhofers, there is a courtyard with a copy of the St. Mary's Holy House of Nazareth. Since the placement of the first construction stone in 1626, the Loreto has faced many construction phases with many alterations. The majority of the works progressed between 1698 and 1748 under the supervision of Christoph and Kilian Ignaz Dientzenhofer. These alterations also generated some changes in the configuration of the roof structure and in some parts caused even damages. Some of interventions observed on timber frames are not documented and their purpose is not always obvious.

For a better understanding, a historical analysis of the Loreto complex was used recently refined by dendrochronological dating of timber roofs elements from different time periods, so the historical chronology of the building could be accomplished.

Afterwards, diagnostic tests were conducted on site for the health evaluation of the members to assess their condition. The mechanical parameters are obtained with the new diagnostic tool which is the loading jack and correlates well to the compressive strength parallel to fibers. Due to the historic interventions excessive deformation is observed in one of the timber frames. Utilizing the obtained health and mechanical parameters a numerical model of the south-west wing timber roof is modeled. From this global approach then is built a numerical model of the truss of concern and three scenarios are verified to achieve a possible hypothesis of the deformation. The structural numerical model provides valuable information of the existing deformation.

Additionally, the current stability of the timber frame is assessed which proves to be safe under the actual conditions. In order to eliminate future problems

for the truss two possible strengthening solutions are provided with the minimal intrusiveness on the historic timber roof.

Keywords: *health assessment, historic timber structure, non-destructive tests, dendrochronology, structural analysis*

Use of Incremental Dynamic Analysis for the Seismic Performance Assessment of RC Framed Structures

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Abstract

In this study the seismic performance assessment of existing low and mid-rise reinforced concrete buildings is presented by using Incremental Dynamic Analysis. Incremental dynamic analysis (IDA) is known as an accurate method and it can provide the whole range of structural responses from elastic to collapse. The method performs a series of nonlinear dynamic analyses in which the intensity is incrementally increased for the ground motion selected to investigate the behavior until the global collapse capacity of the structure is reached. The mathematical models are prepared in the environment of Zeus-NL software, a finite element program developed especially for earthquake engineering applications. IDA curves are developed considering spectral acceleration ($S_a(T_1, 5\%)$) as intensity measure (IM) parameter. The nonlinear dynamic analyses were conducted using a set of twenty natural ground motion records selected with a range from 0.042g-3.5g peak ground acceleration and without directivity influence.

In addition, the immediate occupancy (IO), collapse prevention (CP) and global instability (GI) limit states are defined based on FEMA guidelines. Moreover, the IDA curves are summarized based on 16%, 50% and 84% fractiles.

Finally, conclusions are summarized based on the findings done from the analysis results, while recommendations for the future research are presented.

Keywords: *Low and Mid-Rise Buildings; Nonlinear Analysis; Seismic Performance; Incremental Dynamic Analysis; Zeus-NL.*

Observations on the Domed Mosques Built during The Ottoman Empire Period in Prizren - Kosovo

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Abstract

This study focusses on the domed mosques built during the Ottoman Empire period in Prizren, a city in southern Kosovo. It aims to reveals the architectural and ornamental features of these buildings.

Based on site observation there are examined six domed mosques in Prizren. The explanation of the mosques is explained under three basic sections. Firstly, there is provided and introduction part which includes the historical background of the mosques and information about the builder/commissioner. To provide it the study uses both local (Kosovo based) and central (Istanbul based) literature. In second section there are explained architectural features based in four subtitles: plan schemes, the roofing structures, materials, and façades. In the third section are explained the ornamental features of the buildings including: the stone decoration, the wooden decoration, the calligraphic art, and paintings and the last one stained glass.

The methodology used in the study includes archival research, visual documentation through photos, drawings, and analytical interpretation of architectural and ornamental features of the buildings.

In the conclusion the buildings are compared between each other, aiming to reveal the architectural values peculiarities of proper period.

Keywords: *Domed Mosques, Ottoman Period, Prizren, Kosovo*

Spatial and Morphological Potentials of Urban Informality: “Shallvaret” Block

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Abstract

To understand urban developments in a city or region the informality has been and is always issue of outlining. Albania has more than two decades that is dealing with the informality. It is now part of the city and the citizens cannot escape from this reality. Different stakeholders being them real estate developers, urban planners, residents, etc. are engaged in exploring the meaning of this informality for the future of the city. In this context, this research by pointing in one of the buildings that is considered as landmark for years in the city, aims to study informality of “Shallvare Block” by analyzing spatial and morphological interventions in the building.

The impact that this informality has on the visual layout the existing building and consequently on the urban morphology is discussed through the methods of “zoning” and “overlapping” the existing situation with the designed building.

Findings reveal that interventions in the façade are proportional, and the users are aware of the architectural qualities. Further, the program interventions are unidimensional, often focusing on physical improvements. While these led to improved housing conditions one side, it opens discussion on the spatial potentials of the informality.

Keywords: *Urban informality, intervention, spatial quality, Tirana*

Paper Folding Bio-Kinetic Façade: Application of Bat Wing Inspired Façade Design to the Building of Mediterranean University in Tirana, Albania

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Abstract

Design of kinetic and adaptable building shells is one of the recent trends in sustainable construction. In this research the main topic is the application of the foldable and nature inspired kinetic facade onto the contemporary building in Tirana and evaluation of its advantages in terms of the light control and reduction of the cooling loads of the building.

The paper starts from the overview of a history of kinetic architecture. Paper folding is selected as a technique and biomimicry is an approach which helps to design the repetitive units of the facade. The chosen form of nature and the source for the design inspiration is a bat wing. The anatomy of the wing has been adapted for the project and the mathematical calculation was done in order to get the facade module, which is flexible, foldable and which can be closed and opened using the movement which is similar to the bat wing. For the application it is selected the building which currently has the glass facade with very minor shading system. The adaptable kinetic facade is constructed using the series of modules.

The calculation of solar radiation was done for the several models with different percentage of openness. The new building skin allows to have the better quality of light and regulates loss and gain of heat without wasting energy.

Keywords: Biomimicry, kinetic facade, origami technique, responsive facade, sustainable design

Experiencing the Research-Based Learning: Case of the graduate course “Landscape Perspectives in Disaster Risk Management and Fire Safety”

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Abstract

This paper presents the research-based learning (RBL) experience in the graduate course “Arch451- Landscape Perspectives in Disaster Risk Management and Fire Safety”. This experience relied on the principle “the student as researcher and the lecturer as moderator of the process”. The research teams consisted of four students. The study areas were the metropolitan areas of Skopje, Novi Sad, Banja Luka, and Tirana. Students have been introduced into the main theme of wildfire risk within wildland urban interface (WUI). The group discussions during class meetings were helpful in shortlisting the set of criteria implicated either with wildfire ignition and spreading regimes.

Similarly, the weighted impact factor of each criteria was defined as average values of all participants via analytic hierarchy process (AHP) pairwise comparison method. Each group performed their GIS-based analysis for their specific study area following the same methodology that have been developed in the first part of the process. At the final stage each team delivered a technical report and a poster presenting their research work and original findings about their specific study area.

As a result, the RBL process enabled the students to experience a participatory research process that contributes to the enhancement of their teamwork and research skills.

Keywords: *project-oriented research, wildfire, GIS, teamwork, Epoka University*

The effect of Elbasan GGBFS addition on different properties of cement mortars

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Abstract

The purpose of this research is to study the effect of local ground granulated blast furnace slag as a partial replacing material in Portland cement mortars. The GGBFS used in this investigation is delivered as an industrial waste from the Steel Production Factory in Elbasan, Albania. For this reason, six different series of (0/100, 5/95, 10/90, 15/85, 20/80 and 25/75) GGBFS to cement ratios were produced. Normal consistency, initial and final setting time of the pastes as well as flexural strength and compressive strength of the hardened mortars were investigated.

The test results showed that the use of the ground granulated blast furnace slag under investigation as a cement replacing material has different advantages and drawbacks.

Keywords: *GGBFS, mortar, flexural strength, compressive strength, industrial waste, cement replacement*

Polypropylene reinforced mortar coating for improvement of unreinforced masonry shear resistance

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Abstract

This paper describes an experimental program for improvement of the shear resistance of unreinforced masonry (URM) by plastering with two layers of short polypropylene fibers (fiber length = 12 mm) embedded into a cementitious matrix under in-plane loading.

Six diagonal compression tests as of ASTM E519-02, were done on masonry panels of dimensions 1.2 x 1.2 x 0.25 m built and tested in the laboratory. The main mechanical parameters such as the shear strength, modulus of rigidity and ductility were assessed and compared before and after strengthening. Additionally, the panels were also modelled using discrete micro-modelling using DIANA 9.6 and a non-linear analysis was conducted.

The results showed that polypropylene reinforced mortar coating increased the in-plane capacity of the unreinforced masonry by 357%.

Keywords: *polypropylene fibers, masonry retrofitting, unreinforced masonry, diagonal compression test*

Public-Private Partnerships in Albania: From the Legislative Provisions to Risk Management

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Abstract

Public Private Partnerships (PPPs) are frequently used in Albania, mainly in the form of concession, as the main “engine” to make work the public sector in the field of investments. It is estimated that recently, there are more than 170 PPP-s only in the infrastructure sectors in Albania.

The focus in this policy was given by the European Union, and the application of this model initially was based on the EU directive 2004/18/EC of the European Parliament and that of Council of Europe on 31 March 2004 so far, as part the process of *Acquis Communautaire*. The renewed and increased interest on PPPs, where private sector finance public investments in return for realizing profits, is especially present in a fragile state like Albania.

The process is based in a legal framework, which in few years has been amended frequently, with the aim to make increase the investments fields, stakeholders, and benefits. It is to be emphasized that Albania has not only adopted new laws, but it has set up an ad hoc public institution, called the “Agency on the Treatment of Concessions”. The examples of PPP-s contracted and implemented in Albania, are a lot, mainly considered as success story and pathfinders for strategical sectors of Albanian economy.

This paper will review the PPPs legal framework, performing a comparative study on legislative provisions in Western Balkans Countries.

Keywords: PPP-s, Legal framework, Risk management, Albania

The Assessment of Albanian Masonry Typologies by comparison with Italian Masonry Heritage: preliminary analysis

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Abstract

Albania is rich of heritage masonry constructions, and the Albanian territory is also exposed to the seismic hazard. Several destructive earthquakes struck Albania in the last 100 years. Albania's strongest earthquake in decades struck on 26th November 2019, close to the coastal city of Durrës. The 6.4- magnitude quake struck at 3.54 am, leaving 51 people dead and more than 600 injured while setting off a race to find victims buried under the rubble of collapsed masonry buildings. The event destroyed or damaged heritage buildings and caused extensive failures in masonry constructions in particular.

Reconstruction and repair work has already started, but the Government is facing increasing strain to cope with the threat of additional hazards such as aftershocks and extreme weather events. There is an urgent need for multi-hazard assessment, effective mitigation and new remediation approaches to better protect and preserve vulnerable heritage buildings. The masonry buildings constructed between the 14th and 19th centuries in Albania are sometimes recognized for their style and structural vulnerability, while in other cases these are similar to the masonry constructions of other countries, like Italy and Greece.

This research presents the main characteristics of the Albanian masonry materials and of these buildings in the aim of preserving their cultural value. The socio-economic conditions on what they were constructed are identified. This includes the possible reasons for the negative impression attributed to the buildings. The architectural features are described in terms of constituent materials, arrangement, dimensions of the walls, aesthetics, configuration of the buildings and layout. The structural system and materials are discussed and

compared with some Italian masonry typologies, based on the experience of the authors of both the Italian and Albanian situations.

In addition, an estimation of the mechanical properties of the materials is presented based on the visual assessment methods. The main weaknesses and alterations implemented are also identified, putting in evidence the possible consequences for the structure and seismic performance.

Keywords: *masonry typology, preliminary analysis, Italian heritage, Albanian heritage*

An innovative and practical solution for the surface and volume computations in land surveying

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Abstract

Nowadays, earth and excavation works are among the most common and important activities in the civil engineering field. Surveying is used to determine the relative position of the points on the land surface, by using the most appropriate techniques involved in this field. Given the needs of engineering works on aspects of precision, time and cost, the volume calculation has always been an important task in the land surveying. Many researchers have shown in numerous studies the increase in precision of the volume calculation and data computation using various mathematical methods.

This paper aims to present a practical, efficient yet innovative automated solution of volume calculation with high precision. Our algorithm uses the environment of AutoCAD software to compute the volume and surface of the terrain. It utilizes a super spline method for interpolation of the 3D data points gathered from the land measurements. The output of this method are the AutoCAD drawings, including the surface and 3D volume. The whole process requires the data gathered from total station to be tabulated in a Microsoft Excel Spreadsheet and uploaded through a user interface window prepared in python version 3.7 and extracted as executable file “.exe”.

This method was initially applied in the classroom, and later used in the surveying field studies. The results suggest that this approach can substantially improve the process of surface and volume computations.

Nevertheless, there is need for further improvements and future research especially for generating contour maps.

Keywords: *Surveying, Surface and Volume calculations, Total Station, Automation in land computations, Python, AutoCAD.*

Towards a Disaster Risk Management Plan of Historical Centers: Case Study of The Historical Center of Gjirokastra

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Abstract

Disasters, such as earthquakes, floods, wildfires, demonstrate that extreme events can have global impacts, threatening not only human lives and economy, but also cultural heritage.

The UNESCO Venice Office, according to the priorities set by the government of Albania, have implemented the project “Natural Risk Preparedness and Mitigation - Building capacity in the field of risk mitigation for Cultural Heritage properties in Albania”. The project aimed to streamline disaster risk management in the country, using its World Heritage properties as demonstration sites. The project was conceived to assist the country in order to enhance its capacity for Disasters Risk Management (DRM) and advancement in seismological and geological vulnerability of Cultural Heritage properties.

This study identifies the key elements to take into consideration in order to draft an effective Disaster Risk Management Plan for the historic centers in Albania. In this framework, the World Heritage Property of the Historic Center of Gjirokastra is studied. The methodology used in this study and recommendations can be implemented also in the other historical sites.

Keywords: *Disaster, Risk Management, Cultural Heritage, Gjirokastra*

The behavior of RC frames under quasi-static diagonal loads

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Abstract

The aim of this investigation is to analyze the mechanical behavior of reinforced concrete frames under diagonal loads. The study provides a combination of analytical and experimental work related to the quasi-static diagonal loading of the reinforced concrete frames. The analytical modeling of the RC frames was performed in ETABS software on a real scale frame, whereas the experimental test was performed on a RC frame of a scale 1/3 of the analytical model. The load displacement curves were built from both the investigation methods and the maximum strength, yielding point, maximum displacement parallel and perpendicular to the loads, Modulus of Elasticity, and ductility factor (R_{μ}) of the RC frames were obtained and analyzed.

Keywords: *experimental testing, ductility, masonry, infill walls, RC frame, ETABS*

Sustainability as a Civil Engineer's responsibility

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Abstract

Civil Engineers, as opposed to Military Engineers, should promote peaceful and sustainable human development. To reach sustainability, a complicated scientific approach is needed, taking into account both technical aspects and the natural, social and cultural environment. Civil Engineers, who are the main agents of infrastructure works, should be able to understand the environmental, social and cultural context well and to develop appropriate management and technological treatment of the negative impact of what they perform. Thus, they have to find ways of balancing society's need for solid and functional infrastructure with sustainability.

Rules and constraints on development are necessary, since human activities may have significant negative impact on the state of the environment and the socioeconomic equilibria. It is important for the Civil Engineer to possess a circumstantial knowledge of the relevant problems. In order to address challenges, he has to provide technical and managerial solutions in measurements, modelling, and control through the application of scientific and engineering methods.

The science of Civil Engineering is both theoretical and applied, connected with most of the exact sciences, such as Physics, Chemistry, Material Sciences, Ecology, Biology, Forestry, Geology and Sciences of the Hydrosphere and Atmosphere, Technological Sciences and Medicine as well as with Social Sciences, Economy, History and Law. Management that aims at the maximal possible conservation of the environment and, simultaneously, at the optimal satisfaction of human needs is a complex problem that transcends the abilities of simple quantitative mathematical models of optimization. An interdisciplinary approach is necessary for green development, but the introduction of interdisciplinarity into the way of thinking of Civil Engineers is not an easy venture; their training is overly oriented towards the application of techniques that arise univocally from concrete models. It requires a substantial education on the structure, the function, the particularities and the vulnerabilities of the environmental and social systems. The

introduction of a systemic way of thinking could allow integrated synthesis, taking into account the quantitative or qualitative view of a complex reality.

Engineering education should not excessively focus on skills that could be gained by machines in a near future. Today's engineers need to be more than individuals who simply "like maths and science". They have to understand complicated economic, social, environmental or urban systems by quantitative or qualitative approaches. Civil Engineers should do more than the application of mathematical and technological tools to solid and fluid structures. They must be "creative problem-solvers" who help shape the future by improving health, happiness, and safety. However, the simplistic mechanistic perception of civil engineering attracts many gifted students of technical universities who are expecting just mathematics and mechanics.

During this 21st century, Civil Engineers will face challenges related to big international problems like climate change and energy transition, as well as social and cultural issues, especially in developing countries. Important infrastructure investments cannot be realized with the imprudent way of the past. Broader education should be necessary to understand the impact of engineering solutions in complex or vulnerable environments. Beyond technical aspects, Civil Engineers should know why, how or where they should apply their skills. Humanities offer integrated ways of thinking that include uncertainty, doubt and skepticism. A substantial part of a Civil Engineer's education should address the great questions of Western Civilization as they have been developed, for example, by Thales, Plato, Aristotle, Thucydides, Lucretius, Shakespeare, Descartes, Hobbes, Locke, Kant, Mill, Marx, Nietzsche, Freud, Popper, Keynes etc. in order to penetrate a long-established mechanistic mentality of Civil Engineers.

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