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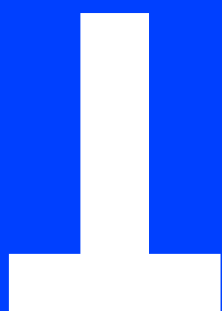
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ADVANTECHS 2026



Book of Abstracts



Mostar, July 17, 2026

BOOK OF ABSTRACTS: International Scientific and Professional Conference Advances in
Technical Sciences (ADVANTECHS 2026)

BOOK OF ABSTRACTS: International Scientific and Professional Conference
Advances in Technical Sciences (ADVANTECHS 2026)

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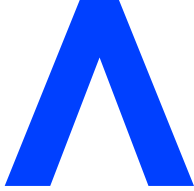
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OD RANJIVOSTI ZGRADA DO SEIZMIČKOG RIZIKA: VIŠERAZINSKI OKVIR ZA PROCJENU U BOSNI I HERCEGOVINI

prof. dr. sc. NAIDA ADEMOVIĆ

Univerzitet u Sarajevu, Građevinski fakultet

Sažetak: Prema analizi Cummins i Mahula iz 2009. godine, zemlje sa srednjim dohotkom pokazale su veću ranjivost tijekom protekla dva desetljeća u odnosu na zemlje s niskim dohotkom te zemlje s visokim BDP-om. Bosna i Hercegovina se svrstava u skupinu zemalja s nižim srednjim dohotkom. Ranjivost postojećeg stambenog fonda u Bosni i Hercegovini, od kojeg je 44% izgrađeno prije 1980. godine, a koji se sastoji od zidanih zgrada podignutih bez suvremenih propisa za potresno projektiranje, ima značajan utjecaj na seizmički rizik zemlje. Ovo istraživanje predstavlja višerazinsku metodu koja objedinjuje brzu procjenu seizmičkog rizika i procjenu ranjivosti na razini pojedinačnih zgrada. Kombiniranjem podataka o seizmičkoj opasnosti, izloženosti građevina i funkcija ranjivosti temeljenih na tipologiji, procjenjuje se prostorna distribucija očekivanih oštećenja zgrada i rizika diljem Bosne i Hercegovine. Prema analizama, područja s najvećim vršnim ubrzanjem tla (PGA) nisu nužno i područja s najvećim rizikom, budući da na razinu rizika presudno utječu gustoća naseljenosti i karakteristike postojećeg stambenog fonda. Nasuprot tome, pojedini gradovi s nižim vrijednostima PGA, ali većom gustoćom naseljenosti, mogu biti izloženi značajnim posljedicama i potencijalnim katastrofama za koje su nedovoljno pripremljeni. Rezultati ukazuju na to da zidane zgrade predstavljaju glavni čimbenik seizmičkog rizika, osobito u urbanim područjima s gustim i zastarjelim stambenim fondom. Predloženi integrirani okvir predstavlja učinkovit instrument za procjenu rizika velikih razmjera i podržava određivanje prioriteta sanacijskih intervencija temeljeno na dokazima. Nadalje, studija naglašava važnost povezivanja seizmičke sigurnosti s održivošću putem ciljanih strategija sanacije koje istodobno smanjuju rizik i utjecaj na okoliš.

Ključne riječi: procjena seizmičkog rizika, ranjivost zgrada, zidane zgrade, seizmička sanacija, održiva sanacija



Invited Lecture

FROM BUILDING VULNERABILITY TO SEISMIC RISK: A MULTI-SCALE ASSESSMENT FRAMEWORK FOR BOSNIA AND HERZEGOVINA

prof. NAIDA ADEMOVIĆ, Ph.D.

University of Sarajevo, Faculty of Civil Engineering

Abstract: According to Cummins and Mahul's 2009 analysis, middle-income nations have been more vulnerable over the past 20 years than low-income and high-GDP countries. Bosnia and Herzegovina is classified as lower-middle-income. The vulnerability of Bosnia and Herzegovina's current building stock, 44% of which was built before 1980, consisting of masonry buildings erected without modern seismic design provisions, has a significant impact on the country's seismic risk. This study offers a multi-scale method that combines rapid seismic risk assessment with building-level vulnerability assessment. By combining seismic hazard data, building exposure, and typology-based vulnerability functions, spatial distributions of expected building damage and risk are evaluated across Bosnia and Herzegovina. According to the analyses, areas with the highest peak ground acceleration (PGA) are not necessarily identified as the ones with the highest risk, as risk is strongly influenced by population density and the characteristics of the building stock. Conversely, some cities with lower PGA values but higher density may face significant impacts and potential disasters for which they are insufficiently prepared. The results highlight that masonry buildings represent a major contributor to seismic risk, particularly in urban areas with dense and aging building stock. The proposed integrated framework provides an efficient tool for large-scale risk screening and supports evidence-based prioritization of retrofitting interventions. Furthermore, the study emphasizes the importance of linking seismic safety with sustainability through targeted rehabilitation strategies that reduce both risk and environmental impact.

Key words: seismic risk assessment, building vulnerability, masonry buildings, seismic retrofitting, sustainable rehabilitation

SUVREMENI MODELI URBANIH PREOBRAZBI I NJIHOVA PRIMJENA U HRVATSKIM GRADOVIMA

prof. dr. sc. KRUNOSLAV ŠMIT

Sveučilište u Zagrebu, Arhitektonski fakultet,
Sveučilište u Mostaru, Fakultet građevinarstva, arhitekture i geodezije

Sažetak: Rad analizira primjenjivost i stvarnu prisutnost suvremenih modela urbanih preobrazbi u hrvatskim gradovima. Polazište istraživanja čini kataloška zbirka dvadeset i dva modela, strukturirana u tematske cjeline mobilnosti, javnog prostora, gustoće i morfologije, ekologije, infrastrukture, transformacije te društva i upravljanja. Istraživanje propituje njihovu razinu implementacije, od konkretnih prostornih zahvata do integracije u planske dokumente i razvojne strategije, s posebnim naglaskom na odnos između deklarativnog prihvatanja i stvarne operativne primjene. Kataloška zbirka obuhvaća modele poput kronourbanizma (15-minutnog grada), superblokova, dijeljenog prostora, tranzitno orijentiranog razvoja, multimodalnih čvorišta, taktičkog urbanizma, urbane akupunkture, aktivnih prizemlja, pješačkog grada, niskoprometnih zona, kompaktnog grada, hibridnog bloka, retrofitiranja suburbije, rješenja utemeljenih na prirodi, spužvastog grada, renaturalizacije, krajobraznog urbanizma, plavo-zelene infrastrukture, adaptivne ponovne uporabe, cirkularnog grada, kolaborativnog planiranja te prava na grad. Navedeni modeli analiziraju se kroz reprezentativne primjere urbanih preobrazbi u Zagrebu, Splitu, Rijeci i Osijeku, uz uključivanje Mostara kao dodatnog komparativnog slučaja koji omogućuje uvid u različite razvojne uvjete i upravljačke okvire. Analiza obuhvaća više razina djelovanja: prostornu organizaciju, tipologiju zahvata, odnos prema postojećem urbanom tkivu, ulogu infrastrukture te modele upravljanja i sudjelovanja dionika. Posebna se pozornost usmjerava na adaptivnu ponovnu uporabu, transformaciju javnih prostora u pješački orijentirane sustave, integraciju plavo-zelene infrastrukture te preobrazbu industrijskih i infrastrukturnih zona u nove urbane programe. Time se omogućuje razlikovanje između projekata koji djeluju kao izolirani primjeri i onih koji generiraju šire prostorne i funkcionalne učinke. Rezultati upućuju na fragmentiranu, ali jasno prepoznatljivu prisutnost suvremenih modela urbanih preobrazbi. Najizraženiji su u domenama obnove postojećih struktura, javnog prostora i krajobraznih pristupa, dok su modeli koji zahtijevaju visoku razinu koordinacije i dugoročnog planiranja, poput tranzitno orijentiranog razvoja, niskoprometnih zona, koncepta spužvastog grada i cirkularnog urbanizma, prisutni sporadično ili na razini pilot-projekata. Uočava se diskontinuitet između strateških dokumenata i njihove provedbe te izražena ovisnost o pojedinačnim projektima kao nositeljima promjene. Urbane preobrazbe u hrvatskim gradovima stoga dominantno proizlaze iz projektno orijentiranih intervencija, dok sustavno uspostavljeni operativni modeli implementacije ostaju nedovoljno razvijeni.

Ključne riječi: urbana transformacija, hrvatski gradovi, suvremeni urbanizam, javni prostor, adaptivna ponovna upotreba, infrastrukturni krajolici, participativno planiranje



Invited Lecture

CONTEMPORARY MODELS OF URBAN TRANSFORMATION AND THEIR IMPLEMENTATION IN CROATIAN CITIES

prof. KRUNOSLAV ŠMIT, Ph.D.

University of Zagreb, Faculty of Architecture;

University of Mostar, Faculty of Civil Engineering, Architecture and Geodesy

Abstract: This paper examines the applicability and actual presence of contemporary models of urban transformation in Croatian cities. The research is based on a catalogue of twenty-two models structured into thematic groups: mobility, public space, density and morphology, ecology, infrastructure, transformation, and governance. It investigates their level of implementation, from spatial interventions to their integration into planning documents and development strategies, with particular attention to the gap between declarative adoption and operational application.

The catalogue includes models such as the 15-minute city, superblocks, shared space, transit-oriented development, multimodal hubs, tactical urbanism, urban acupuncture, active frontages, walkability frameworks, low-traffic neighbourhoods, compact city, hybrid block, retrofitting suburbia, nature-based solutions, sponge city, urban rewilding, landscape urbanism, blue-green infrastructure, adaptive reuse, circular city, collaborative planning, and the right to the city. These models are analysed through representative urban transformation cases in Zagreb, Split, Rijeka, and Osijek, with the inclusion of Mostar as an additional comparative case providing insight into differing development conditions and governance frameworks. The analysis addresses multiple levels: spatial organisation, intervention typologies, relationships with existing urban fabric, the role of infrastructure, and governance models. Particular attention is given to adaptive reuse, pedestrian-oriented transformation of public space, integration of blue-green infrastructure, and the transformation of industrial and infrastructural zones into new urban programmes. This enables a distinction between isolated project-based interventions and those capable of generating broader spatial and functional impacts. The findings indicate a fragmented yet clearly identifiable presence of contemporary transformation models. While some are evident through individual projects—such as adaptive reuse and public space regeneration—others remain weakly institutionalised, particularly transit-oriented development, low-traffic neighbourhoods, sponge city approaches, and circular urbanism. A discontinuity between strategic frameworks and their implementation is observed, alongside a strong reliance on individual projects as drivers of change. Urban transformation in Croatian cities therefore predominantly emerges through project-oriented interventions, while systematically established operational implementation models remain underdeveloped.

Key words: procjena seizmičkog rizika, ranjivost zgrada, zidane zgrade, seizmička sanacija, održiva sanacija

OKVIRI ZA ANALIZU I UPRAVLJANJE RIZICIMA U SUVREMENOM GRAĐEVINARSTVU: PRIMJER PROJEKATA TUNELOGRAĐNJE

prof. dr. sc. ZLATKO ZAFIROVSKI

Sveučilište sv. Ćirila i Metoda u Skoplju, Građevinski fakultet - Skoplje,
Republika Sjeverna Makedonija

Sažetak: Koncept analize i upravljanja rizicima ima značajan utjecaj te nalazi široku primjenu u raznim društveno-ekonomskim sektorima. Danas u području građevinarstva, osobito u provedbi mega-infrastrukturnih projekata, sustavna procjena rizika predstavlja ključni operativni imperativ koji se više ne može zaobilaziti, odgađati ili podcjenjivati. Iako akademska literatura nudi različite konceptualne okvire i definicije onoga što predstavlja „rizik“, bitno je da se svaki inženjerski izazov razmotri pojedinačno, uzimajući u obzir njegova jedinstvena prostorna, okolišna i strukturna ograničenja. U tunelogradnji su nesigurnosti i opasnosti trajno prisutne zbog inherentno nepredvidivih geoloških formacija, složenih hidroloških uvjeta i promjenjivih geotehničkih parametara. Slijedom toga, razvoj i provedba naprednih mjera ublažavanja te dinamičkih okvira za upravljanje rizicima su ključni za osiguranje strukturalnog integriteta, sigurnosti radnika, ekonomske isplativosti i poštivanja strogih vremenskih planova projekta. Ovaj rad daje sveobuhvatan pregled suvremenih metodologija za identifikaciju, kvantifikaciju i upravljanje podzemnim rizicima, pružajući strateški nacrt za minimiziranje negativnih utjecaja i optimizaciju donošenja odluka u složenim projektima tunelogradnje.

Ključne riječi: tuneli, upravljanje rizicima, vjerojatnost pojave i otkaza, kvantitativna analiza



Invited Lecture

RISK ANALYSIS AND MANAGEMENT FRAMEWORKS IN MODERN CIVIL ENGINEERING: THE CASE OF TUNNELLING PROJECTS

prof. ZLATKO ZAFIROVSKI, Ph.D.

Ss. Cyril and Methodius University in Skopje, Faculty of Civil Engineering-Skopje,
Republic of North Macedonia

Abstract: The concept of risk analysis and management exerts a profound influence and finds widespread application across various socio-economic sectors. Today, within the field of civil engineering—particularly in the execution of mega-infrastructure projects—the systematic evaluation of risk represents a critical operational imperative that can no longer be bypassed, delayed, or underestimated. While academic literature offers diverse conceptual frameworks and definitions of what constitutes a "risk", it is essential that every engineering challenge is reviewed individually, accounting for its unique spatial, environmental, and structural constraints. In tunnelling engineering, uncertainties and hazards are perpetually present due to inherently unpredictable geological formations, complex hydrological conditions, and changing geotechnical parameters. Consequently, the development and implementation of advanced mitigation measures and dynamic risk management frameworks are vital to ensuring structural integrity, worker safety, economic viability, and adherence to strict project schedules. This paper comprehensively reviews contemporary methodologies for identifying, quantifying, and managing subsurface risks, providing a strategic blueprint for minimizing adverse impacts and optimizing decision-making in complex tunnelling projects.

Key words: tunnels, risk management, probability of occurrence and failure, quantitative analysis

PREDNOSTI I NEDOSTACI SVESTRANO POMIČNIH LEŽAJEVA NA SREDNJIM STUPOVIMA VIJADUKTA U ČVORU ANĐELI NA PODDIONICI 2B2-4 VEPRINAC-ANĐELI-ISTARSKI IPSILON

NEDA BEBEK, dipl. ing. građ., MARIO BEVANDA, dipl. ing. građ., MARKO BOŠNJAK, dipl. ing. građ., IVAN LUKIĆ, dipl. ing. građ., IVAN IVANKOVIĆ, dipl. ing. građ.

Hering d. d. za projektiranje i graditeljstvo

Sažetak: U ovom radu biti će prikazan odabir načina oslanjanja na donji ustroj vijadukta u čvoru Anđeli, koji se nalazi na Istarskom ipsilonu, u fazi I. , Izmjene i dopune glavnog projekta, te prednosti i nedostaci odabranog načina oslanjanja. Objekt je koncipiran kao kontinuirana pločasta monolitna AB konstrukcija. Rasponska konstrukcija objekta je kontinuirani pločasti monolitni sklop preko tri polja raspona 15,08 m + 20,10 m + 15,08 m. Donji ustroj čine stupišta S1 i S2, te upornjaci U1 i U2. Srednji stupovi se nalaze na strmim kosinama suhe prepreke preko koje prelazi vijadukt, te je nepovoljan s aspekta izvođenja iskopa za temelje. Na srednjim stupovima su usvojeni svestrano pomični lončasti ležajevi koji prenose samo vertikalnu silu, te su temelji stupova oblikovani od dva pilota promjera 120 cm s razmakom od 541 cm poprečno na vijadukt. Iznad pilota se nalazi naglavica, iznad koje se nastavljaju dva okrugla stupa promjera 120 cm u pravcu pilota. Odabrani način oslanjanja rasponske konstrukcije na donji ustroj srednjih stupova, pojednostavio je dimenzioniranje srednjih stupova i temelja i izvođenje iskopa za temeljenje. Na upornjacima je bilo potrebno odrediti najpovoljniju dispoziciju svestrano nepomičnih ležajeva za preuzimanje horizontalnih seizmičkih sila. Računski model objekta je rađen u programu SOFiSTiK. Na upornjaku U1, odabran je jedan ležaj kao svestrano nepomični, a drugi ležaj kao svestrano pomični. Na upornjaku U2, jedan ležaj je odabran kao poprečno nepomični, a drugi ležaj kao svestrano pomični. Dimenzioniranje upornjaka U1 i temelja upornjaka U1 je bilo zahtjevnije, nego je to uobičajeno, zbog svladavanja velike uzdužne seizmičke sile sa svestrano nepomičnog ležaja, uz ostala pripadajuća opterećenja s nasipa na upornjaku U1. Izbor svestrano pomičnih ležajeva na srednjim stupovima ima prednost u oblikovanju samog ležaja, u oblikovanju i dimenzioniranju srednjih stupova i temelja, uz značajno smanjenje iskopa za izvođenje pilota i naglavice na jako strmom i nepovoljnom terenu. Nedostatak izbora svestrano pomičnih ležajeva na srednjim stupovima je u zahtjevnom dimenzioniranju svestrano nepomičnog ležaja na upornjaku, kao i upornjaka koji prenosi jake horizontalne seizmičke sile na temelj upornjaka. Zaključno, za predmetni vijadukt, opisani izbor ležajeva je najoptimalniji izbor, zbog samog pristupa za izvođenje pozicija temelja srednjih stupova i upornjaka.

Ključne riječi: vijadukt, ležajevi, temelji, seizmičke sile

Poster presentation

ADVANTAGES AND DISADVANTAGES OF MULTI-DIRECTIONAL MOVABLE BEARINGS ON THE INTERMEDIATE PIERS OF THE VIADUCT AT THE ANĐELI INTERCHANGE ON SUBSECTION 2B2-4 VEPRINAC-ANĐELI-ISTRIAN Y

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Hering d.d. for design and construction

Abstract: This paper presents the selection of the bearing system for the substructure of the viaduct at the Anđeli Interchange, located on the Istrian Y, during Phase I of the Amendments to the Main Design, as well as the advantages and disadvantages of the chosen bearing method. The structure is designed as a continuous monolithic reinforced-concrete slab structure. The superstructure is a continuous monolithic slab system with three spans measuring 15.08 m + 20.10 m + 15.08 m. The substructure consists of piers S1 and S2, and abutments U1 and U2. The intermediate piers are located on steep slopes of a dry obstacle crossed by the viaduct, which is unfavourable in terms of excavation for the foundations. Multi-directional movable pot bearings, transmitting only vertical forces, are adopted at the intermediate piers. The pier foundations are formed of two piles with a diameter of 120 cm, spaced 541 cm apart transversely to the viaduct. Above the piles is a pile cap, from which two circular piers with a diameter of 120 cm extend in the direction of the piles. The selected method of supporting the superstructure on the substructure at the intermediate piers simplified the dimensioning of the intermediate piers and foundations, as well as the excavation for the foundation. At the abutments, it was necessary to determine the most favourable arrangement of fully fixed bearings for the transfer of horizontal seismic forces. The calculation model of the structure was developed using the SOFiSTiK software. At abutment U1, one bearing was designated as a fully fixed bearing, and the other was designated as a multi-directional movable bearing. At abutment U2, one bearing was designated as transversely fixed, and the other was designated as a multi-directional movable bearing. The dimensioning of abutment U1 and its foundation was more demanding than usual due to the need to withstand a large longitudinal seismic force from the fully fixed bearing, along with other associated loads from the embankment at abutment U1. The selection of multi-directional movable bearings at the intermediate piers offers advantages in the design of the bearings themselves, in the design and dimensioning of the intermediate piers and foundations, along with a significant reduction in excavation for the construction of piles and the pile cap on very steep and unfavourable terrain. The main disadvantage of selecting multi-directional movable bearings at the intermediate piers is in the demanding dimensioning of the fully fixed bearing at the abutment, as well as the dimensioning of the abutment itself, which transfer substantial horizontal seismic forces to its foundation. In conclusion, the described selection of bearings is the most optimal choice for the subject viaduct due to the access for constructing the foundations of the intermediate piers and abutments.

Key words: viaduct, bearings, foundations, seismic forces

RAZVOJ MODELA ZA ODRŽIVO UPRAVLJANJE PLAŽAMA I OBALNIM PODRUČJIMA - ANALIZA PROJEKTA CLIMBEACH

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Sažetak: Obalna područja, koja predstavljaju neka od najvažnijih turističkih odredišta u svijetu, sve su više izložena negativnim utjecajima klimatskih promjena. Djelovanje valova uzrokovanih vjetrom te porast prosječne razine mora dovode do plavljenja obale i smanjenja površina koje se koriste u rekreativne, sportske i turističke svrhe. Kako bi takva područja zadržala svoju gospodarsku, društvenu i okolišnu vrijednost, nužno je uspostaviti učinkovit sustav upravljanja obalnim prostorom. U tom kontekstu projekt ClimBeach provodi se u okviru programa Interreg VI-A Croatia – Bosnia and Herzegovina – Montenegro te je usmjeren na zaštitu obalnih područja od negativnih utjecaja klimatskih promjena. Glavni cilj projekta jest, kroz prekograničnu suradnju Bosne i Hercegovine, Hrvatske i Crne Gore, uspostaviti učinkovit i održiv sustav upravljanja plažama i obalnim područjima. Projekt obuhvaća razvoj sustava za praćenje i prikupljanje podataka o meteorološkim i klimatskim pokazateljima, dinamici mora, volumetrijskim promjenama plaža te procesima erozije i plavljenja obale unutar područja istraživanja. U sklopu projektnih aktivnosti na području Bosne i Hercegovine, preciznije u Neumu na plaži Druga strana, planirana je instalacija mjernog uređaja za praćenje dinamike mora, s posebnim naglaskom na parametre vjetrom generiranih valova i morskih struja. Uz terenska mjerenja, predviđeno je i provođenje simulacija na fizičkom modelu u laboratoriju, kao i numeričko modeliranje na temelju izmjerenih podataka u softveru Aquaveo. Kroz ovaj projekt poseban naglasak stavlja se na primjenu suvremenih tehnologija i digitalnih alata u praćenju i analizi promjena u obalnim područjima, pa je stoga predviđen i razvoj, implementacija te održavanje IT alata BeachCloud. Sustav BeachCloud razvija se s ciljem objedinjavanja prikupljenih podataka, procjene rizika od erozije te definiranja odgovarajućih strategija za odgovor na identificirane rizike, kako bi se povećala otpornost obalnih područja na negativne učinke klimatskih promjena. Za provedbu ove aktivnosti zadužen je Fakultet građevinarstva, arhitekture i geodezije Sveučilišta u Mostaru. Projekt ClimBeach značajno doprinosi jačanju institucionalne prekogranične suradnje i razmjeni znanja među projektnim partnerima, čime se stvaraju preduvjeti za dugoročno planiranje i zaštitu obalnog prostora. Ključni doprinos ovog projekta ogleda se u razvoju integriranog i prilagodljivog modela upravljanja obalnim prostorom, primjenjivog ne samo na područja obuhvaćena projektom već i na druga obalna područja suočena sa sličnim izazovima. Za razliku od konvencionalnih pristupa obalnom inženjerstvu i zaštiti obale, ovim projektom nastoji se razviti inovativni sustav potpore odlučivanju koji omogućuje učinkovitije suočavanje s negativnim učincima klimatskih promjena, povećavajući otpornost plaža na procese erozije i rizike od obalnih poplava.

Ključne riječi: upravljanje, plaže, obalna područja, klimatske promjene, otpornost



Oral presentation

DEVELOPMENT OF A MODEL FOR SUSTAINABLE MANAGEMENT OF BEACHES AND COASTAL AREAS – ANALYSIS OF THE CLIMBEACH PROJECT

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Abstract: Coastal areas, which represent some of the most important tourist destinations in the world, are increasingly exposed to the negative impacts of climate change. The action of wind-driven waves and the rise in average sea level lead to coastal flooding and a reduction of areas used for recreational, sports, and tourism purposes. To preserve the economic, social, and environmental value of such areas, it is essential to establish an effective coastal zone management system. In this context, the ClimBeach project is being implemented under the Interreg VI-A Croatia – Bosnia and Herzegovina – Montenegro programme and is aimed at protecting coastal areas from the negative impacts of climate change. The main objective of the project is to establish an effective and sustainable beach and coastal area management system through cross-border cooperation between Bosnia and Herzegovina, Croatia, and Montenegro. The project includes the development of a system for monitoring and collecting data on meteorological and climatic indicators, sea dynamics, volumetric changes in beaches and coastal erosion and flooding processes within the research area. As part of the project activities in Bosnia and Herzegovina, more precisely in Neum on the Druga Strana beach, the installation of a measuring device for monitoring sea dynamics is planned, with a special emphasis on the parameters of wind-generated waves and sea currents. In addition to field measurements, it is also planned to conduct simulations on a physical model in the laboratory, as well as numerical modelling based on measured data in the Aquaveo software. This project places special emphasis on the application of modern technologies and digital tools in monitoring and analysing changes in coastal areas, and therefore the development, implementation, and maintenance of the IT tool BeachCloud is also planned. The BeachCloud system is being developed with the aim of integrating the collected data, assessing erosion risks and defining appropriate strategies to respond to identified risks, in order to increase the resilience of coastal areas to the negative impacts of climate change. The implementation of this activity is entrusted to the Faculty of Civil Engineering, Architecture and Geodesy, University of Mostar. The ClimBeach project significantly contributes to strengthening institutional cross-border cooperation and knowledge exchange among project partners, thus creating the prerequisites for long-term planning and protection of coastal areas. The key contribution of this project lies in the development of an integrated and adaptive coastal area management model, applicable not only to the areas covered by the project but also to other coastal areas facing similar challenges. Unlike conventional approaches to coastal engineering and protection, this project seeks to develop an innovative decision-support system that enables a more effective response to the negative impacts of climate change, increasing the resilience of beaches to erosion processes and coastal flooding risks.

Key words: management, beaches, coastal areas, climate change, resilience

METODOLOŠKI PRISTUP IDENTIFIKACIJI MODERNISTIČKE ARHITEKTONSKE BAŠTINE U ZAPADNOJ HERCEGOVINI

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Sažetak: Tema očuvanja modernističke arhitekture u posljednjim je desetljećima privukla znatnu pozornost. To se u prvom redu može pripisati međunarodnim organizacijama poput ICOMOS-a, Docomomoa ili Getty instituta. U Bosni i Hercegovini autentičnost i integritet modernističke baštine narušeni su gubitkom arhivske građe i neprimjerenim poslijeratnim intervencijama na zgradama, što naglašava potrebu za sustavnom identifikacijom baštine u zemlji. Zakonodavni okvir Bosne i Hercegovine ne prepoznaje modernističku arhitekturu kao zasebnu kategoriju, već svu baštinu vrednuje prema istim kriterijima. Osim toga, propisi predviđaju da se nacionalnim spomenikom može proglasiti samo baština izgrađena do 1960. godine, uz mogućnost određenih iznimki. Međunarodni dokumenti i povelje, poput Dokumenta iz Nare, naglašavaju potrebu definiranja kriterija valorizacije unutar svakog geokulturnog konteksta. U tom smislu, Povijesni tematski okvir za dvadeseto stoljeće, koji je objavio Getty Conservation Institute, služi kao metodološki alat za interpretaciju i identifikaciju baštine dvadesetog stoljeća. Knjiga kroz eseje predstavlja deset ključnih tema, uz katalog tipova građevina i galeriju primjera za svaku temu, čime se uspostavlja kontekstualni okvir za prepoznavanje baštine. Svaka od ovih tema, poput brze urbanizacije, znanstvenog i tehnološkog razvoja ili mehanizirane i industrijalizirane poljoprivrede, omogućuje identifikaciju baštine unutar lokalnog konteksta zapadne Hercegovine. Primjerice, teme povezane s poljoprivredom pomažu nam u prepoznavanju tipologija kao što su vinarije (Vinarija Hepok, Stanko Fabris, 1957.). Znanstveni i tehnološki razvoj ističe zgrade javnog zdravstva (Antituberkulozni dispanzer, Tihomir Ivanović, 1949.), a teme prometa i masovne komunikacije ukazuju na važnost poštanskih objekata (Pošta Tomislavgrad, Ahmed Kapidžić, 1979.). Primjena međunarodnog tematskog okvira i njegova prilagodba specifičnom lokalnom kontekstu predstavljaju ključne korake u prepoznavanju baštine na određenom području. Moderna arhitektonska baština u zapadnoj Hercegovini dugo je bila zanemarena i marginalizirana u javnosti i unutar nadležnih institucija, unatoč svojoj ulozi u stvaranju urbanog identiteta regije. Sustavna identifikacija baštine pomaže u stvaranju osnove za njezinu valorizaciju i očuvanje.

Ključne riječi: modernistička arhitektonska baština, kriteriji valorizacije, tematski okvir, identifikacija baštine, zapadna Hercegovina



Oral presentation

METHODOLOGICAL APPROACH TO THE IDENTIFICATION OF MODERNIST ARCHITECTURAL HERITAGE IN WESTERN HERZEGOVINA

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Abstract: The topic of modernist architecture conservation gained significant attention in recent decades. This is something we can primarily attribute to international organizations such as ICOMOS, Docomomo or the Getty Institute. In Bosnia and Herzegovina, the authenticity and integrity of modernist heritage have been compromised by the loss of archives and inappropriate post-war interventions on buildings, highlighting the need for systematic identification of heritage in the country. The legislative framework of Bosnia and Herzegovina does not recognize modernist architecture as a distinct category but evaluates all heritage according to the same criteria. In addition, regulations propose that only heritage built until 1960 can be designated as a national monument, with the possibility of some exceptions. International documents and charters, such as the Nara Document, emphasize the need to define valorisation criteria within each geocultural context. In this sense, the Twentieth-Century Historic Thematic Framework, published by the Getty Conservation Institute, serves as a methodological tool for the interpretation and identification of twentieth-century heritage. The book presents ten key themes through essays, alongside a catalogue of building types and a gallery of examples for each theme, establishing a contextual framework for heritage recognition. Each of these themes, such as rapid urbanization, scientific and technological development or mechanized and industrialized agriculture, enables the identification of heritage within the local context of Western Herzegovina. For example, themes related to agriculture help us recognize typologies such as wineries (Hepok Winery, Stanko Fabris, 1957). Scientific and technological development highlights public health buildings (Anti-tuberculosis dispensary, Tihomir Ivanović, 1949) and themes of transportation and mass communication indicate the importance of postal facilities (Tomislavgrad post office, Ahmed Kapidžić, 1979). The use of an international thematic framework and its adaptation to a specific local context are key steps for the identification of heritage in a certain area. Modern architectural heritage in western Herzegovina has long been neglected and ignored by the public and the authorities, despite its role in the creation of the region's urban identity. The systematic identification of heritage helps form the basis for its valorisation and conservation.

Key words: modernist architectural heritage, valorisation criteria, thematic framework, heritage identification, Western Herzegovina

USPOREDBA ANALIZE ARMIRANOBETONSKOG PREDNAPETOG NOSAČA U SOFTVERSKIM PAKETIMA TOWER 8 I SOFiSTiK

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Sažetak: U radu je prikazana usporedba analize armiranobetonskog prednapetog nosača u dva različita softverska paketa: Tower 8 tvrtke Radimpex i SOFiSTiK AG. Prednapeti AB nosač prolazi kroz dvije faze: u prvoj fazi riječ je o slobodno oslonjenom nosaču raspona 11,55 m i visine 0,85 m; u drugoj fazi postaje kontinuirani nosač preko četiri raspona (12,45 m + 12,50 m + 12,50 m + 12,45 m) visine 1,10 m. Uz promjenu statičkog sustava, dolazi i do promjene poprečnog presjeka, čija se visina povećava s 0,85 m na 1,10 m izvedbom monolitizacije betonom ugrađenim na licu mjesta. Prednapinjanje je predviđeno s dva kabela $12 \times 150 \text{ mm}^2$, uz korištenje čelika kvalitete Y1860S7 15,7 (St. 1600/1860). U prvoj fazi nosač preuzima opterećenja od vlastite težine, težine šupljih ploča međukatne konstrukcije i težine betona ugrađenog na licu mjesta za monolitizaciju. U ovoj se fazi također izvodi prednapinjanje nosača. U drugoj fazi nosač preuzima dodatno trajno opterećenje od međukatne konstrukcije u iznosu od $2,50 \text{ kN/m}^2$ te korisno opterećenje od 6 kN/m^2 . Analiza nosača provedena je zasebno za prvu i drugu fazu, primjenom i Towera i SOFiSTiK-a. Proračun je proveden u skladu s normama Eurokoda. U softverskom paketu SOFiSTiK, faze izgradnje su uzete u obzir pomoću Construction Stage Managera (CSM), koji omogućuje analizu nosača kod kojeg se mijenja i presjek i statički sustav. Pored ovih čimbenika, u obzir su uzeti i učinci puzanja i skupljanja betona koji se javljaju između pojedinih faza. U softverskom paketu Tower 8, također je korištena mogućnost modeliranja faza izgradnje. Iako nije moguće uzeti u obzir reologiju betona između pojedinih faza, bilo je moguće modelirati različite poprečne presjeke koji se mijenjaju kroz faze, kao i promjenjive statičke sustave. Utvrđeno je da nosač analiziran pomoću CSM-a u SOFiSTiK-u pokazuje očekivano ponašanje. Za nosač analiziran kroz faze izgradnje u Toweru 8, dobivene rezne sile su u skladu s očekivanjima. Međutim, dimenzioniranje betonskog poprečnog presjeka za ove sile ne podudara se s očekivanim rezultatima. Iako su promjene statičkog sustava kroz faze izgradnje u Toweru 8 dobro obuhvaćene, promjene poprečnog presjeka kroz faze i dalje daju neočekivane rezultate. To ukazuje na potencijalno područje za daljnji razvoj softvera u tom smjeru.

Ključne riječi: prednapregnuti nosač, faze izgradnje, Tower 8 Radimpex, SOFiSTiK AG



Poster presentation

COMPARISON OF RC PRESTRESSED BEAM ANALYSIS IN TOWER 8 AND SOFiSTIK SOFTWARE PACKAGES

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Abstract: The paper presents a comparison of the analysis of an RC prestressed beam in two different software packages: Tower 8, Radimpex and SOFiSTiK AG. The RC prestressed beam undergoes two stages: in the first stage, it is a simple beam with a span of 11.55 m and a height of 0.85 m; in the second stage, it becomes a continuous beam over four spans (12.45 m + 12.50 m + 12.50 m + 12.45 m) with a height of 1.10 m. In addition to the change in the static system, the cross-section also changes, increasing in height from 0.85 m to 1.10 m through the casting of in-situ concrete for monolithization. Prestressing is planned with two 12x150 mm² cables, using Y1860S7 15.7 (St. 1600/1860) grade steel. In Stage 1, the beam carries the loads from its self-weight, the weight of the hollow-core slabs of the floor structure, and the weight of the in-situ concrete for monolithization. The prestressing of the beam also takes place during this stage. In Stage 2, the beam carries an additional permanent load from the floor structure amounting to 2.50 kN/m² and a live load of 6 kN/m². The beam analysis was performed for both Stage 1 and Stage 2 separately using both Tower and SOFiSTiK. The calculation was carried out in accordance with Eurocode standards. In the SOFiSTiK software package, the construction stages were accounted for using the Construction Stage Manager (CSM), which enables the analysis of a beam that changes both its cross-section and static system. In addition to these factors, the effects of concrete creep and shrinkage occurring between individual stages are also taken into consideration. In the Tower 8 software package, the construction stage modelling feature was also utilized. Although it is not possible to account for concrete rheology between individual stages, it was possible to model the different cross-sections that change through the phases, as well as the evolving static systems. It was determined that the beam analysed using CSM in SOFiSTiK performs as expected. For the beam analysed via construction stages in Tower 8, the resulting internal forces are consistent with expectations. However, the dimensioning of the concrete cross-section for these forces does not align with the expected results. While changes to the static system through construction stages are well-accounted for in Tower 8, changes to the cross-section across stages still yield unexpected results. This indicates a potential area for further software development in this direction.

Key words: prestressed beam, construction stages, Tower 8 Radimpex, SOFiSTiK AG

ZELENI VODIK U FUNKCIJI SKLADIŠTENJA VIŠKOVA ENERGIJE IZ SOLARNIH FOTONAPONSKIH ELEKTRANA I VJETROELEKTRANA

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Sažetak: Europski zeleni plan (engl. European Green Deal) obuhvaća niz mjera i političkih inicijativa kojima Europska unija nastoji postići klimatsku neutralnost do 2050. godine te potaknuti razvoj održivog gospodarstva. Posljednjih godina sve se više ulaže u obnovljive izvore energije, prvenstveno zbog potrebe za smanjenjem emisija stakleničkih plinova, ali i zbog rastuće nesigurnosti u opskrbi fosilnim gorivima uzrokovane globalnim političkim i gospodarskim krizama. Ubrzana izgradnja solarnih fotonaponskih elektrana i vjetroelektrana dovodi do sve češće pojave viškova električne energije koje postojeća elektroenergetska infrastruktura ne može prihvatiti. Jedno od mogućih rješenja je zeleni vodik. Za proces proizvodnje 1 kg zelenog vodika potrebno je oko 15 litara vode, električna energija iz obnovljivih izvora i elektrolizer. Mnoge države danas ulažu u proizvodnju jeftine električne energije iz sunčeve energije i energije vjetra kako bi proizvele zeleni vodik za vlastite potrebe ili izvoz. Očekuje se da će tržište elektrolizera značajno rasti. Njemačka energetska tvrtka RWE u okviru strategije „Growing Green” planira ostvariti oko 2 GW vlastitih kapaciteta elektrolizera. Od projekata trenutno se ističe postrojenje u Lingenu u Njemačkoj, planirane snage oko 300 MW s početkom rada 2027. godine, dok je u Nizozemskoj u razvoju projekt Eemshydrogen snage 50 MW. Viškovi električne energije proizvedene iz obnovljivih izvora mogu se iskoristiti za proizvodnju i skladištenje vodika, koji se potom može transportirati postojećom infrastrukturu uz gotovo nikakve emisije štetnih plinova. Za razliku od baterijskih sustava skladištenja energije, koji imaju ograničen kapacitet, podložni su degradaciji i ovise o uvjetima okoline, vodik omogućuje dugotrajnije skladištenje energije. Istražuju se i mogućnosti skladištenja vodika u akumulacijskim jezerima i rezervoarima. Zeleni vodik se preko gorivnih ćelija najčešće koristi u prometu za pogon vozila namijenjenih kopnenom i pomorskom prijevozu teških tereta, dok se dio istraživanja usmjerava i prema zrakoplovstvu. Značajnu primjenu zeleni vodik ima i u metalurškoj i kemijskoj industriji, te u opskrbi energijom velikih podatkovnih centara. Za razliku od ostalih nijansi vodika kao što su plavi, sivi ili tirkizni, zeleni vodik ima najveće izgleda postati gorivo budućnosti jer predstavlja poveznicu na obnovljive izvore energije.

Ključne riječi: solarni FN sustavi, vjetroelektrane, zeleni vodik, elektrolizer, skladištenje, gorivne ćelije, prijevoz



Poster presentation

GREEN HYDROGEN AS A MEANS OF STORING SURPLUS ENERGY FROM SOLAR PHOTOVOLTAIC POWER PLANTS AND WIND FARMS

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Abstract: The European Green Deal comprises a set of measures and policy initiatives through which the European Union seeks to achieve climate neutrality by 2050 and stimulate the development of a sustainable economy. In recent years, there has been increasing investment in renewable energy sources, primarily due to the need to reduce greenhouse gas emissions, but also due to the growing uncertainty in the supply of fossil fuels caused by global political and economic crises. The accelerated construction of solar photovoltaic power plants and wind farms leads to an increasingly frequent occurrence of surplus electricity that cannot be accommodated by the existing power infrastructure. One of the potential solutions is green hydrogen. The production process for 1 kg of green hydrogen requires approximately 15 litres of water, electricity from renewable sources, and an electrolyser. Many countries are currently investing in the generation of low-cost electricity from solar and wind energy in order to produce green hydrogen for domestic use or export. The electrolyser market is expected to grow significantly. The German energy company RWE, as part of its “Growing Green” strategy, plans to develop approximately 2 GW of its own electrolyser capacity. Among the projects, the plant in Lingen, Germany, currently stands out with a planned capacity of around 300 MW and commissioning scheduled for 2027, while the Eemshydrogen project with a capacity of 50 MW is under development in the Netherlands. Surplus electricity generated from renewable sources can be used for the production and storage of hydrogen, which can then be transported through the existing infrastructure with almost no emissions of harmful gases. Unlike battery energy storage systems, which have limited capacity, are subject to degradation and depend on environmental conditions, hydrogen enables longer-term energy storage. The possibilities of storing hydrogen in storage reservoirs and tanks are also being explored. Green hydrogen is most commonly used through fuel cells in transport to power vehicles intended for land and maritime transport of heavy cargo, while part of the research is also focused on its application in aviation. Green hydrogen also has significant applications in the metallurgical and chemical industries, and in the energy supply of large data centres. Unlike other shades of hydrogen such as blue, gray or turquoise hydrogen, green hydrogen has the greatest potential to become the fuel of the future as it represents a link to renewable energy sources.

Key words: solar PV systems, wind farms, green hydrogen, electrolyser, storage, fuel cells, transport

ISPITIVANJE PROBNIM OPTEREĆENJEM VIJADUKTA BABINA RIJEKA

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Sažetak: Rad prikazuje ispitivanje probnim opterećenjem vijadukta Babina Rijeka smještenog na koridoru Vc, dionica: Donja Gračanica-Klopče, Zenica Bypass. Vijadukt Babina rijeka sastoji se od dva paralelna objekta pojedinačne dužine 385 m. Objekti imaju po tri raspona sa srednjim rasponom od 165 m. Rasponska konstrukcija je sandučastog poprečnog presjeka promjenjive visine, izvedena od prednapregnutog betona. Srednji stupovi su visine cca 60 i 80 m. Temeljenje objekata je na armiranobetonskim bunarima dubine 18 m i promjera 12 m. Oba objekta su građena metodom slobodne konzolne gradnje. Normom oznake U.M1.046 iz 1984. godine, preuzetom iz JUS standarda, vrši se ispitivanje mostova probnim opterećenjem u Bosni i Hercegovini što je jedan od uvjeta za tehnički pregled i izdavanje uporabne dozvole a odnosi se na cestovne mostove raspona većeg od 15 m i željezničke mostove raspona većeg od 10 m. Ispitivanjem se utvrđuju odgovori konstrukcije mosta na statička i dinamička opterećenja predviđena projektom. Na vijaduktu Babina Rijeka mjereni su progibi u svim poljima dok su se relativne deformacije betona mjerile u polju 2 te iznad stupa S2. Mjerenje naprezanja, progiba i deformacija se vršilo prije, za vrijeme i poslije nanošenja probnog opterećenja (rasterećenje). Probno opterećenje je izvedeno s 10 teretnih vozila pojedinačne težine od oko 400 kN postavljenih u položaje u kojem izazivaju najveća naprezanja u poljima i nad stupom S2. Za navedena probna opterećenja izvršen je proračun vijadukta u programskom paketu Radimpex, Tower te su prikazani potrebni dijagrami za računsko prometno opterećenje i probno opterećenje. Odnos između promatranih veličina računskog prometnog i probnog opterećenja u svim promatranim dijagramima je veći od 0,50 a manji od 1,0 što i zahtjeva norma za ispitivanje mostova. Odnosno, koeficijent efikasnosti za mjerenje utjecaja u poljima vijadukta iznosio je od 0,57 do 0,98 ovisno o polju dok je koeficijent efikasnosti za mjerenje utjecaja na stupu S2 iznosio 0.57. Dinamički odgovor konstrukcije se mjerio za dinamičku pobudu koji je izazvalo jedno teretno vozilo prelaskom preko daske debljine 5 cm pri brzini oko 20 km/h. Vlastite frekvencije konstrukcije vijadukta su određene iz dijagrama ubrzanja dobivenog mjerenjem akcelerometrom. Nakon izvršenih mjerenja i provedenih računskih analiza utvrđena je visoka razina podudarnosti izmjerenih parametara te je verificirana izvedba građevine.

Ključne riječi: mostovi, probno opterećenje, pomaci, naprezanja, frekvencije osciliranja



Oral presentation

LOAD TESTING OF THE BABINA RIJEKA VIADUCT

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Abstract: The paper presents the load testing of the Babina Rijeka viaduct, located on Corridor Vc, section Donja Gračanica–Klopče, Zenica Bypass. The Babina Rijeka viaduct consists of two parallel structures, each with a length of 385 m. The structures have three spans, with the middle span measuring 165 m. The superstructure is with box cross section of variable height, made of prestressed concrete. The middle piers are approximately 60 and 80 m high. The foundations of the structures are on reinforced concrete wells 18 m deep and 12 m in diameter. Both structures were constructed using the free cantilever construction method. According to the standard designated as U.M1.046 from 1984, derived from the JUS standard, bridge load testing is carried out in Bosnia and Herzegovina as one of the requirements for technical inspection and issuance of an operating permit. This applies to road bridges with spans greater than 15 m and railway bridges with spans greater than 10 m. The testing determines the response of the bridge structure to static and dynamic loads specified in the design. On the Babina Rijeka viaduct, deflections were measured in all spans, while relative deformations of the concrete were measured in span 2 and above pier S2. Measurements of stresses, deflections, and deformations were performed before, during, and after the test loading (unloading). The load testing was performed with 10 freight vehicles, each with a weight of about 400 kN, positioned to induce maximum stresses in the spans and above pier S2. For the specified test loads, a structural analysis of the viaduct was performed using the Radimpex Tower software package, and the required diagrams for the design traffic load and the test load were presented. The ratio between the observed values of the design traffic load and the test load in all of the examined diagrams is greater than 0.50 and less than 1.0, as required by the bridge testing standard. Specifically, the efficiency coefficients were between 0.57 to 0.98, depending on the span, for measuring the effect in the viaduct spans, while the efficiency coefficient for measuring the effect on pier S2 was 0.57. The dynamic response of the structure was measured for the dynamic excitation caused by a freight vehicle passing over a 5 cm thick plank at a speed of about 20 km/h. The natural frequencies of the viaduct structure were determined from the acceleration diagram obtained by accelerometer measurements. After the measurements were carried out and computational analyses were performed, a high level of agreement between the measured parameters was established, and the performance of the structure was verified.

Key words: bridges, test load, displacements, stresses, oscillation frequencies

PROCJENA SEIZMIČKE OTPORNOSTI POSTOJEĆE ZIDANE ZGRADE

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Sažetak: Na području Hercegovine nalazi se veliki broj građevina sa zidanim zidovima od kamenih blokova kao glavnim vertikalnim nosivim elementima. Ovi zidovi su većinom izgrađeni od obrađenog i poluobrađenog kamena, vezanog vapnenim mortom. Međukatne konstrukcije se vrlo često sastoje od drvenih nosivih greda preko kojih su pribijene daske, dok je prostor između greda djelomično ispunjen šutom. Zgrada gimnazije u Širokom Brijegu je izgrađena između 1924. i 1929. godine. Njezine tlocrtne dimenzije su $65,7 \times 30,6$ metara. Zgrada ima tlocrt u obliku slova E te se sastoji od sjevernog krila, južnog krila i središnjeg dijela. Sjeverno krilo obuhvaća podrum, prizemlje i jedan kat, dok se južno krilo sastoji od prizemlja i jednog kata. Središnji dio obuhvaća prizemlje i tri kata. Krovna konstrukcija je tradicionalna drvena, s pokrovom od bakrenog lima. Kroz statičku i dinamičku analizu konstrukcije određeni su razina i način ojačanja pojedinih dijelova konstrukcije. Propisi zahtijevaju da konstrukcija zadovolji granična stanja ograničenja oštećenja (DL) i značajnog oštećenja (SD). U tu svrhu provedena je nelinearna statička (pushover) analiza kako bi se provjerilo zadovoljenje navedenih dvaju kriterija. Provedena je i preliminarna linearna dinamička analiza koja je isto tako pokazala da konstrukcija zgrade ne zadovoljava zahtijevanu seizmičku otpornost. Iz svega navedenog može se zaključiti da je konstrukciju zgrade potrebno ojačati. Ovo ojačanje se prvenstveno odnosi na kamene zidove. Postoji nekoliko načina za ojačanje zidova, a odabir uglavnom ovisi o vrsti sloma pojedinog zida (savojni, posmični, vlačni ili tlačni slom). Projektom je predviđena i zamjena drvenih međukatnih konstrukcija spregnutom konstrukcijom čelik-beton, kako bi se ostvarila bolja veza između zidova i stropne konstrukcije, što je osnovni preduvjet za dobru seizmičku otpornost građevine.

Ključne riječi: kameni zidovi, drveni stropovi, seizmička analiza, seizmička otpornost, granična stanja, konstrukcijsko ojačanje



Oral presentation

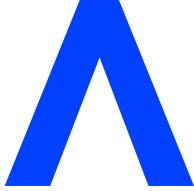
SEISMIC ASSESSMENT OF AN EXISTING MASONRY BUILDING

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Abstract: In the Herzegovina region, there is a large number of buildings with masonry walls made of stone blocks as the main vertical load-bearing elements. These walls are mostly constructed from dressed and semi-dressed stone, bonded with lime mortar. The floor structures very often consist of wooden load-bearing beams with planks nailed over them, while the space between the beams is partially filled with rubble. The gymnasium building in Široki Brijeg was constructed between 1924 and 1929. Its plan dimensions are 65.7×30.6 meters. The building has an E-shaped floor plan and consists of a northern wing, a southern wing, and a central section. The northern wing comprises a basement, ground floor, and one upper floor, while the southern wing consists of a ground floor and one upper floor. The central section has a ground floor and three upper floors. The roof structure is a traditional wooden construction, with copper sheet roofing. Through static and dynamic analysis of the structure, the level and method of strengthening for individual parts of the structure were determined. Regulations require that the structure satisfy the limit states of Damage Limitation (DL) and Significant Damage (SD). For this purpose, a nonlinear static (pushover) analysis was performed to verify the fulfilment of these two criteria. A preliminary linear dynamic analysis was also conducted, which likewise showed that the building structure does not meet the required seismic resistance. From all of the above, it can be concluded that the structure of the building needs to be strengthened. This strengthening primarily applies to stone walls. There are several ways to strengthen walls, and the choice mainly depends on the type of failure of a particular wall (bending, shear, tension, or crushing). The project also provides replacing wooden interfloor structures with a composite steel-concrete structure, in order to achieve better connection between walls and floor structure, which is a basic prerequisite for good seismic resistance of the structure.

Key words: stone walls, wooden ceilings, seismic analysis, seismic resistance, limit states, structural strengthening



ARHITEKTONSKA OTVORENOST: NEODREĐENOST KAO STRATEGIJA PROJEKTIRANJA U OBITELJSKOM STANOVANJU

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Sažetak: Koncept otvorenosti u arhitekturi proteže se daleko izvan vizualne transparentnosti. To je projektna karakteristika koja obuhvaća dinamičnu i nepredvidivu prirodu ljudskog stanovanja. Utemeljena na načelima otvorenih sustava, otvorenost djeluje kao latentno svojstvo koje građevini omogućuje aktivnu razmjenu energije, tvari i utjecaja s okolinom. Dok arhitektonski diskurs ovaj potencijal često pretjerano pojednostavljuje svodeći ga na fleksibilnost, odnosno konačan skup permutacija unutar zatvorenog sustava, ova studija definira otvorenost kao širi sustavni kapacitet. To je specifično svojstvo koje građevini omogućuje da prihvati nepredviđene promjene bez narušavanja vlastitog identiteta. Kako bi se ispitala neodređenost kao promišljena strategija projektiranja, istraživanje koristi tipologiju obiteljske kuće kao pokusni poligon. Unatoč svojoj velikoj zastupljenosti, obiteljska kuća ostaje nedovoljno istražena u pogledu svog kapaciteta za promjenu. Obiteljska kuća pokazuje se idealnim mjerilom za analizu namjere arhitekta u pogledu prostorne neodređenosti, aktivne uloge korisnika i inherentne sposobnosti građevine za buduću prilagodbu. Konceptualizacija građevine kao otvorenog djela obuhvaća pitanje prijenosa autoriteta. Otvorenost se oslanja na materijalne konfiguracije koje preraspodjeljuju kontrolu nad transformacijom prostora s arhitekta na stanara. Namjernim prepuštanjem dijela autorske kontrole i ostavljanjem određenih prostora namjerno neodređenima, arhitekt osnažuje stanara stvarnom aktivnom ulogom. Stoga se težište istraživanja pomiče s pretjerano definiranih tlocrta prema fleksibilnim okvirima, s ciljem izoliranja specifičnih tehničkih mehanizama koji generiraju otvorenost. Ti se mehanizmi ispituju kroz napetost između fiksnih infrastrukturnih sidrišta i varijabilnih prostornih kapaciteta. Razumijevanje tih mehanizama otkriva da istinska prilagodljivost nije samo prostorna pogodnost, već temeljni preduvjet za dugoročnu održivost. Otvorenost je duboko održivo svojstvo koje produljuje životni vijek izgrađenog okoliša i redefinira odnos između arhitekta, građevine i onih koji u njoj borave. Ona pruža okvir za promatranje izgrađenog okoliša kao živog i promjenjivog procesa te nudi alate za arhitekturu koja napreduje kroz vlastitu transformaciju.

Ključne riječi: otvorenost, neodređenost, obiteljska kuća, aktivna uloga korisnika, otvoreni sustav





Oral presentation

ARCHITECTURAL OPENNESS: INDETERMINACY AS A DESIGN STRATEGY IN SINGLE-FAMILY HOUSING

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Abstract: The concept of openness in architecture extends far beyond visual transparency. It is a design feature that addresses the dynamic and unpredictable nature of human dwelling. Rooted in open system principles, openness acts as a latent trait that enables a building to actively exchange energy, matter, and influence with its surroundings. While architectural discourse often oversimplifies this potential as flexibility, a finite set of permutations within a closed system, this study defines openness as a broader systemic capacity. It is a distinct quality that allows a building to accommodate unforeseen changes without compromising its identity. To explore indeterminacy as a deliberate design strategy, the research uses the typology of the single-family house as a testing ground. Despite its predominance, the single-family house remains under-researched regarding its capacity for change. The private house proves to be an ideal scale for analysing architect's intent regarding spatial indeterminacy, user agency, and the building's inherent capacity for future adaptation. Conceptualizing a building as an open work encompasses the issue of authority transfer. Openness relies on material configurations that redistribute control over transformation of space from architect to the inhabitant. By intentionally letting go of a degree of authorial control and leaving certain spaces deliberately indeterminate, the architect empowers the inhabitant with genuine agency. Therefore, the focus of the research shifts from overly defined floor plans towards resilient frameworks, aiming to isolate the specific technical mechanisms that generate openness. These mechanisms are examined through the tension between fixed infrastructural anchors and variable spatial capacities. Understanding these mechanisms reveals that true adaptability is not merely a spatial convenience, but a foundational requirement for long-term endurance. Openness is a deeply sustainable property that extends the lifecycle of the built environment and redefines the relationship between the architect, the structure, and those who dwell in it. It provides a framework for viewing the built environment as a living, evolving process and offers a toolkit for architecture that flourishes through its own transformation.

Key words: openness, indeterminacy, single-family housing, user agency, open system

VIŠEKRITERIJSKO DONOŠENJE ODLUKA U PLANIRANJU I PROJEKTIRANJU TRASE ŽELJEZNIČKE PRUGE

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Sažetak: Ovaj rad istražuje proces donošenja odluka u planiranju i projektiranju trasa željezničkih pruga primjenom višekriterijskog odlučivanja, s posebnim naglaskom na metodu VIKOR. Donošenje odluka je ključan proces za utvrđivanje i odabir alternativa, koji zahtijeva pronalaženje najboljeg rješenja uzimajući u obzir različite čimbenike i očekivanja donositelja odluka. Složenost ovog procesa naglašava prisutnost brojnih, često suprotstavljenih kriterija i sudjelovanje interdisciplinarne skupine stručnjaka, među kojima su građevinski i željeznički inženjeri, prometni stručnjaci i konzultanti za zaštitu okoliša. U radu se predstavlja sveobuhvatna metodologija odabira trase za planiranje i projektiranje željezničke pruge temeljena na metodama višekriterijskog odlučivanja. Kako bi se obuhvatio značajan utjecaj težinskih koeficijenata na konačno rangiranje, težine kriterija su strogo određene na temelju stručnih prosudbi primjenom metode analitičkog hijerarhijskog procesa (AHP-a). Evaluacijski okvir obuhvaća detaljne tehničke, ekonomske i okolišne kriterije, s posebnim naglaskom na kapitalne troškove investicije, geometrijska ograničenja projektiranja (poput polumjera horizontalnih krivina i njihova utjecaja na trošenje tračnica), funkcionalnu klasifikaciju kolodvora i okolišnu održivost. Glavni je naglasak na metodi kompromisnog rangiranja VIKOR, koja se primjenjuje za učinkovit odabir najbolje alternative. Kroz praktičan primjer, razvijena je metodologija verificirana pri odabiru jedne od četiriju varijanti trase željezničke pruge za stvarni infrastrukturni projekt duž Paneuropskog koridora VIII u Sjevernoj Makedoniji, čime je model prešao iz teorijske simulacije u praktičan inženjerski alat. Rezultati pokazuju da predložena metodologija omogućuje donošenje informiranih odluka uzimajući u obzir različite aspekte, uključujući ekonomsku učinkovitost, okolišnu održivost i funkcionalnost. Zaključci ovog istraživanja naglašavaju važnost višekriterijskog pristupa donošenju odluka u planiranju infrastrukturnih projekata te istodobno otvaraju mogućnosti za daljnja istraživanja i primjenu ovih metoda u različitim kontekstima.

Ključne riječi: planiranje i projektiranje, željeznička trasa, višekriterijsko donošenje odluka, VIKOR, kompromisno rješenje



Poster presentation

MULTICRITERIA DECISION-MAKING IN THE PLANNING AND DESIGN OF RAILWAY LINE ALIGNMENT

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Abstract: This paper explores the decision-making process for planning and designing railway track routes using multi-criteria decision-making, with a particular focus on the VIKOR method. Decision-making is a crucial process for identifying and selecting alternatives, requiring the identification of the best solution by considering various factors and the decision-maker's expectations. The complexity of this process is underscored by the presence of multiple, often conflicting criteria and the involvement of an interdisciplinary group of experts, including structural and railway engineers, traffic specialists, and environmental consultants. The paper presents a comprehensive methodology for selecting a route for railway track planning and design based on multi-criteria decision-making methods. To address the significant influence of weighting coefficients on the final ranking, the criteria weights were rigorously determined based on expert judgments using the Analytic Hierarchy Process (AHP) method. The evaluation framework encompasses detailed technical, economic, and environmental criteria, specifically focusing on capital investment costs, geometric design constraints (such as horizontal curve radii and their impact on rail wear), functional classification of stations, and environmental sustainability. The main focus is on the VIKOR compromise ranking method, which is applied for efficient selection of the best alternative. Through a practical example, the developed methodology was verified in the selection of one of four railway track route variants for a real infrastructure project along Pan-European Corridor VIII in North Macedonia, transitioning the model from a theoretical simulation to a practical engineering tool. The results show that the proposed methodology enables informed decision-making by considering various aspects, including economic efficiency, environmental sustainability, and functionality. The conclusions of this research emphasize the importance of a multi-criteria approach to decision-making in the planning of infrastructure projects, while opening avenues for further research and the application of these methods in various contexts.

Key words: planning and designing, railway route, multi-criteria decision-making, VIKOR, compromise solution

RAZVOJ ANALITIČKOG OKVIRA ZA MODELIRANJE PROCESA TRANSFORMACIJE I ISHODA TAKTIČKIH URBANIH INTERVENCIJA

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Sažetak: U posljednjem desetljeću taktički urbanizam se sve više koristi kao urbanistički pristup za testiranje prostornih i prometnih rješenja kroz privremene i eksperimentalne intervencije u javnom prostoru. Unatoč širokoj primjeni i dalje nije dovoljno razjašnjeno zašto neke intervencije dovode do trajnih urbanih transformacija, dok druge ostaju privremene, ponavljaju se kroz vrijeme ili ne rezultiraju daljnjom implementacijom. Polazeći od tog problema, rad se usmjerava na razumijevanje različitih razvojnih putanja taktičkih urbanih intervencija. Cilj rada je razviti strukturirani analitički okvir za proučavanje procesa transformacije taktičkih urbanih intervencija te identificirati ključne čimbenike koji utječu na njihove ishode. Taktičke intervencije pritom se promatraju kao dio šireg spektra eksperimentalnih pristupa u urbanizmu. Provedena analiza ukazuje na to da taktički pristup može imati različite uloge u procesu urbane transformacije. Može biti integriran u formalne pilot projekte kao način izvedbe i testiranja rješenja ili se pojaviti kao samostalna intervencija usmjerena na aktivaciju prostora. Istraživanje se temelji na komparativnoj analizi studija slučaja u europskom kontekstu, pri čemu je uzorak definiran kroz skup jasno utvrđenih kriterija odabira koji osiguravaju prisutnost eksperimentalne faze, mogućnost rekonstrukcije procesa te identifikaciju konačnog ishoda. Odabrani primjeri klasificirani su prema tipu intervencije (design-based, mobility-based i hibridne), a analiza se provodi kroz strukturirani sustav varijabli koji obuhvaća kontekst, proces, čimbenike i ishod. Analitički okvir posebno naglašava procesne varijable koje omogućuju rekonstrukciju tijekom razvoja intervencija, uključujući način implementacije, trajanje pilot faze, strukturu faza, razinu iteracija, prisutnost evaluacije i brzinu transformacije, te njihovu povezanost s analitičkim varijablama kao ključnim čimbenicima. Na temelju primjene okvira predlaže se preliminarna tipologija procesa transformacije te konceptualni model koji objašnjava kako različiti čimbenici utječu na divergentne ishode intervencija. Preliminarni uvidi ukazuju na postojanje različitih obrazaca transformacije, uključujući linearne procese koji vode do trajne implementacije, iterativne procese koji se razvijaju kroz ponavljanje i prilagodbu te procese koji ne rezultiraju daljnjom transformacijom. Također se uočava da početni tip intervencije ne određuje nužno ishod, već ključnu ulogu imaju čimbenici poput institucionalne podrške, prisutnosti evaluacije i razine iterativnog razvoja. Time se taktički urbanizam interpretira kao procesualni pristup, čime se doprinosi njegovom sustavnijem razumijevanju i primjeni u urbanističkoj praksi.

Ključne riječi: taktičke urbane intervencije, transformacijski procesi, analitički okvir, tipologija transformacije, ishodi transformacije



Poster presentation

DEVELOPMENT OF AN ANALYTICAL FRAMEWORK FOR MODELLING TRANSFORMATION PROCESSES AND OUTCOMES OF TACTICAL URBAN INTERVENTIONS

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Abstract: In the last decade, tactical urbanism has been increasingly used as an urban planning approach for testing spatial and traffic solutions through temporary and experimental interventions in public space. Despite its wide application, it remains insufficiently understood why some interventions lead to permanent urban transformations, while others remain temporary, are repeated over time, or fail to result in further implementation. Starting from this problem, the paper focuses on understanding the different developmental trajectories of tactical urban interventions. The aim of the paper is to develop a structured analytical framework for studying the transformation processes of tactical urban interventions and to identify the key factors influencing their outcomes. Tactical interventions are viewed as part of a wider spectrum of experimental approaches in urban planning. The conducted analysis indicates that the tactical approach can play different roles in the process of urban transformation. It can be integrated into formal pilot projects as a method of implementing and testing solutions or appear as an independent intervention aimed at activating space. The research is based on a comparative analysis of case studies in the European context, with the sample defined through a set of clearly established selection criteria that ensure the presence of an experimental phase, the possibility of reconstructing the process and the identification of the final outcome. The selected cases are classified by type of intervention (design-based, mobility-based, and hybrid), and the analysis is conducted through a structured system of variables that includes context, process, factors, and outcome. The analytical framework particularly emphasizes process variables that enable the reconstruction of the intervention development course, including the implementation method, pilot phase duration, phase structure, iteration level, presence of evaluation and pace of transformation, as well as their relationship with analytical variables as key factors. Based on the application of the framework, a preliminary typology of transformation processes is proposed along with a conceptual model that explains how different factors influence the divergent outcomes of interventions. Preliminary insights indicate the existence of different transformation patterns, including linear processes that lead to permanent implementation, iterative processes that develop through repetition and adaptation, and processes that do not result in further transformation. It is also observed that the initial type of intervention does not necessarily determine the outcome; rather, factors such as institutional support, the presence of evaluation, and the level of iterative development play a key role. In this way, tactical urbanism is interpreted as a process approach, which contributes to its more systematic understanding and application in urban planning practice.

Key words: tactical urban interventions, transformation processes, analytical framework, transformation typology, transformation outcomes

NAPREDNE TEHNOLOGIJE U POSLOVNIM ZGRADAMA 20. I 21. STOLJEĆA — PROSTORNI ODNOSI S KLASIČNIM MODELOM PALAČE

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Sažetak: Ovo istraživanje preispituje trajnost i transformaciju klasičnog modela palače kao prostorne paradigme unutar poslovnih zgrada 20. i 21. stoljeća s naglaskom na ulogu naprednih tehnologija u oblikovanju forme toga modela. Prostorna logika klasične palače Zapada, nastale u carskim kompleksima rimskog Palatina, ovisi o više prostornih parametara među kojima su najvažniji urbanistički kontekst i tipologija građevine. Samostojeća palača zasnovana je na hijerarhiji, osnovnoj organizaciji i kontroliranoj sekvenci kretanja kroz prostor, dok modernistička samostojeća palača dvadesetog stoljeća uvodi asimetričnost, djelomično odbacuje kontinuitet u korist funkcionalističkog i formalnog raskida, te zajedno s poluugrađenom i ugrađenom gradskom palačom transformira spomenute parametre, pritom zadržavajući neke od glavnih prostornih karakteristika osnovnog modela. Premda razmjerno fiksna u obliku, palača je iznimno fleksibilna u korištenju, pružajući prikladne prostore za različite uporabe. Istraživanja tipologije u arhitekturi pokazuju razvoj tipova zgrada a ne njihov nestanak, prilagođavajući se novim kulturnim, tehnološkim i ekonomskim uvjetima. Poslovne zgrade 20. i 21. stoljeća predstavljaju složene hibride u kojima se prostorna organizacija i specifična tehnološka inovacija prožimaju. Napredne tehnologije u poslovnim zgradama 20. i 21. stoljeća poput korištenja prednapregnutog betona i čelika u konstruktivnim sustavima zgrada, pristupa projektiranju osvjetljenja radnih prostora, velikih kondicioniranih interijerskih prostora koje prate kompleksni i pametni klimatski sustavi, materijalizacije adaptivnih pročelja i zaštite od sunca, digitalne infrastrukture senzorskog upravljanja prostorom, ne odmiču se već transformiraju klasični model palače. Napredne tehnologije prilagođene su suvremenom fleksibilnom radnom mjestu, velikim dvoranskim prostorima i tipologiji unutarnjih dvorišta kao nekima od prostornih karakteristika palače, te omogućuju međusobno povezivanje vertikalnih etaža interijera te time reinterpetiraju klasičnu tlocrtnu hijerarhiju u drugačijem pristupu projektiranja kroz presjek. Metodološki, istraživanje kombinira tipološko-povijesnu analizu s komparativnim urbanističkim mapiranjem te dijagramskom arhitektonskom analizom odabranih kanonskih primjera kroz jasno postavljene kriterije. Istraživanje pokazuje kako se prostorna hijerarhija ponovno artikulira putem tehnološkog posredovanja, stvarajući ambijente radnih prostora koji balansiraju između otvorenosti i kontrole, centraliziranosti i disperzije, reprezentacije i učinkovitosti. Cilj je pokazati da tehnološke inovacije ne djeluju kao prekid nego kao uvjet za reaktivaciju prostornih načela naslijeđenih iz klasičnog modela palače.

Ključne riječi: klasični model palače, prostorna paradigma, arhitektonska tipologija, poslovne zgrade 20. i 21. stoljeća, arhitektura radnog mjesta, napredne tehnologije zgrada, tehnološko posredovanje



Poster presentation

ADVANCED TECHNOLOGIES IN 20TH- AND 21ST-CENTURY OFFICE BUILDINGS — SPATIAL RELATIONS TO THE CLASSICAL PALACE MODEL

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Abstract: This research examines the persistence and transformation of the classical palace model as a spatial paradigm within 20th- and 21st-century office buildings, with particular emphasis on the role of advanced technologies in shaping its form. The spatial logic of the classical Western palace, which originated in the imperial complexes of the Roman Palatine, depends on several spatial parameters, the most important of which are the urban context and the building's typology. The free-standing palace is based on hierarchy, axial organization, and a controlled sequence of movement through space. In contrast, the modernist free-standing palace of the twentieth century introduces asymmetry, partially discards continuity in favour of a functionalist and formal break, and, together with the semi-built and built-in city palace, transforms these parameters, while retaining some of the main spatial characteristics of the basic model. Although relatively fixed in shape, the palace is extremely flexible in use, providing suitable spaces for various uses. The study of typology in architecture shows the development of building types rather than their disappearance, adapting to new cultural, technological, and economic conditions. Office buildings of the 20th and 21st centuries are complex hybrids in which spatial organization and specific technological innovation are intertwined. Advanced technologies in 20th- and 21st-century office buildings, such as the use of prestressed concrete and steel in building construction systems, approaches to designing workplace lighting, large air-conditioned interior spaces accompanied by complex and intelligent climate systems, materialization of adaptive facades and sun protection, digital sensor space management infrastructure, do not depart from but transform the classical palace model. Advanced technologies are adapted to the modern flexible workplace, large hall spaces, and typologies of inner courtyards as some of the spatial characteristics of the palace, and allow the interconnection of vertical interior spaces, and thus reinterpret the classical floor hierarchy in a different approach to design through the cross-section. Methodologically, the research combines typological-historical analysis with comparative urban mapping and diagrammatic architectural analysis of selected canonical examples through clearly defined criteria. Research shows how spatial hierarchies are being re-articulated through technological mediation, creating workplace environments that balance openness and control, centralization and dispersion, representation and efficiency. The aim is to show that technological innovation does not act as a disruption but as a condition for the reactivation of the spatial principles inherited from the classical palace model.

Key words: classical palace model, spatial paradigm, architectural typology, 20th- and 21st-century office buildings, workplace architecture, advanced building technologies, technological mediation

ISTRAŽIVANJE OBJEKATA U KRŠU U CILJU FORMIRANJA PROTOKOLA ISTRAŽIVANJA – OSVRT NA OTVORENE BUNARE

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Sažetak: Rad predstavlja dio istraživanja provedenih tijekom trajanja znanstveno-istraživačkog projekta pod nazivom „Unaprjeđenje i razvoj metoda za istraživanje i upravljanje objektima u kršu (poseban osvrt na otvorene bunare) u cilju istraživanja fenomena u kršu i mogućnosti korištenja u svrhu opskrbe vodom“. Projekt je financiran temeljem Javnog poziva FBiH Ministarstva obrazovanja i znanosti za podršku znanstveno-istraživačkih i istraživačko-razvojnih projekata s aktivnom primjenom u gospodarstvu u Federaciji Bosne i Hercegovine, u suradnji s Razvojnim programom Ujedinjenih naroda (UNDP) i projektima „Boljom upravom do bržeg ekonomskog rasta“ (EGG2) i „Prevođenje Okvira za realizaciju ciljeva održivog razvoja u Bosni i Hercegovini u održivi i inkluzivni rast“ (SDG2BIH) – R&D grant shema u 2024. godini. Kroz povijest, otvoreni bunari su služili za opskrbu vodom u krškim područjima gdje nije bilo moguće ostvariti zahvat pitke vode putem otvorenih tokova niti je postojao bilo kakav drugi pristup pitkoj vodi. Stanovništvo ih i danas koristi za određene potrebe u poljoprivredi ili stočarstvu. U prošlosti, za vrijeme velikih suša, ti bunari su predstavljali jedini izvor pitke vode. Radi se o objektima zidanim od kamena koji je bio osnovni građevinski materijal na ovom području. Objekti su neistraženi, te samo postoje predaje o tome kako su nastali i tko ih je gradio. Ne postoji izrađen protokol istraživanja ovakvih i sličnih objekata. Primijenjen je multidisciplinarni pristup istraživanju ovakvih objekata koji uključuje: arheološka, geološka, hidrogeološka, geodetska, konstrukcijska i hidraulička istraživanja koja će rezultirati s bazom podataka o području koje gravitira prema otvorenom zidanom kamenom bunaru – područje istraživanja je otvoreni bunar Jezerac, selo Goranci, Mostar. Projekt bi se mogao podijeliti na četiri cjeline koje uključuju sljedeće: analizu postojeće dokumentacije o predmetnom području, pregled sličnih istraživanja na drugim lokacijama i planiranje istražnih radova; izvođenje istražnih radova koji podrazumijevaju: geodetska, geološka, hidrogeološka, geofizička, konstrukcijska i hidraulička istraživanja „in situ“; obradu i analizu dobivenih rezultata istraživačkih radova; pisanje i objavljivanje rezultata istraživanja, formiranje protokola istraživanja otvorenih bunara i predstavljanje rezultata projekta. Projekt je rezultirao sa znanstvenim istraživanjima u različitim područjima tehničkih znanosti što u konačnici ima za cilj razvijen protokol istraživanja koji bi se mogao koristiti na bilo kojem objektu ove vrste. Kontinuirano se obavlja monitoring padalina i razina vode, izvršeno je pražnjenje Jezerca sa stalnim mjerenjem povrata vode i ispitivanjem parametara vode, urađeni su geofizički profili, kao i opsežna geodetska mjerenja u cilju formiranja digitalnog modela i terena i bunara. Izvršena je i procjena stanja zidane konstrukcije. U narednom razdoblju, nastaviti će se s monitoringom i radit će se analiza svih prikupljenih podataka dobivenih terenskim istraživanjima. Dobiveni rezultati predstavljaju temelj za uspostavljanje protokola istraživanja otvorenih bunara te doprinose boljem razumijevanju njihovih značajki i mogućnosti održivog korištenja u budućnosti.

Ključne riječi: krš, otvoreni bunar, protokol istraživanja, crpljenje, podzemna voda



Oral presentation

INVESTIGATION OF STRUCTURES IN KARST AIMED AT DEVELOPING A RE-SEARCH PROTOCOL – A REFERENCE TO OPEN WELLS

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Abstract: This paper presents part of the research conducted within the scientific research project entitled "Improvement and development of methods for the investigation and management of structures in karst (with special reference to open wells) aimed at studying karst phenomena and their potential use for water supply." The project was funded under the Public Call of the FBiH Ministry of Education and Science to support scientific-research and research-development projects with active application in the economy of the Federation of Bosnia and Herzegovina, in cooperation with the United Nations Development Programme (UNDP) and the projects "Economic Governance for Growth" (EGG2) and "Translating the Sustainable Development Goals Framework in Bosnia and Herzegovina into Sustainable and Inclusive Growth (SDG2BIH)" – R&D grant scheme in 2024. Throughout history, open wells were used for water supply in karst areas where drinking water could not be abstracted from open streams and no other access to drinking water existed. The population still uses them today for certain needs in agriculture and livestock farming. In the past, during severe droughts, these wells represented the only source of drinking water. These structures are built of stone, which was the primary construction material in this area. The structures are unexplored, and there is only oral tradition about how they were created and who built them. There is no developed research protocol for such and similar structures. A multidisciplinary approach to studying these structures was applied, which includes: archaeological, geological, hydrogeological, geodetic, structural, and hydraulic investigations. This will result in a database of the area associated with the open masonry stone well - the study area is the Jezerac open well, Goranci village, Mostar. The project can be divided into four stages, which include the following: analysis of existing documentation on the subject area, review of similar studies at other locations and planning of investigations; carrying out investigation works that include: geodetic, geological, hydrogeological, geophysical, structural and hydraulic in situ investigations; processing and analysis of the obtained research results; writing and publishing research results, establishing an investigation protocol for open wells and presenting the project results. The project resulted in scientific research in different fields of technical sciences, ultimately aiming to develop a research protocol that could be used on any structure of this type. Continuous monitoring of precipitation and water levels has been carried out; Jezerac was pumped out while continuously measuring the water level recovery and testing water parameters; geophysical profiles along with extensive geodetic surveys were conducted in order to develop a digital model of both the terrain and the well. An assessment of the condition of the masonry structure was also performed. In the coming period, monitoring will continue and an analysis of all collected data obtained from field investigations will be conducted. The obtained results provide a foundation for establishing a protocol for the investigation of open wells and contribute to a better understanding of their characteristics and potential for sustainable use in the future.

Key words: karst, open well, research protocol, pumping, groundwater



ARHITEKTONSKA OBILJEŽJA VIŠESTAMBENIH ZGRADA MOSTARA OD 1947. DO 1990. GODINE

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Sažetak: Ovaj rad bavi se sustavnom analizom arhitektonskih obilježja višestambene izgradnje Mostara od 1947. do 1990. godine. Neposredno nakon završetka Drugoga svjetskog rata Mostar doživljava najveću ekspanziju. Grad se obnavlja, uspostavlja se nova vlast te se pokreću veliki industrijski pogoni smješteni sjeverno i južno od Mostara. Porastom industrije raste broj stanovnika koji se doseljavaju iz drugih mjesta u Hercegovini, ali i iz cijele Jugoslavije. Proces industrijalizacije donio je zamjetnu količinu prateće izgradnje koja je utjecala na razvoj grada, posebice s arhitektonskog i urbanističkog gledišta. Iako obilježena zajedničkim nazivnikom modernosti, stambena arhitektura s vremenom apsorbira ovakav populacijski rast rezultirajući ostvarenjima heterogenih značajki. Upravo se heterogenost može okarakterizirati bitnom odrednicom korpusa promatranih ostvarenja te se ovim radom nastoje detektirati specifičnosti vezane uz pojedinačna rješenja dovodeći pritom iste u relaciju s kontekstom unutar kojega nastaju. Pored različitih prostornih i programskih zadanosti utvrđenih kroz same projektne zadatke, pritom se uzima u obzir različito porijeklo projektantskih praksi i modaliteti izrade projekata. Uzimajući u obzir mikroklimu Mostara kao temperaturnog ekstrema na razini države, različiti pristupi nadalje se promatraju kroz leću adaptabilnosti klimatskim uvjetima podneblja odnosno relevantnim prirodnim datostima lokacije. Uzimajući u obzir lokalnu graditeljsku tradiciju prepoznatu upravo u području stanovanja nastoje se detektirati njezini elementi koji usmjeravaju pristupe u domeni kulture. Istraživanje potvrđuje doprinose lokalnih autora kao što su Romeo Tiberio, Dušan Miljak i Hido Hasanbegović te regionalnih arhitekata poput Vuke Bombardellija i Andrije Čičin Šaina čiji je rad u kontekstu Mostara ostao nedovoljno interpretiran. Cilj ovog istraživanja je utvrditi specifične periode unutar promatranog razdoblja te kroz analizu primjera iz svakog perioda doći do određenih zaključaka koje će odgovoriti na unaprijed postavljena pitanja. Nadalje, u radu će se identificirati i analizirati prostorne karakteristike stanova nastalih u promatranom periodu što će rezultirati definicijom taksonomije „mostarskog stana“. Znanstveni doprinos ovog rada ogleda se u uspostavi temelja za zaštitu i valorizaciju vrijedne arhitektonske baštine višestambenih zgrada Mostara iz promatranog perioda. Kao takav rad će doprinijeti uspostavljanju smjernica za projektiranje višestambenih zgrada koje integriraju lokalne tipološke, morfološke i klimatske značajke promatranog područja.

Ključne riječi: višestambena arhitektura, socijalistički modernizam, urbanistička transformacija, arhitektonska baština



Oral presentation

ARCHITECTURAL CHARACTERISTICS OF RESIDENTIAL BUILDINGS IN MOSTAR FROM 1947 TO 1990

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Abstract: This paper presents a systematic analysis of the architectural characteristics of residential construction in Mostar from 1947 to 1990. Immediately after the end of World War II, Mostar experienced its greatest expansion. The city was rebuilt, a new administration was established, and large industrial plants were launched to the north and south of Mostar. With the growth of industry, the number of residents increased as population migrated from other areas in Herzegovina, but also from all over Yugoslavia. The process of industrialization generated substantial associated development that influenced the city's growth, particularly from an architectural and urban planning perspective. Although marked by the common denominator of modernity, residential architecture gradually absorbed this population growth, resulting in designs with heterogeneous characteristics. It is precisely this heterogeneity that can be described as a defining characteristic of the corpus of observed works, and this paper seeks to identify the specific features of individual designs, situating them within the context from which they emerged. In addition to the different spatial and programmatic requirements established through the terms of reference, the different design practice backgrounds and project development methodologies are taken into account. Considering the microclimate of Mostar as a temperature extreme at the state level, different approaches are further examined through the lens of adaptability to the climatic conditions of the region and to the relevant natural features of the location. Taking into account the local architectural tradition recognized precisely in the field of housing, this study aims to identify its elements that guide approaches in the domain of culture. The research confirms the contributions of local authors such as Romeo Tiberio, Dušan Miljak, and Hido Hasanbegović, and regional architects such as Vuko Bombardelli and Andrija Čičin Šain, whose work in the context of Mostar has remained insufficiently interpreted. The objective of this research is to identify specific periods within the observed timeframe and, through an analysis of examples from each period, draw conclusions that will address the predefined research questions. Furthermore, the paper will identify and analyse the spatial characteristics of apartments developed in the observed period, which will result in the definition of a taxonomy of the "Mostar apartment". The scientific contribution of this paper lies in establishing a foundation for the protection and valorisation of the valuable architectural heritage of Mostar's apartment buildings from the observed period. As such, the paper will contribute to the establishment of guidelines for the design of residential buildings that integrate the local typological, morphological, and climatic characteristics of the studied area.

Key words: residential architecture, socialist modernism, urban transformation, architectural heritage

