

ZIDNE SLIKE I ŠTUKATURA NA ŽBUKANIM DRVENIM KONSTRUKCIJAMA

– izazovi i rješenja

KNJIGA SAŽETAKA

Stručni skup s međunarodnim sudjelovanjem
Nacionalna i sveučilišna knjižnica
Zagreb, 20. studenoga 2025.

WALL PAINTINGS AND STUCCO ON PLASTERED WOODEN STRUCTURES – *Challenges and Solutions*

BOOK OF ABSTRACTS

Professional conference with international participation
National and University Library
Zagreb, November 20th 2025

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dr. sc. Krasanka Majer Jurišić, Iskra Karniš Vidović,
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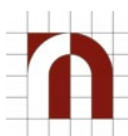
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Zagreb, Nacionalna i sveučilišna knjižnica (dvorana Judita)
Zagreb, National and University Library (conference hall Judita)

20. studenoga 2025.
November 20th 2025

Zidne slike i štukatura na žbukanim drvenim konstrukcijama – izazovi i rješenja

Wall Paintings and Stucco on Plastered Wooden Structures – Challenges and Solutions



**Hrvatski
restauratorski
zavod**

Program stručnog skupa

Professional Conference Programme

20. studenoga 2025.
November 20th 2025

8:30 Registracija sudionika / Registration
9:00 Otvaranje skupa / Conference opening

Moderatorica / Chair: Ana Škevin Mikulandra

9:30 Kristina Krulić, Teodora Kučinac
Uvodno izlaganje / Keynote speech

9:45 Juraj Pojatina, Hrvoje Turkulin
Integralni pristup obnovi povijesnih drvenih konstrukcija
Integrated approach to the restoration of historic timber structures

10:30 Zoran Veršić
Izazovi energetske obnove zgrada sa statusom kulturnog dobra
Challenges of energy renovation of buildings with cultural heritage status

10:50 RASPRAVA / DISCUSSION

11:00 Stanka / Break

Moderatorica / Chair: Teodora Kučinac

11:40 Blanda Matica
Građevinska sanacija pregradnih zidova na prvom katu palače Kerša (Festivalaska palača) u Dubrovniku
Structural rehabilitation of partition walls on the first floor of the Kerša Palace (Festival Palace) in Dubrovnik

12:10 Christoph Tinzl
Tradition and innovation – Structural stabilisation of suspended wooden ceilings in Austria
Tradicijska i inovativna – strukturna stabilizacija ovješanih drvenih stropova u Austriji

12:30 Branko Orbanić
Tehnička sanacija oslikanih, vapnenih žbuka na drvenim konstrukcijama stropova
Technical restoration of painted lime plasters and stucco on wooden ceilings

13:00 Toni Šaina
Strop u crkvi sv. Jurja u Buzetu, analiza stanja i zaštitni radovi
Ceiling of the church of St George in Buzet: condition analysis and protective works

13:15 RASPRAVA / DISCUSSION

13:30 Stanka / Break

Moderatorica / Chair: Kristina Krulić

- 14:30** Andrej Jazbec
The Problem of Wall Paintings on Wooden Structures – Restoration of the Ceiling of the Grand Salon in the Lanthieri Mansion in Vipava, Slovenia
Problem zidnih slika na drvenim konstrukcijama – restauriranje stropa Velikog salona u dvorcu Lanthieri u Vipavi, Slovenija
- 14:45** Antonija Gluhan, Ivana Jerković
Primjena metode pribadanja pri učvršćenju oslika na stropovima – odabrani primjeri iz Dalmacije
Application of the pinning method in consolidation of ceiling paintings – selected examples from Dalmatia, Croatia
- 15:00** Marko Buljan: Analiza konzervatorsko-restauratorskih radova na oslikanim stropovima palače Hrvatskoga povijesnog muzeja u Zagrebu i dvorca Normann u Bizovcu
Analysis of conservation and restoration of the painted ceilings of the Croatian History Museum palace in Zagreb and the Normann Castle in Bizovac
- 15:15** RASPRAVA / DISCUSSION
- 15:30** Stanka / Break

Moderatorica / Chair: Lana Križaj

- 15:50** Antonia Matković Šerić
Obnova i prezentacija stropnih oslika u sklopu cjelovite obnove zgrada oštećenih u potresima 2020. – zagrebački primjeri
Restoration and presentation of ceiling paintings within the comprehensive renovation of buildings damaged in the 2020 earthquakes – Zagreb case studies
- 16:05** Mladen Obad Šćitaroci, Petra Tončić Lipovšćak
Zidni i stropni oslici i štukature u četiri zgrade Hrvatske akademije znanosti i umjetnosti – poslijepotresna obnova palače HAZU-a, palače Drašković, palače Prister i vile Ehrlich-Marić
Wall and ceiling paintings and stucco decoration in the four buildings of the Croatian Academy of Sciences and Arts (HAZU) – Post-Earthquake restoration of the HAZU Palace, Drašković Palace, Prister Palace, and Ehrlich-Marić Villa
- 16:20** Ela Kreutz, Marija Puović
Konzervatorsko-restauratorsko učvršćivanje i rekonstrukcija zidnih slika na žbukanom trščanom nosiocu u palači Drašković
Consolidation and reconstruction of wall paintings on plastered reed supports in the Drašković Palace
- 16:35** Adela Filip
Oštećenja i konzervatorsko-restauratorski radovi na oslikanom stropu Pompejanske sobe Palače bogoštovlja i nastave nakon potresa 2020. godine
Damage, conservation and restoration of the painted ceiling in the Pompeian Room of the Palace of Religious Affairs and Education after the 2020 earthquake
- 16:50** Rasprava i zatvaranje skupa
Discussion and conference closing

Predgovor

Foreword

Za očuvanje zidnih slika i štukatura u njihovu izvornom okruženju, osim poznavanja slikarske i kiparske tehnologije, iznimno je važno razumijevanje stratigrafije i materijala od kojih je građena građevina i uvjeta u kojima se zidne slike i štukature nalaze. Uz građu od kamena i opeke, nije rijetkost da su pojedini dijelovi građevine – zidovi, stropovi ili svodovi – izvedeni od drvene građe, koja je potom žbukana i ukrašena zidnim slikama i/ili štukaturama. U tim se slučajevima formira složeni sustav od više vrsta materijala, koji različito reagiraju na promjene temperature i vlage, pomake konstrukcije ili mikrobiološke procese. Stoga je pri planiranju postupaka sanacije i konzervacije potrebno pristupiti složenijoj analizi te omogućiti neposredan pristup s obje strane zida, stropa ili svoda.

Nedavno iskustvo potresa na području Zagreba i središnje Hrvatske, zbog brojnih građevina sa zidnim oslicima i štukaturama izvedenima na žbukanim drvenim nosiocima, otvorilo je pitanje načina provedbe konzervatorsko-restauratorskih i građevinskih radova u sklopu konstrukcijske obnove. Na ovješanim stropovima povijesnih građevina posebno je učestala uporaba trske kao nosioca žbuke, no kao nosilac žbuke korištene su i drvene letvice: kalane ili piljene. Takvi načini gradnje široko su rasprostranjeni i primjenjivani u europskoj graditeljskoj tradiciji. Kako bi se spriječilo pucanje žbuke kao krčkog materijala na elastičnom nosiocu, u žbuke se nerijetko dodavao vlaknasti materijal.

Zbog složenosti navedenih sustava, ovim stručnim skupom želi se potaknuti još intenzivniji dijalog i suradnja konzervatora-restauratora, konzervatora, arhitekata, građevinskih inženjera, povjesničara umjetnosti i drugih stručnjaka te time pridonijeti boljem razumijevanju i očuvanju takve specifične baštine.

Izlaganja stručnjaka stoga objedinjuju različita stručna područja: fiziku građevine i utjecaj protoka zraka, temperature i vlage na takve sustave, konstruktivne i konzervatorsko-restauratorske izazove, složenost interakcija različitih materijala te promjene u strukturi drva kao građevnog materijala. Primjerima iz recentne poslijepotresne obnove, ali i iz starijih zahvata (poput poslijeratnih obnova te zahvata koji su dio redovite obnove baštine s vidljivim rezultatima u proteklom vremenu), bit će izneseni različiti pristupi sanaciji i očuvanju. Uz primjere iz Hrvatske, navest će se primjeri iz Slovenije i Austrije, a posebna je vrijednost skupa i u predstavljanju bogatoga fonda takve vrste kulturne baštine.

Kako bismo produbili razumijevanje postojećih izazova i mogućih rješenja, knjiga sažetaka ovoga stručnog skupa završava pregledom dosad prikupljene relevantne stručne literature s navedenoga područja, koja će se, nema sumnje, u budućnosti nadograđivati i upotpunjavati.

On top of possessing knowledge of painting and sculptural techniques, it is extremely important to understand the stratigraphy and materials from which the building that houses wall paintings and stucco is constructed in order to preserve them in their original environment. Alongside stone and brick constructions, it is not uncommon that certain parts of a building – walls, ceilings or vaults – are made of wood which is then plastered and decorated with wall paintings and/or stucco. In such cases, a complex system composed of several types of materials is formed, each reacting differently to changes in temperature and humidity, construction shifts, or microbiological processes. Therefore, when planning structural rehabilitation and conservation procedures, it is necessary to prepare a more complex analysis and allow direct access to the plaster carrier both from the front and the back of the wall, ceiling, or vault.

The recent earthquakes in Zagreb and central Croatia have raised the question of how to carry out conservation, restoration and construction work as part of structural rehabilitation due to numerous buildings that have wall paintings and stucco on plastered wooden carriers. The use of reed as a plaster carrier is particularly frequent in the suspended ceilings of historic buildings, although wooden laths – split or sawn – are also used. Such construction methods are widespread and used in the European architectural tradition. In order to prevent cracking of the plaster, a brittle material on an elastic carrier, fibrous material was often added.

Due to the complexity of these systems, the aim of this professional conference is to encourage even more intensive dialogue and collaboration between conservator-restorers, conservators, architects, civil engineers, art historians and other experts, and contribute to a better understanding and preservation of this very specific heritage.

The presentations cover a range of specialist fields: building physics and the impact of air flow, temperature and humidity on this type of systems, structural, conservation and restoration challenges, the complexity of interactions between different materials, and changes in the structure of wood as a building material. The conference will present different approaches to structural rehabilitation and preservation through examples from the recent post-earthquake reconstructions, but also older interventions such as post-war repairs and regular maintenance interventions with visible results over time. Alongside examples from Croatia, there will also be examples from Slovenia and Austria, and the particular value of the conference lies in the presentation of the rich corpus of this type of cultural heritage.

To deepen our understanding of current challenges and possible solutions, the book of abstracts has a review of the relevant specialist sources collected in this field, which will undoubtedly be expanded and supplemented in the future.

Sažetci izlaganja

Abstracts





Integralni pristup obnovi povijesnih drvenih konstrukcija

Integrated approach to the restoration of historic timber structures

Drvene povijesne konstrukcije u hrvatskoj praksi obnove nepokretne kulturne baštine donedavno su bile često zapostavljane. Uglavnom nevidljiv, tavanski krovni ili međukatni sklop nosive konstrukcije građevine nije imao primjeren tretman u većini slučajeva obnove. Posljedično se uglavnom licitiralo u smjeru bilo kompletne zamjene, bilo potpunog zanemarivanja tih dijelova građevine. Prekretnica je bila konstrukcijska obnova nakon potresa 2020. godine, koja je obuhvaćala širok spektar pojedinačno zaštićenih građevina u sklopu kojih su i drvene konstrukcije kao njihov neodvojiv dio, a ponegdje i jedini povijesni materijal nosive konstrukcije. Autorski je dvojac u simbiotskom spoju dviju osnovnih disciplina koje tretiraju drvene konstrukcije pokrenuo i odradio tridesetak postupaka obnove u svim fazama planiranja i projektiranja. Stoga je i izlaganje zamišljeno konceptijski dvodijelno: prvi dio odnosi se na istražnu fazu (Turkulín), dok se drugi dio bavi tehnikama popravka i pojačanja (Pojatina): od izrade arhitektonske snimke, stručnog pregleda i preliminarne ocjene stanja, nadalje ispitivanja i mjerenja koja provode drvnotehnološki inženjer te konstruktor, sve do prezentacije niza mogućih intervencija na nosivoj konstrukciji.

U izlaganju se komentiraju brojni izvedbeni detalji, ali i prenoše iskustva s gradilišta (poteškoće i izazovi u realizaciji obnove tih specifičnih sklopova). Imajući u vidu posebnosti drvenih konstrukcija kao što su: organsko porijeklo materijala, primjena tradicijskih spojeva uz minimalnu uporabu metalnih spojnih sredstava, utjecaj mikrobiologije (mogućnost zaraze drva), utjecaj vode u materijalu i okolišu te ostalo, evidentno je da se radi o složenoj problematici te nužnoj multidisciplinarnosti pristupa, kako bi se osigurala primjerena analiza i donijela odluka o postupanju s konstrukcijom. Zato je pri ocjeni stanja važna suradnja konstruktora i arhitekata, ali i drvnotehnoloških inženjera, specijaliziranih za drvo u graditeljstvu. U svakom slučaju, a pogotovo se to odnosi na povijesno vrijedne primjere te žbukane i oslikane dijelove, u timu je obavezno i konzervator-restaurator. Svi oni svojim znanjima samo zajedno mogu kvalitetno sagledati stanje nosive konstrukcije i pažljivo odabrati postupke i metode njezina popravka, obnove i očuvanja.

Izlaganje je bogato primjerima, ručnim skicama, fotografijama s izvođenja i brojnim drugim ilustracijama iskustava u provedbi obnova.

KLJUČNE RIJEČI: obnova, drvene konstrukcije, ispitivanja, popravak, pojačanje

Historic timber structures in Croatian practice of immovable cultural heritage restoration have, until recently, often been neglected. Being largely invisible, attic roof's or interfloor's load bearing structures of a building rarely received appropriate treatment in most restoration cases. As a result, they were usually either completely replaced or entirely disregarded. A turning point came with the structural restoration campaign following the 2020 earthquakes which encompassed a wide range of individually protected buildings where timber structures represented an inseparable part, and in some cases the only surviving historical material of the load-bearing structure. The authors, combining two core disciplines dealing with timber structures, initiated and carried out around thirty restoration projects, covering all phases from planning to design. Accordingly, the presentation is conceived in two parts: the first (Turkulín) focuses on the research phase, while the second (Pojatina) addresses repair and strengthening techniques. The process ranges from architectural surveys, professional inspections, and preliminary assessments, through testing and measurements conducted by a wood technology engineer and a structural engineer, to the presentation of a range of possible interventions on the load-bearing structure.

The presentation discusses numerous technical details and conveys on-site experiences, including the difficulties and challenges encountered during implementation. Considering the specific features of timber structures – organic origin of the material, use of traditional joints with minimal use of metal fasteners, susceptibility to microbiological attack, impact of water within the material and environment, and other factors – this is clearly a complex issue and requires a multidisciplinary approach to ensure proper analysis and decision-making regarding structural treatment. In assessing the condition of these structures, collaboration between structural engineers, architects, and wood technology engineers (specialists in construction timber) is essential. Every team must also include a conservator-restorer, especially when dealing with historically significant examples or structures with plastered and painted elements. Only together can such a team achieve a comprehensive understanding of the load-bearing structure's condition and carefully select appropriate methods of protection.

The presentation is enriched with examples, hand-drawn sketches, site photographs, and numerous other illustrations from restoration practice.

KEYWORDS: restoration, timber structures, testing, repair, strengthening

Juraj Pojatina rođen je 1977. godine u Zagrebu, gdje je 2003. diplomirao na Građevinskom fakultetu (konstruktorsko usmjerenje). Dobitnik je Rektorove nagrade za rad s područja drvenih konstrukcija. Nakon pripravništva u Metal-projekt, prelazi u Studio Arhing gdje radi i danas kao projektant voditelj na projektima konstrukcija. Stručno usavršavanje nastavlja u Barceloni na konstrukcijskoj obnovi povijesnih građevina (SAHC – Structural Analysis of Historical Constructions). Za U.S. Department of State provodi seizmičke procjene postojećih građevina u nekoliko država regije. Uže područje specijalizacije su mu inženjerske drvene i čelične konstrukcije, seizmičke analize i sanacije povijesnih građevina. Član je Međunarodnoga vijeća za spomenike i spomeničke cjeline – ICOMOS. Nakon zagrebačkog potresa 2020. godine postaje redoviti član stručnih povjerenstava za konstrukcijsku obnovu graditeljske baštine pri Ministarstvu kulture i medija RH i Ministarstvu graditeljstva RH, član ekspertnih skupina Hrvatske komore inženjera građevinarstva i Građevinskog fakulteta u Zagrebu te aktivno sudjeluje u radu Hrvatskoga centra za potresno inženjerstvo. Dobitnik je Medalje Grada Zagreba za nesebičan doprinos u pregledu i procjeni stanja najsloženijih i najvažnijih zagrebačkih građevina oštećenih u potresu u Zagrebu te nagrade Hrvatske komore inženjera građevinarstva *Kolos* za izuzetna dostignuća u struci.

Prof. dr. sc. Hrvoje Turkulin (1960.) redoviti je profesor u trajnom zvanju Sveučilišta u Zagrebu, Fakulteta šumarstva i drvene tehnologije. Nastavnik je kolegija *Uporaba drva u graditeljstvu, Tehnologija drvnih proizvoda za graditeljstvo te Modifikacije drva*. Diplomirao je i magistrirao na Šumarskom fakultetu u Zagrebu te doktorirao 1996. disertacijom *Photodegradation of exterior timber building components*.

Kao gostujući znanstvenik djelovao je u više navrata u Njemačkoj, Velikoj Britaniji i Švicarskoj. Bio je gostujući profesor na Sveučilištu Basilicate u Potenzi (Italija) te predavao na TUM-u (Tehničko sveučilište u Münchenu). Bio je voditelj triju međunarodnih te dvaju domaćih znanstvenih projekata. Osnivač je i voditelj akreditiranog *Laboratorija za drvo u graditeljstvu (LDG)* Šumarskoga fakulteta. Bio je glavni urednik znanstveno-stručnoga časopisa *Drvna industrija*, sada je član uredničkih odbora i recenzent uglednih časopisa o drvenoj znanosti. Dobitnik je Nagrade za posebna postignuća Fakulteta šumarstva i drvene tehnologije te Nagrade za doprinos drvnotehnološkoj struci Hrvatske gospodarske komore.

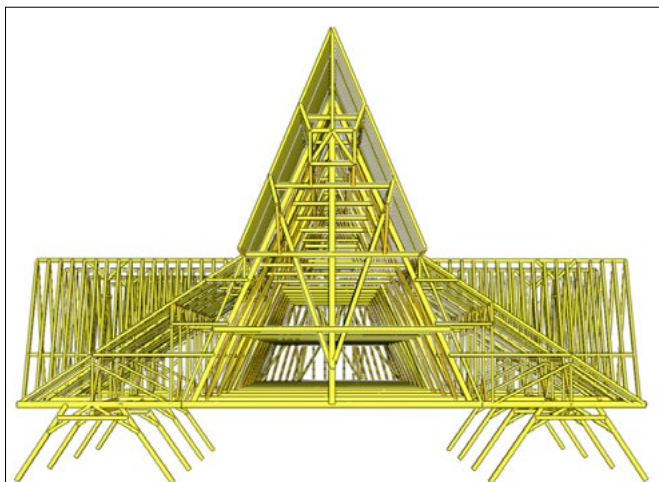
Objavio je 64 znanstvena rada i 86 stručnih radova, tri znanstvene brošure i nekoliko stručnih brošura te nastupio na šezdesetak konferencija. Nakon potresa vodio je brojna ispitivanja i izradio tridesetak elaborata ocjene stanja i prijedloga sanacije hrvatskih povijesnih drvenih konstrukcija i drvenih prozora na zaštićenim kulturnim dobrima.

Juraj Pojatina (b. 1977, Zagreb) graduated in 2003 from the Faculty of Civil Engineering (structural engineering). He received the Rector's Award for his work in the field of timber structures. After an internship at Metal-projekt, he joined Studio Arhing where he continues to work as a lead structural engineer. He further specialized in Barcelona through the SAHC (Structural Analysis of Historical Constructions) program. On behalf of the U.S. Department of State, he carried out seismic assessments of existing buildings in several countries in the region. His areas of expertise are timber and steel structures, seismic analysis, and the restoration of historic buildings. He is a member of ICOMOS. Following the Zagreb earthquake of 2020, he became a regular member of expert committees for structural restoration of architectural heritage at the Ministry of Culture and the Media and the Ministry of Construction, as well as expert groups of the Croatian Chamber of Civil Engineers and the Faculty of Civil Engineering in Zagreb. He actively participates in the Croatian Centre for Earthquake Engineering. He is a recipient of the Medal of the City of Zagreb for his selfless contribution in assessing some of the city's most complex and important earthquake-damaged buildings, as well as the *Kolos* Award of the Croatian Chamber of Civil Engineers for outstanding professional achievements.

Prof. Hrvoje Turkulin, PhD (b. 1960) is a tenured full professor at the University of Zagreb, Faculty of Forestry and Wood Technology. He teaches courses *Use of wood in construction, Wood products technology for construction, and Wood modifications*. He graduated and obtained his master's degree at the Faculty of Forestry in Zagreb and earned his doctorate in 1996 with a dissertation *Photodegradation of exterior timber building components*.

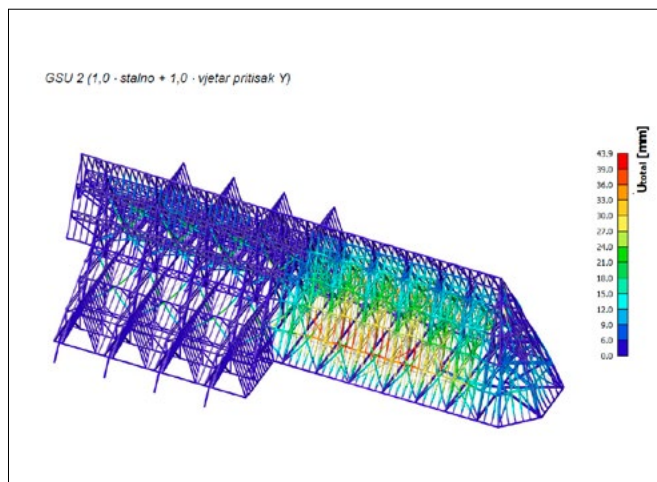
He has served as visiting researcher in Germany, the UK, and Switzerland, and as visiting professor at the University of Basilicata in Potenza (Italy) and the Technical University of Munich (TUM). He has led three international and two national scientific projects. He is the founder and head of the accredited Laboratory for Timber in Construction (LDG) of the Faculty of Forestry and Wood Technology. Formerly Editor-in-Chief of the scientific journal *Drvna industrija*, he now serves on editorial boards and as reviewer for leading journals in wood science. He has received the Award for Outstanding Achievements from the Faculty of Forestry and Wood Technology, and the Award for Contribution to the Wood Technology Profession from the Croatian Chamber of Economy.

He has published 64 scientific papers, 86 professional articles, three scientific booklets, and several professional manuals, and has presented at more than sixty conferences. Following the 2020 earthquakes, he led numerous investigations and produced around thirty reports assessing the condition and proposing rehabilitation strategies for Croatia's historic timber structures and timber windows in protected cultural properties.



Drvena peterokatna visulja krovija glavne lađe te konstrukcije stolica i visulja nad bočnim lađama zagrebačke katedrale (izvor: Studio Arhing d.o.o.)

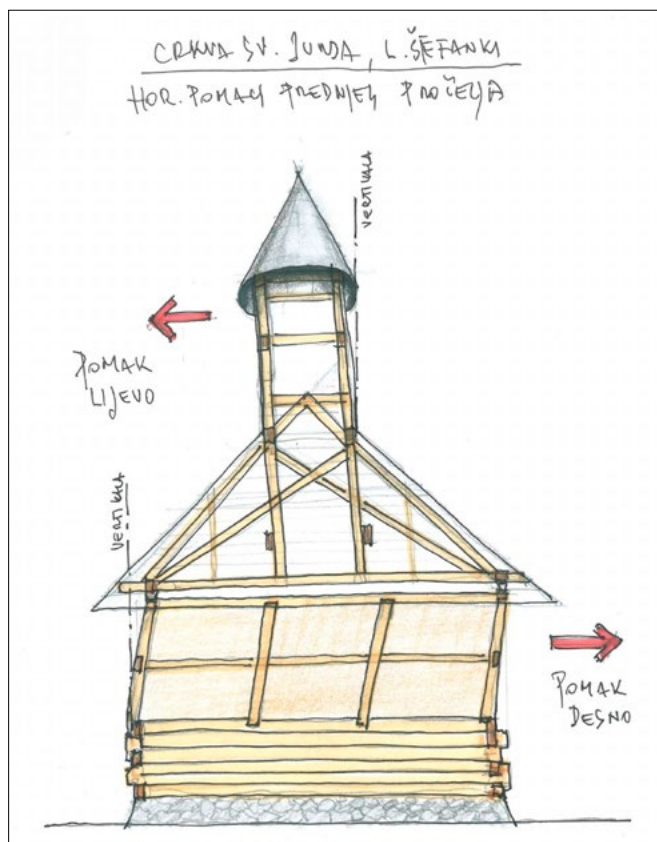
Five-storey timber hanging trusses of the nave roof, together with queen-post trusses and hanging trusses above the aisles of Zagreb Cathedral (source: Studio Arhing d.o.o.)



Složeni 3D proračunski model krovija (izvor: Studio Arhing d.o.o.)

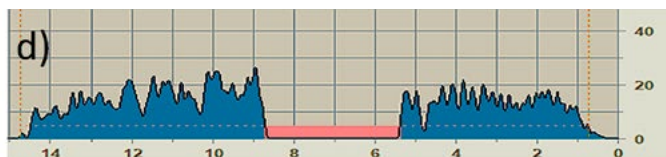
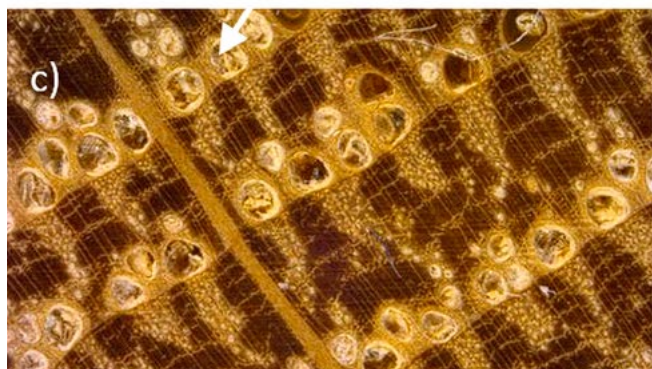
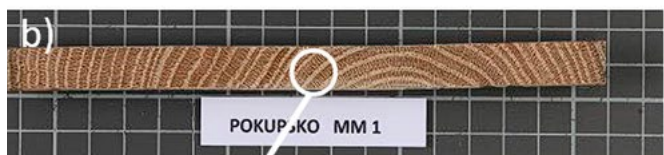
Complex 3D computational model of a roof structure (source: Studio Arhing d.o.o.)

12 |



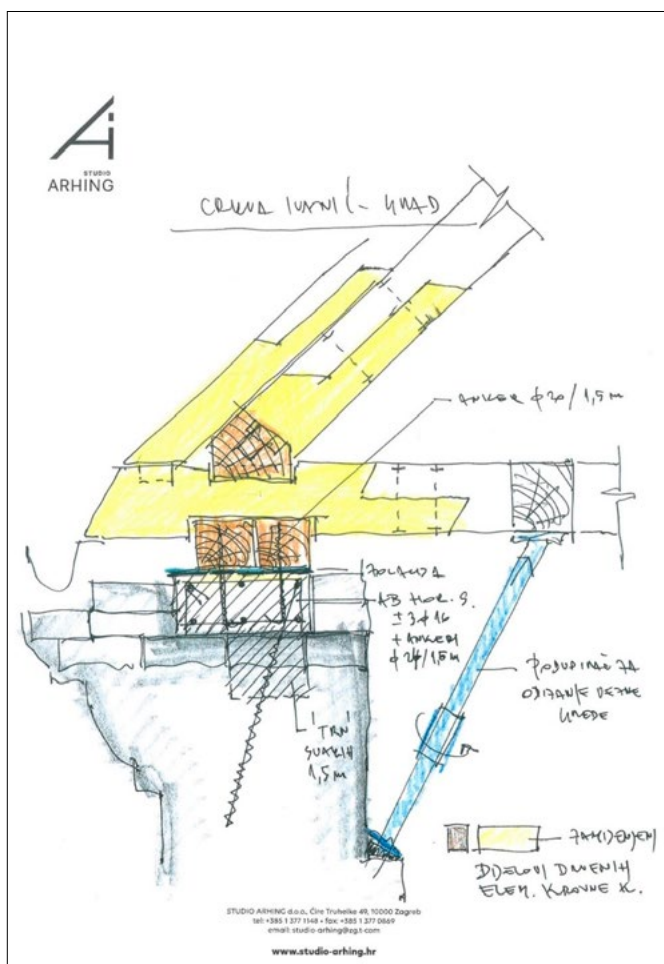
Zbog izvornih nedostataka izvedenog statičkog sustava (sustav nepridrženih okvira), kapela sv. Jurja u L. Štefankima doživjela je znatan horizontalni translacijski pomak, što je posebno izraženo na prednjem pročelju. Horizontalni otklon konstrukcije uočava se i na zvoniku, ali je on suprotnog smjera od otklona prednjeg pročelja (izvor: Studio Arhing d.o.o., crtež: J. Pojatina)

Due to inherent deficiencies in the original structural system (unsupported frames), the St. George chapel in L. Štefanki experienced significant horizontal displacement, most pronounced at the front façade. A horizontal shift is also visible in the bell tower, but in the opposite direction to that of the façade (source: Studio Arhing d.o.o., J. Pojatina)



Primjeri analitičkih uzoraka: slike od a) do c): rezistogram zdrave nazidnice (a), izvrtak 12,5 mm (b) kao i mikrografija (40 x) (c) pokazuju potpuno zdravo drvo, njemu se mjeri sadržaj vode 11–12 % i velika gustoća (oko 700 kg/m³), što odgovara maloj širini goda i udjelu kasnog drva od oko 80 % (rezistografski prikaz). (izvor: Laboratorij za drvo u graditeljstvu (LDG) Fakulteta šumarstva i drvne tehnologije Sveučilišta u Zagrebu)

Examples of analytical samples: images a) to c): resistograph of a sound wall plate (a), 12.5 mm core sample (b), and micrograph at 40x (c) showing completely sound wood. Moisture content measures 11–12%, with high density (approx. 700 kg/m³), corresponding to narrow annual rings and a latewood proportion of about 80% (resistograph display). (source: Laboratory of Wood in Construction (LDG), Faculty of Forestry and Wood Technology, University of Zagreb)



Konceptualna skica privremenog pridržanja vezne grede (izvor: Studio Arhing d.o.o., crtež: J. Pojatina)

Conceptual sketch of temporary bracing of a tie beam (source: Studio Arhing d.o.o., J. Pojatina)

Izazovi energetske obnove zgrada sa statusom kulturnog dobra

Challenges of energy renovation of buildings with cultural heritage status

Obnova kulturnog dobra počinje kvalitetnom analizom postojećeg stanja zgrade sa svim potrebnim istražnim radovima, kako bi se u procesu projektiranja prepoznala vrednovana svojstva kulturnog dobra i njegova uspješna obnova, i to očuvanjem svojstva kulturnog dobra primjenom mjera zaštite, u skladu s načelima održive, energetske i ekološke svjesne arhitekture.

Očuvanje cjelovitosti, izvornosti i utvrđenih vrijednosti kulturnih dobara osnovni je konzervatorski pristup zaštite i očuvanja kulturnih dobara. Oslanjajući se na osnovno načelo zaštite, potrebno je osvrnuti se na očuvanje vizualnog identiteta građevine, načelo održivosti zahvata, potrebe kontinuiranog održavanja građevine, upravljanja prihvatljivim promjenama, kompatibilnosti ugrađivih materijala, dopune tehničkih rješenja, unaprjeđenje energetske učinkovitosti i primjenu mjera koje pridonose klimatskoj otpornosti. Glavna prednost cjelovitog pristupa obnovi kulturnog dobra jest mogućnost optimiziranja primjene pojedinih mjera u jednom zahvatu. Na taj je način moguće učinkovitije optimizirati i uštedu energije, što nije moguće pri djelomičnoj i neusklađenoj energetske obnovi pojedinih građevinskih sklopova zgrade.

Za obnovu zgrade sa statusom kulturnog dobra potrebno je osigurati optimalne mjere obnove koje proizlaze iz detaljnih analiza postojećeg stanja zgrade i pravilne procjene projektanta koje je mjere prihvatljivo primijeniti da bi se ostvarili zadani ciljevi; temelj za to trebaju biti utvrđene vrijednosti kulturnog dobra, mjere zaštite i posebni uvjeti zaštite kulturnog dobra. Da bi se zgrada koja ima status kulturnog dobra uspješno i kvalitetno energetske obnovila (a da se ne naruši njezina kulturno-povijesna vrijednost), prije svega je potrebno utvrditi na koji način zgrada „diše“ u pogledu fizike zgrade, a posebno je bitno utvrditi odnose građevinskih struktura i termotehničkih sustava i zdravih unutarnjih klimatskih uvjeta, kao i ravnoteže topline i vlažnosti u zgradi. Zgradu treba promatrati i analizirati kao cjelinu, a ne kao skup neovisnih dijelova.

Dodatna toplinska zaštita na ovojnici zgrade može dovesti i do negativnih posljedica, kao što je neželjena kondenzacija vodene pare. Pri svakoj se obnovi s naročitom pozornošću moraju provjeriti detalji, toplinski mostovi, koji su mjesta potencijalne opasnosti nastanka kondenzata i naknadnih šteta. Kontrola toplinsko-difuznih procesa izuzetno je važna za drvene konstrukcije, gdje kondenzacija uzrokuje razvoj gljivica i plijesni te propadanje drva.

KLJUČNE RIJEČI: energetska obnova, toplinska zaštita, difuzija vodene pare

The renovation of a cultural heritage building begins with a thorough analysis of its existing condition, including all necessary research, in order to identify and assess the valued features of the cultural property during the design process and ensure its successful restoration. This is achieved by preserving the property's heritage qualities through the use of protection measures in accordance with the principles of sustainable, energy-efficient, and environmentally conscious architecture.

Preserving the integrity, authenticity, and recognized values of cultural heritage is the fundamental conservation approach to the protection and preservation of cultural heritage. Building on this principle, attention must be given to the preservation of the structure's visual identity, sustainability of interventions, need for continuous maintenance, management of acceptable changes, compatibility of materials, refinement of technical solutions, improvement of energy efficiency, and implementation of measures that contribute to climate resilience. The main advantage of a comprehensive approach to cultural heritage renovation is the possibility of optimizing the application of various measures within a single intervention. This makes it possible to more effectively optimize energy savings, which cannot be realized through partial or uncoordinated energy renovations of individual building components.

For the renovation of a building with cultural heritage status, it is necessary to ensure optimal restoration measures based on detailed analyses of its condition and the designer's informed assessment of which measures are acceptable in order to achieve the set goals. The basis for this should be the established values of the cultural property, prescribed protection measures, and specific conservation requirements. For a successful and high-quality energy renovation of this type of building, and without compromising its cultural and historical value, it is first necessary to understand how the building “breathes” in terms of building physics. It is especially important to establish the relationship between building structures, HVAC systems, and healthy indoor climate conditions, as well as the balance of heat and humidity. The building must be viewed and analysed as a whole, rather than as a collection of independent parts.

Additional thermal protection on the building envelope can lead to negative consequences such as unwanted condensation of water vapor. Details and thermal bridges must be checked with particular care during every renovation, as these are potential sites for condensation and subsequent damage. Controlling thermal and diffusion processes is especially important for wooden structures where condensation can cause fungi and mould to develop and lead to timber decay.

KEYWORDS: energy renovation, thermal protection, water vapor diffusion

Prof. dr. sc. Zoran Veršić, dipl. ing. arh. redoviti je profesor na Arhitektonskom fakultetu Sveučilišta u Zagrebu (Katedra za arhitektonske konstrukcije i zgradarstvo na kolegijima Kabineta za arhitektonske konstrukcije, fiziku zgrade, materijale u arhitekturi i tehnologiju građenja). Od 1997. do 1999. godine polaznik je poslijediplomskog znanstvenog studija „Graditeljsko naslijeđe” Arhitektonskoga fakulteta Sveučilišta u Zagrebu i Filozofskoga fakulteta u Zadru Sveučilišta u Splitu. Godine 2001. stekao je akademski stupanj magistra znanosti s temom „Metode sanacije starih građevina i građevina pod zaštitom sa stanovišta toplinske zaštite i uštede energije”. Doktorirao je 2011. godine s disertacijom na temu „Zaštita zgrada od vanjskih izvora buke”. Voditelj je i suradnik na više znanstveno-istraživačkih projekata. Od 2012. ovlašten je za obavljanje poslova na zaštiti i očuvanju kulturnih dobara.

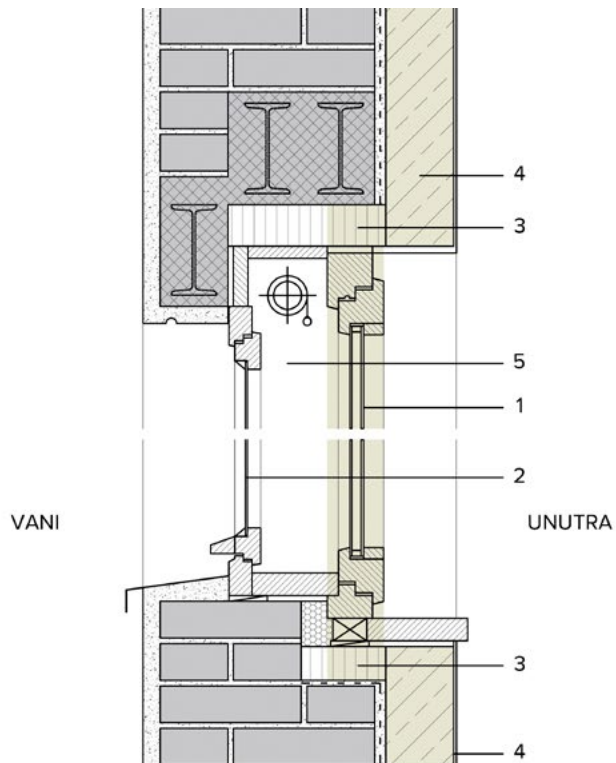
Kao autor ili koautor izradio je velik broj stručnih radova: arhitektonskih projekata, razrada projektne dokumentacije, izrada arhitektonskih detalja. Projektant je projekata toplinske zaštite i uštede energije i elaborata akustičkih svojstava i zaštite od buke za više stotina zgrada. Suradnik je Akademije tehničkih znanosti Hrvatske i tajnik na Odjelu arhitekture i urbanizma. Predsjednik je Klastera za energetske učinkovitost i održivost u zgradarstvu – nZEB.hr. Član je Društva arhitekata Zagreba (DAZ), Udruženja hrvatskih arhitekata (UHA), Skupštine i Upravnog odbora Hrvatske komore arhitekata (HKA) i dopredsjednik Hrvatskog akustičkog društva (HAD).

Prof. Zoran Veršić, Ph.D., Dipl. Ing. Arch. is a full professor at the Faculty of Architecture, University of Zagreb (Department of Architectural Structures and Building Construction, teaching courses in architectural structures, building physics, architectural materials, and construction technology). From 1997 to 1999, he attended the postgraduate scientific program “Building Heritage” at the Faculty of Architecture, University of Zagreb, and at the Faculty of Humanities and Social Sciences in Zadar, University of Split. In 2001, he obtained the degree of Master of Science with the thesis “Methods of rehabilitation of old and protected buildings from the perspective of thermal protection and energy saving.” He earned his doctorate in 2011 with the dissertation “Protection of buildings from external sources of noise.” He has led and collaborated on numerous research projects. He has been licensed to carry out work in the protection and preservation of cultural heritage since 2012.

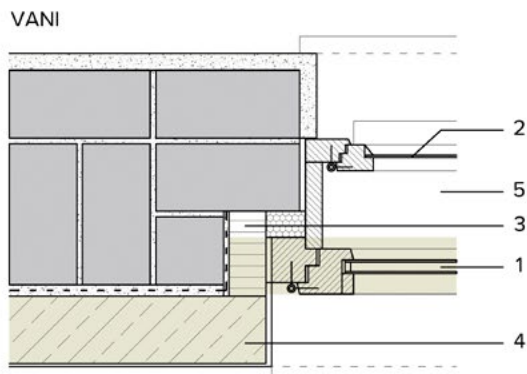
As author or co-author, he has completed a large number of professional works, including architectural projects, detailed project documentation, and architectural detailing. He has designed projects in thermal protection and energy saving, as well as acoustic property studies and noise protection solutions for several hundred buildings. He collaborates with the Croatian Academy of Engineering and serves as secretary of its Department of Architecture and Urbanism. He is President of the Cluster for Energy Efficiency and Sustainability in Buildings – nZEB.hr. He is a member of the Zagreb Society of Architects (DAZ), the Association of Croatian Architects (UHA), the Assembly and Management Board of the Croatian Chamber of Architects (HKA), and Vice President of the Croatian Acoustical Society (HAD).

Kontinuitet toplinske izolacije

1. Prozor ostakljen IZO staklom
2. Prozor ostakljen jednostrukim staklom
3. Toplinska izolacija špalete (XPS ili CG)
4. Toplinska izolacija za postavu s unutarnje strane
5. Lagano provjetravani međuprostor



PRESJEK

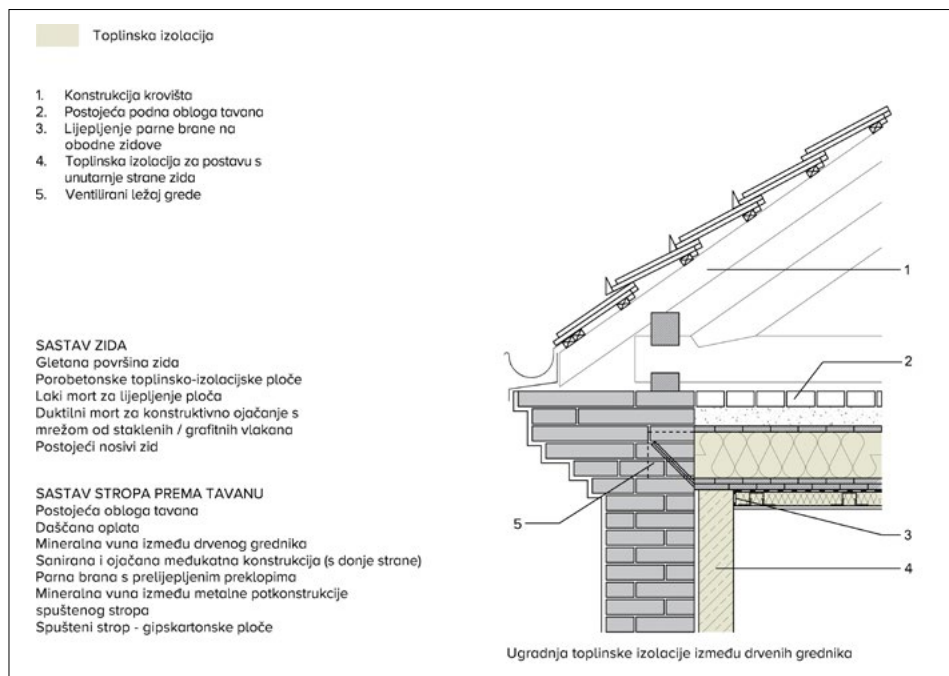


SASTAV ZIDA

Gletana površina zida
 Porobetonke toplinsko-izolacijske ploče
 Laki mort za lijepljenje ploča
 Duktilni mort za konstruktivno ojačanje s mrežom od staklenih / grafitnih vlakana
 Postojeći nosivi zid

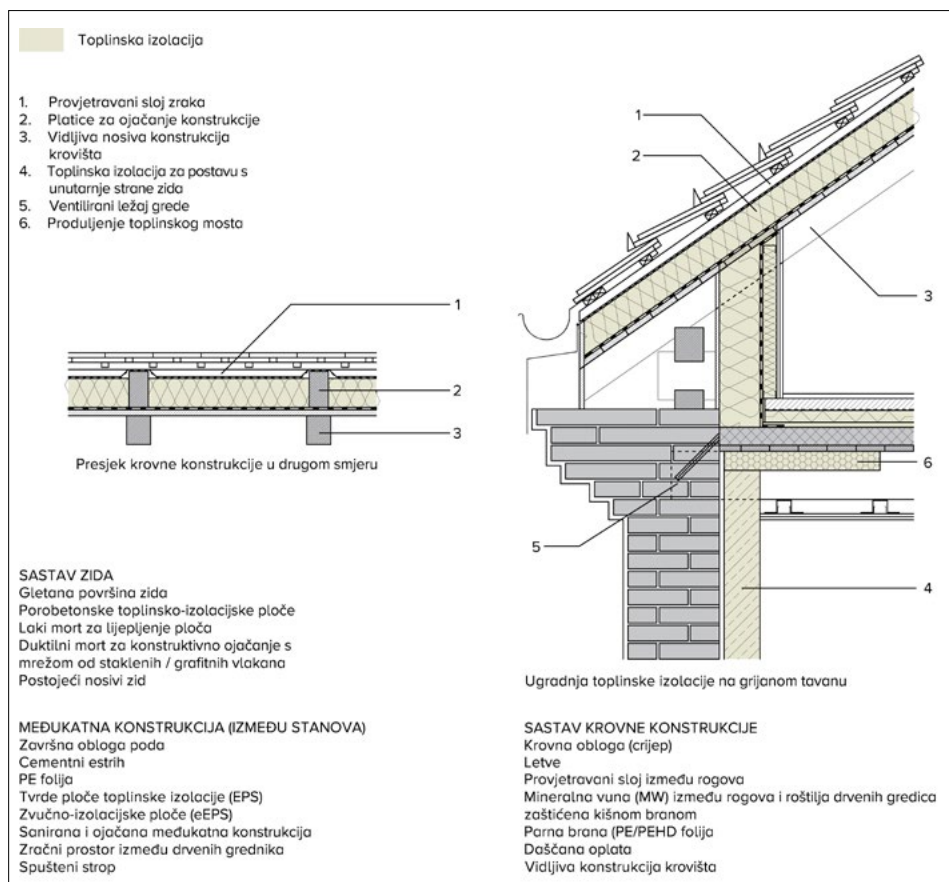
Primjer zamjene unutarnjeg prozorskog krila kod dvostrukog prozora - toplinska izolacija iznutra
 (izvor: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)

Example of replacing the internal window of a double window - thermal insulation from the inside
 (source: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)



Mjera toplinske izolacije stropa prema negrijanom tavanu: rješavanje toplinskih mostova kada je toplinska izolacija zida etaže ispod izvedena s unutarnje strane, a toplinska izolacija međukatne konstrukcije s donje strane (izvor: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)

Measure of thermal insulation of the ceiling towards an unheated attic: solving thermal bridges when the thermal insulation of the wall on the floor below is installed on the interior side, and the thermal insulation of the intermediate floor structure is installed from below (source: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)



Pravilna izvedba toplinske izolacije krovišta i spoj na unutarnju toplinsku izolaciju. Prikaz izvedbe slojeva krova bez povećanja visine krovne obloge (izvor: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)

Proper implementation of thermal insulation of the roof and connection to the internal thermal insulation. Illustration of roof layers without increasing the height of the roof covering (source: SMJERNICE ZA ENERGETSKU OBNOVU ZGRADA SA STATUSOM KULTURNOG DOBRA)

Građevinska sanacija pregradnih zidova na prvom katu palače Kerša (Festivalaska palača) u Dubrovniku

Structural rehabilitation of partition walls on the first floor of the Kerša Palace (Festival Palace), Dubrovnik

Zgrada palače Kerša dio je bloka u staroj jezgri Dubrovnika, na sjevernoj strani Straduna, uz franjevački samostan i crkvu Sv. Spasa, nedaleko od Vrata od Pila. Barokna dvokatnica s četiri prozorske osi na glavnom pročelju, nekoć u prizemlju javne, trgovačke namjene, a na katovima stambene, danas je Festivalaska palača. U prizemlju se nižu karakteristični veći otvori trgovina, na prvom katu pravokutni, a na drugom mali kvadratični prozori. Saloni na prvom katu imaju zrcalne stropove i zidove ukrašene vučenim profilacijama, oslicima, štukaturama, štukomramorom i pozlatom te profiliranim vratnim okvirima i stupovima.

Vanjski i nosivi zidovi palače građeni su kamenom, a stubište, međukatne konstrukcije i krovna konstrukcija su drveni. Pregradni, tanki, žbukani zidovi su skeletni s okvirom od drvenih gredica i ispunom od opeke i žbuke. Tanki žbukani zidovi uz stubišni prostor izvedeni su kao suhomontažni, bez ispune, s okvirima od drvenih gredica obostrano povezanih nizom dijagonalnih i razmaknutih drvenih letvica – štuketa.

U požaru nakon granatiranja Dubrovnika, 6. prosinca 1991. godine, drveni dijelovi u unutrašnjosti palače većinom su uništeni: krov, međukatne konstrukcije potkrovlja i drugog kata. Dio pregradnih zidova sa svom štukodekoracijom urušio se do prvog kata i prizemlja. Ostala je očuvana međukatna konstrukcija prvog kata, zaštićena odozgo podom od mramornih ploča, te pregradni ožbukani skeletni zidovi s ispunom od opeke.

Građevinska i konstrukcijska sanacija provedena je uz maksimalno poštovanje izvornih oblika i elemenata zgrade uz primjenu tradicionalnih materijala i građevnih tehnika s nužnim ojačanjima s obzirom na trusnost područja. Radovi obnove počeli su 1995., a završili 1998. godine.

Svi pregradni skeletni ožbukani zidovi, s djelomično otkrivenim oslicima ispod višeslojnih recentnih naliča bili su ostali nesaniрани jer je projektom predviđeno njihovo rušenje i ponovna izgradnja. Srećom, nadležni Konzervatorski odjel je to zabranio. Nisu bili nanovo izgrađeni ni izgorjeni skeletni zidovi uz stubište, kao ni podgledi stubišnih krakova.

Tijekom 2002. godine Hrvatski restauratorski zavod izradio je troškovnik s programom restauratorskih radova u ulaznom dijelu prizemlja i na prvom katu. Izrađen je izvedbeni projekt rekonstrukcije prostora prizemlja, stubišta i prvog kata s nacrtima: tlocrtima, pogledima na zidove i stropove, presjecima i detaljima te troškovnikom za pripremne radove na zidnim oslicima, štukodekoraciji i stolariji vrata; za građevinsku sanaciju zatečenih i izgradnju novih pregradnih skeletnih zidova u stubištu, grubo i fino žbukanje zidova te za obrtničke radove – dobavu mramornih kamenih ploča u dvije boje, izradu podloge i postavu poda od kamenih ploča.

Građevinska sanacija pregradnih zidova, izvedenih od vertikalnih, drvenih nosača (skeleta) s ponekom vodoravnom ukrutom od drvenih letvica te ispunom od tupine (lapora), opeke i vapna, bila je posebno zahtjevna jer su zidovi gotovo četiri godine bili

The Kerša Palace forms part of a historic block within the old town of Dubrovnik. It is located on the north side of Stradun, adjacent to the Franciscan Monastery and the Church of St Saviour, and near the Pile Gate. This Baroque two-storey building, with four window axes on its main façade, originally had public and commercial functions on the ground floor and residential spaces on the upper floors. Today, it serves as the Festival Palace. The ground floor features characteristic large shop openings, while the first floor has rectangular windows and the second small square ones. The first-floor salons have mirrored ceilings and walls adorned with moulded profiles, wall paintings, stucco, stucco marble, gilding, and profiled door frames and columns.

The exterior and load-bearing walls are built of stone, while the staircase, intermediate floor structures, and roof are wooden. The thin plastered partition walls are skeletal, and constructed with wooden beam frames filled with brick and plaster. Thin plastered walls along the staircase were built as dry partitions without infill with wooden frames connected on both sides by a network of diagonal and spaced wooden laths (*štukete*).

Following the shelling of Dubrovnik on 6 December 1991, a fire destroyed most of the palace's wooden interior elements including the roof, attic floor, and second-floor structure. Sections of the partition walls, along with their stucco decoration, collapsed to the first floor and ground level. The first-floor ceiling structure, protected above by marble flooring, remained preserved as did several plastered skeletal partition walls with brick infill. Structural rehabilitation was carried out with the utmost respect for the original architectural features and materials using traditional construction methods complemented by necessary reinforcements suited to the area's seismic activity. Restoration work began in 1995, and was completed in 1998.

All skeletal plastered partition walls, some of which had partially revealed wall paintings beneath layers of overpaint, remained unrestored as the project had originally planned for their demolition and reconstruction. Fortunately, the competent Conservation Department prohibited this. The burned skeletal walls along the staircase, as well as the soffits of the stair flights, were also not rebuilt.

In 2002, the Croatian Conservation Institute prepared a cost estimate and program for the restoration of the entrance area of the ground floor and the first floor. A detailed design was developed for the reconstruction of these spaces including blueprints (plans, wall and ceiling elevations, cross sections, and details), and cost estimates for preparatory work on wall paintings, stucco decoration, and door joinery. The project also covered the structural rehabilitation of existing and new skeletal partition walls in the staircase, rough and fine plastering, and related craftwork including the supply and installation of marble flooring in two colours. Structural rehabilitation of the partition walls, constructed from vertical wooden posts (skel-

izloženi atmosferilijama. U drvenim elementima to je izazvalo periodično bubrenje i skupljanje. Došlo je do odvajanja žbuke od zida, a na mjestima na kojima je žbuka potpuno otpala, odvojila se ispunja od drvenih greda. Posebno je bila složena sanacija pregradnog zida između salona S-I-5 (srednji) i S-I-4 (sjeverni), ugrađenog unutar pročelnog i srednjeg nosivog zida, oslonjenog na čeličnu gredu umetnutu u drveni grednik prvog kata. Na zapadnoj strani zida je otvor za dvokrilna vrata na kojem je izvedeno podupiranje i podizanje s horizontiranjem nadvojne grede te spajanje s novim drvenim dovratnikom od hrastovine. Sanacija ispune zidova bez žbuke izvedena je prezidavanjem uz upotrebu postojećeg i novog materijala. Od vodootporne blažujke izrezana je kvadratična ploča koja je na jednoj strani ukružena drvenim gredicama, a na drugoj omekšana filcom. Lice žbuke s profilacijama zaštićeno je japanskim papirom i stiroporom. Ploča je zatim vrlo pažljivo pristonjena uz odvojenu žbuku, hidrauličkom primaknuta pregradnom zidu i učvršćena. Po vrhu zida postavljeni su kontejneri s cjevčicama iz kojih je injekcijska smjesa slobodnim padom otjecala u zid. Sušenje injektiranog zida trajalo je oko mjesec dana. Oplata je tada skinuta, a žbuka je dodatno učvršćena vijcima. Gornji krajevi drvenih, vertikalnih nosača "ograđeni" su obostrano drvenim gredicama učvršćenima za stropne grede, koje su ujedno i nosači za profilirane, vučene stropne vijence.

KLJUČNE RIJEČI: palača Kerša, požar, ratne štete, građevinska sanacija, pregradni skeletni zidovi

Blanda Matica, dipl. ing. arh., konzervator savjetnik arhitekt, diplomirala je na Arhitektonskom fakultetu u Zagrebu 1980. godine. Od 1981. do 1997. godine radila je u Restauratorskom zavodu Hrvatske, najprije kao pripravnica, zatim kao suradnica, odgovorna projektantica te kao voditeljica Odjela za graditeljsko naslijeđe. Od 1997. do 2005. godine obnašala je dužnost pročelnice Službe za nepokretne spomenike kulture u Hrvatskom restauratorskom zavodu. Godine 2005. postala je pročelnica Konzervatorskog odjela u Rijeci, a od 2007. do 2008. godine radila je kao glavna konzervatorica u Upravi za zaštitu kulturne baštine Ministarstva kulture Republike Hrvatske te kao pročelnica Konzervatorskog odjela u Krapini. Od 2008. do 2012. godine obnašala je funkciju ravnateljice Uprave za zaštitu kulturne baštine u Ministarstvu kulture, od 2012. do 2016. godine radila je kao pomoćnica ravnatelja za posebne projekte, a od 2016. do 2019. godine bila je pomoćnica ravnatelja za nepokretnu baštinu u Hrvatskom restauratorskom zavodu.

Tijekom profesionalne karijere bila je uključena kao suradnica ili voditeljica u brojne složene programe zaštitnih radova na kulturnim dobrima: od izrade idejnih i izvedbenih projekata do nadzora građevinskih radova, a bila je i voditeljica izrade konzervatorskih studija, što je nastavila raditi i nakon umirovljenja. Članica je Hrvatske komore arhitekata od 1998., a od 2024. godine upisana je na popis specijaliziranih osoba za obavljanje poslova na zaštiti i očuvanju nepokretnih kulturnih dobara.

eton) with limited horizontal bracing of wooden slats and infill made of marl, brick, and lime, proved particularly demanding. The walls had been exposed to weathering for nearly four years which caused periodic swelling and shrinkage in the wooden elements. This led to the detachment of plaster from the walls and, in places where the plaster had completely fallen away, to the separation of the infill from the wooden beams. The repair of the partition wall between S-I-5 (central) and S-I-4 (northern) salons was especially complex. The wall, located between the façade and the central load-bearing wall, was supported by a steel beam inserted into the wooden floor structure of the first floor. There was an opening for a double door on the west side of the wall where propping and lifting were carried out to level the lintel beam and connect it to a new oak door frame. The structural rehabilitation of the infill (without plaster) was performed by rebuilding using both existing and new materials. A square board was cut from waterproof plywood, stiffened on one side with wooden battens and softened on the other with felt. The plaster surface with its mouldings was protected using Japanese paper and polystyrene. The board was then carefully pressed against the detached plaster, hydraulically aligned with the partition wall, and fixed in place. Containers with tubes were installed along the top of the wall, allowing the injection mixture to flow freely into the wall. The injected wall was left to dry for about a month, after which the formwork was removed and the plaster was further reinforced with screws. The upper ends of the vertical wooden posts were framed on both sides with wooden battens fixed to the ceiling beams, which also served as supports for the profiled, moulded ceiling cornices.

KEYWORDS: Kerša Palace, fire, war damage, structural rehabilitation, skeletal partition walls

Blanda Matica, M.Arch., senior conservation advisor, graduated from the Faculty of Architecture, University of Zagreb, in 1980. From 1981 to 1997, she worked at the Croatian Conservation Institute, first as an intern, then as associate, responsible designer, and later as Head of the Department for Architectural Heritage. From 1997 to 2005, she served as Head of the Division for Immovable Heritage at the Croatian Conservation Institute. In 2005, she became Head of the Conservation Department in Rijeka, and from 2007 to 2008, she worked as Chief Conservator in the Directorate for the Protection of Cultural Heritage of the Ministry of Culture of the Republic of Croatia, as well as Head of the Conservation Department in Krapina. From 2008 to 2012, she held the position of Director of the Directorate for the Protection of Cultural Heritage at the Ministry of Culture. Between 2012 and 2016, she was Assistant Director for Special Projects, and from 2016 to 2019, Assistant Director for Immovable Heritage at the Croatian Conservation Institute.

Throughout her professional career, she has participated as collaborator or project leader in numerous complex conservation programs for cultural heritage encompassing all stages from conceptual and detailed design to construction supervision. She has also led the preparation of numerous conservation studies, a practice she continues after retirement. She has been a member of the Croatian Chamber of Architects since 1998 and, since 2024, is listed among the specialized professionals authorized to perform work on the protection and preservation of immovable cultural heritage.



Palača Kerša (Festivalska palača) Dubrovnik, Salon S-I-5, pogled na sjeverni pregradni zid prije radova (arhiva HRZ-a, snimka: I.Srša, 2002.)

Kerša Palace (Festival Palace), Dubrovnik, Salon S-I-5, view of the north partition wall before restoration (HRZ Archive, photo: I. Srša, 2002)



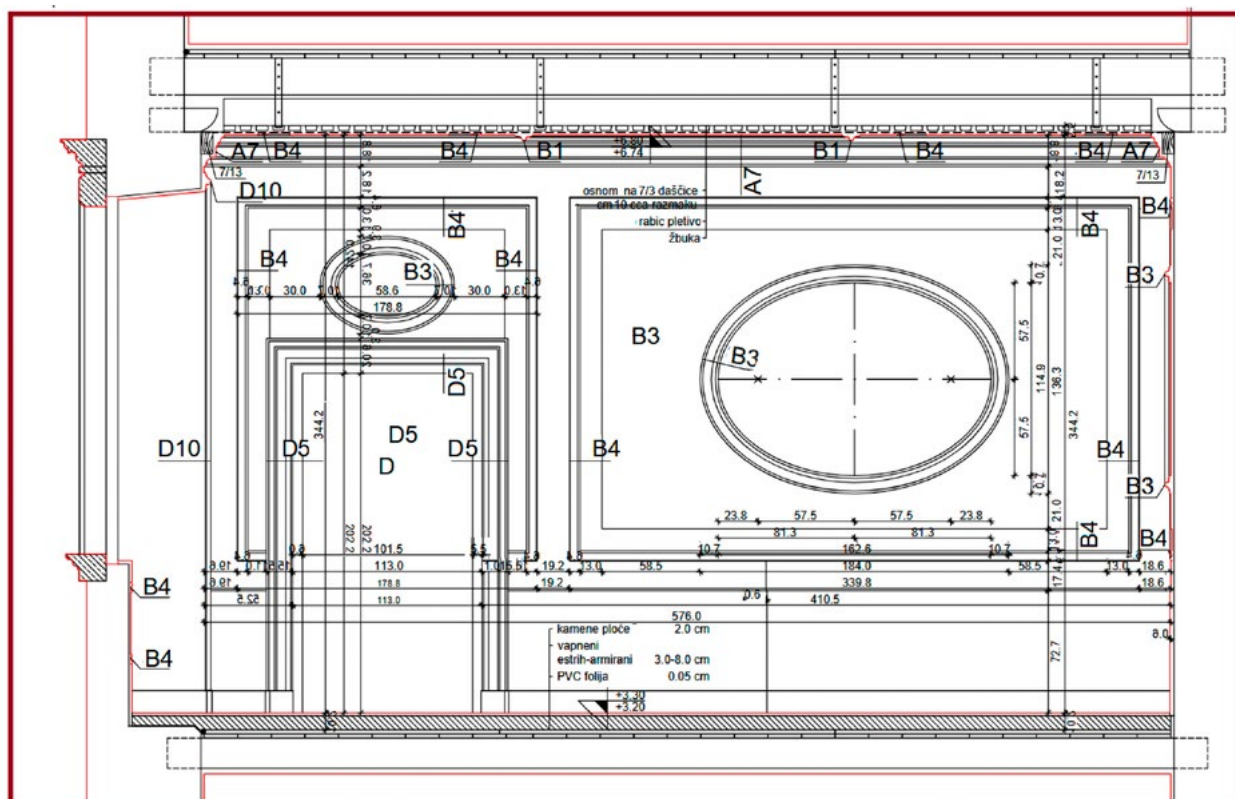
Palača Kerša (Festivalska palača) Dubrovnik, Salon S-I-5, pogled na sjeverni pregradni zid nakon radova (arhiva HRZ-a, snimka: I.Srša, 2002.)

Kerša Palace (Festival Palace), Dubrovnik, Salon S-I-5, view of the north partition wall after restoration (HRZ Archive, photo: I. Srša, 2002)



Palaca Kerša (Festivalaska palaca) Dubrovnik, Salon S-I-5, pogled na sjeverni pregradni zid s ucrtanom shemom nosive konstrukcije (snimka: I. Srša, 2002., crtala: B. Matica, 2025.)

Kerša Palace (Festival Palace), Dubrovnik, Salon S-I-5, view of the north partition wall with schematic drawing of the supporting structure (photo: I. Srša, 2002., drawn by: B. Matica, 2025)



Palača Kerša (Festivalska palača) Dubrovnik, Presjek kroz salon S-I-5, pogled sjever (crtala: B. Matica)

Kerša Palace (Festival Palace), Dubrovnik, Cross section through Salon S-I-5, north view (author: B. Matica)

Tradition and innovation – Structural stabilisation of suspended wooden ceilings in Austria

Tradicija i inovacija – strukturna stabilizacija ovješanih drvenih stropova u Austriji

Earthquakes are one of the causes of structural instability in ceiling paintings on wooden support systems, wars are another. In Austria, experience with these issues is mainly based on the destructions during World War II and its aftermath. Stabilisation efforts often involved bonding the lime plaster to the reed support, the dominant plaster support alongside pecked wooden battens, using screws, plates and infills in the cracks. A notable example is the Marble Hall in the Upper Belvedere in Vienna, where the ceiling painting by Carlo Innocenzo Carlone, created in 1723, was last restored in May 2004.

A more innovative, albeit more complex, approach can be presented through the restoration of the ceiling painting of the Jesuit Theatre in Vienna. In a lengthy process, restorer Prof. Heinz Leitner developed a suspension system in which the large-scale ceiling painting and its support, probably designed by Franz Anton Danne in 1735, was sewn together from the roof space with cord suspensions, thereby stabilising it. This method avoided the disadvantage of rigid fastening systems. The intervention, carried out in the mid-1990s, has proven durable and effective to this day.

KEYWORDS: suspended wooden ceiling, wooden support systems, suspension system, fastening systems, rigid versus flexible

Potresi su jedan od uzroka strukturne nestabilnosti stropnih slika na drvenim potpornim sustavima, a drugi su uzrok ratovi. U Austriji se iskustvo s takvim problemima temelji na razaranja tijekom Drugoga svjetskog rata i njihovim posljedicama. Stabilizacijske mjere često su uključivale učvršćivanje vapnene žbuke na trsku (dominantni oblik podloge za žbuke uz nabijene drvene letvice) vijcima, pločama i ispunima u pukotinama. Ogledni primjer je Mramorna dvorana u Gornjem Belvedereu u Beču, gdje je stropna slika Carla Innocenza Carlonea, nastala 1723., posljednji put restaurirana u svibnju 2004. godine.

Inovativniji, iako složeniji pristup može se predstaviti na primjeru restaurirane stropne slike Isusovačkoga kazališta u Beču. U dugotrajnom procesu, restaurator prof. Heinz Leitner razvio je sustav ovjesa u kojem su velika stropna slika i njezina podloga, vjerojatno djelo Franza Antona Dannea iz 1735. godine, spojene šivanjem užetima iz potkrovlja, čime je postignuta njihova stabilizacija. Tom metodom izbjegnuti su nedostaci krutih sustava učvršćivanja. Ta se intervencija, provedena sredinom devedesetih godina 20. stoljeća, pokazala izdržljivom i učinkovitom do danas.

KLJUČNE RIJEČI: ovješani drveni strop, drveni potporni sustavi, sustav ovjesa, sustavi pričvršćivanja, kruto naspram fleksibilnog

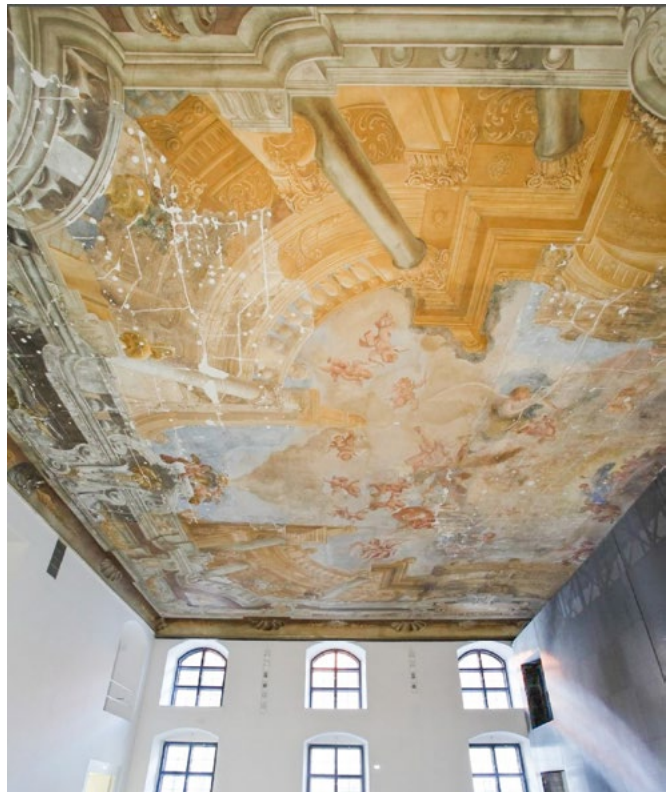
Christoph Tinzl, born in 1965, studied art history, archaeology, and law in Vienna and Salzburg holding a diploma degree in art history. He further studied Wall Painting Conservation at the Courtauld Institute in London (Dipl.-Cons.). From 1994 to 2014, he operated a studio for restoration of wall paintings with his wife. Since then, he has been employed by the Federal Monuments Authority Austria (*Bundesdenkmalamt*), where until 2019 he served as an area consultant for Lower Austria and the Wachau World Heritage region. Currently, within the Department of Conservation and Restoration in Vienna, he is senior specialist in mural and stained-glass restoration as well as architectural surface conservation.

Christoph Tinzl, rođen 1965. godine, magistrirao je povijest umjetnosti, arheologiju i pravo na sveučilištima u Beču i Salzburgu. Daljnje obrazovanje s područja konzervacije zidnog slikarstva pohađao je na Courtauld institutu u Londonu. Od 1994. do 2014. sa suprugom je vodio restauratorski atelje specijaliziran za zidno slikarstvo. Otada je zaposlen na Saveznom zavodu za zaštitu spomenika Republike Austrije (*Bundesdenkmalamt*), gdje je do 2019. obnašao dužnost konzervatorskog savjetnika za područje Donje Austrije i regije svjetske baštine Wachau. Trenutno radi kao viši stručnjak za restauriranje zidnih slika i vitraja te konzerviranje arhitektonskih površina na Odjelu za konzervaciju i restauraciju u Beču.



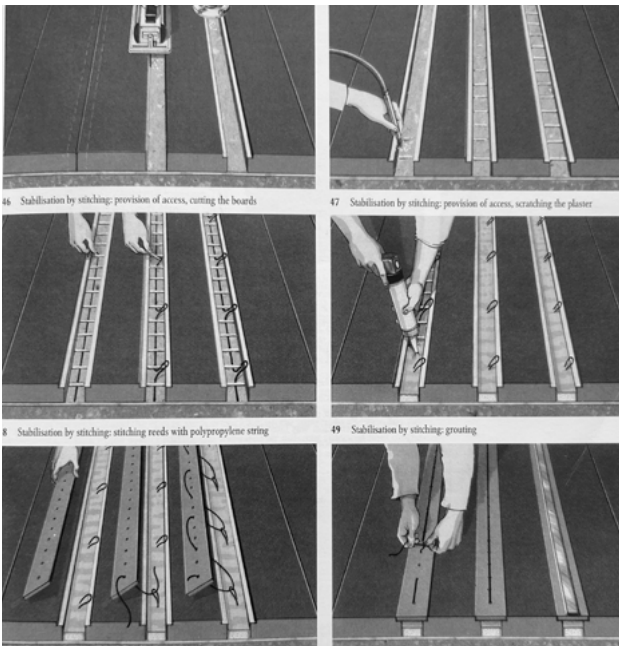
Marble Hall in the Upper Belvedere, Vienna, after restoration. The structure was heavily damaged in 1944. (BDA Archive, photo: Tinzl, 2005)

Mramorna dvorana u Gornjem Belvedereu u Beču nakon restauracije. Konstrukcija je teško oštećena 1944. (arhiva BDA, snimka: Tinzl, 2005.)



An impression of the Jesuit Theatre in Vienna. The whole ceiling was at risk of collapse and presented a potentially irreplaceable loss (BDA Archive, photo: unknown, 2023)

Isusovačko kazalište u Beču. Cijelom je stropu prijetila opasnost od urušavanja, što bi bio nenadoknadv gubitak (arhiva BDA, snimka: nepoznat autor, 2023.)



Restorer Prof. Heinz Leitner developed a suspension system in which the large-scale ceiling painting and its support was sewn together from the roof space with cord suspensions thereby re-stabilising the entire structure. (source: Leitner, Heinz, Brittle and flexible – the structural stabilisation of painted plaster on suspended wooden ceilings, Kunsttechnologie und Konservierung, Jg 14/2000, Heft 1, p.125)

Restaurator prof. Heinz Leitner razvio je sustav ovjesa u kojem su velika stropna slika i njezina podloga spojene šivanjem užetima iz potkrovlja, čime je cijela konstrukcija ponovno stabilizirana (izvor: Leitner, Heinz, Brittle and flexible – the structural stabilisation of painted plaster on suspended wooden ceilings, Kunsttechnologie und Konservierung, Jg 14/2000, Heft 1, str. 125)



Typical metal attachments to reattach structurally unstable supports, dating from the late 1940s. (BDA Archive, photo: Tinzl, 2005)

Tipični metalni učvršćivači za ponovno pričvršćivanje strukturno nestabilnih nosača koji datiraju iz kasnih 1940-ih (arhiva BDA, snimka: Tinzl, 2005.)

Tehnička sanacija oslikanih, vapnenih žbuka i štukatura na drvenim konstrukcijama stropova

Technical restoration of painted lime plasters and stucco on wooden ceilings

Cilj izlaganja je sagledavanje nužnih koraka u tehničkoj sanaciji žbuka drvenih stropnih konstrukcija a da se pritom ne degradira umjetničko djelo ili da se ne potaknu procesi propadanja. Prikazat će se primijenjena metoda tehničke stabilizacije drvene konstrukcije i žbuke stropova na nekoliko primjera graditeljskog nasljeđa.

Povijesno oslikana stropna žbuka koja se mjestimično odvojila od drvene potkonstrukcije često se uruši, padne na tlo bez moguće rekonstrukcije. Međutim, osim žbuke, u stropnom sustavu nalazi se još elemenata (nosiva drvena stropna konstrukcija i drvena potkonstrukcija) koji mogu pojedinačno utjecati na stabilnost cjeline; naročito se negativno na stabilnost sustava odražava istodobno djelovanje više pojedinačnih nepovoljnih loših pojava.

Vrlo se često drvena krovna konstrukcija koristi kao podloga za pribijanje drvenih stropnih letvica na koje se navlači vapneni mort (stropna žbuka). Najbolji sustav stropne drvene konstrukcije odvojen je od krovne drvene konstrukcije, što predstavlja statičku autonomiju i omogućuje zasebne tehnološke procese pri obnovi.

Drugi važni element stropnog sustava je drvena potkonstrukcija – stropne letvice ili trska. Problematično je ako su stropne letvice prevelike (previsoke ili preširoke), ako je razmak između letava premali ili prevelik, ako nastaje bubrenje ili skupljanje drva ili ako su pribijene konusnim kovanim čavlima. Najzorniji primjer neodgovarajućih stropnih letvica vidljiv je na oslikanom stropu Muzeja grada Rovinja ili stropu Teatrina u Labinu.

Treći važni element stropnog sustava je vapneni mort koji je medij za brtvljenje, kohezivnu stabilnost i "platno" za slikarske aplikacije. Svaka nepravilnost (neravnoteža omjera, neumjerenost u debljinama, neispravna receptura i sl.) umanjuje kvalitativne karakteristike, jer stabilnost počinje progresivno opadati. Primjer je strop Teatrina u Labinu ili strop župne crkve u Motovunu.

Tehnička stabilizacija podrazumijeva stabilizaciju drvene nosive stropne konstrukcije, stropnih letvica i vapnene viseće žbuke. Poznate metode za stabilizaciju drvene nosive konstrukcije su sanacija zatečenih nosivih greda dodavanjem drvenih ili metalnih proteza, dodavanje novih nosivih metalnih greda na koje se vješaju povijesne oštećene drvene stropne grede, dodavanje novih drvenih greda na koje se pričvršćuju zatečene stropne letvice ili kombinacija spomenutih metoda. Tehnička stabilizacija stropnih letvica postiže se rekonstrukcijom (zamjenom) trulih letava novima ili ponovnim pričvršćivanjem vijcima zatečenih letava.

U izlaganju se prezentira metoda tehničke stabilizacije vapnene viseće žbuke, koja obuhvaća čišćenje nefunkcionalne gornje (tavanske) žbuke i isisavanje prašine, namakanje vapnenom vodom (s ciljem reaktivacije vapnenog morta i impregnacije prašnih površina), zalijevanje međuprostora kroz razmake između letava kompozitom PLM-AL, podvezivanje PVC vezicama donje žbuke, ugradnju nove gornje (tavanske) žbuke od prirodnog hidrauličnog vapna (NHL 3,5) s položenim stakloplastičnim pletivom

The aim of this presentation is to examine the necessary steps that need to be taken during technical restorations of plaster on wooden ceiling structures to not damage the artwork or cause further processes of deterioration. The method of technical stabilization of the wooden structure and ceiling plaster that was used will be presented through several examples.

Painted ceiling plaster that detaches from the wooden substructure often collapses, and falls to the ground without the possibility of reconstruction. In addition to the plaster, there are other elements in the ceiling system (load-bearing wooden ceiling structure and wooden substructure) that can individually affect its stability. The simultaneous action of several individual unfavourable factors can have a particularly negative impact on the stability of the system.

The wooden roof structure is often used as the base for nailing wooden ceiling laths onto which lime mortar (ceiling plaster) is applied. The best ceiling construction system is the one in which the ceiling wooden structure is separated from the roof wooden structure ensuring structural autonomy and allowing for independent technological processes during restoration.

Another important element of the ceiling system is the wooden substructure – ceiling laths or reeds. Problems arise if the laths are too large (too thick or too wide), if the spacing between them is too narrow or too wide, if the wood swells or shrinks, or if they are nailed with conical forged nails. The most evident examples of inadequate ceiling laths can be seen on the painted ceiling of the Rovinj City Museum or the ceiling of the Teatrino in Labin.

The third important element of the ceiling system is lime mortar which acts as a sealing medium, provides cohesive stability, and serves as the "canvas" for painting. Any irregularity (imbalance in proportions, excessive thickness, incorrect recipe, etc.) reduces the quality as stability progressively declines. Examples include the ceiling of the Teatrino in Labin, and the ceiling of the parish church in Motovun.

Technical stabilization involves stabilizing the load-bearing wooden ceiling structure, ceiling laths, and suspended lime plaster. Known methods for stabilizing the wooden load-bearing structure include repairing existing beams by adding wooden or metal braces, adding new supporting metal beams onto which the historical damaged wooden beams are hung, adding new wooden beams onto which the existing ceiling laths are attached, or a combination of these methods. Technical stabilization of ceiling laths is achieved by reconstructing (replacing) rotten laths with new ones or by reattaching existing laths with screws.

The presentation highlights a method of technical stabilization of suspended lime plaster, which includes: cleaning of the non-functional upper (attic-side) plaster and vacuuming dust, soaking with limewater (to reactivate the lime mortar and impregnate dusty surfaces), filling cavities through gaps between laths with PLM-AL composite, tying the lower plaster with PVC

za koje se vezuju PVC vezice te njegovanje svih novih slojeva žbuke. Radovi na sanaciji stropne žbuke često se izvode u vrlo složenim uvjetima, kao na stropu Teatrina u Labinu ili stropu župne crkve u Roču. Kako bi se osigurao zdrav i dugovječan strop, što podrazumijeva drvenu konstrukciju, stropnu žbuku, oslik i štukaturu, važno je nastojati održavati vodonepropusnost krova, urednost ventiliranog tavana (nepristupačno za ptice te postojanje funkcionalnih otvora za ventilaciju) i pravovremeno reagirati u slučaju potrebe za konzervatorsko-restauratorskim radovima koji bi produljili materijalni vijek kulturnog dobra.

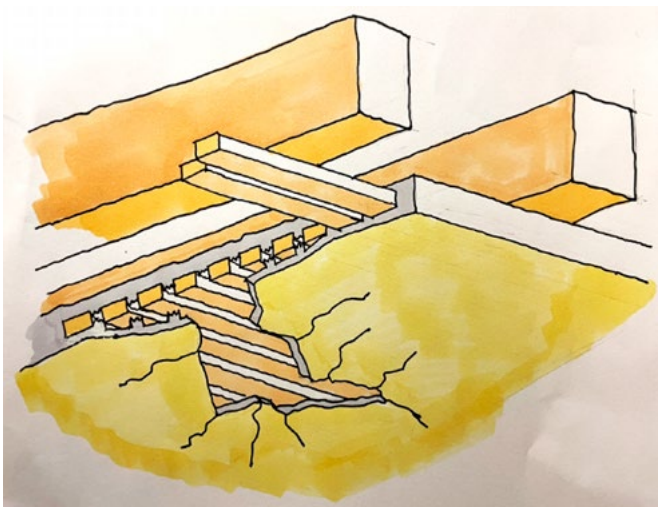
KLJUČNE RIJEČI: žbuka, oslik, štukature, drvo, strop, sanacija, pro-šivanje

ties, installing new upper (attic-side) plaster made of natural hydraulic lime (NHL 3.5) with fiberglass mesh onto which PVC ties are fixed, and curing all new plaster layers. Restoration of ceiling plaster is often carried out in very complex conditions, like the ceiling of the Teatrino in Labin or the ceiling of the parish church in Roč. To ensure a sound and long-lasting ceiling, which includes the wooden structure, ceiling plaster, wall paintings, and stucco, it is important to strive to maintain the watertightness of the roof, keep the ventilated attic clean (inaccessible to birds, with functional ventilation openings), and respond promptly when conservation and restoration is needed to prolong the life of cultural heritage.

KEYWORDS: plaster, wall paintings, stucco, wood, ceiling, restoration, stitching

Branko Orbanić rođen je 1961. godine. Živi u Žminju u Istri. Od završetka studija arhitekture počinje se baviti vernakularnom arhitekturom i njezinom revitalizacijom. Obuzetost graditeljskom baštinom i spomenicima kulture njegova je preokupacija već 39 godina. Aktivan je u privatnoj tvrtki Kapitel d.o.o. Žminj i član je Hrvatske komore arhitekata. Posebnu strast gaji prema suhozidnoj arhitekturi, tradicijskim materijalima i tehnikama građenja. Razumijevanje naslijeđene graditeljske baštine bistri mu rješenja za njihovu obnovu.

Branko Orbanić was born in 1961. He lives in Žminj, Istria. Since completing his studies in architecture, he has been engaged in vernacular architecture and its revitalization. His dedication to architectural heritage and cultural monuments has been his main preoccupation for 39 years. He is active in the private company *Kapitel d.o.o.* in Žminj and is a member of the Croatian Chamber of Architects. He has a particular passion for dry-stone architecture, traditional materials, and building techniques. His understanding of inherited architectural heritage helps him find solutions for their restoration.



Ilustracija oštećenja stropne žbuke (B. Orbanić, 2025.)

Drawing of damage to the ceiling plaster (B. Orbanić, 2025)

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Labin, Teatrino, preširoko postavljene stropne letvice (snimka: S. Tomišić, 2019.)

Labin, Teatrino, ceiling battens set too wide (photo: S. Tomišić, 2019)



Rovinj, Muzej grada Rovinja, preširoke stropne letvice s premalim razmakom (snimka: B. Orbanić, 2025.)

Rovinj, Rovinj City Museum, ceiling battens too wide with a too small gap (photo: B. Orbanić, 2025)

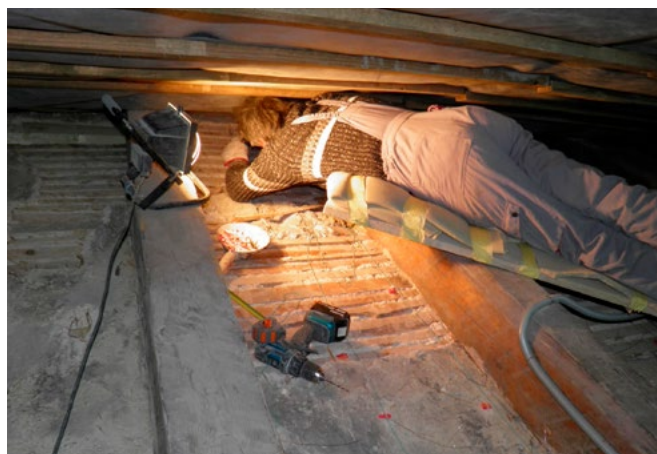


Labin, Teatrino, rupa u stropnom sustavu (snimka: S. Tomišić, 2019.)

Labin, Teatrino, hole in the ceiling system (photo: S. Tomišić, 2019)



Motovun, crkva sv. Stjepana, otpala oslikana žbuka sa stropa (snimka: B. Orbanić, 2007.)
 Motovun, Church of St. Stephen, painted plaster falling off the ceiling
 (photo: B. Orbanić, 2007)



Labin, Teatrino, radovi u skučenom prostoru tavana (snimka: S. Tomišić, 2019.)
 Labin, Teatrino, working in the cramped attic (photo: S. Tomišić, 2019)



Motovun, crkva sv. Stjepana, strop glavnog broda nakon radova (arhiva HRZ-a, 2010.)
 Motovun, church of St Stephen, ceiling of the main nave after conservation (HRZ Archive, 2010)

Strop u crkvi sv. Jurja u Buzetu, analiza stanja i zaštitni radovi

Ceiling of the church of St George in Buzet: condition analysis and protective works

Strop crkve sv. Jurja u Buzetu, koji je današnji izgled dobio preuređenjem potkraj 18. stoljeća, izdvaja se kao reprezentativni primjer zidnih slika i štukatura izvedenih na žbukanim drvenim konstrukcijama na području Istre na kojima su nosioci žbuke drvene letvice. Ukrašen je slikama mletačkoga majstora Mattea Furlanetta i štukaturama Francesca Schiavija iz Tolmezza. Tijekom vremena nastala su ozbiljna strukturna oštećenja, a prodor vode tijekom zamjene krova 2009. godine prouzročio je naglo pogoršanje stanja stropa. Žbuke i štukature počele su se odvajati i otpadati, a slikani slojevi medaljona oštećeni su na više mjesta. Provedene su hitne mjere zaštite i izrađena je detaljna dokumentacija zatečenoga stanja, nakon čega je strop 'mekano' poduprt prilagođenom skelom i drvenom konstrukcijom obloženom spužvom.

Projektom sanacije predviđeno je ojačavanje drvene konstrukcije ugradnjom pocinčanih čeličnih ojačanja i lameliranog drva. Nestabilni su dijelovi žbuke s tavanke strane uklonjeni, a žbuka je učvršćena 'šivanjem' PVC nitima za drvene letvice. Pritom su se pažljivo birale pozicije za bušenje malih rupa potrebnih za 'šivanje', kako se oslik unutar medaljona i štukature ne bi oštetili. Dodatno je izvedeno injektiranje odvojenih dijelova žbuka s donje strane stropa te sanacija manjih oštećenja u žbuci. Nastali raster pozicija 'šivanja' u završnoj je fazi retuširan tehnikom *trateggio*, uz prethodno provedene sve nužne faze konzervatorsko-restauratorskih radova.

Ukrasni štukookviri medaljona dodatno su učvršćeni vijcima za drvenu konstrukciju stropa, a oštećenja i nedostajući dijelovi štukatura nadomješteni su nanošenjem i modeliranjem nove vapnene žbuke u nekoliko slojeva na identičan način kao i izvorni dijelovi. S tavanke je strane izvorna žbuka konsolidirana te je postavljena PVC mrežica koja je učvršćena za drvene grede stropa; nanosena je i nova vapnena hidraulična žbuka. U završnoj fazi izvedeno je obojenje neoslikanog dijela stropa i zidova sa štukaturama temeljem rezultata istraživanja, prema tragovima izvornih tonova boja.

Zaštitni radovi na stropu crkve sv. Jurja u Buzetu primjer su karakterističnih izazova obnove zidnih slika i štukature na žbukanim drvenim konstrukcijama. Njihova složenost proizlazi iz potrebe za očuvanjem statičke stabilnosti, ali i iz osjetljive ravnoteže između intervencije i poštovanja izvornih slojeva, što zahtijeva interdisciplinarnu suradnju svih uključenih struka i razmjenu znanja.

Unutrašnjost crkve sv. Jurja obnavljala se u cijelosti od 2010. do 2018. godine, a građevinski, obrtnički i konzervatorsko-restauratorski radovi, osim stropa, uključivali su i zidove te sav pokretni inventar crkve, čime joj je vraćena reprezentativnost i funkcija.

KLJUČNE RIJEČI: strop, statička sanacija, konzerviranje i restauriranje, oslikani medaljoni, štukodekoracija

The ceiling in the church of St George in Buzet acquired its present form during a renovation at the end of the 18th century. It stands out as a representative example of wall paintings and stucco on plastered wooden structures in Istria (wooden laths serve as base for the plaster). It is decorated with paintings by the Venetian master Matteo Furlanetto and stuccoes by Francesco Schiavi from Tolmezzo. Over time, there were signs of serious structural damage, and water damage from 2009 when the roof was replaced caused a sudden deterioration of the ceiling. Plaster and stucco began detaching and falling off, and the painted layers of the medallions were damaged in several places. This resulted in emergency protective measures being carried out, and detailed documentation of the existing condition being prepared. Afterwards, the ceiling was "softly" propped with a custom scaffold and a wooden structure padded with sponge.

The rehabilitation project proposed reinforcing the wooden structure with galvanized steel reinforcements and laminated wood. Unstable plaster on the attic side was removed, and the plaster was secured by "stitching" with PVC threads to the wooden laths. The drilling positions for the small holes required for stitching were carefully selected so that the medallion paintings and stuccoes would not be damaged. Detached parts of the plaster on the underside of the ceiling were also injected, and minor plaster damage was repaired. The resulting grid of "stitching" points was retouched using the *trateggio* technique, following all necessary phases of conservation and restoration process.

The decorative stucco frames of the medallions were further reinforced with screws anchored to the wooden ceiling structure, and the damaged or missing stucco elements were replaced by applying and modelling new lime plaster in several layers, in the same manner as the original. On the attic side, the original plaster was consolidated, and a PVC mesh was installed and attached to the wooden beams of the ceiling; a new hydraulic lime plaster was also used. In the final phase, the unpainted part of the ceiling and the stuccoed walls were painted based on research results and traces of the original colours.

The protective works on the ceiling of St George's Church in Buzet are an example of the characteristic challenges involved in the restoration of wall paintings and stucco decoration on plastered wooden structures. Their complexity arises from the need to preserve structural stability, and the delicate balance between intervention and respect for the original layers which requires interdisciplinary cooperation of all various professions and the exchange of expertise.

The entire interior of St George's Church was restored between 2010 and 2018. Construction and finishing work, conservation and restoration, in addition to the ceiling, also included the walls and all of the church's movable inventory, thus restoring its representative character and function.

KEYWORDS: ceiling, structural rehabilitation, conservation and restoration, painted medallions, stucco decoration

Toni Šaina, viši konzervator-restaurator, diplomirao je 2007. na Odsjeku za konzervaciju-restauraciju Umjetničke akademije Sveučilišta u Splitu, specijaliziravši se za zidne slike i mozaike. Iste godine zapošljava se u Hrvatskom restauratorskom zavodu. Radi na Odsjeku za zidno slikarstvo i mozaik sa sjedištem u Rijeci. Kontinuirano sudjeluje u programima konzervatorsko-restauratorskih radova i istraživanja na zidnim slikama i mozaicima, uključujući Eufrazijevu baziliku u Poreču, upisanu na UNESCO-ov Popis svjetske baštine. Izlaže na domaćim i međunarodnim znanstvenim i stručnim skupovima, predstavljajući rezultate istraživanja i izvedene radove; aktivno je sudjelovao u organizaciji nekoliko stručnih međunarodnih skupova. Autor je i suautor više stručnih i znanstvenih radova. Trenutno je doktorand Sveučilišta u Ljubljani, gdje istražuje metode konzervatorsko-restauratorskih zahvata na antičkim i kasnoantičkim mozaicima u Puli.

Toni Šaina, senior conservator-restorer, graduated in 2007 from the Department of Conservation-Restoration at the Academy of Arts, University of Split, specializing in wall paintings and mosaics. In the same year, he was employed at the Croatian Conservation Institute. He works in the Department for Wall Painting and Mosaics, based in Rijeka. He continuously participates in conservation-restoration programs and research on wall paintings and mosaics, including the Euphrasian Basilica in Poreč, part of the UNESCO World Heritage List. He presents his research results and restoration projects at scientific and professional conferences in Croatia and abroad, and has actively participated in organizing several international professional meetings. He is the author and co-author of several professional and scientific papers. He is currently a doctoral candidate at the University of Ljubljana, where he is researching methods of conservation-restoration interventions on ancient and late antique mosaics in Pula.



Buzet, crkva sv. Jurja, strop crkve prije radova (arhiva HRZ-a, snimka: M. Čubrić, 2010.)

Buzet, church of St George, ceiling before conservation (HRZ Archive, photo: M. Čubrić, 2010)



Buzet, crkva sv. Jurja, strop nakon radova (arhiva HRZ-a, snimka: J. Kliska, 2018.)

Buzet, church of St George, ceiling after conservation (HRZ Archive, photo: J. Kliska, 2018)



Buzet, crkva sv. Jurja, podupiranje stropa i konstruktivna sanacija žbuke i štukatura stropa (arhiva HRZ-a, snimka: T. Šaina, 2010.)

Buzet, church of St George, propping the ceiling and structural rehabilitation of ceiling plaster and stuccoes (HRZ Archive, photo: T. Šaina, 2010)



Buzet, crkva sv. Jurja, detalj oslika stropa nakon učvršćivanja PVC nitima (arhiva HRZ-a, snimka: J. Kliska, 2013.)

Buzet, church of St George, detail of the ceiling painting after consolidation with PVC threads (HRZ Archive, photo: J. Kliska, 2013)

The Problem of Wall Paintings on Wooden Structures – Restoration of the Ceiling of the Grand Salon in the Lanthieri Mansion in Vipava, Slovenia

Problem zidnih slika na drvenim konstrukcijama – restauriranje stropa Velikog salona u dvorcu Lanthieri u Vipavi, Slovenija

Wall paintings on plaster applied to wooden structures are quite vulnerable to deterioration as they combine two very different materials: organic (wood) and mineral (plaster). Structurally, they are often prone to sagging and deformations due to excessive loads and spans, and as a support made of chopped laths, they are subject to swelling and shrinking. Both types of damage cause stress in the plaster which is a rigid material. A frequent additional cause of damage and decay is poor maintenance (roof leaks).

The 17th-century Grand Salon of the Lanthieri Mansion in Vipava is located on the first floor of the main building. The ceiling, except for the central field where an oil painting was suspended, was painted in the 19th century. The ceiling measures 9.2 × 13.6 meters and is supported by 16 load-bearing beams, onto which chopped spruce laths were nailed from below. Coarse plaster, reinforced with horsehair and straw, encases the laths on all sides. The painted plaster layer was applied over an already completed and repeatedly whitewashed surface. The painting was mostly executed in the *mezzo fresco* technique on partially dried and re-moistened plaster.

The main issue was the detachment of the coarse plaster from the wooden support on the underside where the painting is located.

Before consolidating the plaster and wooden structure, the entire ceiling of the hall was braced with foam-padded laths screwed through the plaster into the wooden structure. The work then continued from the upper side of the ceiling: removing dirt, removing deteriorated old plaster above and between the laths, and consolidating the original plaster with a lime-in-alcohol emulsion (CaLoSil E25) applied in the spaces between the laths.

A combination of two methods was used for consolidation in areas where the upper layer of plaster had been removed. The first was filling the spaces between the laths and stabilising them with lime mortar. Strips of plastic reinforcement mesh strips, approximately 10 cm wide and spaced about 7 cm apart, were inserted onto and between the laths. A fine lime mortar mixed with 5% of the acrylic emulsion Sokrat 2804 and microfibers was applied through the mesh onto the original mortar.

The second method was point bonding. In the gaps between the mesh strips and mortar, the ceiling plaster was additionally bonded using low-expansion polyurethane foam. The entire area was then covered with a layer of coarse lime mortar, also mixed with microfibers and 5% acrylic emulsion.

The original plaster, that had been preserved on the upper side of the ceiling, was consolidated with nano-lime (CaLoSil E25) poured through holes about 6 mm wide, made between the load-bearing laths at intervals of approximately 7 cm and

Zidne slike na žbuci na drvenim konstrukcijama prilično su osjetljive jer kombiniraju dva vrlo različita materijala: organski (drvo) i mineralni (žbuka). Strukturno su često sklone udubljenjima i deformacijama zbog velikih opterećenja i raspona, a nosač od cijepanih letvica podložan je bubrenju i skupljanju. Obje vrste oštećenja uzrokuju naprezanje žbuke koja je kruti materijal. Dodatni uzrok oštećenja i propadanja je često loše održavanje, najčešće prokišnjavanje.

Veliki salon dvorca Lanthieri u Vipavi iz 17. stoljeća nalazi se na prvom katu glavne zgrade. Strop, osim središnjega polja (na kojemu je bila postavljena uljana slika), oslikan je u 19. stoljeću. Strop je dimenzija 9,2 × 13,6 metara i podupire ga 16 nosivih greda na koje su odozdo pribijene cijepane smrekove letve. Gruba žbuka, ojačana konjskom dlakom i slamom, obavlja letve sa svih strana. Sloj oslikane žbuke nanesen je preko već dovršene i više puta okrečene površine. Slika je uglavnom izvedena u tehnici *mezzo fresco* na djelomično osušenoj i ponovno navlaženoj žbuci.

Glavni problem bio je odvajanje grube žbuke od drvenog nosioca na donjoj strani na kojoj je slika. Prije konsolidacije žbuke i drvene konstrukcije, cijeli strop dvorane učvršćen je letvama obloženim s umjetnom pjenom koje su vijcima pričvršćene kroz žbuku za drvenu konstrukciju. Radovi su zatim nastavljeni s gornje strane stropa: uklonjena je prljavština, kao i dotrajala stara žbuka iznad i između letvi, a izvorna žbuka je konsolidirana emulzijom vapna u alkoholu (*CaLoSil E25*) nanesenom u prostore između letvi.

Za konsolidiranje područja na kojima je uklonjen gornji sloj žbuke primijenjena je kombinacija dviju metoda. Prva je bila ispunjavanje prostora između letvica i njihova stabilizacija vapnenim mortom. Trake od plastične armaturne mreže, širine otprilike 10 cm i razmaka od oko 7 cm, umetnute su preko i između letvica. Fini vapneni mort pomiješan s 5 % akrilne emulzije *Sokrat 2804* i mikrovlaknima nanesen je kroz mrežicu na originalni mort.

Druga metoda bila je točkasto lijepljenje. U praznine između mrežastih traka i morta, žbuka stropa dodatno je lijepljena poliuretanskom pjenom niske ekspanzije. Cijelo područje zatim je prekriveno slojem grubog vapnenog morta, također pomiješanog s mikrovlaknima i 5 % akrilne emulzije.

Originalna žbuka, koja je očuvana na gornjoj strani stropa, učvršćena je nanovapnom (*CaLoSil E25*) izlivenim kroz rupice (širine oko 6 mm i dubine oko 4 cm) između nosivih letvica u razmacima od otprilike 7 cm. U te je rupe zatim ubrizgana poliuretanska pjena niske ekspanzije radi točkastog pričvršćivanja, a zatim je provedeno krpanje vapnenim mortom.

Drvena konstrukcija, koja je bila u dobrom stanju, također je ojačana. Da bi se spriječilo odvajanje nosivih letvi od greda, svaka druga letva pričvršćena je vijcima u gredu perforiranim

to a depth of about 4 cm. Low-expansion polyurethane foam was then injected into these holes for point fixing, followed by patching with lime mortar.

The wooden structure, which was in good condition, was also reinforced. To prevent the detachment of the supporting laths from the beams, every second lath was screwed into the beam using perforated metal straps. After completing the work on the upper side of the ceiling, the load-bearing beams were further reinforced with two laminated wooden supports attached to their sides, and anchored into the longitudinal walls. Each beam was fastened using steel rods inserted through the beam and both side supports.

KEYWORDS: Wall paintings, wooden support structure, consolidation, plaster detachment

metalnim trakama. Nakon završetka radova na gornjoj strani stropa, nosive grede su dodatno ojačane dvama lameliranim drvenim nosiocima pričvršćenima na njihove bočne strane i uzdužne zidove. Svaka greda pričvršćena je čeličnim šipkama umetnutima kroz gredu i oba bočna nosača.

KLJUČNE RIJEČI: zidne slike, drvena nosiva konstrukcija, konsolidacija, odvajanje žbuke

Andrej Jazbec obtained the title of academic painter in 1997 at the Accademia di Belle Arti in Venice, and in 2002 he earned a Master of Arts degree at the Academy of Fine Arts and Design, University of Slovenia. Since 1997, he has been employed at the Institute for the Protection of Cultural Heritage of Slovenia as a conservator-restorer in the field of wall painting. He is a member of the Working Group for the Protection and Conservation of Wall Paintings at the Institute. In 2017, he received the *Mirko Šubic* Award. As organizer and co-mentor, he participated in the international workshop Gradišče Summer School in Gradišče pri Divači from 2021 to 2023. He has led numerous conservation-restoration interventions on wall paintings.

Andrej Jazbec stekao je titulu akademskoga slikara 1997. na Accademia di belle arti u Veneciji, a 2002. magistrirao je na Akademiji likovnih umjetnosti i dizajna Sveučilišta u Ljubljani. Od 1997. zaposlen je na Zavodu za zaštitu kulturne baštine Slovenije kao konzervator-restaurator za područje zidnog slikarstva. Član je Radne skupine za zaštitu i konzervaciju zidnih slika u Zavodu. Godine 2017. dobio je Nagradu *Mirko Šubic*. Kao organizator i komentor sudjelovao je na međunarodnoj radionici *Ljetna škola Gradišče* u Gradišću pri Divači od 2021. do 2023. Vodio je brojne konzervatorsko-restauratorske zahvate na zidnim slikama.



Consolidation of the upper side of the painted ceiling (photo: A. Jazbec, 2012)
Učvrščivanje gornje strane oslikanog stropa (snimka: A. Jazbec, 2012.)



Upper side of the painted ceiling after restoration (photo: A. Jazbec, 2012)
Gornja strana oslikanog stropa nakon restauracije (snimka: A. Jazbec, 2012.)



Consolidation of damaged edges of the painting (photo: A. Jazbec, 2012)
Konsolidacija oštećenih rubova oslika (snimka: A. Jazbec, 2012.)



Protection of the ceiling from detachment using foam-covered slats fastened with screws through the plaster into the wooden structure (photo: A. Jazbec, 2012)
Zaštita stropa od odvajanja pomoću letvica obloženih pjenom, pričvršćenih vijcima kroz žbuku u drvenu konstrukciju (snimka: A. Jazbec, 2012.)



Painted ceiling after restoration (photo: A. Jazbec, 2012)
Oslíkani strop nakon restauracije (snimka: A. Jazbec, 2012.)

Primjena metode pribadanja pri učvršćenju oslika na stropovima – odabrani primjeri iz Dalmacije

Application of the pinning method in consolidation of ceiling paintings – selected examples from Dalmatia, Croatia

Metoda pribadanja kao način učvršćenja stropova primijenjena je na više zidnih slika na stropovima i svodovima građevina u Dalmaciji, od kazališta u Hvaru, kuće Dešković u Splitu do Hrvatskog narodnog kazališta i palače Mattiazzi u Šibeniku.

Sustav stropa u svim odabranim prostorima pripada skupini ovješanih stropova, a sastoji se od žbuke sa slikanim slojem i drvene armature učvršćene za masivne drvene grede međukatne konstrukcije. Stropovi se razlikuju po armaturi u koju je utisnuta žbuka. Ona je rađena trskom ili drvenim letvicama, zbog čega je i način učvršćenja za drvenu potkonstrukciju drugačiji. Još jedna razlika je drvena potkonstrukcija, koju čini raster drvenih letvi koje su svojim kraćim stranicama učvršćene za nosive grede.

Razlog nestabilnosti stropa, zbog čega je izvedeno učvršćenje metodom pribadanja, jest popuštanje i kidanje veza unutar sustava stropne konstrukcije. Najprije dolazi do pucanja krućeg materijala, žbuke, koja ne može na jednak način podnijeti gibanja kao drveni dijelovi konstrukcije stropa. Navedeni primjeri stropova pokazivali su, uz nestabilnost stropne konstrukcije, i različite stupnjeve i razine oštećenja, poput napuknuća i delaminacije razine žbuke, odvajanja i urušavanja žbuke i potpunoga gubitka i oštećenja drvene armature.

Oštećenja i nestabilnosti uzrokuje, osim prirodnoga slabljenja materijala (zbog starenja i djelovanja gravitacijske sile), i djelovanje vlage, s nizom negativnih procesa koje potiče, ali i neprikladno ljudsko djelovanje koje je izazvalo mehanička oštećenja naglim djelovanjem sile odozgo.

Predavanje će se usmjeriti na primijenjene metode učvršćenja i prilagodbe, koje su bile potrebne da bi se ostvarili maksimalni učinci učvršćenja žbuke za stropnu konstrukciju, ali i riješili specifični izazovi u svakome od odabranih primjera.

KLJUČNE RIJEČI: učvršćenje oslikanih stropova, metoda pribadanja, Hvarsko kazalište, kuća Dešković, HNK u Šibeniku, palača Mattiazzi

The pinning method as a way of consolidating ceilings has been used on several wall paintings on ceilings and vaults in Dalmatia, from the theatre in Hvar and the Dešković House in Split to the Croatian National Theatre and the Mattiazzi Palace in Šibenik.

The ceiling systems in all these sites belong to the group of suspended ceilings and consist of plaster with a painted layer and a wooden framework fixed to massive wooden beams of the interfloor structure. The ceilings differ in the reinforcement into which the plaster was pressed. It was made either using reed or wooden laths, which also required different methods of fastening to the wooden substructure. Another difference lies in the wooden substructure which is made of a grid of wooden laths attached by their shorter sides to the supporting beams.

The reason for the instability of the ceilings, and why the pinning method was used, was the loosening and breaking of the connections within the ceiling construction system. Cracks would first appear in the plaster, a rigid material which cannot withstand movements in the same way as the wooden elements of the ceiling structure. In addition to the instability of the ceiling system, the selected cases also showed varying degrees and types of damage such as cracks and uneven plaster levels, detachment and collapse of plaster, and complete loss or damage of the wooden reinforcement.

Damage and instability are caused not only by the natural weakening of materials (due to ageing and gravity), but also by moisture which triggers a range of harmful processes, and inappropriate human interventions that resulted in mechanical damage through sudden application of force from above.

The lecture will focus on the applied methods of consolidation and the adjustments required to achieve maximum effectiveness in securing the plaster to the ceiling structure, while at the same time addressing the specific challenges in each of the selected cases.

KEYWORDS: consolidation of painted ceilings, pinning method, Hvar Theatre, Dešković House, Croatian National Theatre in Šibenik, Mattiazzi Palace

Dr. sc. Antonija Gluhan je viša konzervatorica-restauratorica za zidne slike i mozaike. Od 2003. godine zaposlena je u Hrvatskom restauratorskom zavodu, Odjel u Splitu, na Odsjeku za zidne slike, mozaike i štukaturu. Godine 2020. imenovana je voditeljicom Odjela za nepokretnu baštinu u Splitu.

Diplomirala je konzervaciju-restauraciju na Umjetničkoj akademiji Sveučilišta u Splitu (UMAS), a poslijediplomski magistarski studij restauracije završila je na Akademiji za likovno umetnost in oblikovanje u Ljubljani, Slovenija, s temom koja obrađuje dizanje i prijenos zidnih slika i mozaika. Doktorirala je na poslijediplomskom studiju *Humanističke znanosti* (smjer povijest umjetnosti) Sveučilišta u Zadru s temom koja obrađuje zidne slike iz 19. stoljeća u Dalmaciji.

Mr. sc. Ivana Jerković diplomirala je konzervaciju-restauraciju na Umjetničkoj akademiji Sveučilišta u Splitu 2002. godine. Godine 2021. završila je poslijediplomski znanstveni studij *Arheologije istočnog Jadrana* na Sveučilištu u Zadru, gdje je obranila magistarski rad s temom *Ranokršćanski mozaici na području Salone*. Od 2003. godine zaposlena je u Hrvatskom restauratorskom zavodu u Splitu kao konzervator-restaurator. Od veljače 2020. godine obnaša dužnost voditeljice Odjela za zidno slikarstvo, mozaik i štuko, gdje koordinira i nadzire stručne i terenske projekte koji se odnose na očuvanje kulturne baštine.

Antonija Gluhan, Ph.D., is a senior conservator-restorer for wall paintings and mosaics. She has been employed at the Section for Wall Paintings, Mosaics and Stucco in Split of the Croatian Conservation Institute since 2003. In 2020, she was appointed head of the Department for Stone Sculptures, Wall Paintings, Mosaics and Stucco in Split.

She graduated in Conservation-Restoration at the Arts Academy of the University of Split (UMAS) and completed a postgraduate Master's degree in Restoration at the Academy of Fine Arts and Design in Ljubljana, Slovenia, with a thesis on lifting and transferring wall paintings and mosaics. She received her PhD in the Postgraduate Doctoral Programme in Humanities (Art History track) at the University of Zadar with a dissertation on 19th-century wall paintings in Dalmatia.

Ivana Jerković, MSc, graduated in Conservation-Restoration at the Arts Academy of the University of Split in 2002. In 2021, she completed a postgraduate scientific programme in Archaeology of the Eastern Adriatic at the University of Zadar, where she defended her Master's thesis on Early Christian mosaics in the area of Salona.

She has been employed at the Croatian Conservation Institute in Split since 2003 as a conservator-restorer. In February 2020, she became head of the Section for Wall Paintings, Mosaics and Stucco where she coordinates and supervises professional and field projects related to the preservation of cultural heritage.



Hvar, Kazalište, priprema za umetanje drvenih štapića (snimka: A. Gluhan, 2010.)

Hvar, Theatre, preparation for inserting wooden sticks (photo: A. Gluhan, 2010)



Split, Palača Bajamonti-Dešković, umetanje drvenih štapića (snimka: I. Jerković, 2010.)

Split, Bajamonti-Dešković Palace, inserting wooden sticks (photo: I. Jerković, 2010)



Split, Palača Bajamonti-Dešković, učvršćenje odvojenih dijelova stropa (snimka: A. Gluhan, 2018.)

Split, Bajamonti-Dešković Palace, fixing of separate parts of the ceiling (photo: A. Gluhan, 2018)



Hvar, Kazalište, pogled na gledalište nakon konzervatorsko-restauratorskih radova (sinimka: Z. Alajbeg, 2011.)

Hvar, Hvar Theatre, view of the auditorium after conservation (photo: Z. Alajbeg, 2011)

Analiza konzervatorsko-restauratorskih radova na oslikanim stropovima palače Hrvatskoga povijesnog muzeja u Zagrebu i dvorca Normann u Bizovcu

Analysis of conservation and restoration of the painted ceilings of the Croatian History Museum palace in Zagreb and the Normann Castle in Bizovac

Izlaganje donosi stručnu analizu konzervatorsko-restauratorskih radova na oslikanim stropovima dvorca Normann u Bizovcu te palače Vojković – Oršić – Kulmer – Rauch (današnje sjedište Hrvatskoga povijesnog muzeja) u Zagrebu. U oba slučaja nosivu podlogu čini sustav drvene konstrukcije na koji je nanosena vapnena žbuka, dodatno ojačana armaturom od trske. Zidne slike izvedene su tehnikom *secco*.

Poseban je izazov kod navedenih stropova degradacija svih slojeva oslika i njegova nosioca, nastala kao posljedica statičkih oštećenja podloge, prodora vlage, neprimjerenih zahvata u prošlosti te potresa. Navedeni procesi uzrokovali su odvajanje žbuke, pulveriziranje slikanog sloja i gubitak materijalne cjelovitosti.

Konzervatorsko-restauratorski radovi na oba objekta pokazuju konkretne primjere postupaka učvršćivanja i reintegracije žbukano sloja, metode stabilizacije drvene nosive strukture i trske te pristupe estetskoj prezentaciji i integraciji slikanog sloja, što se naročito odnosi na očuvanje likovnih obilježja i povijesne vrijednosti zidnih slika.

Na mjestima na kojima je izvorna žbuka potpuno otpala sa stropa, ugrađena je nova armaturna trstika. Trstika je pričvršćena na grede vijcima ojačanim okruglim pločicama od inoksa, a međusobno je povezana tankom žicom radi dodatne stabilnosti. Sličan postupak primijenjen je i na manjim oštećenjima gdje je izvorna trstika ostala netaknuta, uz dodatno učvršćivanje postojećeg sloja. Prije nanošenja prvog grubog sloja žbuke, površinske nečistoće uklonjene su mekim kistom. Nakon toga je nanosen tanji sloj finije vapnene žbuke, a završni sloj činio je vapneni glet na kojem je izvedena rekonstrukcija nedostajućeg slikanog sloja.

KLJUČNE RIJEČI: konzerviranje-restauriranje, zidni oslik, strop, žbuka, trska, drvena konstrukcija

This presentation analyses the conservation and restoration project carried out on the painted ceilings of the Normann Castle in Bizovac and the Vojković – Oršić – Kulmer – Rauch Palace, today the seat of the Croatian History Museum in Zagreb. In both buildings, the structural support consists of a wooden framework covered with lime plaster reinforced by reed lathing. The wall paintings were executed in the *secco* technique.

A key challenge in treating these ceilings was the degradation of all layers of wall paintings and their support caused by structural instability, moisture penetration, inappropriate earlier interventions, and earthquakes. These factors resulted in plaster detachment, pulverization of the paint layer, and the loss of material cohesion.

The conservation and restoration carried out on both sites provide practical examples of procedures for consolidating and reintegrating the plaster layer, stabilizing the wooden framework and reed lathing, and approaches to the aesthetic presentation of the painted layer with particular emphasis on preserving the artistic qualities and historical value of wall paintings.

New reed lathing was installed in places where the original plaster had entirely detached from the ceiling. Reed lathing was secured to the beams with screws reinforced by round stainless-steel washers, and interconnected with thin wire for additional stability. A similar procedure was employed in areas of partial loss where the original reed remained intact, with additional strengthening of the existing layer. Surface deposits were removed with a soft brush before applying the first coarse layer of lime plaster. This was followed by a finer layer of lime plaster, and finally a lime putty finish, onto which the reconstruction of the missing painted layer was carried out.

KEYWORDS: conservation-restoration, wall paintings, ceiling, plaster, reed lathing, wooden framework

Marko Buljan diplomirao je 2010. godine na Odsjeku za konzerviranje i restauriranje umjetnina (smjer slikarstvo) Akademije likovnih umjetnosti u Zagrebu. Nakon diplome zaposlen je na Restauratorskom odjelu Osijek Hrvatskog restauratorskog zavoda, gdje je radio na objektima nepokretne kulturne baštine. Godine 2012. položio je stručni ispit za temeljno stručno zvanje konzervator-restaurator za užu specijalnost zidno slikarstvo, a 2013. dobio je dopuštenje (licencu) za izvođenje konzervatorsko-restauratorskih radova na zidnim slikama te je 2014. otvorio svoj obrt za konzervatorsko-restauratorske usluge *Mural*. Godine 2022. dodijeljeno mu je stručno zvanje višega konzervatora-restauratora za užu specijalnost zidno slikarstvo; iste godine postaje prvi stalni sudski vještak konzervatorsko-restauratorske struke. Trenutačno je predsjednik Hrvatskog restauratorskog društva.

Marko Buljan graduated in 2010 from the Department of Conservation and Restoration of Works of Art (painting specialization) at the Academy of Fine Arts, University of Zagreb. Following graduation, he joined the Osijek Department for Conservation of the Croatian Conservation Institute, where he worked on projects involving immovable cultural heritage. In 2012, he passed the state professional exam, qualifying as a conservator-restorer specializing in wall painting. In 2013, he obtained official authorization to carry out conservation and restoration of wall paintings, and in 2014 he established his own conservation-restoration studio, *Mural*. In 2022, he was awarded the professional title of Senior Conservator-Restorer in wall painting, and in the same year he became the first permanent court expert in the field of conservation and restoration. He currently serves as President of the Croatian Conservation-Restoration Association.



Zagreb, Hrvatski povijesni muzej, rekonstrukcija drvenog nosioca holkela (snimka: D. Matešan, 2025.)

Zagreb, Croatian History Museum, reconstruction of the wooden support of the wall-to-floor junction (photo: D. Matešan, 2025)



Zagreb, Hrvatski povijesni muzej, nanošenje nove vapnene žbuke na trščanu građu holkela (snimka: D. Matešan, 2025.)

Zagreb, Croatian History Museum, applying new lime plaster to the reed structure of the wall-to-floor junction (photo: D. Matešan, 2025)



Zagreb, Hrvatski povijesni muzej, strop nakon završenih konzervatorsko-restauratorskih radova (snimka: M. Buljan, 2025.)

Zagreb, Croatian History Museum, ceiling after conservation and restoration (photo: M. Buljan, 2025)



Bizovac, dvorac Norman, učvršćivanje tršćane građe stropa
(snimka: D. Jurčić, 2022.)

Bizovac, Norman castle, consolidation of the ceiling reed structure
(photo: D. Jurčić, 2022)



Bizovac, dvorac Norman, priprema za učvršćivanje tršćane građe stropa
(snimka: D. Jurčić, 2022.)

Bizovac, Norman castle, preparation for consolidation of the reed ceiling structure
(photo: D. Jurčić, 2022)



Bizovac, dvorac Norman, prostorija nakon reintegracije žbuknog sloja (snimka: M. Buljan, 2022.)

Bizovac, Norman castle, room after reintegration of the plaster layer (photo: M. Buljan, 2022)

Obnova i prezentacija stropnih oslika u sklopu cjelovite obnove zgrada oštećenih u potresima 2020. – zagrebački primjeri

Restoration and presentation of ceiling paintings within the comprehensive renovation of buildings damaged in the 2020 earthquakes – Zagreb case studies

Cjelovita protupotresna obnova kulturnih dobara slojevit je i zahtjevan proces, a za sve njezine sudionike velik izazov. Posebno se to odnosi na konzervatorsku struku, čija je uloga zaštititi najvrjednije povijesno-umjetničke i arhitektonsko-graditeljske značajke pojedinoga kulturnog dobra, uvažavajući sve zahtjeve protupotresne obnove javnih zgrada koje trebaju biti ojačane do propisane razine.

U sklopu cjelovite obnove Gornjogradske gimnazije restauriran je oslikani strop svečane dvorane, izvorno namijenjene kazališnim izvedbama učenika, koja je poslije prenamijenjena u školsku sportsku dvoranu.

Zidovi dvorane su konstrukcijski ojačani, a vrijedni stropni oslik restauriran je i očuvan *in situ*. Cijela površina stropnog oslika je injektirana i stabilizirana te je s gornje strane povezana s drvenom stropnom konstrukcijom da bi se spriječilo daljnje propadanje žbukane podloge. Stare zakrpe od cementne žbuke su uklonjene i zamijenjene novom na bazi vapna. Bojeni sloj je očišćen od naknadnog naliča i soli te je u cijelosti fiksiran i retuširan.

Tijekom aktualne obnove palače Erdödy – Keglević (Jezuitski trg 2) konzervatorsko-restauratorskim su istraživanjima u većini prostorija, i na prvom katu i u prizemlju, otkriveni oslici na zidovima, svodovima i stropovima. Preliminarnom analizom oslika utvrđeno je da oslici zapadnog dijela kompleksa pripadaju najstarijem sloju, odnosno da su slikani neposredno nakon izgradnje palače, na prijelazu iz 18. u 19. stoljeće. Slikani su u duhu bidermajera, no uz primjenu još nekih slikarskih odlika kasnobaroknoga iluzionizma, pa su s povijesno-umjetničkog aspekta kvalitativno najzanimljivije otkriće. Oslici na stropu, pronađeni u brojnim prostorijama ostaloga dijela kompleksa palače, pripadaju historicističkomu sloju, a oslikani su potkraj 19. stoljeća. U svim se navedenim prostorijama, na drvenim stropnim konstrukcijama iznizeliranim trskom, ponavlja vrlo sličan kompozicijski koncept oslika s različito oblikovanim rozetama u središtu te geometriziranim dekorativnim bordurama na rubovima stropova. Restauriranje se izvodi *in situ* i planirana je njihova cjelovita prezentacija.

U sklopu radova konstrukcijske i cjelovite obnove palače Drašković (Opatička 29 / Demetrova 17) provedena su opsežna konzervatorsko-restauratorska istraživanja kojima je otkriveno više slojeva kvalitetnih dekorativnih i figurativnih zidnih oslika, različitih stilskih karakteristika (kasnobaroknih, barokno-klasicističkih, bidermajerskih) i tehnika izvedbe. Projektom cjelovite obnove predviđeno je restauriranje i prezentiranje najvrednijih oslika u salonima palače na prvom katu, kao i u pojedinim prostorijama drugog kata i prizemlja. Zbog lošeg stanja stropa (žbuka na trstici pričvršćena na drvene grede) i konstruktivnih radova ojačanja, oslik je dokumentiran i 3D skeniran, a dijelovi tehnikom *stacco a masello* odvojeni s grednika i pohranjeni, da bi se mogli vratiti na izvornu poziciju i prezentirati.

Spomenuti oslici primjeri su vrijednih pronalazaka tijekom obno-

Comprehensive seismic retrofitting of cultural heritage is a layered and demanding process, and a major challenge for all participants. This is especially true for the conservation profession whose role is to protect the most valuable art historical and architectural features of individual cultural property, and take into account all requirements for seismic retrofitting of public buildings, which must be reinforced to the prescribed level.

As part of the comprehensive renovation of the Gornjogradska gimnazija high school, its ceremonial hall was also restored. Originally intended for student theatre performances, the hall was later repurposed as a school sports hall.

The walls of the hall were structurally reinforced, and the valuable ceiling paintings were restored and preserved *in situ*. The entire surface of the ceiling paintings was injected and stabilized, and it was connected with the wooden ceiling structure from above to prevent further deterioration of the plaster base. Old cement plaster patches were removed and replaced with new lime-based plaster. Salts and layers of overpainting were removed from the painted layer which was then secured and retouched.

During the ongoing renovation of the Erdödy–Keglević Palace (Jezuitski trg 2), conservation and restoration research revealed wall, vault, and ceiling paintings in most rooms on both the ground and first floor. A preliminary analysis established that the paintings in the western part of the complex belong to the oldest layer that was painted immediately after the construction of the palace at the turn of the 19th century. They were painted in the Biedermeier style with certain features of late Baroque illusionism making them the most artistically significant discovery. Ceiling paintings discovered in many other rooms of the palace belong to the historicist layer painted in the late 19th century. In all of these rooms, a very similar compositional concept of paintings is repeated on the wooden ceiling structures levelled with reeds, with differently shaped rosettes in the centre and geometric decorative borders on edges. Restoration is being carried out *in situ*, with a full presentation planned.

As part of the structural and comprehensive renovation of the Drašković Palace (Opatička 29 / Demetrova 17), extensive conservation and restoration research revealed several layers of high-quality decorative and figurative wall paintings of different stylistic characteristics (late Baroque, Baroque-classicist, Biedermeier) and techniques. The comprehensive renovation project foresees the restoration and presentation of the most valuable paintings in the salons on the first floor, as well as in selected rooms on the second and ground floor. Due to the poor condition of the ceiling (plaster on reed attached to wooden beams) and structural reinforcement, the paintings were documented and 3D-scanned. Parts of the ceiling were detached using the *stacco a massello* technique and stored so that they may later be returned to their original position and presented.

ve, čija će prezentacija u bitnome izmijeniti interijere predmetnih kulturnih dobara. Također, u sklopu cjelovite obnove obnovljeni su ili će se obnoviti oslici za koje do sada nije bilo dovoljno mogućnosti i sredstava da se kvalitetno obnove i prezentiraju.

Protupotresna i cjelovita obnova u Zagrebu donijela je nova saznanja koja pridonose razvoju konzervatorske struke, afirmirajući vrijedne i složene povijesne slojeve, uz preispitivanje i analiziranje dosadašnjih praksi i metoda obnove. Uloga konzervatora pokazala se iznova iznimno važnom. Upravo su zahvaljujući naporima i nastojanjima konzervatora očuvana spomenička svojstva kulturnih dobara koja su podvrgnuta opsežnom, sveobuhvatnom i nerijetko invazivnom procesu cjelovite obnove, pri čemu obveza očuvanja vrijednih povijesno-umjetničkih i arhitektonsko-graditeljskih elemenata postaje još jedan veliki izazov.

KLJUČNE RIJEČI: cjelovita obnova, protupotresna obnova, očuvanje, prezentacija, oslik

These paintings are valuable discoveries made during the renovation, and their presentation will fundamentally transform the interiors of these cultural properties. As part of the comprehensive renovation, paintings, for which there have not been sufficient opportunities and funds to restore and present in a quality manner, have been or will be restored.

Seismic and comprehensive renovation in the Zagreb has brought new insights that contribute to the development of the conservation profession, affirming valuable and complex historical layers while re-examining and analysing past practices and methods of restoration. The role of conservators has once again proven to be of crucial importance. Thanks to the efforts and commitment of conservators, heritage qualities of cultural properties subjected to an extensive, all-encompassing, and often invasive process of comprehensive renovation have been preserved, with the obligation of safeguarding valuable art-historical and architectural elements becoming yet another challenge.

KEYWORDS: comprehensive renovation, seismic retrofitting, conservation, presentation, painting

Antonia Matković Šerić rođena je 1989. u Splitu. Diplomirala je na Akademiji likovnih umjetnosti Sveučilišta u Zagrebu 2012. s područja konzerviranja-restauriranja umjetnina. Tijekom studija provela je jedan semestar na studijskom boravku na Akademiji likovnih umjetnosti u Pragu. Nakon dvije godine iskustva i rada na konzervatorsko-restauratorskim radovima na zidnim slikama, zapošljava se 2014. u Gradskom zavodu za zaštitu spomenika kulture i prirode Grada Zagreba, a od rujna 2025. raspoređena je na mjesto voditeljice Odjela za provedbu programa protupotresne, energetske i cjelovite obnove nepokretne kulturne baštine.

Antonia Matković Šerić was born in Split in 1989. She graduated in 2012 from the Academy of Fine Arts, University of Zagreb, specializing in conservation-restoration of artworks. During her studies, she spent a semester at the Academy of Fine Arts in Prague. In 2014, after two years of working on conservation and restoration of wall paintings, she was employed at the City Institute for the Conservation of Cultural and Natural Heritage of the City of Zagreb. Since September 2025, she has held the position of Head of the Department for the Implementation of Seismic, Energy, and Comprehensive Renovation Programs of Immoveable Cultural Heritage.



Zagreb, Palača Erdödy Keglević, novootkriveni zidni oslik (snimka: S. Veršić, 2025.)

Zagreb, Erdödy Keglević Palace, newly discovered wall painting (photo: S. Veršić, 2025)



Zagreb, Gornjogradska gimnazija, stropni oslik svečane dvorane tijekom radova (arhiva GZSKP-a, snimka: A. M. Šerić, 2024./2025.)

Zagreb, Gornjogradska gimnazija high school, ceiling painting of the ceremonial hall during conservation (GZSKP archive, photo: A. M. Šerić, 2024/2025)



Zagreb, Palača Drašković, Opatička 29, detalji novootkrivenog oslika (snimka: M. G. Čumbrek, 2024./2025.)

Zagreb, Drašković Palace, Opatička 29, details of the newly discovered wall painting (photo: M. G. Čumbrek, 2024/2025.)



Zagreb, Gornjogradska gimnazija, strop svečane dvorane prije i nakon radova (ortofoto snimka: Koto d.o.o., 2024./2025.)

Zagreb, Gornjogradska gimnazija high school, ceiling of the ceremonial hall before and after conservation (orthophoto: Koto d.o.o., 2024/2025)

Zidni i stropni oslici i štukature u četiri zgrade Hrvatske akademije znanosti i umjetnosti – poslijepotresna obnova palače HAZU-a, palače Drašković, palače Prister i vile Ehrlich-Marić

Wall and ceiling paintings and stucco decoration in the four buildings of the Croatian Academy of Sciences and Arts (HAZU) – Post-Earthquake restoration of the HAZU Palace, Drašković Palace, Prister Palace, and Ehrlich-Marić Villa

Hrvatska akademija znanosti i umjetnosti poslije potresa u Zagrebu obnavlja osam zgrada na kojima je završena konstrukcijska, a u tijeku je cjelovita i energetska obnova. Obnova zidnih i stropnih oslika, kao i štukatura u unutrašnjosti, provodi se u četiri zgrade: palači HAZU-a, palači Drašković, palači Prister i Vili Ehrlich-Marić. Istražni radovi provedeni su 2021. i u konstrukcijskoj obnovi 2023. godine. Restauratorski radovi započeti su u konstrukcijskoj, a nastavljani u cjelovitoj obnovi.

Palača HAZU-a sagrađena je 1884. prema projektu Friedricha von Schmidta i Hermana Bolléa za sjedište Akademije prema narudžbi biskupa J. J. Strossmayera. Poslije potresa 2020. provodi se temeljita obnova koja uključuje opsežne restauratorske radove na svodovima atrija na tri etaže i na zidovima stubišta. U Velikoj sjedničkoj dvorani izvedeni su restauratorski radovi na stropu od trstične građe – konsolidirana je žbuka, injektirani su procijepi i sanirane pukotine te su restaurirani oslici.

Palača Drašković u Opatičkoj ulici 18 sagrađena je 1839. godine. Ilirci je kupuju 1846. za Narodni dom (Ilirska / Preporodna dvorana), a 1866. postaje sjedište Akademije nakon njezina osnivanja, do 1880., kad je sagrađena Akademijina palača na Zrinjevcu. Tijekom poslijepotresne obnove pronađeni su vrijedni oslici na stropovima i zidovima u prizemlju i na katu, položeni na žbuku i trstiku. U tijeku su radovi zaštite lica oslika i podljepljivanje razdvojenih dijelova, a u Preporodnoj dvorani izvodi se injektiranje žbuke i na pojedinim mjestima i učvršćenje trstične građe. Svi oslici bit će restaurirani i prezentirani.

Palača Prister na Strossmayerovu trgu 2 izvedena je prema projektu Hönigsberga i Deutsch 1893. za gospodarstvenika Guida Pristera, čija se obitelj koristila zgradom do 1911. godine. Potom je izmijenjeno nekoliko vlasnika, a nakon Drugoga svjetskog rata u zgradu se smješta Arhiv Akademije. Osim na stubišnim zidovima, štukturni uresi očuvani su na stropovima salona na prvom katu. Otkrivena su dva načina izvedbe štukature: a) na podlozi od opeke s grubom žbukom i tankim slojem gipsa i b) profilacije oko oslika na podlozi od drva obloženoga redom trstike, na čemu je žbuka i gips. Izdvaja se strop jednog salona koji ostavlja dojam da je drveni, premda je izveden od gipsa na žbuci i trstici, imitirajući drvo (tehnika „flandranja“).

Vila Ehrlich-Marić sagrađena je 1891. kao ljetnikovac s restauracijom u ljetnikovačkom naselju na Josipovcu, prema projektu Mije Gehera. Vilu radikalno pregrađuje dr. Artur Marić 1928. prema projektu Aladara Baranyaija i Slavka Benedika. Tijekom i nakon Drugoga svjetskog rata vilom su se koristili različiti korisnici uz daljnje pregradnje. Od 1952. do 1984. u vili je bila Majstorska radionica za arhitekturu JAZU (danas HAZU). Od 1995. u zgradi je Hrvatski muzej arhitekture HAZU. U poslijepotresnoj obnovi izvedeni su veliki konstrukcijski zahvati. U cjelovitoj obnovi u

Following the Zagreb earthquake, the Croatian Academy of Sciences and Arts (HAZU) undertook the restoration of eight buildings. Structural rehabilitation has been completed, while comprehensive and energy-efficient renovation is currently underway. The restoration of wall and ceiling paintings, as well as stucco decoration in the interiors, is being carried out in four buildings: the Palace of the Croatian Academy, Drašković Palace, Prister Palace, and the Ehrlich-Marić Villa. Research was conducted in 2021 and during the structural restoration in 2023. Conservation and restoration began during the structural phase and continued during the comprehensive restoration.

The Palace of the Croatian Academy, built in 1884 based on the designs by Friedrich von Schmidt and Hermann Bollé as the Academy's headquarters on the initiative of Bishop J. J. Strossmayer, is undergoing thorough restoration following the two 2020 earthquakes. It includes extensive conservation and restoration of the vaulted ceilings of the three-level atrium and the walls of the staircase. In the Great Hall, work was carried out on the ceiling with reed lathing: the plaster was consolidated, cracks were injected and repaired, and wall paintings were restored.

The Drašković Palace at Opatička 18, constructed in 1839, was purchased in 1846 by the Illyrian movement as the National Home Palace (Illyrian / Revival Hall). It served as the Academy's seat from its founding in 1866 until 1880 when the Academy Palace on Nikola Šubić Zrinski Square was built. Valuable wall and ceiling paintings (on plaster with reed lathing) were discovered on the ground and first floors during the post-earthquake restoration. Current works include surface protection of the painted layers and re-adhesion of detached sections. Plaster injection and, in some places, stabilization of reed lathing are being carried out in the Revival Hall. All discovered paintings will be conserved and presented.

The Prister Palace at Trg Josipa Jurja Strossmayera 2 was built in 1893. It was designed by Hönigsberg and Deutsch for industrialist Guido Prister, whose family used the building until 1911. After a succession of owners, the building became home to Archives of the Croatian Academy after World War II. Stucco decoration is preserved on the staircase walls and on the ceilings of the first-floor salons. Two methods of stucco have been identified: a) on a brick base with coarse plaster and a thin layer of gypsum plaster, and b) mouldings around painted elements on a wooden base covered with reed with plaster and gypsum on top. Particularly noteworthy is the ceiling of one salon that gives the appearance of being wooden, though it was in fact executed in gypsum on plaster and reed, imitating wooden panelling.

The Ehrlich-Marić Villa, built in 1891 as a summer residence with a restaurant in the Josipovac summer colony, was de-

jugoistočnom salonu obnovljeni su znatno oštećeni štukturni vjenčiči s cvjetnim motivima iz 1928., izvedeni na daščanoj podlozi, trstici i žbuci. Konstrukcijska i cjelovita obnova Akademijinih palača i zgrada omogućila je temeljito restauratorsko istraživanje te obnovu oštećenih, prebojanih i novootkrivenih zidnih i stropnih oslika. Upravo oni postaju novi čimbenik identiteta Akademijinih interijera. Nedvojbeno najatraktivniji bit će interijeri palače HAZU-a zbog restauriranih oslika koji su bili očuvani ispod premaza boje izvedenih poslije Drugoga svjetskog rata.

KLJUČNE RIJEČI: zidni oslici, stropni oslici, štukature, poslijepotresna obnova

**Tehnička suradnja: mr. sc. Jelena Đukić i dr. sc. Snježana Ivčić, Služba za međunarodnu suradnju i EU programe i projekte Hrvatske akademije znanosti i umjetnosti*

signed by Mijo Geher. In 1928, it was thoroughly remodelled by Dr. Artur Marić according to designs by Aladar Baranyai and Slavko Benedik. During and after World War II, the villa was used by various tenants with further alterations. From 1952 to 1984, it housed the Master Workshop for Architecture of JAZU (today HAZU). Since 1995, it has been the home of the Croatian Museum of Architecture HAZU. Major structural work was carried out during the post-earthquake restoration. As part of the comprehensive restoration, severely damaged stucco cornices with floral motifs from 1928, executed on wooden boarding, reed lathing, and plaster, were restored in the southeast salon.

The structural and comprehensive restoration of the Academy's palaces and buildings has enabled thorough conservation research and the restoration of damaged, overpainted, and newly discovered wall and ceiling paintings. These artworks are becoming a renewed component of the Academy's interior identity. The interior of the HAZU Palace will undoubtedly be the most fascinating one with the now restored paintings that were discovered beneath layers of overpaint applied after World War II.

KEYWORDS: wall paintings, ceiling paintings, stucco decoration, post-earthquake restoration

**Technical collaboration: Jelena Đukić, MSc, and Snježana Ivčić, PhD, Department for International Cooperation and EU Programs and Projects, Croatian Academy of Sciences and Arts*

Mladen Obad Šćitaroci redoviti je član HAZU-a, *professor emeritus* Arhitektonskog fakulteta Sveučilišta u Zagrebu, dipl. ing. arhitekture. U njegovu znanstvenom i stručnom opusu prevladavaju teme obnove i revitalizacije kulturnoga naslijeđa – od pojedinačnih zgrada, gradova i naselja do kulturnoga krajolika. Dobitnik je Državne nagrade za znanost za životno djelo na području tehničkih znanosti. Tajnik je Razreda za likovne umjetnosti HAZU-a, zamjenik predsjednika Odbora i Radne skupine za obnovu zgrada Hrvatske akademije znanosti i umjetnosti u Zagrebu poslije potresa. Aktivno sudjeluje u svim aktivnostima na obnovi Akademijinih zgrada od ožujka 2020. godine – od prvih pregleda šteta, pripreme projektnih zadataka za stručne elaborate i projektnu dokumentaciju za konstrukcijsku i cjelovitu obnovu do praćenja izrade projektne dokumentacije, sudjelovanja u pripremi javne nabave za izvedbu, praćenja izvedbe konstrukcijske i cjelovite obnove Akademijinih zgrada i muzejskih prostora do priprema za muzejske postave i uređenja interijera te priprema za povratak u obnovljene zgrade.

Petra Tončić Lipovšćak, dipl. ing. arhitekture, voditeljica je Službe za obnovu i upravljanje nekretninama HAZU-a (trenutno i projekta obnove sedam Akademijinih zgrada) i članica Radne skupine za obnovu zgrada Hrvatske akademije znanosti i umjetnosti u Zagrebu poslije potresa. Aktivno sudjeluje u svim aktivnostima na obnovi Akademijinih zgrada od srpnja 2021. godine obavljajući sljedeće zadaće: priprema projektnih zadataka za stručne elaborate i projektnu dokumentaciju za konstrukcijsku i cjelovitu obnovu, praćenje izrade projektne dokumentacije, sudjelovanje u pripremi javne nabave za projektiranje i izvođenje radova, praćenje izvedbe konstrukcijske i cjelovite obnove Akademijinih zgrada i muzejskih prostora.

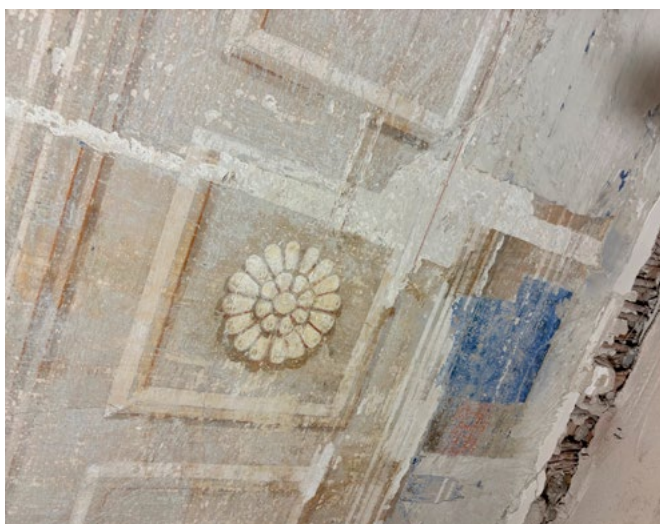
Mladen Obad Šćitaroci is a full member of HAZU (Croatian Academy of Sciences and Arts), professor emeritus of the Faculty of Architecture, University of Zagreb, and graduate architect. His scholarly and professional work is centred on the restoration and revitalization of cultural heritage – from individual buildings, towns, and settlements to cultural landscapes. He is the recipient of the C Lifetime Achievement Award in the field of technical sciences. He serves as Secretary of the Fine Arts Division of HAZU, Deputy Chair of the Committee and Working Group for the Restoration of HAZU Buildings in Zagreb after the Earthquake, and has been actively engaged in all phases of restoration since March 2020 – from initial damage assessments and preparation of design briefs for professional studies and project documentation through monitoring the preparation of project documentation and participation in public procurement, to overseeing structural and comprehensive restoration works, museum installations, interior arrangements, and preparations for the Academy's return to its restored buildings.

Petra Tončić Lipovšćak, March, is Head of the HAZU Department for property renovation and management (currently also managing the restoration of seven Academy buildings) and a member of the Working Group for the Restoration of HAZU Buildings in Zagreb after the Earthquake. She has been actively involved in all phases of restoration since July 2021, undertaking tasks that include preparing design briefs for professional studies and project documentation for structural and comprehensive restoration, monitoring project documentation, participating in procurement procedures for design and construction, and overseeing the implementation of structural and comprehensive restoration of Academy buildings and museum spaces.



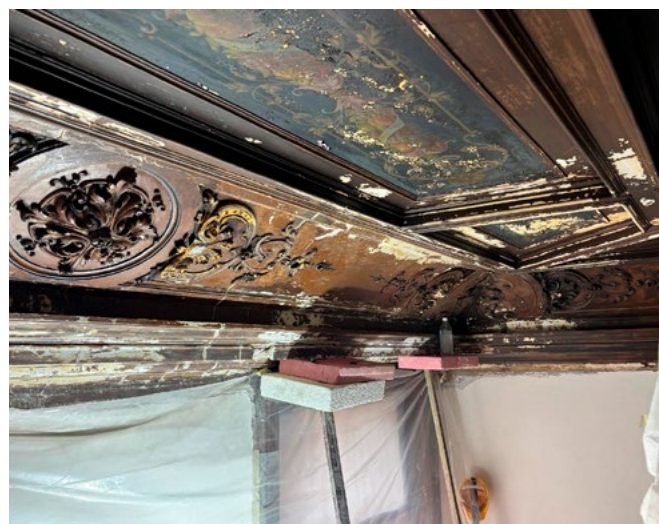
Palača HAZU-a, restaurirani stropni oslik u Velikoj sjedničkoj dvorani (snimka: P. T. Lipovščak, 2025.)

HAZU Palace, restored ceiling painting in the Great Hall (photo: P. T. Lipovščak, 2025)



Palača Drašković, novopronađeni stropni oslik u čitaonici u prizemlju (snimka: P. T. Lipovščak, 2025.)

Drašković Palace, newly discovered ceiling painting in the ground-floor reading room (photo: P. T. Lipovščak, 2025)



Palača Prister, stropna štukatura od gipsa koja imitira drvenu oblogu, stanje tijekom obnove (snimka: P. T. Lipovščak, 2025.)

Prister Palace, stucco ceiling in gypsum imitating wooden panelling during restoration (photo: P. T. Lipovščak, 2025)



Vila Ehrlich-Marić, strop prije obnove (snimka: J. Đukić, 2024.)

Ehrlich-Marić Villa, ceiling before restoration (photo: J. Đukić, 2024)



Vila Ehrlich-Marić, restaurirani štukaturni vjenčici s cvjetnim motivima (snimka: J. Đukić, 2025.)

Ehrlich-Marić Villa, restored stucco cornices with floral motifs (photo: J. Đukić, 2025)

Konzervatorsko-restauratorsko učvršćivanje i rekonstrukcija zidnih slika na žbukanom trščanom nosiocu u palači Drašković

Consolidation and reconstruction of wall paintings on plastered reed supports in the Drašković Palace

Palača Drašković u Opatičkoj ulici 18 u Zagrebu sagrađena je 1838. godine, a već nakon deset godina proširuje se i uređuje Ilirska dvorana, dok se u ostalim prostorijama obavljaju oslici. U posljednjoj obnovi palače početkom devedesetih godina 20. stoljeća izvedena je cjelovita replika oslika druge faze dvorane. U potresima 2020. godine nastala su oštećenja zbog kojih je bila potrebna cjelovita obnova palače, u sklopu koje se provode i složeni konzervatorsko-restauratorski radovi u dvorani i na stropnim oslicima salona.

Palača je građena opekom, a međukatne konstrukcije drvenim gredama. Stropne strane greda grubo su poravnate tesaњem, a potom obložene trskom u salonima i letvicama u hodnicima. Trskom su obložene i letve kaseta i grede Ilirske dvorane te stupovi stubišta. Trska je uvezana željeznom žicom s razmacima do 1 cm i ovješena na željezne četvrtaste kovane klinove T-oblika. Među stapkama trske utisnuta je podložna grublja vapnena žbuka debljine oko 2 cm, a zaključena je finom žbukom debljine 1 cm. Saloni prizemlja izvorno su oslikani *grisaille* reljefima sjenčanicama u odnosu na izvor prozorske svjetlosti. Na manjem stropu kata očuvani su i stariji oslici s iluzionističkim reljefima i florealnim kompozicijama. Recentno rekonstruirani dekorativni oslik Ilirske dvorane izveden je industrijskim zidnim bojama.

Vibracije od potresa uzrokovale su pukotine s mjestimičnim denivelacijama. Pojedine kasete dvorane natopljene su od padalina s propusnih krovnih prozora. Zbog elektrifikacije stropova zarezane su sve centralne slikane rozete. U građevinskom konstruktivnom ojačanju na rubovima dvaju salona nadomještene su nove grede, zbog čega nedostaje dio oslikane žbuke i trske. Na gredama i trski salona potom nisu primijećeni znakovi biološke aktivnosti i vlaženja, a željezni četvrtasti kovani klinovi i žice su očuvani. Struktura podložne žbuke također je očuvana i dobro prijanja uz podlogu, dok je zaključna žbuka mjestimično sipka. Izvorni oslici oštećeni su i stanjeni mehaničkim struganjem slojeva u prijašnjim obnovama.

U konzervatorsko-restauratorskim radovima, koji su počeli 2024. godine, oslici su podlijepljeni hidroksimetil celulozom, a potom su u salonima očišćeni od naliča. Mrlje od prokišnjavanja u Ilirskoj dvorani uklonjene su puferiranim agar gelom. Zaključna žbuka tretirana je nanovapnom *CaLoSil® E25*. S obzirom na materijale osjetljive na vodu, drvo i željezo, u kompozitnom sustavu, učvršćivanjem podložne žbuke injektiranjem minimizirao bi se unos vodene faze. Probe s injektivnim mortovima *PLM-AL®*, *Ledan D2®*, *CalXnova®* uz provodna sredstva vode i etanola, aktivirale su migraciju tanina iz greda na površinu oslika. Injektiranjem morta *CalXnova®* s dodatkom staklenih mikroštapića uz provodno sredstvo mješavine *Shellsol T®*: aceton u omjeru 1 : 1, žbuka je učvršćena bez pojave mrlja. S obzirom na nemogućnost sagledavanja cjelokupnoga stanja stropne žbuke dvorane zbog posljednjega pokrivnog oslika, kasete su dodatno injektirane između letvica s krovne strane. Oštećeni dijelovi letvi nadomješteni su drvenim umecima, a oštećenja žbuke su armirana vlaknima s vapnenim mortom. U salonima su manji otvori na žbukama i trski armirani metalnim mrežicama, a trska je pričvršćena

The Drašković Palace at Opatička 18 in Zagreb was built in 1838. The Illyrian Hall was expanded and decorated just 10 years later, and wall paintings in other rooms were also restored. A complete replica of wall paintings from the second-phase of the hall was made during the palace's most recent renovation in the early 1990s. The 2020 earthquakes caused extensive damage that required a comprehensive restoration of the palace, including complex conservation and restoration of the hall and ceiling paintings of the salons. The palace was built of brick with timber beams as floor structures. The underside of the beams was roughly levelled by hewing and then covered with reed in the salons and laths in the corridors. The coffers and beams of the Illyrian Hall, as well as the staircase columns, were also covered with reed. The reed was bound with iron wire at intervals of up to 1 cm and suspended on T-shaped nails. A coarse lime plaster layer about 2 cm thick was pressed between the reed stalks, and finished with a fine plaster layer about 1 cm thick. The ground-floor salons were originally painted with *grisaille* reliefs shaded in relation to the window light source. Older wall paintings with illusionistic reliefs and floral compositions were preserved on a smaller upper-floor ceiling. The recently reconstructed wall paintings of the Illyrian Hall were done with industrial wall paints.

Vibrations from the earthquakes caused cracks with localized displacements. Some hall coffers were soaked by rainfall penetrating through leaking roof windows. Due to electrification, all central painted rosettes had been cut through. In the course of structural reinforcement of the building, new beams were added at the edges of two salons, resulting in losses of painted plaster and reed. No signs of biological activity or dampness were found on the beams and reed of the salons, and the nails and wires were preserved. The structure of the underlying plaster was also preserved and adhered well to the support, while the finish coat was loose in places. The original wall paintings were damaged and thinned by mechanical scraping during previous restorations.

During the conservation and restoration project which began in 2024, wall paintings were glued with hydroxypropyl cellulose followed by the removal of overpaint in the salons. Stains caused by water ingress in the Illyrian Hall were removed with buffered agar gel. The finish coat was treated with nanolime *CaLoSil® E25*. Considering the sensitivity of materials to water, wood and iron in a composite system, consolidation of the underlying plaster by injection aimed to minimize the introduction of a water phase. Trials with injection mortars *PLM-AL®*, *Ledan D2®*, and *CalXnova®* using conductive media of water and ethanol activated the migration of tannins from the beams to the painting surface. Injection with *CalXnova®* mortar, supplemented with glass micro-rods and using a conductive medium of *Shellsol T®*: acetone in a ratio 1:1, consolidated the plaster without staining. As the overall condition of the ceiling plaster in the hall could not be fully assessed due to overpainting, coffers were additionally injected between the laths from the attic side. Damaged parts of the laths were replaced with wooden inserts, and damage to the plaster was reinforced with fibres with lime mortar. Smaller openings in the plaster and reeds in the salons were rein-

vijcima s maticama. Oštećenja zapunjena vapnenom žbukom i gletom u salonima retuširana su pigmentima s vezivom, a u dvorani mineralnim bojama (*Keim*). Nedostajući dijelovi dvaju salonskih stropova nadomješteni su izvornom tehnologijom. Prethodilo je tesanje površine novih greda i zaštita greda od močenja 5 %-tnom otopinom *Paraloida B-75*. Trščana prostirka ovješena je na nehrđajuće vijke, dok su spojevi stare i nove trske isprepleteni. Podložna žbuka od gašenog vapna, kvarcnog pijeska i riječnog šljunka utisnuta je u trsku, a zaključena je finom vapnenom žbukom i gletom. Rekonstrukcija oslika izvedena je prenošenjem šablonskih nacrti a oslikavanjem.

KLJUČNE RIJEČI: trščani nosilac, drvene konstrukcije, injektiranje, taninske mrlje, rekonstrukcija, konzervatorsko-restauratorski radovi

** Radove izvodi tvrtka Terracotta d.o.o. Voćarska 84, Zagreb. Vođenje i stručno savjetovanje: Goran Mišić, Ana Dumbović, Ela Kreutz, Marija Puović. Ostali suradnici: Stjepan Pranjković, Lana Linda Fisković, Martina Bilobrk, Filip Malovča, Melita Horvat, Iva Valenta, Sara Kršnjavi, i mnogi drugi.*

Ana Dumbović rođena je u Zadru, gdje je završila klasičnu gimnaziju. Na Akademiji likovnih umjetnosti u Zagrebu završila je studij konzervacije i restauracije. Od 2005. radi u Hrvatskom restauratorskom zavodu na Odjelu drvene polikromirane skulpture. Od 2008. do 2020. godine samostalno vodi programe konzerviranja i restauriranja polikromiranih skulptura i oltara i sudjeluje u radu više stručnih timova. Godine 2020. zapošljava se u Nacionalnom muzeju moderne umjetnosti, gdje radi na proširenom polju materijala, osobito na slikama na različitim nosiocima. Stručno se usavršava u temama vezanim uz metode čišćenja slikanih površina (kod P. Cremonesi, R. Wolbersa, C. Lallija i O. Sartiani) i metode retuša (S. Scarpelli). Članica je IIC-a i Hrvatskog restauratorskog društva.

Ela Kreutz rođena je u Zagrebu 1988. godine, gdje je završila Školu primijenjene umjetnosti i dizajna – smjer kiparski dizajner. Na Akademiji likovnih umjetnosti u Zagrebu diplomirala je na Odsjeku za konzerviranje i restauriranje umjetnina – smjer kiparstvo (diplomski rad s područja štuka). Praktični dio diplomskog rada „Konzervatorsko-restauratorski radovi na nadvoju ophoda štukomramornog oltara Blažene Djevice Marije Pomoćnice krščana iz istoimene crkve u Sotinu i tehnologija izrade štukomramora“ omogućen joj je u suradnji s Hrvatskim restauratorskim zavodom na Odjelu za štuko. Nakon završetka fakulteta 2016. godine nastavlja suradnju s HRZ-om kao vanjska suradnica. Sudjelovala je u timskim programima kolega s Odjela za štuko, Odjela za kamenu plastiku te Odjela za zidno slikarstvo i mozaik. Surađuje i s privatnim obrtima i tvrtkama čija je djelatnost konzerviranje i restauriranje umjetnina. Članica je Hrvatskog restauratorskog društva.

Marija Puović rođena je u Splitu 1994. godine, gdje završava Školu likovnih umjetnosti – smjer slikarski dizajner. Na Akademiji likovnih umjetnosti u Zagrebu diplomirala je na Odsjeku za konzerviranje i restauriranje umjetnina (diplomski rad s područja zidnog slikarstva). Jedan studijski semestar provela je na studentskoj razmjeni u Italiji na *Accademia di Belle Arti L'Aquila, Scuola di Restauro*. Od 2020. godine, nakon završetka fakulteta, radi kao vanjska suradnica Hrvatskog restauratorskog zavoda i surađuje s privatnim tvrtkama na području konzerviranja i restauriranja zidnih slika. U srpnju 2023. godine stječe dopuštenje za obavljanje poslova na zaštiti i očuvanju kulturnih dobara za zidno slikarstvo i iste godine otvara svoj obrt INTONACO ART (primarne djelatnosti: konzervacija i restauracija zidnih slika). Članica je Hrvatskog restauratorskog društva.

forced with metal mesh, and reeds were fastened with screws and nuts. Parts of the plaster that was damaged were filled with lime plaster and putty, retouched with pigments bound with binder in the salons, and mineral paints (*Keim*) in the hall. Missing parts of the two salon ceilings were reconstructed using original technology. This was preceded by hewing the surface of new beams and protecting them against wetting with a 5% *Paraloid B-75* solution. Reed mats were suspended on stainless steel screws, with joints between old and new reed interwoven and plastered with fibrous mortar. Undercoat plaster of slaked lime, quartz sand, and river gravel was pressed into the reed, finished with fine lime plaster and putty. The reconstruction of the paintings was carried out by transferring stencil drawings and painting.

KEYWORDS: reed support, wooden structures, injection, tannin stains, reconstruction, conservation and restoration

** The work was carried out by the company Terracotta d.o.o., Voćarska 84, Zagreb. Project management and professional consulting: Goran Mišić, Ana Dumbović, Ela Kreutz, Marija Puović. Other collaborators: Stjepan Pranjković, Lana Linda Fisković, Martina Bilobrk, Filip Malovča, Melita Horvat, Iva Valenta, Sara Kršnjavi, and many others.*

Ana Dumbović was born in Zadar, where she graduated from classical secondary school. She studied Conservation and Restoration at the Academy of Fine Arts in Zagreb. In 2005, she started working at the Croatian Conservation Institute in the Department of Wooden Polychrome Sculpture. From 2008 to 2020, she independently managed conservation and restoration programs of polychrome sculptures and altars, and participated in several expert teams. In 2020, she joined the National Museum of Modern Art working on a wider range of materials, especially paintings on various supports. She has specialized in methods of cleaning painted surfaces (with P. Cremonesi, R. Wolbers, C. Lalli, O. Sartiani) and retouching methods (S. Scarpelli). She is a member of IIC and the Croatian Conservation-Restoration Association.

Ela Kreutz was born in Zagreb in 1988, where she graduated from the School of Applied Arts and Design, Department of Sculpture Design. At the Academy of Fine Arts in Zagreb, she earned her degree in Conservation and Restoration of Works of Art, Sculpture track (thesis on stucco). The practical part of her thesis „*Conservation-Restoration of the Stucco-Marble Altar of the Blessed Virgin Mary Help of Christians in Sotin and the Technology of Stucco-Marble Production*“ was carried out in collaboration with the Croatian Conservation Institute, Department for Stucco. After graduating in 2016, she continued her collaboration with the Institute as an external associate. She has participated in team projects with the Department for Stucco, Department for Stone Sculpture, and Department for Wall Paintings and Mosaics. She also collaborates with private workshops and companies engaged in conservation and restoration. She is a member of the Croatian Conservation-Restoration Association.

Marija Puović was born in Split in 1994, where she attended the School of Fine Arts, Painting Design. She graduated in Conservation and Restoration of Works of Art at the Academy of Fine Arts in Zagreb (thesis in wall painting). She spent one semester in Italy at the *Accademia di Belle Arti L'Aquila, Scuola di Restauro*. Since 2020, she has worked as an external associate of the Croatian Conservation Institute and has collaborated with private companies in the conservation and restoration of wall paintings. In July 2023, she obtained a license to carry out work in the protection and preservation of cultural heritage in wall painting and, in the same year, opened her own business (specialized in conservation and restoration of wall paintings). She is a member of the Croatian Conservation-Restoration Association.



Zagreb, Palača Drašković, Opatička 18. Salon 8 – stanje stropa tijekom uklanjanja recentnih naliča i cementnih zakrpa (ortofoto snimka: Pro Elemento d.o.o., 2025.)

Zagreb, Drašković Palace, Opatička 18. Salon 8 – condition of the ceiling during the removal of recent paint and cement patches (orthophoto: Pro Elemento d.o.o., 2025)



Zagreb, Palača Drašković, Opatička 18. Salon 9 – probe injektiranja žbuke (snimka: A. Dumbović, 2025.)

Zagreb, Drašković Palace, Opatička 18. Salon 9 – plaster injection tests (photo: A. Dumbović, 2025)



Zagreb, Palača Drašković, Opatička 18. Salon 8 – učvršćivanje odvojene tršćane građe za gredu ankeriranjem nehrđajućim vijcima s maticama i vlaknastom žbukom (snimka: A. Dumbović, 2025.)

Zagreb, Drašković Palace, Opatička 18. Salon 8 – attaching the separated reed material to the beam by anchoring with stainless steel screws with nuts and fibrous plaster (photo: A. Dumbović, 2025)



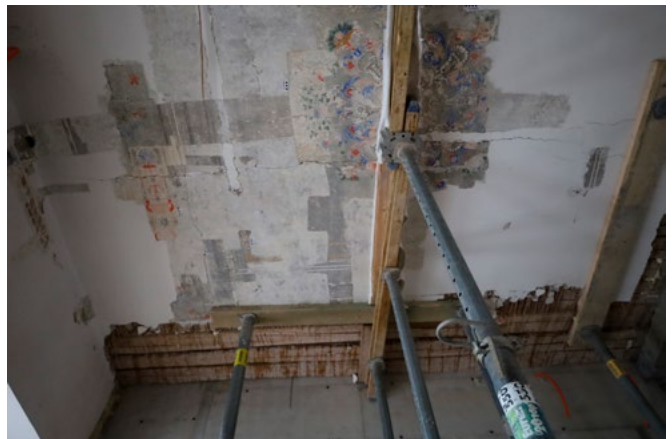
Zagreb, Palača Drašković, Opatička 18. Salon 9 – nedostatak tršćano-žbukane građe s oslikom na južnoj strani stropa (snimka: A. Dumbović, 2025.)

Zagreb, Drašković Palace, Opatička 18. Salon 9 – missing reed-plaster with wall painting on the south side of the ceiling (photo: A. Dumbović, 2025)



Zagreb, Palača Drašković, Opatička 18. Ilirska dvorana – detalj oštećenja na stropu (snimka: A. Dumbović, 2024.)

Zagreb, Drašković Palace, Opatička 18. Illyrian Hall – ceiling damage detail (photo: A. Dumbović, 2024)



Zagreb, Palača Drašković, Opatička 18. Salon 19 – strop tijekom učvršćivanja razdvojene tršćane i žbukane građe (snimka: A. Dumbović, 2025.)

Zagreb, Drašković Palace, Opatička 18. Salon 19 – ceiling during the consolidation of separated reed and plaster (photo: A. Dumbović, 2025)

Konzervatorsko-restauratorski radovi na oslikanom stropu Pompejanske sobe Palače bogoštovlja i nastave nakon potresa 2020. godine

Conservation and restoration of the painted ceiling in the Pompeian Room of the Palace of Religious Affairs and Education after the 2020 earthquake

Zagrebački potres u ožujku 2020. godine, a potom i petrinjski potres u prosincu iste godine, uzrokovali su znatna oštećenja na graditeljskoj baštini širega zagrebačkog područja. Među oštećenim građevinama je i zagrebačka Palača bogoštovlja i nastave, smještena na istočnom rubu povijesnoga Gradeca, u Opatičkoj 10. Riječ je o klasicističkoj palači građenoj sredinom 19. stoljeća, koja je ubrzo nakon izgradnje preoblikovana u neorenesansnom stilu; objedinjuje vrhunska ostvarenja likovnih i primijenjenih umjetnosti unutar historicističkoga arhitektonskog okvira. Palača je tijekom više od stoljeća očuvala svoj kulturni identitet – i u oblikovnom i u simboličkom i društvenom smislu – te i danas u njoj djeluje Hrvatski institut za povijest.

Ozbiljna potresna oštećenja nose konstrukcije zgrade utjecala su i na zidne slike u reprezentativnim prostorijama prvoga kata – u tzv. Zlatnoj dvorani i Pompejanskoj sobi, kao i na oslikanim zidovima stubišta. Na zidnim slikama provedeni su preventivni zaštitni konzervatorsko-restauratorski radovi, a na cijeloj zgradi konstrukcijska sanacija. Obnovljena zgrada rezultat je uspješne interdisciplinarnе suradnje temeljene na usklađivanju analiza i prijedloga svih uključenih stručnjaka – statičara, arhitekata, povjesničara umjetnosti, konzervatora-restauratora, konzervatora, izvođača građevinskih radova i predstavnika vlasnika – s glavnim ciljem zaštite i očuvanja kulturnog dobra, uz istodobno ispunjavanje suvremenih zahtjeva koji se odnose na poboljšanje otpornosti graditeljske baštine na seizmička djelovanja.

Primijenjena metodologija konzervatorsko-restauratorskih radova predstavlja se na primjeru oslikanoga stropa Pompejanske sobe. Tijekom potresa došlo je do gibanja međukatne drvene konstrukcije, što je izazvalo pucanje vezivnih žica kojima je trska bila učvršćena. Pritom se žbukana trska odvojila od nosive konstrukcije pa je došlo do deformacija, pucanja žbukanog i slikanog sloja, kao i gubitka dijelova oslika, koji su nepovratno uništeni. Da bi se reintegrirali oštećeni dijelovi, trebalo je doći do žbuke i do trske kao nosioca žbuke i s donje, ali i s gornje strane stropne konstrukcije. Uspostavljanjem veze među svim stratigrafskim slojevima omogućeni su cjeloviti konzervatorsko-restauratorski radovi i očuvanje reprezentativnog zidnog oslika Pompejanske sobe.

Konzervatorsko-restauratorski radovi uključivali su istraživanje, dokumentiranje i reintegraciju oštećenih dijelova.

KLJUČNE RIJEČI: potres, graditeljska baština, Pompejanska soba, strop, trska, zidne slike

The Zagreb earthquake of March 2020, followed by the Petrinja earthquake in December of the same year, caused significant damage to the architectural heritage of the wider Zagreb area. Among the damaged buildings is the Palace of Religious Affairs and Education in Zagreb, located on the eastern edge of historic Gradec, at Opatička 10. It is a classicist palace built in the mid-19th century. Soon after the construction, it was remodelled in the Neo-Renaissance style. It merges outstanding achievements of fine and applied arts within a historicist architectural framework. For more than a century, the palace has preserved its cultural identity – in terms of design, symbolism, and social role – and it still houses the Croatian Institute of History.

Extensive earthquake damage to the building's load-bearing structure also affected the wall paintings in the rooms on the first floor – the so-called Golden Hall and the Pompeian Room – as well as the painted walls of the staircase. Preventive protective conservation and restoration was carried out on the wall paintings, while structural rehabilitation was conducted on the entire building. The structurally rehabilitated palace is the result of a successful interdisciplinary cooperation based on combining analyses and proposals from all experts – structural engineers, architects, art historians, conservator-restorers, conservators, construction contractors, and representatives of the owner – with the primary goal of protecting and preserving the cultural property, and meeting contemporary requirements for improving the seismic resilience of architectural heritage.

The methodology applied during the conservation and restoration project is presented using the painted ceiling of the Pompeian Room as an example. During the earthquake, the movement of the inter-floor wooden structure caused the binding wires securing the reed lathing to break. Consequently, the plastered reed detached from the structural framework, resulting in deformations, cracks in the plaster and painted layer, and irretrievable losses of parts of the wall paintings. In order to reintegrate the damaged parts, it was necessary to access the plaster and the reed lathing from both the underside and the upper side of the ceiling structure. By re-establishing the cohesion between all stratigraphic layers, comprehensive conservation and restoration was made possible, ensuring the preservation of wall paintings in the Pompeian Room.

Conservation and restoration included research, documentation, and reintegration of the damaged areas.

KEYWORDS: earthquake, architectural heritage, Pompeian Room, ceiling, reed, wall paintings

Adela Filip je majstor uže specijalnosti za zidno slikarstvo. Od 1999. do 2001. godine angažirana je kao vanjska suradnica u Hrvatskom restauratorskom zavodu, a od 2001. godine do danas zaposlena je na Odjelu za zidno slikarstvo i mozaik. Radi kao voditeljica i suradnica u složenim programima konzervatorsko-restauratorskih istraživanja i projektima obnove nepokretne kulturne baštine te u dokumentiranju i arhiviranju gradiva.

Adela Filip is a master craftsman specializing in wall paintings. From 1999 to 2001, she worked as an external associate at the Croatian Conservation Institute, and since 2001 she has been employed at the Department for Wall Painting and Mosaic. She works as a project leader and collaborator in complex programs of conservation and restoration research and immovable cultural heritage restoration projects, as well as in the documentation and archiving of materials.



Zagreb, Palača bogoštovlja i nastave (Hrvatski institut za povijest), Pompejanska soba – tijekom konzervatorsko-restauratorskih radova; preventivna zaštita oštećenog dijela stropa (arhiva HRZ-a, snimka: A. Filip, 2022.)

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