

PERISTIL 2003-2013 PERISTYLE

PERISTIL

PERISTYLE

2003–2013

IZLOŽBA O KONZERVATORSKO-
RESTAURATORSKIM RADOVIMA
NA PERISTILU DIOKLECIJANOVE
PALAČE U SPLITU

EXHIBITION OF CONSERVATION-
RESTORATION WORKS AT THE
PERISTYLE OF DIOCLETIAN'S
PALACE IN SPLIT

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2013

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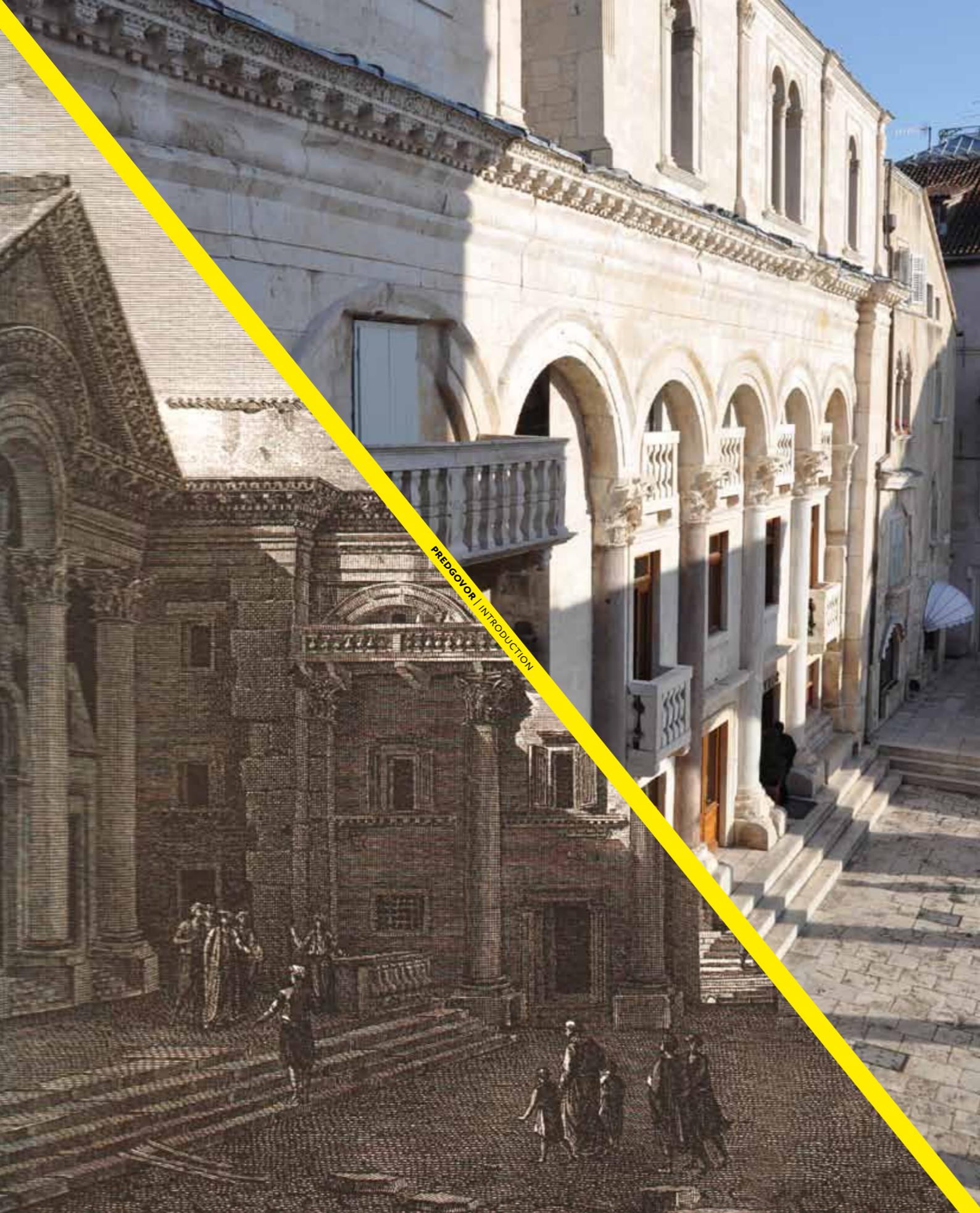
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NA ZAVRŠETKU DESETLJEĆA OBNOVE PERISTILA

DR. SC. GORAN NIKŠIĆ,
voditelj Odsjeka za staru gradsku jezgru

AT THE END OF A DECADE OF THE PERISTYLE RESTORATION

DR. SC. GORAN NIKŠIĆ,
Head of the Service for the Old City Core

Konzervatorsko-restauratorski radovi na Peristilu Dioklecijanove palače predstavljaju bez sumnje po mnogo čemu najznačajniji projekt u sklopu obnove povijesne jezgre Splita u novijem razdoblju.

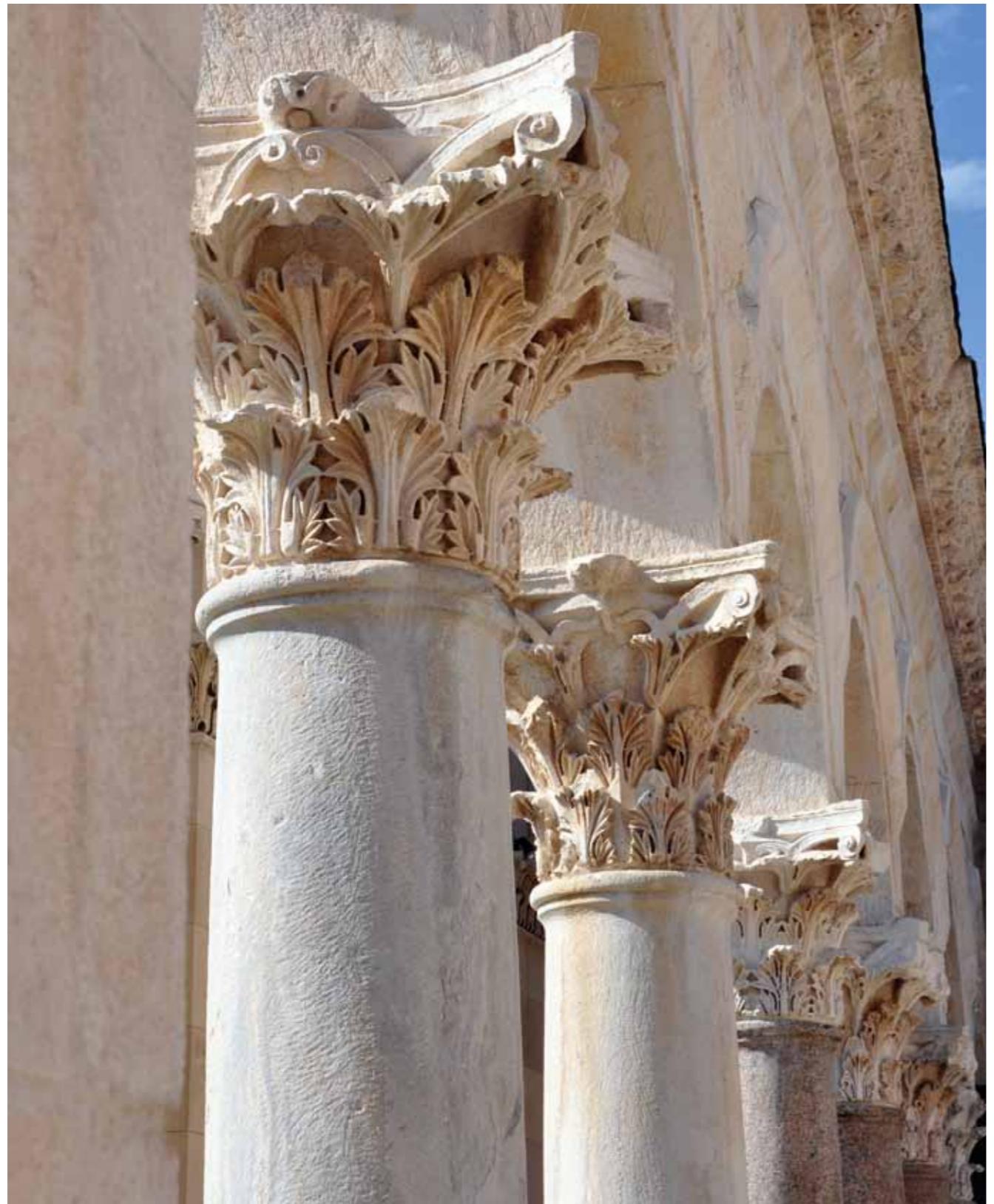
Peristil je središte i najreprezentativniji dio carske palače, ali i srce grada koji se iz nje iznjedrio. Taj trg na kojemu se najbolje vide povijesni slojevi nastanka i razvitka grada postao je njegov svojevrsni simbol i najveća turistička atrakcija. On je najljepša scenografija za kulturne priredbe, ali i pozornica gradskog života. U sedamnaest stoljeća svoje povijesti nebrojeno puta njegova je arhitektura pregradivana, obogaćivana novim stilovima i značajnim sadržajima vjerskoga i svjetovnog karaktera. Čudesno je kako je nakon svih tih zahvata antička arhitektura s granitnim i mramornim stupovima, korintskim kapitelima, lukovima i vijencima ostala gotovo u potpunosti sačuvana, ali napačena oštećivanjima i prekrivena višestoljetnom prljavštinom. U posljednjih dvjestotinjak godina na Peristilu su se nizali brojni konzervatorski i restauratorski zahvati različite razine i učinka, što pokazuje da je Peristil odvijek bio u žizi stručne, ali i široke javnosti. Tim parcijalnim zahvatima rješavali su se pojedini problemi, a ponekad i stvarali novi.

Na početku trećega tisućljeća konačno smo svjedoci opsežnog projekta kojim se po prvi put sagledava taj prostor u cijelini. Potaknut inicijalnim sredstvima donacije World Monuments Fund-a, uz dodatnu finansijsku potporu Ministarstva kulture RH, zahvat je najvećim dijelom financirao Grad Split. Na inicijativu Odsjeka za staru gradsku jezgru godine Hrvatski restauratorski zavod izveo je konzervatorsko-restauratorska istraživanja stanja Peristila. Metodologija zahvata i restauratorski postupci utvrđeni su u suradnji sa širokim krugom domaćih i međunarodnih stručnjaka. U početku zamišljen kao čišćenje antičke kamene arhitekture, prerastao je u složen konzervatorski i restauratorski posao koji je obuhvatio sve segmente, od sanacije temelja i konstrukcije, preko čišćenja i konzervacije kamena, žbuke i ostalih materijala do krajne prezentacije toga slojevitog spomenika. Valja istaknuti da je to, uz istovremeni zahvat na Zlatnim vratima, prvi projekt kod nas gdje se kao osnovni postupak čišćenja kamena koristila najsuvremenija laserska metoda, koja je od tada našla široku primjenu. Uspoređeno s restauratorskim radovima izvedena je konstruktivna sanacija prema projektu koji je koristio složeni računalni trodimenzionalni model. Osnovni princip konstruktivne sanacije je bio povratiti stabilnost i zaustaviti

The conservation and restoration work on the Peristyle of Diocletian's Palace has been in many ways the most important project in recent period within the scope of renovation of the historical core of the town of Split.

The Peristyle is the centre and the most impressive part of the imperial palace, and also the heart of the town which has grown around it. The square, which reflects historical layers of the creation and development of the town, has become its symbol and its main tourist attraction. It serves as the most attractive backdrop for cultural events, and a stage at which public life evolves. During the seventeen centuries of its history, the architecture of the Peristyle has been altered many times, enriched with new styles and important elements, both religious and secular in character. Amazingly, in spite of all the interventions, the ancient architecture with its granite and marble columns, Corinthian capitals, arches and cornices, has been preserved almost completely, though nonetheless damaged and covered with centuries of grime. Over the past two hundred years, the Peristyle has seen numerous conservation and restoration interventions of various scopes and outcomes, indicating that the Peristyle has always attracted attention of experts, and of the general public. Such partial interventions resolved specific problems, but sometimes also resulted in the creation of new ones.

At the beginning of the third millennium, we have finally witnessed a comprehensive project which, for the first time, encompassed the complex in its entirety. The work was stimulated by initial grant of the World Monuments Fund, and additional financial support of the Ministry of Culture of the Republic of Croatia, while most of the funding was provided by the City of Split. At the initiative of the Service for the Old City Core, the Croatian Conservation Institute undertook the research of the condition of the Peristyle. The methodology of the work and specific restoration procedures were outlined in cooperation with a wide circle of Croatian and international experts. The project, at first envisaged as the cleaning of the ancient stone architecture, has turned into a complex conservation and restoration endeavour, encompassing all the aspects; from the rehabilitation of the foundations and structure, through the cleaning and conservation of stone, plaster and other materials, to the final presentation of this multilayered monument. It should



ISTOČNA KOLONADA PERISTILA
THE EAST COLONNADE OF THE PERISTYLE

daljnje deformacije minimalnim, neinvazivnim zahvatima. U svrhu dobivanja podataka za projekt sanacije izvedena su istražna geomehanička, arheološka i konzervatorska istraživanja, u sklopu kojih smo dobili niz značajnih novih podataka o povijesti građevina i uzrocima njihovog propadanja.

Osobita pozornost posvećena je prezentaciji Peristila. Postavljena je nova rasvjeta koja diskretno naglašava arhitektonске vrijednosti i stvara jedinstven noćni ugodaj. Izrađeni su vjerni odljevi sfinge i jednog kapitela Protirona u prirodnoj veličini, kako bi se omogućilo sagledavanje izbliza svih detalja izrade, kao i oštećenjâ, što će u budućnosti biti dragocjeno za usporedbu i praćenje stanja materijala. Ti će se odljevi trajno izložiti u Muzeju grada, dok će Niemannov model Peristila, koji je u vlasništvu Arheološkog muzeja, naći svoje mjesto u jednoj od kapelica u Protironu, gdje je i izvorno bio izložen, u sklopu trajne izložbe o Peristilu i konzervatorsko-restauratorskim radovima na njemu.

Zbog važnosti Peristila koji je najznačajniji dio splitske povjesne jezgre upisane na UNESCO-ovu Listu svjetske kulturne baštine, te obzirom na složenost konzervatorskih problema i uključivanje brojnih domaćih i stranih stručnjaka i institucija, njegova obnova predstavlja jedan od najznačajnijih konzervatorsko-restauratorskih zahvata u Hrvatskoj. Tim zahvatom, koji je bio i izvrsna prigoda da se mladi stručnjaci usavrše u najsvremenijim konzervatorskim i restauratorskim postupcima, postavljeni su visoki standardi konzervacije i restauracije u splitskoj povjesnoj jezgri, ali i na širem prostoru.

Obnovljeni Peristil će zasigurno povećati zanimanje za Dioklecijanovu palaču, te biti podsticaj za kvalitetno dovršenje drugih projekata obnove povjesne jezgre koji su u tijeku i za početak novih. Na samom Peristilu i njegovoj neposrednoj blizini već je u tijeku ili je pred početkom niz zahvata: novi Muzej crkvene umjetnosti u palati Skočibučić-Lukaris, uređenje okoliša katedrale i prostora antičkog *decumanusa* sjeverno od nje, te Vestibula, a trebalo bi razmislići i o ponovnoj aktualizaciji pitanja razine pločnika i trajnog rješenja još uvijek privremenog, neuglednog ulaza u podrumе i nekadašnje carske odaje.

be stressed that the Peristyle project was, together with the simultaneous work on the Golden Gate, the first case where the most advanced laser technology was used as the basic method of stone cleaning, marking the start of its widespread use in Croatian conservation practice. In parallel with restoration work, the structural strengthening was carried out, according to the design based on a complex computer 3D model. The leading principle of the structural strengthening consisted in recovering the stability and preventing further deformations using minimum and non-invasive interventions. During geotechnical and archaeological investigations, performed to collect data necessary for the structural design, a series of important new information was found about the history of the buildings and about the causes of decay.

Particular attention was given to the presentation of the Peristyle. The new lighting discreetly enhances the architectural features and creates a unique atmosphere at night. Accurate casts of the sphinx and a capital from the Prothyron were made to enable the inspection of the smallest surface detail and of deterioration, which will be invaluable for future comparison and monitoring of the state of preservation of the original material. The casts will be permanently displayed in the City Museum, and the model of the Peristyle by Niemann, property of the Archaeological Museum, will return to its original place in one of the chapels in the Prothyron, as part of the permanent exhibition on the Peristyle and the restoration work.

Because of the importance of the Peristyle as the most significant element of the historical core of Split, inscribed on the UNESCO World Heritage List, and in view of the complexity of conservation issues, involving a large number of Croatian and foreign experts and institutions, the project has been one of the most important conservation and restoration campaigns in Croatia. The works on the Peristyle, which provided an excellent opportunity for the professional development of young experts in state-of-the-art restoration procedures, raised the bar for improving the conservation standards in the historic core of Split and in the region.

The restored Peristyle will certainly attract even more attention to Diocletian's Palace, stimulate high-quality work in the finalization of the actual works, and inspire new restoration projects in the historic core of Split. At the very Peristyle or in its immediate vicinity a series of projects are taking place: the new Museum of Religious Art in the Skočibučić-Lukaris palace, the improvement of the space surrounding the Cathedral and the area of the Roman *decumanus* to the north, and the restoration of the Vestibule. This is probably the right time to reexamine the issue of the level of the pavement of the Peristyle, and to find a permanent replacement for the existing, still a temporary and unsightly, entrance to the substructures and to the once imperial apartments.



ZABAT PROTIRONA PRIJE I NAKON KONZERVATORSKO-RESTAURATORSKOG ZAHVATA
THE PEDIMENT OF THE PROTHYRON BEFORE AND AFTER RESTORATION

ZNAČAJ OBNOVE PERISTILA ZA RESTAURATORSKU PRAKSU U HRVATSKOJ

MARIO BRAUN,
ravnatelj Hrvatskog restauratorskog zavoda

THE IMPORTANCE OF THE PERISTYLE PROJECT FOR THE CONSERVATION PRACTICE IN CROATIA

MARIO BRAUN,
Director of the Croatian Conservation Institute

Prisjećajući se početaka projekta Peristil i sastanka u Splitu na kojem se prije više od jedanaest godina razgovaralo o nužnosti konzervatorsko-restauratorskih radova na Peristilu Dioklecijanove palače, osvrnuo bih se ukratko na organizaciju i onodobno djelovanje konzervatorske i restauratorske struke u Hrvatskoj.

Pri rezimiranju djelatnosti i izdvajajući najznačajnije aktivnosti u djelokruzu Ministarstva kulture to će razdoblje biti zapamćeno po velikim izložbama koje su, poput one »Hrvati i Karolinzi«, ponovno uspostavljale oslabjene veze između Hrvatske i Europe, ali i po tada još uvjek intenzivnoj obnovi spomenika oštećenih u Domovinskom ratu, oko čega je na prijelazu stoljeća, a i nadalje bila mobilizirana gotovo cijelokupna služba zaštite spomenika.

Na svim nivoima unutar struke bio formiran načelni stav o nužnosti stvaranja odgovarajuće infrastrukture za sanaciju velikih ratišnih šteta na spomeničkoj baštini i razvijena svijest o tome da su spomenici i spomeničke cjeline, kao i njihova adekvatna prezentacija, jedan od temelja hrvatskog gospodarskog razvoja kroz segment turizma.

Sretnom trenutku početka konzervatorsko-restauratorskih radova na Peristilu – pripremnim radovima u Hrvatskom restauratorskom zavodu 2003. i početku radova 2004. – prethodilo je višegodišnje osnaživanje »infrastrukture« restauratorske djelatnosti u Hrvatskoj. Godine 1997. utemeljen je Hrvatski restauratorski zavod formiran spajanjem postojećih restauratorskih ustanova u čitavoj Hrvatskoj, koji je okupivši znanja, kompetencije i vještine »na jednom mjestu« postao relevantna ustanova za ambiciozne konzervatorsko-restauratorske zahvate. Iste 1997. godine osnovan je i studij konzervacije-restauracije pri Umjetničkoj akademiji Sveučilišta u Splitu, kao i Katedra za restauriranje umjetnina u Zagrebu, vrele kvalificiranih restauratora različitih specijalizacija.

Remembering the beginning of the Peristyle project and meetings held in Split more than eleven years ago, when the necessity of conservation-restoration works in Peristyle of Diocletian's Palace was discussed, I would like to briefly reflect upon the organization and functioning of the conservation and restoration profession in Croatia at that time.

While summarizing the activities of the Ministry of Culture in that period and stressing the most important ones, one should mention major exhibitions such as "Croats and Carolingians" that have re-established the impaired connections between Croatia and Europe. Also, rehabilitation of monuments damaged during the Homeland War was still very intense and the whole department of monument protection that had been mobilized at the turn of the century was still active.

All the professional levels shared the basic attitude of the need of creation of the appropriate infrastructure for the repair of great damages of war inflicted upon the cultural heritage. It was very clear that monuments and complexes of monuments, as well as their proper presentation were one of the foundations for the economic development through a segment of tourism.

Joyous moment of the beginning of conservation-restoration works in Peristyle – preparatory works in the Croatian Conservation Institute in 2003 and the beginning of works in 2004 – was preceded by years of reinforcement of the "infrastructure" of restoration in Croatia. In the year 1997, Croatian Conservation Institute was established by uniting all the restoration institutions in Croatia. By gathering knowledge, competence and skills "in one place" it has become a relevant institution for the ambitious conservation-restoration projects. The same year of 1997, Department of Conservation-Restoration was founded within the Arts Acad-

Ta ishodišta današnje restauratorske prakse dodatno su se razvijala kroz suradnju s inozemnim konzervatorsko-restauratorskim ustanovama u Italiji i Njemačkoj, kroz istraživački i stručni rad na zajedničkim projektima, kao što je primjerice bila suradnja HRZ-a s *Opificio delle pietre dure* u Firenzi. Suradnja s *Opificiom* potaknula je također neke druge projekte, osobito znanstvene, od kojih se neki realiziraju i danas, a dovedeni su na razinu europskih znanstvenih istraživanja. Već je rečeno kako se u prvim godinama 21. stoljeća svakodnevno i intenzivno radilo na sanaciji ratnih šteta na kulturnim dobrima, pa je početak radova na obnovi Peristila za Hrvatski restauratorski zavod ujedno označio i povratak u svojevrsnu mirnodopsku praksu, što je uvjetovalo prilagodbu drugačijim uvjetima rada i vođenja zahvata. Važni elementi u tome su kontekstu bili ekonomski kriteriji, »monitoring« stanja i dubinska analiza ugroženosti spomenika, opsežnije statičke analize, detaljnija istraživanja materijala i kamene strukture, preciznije dokumentiranje oštećenja, uključivanje novih metoda čišćenja kamenja, uporaba novih, do tada u Hrvatskoj rijetko korištenih materijala pri sanaciji oštećenja. Tehnološke inovacije su imperativ, a u našu restauratorsku praksu ulazile su sporor, zanemarene osobito u 90-tim godinama zbog svima znanih okolnosti. Važan i inovativan element konzervatorsko-restauratorskih zahvata na Peristilu bila je uporaba lasera za čišćenje kamenja, tehnika s kojom se eksperimentalno započelo 70-ih godina 20. stoljeća u Italiji i Americi, a u praksi se redovito primjenjivala od sredine 90-ih.

Verifikaciju i konačnu afirmaciju ta je metoda u širim restauratorskim krugovima dobila 2003. godine, nakon što je objavljen zasebni dodatak časopisa Međunarodnog instituta za konzervaciju povijesnih i umjetničkih djela (*International Institute for Conservation of Historic and Artistic Works*) Studies in Conservation, gdje su rekaptulirana dotadašnja iskustva u čišćenju kamenja, a laserska tehnika priznata kao optimalna, najmanje destruktivna metoda. Stoga je ta nova i pozitivno ocijenjena tehnologija uvedena kao osnovni način čišćenja kamenja na Peristilu.

Čišćenju su prethodile analize i definiranje raznovrsnih metoda i postupaka. U Hrvatskoj tada nije bilo odgovarajućeg specijalističkog laboratorija, a prirodoslovni laboratorij HRZ-a je surađujući sa stranim i domaćim institucijama osigurao relevantnu znanstvenu i stručnu podlogu za donošenje brojnih kvalitetnih i ispravnih konzervatorskih odluka. Nažalost, plan da se taj laboratorij tehnički adekvatno opremi ostao je nerealiziran kao zalog kasnjem razvoju i radu ustanove.

Još je jedna specifičnost rada na Peristilu Dioklecijanove palače: usprkos u nas sveprisutnoj i cvjetajućoj sklonosti promoviranju vlastitoga ega, konzervatorsko-restauratorski zahvat na splitskom spomeniku trijumf je kolektivnog rada i zajedničkog projekta. Uspjeh toga zahvata ovisio je i ostvaren je uskladenim djelovanjem velikog

my in Split, as well as the Restoration Department in Zagreb. Both became fountains of qualified restorers of various specializations.

These origins of present restoration practice were further developed through collaboration with foreign conservation-restoration institutions in Italy and Germany, through research and professional work on joint projects such as collaboration of Croatian Conservation Institute and *Opificio delle pietre dure from Florence*. The *Opificio* collaboration has resulted in other projects as well, especially scientific ones. Some of them are being realized now and have reached a level of European scientific research. It has already been said that in the early 21st century intensive work was done in repairing war damages of cultural heritage. Start of the Peristyle works for Croatian Conservation Institute meant the return to the work done in peaceful times which demanded a change in working conditions and organization. In that context, important elements were the economic criteria, monitoring and deep analysis of the material and stone structure, precise damage documentation, introduction of new methods of cleaning of stone, use of new materials previously rarely used in Croatia.

Technological innovations are the imperative and they were slowly introduced to our practice. They were neglected, especially in the 1990s for all the known reasons. Important innovative element in conservation-restoration work in Peristyle was the introduction of laser for cleaning of stone, technique that was experimented with in 1970s in Italy and America and was widely used since mid-1990s. This method was verified and finally affirmed in 2003 when an appendix was published in the magazine called *Studies in Conservation* published by the International Institute for Conservation of Historic and Artistic Works where all the experiences in cleaning of stone were reviewed and laser technique was acknowledged as most optimal, the least destructive method. Therefore, this new and positively reviewed technique was introduced as a basic method of stone cleaning in Peristyle.

Cleaning was preceded by analyses and definitions of various methods and procedures. There was no adequate laboratory in Croatia at the time and the Natural laboratory of the Croatian Conservation Institute, in cooperation with foreign and domestic institutions has secured relevant scientific and professional foundation for reaching numerous quality and proper decisions on conservation. Sadly, plan for that laboratory to be adequately equipped was not carried out and remains as pledge for future development and work of the institution.

There is another specific characteristic of work in the Peristyle of Diocletian's Palace: in spite of the prevailing and flourishing inclination towards egotistic promotion of individuals, conservation-restoration treatment of Split monument is a triumph of collec-

broja osoba, zahvaljujući njihovom timskom radu. Doprinos svih, dakako, nije bio podjednak; među brojnim suradnicima bilo je onih koji su se istaknuli i onih manje uočljivih, ali nikako ne i beznačajnih. Stoga u ime prethodnog ravnatelja Zavoda i u svoje ime svima iskreno zahvaljujem na uloženom trudu. Vjerujem da uistinu jednoglasno hvaljen rezultat predstavlja i zadovoljstvo i svojevrsnu satisfakciju svima.

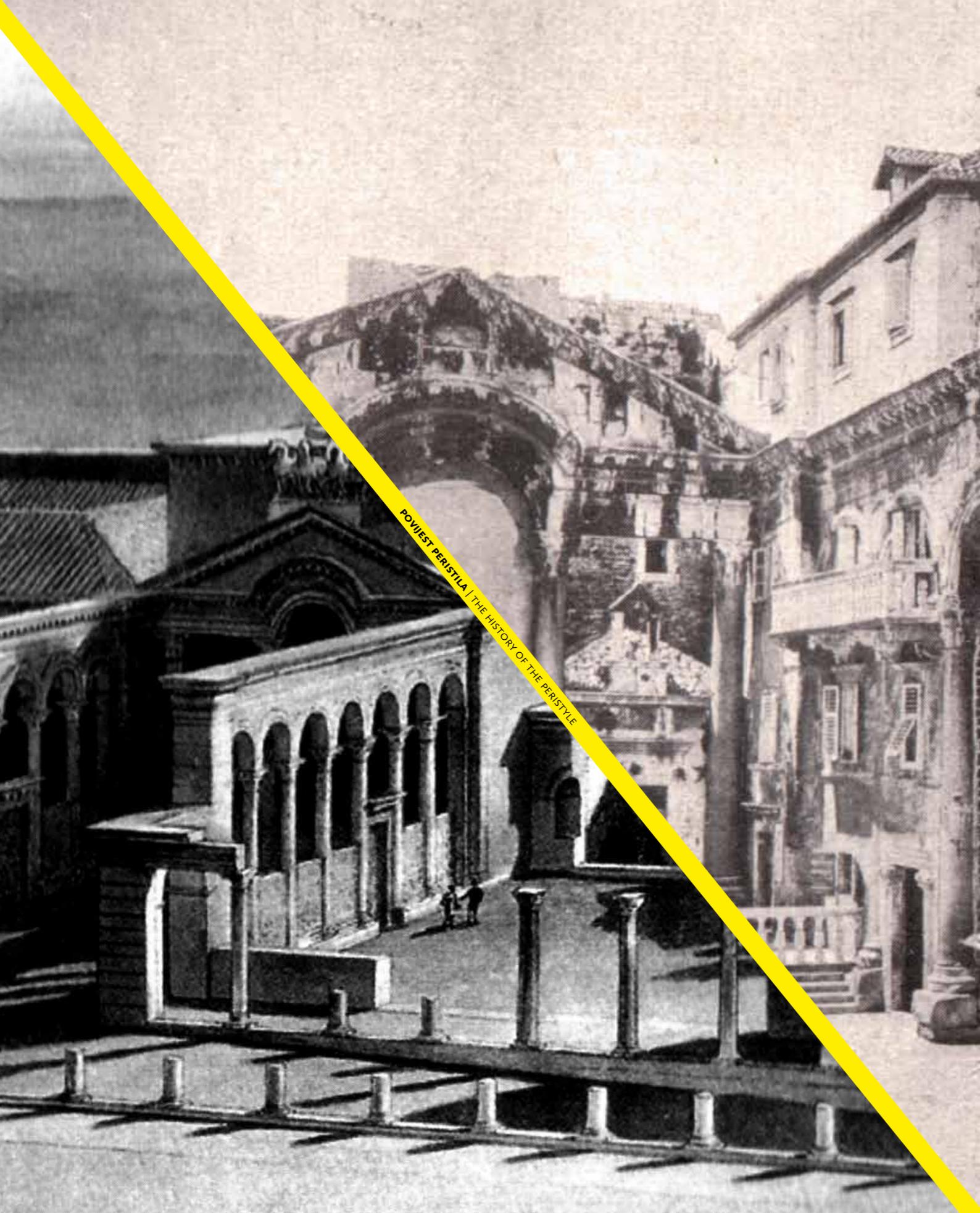
Na kraju treba zahvaliti i onima koji su projekt finansijski podržali, a to su *World Monuments Fund*, *Ministarstvo kulture Republike Hrvatske* i osobito Grad Split, njegova uprava i građani grada Splita. Izvođači su, ne samo djelatnici Hrvatskog restauratorskog zavoda već i ostali suradnici na projektu, dali sve od sebe da najistaknutiji dio Dioklecijanove palače poprimi izgled primjeren spomeniku uvrštenom 1979. u popis UNESCO-ve svjetske baštine.

DETALJ VIJENCA SA ZABATA PROTIRONA
DETAIL OF THE PROTHYRON CORNICE

tive work and communal project. Success of this project depended on and is realized through coordinated activities of many people, through their team work. Of course, contribution was not equal: among many co-workers there were some that stood out, some were less visible but none were irrelevant. Therefore, on behalf of the previous director of the Institute and myself I honestly thank everyone for their efforts. I believe that this truly unanimously praised result gives pleasure and satisfaction to everyone.

In the end, the ones that have financed this project should also be thanked. Those are the World Monuments Fund, Ministry of Culture of the Republic of Croatia and especially the City of Split, its authorities and its citizens. People who have worked on this project, not only employees of the Croatian Conservation Institute but all the other collaborators, have given their best to provide to the most prominent part of Diocletian's Palace that has been inscribed on the UNESCO World Heritage list in 1979, the appearance it deserves.





POVIJEST PERISTILA

DR. SC. GORAN NIKŠIĆ

THE HISTORY OF THE PERISTYLE

DR. SC. GORAN NIKŠIĆ

Nakon dvadeset i jedne godine vladanja, 1. svibnja 305. godine rimski car Gaj Aurelije Valerije Dioklecijan abdicira i povlači se u veličanstveno boravište koje je pripremio za svoju mirovinu. Izgradnja Palače je započela desetak godina ranije u uvali Marjanskog poluotoka, nedaleko od Salone uz koju povjesni izvori vezuju carevo potrjeklo. Monumentalna rezidencija umirovljenog vladara predstavlja sasvim originalno i neobično ostvarenje kasnoantičke arhitekture, koristeći oblikovne elemente antičkoga grada, vojnog logora i raskošne vile. U palači pored carskog stana istaknuto mjesto zauzimaju građevine posvećene carskom kultu, ali i tekstilna radionica u sjevernoj polovici, koju je vodom opskrbljivao akvedukt velikog kapaciteta. Jedna od najvažnijih uloga arhitekture Palače je bila da impresionira posjetitelja veličinom i bogatom dekoracijom, a vrhunac doživljaja se odigravao na Peristilu, svojevrsnoj "otvorenoj dvorani" između hramova, mauzoleja i ulaza u carske odaje, gdje se divinizirani car u pažljivo režiranom ceremonijalu pojavljuje pred podanicima od središnjim lukom Protirona.

Dioklecijan umire vjerojatno 316. godine. Nakon njegove smrti Palača se postupno transformira, a naseljavanjem novog stanovništva, osobito nakon pada Salone, započinje njezina pretvorba u grad. Građevine podignute u razdoblju srednjeg vijeka Palači su dale gradsku strukturu koju je zadržala do današnjih dana. Graditeljske transformacije nisu mimošle ni kolonade Peristila, ali su one najvećim dijelom sačuvale svoj izvorni oblik.

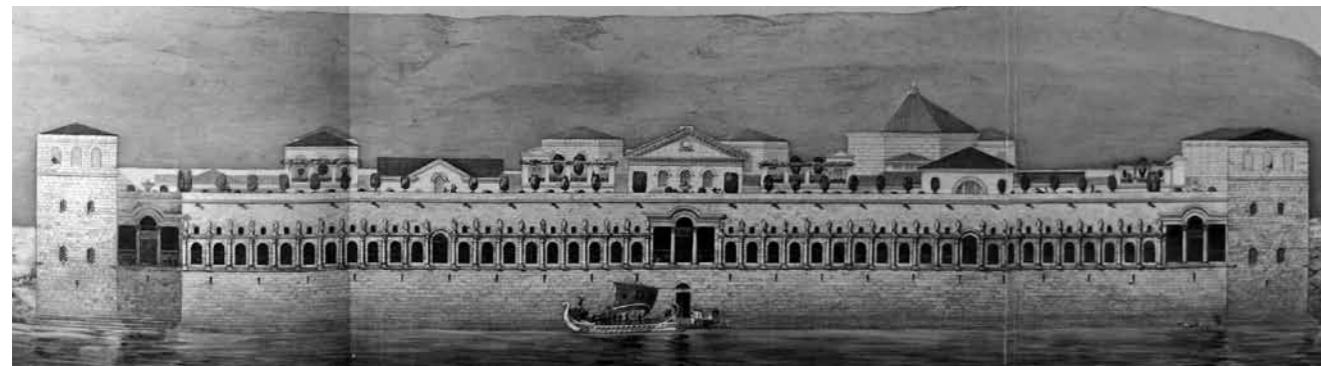
Arhitektura Peristila, sa stupovima od ružičastoga granita i mramora, na čijim kapitelima izravno počivaju arkature, te s karakterističnim zabatom Protirona s polukružnim lukom u sredini, odaje sirijski utjecaj. Nesavršenosti i pogreške koje su nastale zbog žurbe i izmjena projekta tijekom gradnje izvrsno su zamaskirane pa se primjećuju tek pažljivim pregledom.

U srednjem vijeku Peristil se transformirao u katedralni trg, a prostor ispred Protirona je postao svojevrsna pozornica gradskog živo-

The Roman Emperor Gaius Aurelius Valerius Diocletianus, after twenty-one year period of his reign, on May 1, 305 abdicated from the throne and retreated to the magnificent residence he had previously prepared for his retirement. The construction of his Palace was initiated some ten years earlier, in the midst of a bay of Marjan peninsula, close to Salona, which historical sources link to the Emperor's origin. The monumental residence of the retired sovereign is a very original and unusual achievement of the late antique architecture, which uses formal elements of an ancient Roman town, a military camp and a luxurious villa. Along with the imperial apartments, a prominent place within the Palace is occupied by the buildings dedicated to the imperial cult, but also by a weaving workshop in the northern half, supplied with water by an aqueduct of great capacity. One of the most important purposes of the Palace was to impress the visitor by its size and lavish decoration. The climax of the experience took place at the Peristyle, a kind of an "open hall" in the midst of temples, Mausoleum and the entrance to the imperial apartments, from where the emperor would appear to his subjects in a carefully staged ceremony, below the central arch of the Prothyron.

Diocletian probably died in the year 316. After his death, the Palace was gradually transformed, and the incoming population, particularly after the fall of Salona, initiated the process of its transformation into a city. The buildings constructed during the Middle Ages have given to the Palace the urban structure which it has managed to preserve until today. The colonnades of the Peristyle were not spared from architectural transformations, but they have mostly preserved their original form.

The architecture of the Peristyle, its columns of purple granite and of marble, the arches resting directly upon its capitals, and the distinctive gable of the Prothyron with the arcuated lintel, reveal a Syrian influence. The imperfections and mistakes that were made due to the short deadlines and changes in the architectural design of the Peristyle were skillfully disguised and can be detected only by careful inspection.



REKONSTRUKCIJA JUŽNOG PROČELJA PALAČE, E. HÉBRARD, 1912.

RECONSTRUCTION OF THE SOUTH FAÇADE OF THE PALACE, E. HÉBRARD, 1912.

ta, a i danas se koristi za kazališne predstave. U šesnaestom i sedamnaestom stoljeću Protiron je popunjeno kapelicama renesansnog oblika. Istočna kapela iz 1544. godine posvećena je Gospi od Pojasa, a zapadna je podignuta kao zavjet protiv kuge 1650. godine i posvećena Mariji od Bezgrešnog Začeća (kasnije sv. Karlu). Vjerovatno je u sedamnaestom stoljeću podignut i barokni portal sa zidom do vrha interkolumnija.

Crteži Charles-Louisa Clérisseaua iz 1757. godine i Françoisa Cassasa iz 1802. godine prikazuju široki kameni podij ispred Protirona, izdignut za pet stuba i ograden kamenom ogradom. Godine 1860. sred stubišta podija otvoren je prolaz kojim je uspostavljena izravna veza između Peristila i obale kroz supstrukcije carskog stana. Taj je prolaz zatvoren 1928. godine, a ograda od kamenih stupića koja je ogradivala podnožje Protirona uklonjena. Od 1929. pa do 1941. godine na tome je mjestu stajala kolosalna skulptura Grgura Ninskog, rad Ivana Meštrovića, koju su uklonile talijanske okupacijske vlasti. Ulaz prema supstrukcijama ponovo je otvoren početkom 1960-ih godina, kada je pločnik Peristila spušten na pretpostavljenu izvornu razinu. Tijekom sedamnaest stoljeća kontinuiranog življjenja u Palaci zapadna kolonada Peristila uklapljena je u strukturu građevina iz kasnijih razdoblja. Romaničke, gotičke, renesansne i barokne zgrade čvrsto su se sljubile s antičkim stupovima pa je kolonada danas vidljiva samo s trga. U njezin sjeverni dio je ugrađeno pročelje palače Cipci-Grisogono koje pokazuje izuzetnu povijesnu slojavitost, ali i inverziju vremenskog slijeda, karakterističnu za splitske prilike: na vrhu, iznad završnog vijenca rimske kolonade u 16. stoljeću je nadograđen kat u renesansnom stilu, koji je rekonstruiran 1982. godine na temelju Cassasovog crteža i ostataka pronađenih na licu mjesta. Ispod rimskih arkada lijeva polovica nekadašnjeg srednjovjekovnog pročelja pregrađena je u baroku, dok je desna strana tek u 19. stoljeću dograđena u istom stilu, čime je postignuta simetrija. U unutrašnjosti su u spomenutim radovima rekonstrukcije pronađeni ostaci kružne antičke građevine, možda Venerinog hrama, kao

In the Middle Ages the Peristyle was transformed into the cathedral square, and the space in front of the Prothyron became a stage for the life of the city. Nowadays it is still used for theatre performances. In the 16th and 17th century Renaissance chapels were built into the Prothyron. The east chapel dedicated to Our Lady of the Girdle was erected in 1544. The west one, dedicated to Our Lady of the Immaculate Conception was erected in 1650 as a plague ex-voto. The baroque portal with a wall rising to the top of the intercolumnar space was probably erected in the 17th century.

The drawings by Charles-Louis Clérisseau from 1764 and by Francois Cassas from 1802 show a broad dais with a stone balustrade, raised on five steps in front of the Prothyron. In 1860 in the middle of the dais a passage was opened up that established a direct link between the Peristyle and the seafront through the substructures of the imperial apartments. In 1928 the passage was closed, and the balustrade was taken away. A colossal statue of Gregory of Nin by Ivan Meštrović stood on this site between 1929 until 1941, when it was removed by the Italian occupation authorities. The entrance to the substructures was opened again in the early 1960s, when the pavement of the Peristyle was lowered to the hypothesized original level. During seventeen centuries of uninterrupted life within the Palace, the western colonnade of the Peristyle was incorporated into the structure of buildings from later periods. Romanesque, gothic, Renaissance and baroque buildings have become as one with the Roman columns, so this colonnade is today visible only from the square. The façade of the Cipci-Grisogono palace was incorporated into the northern part of the colonnade. It displays a remarkable historical complexity, but also the inversion of the sequence of building periods, characteristic of Split. Above the cornice of the Roman colonnade a Renaissance storey was added in the 16th century. Its reconstruction in 1982 was based upon a drawing by Cassas and upon the physical remains found in situ. Under the Roman arches the left section of the medieval façade was rebuilt in the Baroque style, while



POPREČNI PRESJEK PALAČE, R. ADAM, 1764.

CROSS SECTION OF THE PALACE, R. ADAM, 1764

i srednjovjekovno dvorište s ložom koji su prezentirani u sklopu Luxora, jedne od najstarijih splitskih kavana.

Ostaci drugog okruglog antičkog hrama, vjerojatno posvećenog božici Kibeli, pronađeni su u temeljima palače Skočibučić-Lukarisi, čije se pročelje već u romanici "ugnjjezdilo" među peristilske stupove u južnom dijelu zapadne kolonade. Iz tog vremena datira pojasmni vijenac između prizemlja i prvog kata, da bi kasnija razdoblja donjela nekoliko transformacija: renesansi pripada portal u prizemlju i prozori na prvom katu, dok balkon na drugom katu palače pokazuje barokne odlike.

Sve te gradnje, pregradnje i rušenja svjedoče o odnosu različitih razdoblja prema arhitektonskoj baštini. Ideja o "čišćenju" antičkih građevina u Palači od kasnijih slojeva osobito su snažno zaživjele u devetnaestom stoljeću, ali se javljaju i kroz gotovo čitavo dvadeseto stoljeće. Još je tijekom Drugog svjetskog rata povjerenstvo talijanskih akademika predlagalo da se pročelja palača ugrađenih u zapadnu kolonadu povuku prema unutra kako bi se rimska struktura oslobođila sa svih strana.

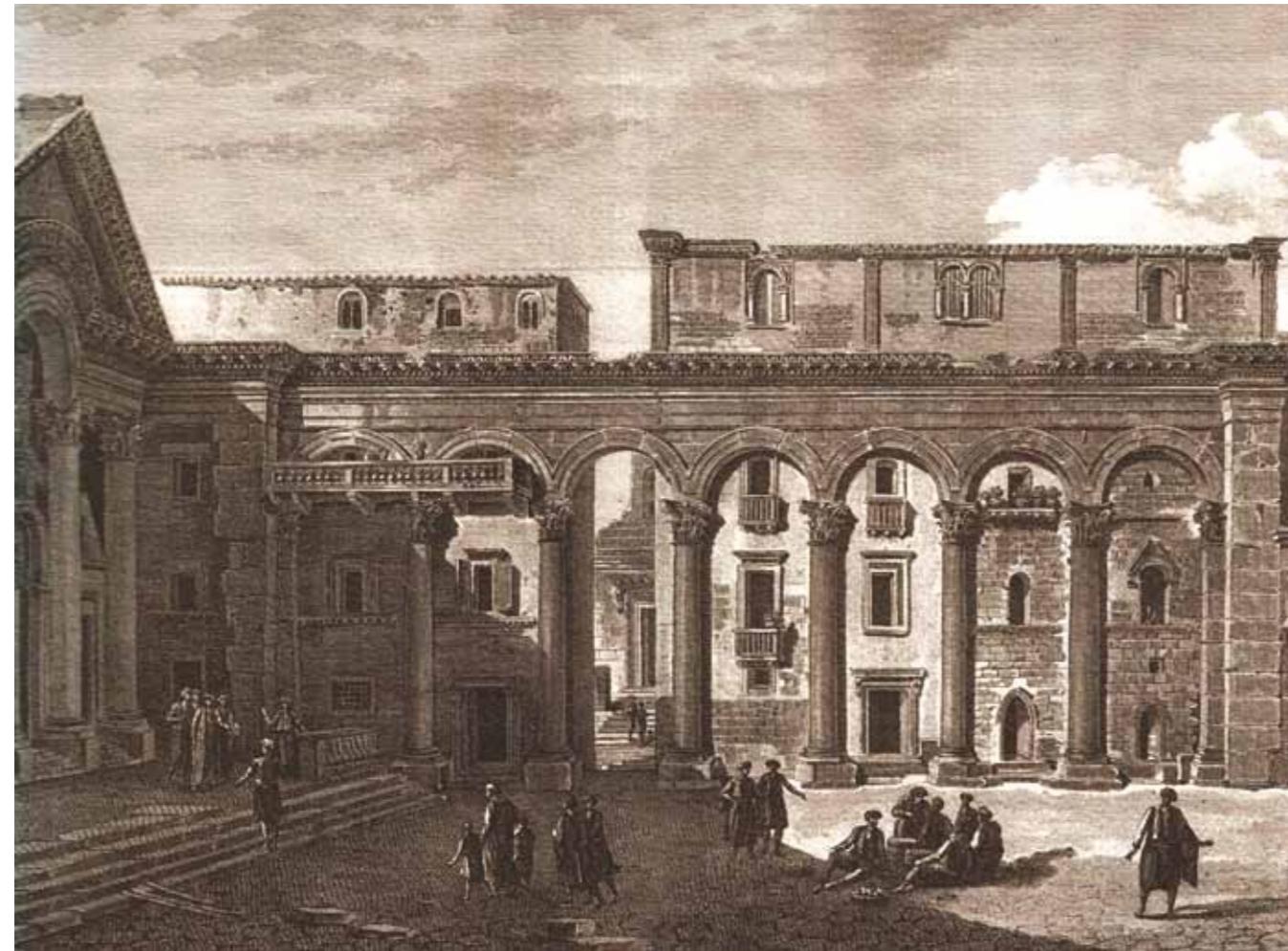
U srednjem vijeku se pod najsjevernijim lukom istočne kolonade nalazila grobnica, dok su susjedna dva interkolumnija bila zazidana. Početkom šesnaestog stoljeća na spoju decumanusa i sjeveroistočnog ugla Peristila sagrada je crkva sv. Roka, dok je u sedamnaestom stoljeću u niski rustični antički luk nekadašnjeg trijema uz sjeveroistočni ugaoni pilon Peristila na mjestu starije crkve ugrađeno pročelje crkve sv. Fabijana i Sebastijana, kasnije posvećene sv. Barbare. U neposrednom susjedstvu je splitski Kaptol 1805. godine unutar rimske kolonade ugrađio jednokatnicu u kojoj je bila smještena kavana 'Al Tempio'. Prije nego je pod utjecajem bečke konzervatorske škole napuštena ideja o 'čišćenju' antičkih građevina, porušeno je nekoliko građevina u okolini katedrale, među njima crkva sv. Barbare i spomenuta kavana 1876. godine. Dio oštećenja

the right section was added in the 19th century using the same style, thus creating symmetry. Remains of a circular ancient building, possibly a temple of Venus, as well as a medieval courtyard with loggia were found in the interior during the reconstruction work and are presented today within Luxor, one of the oldest cafés in Split.

Remains of the second round Roman temple, probably dedicated to the Roman goddess Cybele, were discovered in the foundations of the Skočibučić-Lukaris palace, whose romanesque façade "made its nest" among the columns of the southern part of the western colonnade. To the same time can be dated the stringcourse between the ground floor and the first floor, and to later periods several transformations: the Renaissance main portal and windows on the first floor, and the balcony on the second floor with baroque features.

All these constructions, remodelings and demolitions reflect the attitude of different periods towards the architectural heritage. The idea of "purification" of ancient buildings within the Palace from later constructions was dominant in the 19th century, but was present almost throughout the 20th century. As late as during World War II a commission of Italian academicians proposed that the façades of the buildings incorporated into the western colonnade should be moved inwards in order to free the Roman structure on all sides.

During the Middle Ages, below the northernmost arch of the eastern colonnade a funeral monument was erected, and the two neighbouring intercolumniations were walled in. At the junction of the decumanus and the northeastern corner of the Peristyle the Church of St. Roch was built in the beginning of the 16th century. Next to it, in the 17th century the façade of the church of St. Fabian and St. Sebastian, later dedicated to St. Barbara, was built into the low arch of the decumanus portico. Adjoining that church further to the south, the Chapter of the Cathedral erected in 1805 a one-storey building within the Roman colonnade, which hosted the public coffee-house



POGLED NA PERISTIL, L. F. CASSAS, 1802.

VIEW OF THE PERISTYLE, L. F. CASSAS, 1802

istočne kolonade Peristila preostao nakon rušenja kavane popravljen je u vrijeme samog zahvata, no temeljita restauracija uslijedila je tek 1907. godine, kada su dva teško oštećena mramorna stupa tašelirana i ojačana bakrenim obručima. Demontirani su i ponovo montirani vijenac i trabeacija na tome dijelu istočne kolonade. Između 1959. i 1961. godine, u sklopu zahvata spuštanja pločnika Peristila na prepostavljenu izvornu razinu, rekonstruirana su podnožja i dijelovi baza stupova kolonada.

Od većeg broja sfingi koje je Dioklecijan dao dopremiti iz Egipta za ukrašenje svoje palače pronađeno je i očuvano svega 12 skulptura, odnosno njihovih ulomaka. Najljepša i najveća, sfinga iz vremena Tuthmosisa III jedina je sačuvana u cijelosti. Smještena pod južnim lukom istočne kolonade, postala je prepoznatljiv simbol Peristila i

'Al Tempio'. Before the idea of "purification" of ancient buildings was abandoned due to the influence of the Viennese conservation school, several buildings surrounding the Cathedral were demolished, and among them the church of St. Barbara and the coffee-house in 1876. Part of the damage of the east colonnade that had remained after the 'Al Tempio' demolition was repaired at the time, but a thorough restoration took place only in 1907, when two heavily damaged marble columns were restored by patching and were reinforced with copper rings. The upper part of that section of the colonnade was dismantled and reassembled again. Between 1959 and 1961, during the work on the lowering of the pavement of the Peristyle to its supposed original level, the stlobate and parts of the bases of columns were reconstructed.

Out of the great number of sphinxes that were transferred from Egypt



SFINGA NA PERISTILU

THE SPHINX ON THE PERISTYLE

Splita. Nekoliko znatnih oštećenja na glavi i velika pukotina koja je prepolovila tijelo sfinge nastali su davno, prema predaji, padom kamena gornjih katova zvonika prilikom udara groma. Prilikom izrade odjelja peristilske sfinge otkriven je reljef na šrtveniku na kojem piše, kako je to protumačio egiptolog Igor Uranić, Ankh-det ili „vječan život“, što je simbolična poveznica s dugovječnošću skulpture koja je stara više no sam Peristil.

by order of Diocletian for the embellishment of his palace, only twelve sculptures or their parts have been preserved. The greatest and the most beautiful among them is the sphinx from the reign of Tuthmoses III, and is the only one completely preserved. Placed beneath the southern arch of the eastern colonnade, it has become a symbol of the Peristyle and of Split. According to oral tradition, several significant damages on its head and a large fissure that has split its body in half have been created a long time ago by stones that fell from the upper parts of the bell tower as it was struck by lightning. During the casting of the copy of the sphinx, on its front side a relief was discovered with the inscription *Ankh-Tjet* – "eternal life", as it was deciphered by the Egyptologist Igor Uranić. Therefore it is symbolically connected to the longevity of sculpture that is significantly older than the Peristyle.



ARHEOLOŠKA ISTRAŽIVANJA

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Arheološka istraživanja na Peristilu provedena su usporedno s geomehaničkim sondiranjem radi utvrđivanja stanja temelja crkve sv. Roka, te istočne i zapadne kolonade Peristila. Ukupno je napravljeno 14 arheoloških i geomehaničkih sondi koje su pružile nove spoznaje o povijesti lokaliteta. Također su izvršena istraživanja na krovu i u podu crkve sv. Roka.

Ispod recentnog poda u crkvi sv. Roka otkriven je odlično sačuvan renesansni pločnik. U većem, zapadnom dijelu poda nalazi se osam kamenih grobnih ploča, od kojih četiri pripadaju zapečaćenim kužnim ukopima s natpisima „OB PESTEM“ (od kuge), a četiri ukopima bratima sv. Roka s upisanom 1617. g.

U podu crkve napravljene su dvije manje sonde u jugozapadnom i sjeverozapadnom uglu, te jedna veća u sjeveroistočnom uglu. Tu je utvrđeno da sjeverni i istočni zid crkve, koji su nekad pripadali ranijim romaničkim objektima, stoje izravno na antičkom pločniku *decumanusa*. Antički pločnik u unutrašnjosti crkve vjerojatno je odstranjen kod ukopavanja kamenih grobnica, a ostatak je poda zasut nasipom na kojem je postavljeno renesansno popločanje.

Sondom uz vanjsko lice sjevernog zida potvrđeno je da su romaničke građevine temeljene izravno na pločama *decumanusa*. Bitno

Archaeological investigation was carried out at the Peristyle, in parallel to the geotechnical probing, in order to determine the condition of the foundations of the church of St. Roch, and of the eastern and western colonnades. During these works, 14 archaeological and geotechnical test pits were dug, providing sound insight into the historical development of the buildings. Investigation of the roof and the floor of the church were also carried out.

Underneath the recent floor in the church of St. Roch a well preserved Renaissance pavement was found. Eight stone grave slabs were found in the larger, western section of the floor, of which four belonged to sealed interments of plague victims, while the remaining four were burials of brethren of St. Roch with the year 1617 engraved on them.

Two smaller test pits were excavated in the floor of the church, in the south-west and north-west corners, as well as a larger one in the north-east corner. Here it is apparent that the northern and eastern walls of the church, which once belonged to earlier Romanesque structures, stand directly on the Roman paving of the *decumanus*. The Roman paving was probably removed from the church interior when the stone tombs were dug, while the fill was



RENESSANSNI PLOČNIK CRKVE SV. ROKA PRONAĐEN PRILIKOM ARHEOLOŠKIH ISTRAŽIVANJA

RENAISSANCE PAVEMENT OF THE CHURCH OF ST. ROCH FOUND DURING ARCHEOLOGICAL RESEARCH



različitu situaciju pokazale su dvije sonde na krajevima renesansnog zapadnog pročelja. Prilikom gradnje ovog pročelja antički pločnik je odstranjen, a temelji su oslonjeni na stariji temelj velike antičke konstrukcije na krištu *carda* i *decumanusa*. Pretpostavljeno je, iako ne i dokazano, da ovaj temelj pripada *tetrapilonu* – velikoj antičkoj konstrukciji kvadratnog tlocrta koja je nosila četiri spojena luka.

Sonda iskopana uz južni zid crkve dala je zanimljive podatke vezane uz nekadašnju crkvu sv. Sebastijana na ovom mjestu. Pronadeno je nekoliko ploča od sivog kamena identičnih onima u crkvi sv. Roka i

spread over the remaining floor surface, which was then covered with Renaissance paving.

A similar situation of foundations of Romanesque buildings set on the *decumanus* paving was proven by a test pit dug by the external face of the northern wall. A rather different situation was shown by two test pits at the two ends of the Renaissance western façade. Here it is apparent that the Roman pavement was removed during the construction of this façade, and the foundations were set on the older foundations of a large Roman structure at the intersec-

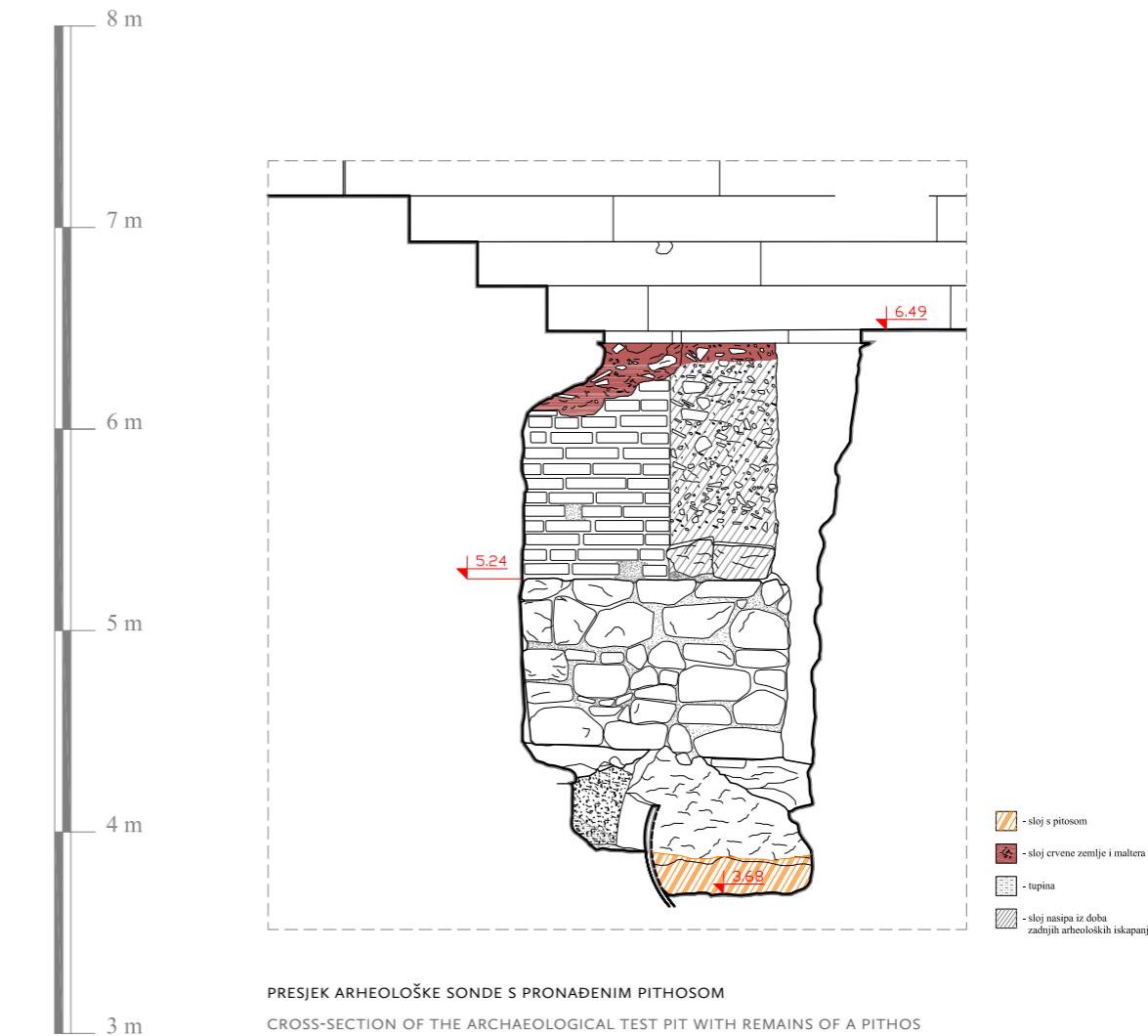
zidana kosturnica oslonjena na temelj rimske kolonade, s vrhom u razini pločnika crkve. Posljednju fazu arheoloških istraživanja crkve predstavljaju radovi na krovu. Nakon skidanja recentnih kupa kanalica utvrđen je deblji sloj nasipa na istočnom dijelu krovista, a ispod njega konstruktivni elementi renesansnog svoda crkve. Na vrhu sjevernog zida crkve pronadeni su ostaci vijenca romaničke stambene kuće s otiskom romaničkog prozora. Slični otisci romaničkih prozora i zidnih niša pronadjeni su i na arhitravnim gredama trijema antičkog *decumanusa* koje čine vrh južnog zida crkve.

tion of the *cardo* and *decumanus*. It has been assumed, albeit not proven, that this foundation belonged to a *tetrapylon*, i.e. a large antique structure square in plan, which carried four linked arches. The test pit excavated by the church's southern wall generated interesting results tied to the former Church of St. Sebastian which stood at this site. Several slabs of gray stone were found, identical to those in the Church of St. Roch, and the masonry ossuary, set on the foundation of the colonnade, with the top at the level of the church's pavement.



ARHEOLOŠKA SONDA U JUGOISTOČNOM DIJELU PERISTILA S PRONAĐENIM PITHOSOM

ARCHAEOLOGICAL TEST PIT IN THE SOUTHEAST PART OF THE PERISTYLE WITH REMAINS OF A PITHOS



PRESJEK ARHEOLOŠKE SONDE S PRONAĐENIM PITHOSOM

CROSS-SECTION OF THE ARCHAEOLOGICAL TEST PIT WITH REMAINS OF A PITHOS

Istočno od crkve sv. Roka, u sondi uz sjevernu stranu južne kolonade decumanusa pronaden je dio pločnika rimske ulice na izvornoj razini, koji je dobro sačuvan jer se nalazio unutar sklopa nadbiskupske palače.

U sondi unutar temenosa mauzoleja, istočno od drugog stupa kolonade Peristila (polazeći od sjevera) pronaden je revizioni šahrt antičkog kanala za odvodnju oborinskih voda. Kanal se pruža od šahta prema sjeveru i jugu, paralelno sa stilobatom kolonade.

Pored najjužnijeg stupa istočne kolonade Peristila, s njegove zapadne strane, arheološka sonda je dala značajne rezultate. U južnom dijelu sonde pronađena je vanjska sjeverna strana konstrukcije antičkog kanala za odvodnju kišnice, koji prolazi kroz temelj ispod stupa prema temenosu Mauzoleja. Unutar sonde posebno je zani-

The final phase of archaeological exploration of the church was related to works on the roof. Below the tiles and a thick layer of fill in the eastern section of the roof, structural elements of the Renaissance vault of the church were identified. On top of the northern wall of the church remains of the cornice of the Romanesque house were found, with an imprint of a Romanesque window. Similar imprints of Romanesque windows and wall niches were found on the architraves of the Roman *decumanus* portico which form the top of the south wall of the church.

To the east of the church of St. Roch, in the test pit near the north side of the decumanus colonnade, a section of the Roman street pavement was found at the original level, because it was preserved inside the Archbishop's palace.

mljiv arheološki sloj čiji je vrh utvrđen ispod razine tankog temeljnog proširenja ispod razine antičkog kanala i temeljnog zida kolonade. U tom sloju otkriven je oštećeni antički *pithos* – velika keramička posuda koja se uglavnom koristila za skladištenje namirnica u antičko doba. Međutim, iz konteksta u kojem je *pithos* pronađen, može se pretpostaviti da je u ovom slučaju korišten za usmjeravanje (kaptazu) vode koja izvire u blizini.

U sondiranju na zapadnoj strani Peristila uz pilon trijema *decumanusa* evidentiran je rascijepljeni kameni blok koji pripada masivnoj zidanoj konstrukciji *tetrapilona*, ispod razine antičkog pločnika.

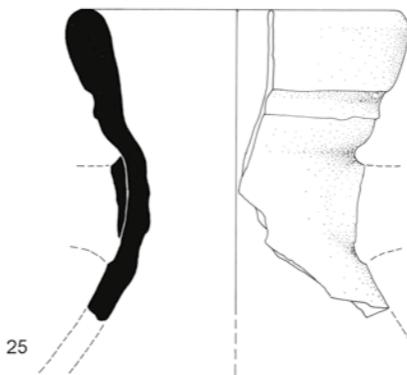
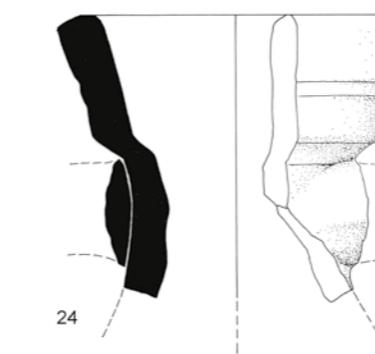
Na istoj strani Peristila iskopana je druga sonda uz stilobat kolonade, pored drugog stupa, promatrano od juga prema sjeveru. U sjevernom

The test pit within the *temenos* of the Mausoleum, to the east of the second column (counting from the north) revealed a manhole of the Roman drainage channel. It is set on the line parallel to the colonnade's *stylobate*, to the north and south of the manhole.

To the west and near the southernmost column of the east colonnade of the Peristyle, the archaeological dig has identified another drainage channel, which extends toward the *temenos*, through the foundation underneath the column. A specially interesting archaeological layer was found in the same test pit, with a damaged ancient *pithos* – a large ceramic vessel, generally used to store foodstuffs in antiquity. However, the context in which the *pithos* was found indicates that in this case it was used to redirect the water that sprang nearby.

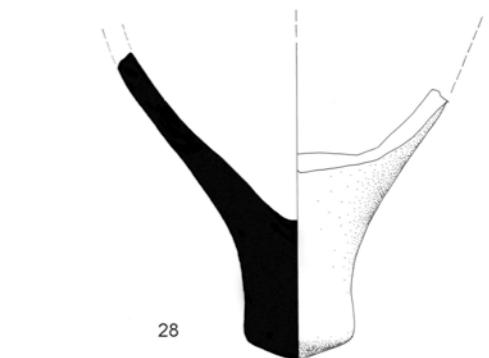
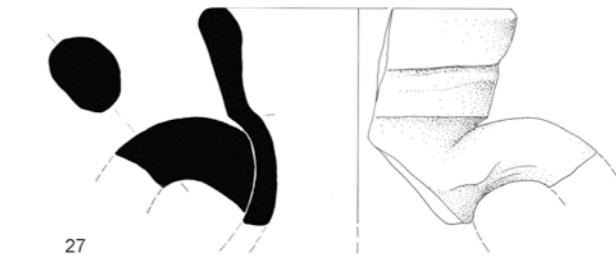


ARHEOLOŠKA ISTRAŽIVANJA NA PERISTILU
ARCHAEOLOGICAL RESEARCH ON THE PERISTYLE



0 4 2 6 cm

PERISTIL - ISTOČNA KOLONADA '09
SONDA 2, SJ 4
02.03.2009.



0 4 2 6 cm

PERISTIL - ISTOČNA KOLONADA '09
SONDA 2, SJ 4
02.03.2009.

CRTEŽI ULOMAKA PRONAĐENIH U PITHOSU
DRAWINGS OF THE FRAGMENTS FOUND IN THE PITHOS
(AUTORICA CRTEŽA / AUTHOR OF DRAWINGS: MARTINA ČURKOVIĆ)

dijelu sonde evidentiran je noviji zid građen manjim neobrađenim kamenom, povezanim crvenkasto – narančastom glinastom zemljom. Posljednja sonda na zapadnoj strani Peristila postavljena je na početku ulice Kraj sv. Ivana, unutar drugog interkolumnija, promatrano od juga prema sjeveru. Tu je evidentirana složena situacija nastala probijanjem kanalizacijskog kanala u 19. st. kroz temelj kolonade Peristila.

In the test pit at the western side of the Peristyle, near the pylon of the *decumanus* portico, a split stone block was identified. It belonged to the masonry structure of the *tetrapylon*, below the level of the Roman pavement.

Near the western colonnade's *stylobate*, to the east of its second column, viewed from south to north, a wall was registered in the northern section of the test pit, made of small, irregular pieces of stone, bonded with reddish-orange argillaceous soil.

The final test pit on the western side of the Peristyle was excavated in the area of the second intercolumniation, viewed from south to north. In the nineteenth century the foundation of the colonnade on this location was cut through to accommodate a sewage channel.



PRIRODOSLOVNA ISTRAŽIVANJA NA PERISTILU

DR. SC. DOMAGOJ MUDRONJA,
voditelj Prirodoslovnog laboratoriјa
Hrvatskog restauratorskog zavoda

NATURAL SCIENCE RESEARCH AT THE PERISTYLE

DR. SC. DOMAGOJ MUDRONJA,
Head of the Natural Science Laboratory
of the Croatian Conservation Institute

U ožujku 2002. godine prije početka restauratorskih radova djelatnići prirodoslovnog laboratoriјa HRZ-a obavili su pregled stanja kamenog vijenca Peristila, te uzeli uzorke za odredbu vrste kamena, sastava kore i patina na kamenu te odredbe vrste i količine soli u kamenu.

Mineraloško petrografskom usporedbom uzorka kamena s vijenca Peristila te nekoliko uzorka kamena iz kamenoloma s Brača ustavljeno je da se radi o biomikritnom vapnencu tipa wackestone vrlo sličnom kamenu iz kamenoloma Škrip, Plate i Rasone s otoka Brača. Crveni stupovi određeni su od strane znanstvenog laboratoriјa instituta Opificio delle pietre dure iz Firence kao egipatski sjenit iz Assuana.

Crne kore na kamenu ponegdje i do centimetra debljine sastavljene su uglavnom od gipsa, čađe i željeznih oksida. U njima se mjestimice javlja i kalcijev oksalat dihidrat (weddellit). Sivkaste patine određene su kao weddellit te mjestimice gipsa. Žućkaste patine, koje se ponegdje nalaze ispod crnih kora sastoje se od kalcijeva oksalata monohidrata (whewellite) te dihidrata (weddellite). Osim mineralnih patina na površini kamena dokazana je prisutnost algi i lišajeva.

Temeljem ovih osnovnih informacija o vrsti i stanju materijala predviđeni su kompatibilni materijali koji će se koristiti prilikom obnove, različite metode čišćenja površine kamena, metodologija odsoljavanja solima zagadenih dijelova te zaštita kamena.

Nakon detaljnijih proba i laboratorijskih ispitivanja u najvećoj mjeri tokom prve faze radova 2004-2006 godine kao metoda odsoljavanja solima najzagadenijih dijelova odabrana je u svijetu uhodana metoda amonij/barij. Ona se sastoji od dva koraka. Prvi korak sastoji se od tretmana gipsa na kamenu otopinom amonijeva karbonata, s kojim se gips pretvara u topljiviji amonijev sulfat. U drugom koraku barijevim hidroksidom preostali gips te amonijev sulfat iz prethodnog koraka pretvara se u ne štetni barijev sulfat.

Za čišćenje naslaga lišajeva i algi uz pranje kamena vodom korištena su biocidna sredstva na bazi kvartarnih amonijevih soli koja su se pokazala najefikasnija za suzbijanje ponovnog razvijanja lišajeva. Za parcijalna učvršćivanja prema potrebi koristila se otopina estera

In March 2002, prior to commencement of restoration works, staff members of the Natural Science Laboratory of the Croatian Conservation Institute conducted an inspection of the condition of the Peristyle's stone cornice and took samples to determine the stone type, composition of the crust and patina on the stone and type and quantity of salts in the stone.

Based on a mineralogical and petrographic comparison of the stone samples from the Peristyle's cornice and several samples of stone from quarries on the island of Brač, it was established that this the stone was biomicrite limestone of the wackestone type, very similar to the stone from the quarries at Škrip, Plate and Rasone on Brač. The scientific laboratory of the Opificio delle Pietre Dure Institute in Florence identified red columns were as Egyptian syenite from Aswan.

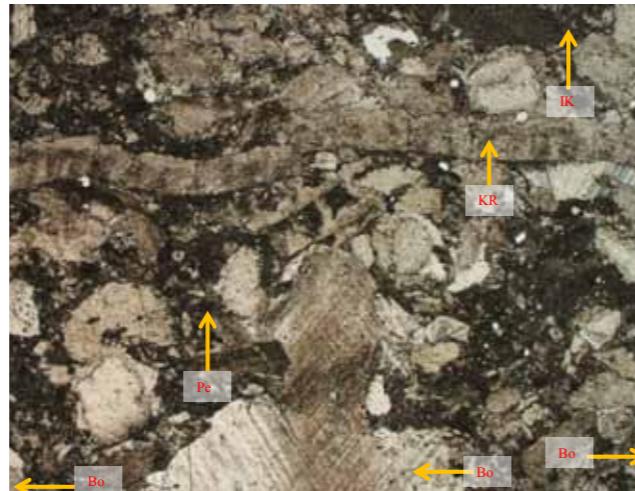
The black crust on the stone, at places up to one centimetre thick, generally consisted of gypsum, soot and iron oxides. Occasionally, there was also calcium oxalate dihydrate (weddellite) in it. The greyish patina was identified as weddellite and, at places, gypsum. The yellowish patina, found in certain places beneath the black crust, consisted of calcium oxalate monohydrate (whewellite) and dihydrate (weddellite). In addition to mineral patinas, the presence of algae and lichen was also ascertained on the surface of the stone.

Based on this basic information on the type and condition of the materials, plans were drafted for compatible materials to be used during restoration, along with various methods of cleaning the stone surface, methodology of desalination for salt-contaminated stone, and conservation of the stone.

After detailed experiments and laboratory testing done largely during the first phase of work in 2004-2006, the method selected for desalination of the most salt-contaminated pieces of stone was the globally prevailing ammonium-barium method. It consists of two steps. The first step involves treating the gypsum on the stone with an ammonium carbonate solution, which transforms the gypsum into a soluble ammonium sulphate. In the second step, barium hydroxide is used to transform the remaining gypsum and



ODREĐIVANJE VRSTE I PORIJEKLA KAMENA
DETERMINING THE TYPE AND ORIGIN OF THE STONE



silicijeve kiseline (etil silikat) s dodatkom Paraloida B 72 kod potrebe za učvršćenjem ljuški.

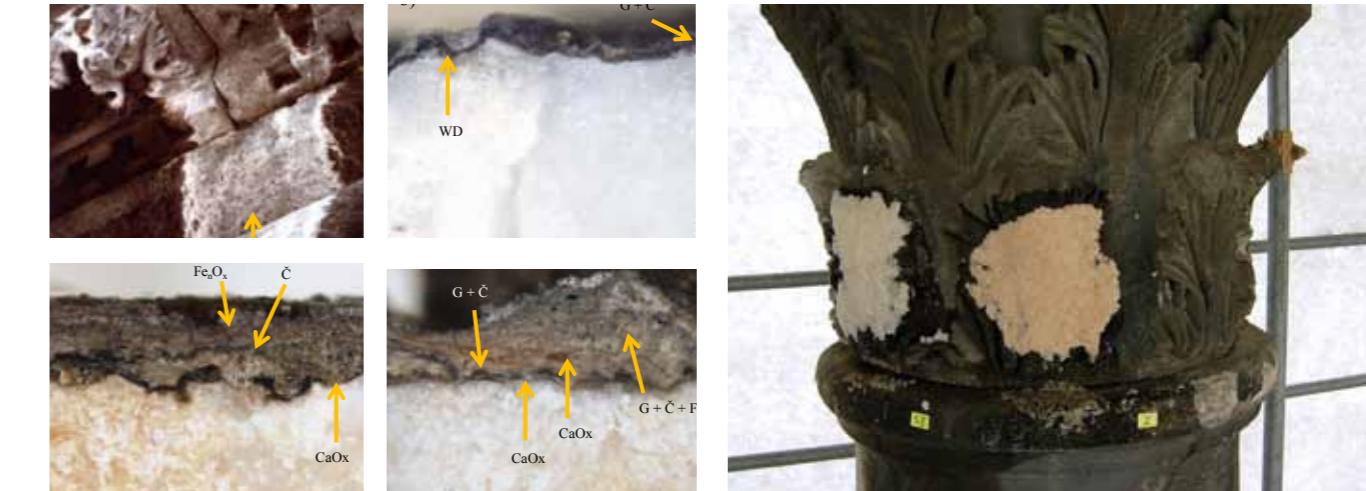
Preciznim laserskim čišćenjem restauratori nisu uklanjali prirodne žućkaste patine sastavljene od kalcijevih oksalata iz razloga što je brojnim znanstvenim istraživanjima u svijetu dokazano da kalcijevi oksalati štite kamenu podlogu. To je iz razloga što je kalcijev oksalat daleko slabije topljiv u kiselom i neutralnom području od kalcijeva karbonata koji čini vaspence i mramore. Temeljem ove spoznaje 90-tih godina u Firenci je osmišljena metoda kojom se pomoću djelovanja amonijeva oksalata na kamen od kalcijeva karbonata stvara umjetni bezbojan zaštitni sloj kalcijeva oksalata. Osim zaštite, koja je daleko prirodnija i kompatibilnija od različitih silikonskih proizvoda, amonijev oksalat djeluje i na gips također stvarajući amonijev oksalat čime je ovim sredstvom moguće raditi i odsoljavanje.

U Italiji ova se metoda koristi samo za zaštitu mramornih kipova nanošenjem amonijeva oksalata u pulpi dok znanstvena istraživanja nisu posve jasna o debljini i homogenosti nastalog sloja na površini različitih vrsta kamenja. Kako prirodna oksalatna patina ne prekriva, a time i ne štiti cijelu površinu kamenja bilo bi idealno stvoriti umjetni oksalatni sloj koji bi zaštitio i preostalu površinu kamenja poput prirodne patine ne koristeći organske silikonske premaze. Sovom idejom i zbog spomenutih činjenica o različitom ponašanju amonijeva oksalata na različitim vrstama kamenja zbog različite površnosti te strukturnih razlika, krenulo se s laboratorijskim istraživanjem najučinkovitijeg načina postizanja ove zaštite. Istraživanje je

ammonium sulphate from the preceding step into harmless barium sulphate. To clean the lichen and algae, besides washing the stone with water, biocidal products were used, based on quaternary ammonium salts, which proved the most effective in preventing the renewed growth of lichen. A solution of silicic acid ester (ethyl silicate) with the addition of Paraloid B-72 was used, where needed, for partial reinforcing the outer surfaces.

Restoration specialists used precise laser cleaning and did not remove the natural yellowish patina consisting of calcium oxalates, because considerable scientific research conducted worldwide has shown that calcium oxalates safeguard the stone base. The reason for this lies in the fact that calcium oxalate is far less soluble in the acidic and neutral zones than calcium carbonate constituting limestone and marble. Based on this knowledge, a method was devised in Florence in the 1990s, whereby an artificial colourless protective layer of calcium oxalate is created through the reaction of ammonium oxalate, and calcium carbonate present in stone. Besides providing protection, which is far more natural and compatible than various silicon products, ammonium oxalate also works on gypsum, resulting in ammonium oxalate, whereby this method can also be used for desalination.

In Italy, this method is used only for conservation of marble statues through the application of ammonium oxalate in pulp, while the scientific research is not entirely clear concerning the thickness and homogeneity of the layers created on surfaces of different types of



ODREĐIVANJE SASTAVA KORA NEČISTOĆE NA KAMENU
DETERMINATION OF THE COMPOSITION OF DIRT LAYER ON THE STONE

PROBE ODSOLJAVANJA
(AMONIJ/BARIJ – LIJEVO; IONSKI IZMJENJAVAČ – DESNO)
EXPERIMENTAL DESALINATION
(AMMONIUM/BARIUM – LEFT; ION EXCHANGER – RIGHT)

stones. Since the natural oxalate patina does not cover, and thus also does not protect the entire surface of stone, an ideal solution would be creating an artificial oxalate layer that would protect the remaining surface of the stone like the natural patina, without the application of any organic silicon coating. Setting forth from this idea, and the above mentioned fact that ammonium oxalate has different reactions on different types of stone due to their diverse levels of porosity and structural differences, laboratory research was launched in an attempt to establish the most effective way of achieving such protection. The research included laboratory testing of samples of limestone called Veselje, originating from the island Brač, and testing of the limestone from the Peristyle, on the basis of the best results achieved in laboratory trials. The research was supposed to provide answers to two crucial questions: 1. Is it possible to secure an adequate protective layer using a method of applying ammonium oxalate on stone different from pulp, due to the fact that covering surfaces this big with pulp would be economically unfeasible? 2. What is the coverage of stone surface and thickness of the new calcium oxalate layer thus created?

Nakon brojnih proba i mjerena u laboratoriju poštujući fizikalno-kemijske zakone same reakcije između kalcijeva karbonata i amonijeva oksalata (transport reaktanta iz otopine preko granice kamena i otopine u kamen) osmišljen je način premazivanja koji bi trebao stvoriti adekvatnu zaštitu na kamenju. Samo premazivanje sastojalo se od 10 intervala tokom jednog sata. Svaki interval sastojao se od 1 minutnog premazivanja 5% otopine amonijeva oksalata s 5 minutnom pauzom između intervala. Na ovaj način postignuto je konstantno brzo obnavljanje koncentracije otopine amonijeva oksalata na granici faza (kamen-tekućina) za razliku od pulpe gdje se koncentracija otopine na granici faza (kamen-pulpa) nadoknađuje vrlo sporim procesom molekularne difuzije.

Da bi se dokazali ovi procesi te na mikro razini vidjela rasprostranjenost oksalatnog sloja na površini kamenja kao i njegovo stvaranje u dubini, bilo je potrebno koristiti izrazito sofisticirane mikro analitičke metode. Klasičnim laboratorijskim metodama poput Fourier transformirane infracrvene spektroskopije (FT-IR), rendgenske di-

After numerous laboratory tests and measurements, with due respect for the physical and chemical laws governing the actual reactions between calcium carbonate and ammonium oxalate (conveyance of the reactant from the solution over the boundaries of the stone and of the solution into stone), a coating method was devised, which should result in an adequate protective layer on the stone. The coating process consisted of 10 intervals during a

frakcije (XRD) koje su rađene kod nas, ustanovili smo da kalcijev oksalat nastaje, ali ne što se događa na mikrorazini na temelju čega bismo mogli uspješno isplanirati sam način aplikacije na kamenu Peristila. Iz tog razloga u suradnji sa institutom „Ruder Bošković“, Prirodoslovno matematičkim fakultetom u Zagrebu te Fakultetom za kemiju iz Antwerpena prijavljen je istraživački projekt čiji cilj je bio da se preciznim sinkrotronskim mikrotehnikama odgovori na ova pitanja. U sklopu tog projekta rađeno je istraživanje na francuskom nacionalnom sinkrotronu „SOLEIL“ te švicarskom sinkrotronu „Swiss light source“ tehnikama SR- μ FT-IR te SR- μ XRD. Ovim tehnikama ustanovljeno je da na površini kamena Veselje osmišljenoj metodom premazivanja, nastaje sloj kalcijeva oksalata ekvivalentan deset-satnom tretmanu pulpom, što je prema istraživanjima u Italiji sasvim dovoljno za postizanje učinkovite zaštite. Također je dokazano da novonastali zaštitni sloj metodom premazivanja ima debljinu od oko 30 μm .

Nakon ovog istraživanja rezultati su primjenjeni na protironu Peristila i to na način da su dijelovi na kojima nije bilo prisutnih soli premazani amonijevim oksalatom na opisani način, dok su dijelovi s kojih je uklonjena crna skrama tretirani pulpom. Pulpom su tretirani dijelovi na kojima je bila nešto viša koncentracija štetnog gipsa, koji je u reakciji s amonijevim oksalatom pretvoren u kalcijev oksalat. Pri tome je nastao i amonijev sulfat koji je kristalizirao u pulpi. Kombinacijom ove dvije metode cijeli protiron zaštićen je stvaranjem umjetnog sloja kalcijeva oksalata na površini kamena. Naknadnom provjerom nije uočena razlika u učinkovitosti stvaranja kalcijeva oksalata na dijelovima kamena tretiranim premazivanjem i onima tretiranim pulpom.

single hour. Each interval entailed one minute of coating with a 5% ammonium oxalate solution, followed by a five-minute pause between intervals. In this manner, the constant rapid renewal of the concentration of ammonium oxalate solution was achieved at the phase threshold (stone-liquid), as opposed to pulp, where the solution concentration at the phase threshold (stone-pulp) is compensated by a very slow molecular diffusion process.

Exceptionally sophisticated micro-analytical methods had to be used to demonstrate these processes and observe (at the microscopic level) the distribution of the oxalate layer on the surface of the stone as well as its creation in depth. Using classical laboratory methods such as Fourier transform infrared spectroscopy (FT-IR) and X-ray diffraction (XRD), we have ascertained, in our facilities, that calcium oxalate is formed, but not what occurs at the micro-level on which basis we could successfully plan the actual method for application on the stone of the Peristyle. This is why a research project was developed in cooperation with the Ruđer Bošković Institute, the Zagreb Faculty of Natural Sciences and Mathematics and the Department of Chemistry of the University of Antwerp, which was aimed at providing answers to these questions by using synchrotron-based micro-imaging techniques. As part of this project, research was conducted at the French national synchrotron facility Soleil, and the Swiss Light Source synchrotron using SR- μ FT-IR and SR- μ XRD techniques. By means of these techniques, it was ascertained that a layer of calcium oxalate forms on the surface of the Veselje stone when the coating technique is applied, and that this layer is equivalent to ten hours of pulp treatment. This is, according to research conducted in Italy, entirely sufficient to achieve effective protection. Furthermore, it was demonstrated that the new protective layer created by the coating technique has a thickness of approximately 30 μm .

After this research, the results were applied to the Peristyle's prothyron, such that the parts on which no salts were present were coated with ammonium oxalate in the described fashion, while the parts from which black incrustation was removed were treated with pulp. Pulp was used to treat the parts with somewhat higher concentrations of harmful gypsum, which by means of a reaction to ammonium oxalate was transformed to calcium oxalate. In addition, ammonium sulfate was also formed, which crystallized in the pulp. By combining these two methods, the entire prothyron was protected through the creation of an artificial layer of calcium oxalate on the surface of the stone. During a subsequent verification, no difference was noted between the effectiveness of creation of calcium oxalate on the parts of stone treated by coating and those treated by pulp.

NANOŠENJE CELULOZNE PULPE SA AMONIJ-KARBONATOM

U SVRHU DESALINIZACIJE KAMENA

DESALINATION OF STONE BY APPLICATION OF CELLULOSE

PULP WITH THE SOLUTION OF AMMONIUM CARBONATE





SANACIJA KONSTRUKCIJE

DR. SC. GORAN NIKŠIĆ
voditelj Odsjeka za staru gradsku jezgru

STRUCTURAL STRENGTHENING

DR. SC. GORAN NIKŠIĆ
Head of the Service for the Old City Core

Peristil Dioklecijanove palače s kasnijim dogradnjama predstavlja vrlo složenu i heterogenu strukturu. Sedamnaest stoljeća rušenja i gradnji ostavilo je tragove na robustnoj rimskoj konstrukciji, ali i na gradevinama iz kasnijih razdoblja. Neki od problema na koje smo naišli tijekom zahvata konstruktivne sanacije nastali su već u Dioklecijanovo doba. Čini se, naime, da su se graditelji carske palače suočili ne samo s prekratkim rokom za dovršenje radova, nego i s opetovanim zahtjevima imperatora koji je bio opsjednut graditeljskim pothvatima za drastičnim promjenama projekta „u hodu“, a neke od njih se odražavaju na središnjem trgu palače. Još je George Niemann početkom prošlog stoljeća u svojoj knjizi o Dioklecijanovoj palači zabilježio sasvim nelogičan položaj kamenih blokova trabeacije Protirona koji su ugrađeni u njegov istočni zid, ali nije uspio odgovoriti razlog. Po svoj prilici je projektom prvo bilo predviđeno da Protiron kao reprezentativni arhitektonski element na ulazu u carske odaje bude postavljen pred Vestibulom u obliku klasičnog trijema sa zabatom koji nose stupovi, dakle slobodnog s tri strane. Istočna i zapadna kolonada Peristila dogradene su vjerojatno u vrijeme kada se dovršava koncepcija oblikovanja funerarne i kultne arhitekture u središtu Palače. Tada su Protironu dodani bočni zidovi koji su uokvirili njegova četiri stupa i karakteristični zabat s bočnim arhitravima i središnjim lukom. Obzirom da ovdje taj arhitektonski motiv, najvjerojatnije sirijske provenijencije, nije na uobičajen način uklopljen kao dio kolonade (kao što je to slučaj na južnom pročelju Palače), odnosno s jakim bočnim osloncima, bočni potisak središnjeg luka je uzrokovao razmicanje oslonaca i naginjanje stupova. Niemann je precizno izmjerio 11 centimetara otklona bočnih stupova Protirona u odnosu na vertikalnu. Osim toga, stupovi Protirona su se nagnuli i prema vani, možda uslijed horizontalnog potiska masivnih drvenih greda u trenutku rušenja krova i skulpture s postoljem na njegovom vrhu. Naime, mnogi dosadašnji istraživači su pretpostavili da je na postolju na vrhu Protirona bila postavljena skulptura, možda brončana kvadriga, ili neki drugi motiv iz carske ikonografije. I bočne kolonade Peristila uzrokovale su sličan problem stabilnosti konstrukcije. Iako se na njima uočavaju samo relativno male deformacije i oštećenja, lukovi trijemova decumanusa, koji su prislonje-

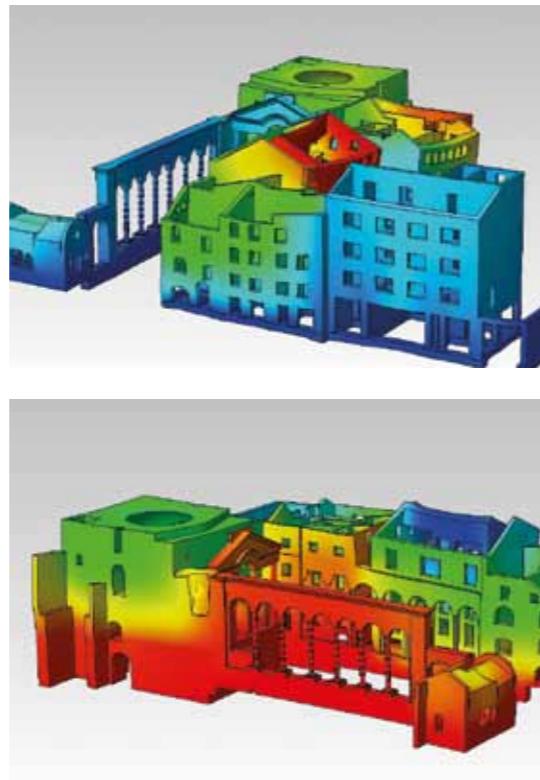
Peristyle of Diocletian's Palace, together with buildings from later periods, represents a very complex and heterogeneous structure. Seventeen centuries of demolitions and constructions have left traces in a robust Roman construction, as well as on buildings dating from later periods. Some of the problems we encountered during the rehabilitation of construction were already present in Diocletian's time. It seems that the constructors of the imperial palace had been faced not only with short deadline, but also with repeated demands of the emperor who was obsessed with the project and was making constant changes, some of them reflected in the main square of the palace. It was George Niemann who, at the beginning of the 20th century in his book about the Diocletian's Palace, noticed the completely inconsistent positioning of the stone blocks of trabeation in Prothyron that had been inbuilt in its east wall, but couldn't decipher the reasons for this. It is probable that the original plan was to design Prothyron as a representative entrance to the imperial chambers and set it in front of the Vestibule in the form of classical porch with pediment carried by columns, open on three sides. East and west colonnades were probably added when the funerary and cult architecture was being completed at the centre of the Palace. That is when side walls were added to Prothyron, flanking its four columns and characteristic pediment with side lintels and central arch. This architectural motif is most likely of Syrian provenance and is not incorporated in a usual way as a part of a colonnade (as is the case in the south front of the Palace). Strong side supports have caused side thrust of the central arch to move the supports and tilt the columns. Niemann has measured precisely 11 cm of vertical deviation in side columns of Prothyron. In addition, the columns of Prothyron have tilted outwards, probably because of the horizontal thrust of massive wooden beams created when the roof with a sculpture had collapsed. In fact, many researchers have assumed that a sculpture, maybe bronze quadriga or some other imperial motif was placed on the base on top of the Prothyron.

Side colonnades of Peristyle have caused a similar problem of construction stability. Although relatively small deformations and



MONITORING VERTIKALNIH PUKOTINA NA CRKVI SV.ROKA

MONITORING THE VERTICAL CRACKING ON THE CHURCH OF ST. ROCH



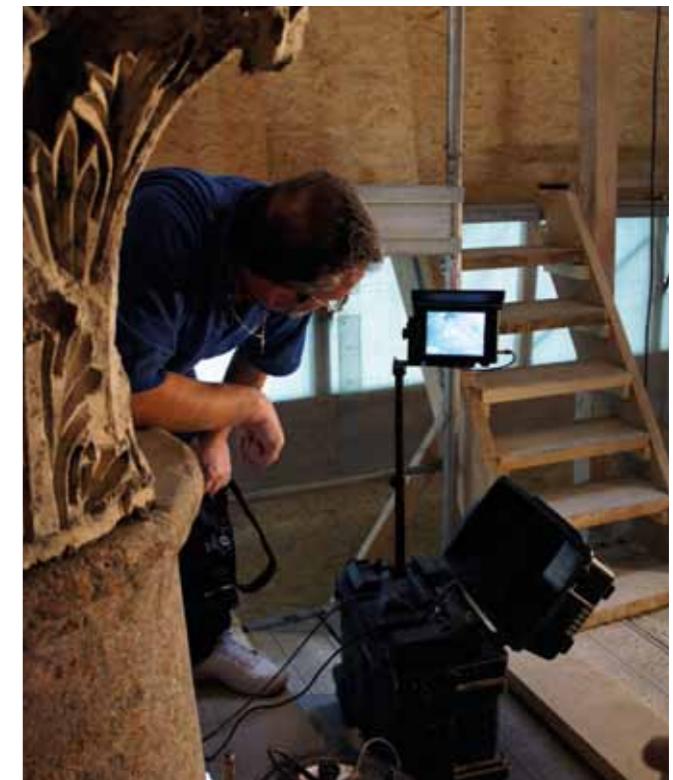
RAČUNALNI MODEL KONSTRUKCIJE PERISTILA

COMPUTER 3D STRUCTURAL MODEL OF THE PERISTYLE



ENDOSKOPSKO ISPITIVANJE ŽELJEZNOG TRNA IZMEĐU GRANITNOG STUPA I KAPITELA NA PROTIRONU

ENDOSCOPIC EXAMINATION OF IRON DOWEL BETWEEN A GRANITE COLUMN AND A CAPITAL ON THE PROTHYRON



ni na sjeverne pilone kolonada, jako su deformirani, možda uslijed bočnog potiska arkatura kojemu se sa suprotne, južne strane su protstavlja snažna masa Vestibula. Najveća oštećenja se, međutim, uočavaju dalje prema sjeveru, na susjednom pročelju crkve sv. Roka čiji se fino klesani blokovi kamena drobe uslijed koncentracije napona. Očigledno je, dakle, da je od početka u koncepciji heterogenoj konstrukciji Peristila ugrađen problem koji se multiplicirao stoljećima, a situaciju su pogoršavale dogradnje i pregradnje građevina koje su se ugnijezdile unutar i oko rimske strukture, često i fizički oštećujući osnovnu nosivu konstrukciju.

U nekoliko navrata konstruktivni problemi na Peristilu su se rješavali parcijalno, pa je tako početkom dvadesetog stoljeća dio istočne kolonade bio demontiran i ponovo montiran, a dva stupna sanirana tašeljanjem. Otpriklje u isto vrijeme pokušala se zaustaviti deformacija Protirona povezivanjem bakrenim kopčama blokova luka i zida nad njim, kao i postavom zatega na dvije razine koje su povezale zid zabata s masom Vestibula.

Tijekom konzervatorsko-restauratorskog zahvata na Peristilu prvi put je u cijelini sagledana problematika konstruktivne stabilnosti. Da bi se dobili podaci o intenzitetu i brzini povećanja deformaci-

damages are visible, arches of the decumanus porch adjacent to the north pillars of the colonnades are severely deformed, possibly because of the side thrust of the arches that are opposed from the south side by a strong mass of Vestibule. The greatest damage is visible further towards north, on the adjacent façade of the church of St. Roch. Its finely carved stone blocks are crumbling because of the concentrated pressure. Therefore, it is obvious that the problem has been inbuilt into the heterogeneous structure of Peristyle from the beginning. It has been multiplied through centuries, made even worse by building annexing and reconstructions that were being made inside and around the Roman structure, often physically damaging the main construction.

Problems of construction were partially dealt with on several occasions, so at the beginning of the 20th century one part of the east colonnade was dismantled and again reassembled and two columns were patched. Approximately at the same time, an attempt was made to stop the deformations in Prothyron, stone blocks of the arch and a wall were reinforced with copper clasps. Anchors were set on two levels connecting the pediment wall to the Vestibule.

ja proveden je monitoring – na kritičnim mjestima postavljeni su instrumenti kojima se prije, za vrijeme i nakon zahvata mjeru pomaci i naponsko stanje u konstrukciji. Mjerjenjem napona u bakrenim kopčama na zabatu Protirona ustanovljeno je da su one pod opterećenjem, odnosno da je zahvat od prije stotinu godina imao učinka. Stanje željeznih trnova na spoju granitnih stupova s bazama i kapitelima ispitano je endoskopski (uvlačenjem u šupljine sonde s kamerom i optičkim vlaknima). Temelji i tlo ispod njih na kritičnim mjestima su istraženi geomehaničkim i arheološkim sondama. Ustanovljeno je da je rimska struktura temeljena uglavnom na čvrstom tlu, odnosno na solidnom ostacima ranijih gradnjih, a manjim dijelom (piloni trijema decumanusa) na nedovoljno stabiliziranom terenu. Zidovi crkve sv. Roka temeljeni su velikim dijelom izravno na rimskom pločniku.

S konstruktivnog stajališta Peristil je vrlo heterogena građevina. Rimske strukture su dijelom slobodno stojčeće, a dijelom ispunjene kasnijim gradnjama. Čitavi blokovi kuća povezani su s Peristilom sa zapadne strane u jednu građevinsku cjelinu, dok se s juga na Protiron nadovezuje snažna masa Vestibula. Zbog svega toga bilo je neophodno ispitati vlastite frekvencije pojedinih građevina, odnosno sklopova. Svi navedeni podaci poslužili su da se izradi vrlo složen

The problem of construction stability was for the first time fully addressed during the conservation- restoration works at Peristyle. Monitoring was conducted in order to obtain information of the intensity and speed of deformation growth. Changes and resonance of the construction were measured before, during and after the treatment. Resonance of the copper clasps on the Prothyron pediment has shown that they were carrying weight, so a hundred-year-old intervention was still effective. Condition of iron bolts located between the granite columns and their bases was examined endoscopically (by inserting a probe with camera and optic fibres). Foundations and ground beneath them were examined in critical areas with geomechanic and archaeological probes. It was established that the Roman structure was mostly founded on solid ground that is on solid remains of older structures and, to a lesser extent (pillars of the decumanus porch) on an insufficiently stable ground. Most of the walls of the church of St. Roch are founded directly on Roman pavement.

From the construction point of view, Peristyle is an exceptionally heterogeneous structure. Roman constructions are partly free-standing, partly embedded with later structures. Whole blocks of houses are connected to Peristyle on its west side and form one

računalni model konstrukcije Peristila, koji se ispitivao osobito na djelovanje horizontalnih sila (zemljotres). Na temelju rezultata tih ispitivanja načinjen je program radova konstruktivne sanacije.

Budući da su deformacije koje je konstrukcija Peristila pretrpjela kroz dugo razdoblje nepovratne, koncepcija sanacija konstrukcije provedena je kroz niz mjera kojima se stanje znatno poboljšalo. Na kritičnim mjestima gdje je sondama ustanovljeno loše stanje, temelji su sanirani prezidavanjem i injektiranjem. Najveći dio prezidanja i injektiranja izveden je na istočnom zidu Protirona s vanjske strane, gdje su bile dogradene srednjovjekovne kuće čiji su stanari odstranjivali dijelove rimske konstrukcije radi povećanja stambenog prostora. Injektiranje je obavljeno i na većim površinama ostalih zidova, a osobito su pažljivo injektirani spojevi kapitelâ sa stupovima i arhitravima, kako bi se rasteretili njihovi rubovi od koncentracije napona do kojih je došlo zbog naginjanja stupova.

Da bi se zaustavila ili barem znatno usporila daljnja deformacija konstrukcije Protirona, izvedeni su neinvazivni zahvati koji su velikim dijelom povratili stabilnost. Nakon što je analiza računalnog modela konstrukcije pokazala da je neophodno povezati zabat Protirona sa čvrstom masom Vestibula, odlučeno je da se krov Protirona koji je bez pravog opravdanja (isključivo s namjerom djelomične i upitne rekonstrukcije izvornog stanja) postavljen sredinom dvadesetog stoljeća, zamijeni novim, ali ovoga puta da se on iskoristi za ukrućivanje cijelokupnog konstruktivnog sustava. Trostruka daščana oplata spregnuta je s drvenim krovnim gredama koje su usidrene s jedne strane u kamenu strukturu zabata, a s druge u masivni sjeverni zid Vestibula. Stare metalne zatege koje su dotrajale i nisu više aktivno povezivale zid zabata na dvije razine zamijenjene su novima. Bakrene kopče, kojima su početkom dvadesetog stoljeća međusobno povezani kameni blokovi zabata na njegovom vanjskom i unutrašnjem licu kako bi se zaustavilo otvaranje sljubnica nisu uklonjene jer su ispitivanja pokazala da su još uvijek pod naponom.

Veliki rasteretni luk građen od opeke i sedre, nad portalom koji iz Protirona vodi u Vestibul, bio je teško oštećen pa je, možda još u srednjem vijeku, djelomično podzidan kamenim blokovima u mortaru. Na taj način je težina zida iznad luka prenesena na kameni arhitrav iznad portala koji je puknuo. Zbog toga je bilo neophodno rekonstruirati rasteretni luk, pri čemu su korištene opeke izvornog rimskog formata i blokovi sedre.

Jedan od složenijih zahvata bila je konstruktivna sanacija crkve sv. Roka. Nakon što je uklonjen pokrov, svod je saniran s gornje strane, a rubovi su zajedno s uzdužnim vijencima ojačani karbonskim trakama, kao i zapadno pročelje s unutrašnje strane. Na tom je pročelju na vanjskom licu nekoliko smravljenih kamenih blokova zamijenjeno novima, odnosno tašelirano kamenom ili umjetnim ka-

constructional unit. Powerful mass of Vestibule is attached on the south side. That is why it was necessary to examine the resonances of particular buildings or complexes. All of the acquired data was used to create a very complex computer model of the construction of Peristyle, which was tested for horizontal forces (earthquake). Based on the results of these tests, a program of construction rehabilitation was designed.

Since deformations of the construction of Peristyle are irreversible, the concept of construction rehabilitation was based upon numerous measures that have significantly improved the condition. Critical areas of foundations and walls were reconstructed and injected. Most of the treatment was performed on the outer side of the east wall of the Prothyron. Medieval houses had been built on that site and its tenants had removed parts of Roman construction to enlarge their living area. Large areas of remaining walls were also injected, and special attention was given to the joints between capitals and columns and lintels, so that corner areas would suffer less thrust created by the tilting of the columns.

To stop or at least slow down further deformation of Prothyron construction, non-invasive interventions were conducted that have greatly reclaimed stability. After the computer model analysis had shown that it was inevitable to connect the pediment to the firm body of the Vestibule, it was decided to replace the roof of the Prothyron that has unjustifiably been installed (exclusively with the intention of partial and questionable reconstruction of the original state) in mid- 20th century, with a new one, but this time to use it to consolidate the whole system of construction. Threefold wooden revetment was strongly bound to wooden roof beams that were anchored to the stone pediment structure on one side and to the massive north wall of the Vestibule on the other. Old metal anchors were no longer actively connecting the pediment wall on two levels, and were replaced with new ones. Copper clasps that were used in the early 20th century to connect the stone blocks of the pediment on its inner and outer side to prevent joints from opening up were not removed, because the surveys have shown that they were still active.

A large supporting arch built of brick and tuff placed over the portal leading from Prothyron to Vestibule was heavily damaged and was, maybe as early as the Middle Ages, supported with stone blocks in mortar. That is how the weight of the wall above the arch was transferred to the stone lintel over the portal that has broken. For this reason it was necessary to reconstruct the supporting arch. Bricks of the original Roman shape and blocks of tuff were used.

Rehabilitation of the construction of the Church of St. Roch was one of the most complex tasks. After the removal of cover, vault was repaired on the upper side and corners. Together with longi-



RASTERETNI LUK U STRAŽNJEM ZIDU PROTIRONA PRIJE, TIJEKOM I NAKON KONZERVATORSKO-RESTAURATORSKOG ZAHVATA
RELIEVING ARCH IN THE BACK WALL OF THE PROTHYRON BEFORE, DURING AND AFTER RESTORATION WORK

menom. Pročelje je injektirano da bi se popunile šupljine, osobito na horizontalnim spojnicama kamenih blokova koji su izvorno bili klesani sa skošenim stranicama i ugrađeni bez sljubnica, tako da je na vanjskom licu došlo do velike koncentracije napona.

Nakon dovršenja radova konstruktivne sanacije Peristila ponovo su postavljeni instrumenti kojima će se još barem nekoliko godina vršiti monitoring, da bi se ustanovilo koliko je zahvat bio uspješan i da li će biti potrebna ponovna intervencija.

tudinal cornices, it was reinforced with carbon straps, as well as the interior side of the west façade. Several crushed stone blocks on the outer side of the same façade were replaced by new ones or patched with stone or artificial stone. Façade was injected so that holes would be filled, especially on the horizontal joints of the stone blocks that have originally been carved with slanted sides and installed without joints, so the exterior walls were overstressed. After the works of construction rehabilitation of Peristyle had been completed, instruments that will monitor the situation for at least a couple of years have been installed to determine the success of the interventions and to indicate whether another interventions would be needed in the future.



KONZERVATORSKO-RESTAURATORSKI ZAHVAT

MLADEN MATIJACA,
dipl. konzervator-restaurator

CONSERVATION-RESTORATION TREATMENT

MLADEN MATIJACA,
conservator-restorer

ZATEČENO STANJE

Tamne skrme, koje su prekrivale većinu kamene strukture Peristila nisu dopuštale uvid u pravo stanje materijala. Tek kada je podignuta skela na segmentu istočne kolonade bilo je moguće provesti istražne radove na temelju kojih su donesene smjernice za konzervatorsko-restauratorski zahvat. Međutim, i svaka pojedina faza projekta donijela je neke nove spoznaje, pa se strategija zahvata postupno nadopunjavala.

Na kamenu Peristila je zabilježeno nekoliko tipova oštećenja i onečišćenja: površinske naslage (crne kore i sivkaste patine), štetne (topljive) soli prisutne u kamenu, biološka onečišćenja, erodirana (isprana) područja i mehanička oštećenja.

Tamne kore nastaju na površinama na koje izravno ne dospijeva kiša. Crna boja potječe od čestica čadi koje su nastale izgaranjem drveta i ugljena u kućnim ložištima i industrijskim postrojenjima. Površine koje su bile izložene kiši nemaju tamne naslage, ali zbog erozije kamena na njima nije sačuvana ni patina. Agresivno djelovanje kišnice na nekim mjestima je uzrokovalo izbrazanost površine i pojavu škrpastih udubljenja (do 2-3 cm dubine). Osim toga na nekim su mjestima prisutna specifična rupičasta oštećenja koja potječe od fosilnih organizama koji su se nalazili u kamenu i koji su zbog erozije i kapilarne vlage ispalii. Zabilježena su i biološka onečišćenja: lišajevi, bakterije, plijesni i mahovina. U sljubnicama između kamenih blokova svoje su stanište našle više biljke koje kemijskim i fizičkim procesima oštećuju kamen. Interpolacija kasnijih građevina u antičku strukturu ostavila je značajna oštećenja i konstruktivne probleme na cijelom arhitektonskom sklopu Peristila. Osim toga, dodatna oštećenja su nastala za vrijeme Drugoga svjetskog rata kada su izravnim pogocima gelera površinski dijelovi kamena raspušnuti i odvaljeni.

U kamene blokove su tokom vremena bili ugrađeni brojni željezni klinovi, čavli i slični elementi koji su pod utjecajem atmosferilja korodirali. Ova korozija je uzrokovala bubrenje metala te na taj način uništavala kamen. Na kapitelima i na stupovima su takva oštećenja zatečena u obliku većih kosih pukotina preko kojih se kamen raspucjepio, a ponegdje i potpuno otpao.

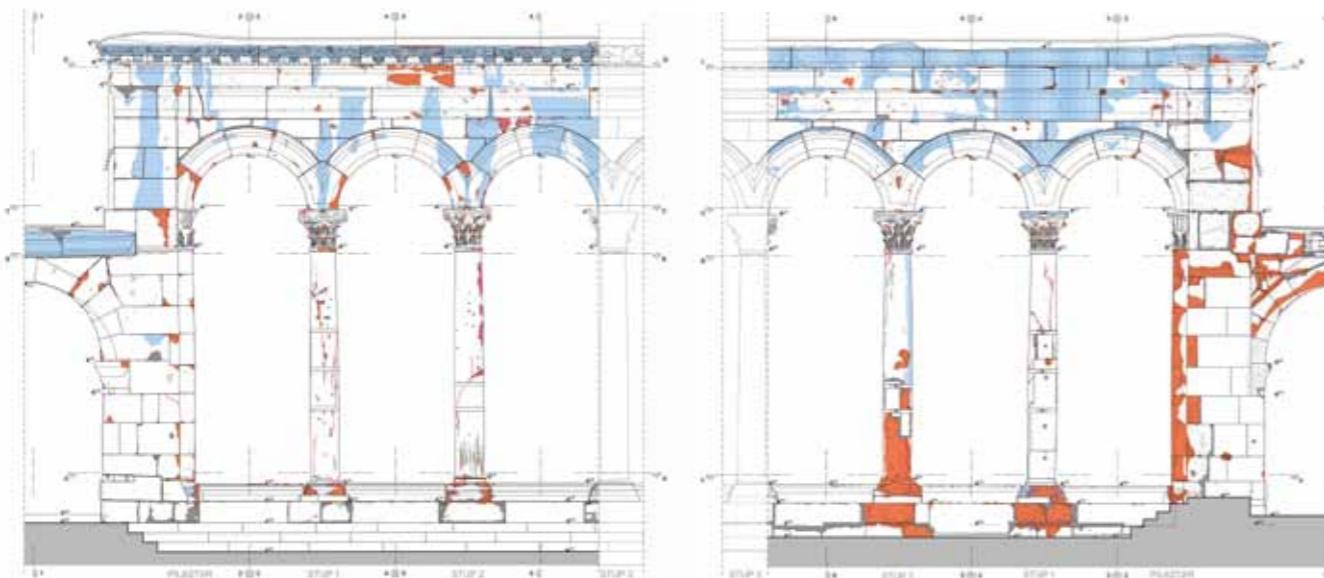
AS-FOUND CONDITION

Dark sediments that were covering most of the stone structure of Peristyle were not allowing the proper insight into the condition of the material. Only upon setting of the scaffolding on a segment of the east colonnade was it possible to conduct research that was later used as a foundation for the guidelines of the conservation-restoration treatment. However, each of the phases of the project has contributed to some new discovery, so the strategy of the treatment was gradually being supplemented.

There were several types of damage and soiling found on the Peristyle stone: surface sediments (black crusts and greyish patinas, harmful (soluble) salts present in stone, biological soiling, eroded (weathered) areas and mechanical damages.

Dark crusts were created on the surfaces not directly exposed to rain. Black colour derives from soot particles created as by-products of wood and coal being burnt in individual fireplaces and industrial plants. Surfaces that had been exposed to rain have no dark sediments but, due to erosion of stone, they have lost all of the patina. Aggressive effect of rain in some places has furrowed the stone and created grooves (up to 2-3 cm deep). Furthermore, some places had specific hole-like damages derived from fossils that have fallen out because of the erosion and capillary condensation. Biological damage was also recorded: lichen, bacteria, mould and moss. Larger plants have found their habitat in joints between the stone blocks and damaged the stone with their chemical and physical processes. Interpolations of later buildings into the ancient structure have also left significant damages and constructional problems on the whole architectural complex of Peristyle. In addition, more damage was created during World War II when surface parts of stone were split and cut off by direct shrapnel hits.

Numerous iron bolts, nails and similar elements were inbuilt in stone over a period of time. Due to weathering they have corroded and rust has damaged the surrounding stone. Such damages were found on capitals and columns in the shapes of large splits and chipped off areas.



NACRTI ISTOČNE KOLONADE SA UCRTANIM OŠTEĆENJIMA | SURVEY OF THE EASTERN COLONNADE WITH MAPPED DAMAGES

(AUTORI | AUTHORS: I. GOBEC, N. MAVAR, A. ŠKEVIN MIKULANDRA, F. DRAKSLER)

KONZERVATORSKO-RESTAURATORSKI ZAHVAT

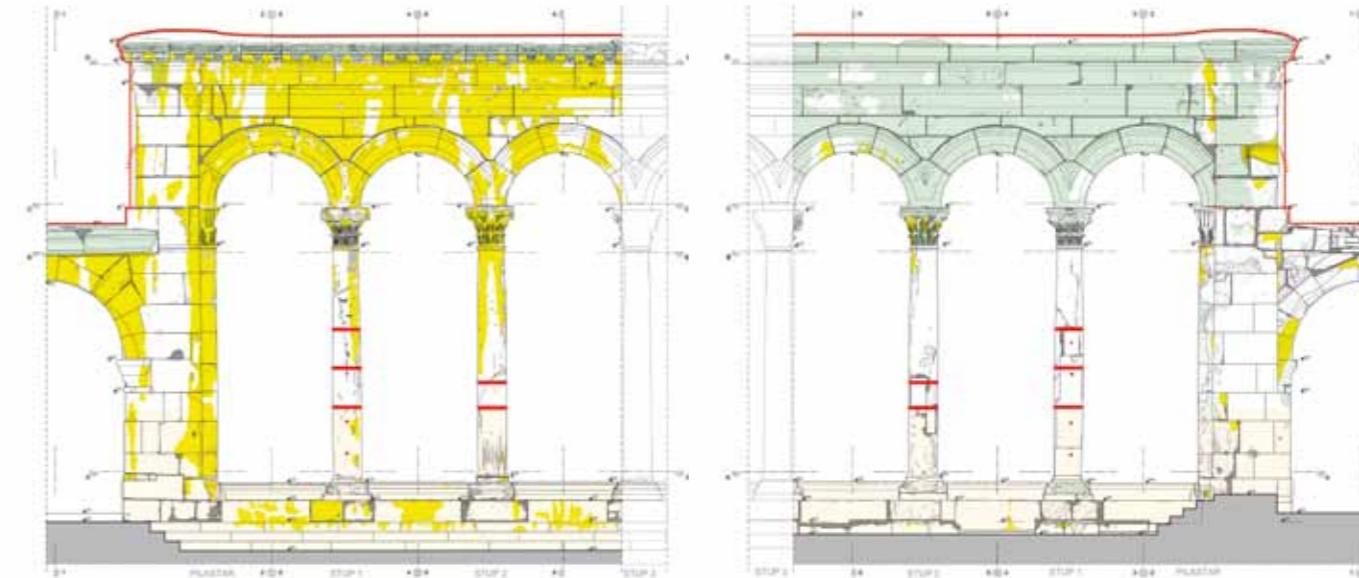
Prostor Peristila je izuzetno složen arhitektonski sklop, pa su radovi na njegovoj obnovi bili podijeljeni u više faza. U prvoj fazi (2004–2005) izvedena je sanacija sjevernog dijela istočne peristilske kolonade. Tada su uklonjene cementne zatrpe iz prethodnih restauracija kao i metalni elementi sidreni u kamen. Usljedilo je čišćenje organskih onečišćenja i lasersko čišćenje tamnih naslaga s površine kamenja, fugiranje, zaštita mortom izbočenih dijelova arhitekture, sanacija pukotina, injektiranje, učvršćivanje nestabilnih dijelova kamenja, izrada rekonstrukcija u umjetnom i prirodnom kamenu i zahvati desalinizacije.

Tijekom 2006. i 2007. godine radovi su nastavljeni na južnom dijelu zapadne kolonade i pročelju palače Skočibučić-Lukaris, upravo zbog odluke da se rjezina unutrašnjost preuredi za potrebe Muzeja sakralne umjetnosti. U obnovi tog važnog i slojevitog graditeljskog sklopa koji osim antičke kolonade obuhvaća romaničke, gotičke, renesansne i barokne dijelove, korištene su metode već provjerene u prvoj fazi radova na Peristilu. Međutim, tu je situacija bila znatno složenija i zahtjevija jer se osim vapnenca i granita na pročelju palače pojavljuje i žbuka koja je zatečena u vrlo lošem stanju. U toj fazi radova konzervatorima-restauratorima specijaliziranim za kamenu plastiku pridružili su se stručnjaci za zidno slikarstvo, mozaike i štuko, te se s radovima na kamenu nastavilo usporedno s onima na žbuci. Nakon opsežnih i temeljiti istražnih radova, dobivena je precizna dijagnoza stanja objekta na osnovu koje su izabrane me-

CONSERVATION- RESTORATION TREATMENT

Peristyle area is an exceptionally complex architectural unit. Therefore, the rehabilitation works have been divided in several phases. Rehabilitation of the north part of the east colonnade was carried out during the first phase (2004-2005). Cement patches from previous restorations were removed as well as the elements anchored in stone. Cleaning of organic dirt followed, then the laser cleaning of dark sediment from the surface of the stone, grouting, protection of the projecting architectural parts with mortar, treatment of cracks, injecting, reinforcement of the unstable parts of stone, reconstruction in artificial and natural stone and desalination treatment.

During 2006 and 2007 the work was continued on the south side of the west colonnade and the façade of the Skočibučić-Lukaris Palace, as a result of the decision to redecorate its interior for the needs of a Museum of Sacral Art. Methods already tested during the first phase were used in rehabilitation of this important and stratified architectural complex that included not only ancient colonnade but also Romanesque, Gothic, Renaissance and Baroque sections. However, the situation was far more complex and demanding because not only limestone and granite were present on the façade of the palace, but also mortar which was in very poor condition. During this phase, conservators-restorers specialised in stone were joined by the experts for wall paintings, mosaics and stucco, and the works on stone and plaster were continued simultaneously. After thorough and detailed research, precise diagnosis of the condition



tode i materijali koji će biti upotrebљeni prilikom konzervatorsko-restauratorskih radova. U 2007. i 2008. godini (treća faza) obnovljeno je sjeverni dio zapadne kolonade, pročelje palače Grisogono-Cipci s ostacima antičkog luka uz glavnu antičku ulicu decumanus u prizemlju. U četvrtoj fazi (od kraja 2008. do sredine 2010. godine) obnovljen je južni dio istočne kolonade Peristila. Uspoređeno s njima započeti su i radovi na crkvi sv. Roka na sjevernom dijelu Peristila, u kojoj je smješten Turistički ured. Tada su sondirani slojevi žbuke, rekonstruirani su nedostajući dijelovi kamene profilacije u unutrašnjosti, očišćeni su pročelje i preslica te rekonstruirani dijelovi južnog bočnog zida u koji su uklopljeni dijelovi arhitrava kolonade trijema decumanusa te sjeverni pilon završnog luka istočne kolonade Peristila. Istovremeno su izvršeni geomehanički i arheološki radovi da bi se utvrdilo stanje temelja, a podignuta je i radna skela na sjevernom dijelu istočne kolonade zbog potrebe za provjerom stanja sanirane arhitekture i korištenih materijala pet godina nakon početka konzervatorsko-restauratorskih zahvata. Potkraj 2009. godine počela je nova faza radova na obnovi pročelja Protirona s renesansnim kapelicama, prolazom u Vestibul te ulaznim portalom Vestibula. Zbog kompleksnosti i velike površine radovi na ovoj fazi su trajali dvije godine. U istoj fazi dovršeni su i svi radovi na pročelju crkvice sv. Roka. Pri kraju ove faze radova na Protironu uzet je otisk egipatske sfinge u silikonskoj gumi, te je izradena njena replika u umjetnom kamenu (Acrystral).

Prije izvođenja zahvata načinjene su probe svih odabralih materi-

was made and methods and materials to be used for conservation-restoration were selected. During the years of 2007 and 2008 (third phase), rehabilitation was conducted on the north section of the west colonnade and the façade of the Grisogono-Cipci Palace with the remains of the ancient arch adjoining the ancient decumanus street on the ground floor. During the fourth phase (from late 2008 to mid-2010) south section of the east colonnade of the Peristyle was repaired. Simultaneously, work on the Church of St. Roch located on the north section of Peristyle, housing a tourist office, was initiated. Layers of mortar were probed, missing parts of the interior stone profilation reconstructed, façade and bell-gable were cleaned and sections of the south side wall with inbuilt parts of the lintel of the decumanus porch colonnade were reconstructed, as well as the north pillar of the final arch of the east Peristyle colonnade. At the same time, geomechanic and archaeological works were conducted to inspect the state of the foundations. Scaffolding was set up on the north section of the east colonnade to enable the inspection of the restored architecture and materials used five years after the conservation-restoration works had been initiated. In late 2009, a new phase of the Peristyle works was initiated with the rehabilitation of Prothyron with its Renaissance chapels, passage and the entrance to Vestibule. Due to complexity and large area these works lasted for two years. During the same phase, all the works on the façade of the Church of St. Roch were finalized. In the final stage of this phase, the sphinx was casted in silicone rubber and its replica was made in artificial stone (Acrystral).

jala i metoda. Cijeli Peristil je arhitektonski snimljen 3D laserskom tehnologijom, a snimke su obrađene u AutoCAD računalnom programu. Ove su snimke poslužile kao osnova za grafičku dokumentaciju raznih vrsta oštećenja i njihovih točnih pozicija. Na temelju te dokumentacije planirani su i izvedeni svi konzervatorski i restauratorski zahvati.

ČIŠĆENJE BIOLOŠKOG OBRAŠTAJA

Jedan dio tamnih površina nije nastao taloženjem kao što je to kod tamnih skrama nego je produkt djelovanja mikroorganizama kao što su alge i lišajevi. To su organizmi koji svojim metaboličkim djelovanjem štetno djeluju na površinu kamenja, stoga ih je bilo potrebno potpuno ukloniti 7%-tnom otopinom "Asepsola" koja je bila tijekom nekoliko dana više puta nanošena i na kraju isprana parnim čistačem. U sljubnicama između kamenih blokova plodno tlo su pronašle i više biljke, koje svojim korijenjem fizički razaraju kamen. Ove biljke su bile tretirane otopinom "Cidokora", te nakon sušenja potpuno uklonjene.

LASERSKO ČIŠĆENJE

Od svih konzervatorsko-restauratorskih radova na kamenu Peristila najupečatljivije je lasersko čišćenje, koje je tu prvi put primijenjeno kao osnovna metoda čišćenja na cijeloj građevini. Crne kore su bile potpuno prekrile finu ornamentiku i originalne tragove alata, najviše u gornjem dijelu kolonada, osobito na razvedenim oblicima ornamentiranih dijelova – kapitela i vijenaca. Na nekim mjestima sloj tamnih skrama bio je deblij od jednog centimetra, pa je prije čišćenja laserom bio stanjen finim klesarskim i Zubarskim alatima. Na Peristilu su korišteni laseri Smart Clean II (talijanske tvrtke EL.EN. SpA), laser Michelangelo (talijanske tvrtke Quanta System) i Phoenix Sparta (engleske tvrtke Lynton Lasers). Lasersko čišćenje kame na je zahtjevno i dugotrajno, ali pruža mnoge prednosti u odnosu na druge tehnike čišćenja: veliku preciznost, minimalnu invazivnost, visok stupanj kontrole i selektivnost. Tom tehnologijom skidaju se štetne sulfatne kore, pritom ne oštećujući sloj oksalata, čiji žučkasto-smeđasti ton pokazuje da je sačuvana patina kamena koja je sastavni njegov dio i predstavlja prirodnu zaštitu površine kamena. Nakon čišćenja laserom Peristil se prikazuje u sasvim novom svjetlu: arhitektura je ponovo čitljiva, otkrivajući ljepotu i raskoš klesarskog rukopisa, kao i tragove alata na ornamentici i ravnim plohama.

NEJEDNOLIKOSTI, NEDOVРŠENOSTI I TRAGOVI ALATA

Uklanjanje mikrobiološkog obraštaja i lasersko čišćenje tamnih skrama otvorilo nam je pogled u prošlost kojom smo mogli iz ne posredne blizine otkriti umijeće i ljepotu klesanja antičkih majstora. Pored ovoga dobili smo uvid i u brzinu kojom je palača morala biti izgrađena o čemu nam svjedoče mnoge nedovršenosti i neu jednachenosti. Ovo je posebno prisutno na dekorativnim elementima koji su na nekim mjestima izrađeni samo u grubim crtama, dok na drugima potpuno izostaju. Nedostatak ornamentike je posebno izra-

Before the work was conducted all the materials and methods were tested. The whole complex of Peristyle was scanned with 3D laser technology and scans processed with AutoCAD programme. These scans were used as a base for the graphic documentation of various types of damages and their exact locations. Based on this documentation, all conservation and restoration works were planned and conducted.

CLEANING OF BIOLOGICAL GROWTH

Some dark areas were not created through depositing such as dark sediments, but are the product of microorganism (algae and lichen) activity. Metabolism of these organisms damages the stone surface so it was necessary to eliminate them with a 7% solution of "Asepsol" that has been applied to the surface several times in the period of a couple of days and eventually cleaned with a steam cleaner. Plants have also found their habitat in joints between the stones, physically ruining the stone with their roots. These plants were treated with the "Cidokor" solution and, when dry, completely removed.

LASER CLEANING

Of all the conservation-restoration work conducted on the stone of Peristyle, laser cleaning stands out the most. For the first time it was used as a primary cleaning method for the whole structure. Fine ornaments and traces of original tools were completely covered in black crusts, especially on the upper parts of the colonnades and ornamented parts of capitals and cornices. In some areas dark crusts were more than one centimetre thick, so they were treated with fine stone carving tools and dental instruments before laser cleaning. Lasers SmartClean II (produced by the Italian company EL.EN.SpA) and Phoenix Sparta (English company Lynton Lasers) were used. Laser cleaning is demanding and long but, compared to other cleaning techniques, has many advantages: high precision, minimum invasiveness, high level of control and selectiveness. Harmful sulphate crusts are removed without damaging the oxalate layer whose yellowish-brown tone indicates that the patina that is a natural part of the stone and serves for its protection, has been preserved. When the laser cleaning has been finalized, the Peristyle is perceived in a completely new light: the complete architecture is visible again with all the beauty and grandeur of the stonemasonry and traces of tools on ornaments and flat surfaces.

VARIETY, INCOMPLETENESS AND TRACES OF TOOLS

Removal of microbiological growth and laser cleaning of the dark sediments have opened a new insight into the history through which we could perceive the skill and beauty of stonemasonry of the ancient masters. In addition, we were given the information of the speed needed for building the Palace in such a short period. All the incompleteness and varieties testify to that. This is particularly present in some decorative elements that have been roughly treated in some sections and completely omitted in other.



DETALJ SA VIJENCA ZABATA PROTIRONA, GLAVA SA BRADOM I ROGOVIMA

DETAIL FROM THE GABLE CORNICE OF THE PROTHYRON - HEAD WITH BEARD AND HORNS

žen na mjestima do kojih ljudski pogled teško dopire. Na Peristilu su zabilježeni nejednaki promjeri i visine stupova, razlike u razmacima između njih, u visinama kapitela i obliku zubaca na vijencima. Profili baza stupova su obrađeni samo s prednje strane, prema trgu, dok su sa stražnje samo grubo oblikovani. Akanthusovi listovi na korintskim kapitelima različiti su oblika, a i sami kapiteli se razlikuju po visini, obujmu i dovršenosti klesanja. S obzirom na tragove alata možemo sa sigurnošću reći da su velike ravne površine kamenih blokova i tijela stupova obrađeni finom martelinom (zubačom), dok je zbog teže pristupačnosti u kutovima korištena gradina (nazubljeni dlijeto). Na gornjoj plohi vijenca vidljivi su tragovi piketa i špice.

DESALINIZACIJA I KONSOLIDACIJA

Dijagnostička ispitivanja kamena pokazala su izuzetno visoku koncentraciju štetnih topljivih soli u kamenu. U pojedinim zona ma koncentracija soli bila je i do deset puta veća od dopuštene. Uzimajući u obzir izrazito destruktivan utjecaj vodotopljivih soli po strukturu kamena, odlučeno je da se odsoljavanju podvrgnu sva područja gdje je dokazana njihova štetna koncentracija, svi dijelovi

Lack of ornaments is especially accentuated in places hidden from view. Uneven diameters and column heights have also been noticed in Peristyle, as well as different intercolumniations, heights of the capitals and shapes of dentils on cornices. Profiles of the column bases were treated only on the front side facing the square, while the backs were only roughly treated. Acanthus leaves of the Corinthian capitals vary in shape and capitals themselves differ in height, volume and completeness. Considering the tool traces we can affirm that large flat areas of stone blocks were treated with fine martelines and corners were treated with tooth chisel because they were hard to reach. The upper surface of the cornice shows traces of pick and point.

DESALINATION AND CONSOLIDATION

Diagnostic surveys of stone have shown high concentration of harmful soluble salts. In several areas, salt concentration was up to ten times higher than allowed. Considering the exceptionally harmful effect of water soluble salts on the structure of stone, it has been decided to desalinate all the areas where their harmful



UČVRŠČIVANJE NAPUKLIH DIJELOVA KAPITELA I LUKA SA PROTIRONA

CONSOLIDATION OF CRACKED PARTS OF THE CAPITAL AND ARCH OF THE PROTHYRON



kamene plastike koji su se osipali i ljskali, kao i područja koja su bila prekrivena naslagama crne kore. Premda je tretman desalinizacije u teoriji logičan i jednostavan, u praksi se pokazao kao jedan od najzahtjevnijih konzervatorsko-restauratorskih zahvata na Peristilu. Za uspješno odvijanje kemijske reakcije prilikom nanošenja celulozne kaše s otopinom amonij-karbonata i barij-hidroksida, bilo je potrebno poštivati točno određene vremenske i temperaturne parametre te omogućiti gotovo laboratorijske uvjete. Ovakav zadatak, ako uzmemu u obzir veličinu građevine i uvjete rada na terenu, organizacijski i fizički je bio vrlo zahtjevan. Pozitivan učinak desalinizacije po strukturu kamena je višestruk: zaustavlja štetne mehanizme topljivih soli, ali ujedno djeluje kao učvršćivač (konsolidant) kamene površine.

Tijekom pete faze konzervatorsko-restauratorskih radova na Peristilu za odsoljavanje i zaštitu kamena koristio se amonij-oksalat. Prirodoslovni laboratorij Hrvatskog restauratorskog zavoda proveo je dijagnostička ispitivanja *in situ* i u laboratoriju, pri čemu je osmišljen najucinkovitiji i ekonomski najisplativiji način apliciranja amonij-oksalata, što je uvelike ubrzalo i pospješilo zaštitu kamena. Dobiveni rezultati, znanstveno potvrđeni dijagnostičkim ispitivanjima, predstavljaju ogledni primjer koji se može koristiti u drugim projektima na polju konzervacije i restauracije kamena.

SANACIJA KAMENIH ELEMENATA

Kameni elementi Peristila su pretrpjeli razna oštećenja. Neka od njih su uzrokvana slijeganjem tla, što pokazuju izvršena geomehanička ispitivanja, a neka pomicanjem konstrukcije uslijed potresa, ljud-

concentration had been proved, all the parts of stone sculpture that had started to flake and powder, as well as the areas covered in black crusts. Although desalination treatment is logical and simple in theory, in practice it has developed into one of the most demanding conservation-restoration treatments at Peristyle. For successful chemical reaction while applying cellulose paste with ammonium carbonate and barium hydroxide solution, exact weather and temperature parameters had to be respected and conditions similar to the ones in a laboratory had to be achieved. If we consider the size of the structure and present conditions, this task has proven to be extremely difficult and physically demanding. Desalination effects stone in many positive ways: it stops harmful mechanisms of soluble salts, but also acts as a consolidant of the stone surface.

During the fifth phase of conservation-restoration works at Prothyron, ammonium-oxalate was used for desalination and conservation of stone. Natural science laboratory of the Croatian Conservation Institute has conducted diagnostic surveys *in situ* and at the laboratory and designed the most effective and economic mode of ammonium-oxalate application on stone. Scientifically confirmed by diagnostic surveys in laboratory and field-proven results have greatly accelerated and improved stone conservation, and have become a reference point for similar stone conservation and restoration projects.

REPAIR OF STONE ELEMENTS

Stone elements of Peristyle have suffered various damages. Some

skih intervencija i djelovanjem horizontalnih sila koje generira sarma konstrukcija. Ovi pomaci su najuočljiviji na Protironu gdje su se dva središnja stupa razmakla svaki u svoju stranu pod teretom zabata i razmicanja oslonaca središnjeg luka. Ovo je dovelo do koncentracije naponu i lomljenja kamena na mnogim dodirnim točkama, najčešće na spojevima kapitelâ sa stupovima i lukovima. Najupečatljiviji primjer je središnji desni kapitel Protirona kojem je velik dio kamennog materijala nedostajao. Kako je ova deformacija bila u aktivnoj fazi, kapitelu je prijetilo daljnje pucanje, pa su sljubnice injektirane ekspanzivnim mortom, kako bi se sile tlaka rasporedile po cijeloj površini dodirnih ploha. Napukla mjesa su sidrena karbonskim šipkama i epoksidnim ljepljilima te opšivena umjetnim kamenom.

Drugi česti uzročnik pucanja kamenih elemenata je korozija željeznih trnova koji bi uslijed dodira s vlagom eksplandirali i izbijali dijelove kamena. Dramatičan primjer takvog oštećenja je željezni trn na najjužnijem kapitelu istočne kolonade čija je hrđa eksplazijom izbacila dio kamene građe kapitela i bloka u podnožju lukova. U tom je slučaju trn bio dostupan pa je mogao biti zamijenjen trnom od nehrđajućeg čelika. U slučajevima gdje to nije bilo moguće, u sve spojeve gdje su pronađeni željezni klinovi ubrizgana je otopina usporivača (inhibitora) korozije.

REKONSTRUKCIJE KAMENA

Neka oštećenja kamena Peristila su tijekom povijesti bila sanirana, najčešće neadekvatno, dok na većem dijelu nije bilo nikakvih intervencija. Najveća takva oštećenja su evidentirana na vijencima istočne i zapadne kolonade. Prije sanacije ili rekonstrukcije oštećenih

of them were caused by ground settling shown by the geomechanic surveys, and some by shifts in construction created by earthquakes, human interventions and horizontal thrusts generated by the construction itself. These shifts were most obvious in Prothyron where the two central columns have tilted in opposite directions under the weight of the pediment and because of the movement in the support of the central arch. This has lead to the concentration of thread and stone braking in many point of contact, especially on connections between capitals and columns and arches. The most distinct example is the central right capital of Prothyron with a large part of the stone material missing. Further demolition was threatening the capital, so joints were injected with expansive mortar so that the threat would be distributed evenly on whole surface of adjoining planes. Cracks were anchored with carbon bars and epoxy glues and further treated with artificial stone.

The second cause of cracks in stone is the corrosion of iron clasps that would expand because of humidity and cut some parts of the stone. The most dramatic example of such damage is the iron clasp in the southernmost capital of the east colonnade whose rust had through expansion broke one part of the capital and block beneath the arches. In this case, the clasp could be reached so it was replaced by a stainless steel one. In cases where this was not possible all the connections with iron clasps were injected with solution of corrosion inhibitor.

RECONSTRUCTIONS OF STONE

Some of the damages of stone in Peristyle have been treated



UGRADNJA I OBRADA KAMENOG BLOKA NA VIJENCU ISTOČNE KOLONADE
MOUNTING AND FINISHING OF STONE BLOCK ON THE EASTERN COLONNADE



OBRADA I RETUŠ NA REKONSTRUIRANOM DIJELU GRANITNOG STUPA
FINAL RETOUCHING OF THE RECONSTRUCTED PART OF A GRANITE COLUMN



mjesta, nametnula se potreba za zaustavljanjem, odnosno usporavanjem novih oštećenja učvršćivanjem same konstrukcije. Stoga je izvršeno injektiranje zidane strukture Peristila, kako bi se prazni prostor među blokovima ispunio i učvrstio. Za injektiranje je korištena smjesa na bazi vapna, komercijalnog naziva "Microlime gel", koja nakon sušenja razvija mehaničku otpornost i modul elastičnosti kompatibilan s odgovarajućim karakteristikama zidane strukture. Osim injektiranja, konstrukcija je učvršćena postavljanjem klamfi od nehrdajućeg čelika umjesto željeznih na vrhu istočne kolonade, kao i na Protironu na mjestima gdje su nedostajale.

Rekonstrukcije kamena su izvedene smjesom umjetnog kamena i kamenim tašelima. Izbor metode ovisio je o stanju kamenja, njegovoj veličini te konstruktivnoj ulozi. Najznačajnije rekonstrukcije u kamenu izvedene su na sredini istočne kolonade s njezine vanjske strane, gdje je nedostajao velik komad kamena iz vijenca, kao i na unutrašnjoj strani zapadne kolonade, iznad ulaza u kavunu "Lvxor", gdje je također nedostajao dio vijenca, ali je rupa bila ispunjena opekom. U oba slučaja kameni tašel je grubo oblikovan u restauratorskoj radionici dok je fina obrada izvedena *in situ*. Slična je situacija bila sa vijencem iznad nadvratnika istočne kapelice u Protironu. Njegova profilacija je bila gotovo u potpunosti uništena, dok je dio koji je bio ugrađen u zid kapelice sasvim raspucao. Ovaj je vijenac,

throughout history, mostly inadequately, while most of them have not been treated at all. The largest damages of that kind have been documented on the cornices of the east and west colonnade.

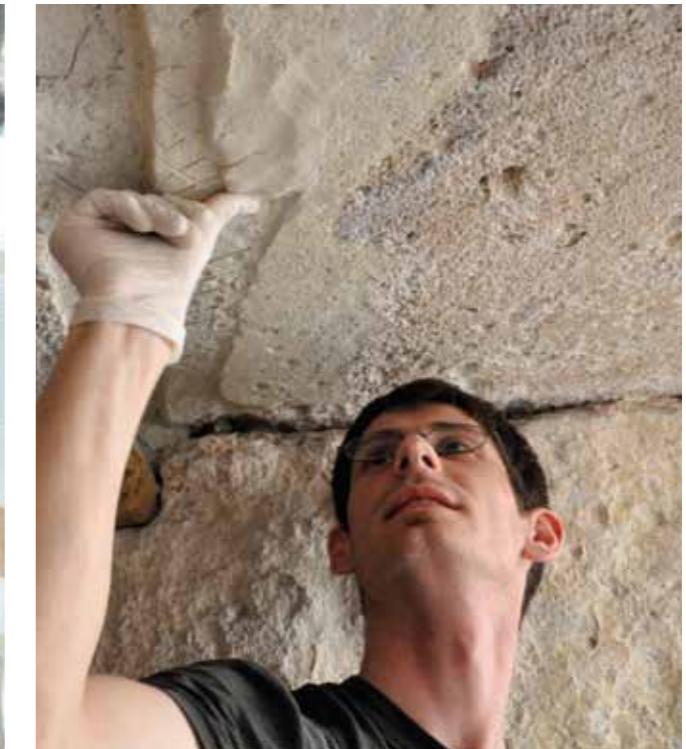
Before the treatment and reconstruction of damaged areas, there was a need to stop or slow down further damages by reinforcement of construction. For that purpose, built structure of Peristyle has been injected, so that the empty space between the blocks would be filled and reinforced. Lime-based mixture was used, commercially known as "Microlime gel" that, when dry, develops the capacity of mechanical resistance and module of elasticity compatible to built structure. In addition, construction was reinforced by the replacement of iron buckles with the ones made of stainless steel- on top of the east colonnade, in Prothyron and other places where they were missing.

Stone reconstructions were made of a combination of artificial stone and stone patches. Selection of method depended on the condition of stone, its size and constructional role. The most important reconstructions were made on the outer part of the central section of the east colonnade where a large piece of stone was missing on the cornice, as well as on the interior side of the west colonnade above the entrance to the "Luxor" café. There, a piece

koji se sastoji od dva bloka, potpuno uklonjen iz zida i zamijenjen novim profiliranim blokovima. Profilacija je bila izrađena po analogiji s vijencem na zapadnoj kapelici.

ZAVRŠNI RADOVI

Na završetku konzervatorsko-restauratorskih radova, površine svih kamenih elemenata su premazane zaštitnim slojem etil-silikata uz dodatak Paraloida B-72 koji stvara tanki film na površini kamena. Ovaj zaštitni sloj sprječava prodror vode i štetnihtopljivih soli u strukturu kamena. Radi sprječavanja onečišćenja pticnjim izmetom, na sve gornje horizontalne plohe postavljena je igličasta zaštita od golubova, dok je iza stupova Protirona u punoj visini i širini postavljena neupadljiva zaštitna mreža. Sve gornje plohe Protirona i obju bočnih kolonada zaštićene su pokrovom od olovnih ploča s okapnicom. Na njih su postavljeni reflektori koji obasjavaju arhitekturu Peristila umjerenom svjetlom i trgu noću daju osobit ugodaj.



REKONSTRUKTIVNI ZAHVATI NA PORTALU VESTIBULA
RECONSTRUCTION OF MISSING PARTS ON THE VESTIBULE PORTAL

of cornice was missing as well, but the hole was filled with brick. In both cases, the stone patch was roughly treated in restoration workshop and finely treated *in situ*. Situation with cornice above the lintel of the east chapel in Prothyron was similar. Its profiling was almost completely ruined and a part built into the chapel wall completely cracked. This cornice consisting of two blocks was completely removed and replaced with new blocks. Profiling was made after the one from the cornice of the west chapel.

FINAL WORKS

In the final stage of conservation-restoration works, all the surfaces of the stone elements were covered with a protective layer of ethyl-silicate with the addition of Paraloid B-72 that creates a fine film on the surface of the stone surface. This protective layer protects from water and harmful soluble salts entering the stone structure. To prevent the damage of bird droppings, spikes as bird control system were installed on all the upper horizontal surfaces and an unobtrusive protective net was installed behind the columns of the Prothyron. All the upper surfaces of Prothyron and both side colonnades were protected by cover of lead plates. Lights were installed on them that provide Peristyle with moderate lighting and create a special atmosphere.



REZULTATI KONZERVATORSKO-RESTAURATORSKIH ZAHVATA

VINKA MARINKOVIĆ,
dipl. konzervator-restaurator

RESULTS OF CONSERVATION-RESTORATION INTERVENTIONS

VINKA MARINKOVIĆ,
conservator-restorer

Na završetku složenog i opsežnog posla koji je, zajedno s priprema, potrajan čitavo desetljeće, možemo sa zadovoljstvom utvrditi da su ciljevi koji su postavljeni na početku u potpunosti ispunjeni, te da je konačni rezultat čak i nadmašio očekivanja. Možemo ukratko nabrojati razloge zbog kojih projekt Peristil predstavlja jedan od najznačajnijih konzervatorsko-restauratorskih pothvata u novije vrijeme u Hrvatskoj, a njegova je kvaliteta prepoznata i u međunarodnim stručnim krugovima.

Zbog važnosti Peristila u domeni antičke arheologije, povijesti umjetnosti i arhitekture, te s obzirom na složnost konzervatorsko-restauratorskih problema, u projekt su uključeni brojni domaći i strani stručnjaci i institucije. Multidisciplinarnost, koja je sve važnija oznaka suvremene konzervatorske i restauratorske prakse, ovdje se pokazala kao bitna odlika bez koje se ne bi mogli ostvariti zacrtani ciljevi, pri čemu su doprinosi stručnjaka iz raznih područja dali projektu i znanstvenu težinu.

Kombinacijom građevinskih i restauratorskih postupaka usporeni su uznapredovali procesi deformacija konstrukcija i propadanja kamena i drugih materijala. Uklanjanje tamnih naslaga nečistoće povratilo je čitost arhitekture i dekorativnih elemenata. Spomeničke vrijednosti su unaprijeđene spoznajom novih činjenica vezanih uz izvorni materijal i povijest izgradnje.

U tom kontekstu vrijedno je spomenuti dekorativne motive koji su tek nakon čišćenja kamena po prvi put u cijelosti prepoznati i dokumentirani. Pet reljefnih lica u jugoistočnom uglu zabata Prothrona predstavljaju simbole Dioklecijanove vladavine: dva fantastična lika u obliju čovjeka-bika, mogući prikaz Jupitra Amona, te dva jako oštećena lika koja nije moguće identificirati, ali su zasigurno dio ikonografskog repertoara carske propagande. Lasersko čišćenje je omogućilo bolji uvid u detalje i plastičnost reljefa, a na vidjelo su izašli i tragovi izvornog klesarskog alata. Desalinizacija i konsolidacija su poboljšali karakteristike materijala i povećali otpornost na atmosferske utjecaje.

Osim unapređenja estetskih i spomeničkih vrijednosti, konzervatorsko-restauratorski zahvati su imali i širu urbanističku i socijalnu dimenziju. Projekt predstavlja značajan korak u redefiniranju vrijednosti stare gradske jezgre u cijelini i putokaz za revitalizaciju

At the close of complex and extensive work which, together with preparations, lasted an entire decade, we can state with satisfaction that the objectives formulated at the outset have been entirely achieved, and that the final result has even surpassed expectations. We can now briefly list the reasons that make the Peristyle Project one of the most important conservation-restoration undertakings in Croatia in the recent past, with praise for its quality expressed by professionals at the international level as well.

Due to the Peristyle's importance in the fields of classical archaeology, art history and architecture, and given the complexity of the relevant conservation-restoration problems, numerous Croatian and foreign experts and institutions were involved in the project. The multidisciplinary approach, which is becoming an increasingly important feature of contemporary conservation and restoration practices, has been shown here as an essential component without which the set objectives could not have been accomplished. The contributions of experts from different fields gave the project additional scientific weight.

The advanced processes of deterioration of the structure and decomposition of stone and other materials have been slowed through a combination of construction and restoration procedures. The removal of dark layers of impurities has restored the cleanliness of the architecture and decorative elements. The value of the monument has also been increased by the discovery of new facts concerning the original materials and construction history.

In this context, noteworthy are the decorative motifs which were fully recognized and documented only after cleaning. The five relief faces in the south-east corner of the Prothron's pediment represent the symbols of Diocletian's reign: two fantastic characters in the form of man-bulls, a possible portrayal of Jupiter Ammon, and two much damaged images which cannot be identified, but which were certainly a component of the iconographic repertoire of imperial propaganda. Laser cleaning facilitated greater insight into the details and plasticity of the relief images, and even some traces of the original stone-carving tools became visible. Desalination and consolidation improved characteristics of the material and increased its resistance to weathering. In addition to enhancing general aesthetic and monumental values, the conservation and restoration interventions also had a wider dimension relating to spatial planning



PERISTIL 2012, PRI KRAJU KONZERVATORSKO-RESTAURATORSKOG ZAHVATA

PERISTYLE 2012, NEAR THE END OF THE CONSERVATION-RESTORATION TREATMENT

njezinih zapuštenih dijelova. Peristil je, vjerujemo, postao ugodnije mjesto boravka za gradane i posjetitelje. Nije zanemariva ni edukativna komponenta: javnost je putem medija i dosadašnjih izložbi upoznata s problemima Peristila i stare gradske jezgre.

O konzervatorsko-restauratorskim zahvatima na Peristilu struka je dala svoju ocjenu – Nagradu Vicko Andrić za izvanredna postignu-

and their social impact. This project constitutes a significant step in redefining the value of the old urban core as a whole and serves as a signpost for revitalization of its neglected sections. We believe the Peristyle has become a more pleasant place to be for both city residents and visitors. The educational component is not negligible either: the public has learned about the problems of the Peristyle and the old city core through the media and exhibitions.

ća u području zaštite kulturne baštine u Hrvatskoj. Manje formalno, ali jednako vrijedno priznanje, dali su građani Splita koji su prihvatali obnovljeni Peristil, nastavljajući tradiciju okupljanja na trgu koji je oduvijek bio i ostao srce Palače i grada.

The profession also made its own assessment of the conservation-restoration work at the Peristyle by awarding it the Vicko Andrić Prize for extraordinary achievements in the field of cultural heritage protection in Croatia. A less formal but no less valuable recognition was bestowed to it by the citizens of Split, who welcomed the restored Peristyle by continuing the tradition of gathering at the square which has always been the heart of the Palace and the entire city.

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PERISTIL

PERISTYLE

2003-2013

**Izložba o konzervatorsko-restauratorskim radovima
na Peristilu Dioklecijanove palače u Splitu**

Exhibition of conservation-restoration works
at the Peristyle of Diocletian's Palace in Split

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1. Peristyle 2. Nikšić, Goran, arhitekt
I. Dioklecijanova palača (Split) --
Restauratorsko-konzervatorski radovi

150130057

**Izložba o konzervatorsko-restauratorskim
radovima na Peristilu Dioklecijanove palače u Splitu**
Exhibition of conservation-restoration
works at the Peristyle of Diocletian's Palace in Split

Stara gradska vijećnica
Old City Hall

Split
Svibanj / May
2013



HRVATSKI
RESTAURATORSKI
ZAVOD