

konzervatorsko-restauratorski radovi na pilu sv. trojstva u osijeku

CONSERVATION AND RESTORATION WORK ON THE HOLY TRINITY VOTIVE
MONUMENT (PIL) IN OSIJEK



povijesni aspekti

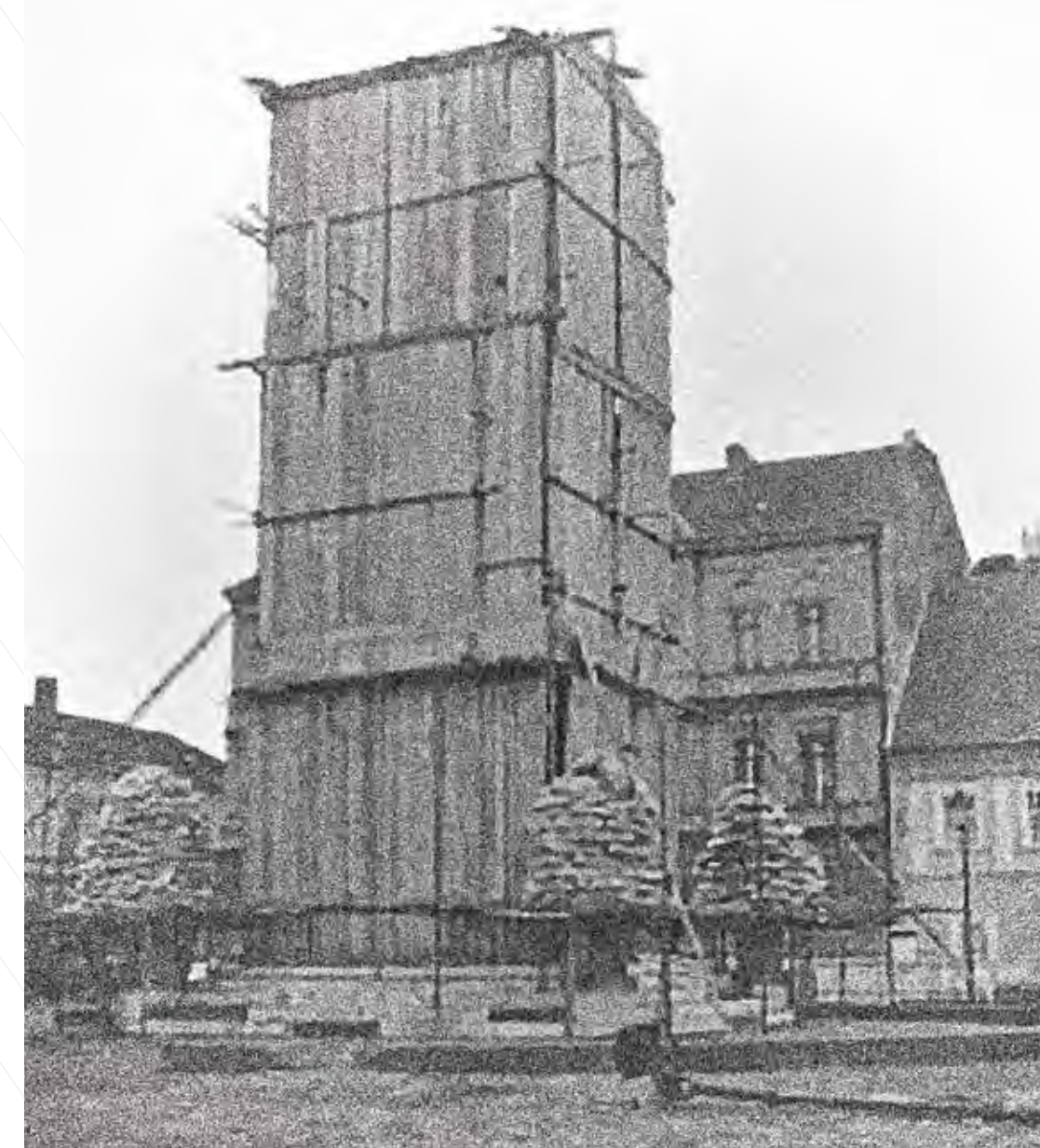
HISTORICAL BACKGROUND



Pil Svetoga Trojstva krajem 19. stoljeća
The Holy Trinity votive monument at the end of the 19th century

RIJEČ PIL POTJEČE od latinske riječi pila što znači stup. U kasnijim razdobljima izraz dobiva značenje zavjetnoga spomenika, odnosno javne skulpture podignute u čast sveca zaštitnika, obično kao znak zavjeta ili u spomen nekoga povijesnoga događaja. Požari, poplave ili epidemije bolesti izazivali su smrt velikoga broja stanovništva u kratkom vremenu pa je ono podižući zavjetne spomenike tražilo utjehu u vjeri te iskazivalo zahvalu svecima na prolasku pošasti istovremeno tražeći zaštitu u budućnosti. Tradicija podizanja kipova svetaca na javnom prostoru bila je prisutna još u srednjem vijeku, o čemu svjedoče stari

zapisi, ali najraniji su primjeri sačuvani iz vremena renesanse, 15. i 16. stoljeća. U razdoblju baroka dolazi do procvata javne skulpture pa se spomenici podižu kako u velikim gradskim središtima tako i u udaljenim ruralnim sredinama. Najčešće se smještaju na središnji prostor naselja, u gradovima na glavni trg ili na sjecište putova. Zavjetni su pilovi bili rasprostranjeni diljem Europe, od Njemačke do Italije, ali najveći broj je podignut u srednjoeuropskim zemljama, osobito Austriji i zemljama koje su bile pod njezinim kulturnim utjecajem, poput Češke i Mađarske. Gotovo da se može reći da je Austrija domovina pilova jer upravo ondje su podignuti najveći i najkvalitetniji primjeri takove skulpture uopće. Epidemije kuge u srednjoj Europi bile su snažan poticaj za podizanje zavjetnih pilova, i to osobito nakon izgradnje velikoga kužnoga pila na bečkom Grabenu kojega je dao podići car Leopold prema projektu znamenitoga arhitekta Johanna Bernharda Fischera von Erlacha. Radi čestih epidemija kuge u Slavoniji u 18. stoljeću, kužni pilovi podizani su i ondje u većim i manjim središtima. U zemljama srednjega Podunavlja zavjetni su pilovi za zaštitu od kuge bili često posvećeni Presvetom Trojstvu, zbog čega su se uz likove Boga Oca, Krista i Duha Svetoga, na njima nalazili i kipovi svetaca zaštitnika od kuge: sv. Roka, Sv. Karla Boromejskog, sv. Sebastijana i sv. Rozalije.

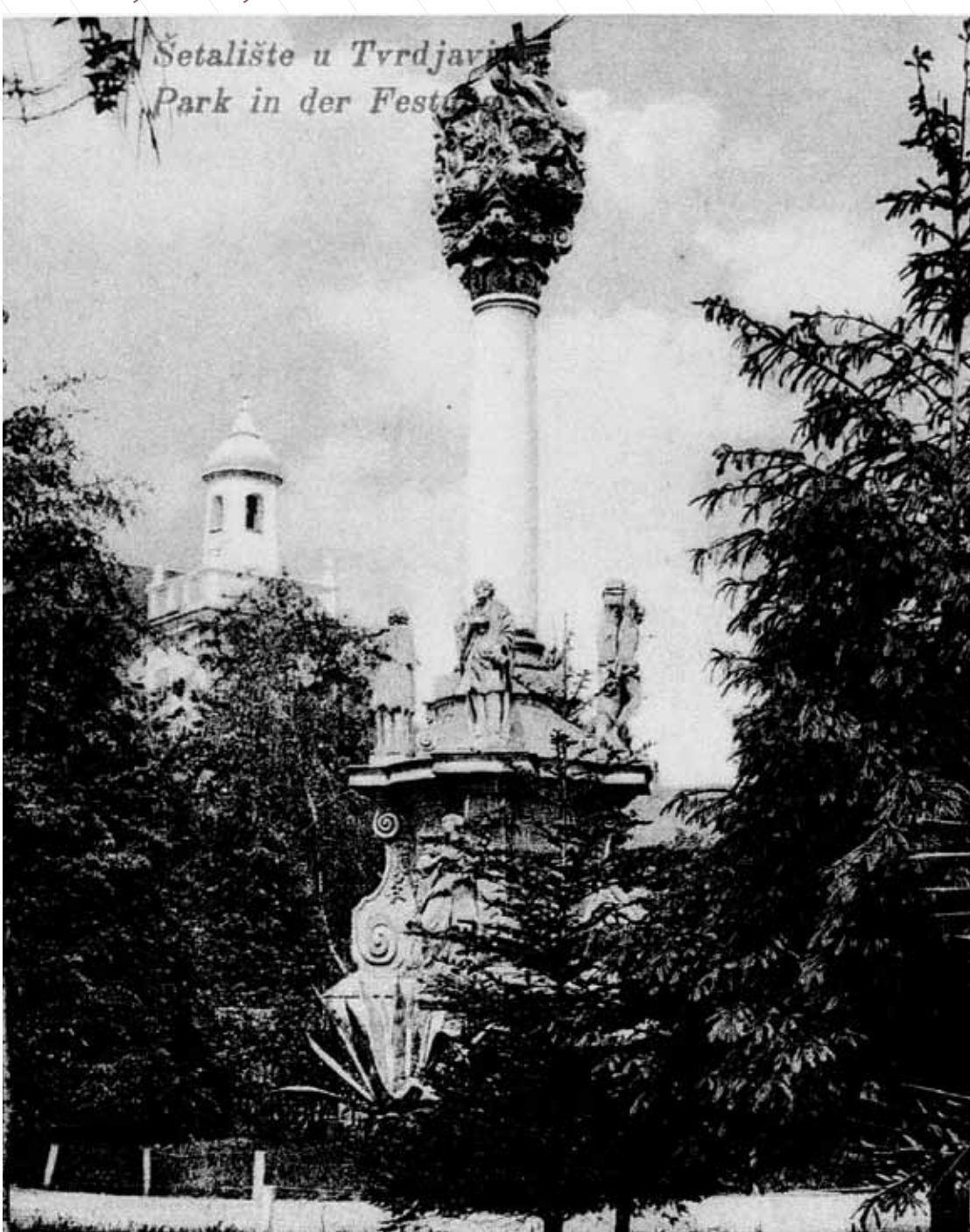


Daščana oplata i vreće s pijeskom za zaštitu pila tijekom Domovinskoga rata
Wooden panels and sand bags for the protection of the monument during the Homeland War

THE WORD PIL is derived from the Latin word pila, meaning a pillar. The term later assumed the meaning votive monument, or a public sculpture erected in honour of a patron saint, usually as a symbol of a pledge, or to commemorate a historical event. Fire, flood or an epidemic would decimate a large portion of the population within a short period of time, so by erecting votive monuments the community would seek solace in faith and express gratitude to saints for the ending of a plight, as well as seek future protection at the same time. Historic records confirm the existence of the tradition of the statues of saints being erected in public spaces as early as the middle ages, however, the earliest preserved

examples date from the renaissance period of the 15th and the 16th centuries. During the baroque period the art of the public sculpture flourished, with monuments erected in large cities, as well as remote rural areas. They were typically located in the central communal spaces, the main city square, or the road junction. Votive monuments could be found around Europe, from Germany to Italy, but the largest number was erected in the countries of Central Europe, particularly Austria, and the countries under Austrian cultural influence, such as the Czech Republic and Hungary. It can almost be said that Austria is the native land of the votive monument, as the largest and the best quality examples of this type of sculpture in general were erected there. The plague epidemic sweeping Central Europe largely prompted erection of votive monuments, particularly after the construction of the large monument in the Viennese Graben, commissioned by emperor Leopold, and designed by the famous architect Johann Bernhard Fisher von Erlach. Due to frequent outbreaks of plague in Slavonia in the 18th century, votive monuments were also erected there, both in larger and smaller communities. In the countries of the central Danube basin, the votive monuments which served to protect against the plague were often dedicated to the Holy Trinity, which is why, along with God the Father, Christ and the Holy Spirit, also found were statues of St. Roch, St. Charles Borromeo, St. Sebastian and St. Rosalia, the patron saints invoked against the plague.

Pil Svetoga Trojstva oko 1900. godine
The Holy Trinity votive monument around 1900



Pil Svetoga Trojstva 1998. godine
The Holy Trinity votive monument in 1998



arhitektura i ikonografija spomenika

THE ARCHITECTURE AND
THE ICONOGRAPHY OF
THE MONUMENTS



Skulptura sv. Karla Boromejskoga
The statue of St. Charles Borromeo



Skulptura Krista
The statue of Christ

Katarine, sv. Ivana Nepomuka i sv. Josipa koje su izvorno ukrašavale Valpovačka i Novogradska vrata Tvrđe.

THE HOLY TRINITY votive monument is considered one of the most representative monuments of architecture and sculpture of the baroque period in continental Croatia. It was erected in 1729, commissioned by Baroness Maria Ana Petraš, widow of the commander of the Osijek Fortress, general Petraš, as a votive monument, following the plague epidemic which devastated the city. Honouring the tradition of erecting votive monuments, it was located in the middle of the main city square of the Osijek Fortress. The square base of the monument comprises six steps with cut angles, on which a high stand with scrolls is mounted, rounded off with a moulded cornice in the



Polje s natpisom na postolju pila
Inscription on a high stand of the monument

upper section. Between the scrolls, on the four sides of the stand are inscriptions framed by ringlet shaped ornaments. On the projecting corners of the cornice of the stand, four standing statues of saints are mounted: St. Sebastian, St. Francis Xavier, St. Charles Borromeo, and St. Roch, and a statue of St. Rosalia reclined between St. Roch and St. Sebastian. All of the saints presented are invoked against the plague, a disease causing high mortality among the population of a city within a short period of time.

Among the statues of the saints, in the central part of the monument on a smaller stand, a monumental composite column is erected on top of which a rendition is given of the Holy Trinity on a cloud: stone statues of Christ and God the Father, and a rendition of the Holy Ghost shaped as a brass dove. Rendered in copper are the halos of God the Father and Christ, and a cross on the sphere held in the hand of God the Father. According to the archival records, it has been established that in 1784 additional four sculptures were added to this architectural and sculptural unit. Along the corners of the base stands were fitted with statues of the Mother of God, St. Catherine, St. John of Nepomuk, and St. Joseph, originally decorating the Valpovo and Novi Grad gates of the Fortress.

Skulptura Boga Oca
The statue of God the Father



ZAVJETNI PIL SVETOGA TROJSTVA ubraja se među najrepzentativnije arhitektonsko-skulpturalne spomenike baroknoga razdoblja u kontinentalnoj Hrvatskoj. Podignut je 1729. godine na poticaj barunice Marije Ane Petraš, udovice zapovjednika osječke tvrđave generala Petraša, kao zavjetni spomenik nakon epidemije kuge koja je poharala grad. U skladu s tradicijom podizanja zavjetnih pilova, smješten je u sredini glavnoga trga osječke Tvrđe. Kvadratno podnožje pila sastoji se od šest stuba zasječenih uglova na kojemu je visoko postolje s volutama koje u gornjem dijelu završava profiliranim vijencem. Između voluta su na četiri strane postolja smještena polja s natpisima uokvirenim vitičastim ornamentom. Na istaknute su uglove završnoga vijenca postolja postavljene četiri stojeće skulpture svetaca: sv. Sebastijan, sv. Franjo

Ksaverski, sv. Karlo Boromejski i sv. Rok te skulptura sv. Rozalije u ležećem položaju između sv. Roka i sv. Sebastijana. Svi su prikazani sveci zaštitnici od kuge, bolesti koja je znala u kratkome razdoblju usmrtniti i do polovice gradskoga stanovništva. Između svetačkih likova, u središnjem se dijelu spomenika na manjoj bazi u vis diže monumentalni kompozitni stup na vrhu kojega je prikaz svetoga Trojstva na oblaku: kameni kipovi Krista i Boga Oca te prikaz Duha Svetoga u obliku posrebrene golubice. Od bakra su i aureola Boga Oca i Krista te križ na kugli u ruci Boga Oca. Prema arhivskim spisima ustanovljeno je da su 1784. godine postojećoj arhitektonsko-skulpturalnoj cjelini dodane još četiri skulpture. Uz uglove podnožja su postavljeni postamenti sa skulpturama Bogorodice bezgrešnoga začeca (Immaculate), sv.

raniji restauratorski radovi

EARLIER
RESTORATION
WORKS



Impregnacija skulpture Krista, 1975. godina
Water-proofing of the statue of Christ in 1975

ZBOG DUGOGODIŠNJE IZLOŽENOSTI atmosferskim utjecajima na pilu su se tijekom vremena pojavila brojna oštećenja. Arhivski izvori i natpisi uklesani na postolju svjedoče o obnovama 1776., 1829. i 1867. godine. Prvi je opsežan konzervatorsko-restauratorski zahvat proveo Restauratorski zavod Hrvatske sedamdesetih godina 20. stoljeća. Kao podloga za radove izrađen je fotogrametrijski snimak, a Regionalni zavod za zaštitu spomenika kulture u Osijeku je utvrdio spomenička svojstva

na temelju čega je pil registriran na listu zaštićenih kulturnih dobara. Radovi na obnovi započeti 1975. godine izvedeni su u skladu s tadašnjom konzervatorsko-restauratorskom praksom minimalne intervencije prilikom restauriranja skulptura i arhitektonske plastike koja je izbjegavala opsežnije dopune oštećenja i nedostajućih dijelova. Provedeni su radovi u svrhu statičke sanacije spomenika u sklopu kojih su izmijenjeni oštećeni postamenti i baze četiri donje skulpture, postavljen je armirano-betonski sreklaz na temelj od opeke radi učvršćivanja podnožja, postavljene su nove stube isklesane od vapnenca te je učvršćena baza središnjega kompozitnoga stupa. Uslijedili su restauratorski radovi integracije odvojenih dijelova skulptura te klesanje i umetanje tašela (isklesanih novih komada kamena u pripremljena ležišta). Tašeliiranje je izvedeno samo na arhitektonskim dijelovima spomenika. Istovremeno su provedeni konzervatorski zahvati čišćenja, učvršćivanja i hidrofobiziranja svih kamenih površina. Mehanički su odstranjene naslage raznih nečistoća, nataloženoga humusa, algi, lišaja, mahovina i raslinja nakon čega su kamene površine oprane mlazom vode. Očišćeni su i grafiti. Figura golubice s vrha pila zamijenjena je kopijom od

pozlaćenoga armiranoga poliestera, a original je pohranjen u Muzej Slavonije. Izrađena je fotodokumentacija stanja prije, za vrijeme i nakon završetka radova te su detaljno iscrtani položaji, dimenzije i izgled novougrađenih dijelova. Glavnina navedenih radova provedena je tijekom 1976. godine. DUE TO LONG-TERM exposure to the elements, over time the monument had sustained extensive damage. Archival records and inscriptions carved in the stand bear testimony to the restorations of 1776, 1829, and 1867. The first comprehensive conservation-restoration undertaking was conducted by the Croatian Restoration Institute during the 1970s. As the basis for the works, photogrammetric records were made, and the Regional Institute of Heritage Preservation in Osijek established the features of a monument required to enter the monument on the list of protected cultural heritage. The restoration work, started in 1975, was carried out in accordance with the conservation-restoration practice at the time, using minimum intervention during the restoration of the sculptures and architectural elements, which included refraining from a more extensive replacement of the damaged or missing parts. Works on the static repair of the monuments were carried out, during which damaged

stands and the bases of the four lower sculptures were replaced; reinforced concrete ring beam was added to the brick foundation to reinforce the base; new limestone steps were put in, and the basis of the central composite column was reinforced. Restoration work followed, including merging of the separate parts of the sculptures, and carving and insertion of new pieces of stone into previously constructed grooves. Insertion of new stone pieces was only carried out on the architectural sections of the monument. Symultaneously, conservation procedures were carried out including cleaning, reinforcement and hydrophobization of all stone surfaces. Layers of dirt were removed mechanically, deposited soil, algae, lichen, moss and growth, after which the stone surfaces were hosed down with water. Graffiti were also removed. The statue of a dove from the top of the column was replaced with a copy made of reinforced polyester, coated in gold-leaf, and the original was deposited in the Museum of Slavonia. Photographic documentation was made of the condition before, during and after completion of the works, with detailed sketches of the positions, dimensions and images of the newly fitted sections. The bulk of the work was carried out during 1976.

Podizanje skulpture Bogorodice, 1975. godina
Mounting of the statue of Mother of God in 1975



zatečeno stanje i evidencija oštećenja

CONDITION
 FOUND AND
 DAMAGE
 RECORDED



Oštećenja kamena na glavama skulptura: anđela, Boga Oca, Krista i sv. Josipa
 Damages of stone on the heads of an angel, God the Father, Christ and St. Joseph

NA POTICAJ MINISTARSTVA KULTURE 2000. godine su ponovno započeti konzervatorsko-restauratorski radovi na pilu Sv. Trojstva. Ustanovljeno je da je čitav spomenik u vrlo lošem stanju te da je potrebno provesti detaljna istraživanja kako bi se locirala i opisala sva dubinska i površinska oštećenja kamena u svrhu cjelovite obnove. Nedugo nakon toga demontirane su četiri donje ugaone skulpture koje su bile u tako lošem stanju da je zaključeno da će ih se zamijeniti kopijama, a originale pohraniti u muzej. Nakon fotografskih snimanja i pregleda pristupilo se izradi arhitektonske dokumentacije, odnosno podloga za unos podataka o oštećenjima. Provedene su laboratorijske analize uzoraka uzetih sa površine kamena, ultrazvučne analize, termografski snimci, ispitivanja vodupojnosti te istraživanja detektorom metala. Izrađeni su detaljni grafički prikazi sa sistematizacijom oštećenja po vrstama.

Ustanovljeno je da su brojni dijelovi spomenika mehanički oštećeni, pogotovo lateralne skulpture izrađene od lošijeg kamena nego ostali dijelovi pila. Neka su mehanička oštećenja nastala kao posljedica granatiranja tijekom Domovinskoga rata, odnosno dijelova projektila koji su oštetili arhitektonsku plastiku, a neka su posljedica vandalskih napada. Nedugo prije početka cjelovite obnove skulptura sv. Katarine je srušena sa svojega postolja prilikom čega je teško oštećena. Osim oštećenja uzrokovanih ljudskim faktorom, mehanička su oštećenja nastala i kao posljedica atmosferskih utjecaja. Oborinska je vlaga na istaknutim dijelovima spomenika uzrokovala eroziju kamene površine, odnosno osipanje i ljuskanje kamena zbog kojega su kamene figure svetaca izgubile plastiku lica, kose i dijelova draperije. Za razliku od istaknutih dijelova spomenika, na dijelovima zaklonjenim od direktnoga utjecaja

oborinske vlage na površinama kamena se stvorio debeli sloj tamne inkrustacije, tzv. skrame. Evidentiran je i velik broj ranijih intervencija krpanja i lijepljenja različitim vrstama veziva, kao što je glava Bogorodice Immaculate neadekvatnom cementnom žbukom pričvršćena na tijelo. U donjim je dostupnim dijelovima pila evidentiran velik broj grafita.

IN 2000, UPON the initiative of the Ministry of Culture, conservation-restoration work on the Holy Trinity votive monument resumed. It was established that the entire monument was in a very bad condition and that a detailed inspection was necessary to locate and describe all the deep structure and surface damage to the stone, for the purpose of a comprehensive renovation project. Soon, the four lower corner sculptures were removed. Due to their extremely bad condition, it was decided that they would be replaced with copies, and the originals deposited in the museum.

After photographing and examination, creation of the architectural documentation started, serving also as a form for entering data on damage. Laboratory analyses were carried out of the samples taken from the stone surface, as well as sonographic analyses, thermal imaging, water absorption tests and metal detector tests. Detailed graphic images were produced with classification of the types of damage detected. It was established that numerous parts of the monument had sustained mechanical damage, particularly the lateral sculptures made of lower quality stone than the rest of the monument. Some of the mechanical

Korodirane željezne klanfe na kapitelu
 Corroded metal pins on the capitel



Oštećenja kamenih dijelova na vrhu spomenika
 Damages of stone at the top of the monument

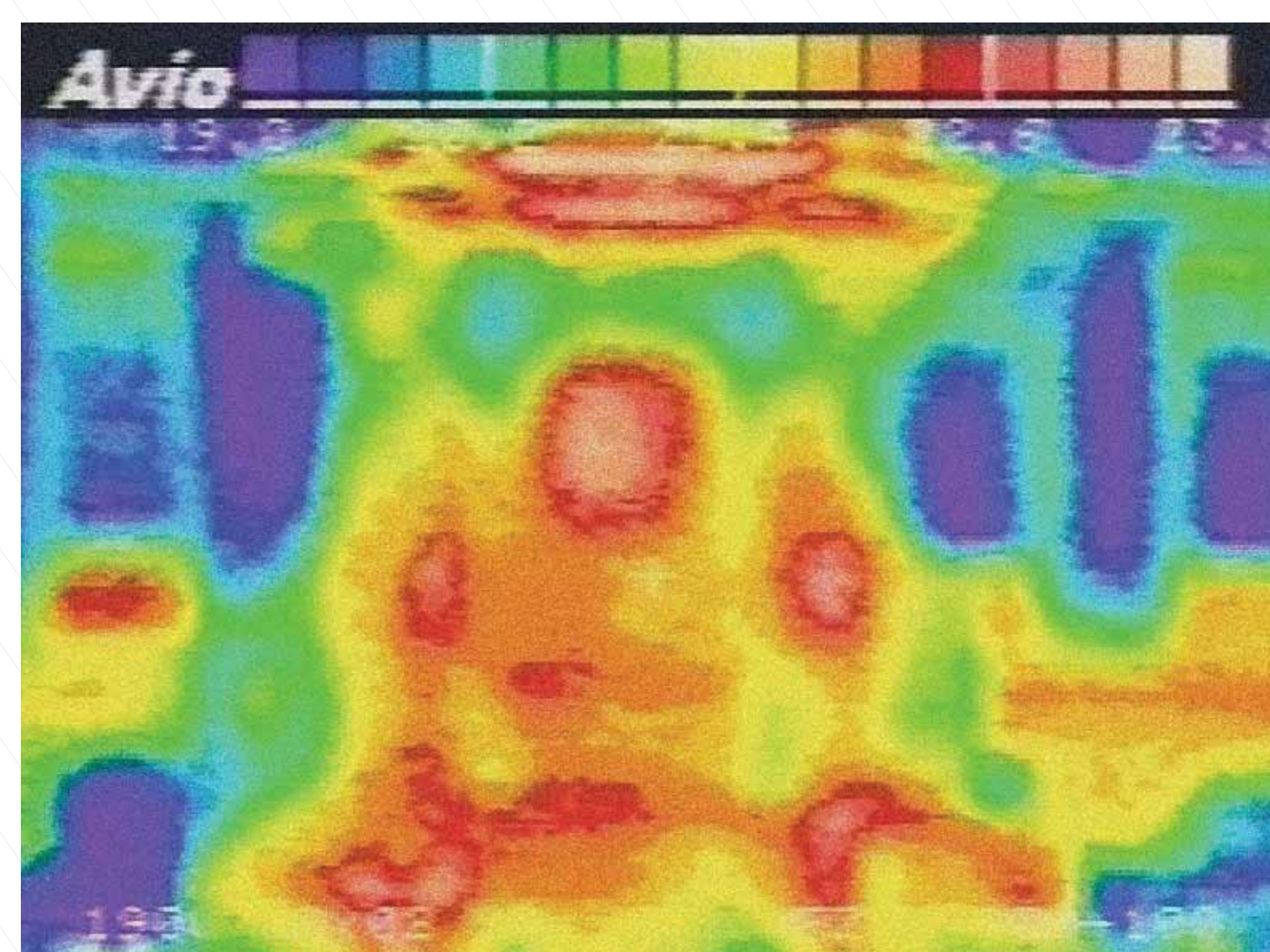
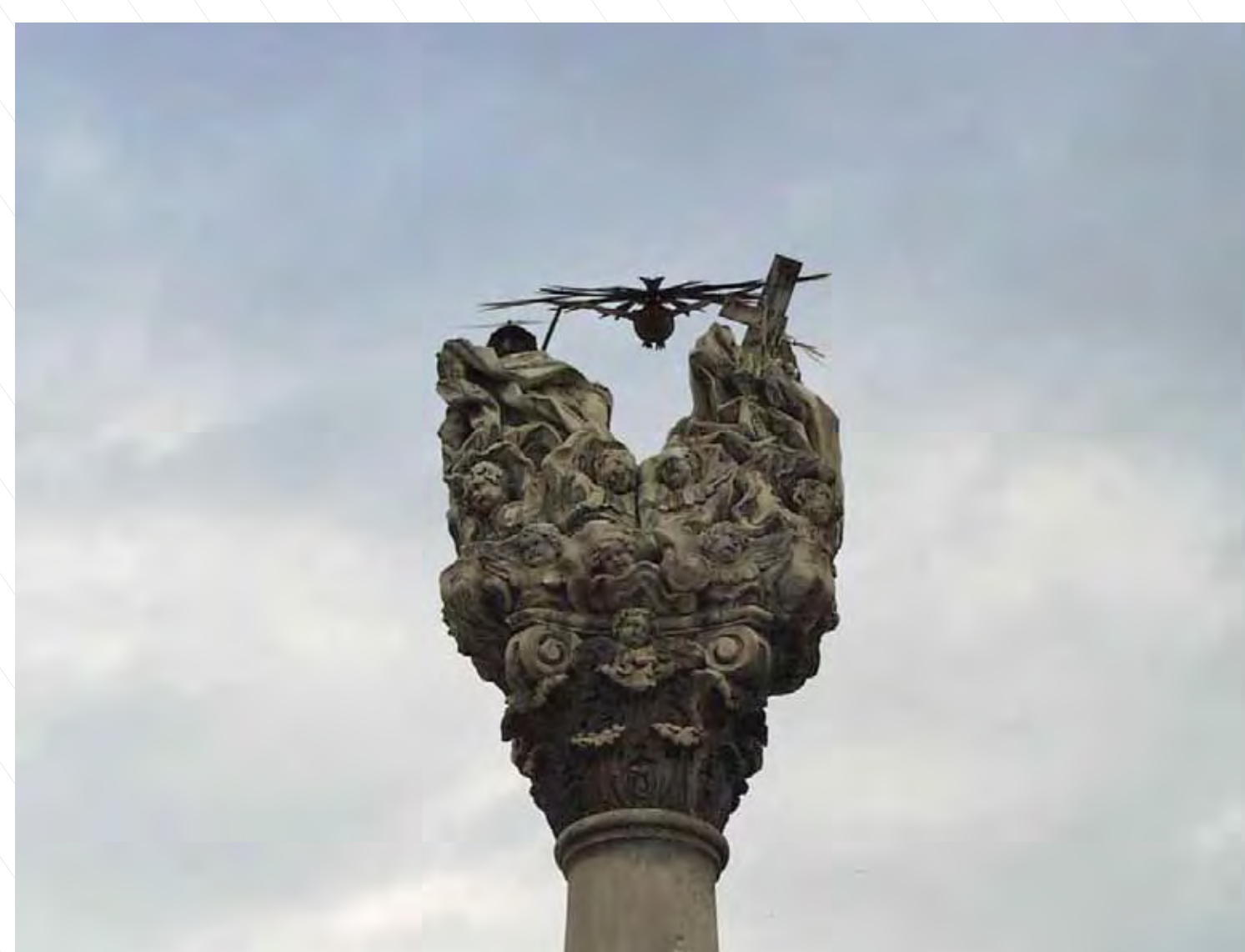
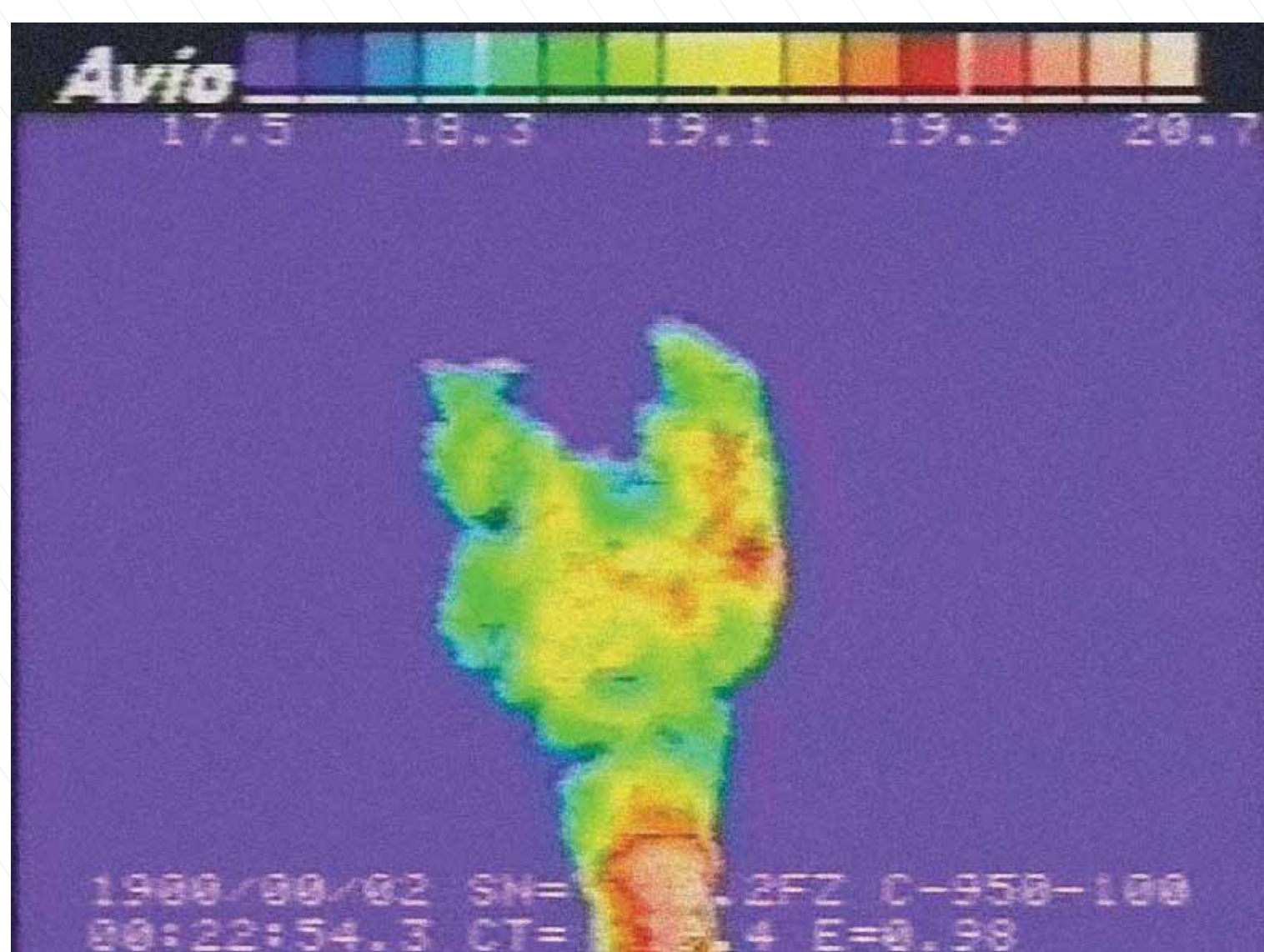
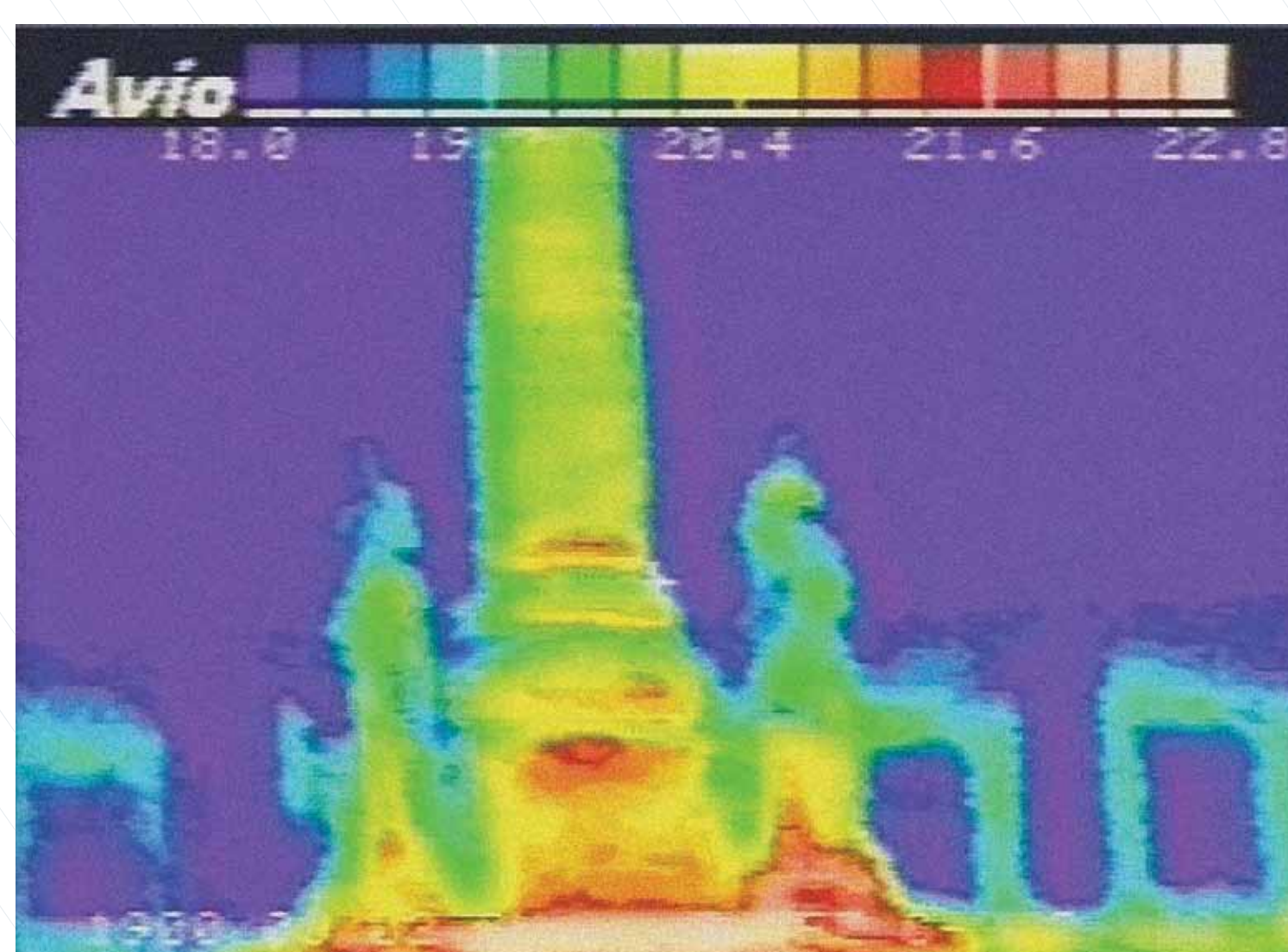
damage occurred as a result of the shelling during the Homeland War, or was caused by fragments of the missiles which had damaged the architectural elements. Some of the damage was caused by vandalism. Not long before the start of extensive renovation, the statue of St. Catherine was toppled from its base, after which it was transported to a workshop in pieces. Apart from the damage caused by the human factor, the mechanical damage was also caused by the elements. Precipitation had caused erosion of the stone surface on the projecting sections of the monument, dusting and scaling of the stone, which was the reason why the stone statues of the saints had lost the contours of the face, the hair, or parts of the drapery.

Unlike the projecting sections of the monument, on the sections shielded from direct impact of precipitation, a thick layer of dark incrustation (crust) was formed on the stone surfaces.

Also recorded was a large number of earlier attempts of patching and repair using different types of binder, such as the one where inadequate cement plaster was used to attach the head of the Mother of God to the body. In the lower accessible parts of the monument a large number of grafitti was recorded.

stanje konstrukcije

CONDITION
OF THE
STRUCTURAL
ELEMENTS



Termografski snimci pokazuju dijelove spomenika na kojima je kamen izrazito porozan (zelene zone), dijelove na kojima se kamen počeo raslojavati i ljuštiti (plave zone) te dijelove spomenika na kojima je kamen kompaktan i zdrav (zone obojane crvenom i drugim toplim tonovima)
Thermal imaging shows parts of the monument where the stone is extremely porous (green areas), parts where the stone surface begun to erode (blue areas) and parts of the monument where the stone is compact and solid (red, yellow and orange areas)

KAKO BI SE DOBIO TOČAN uvid u opće stanje konstruktivnih elemenata od kojih se spomenik sastoji korištene su suvremene tehnologije za ispitivanje stanja materijala i konstrukcije. U tu je svrhu angažirana tvrtka SER.CO.TEC. iz Italije koja je provela ultrazvučna i

termografska snimanja te istarživanja detektorom metala. Ultrazvučno su detektirane pukotine na dijelovima spomenika te je ustanovljeno da su sve pukotine površinske osim pukotine na kapitelu središnjega kompozitnoga stupa koja se proteže punom dubinom kapitela. Termografska su snimanja pokazala da je struktura kamena izrazito porozna zbog čega i podložna propadanju te da nakon završetka konzervatorsko-restauratorskih radova zahtijeva dodatnu površinsku zaštitu od utjecaja oborinske vlage. Detektorom metala su utvrđeni položaji željeznih zatega, tzv.klanfi te ostalih željeznih elemenata. Korozija željeznih predmeta usidrenih u kamen svojim povećanjem volumena prouzrokovala je lomljenje kamena te ih je prilikom konzervatorsko-restauratorskih radova bilo potrebno zamijeniti elementima od nekorodirajućih metala.

IN ORDER TO OBTAIN an accurate view of the general condition of the structural elements which make up the monument, modern technologies were used to test the material and the condition of the structure. SER.CO.TEC. company from Italy was commissioned for this task, which had undertaken sonographic and thermal imaging tests, as well as metal detector tests. The sonographic testing revealed fissures on sections of the monument, establishing all the fissures to be of the surface type, except the fissure on the capitel of the central composite column, extending the full depth of the capitel. Thermal imaging tests revealed the stone structure to be extremely porous, and subsequently prone to decay, so it was established that after completion of the conservation-restoration works, additional surface protection against precipitation was required. The metal detector tests established the position of the iron rods, and other

iron elements. The corrosion of the iron objects anchored in the stone with its increase in volume caused the rupture of the stone, therefore, their replacement during the conservation and restoration works was necessary with non-corrosive metal parts.

Magnetoskopskim se ispitivanjem utvrđuje položaj željeznih klinova
Magnetoscopic testing reveals the position of metal pins



Snimanje spomenika termografskom kamerom
Thermal imaging of the monument

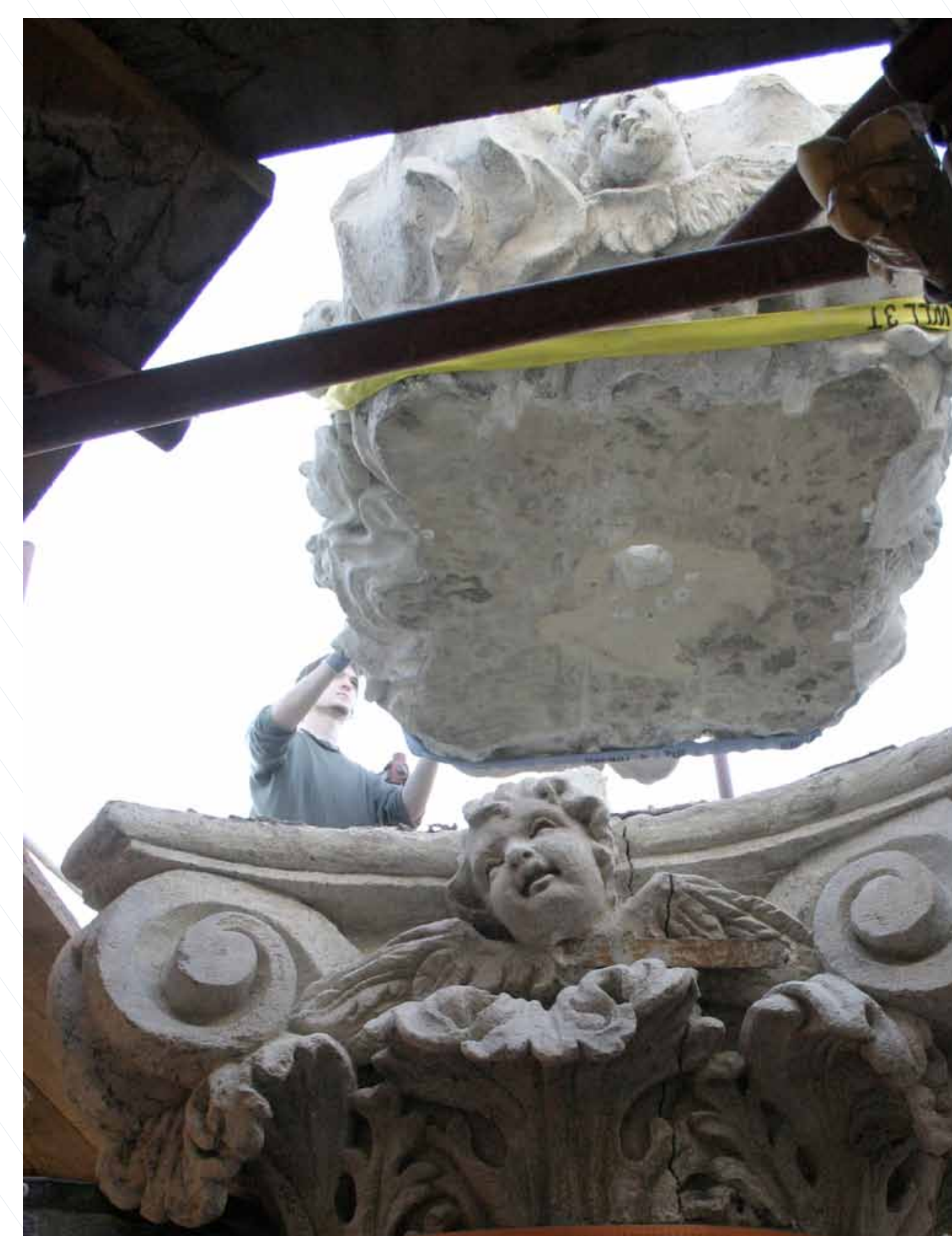


demontaža

DISMANTLING



Demontaža kapitela
Dismantling of capital



Demontaža oblaka kompozicije sv. Trojstva
Dismantling of the cloud from the upper part of the monument

the cloud on which the statues were mounted, and the capital. During and after the dismantling it was revealed that the blocks of stone were linked with a square vertical hand hammered iron pin, 3 meters in length, connecting the column, the capital, the cloud and two of the stone statues on top. The two statues

were additionally bound, fastened and interlinked by a horizontal iron pin, also connected to the central vertical pin. Using the crane, the statues and parts of the architectural elements were dismantled from the top of the monument and transported to a workshop for conservation and restoration work.

Demontaža skulpture Boga Oca
Dismantling of the statue of God the Father

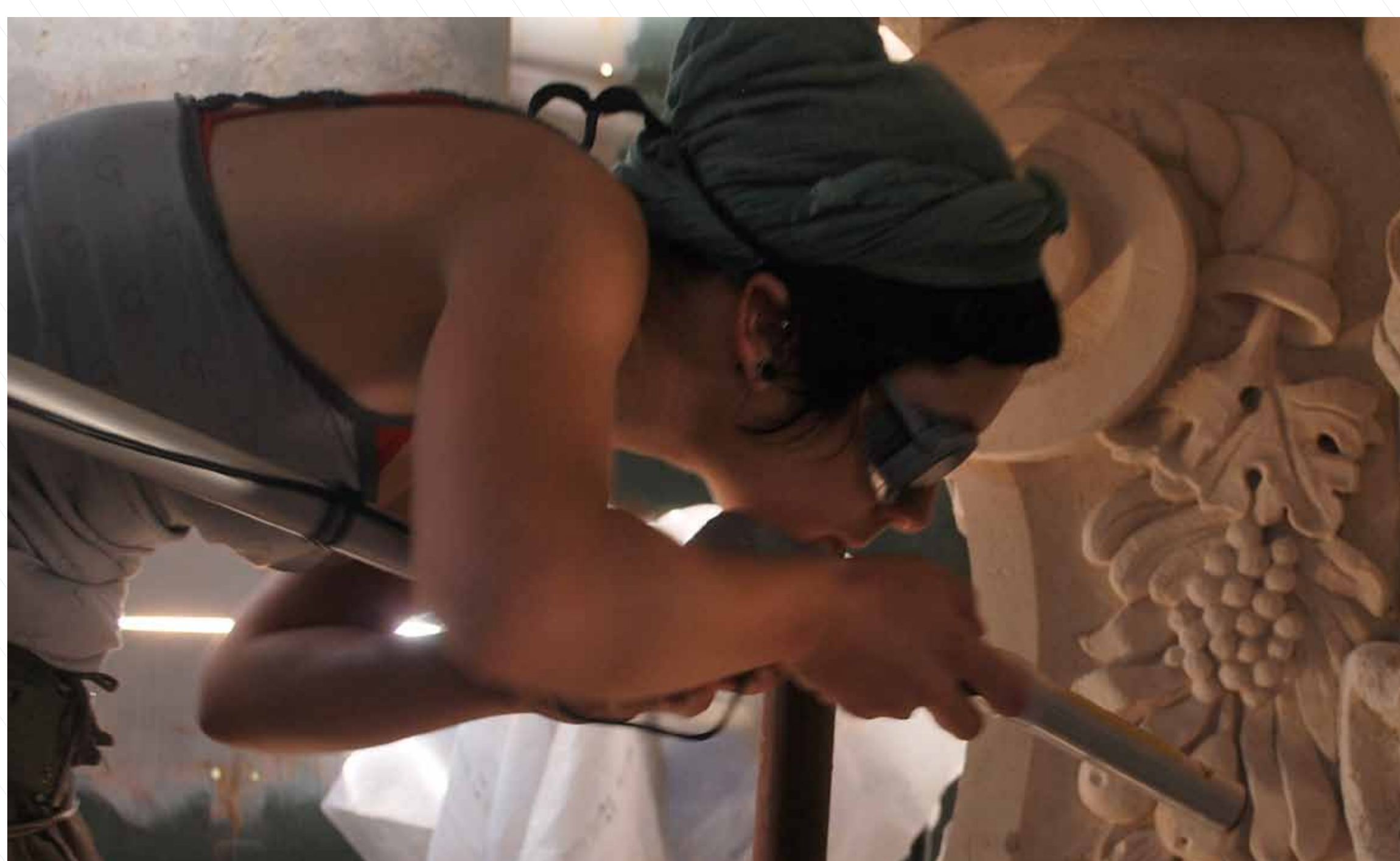


ZBOG VERTIKALNOG PUKNUĆA kompozitnog kapitela u gornjem dijelu spomenika, u svrhu restauratorske obnove je bilo potrebno demontirati gornje dijelove pila. Skela je postavljena 2005. godine, a 2008. su demontirana četiri kamena bloka: skulpture Krista i Boga Oca, oblak na kojemu su skulpture postavljene te kapitel. Tijekom i nakon demontaže je otkriveno da su kameni blokovi bili povezani vertikalnim trnom kvadratnoga presjeka od kovanoga željeza u duljini od 3 metra koji je povezivao stup, kapitel, oblak i dvije kamene skulpture na vrhu. Dvije su skulpture bile dodatno povezane i

učvršćene horizontalnim trnom koji ih je povezivao međusobno, a bio je vezan i na središnji vertikalni trn. Skulpture i dijelovi arhitektonske plastike su dizalicom demontirani sa vrha spomenika te prevezeni u radionicu kako bi se na njima proveli potrebni konzervatorsko-restauratorski zahvati. DUE TO THE VERTICAL rupture of the composite capital in the upper section of the monument, it was necessary to dismantle the upper sections of the column for restoration. The scaffolding was erected in 2005, and in 2008 four stone slabs were removed: the statues of Christ and God the Father,

mehaničko čišćenje

MECHANICAL
CLEANING



Čišćenje dijela podnožja laserom
Laser cleaning of part of the high stand



Lasersko čišćenje polja s natpisom
Laser cleaning of the inscription



Djelomično očišćen segment postolja
Partially cleaned part of the high stand



Čišćenje arhitektonskih dijelova mikropjeskarnikom
Microsandblasting of architectural parts

restauratore Hrvatskoga restauratorskoga zavoda, provodili i djelatnici tvrtke Neir d.o.o. iz Splita.

AT THE START of the conservation and restoration work on the monument, vegetation growing from some of the fissures and subsided sections of the monument had to be cleared. Water hosing of the entire composition was applied, removing some of the moss, lichen and other biological material which had deposited on the stone surfaces over time. From the simple parts of the architectural elements, bearing no decorative elements, using micro sandblaster, larger part of the dark incrustation was removed, sandblasted with glass powder of fine granulation. Micro sandblasting is a procedure whereby very fine sand is dispersed through a special muzzle, using a special machine and aided by compressed air. Considering the mild abrasive action of the micro sandblaster, all the statues



and parts of the architectural elements with carved decorative details required laser cleaning, a more sophisticated technique not damaging to the stone surface. When the laser is used, the impact point ratio, power, frequency and the size of the light beam are regulated according to the structure of the stone material and the type of dirt. Some sections of the monument were cleaned manually, with the scalpel. Laser cleaning of the monument was carried out by the restoration experts from the Croatian Conservation Institute, and the staff of the Neir d.o.o. company from Split.



PRILIKOM POČETKA KONZERVATORSKO restauratorskih radova na pilu bilo je potrebno ukloniti vegetaciju koja je rasla iz pojedinih pukotina i uleknutih dijelova spomenika. Usljedilo je pranje čitave kompozicije vodom čime je uklonjen dio mahovina, lišajeva i ostaloga biološkoga materijala koji se s vremenom nataložio na površinama kamena. Sa jednostavnijih je dijelova arhitektonske plastike, bez dekorativnih detalja, mikropjeskarnikom uklonjen veći dio tamnih inkrustacija, kalcitne skrame, pjeskarenjem staklenim puderom finoga granulata. Mikropjeskarenje

je postupak kojim se posebnim strojem pomoću komprimiranoga zraka raspršuje vrlo sitan pijesak kroz specijalnu mlaznicu. S obzirom na abrazivno djelovanje mikropjeskarnika, sve su skulpture te dijelovi arhitektonske plastike s klesanim dekorativnim detaljima trebali biti očišćeni laserom, sofisticiranijom tehnikom kojom se ne oštećuje površina kamena. Prilikom rada laserom, prema strukturi kamenoga materijala i vrsti nečistoća regulira se omjer udarne točke, snaga i frekvencija te veličina svjetlosnoga snopa. Pojedina su mjesta spomenika čišćena ručno skalpelom. Lasersko su čišćenje pila, uz

kemijsko tretiranje kamena

CHEMICAL
TREATMENT OF
THE STONE



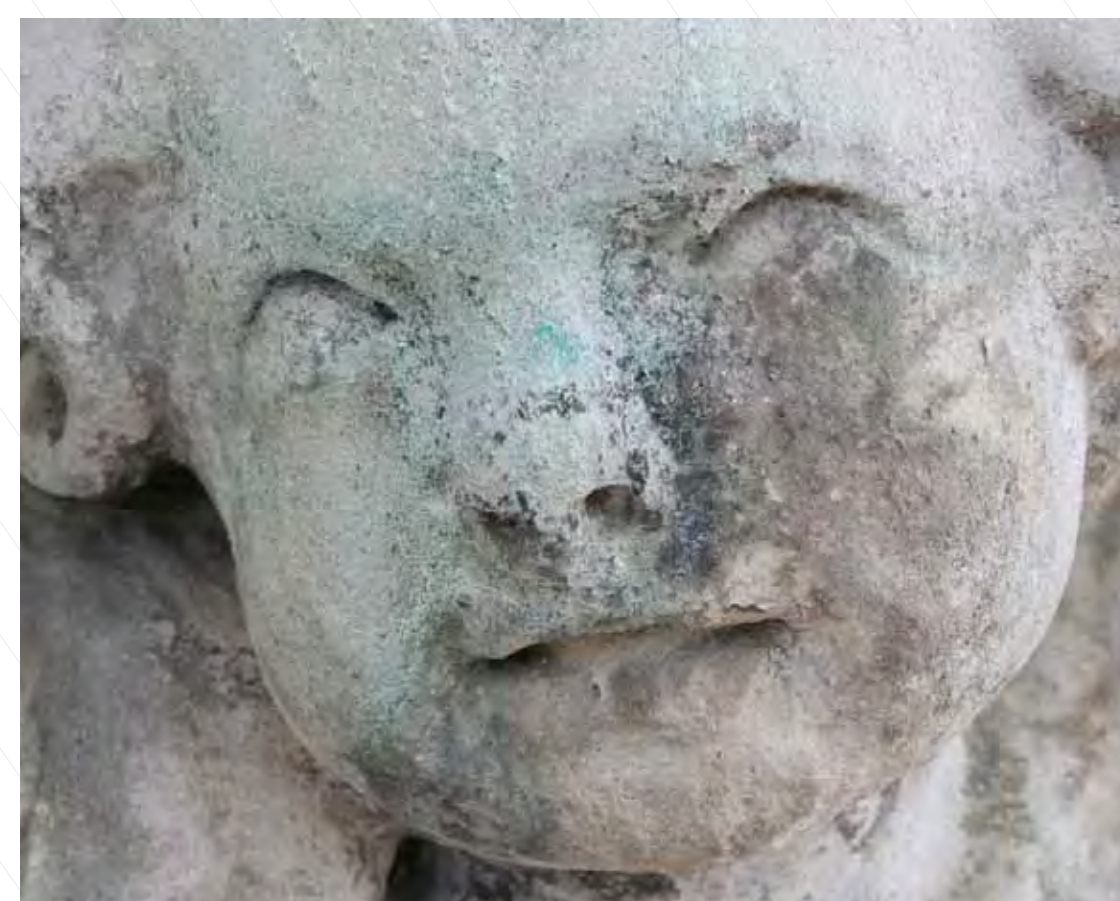
Kemijsko tretiranje kapitela u radionici
Chemical treatment of the capitel in the workshop

taj način polako razaraju kamen. Kako bi ih se pretvorilo u, za kamen neškodljive, netopive soli spomenik je tretiran tzv. Lewinovom metodom. Postupkom se na kamene površine stavljaju oblozi, celulozne pulpe, natopljeni barijevim hidroksidom koji topive soli pretvara u netopive. Postupak je potrebno ponoviti dovoljan broj puta dok se količina topivih soli ne svede na prihvatljivu razinu. Osim tretiranja soli u strukturi materijala, kemijski su tretirane i tzv. malahitne mrlje koje su se pojavile na površinama gornjih dijelova spomenika kao posljedica pada bakrenih čestica sa golubice i ostalih bakrenih dijelova kompozicije sv. Trojstva. Čestice bakra prodrle su u strukturu kamena zbog čega su na površinama nastale zelene mrlje. Mrlje su tretirane natapanjem celuloznom pulpom natopljenom amonijevim karbonatom koji otapa



Uklanjanje malahitnih mrlja sa skulpture Boga Oca pulpom natopljenom amonijevim karbonatom
Removal of malachite stains from the statue of God the Father by pulp saturated with ammonia carbonate

OSIM MEHANIČKI, na pilu je bilo potrebno intervenirati i kemijskim sredstvima. Laboratorijskim je analizama utvrđeno da se u strukturi kamena s vremenom nakupila velika količina topivih soli koja je u materijal dospjela prodorom kapilarne vlage. Topive su soli štetne budući da putuju po strukturi kamena, a sušenjem se kristaliziraju čime im se višestruko povećava volumen te na



Malahitne mrlje na glavi anđela
Malachite stains on the head of an angel

Uklanjanje malahitnih mrlja s glave anđela
Removal of malachite stains from the head of an angel



bakar. Sušenjem pulpa povlači otopljeni bakar na površinu kamena i u samu pulpu na kojoj se on manifestira kao plava mrlja.

APART FROM THE mechanical methods, chemical treatment of the monument was also required. A laboratory analysis found that over time, a large amount of soluble salts had accumulated in the stone structure, permeating the material by way of capillary moist. Soluble salts are damaging, since they move through the stone structure and chrystalize by drying, multiplying manifold in volume, and thus slowly destroying the stone. In order to transform them into insoluble salts, harmless to the stone, the so called Lewin method was used to treat the monument. The procedure involves placement of cellulose pulp saturated with barium hydroxide on the stone, which converts soluble salts into insoluble. It is necessary to repeat the procedure enough times, until the amount of soluble salts is reduced to an acceptable level.

Apart from the treatment of the salt in the material structure, also chemically treated were the so called malachite stains, found on the surfaces of the upper sections of the monument, caused by the copper particles from the dove

and other copper parts of the Holy Trinity composition. Copper particles had penetrated the stone structure, creating green staining on the surfaces. The staining was treated with cellulose pulp saturated with ammonia carbonate which dissolves copper. Drying of the pulp draws the dissolved copper to the stone surface and into the actual pulp, where it manifests as blue staining.

Skulptura Boga Oca u radionici obložena celuloznom pulpom natopljenom barijevim hidroksidom
Statue of God the Father in the workshop covered with cellulose pulp saturated with barium hydroxide



vakuumsko učvršćivanje

VACUUM
REINFORCEMENT



Vakuumsko učvršćivanje skulpture sv. Roka in situ
Vacuum reinforcement of the statue of St. Roch *in situ*

POROZNA SE STRUKTURA kamena od kojega je spomenik napravljen tijekom vremena dodatno povećala. Restauratorskim zahvatom 70-ih su kamene površine tretirane sredstvom za učvršćivanje u skladu s tadašnjom konzervatorsko-restauratorskom praksom što se kasnije pokazao neadekvatnim te je dodatno oštetilo kamen. Sredstvo za učvršćivanje koje se tada koristilo stvrdnulo je samo površinski sloj te je on s vremenom počeo otpadati zbog razlike u čvrstoći

površinskoga i dubinskoga sloja koju je pojačalo djelovanje atmosferskih utjecaja. Zbog navedenih je razloga bilo potrebno kamen učvrstiti suvremenim tehnikama i materijalima. Čitav je gornji dio pila, kapitel, oblak i kipovi Boga Oca i Krista te pet donjih skulptura središnje kompozicije učvršćeno vakuumski. Skulpture i dijelovi arhitektonske plastike su umotani u najlonske vreće te je iz njih vakuum pumpom izvučen zrak na



Skulptura sv. Roka nakon vakuumskoga učvršćivanja
The statue of St. Roch after vacuum reinforcement

mjesto kojega je podtlakom ubačen učvršćivač za kamen (esteri silicijske kiseline). Gornji su demontirani dijelovi vakuumski obrađeni u radioni, a pet skulptura in situ. Opisane je radove izveo Atelier Erich Pummer iz Austrije u suradnji sa tvrtkom Remmers iz Njemačke čiji je zastupnik Arp d.o.o. iz Zeline.

THE POROUS STRUCTURE of the stone used for the construction of the monument had increased over time. During the 1970s restoration work, the stone surfaces were treated with a reinforcement agent, following the conservation and preservation practice standard at the time, which would later prove inadequate, and additionally damage the stone. The reinforcement agent used only hardened the surface layer, causing its flaking over time due to the difference in solidity between the surface and the deep layer, further enhanced by weathering.

This is why the reinforcement of the stone using modern techniques and materials was required. The entire upper section of the monument, the capital, the cloud, the statues of God the Father and Christ, and the five lower sculptures of the central composition were reinforced using the vacuum. The statues and parts of the

architectural elements were wrapped in plastic bags, air was extracted using a vacuum pump and replaced with a reinforcing agent for stone (silicic acid esters). The upper dismantled parts were vacuum processed in the workshop, and the five statues in situ. The described works were carried out by Atelier Erich Pummer from Austria, in cooperation with Remmers company from Germany, represented by agent Arp d.o.o. from Zelina.

Vakuumsko učvršćivanje skulpture Boga Oca u radionici
Vacuum reinforcement of the statue of God the Father in the workshop



montaža ASSEMBLY

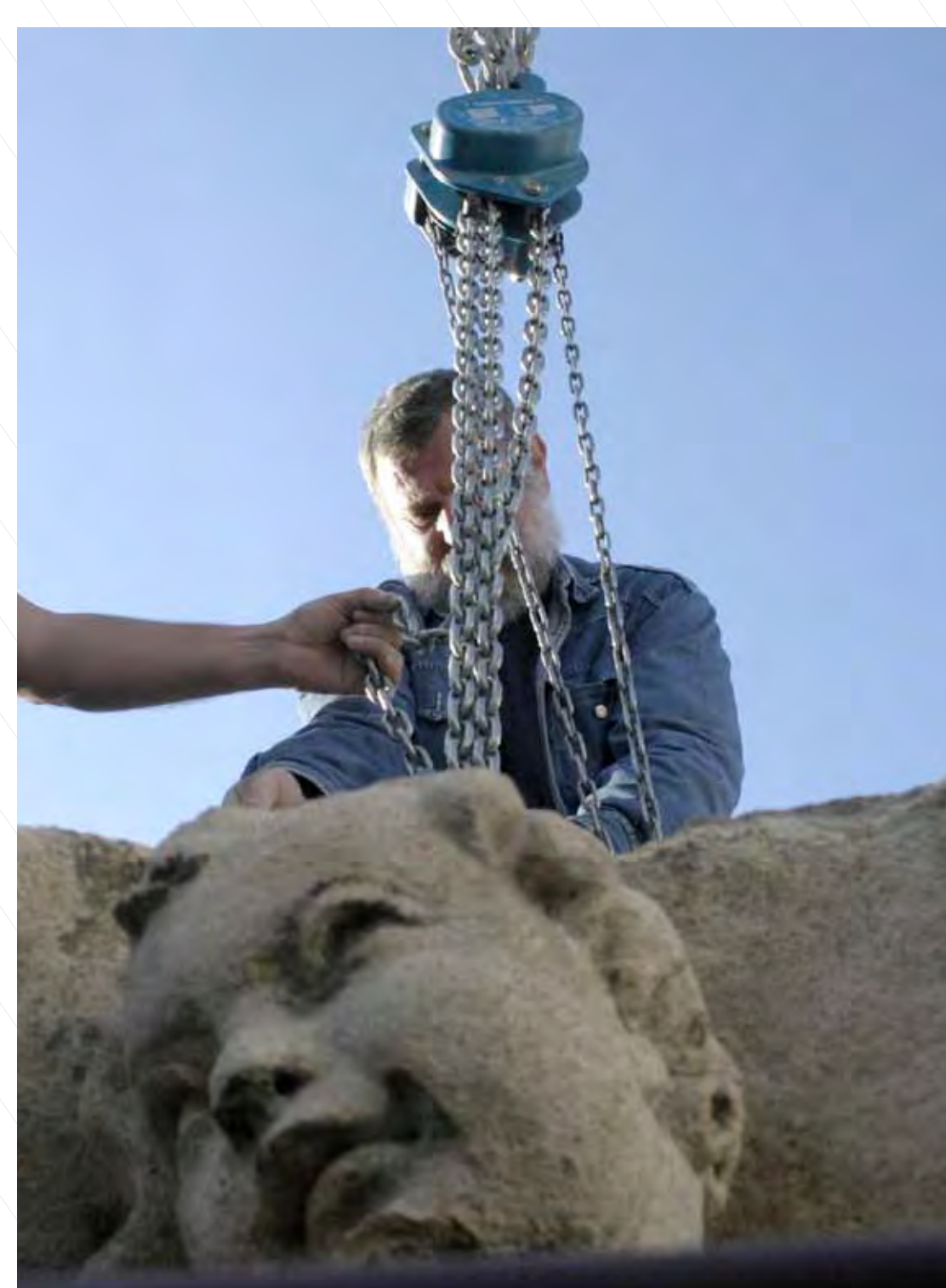


Montaža dijelova kompozicije sv. Trojstva
Assembly of parts of the composition of St. Trinity

the Father and Christ) were placed back to their original positions with the aid of a crane. During the assembly all the traditional procedures for the joining of individual blocks of stone were applied. The main vertical truss, originally an iron rod, was replaced with a seamless inox pipe, 6cm in diameter, in order to prevent corrosion damaging to the stone. The process of corrosion increases the volume of metal objects, causing gradual cracking of the stone elements to which they are affixed through expansion. The statues of God the Father and Christ are interlinked by a horizontally laid piece of inox, fitted to the central vertical rod, increasing the stability. Originally they were joined by a piece of iron which had corroded due to atmospheric damp. Other iron rods, as well as cramps were also replaced with inox versions, and reinforced by melted lead. During the assembly, the



NAKON ZAVRŠETKA konzervatorsko-restauratorskih radova izvedenih u radionici, gornji su demontirani dijelovi spomenika (kapitel, oblak, skulpture Boga Oca i Krista) dizalicom vraćeni na svoj položaj. Prilikom montaže su poštovani svi tradicionalni postupci povezivanja odvojenih kamenih blokova. Glavni je vertikalni nosač, trn, izvorno željezni, zamijenjen bešavnom cijevi promjera 6 cm od inoksa kako bi se izbjegla korozija štetna za kamen. Metalnim se predmetnima procesom korozije višestruko povećava volumen te svojim širenjem postupno uzrokuju pucanje kamenih elemenata na koje su pričvršćeni. Skulpture Boga Oca i Krista međusobno su povezane horizontalno postavljenim komadom inoksa učvršćenoga na središnji vertikalni trn čime im je pojačana stabilnost. Izvorno su bili povezani komadom željeza koje je pod utjecajem atmosferske vlage korodiralo. I ostali su trnovi, kao i klanfe, također zamijenjeni inoksnima te učvršćeni rastaljenim olovom. Prilikom montaže je primijenjen i tradicionalni postupak postavljanja olovnih ploča, tzv. posteljica između kamenih elemenata kako bi se smanjilo



trenje odnosno oštećenja blokova na spojevima. Prilikom montaže demontiranih dijelova pila te postavljanja novih klanfi u donjim dijelovima spomenika ukupno je utrošeno pola tone olova. AFTER THE COMPLETION of the conservation-restoration work carried out in the workshop, the upper dismantled sections of the monument (the capital, the cloud, statues of God



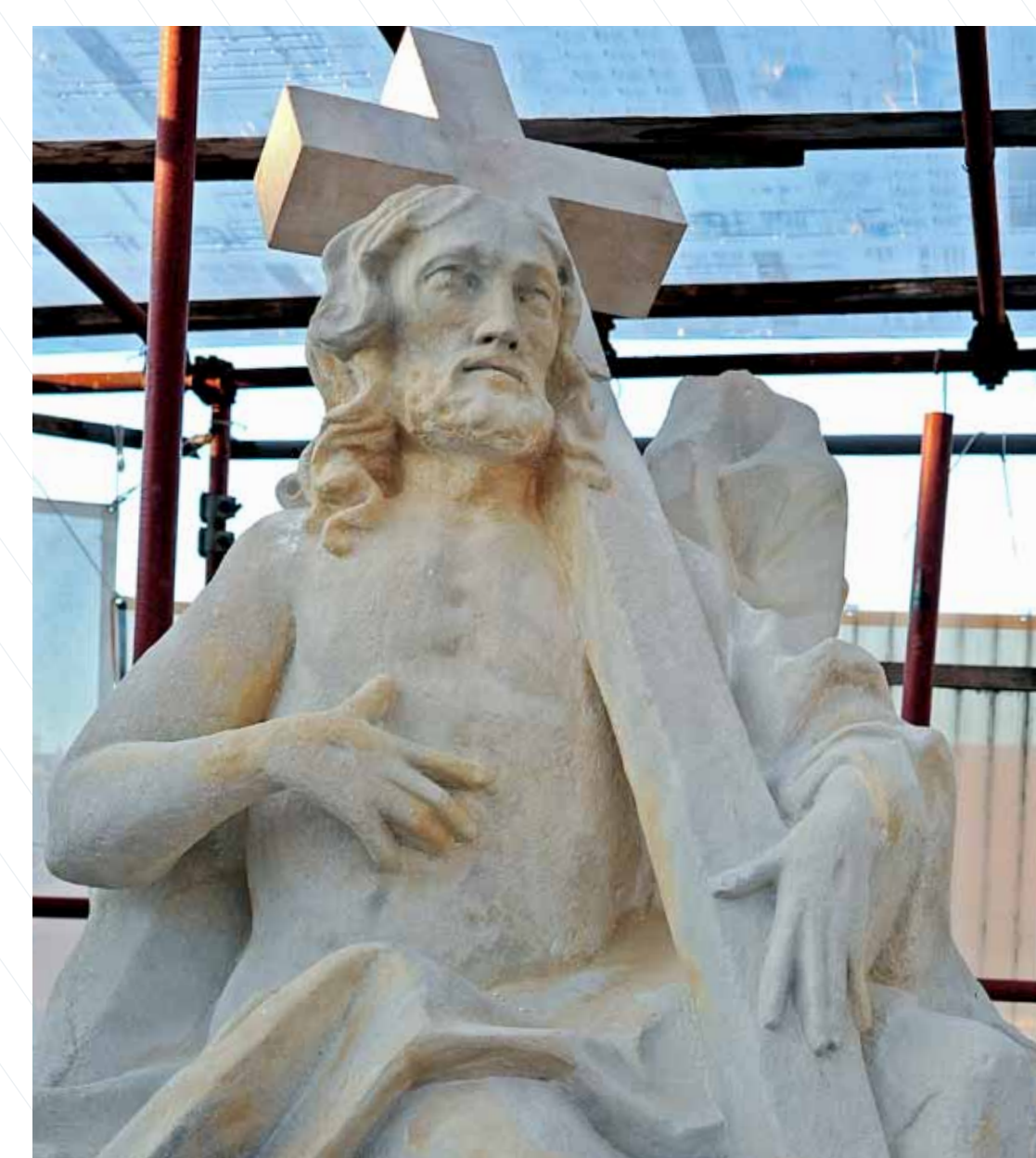
traditional procedure of the fitting of the lead panels was applied, a fitting level, between the stone elements, in order to reduce friction and damage to the blocks at the joints. A total of half a tonne of lead was used during the assembly of the dismantled parts of the monument and the fitting of the new cramps in the lower parts of the monument.

Montaža dijelova kompozicije sv. Trojstva
Assembly of parts of the composition of St. Trinity



restauriranje kamenih dijelova

RESTORATION
OF THE STONE
ELEMENTS



Prije i nakon konzervatorsko-restauratorskih radova: polje s natpisom na podnožju pila, skulptura Krista, skulptura sv. Roka, glava anđela
 Before and after conservation-restoration work: inscription on a high stand, the statue of Christ, the statue of St. Roch, head of an angel

BROJNE JE DIJELOVE spomenika degradirane različitim vrstama oštećenja bilo potrebno restaurirati. Izvorna površina kamena je na svim skulpturama bila uništena erozijom te su likovi svetaca izgubili plastiku lica i ostalih detalja. Erodirane su površine kamena, kao i manji detalji koji su nedostajali (prsti i sl.) rekonstruirani umjetnim kamenom, smjesom vapna, veziva i kamene prašine. Umjetnim su kamenom domodelirane nedostajuće forme čime su figurama vraćeni obrisi, a jača je rekonstrukcija izvedena prilikom izvedbe svetačkih atributa kao što je raspelo u rukama sv. Karla Boromejskog. Osim domodeliranja umjetnim kamenom, primijenjena je i metoda tašeleranja, umetanja zamjenskih isklesanih komada kamena na mjesto oštećenja u prethodno pripremljena

ležišta. Metodom tašeleranja je rekonstruiran križ u ruci Krista. Spojevi kamenih elemenata su zatvoreni posebnom smjesom za fugiranje krupnijeg agregata kojoj je pojačana vodopropusnost kako bi se izbjeglo zadržavanje vode na spojevima blokova. Odvojeni su elementi, odnosno puknuća, ponovno povezani upotrebom karbonskih vlakana umetnutih u strukturu kamena. Karbonska su vlakna materijal otporan na vlak, lagana su i ne korodiraju te se primjenjuju za spajanje odvojenih dijelova prilikom restauratorskih radova na kamenim skulpturama i arhitektonskoj plastici. Rekonstrukcijom kamenoga dijela smatra se i zamjena kamene stuba podnožja uništene granatiranjem tijekom Domovinskoga rata. Nova je stuba isklesana od kamena pješčenjaka.

DEGRADED BY DIFFERENT types of damage, numerous parts of the monument had to be restored. The original stone surface of all the statues was destroyed due to erosion, and the figures of saints had lost the facial features and other details. The eroded stone surfaces, as well as smaller missing details (fingers etc.) were reconstructed using artificial stone, a mix of lime, binder and stone dust. Artificial stone was used to model the missing forms, returning the contours to the figures, with a more extensive reconstruction carried out to replace some of the features of the saints, such as the crucifix in the hands of St. Charles Borromeo. Apart from the modelling in artificial stone, the damaged parts were replaced by insertion of ready made carved pieces of stone in place of the

damaged sections in the previously carved grooves. Using the same method, the crucifix in the hand of Christ was reconstructed. Joints of the stone elements were sealed with a special grout, composed of coarse aggregate with increased water permeability, to prevent water retention on the joints. Individual elements and fissures were reconnected with carbon fibres inserted into the stone structure. The carbon fibres are a type of tension-resistant material, light and non-corrosive, used for the joining of individual parts during the restoration work on stone sculptures and architectural elements. Replacement of the stone step of the base destroyed by shelling during the Homeland War is also considered reconstruction of a stone element. The new step was carved in sandstone.

restauriranje metalnih dijelova

RESTORATION
OF THE METAL
PARTS



Rekonstruirana golubica Duha svetoga sa restauriranom zrakastom aureolom
Replica of the dove depicting the Holy Spirit with restored halo with rays



Poliesterska kopija golubice postavljena tijekom restauratorskih radova 70-ih godina
Replica of the dove made of polyester during the restoration work in the 1970s

OSIM METALNIH DIJELOVA na spomeniku u funkciji trnova, klinova i klanfi koji su služili za povezivanje i učvršćivanje konstrukcije te su uglavnom bili skriveni od pogleda promatrača, izvorno su se na vrhu pila nalazili dijelovi skulpture izrađeni od bakra i mjedi: golubica Duha svetoga sa zrakastom aureolom, Kristova zrakasta aureola, trokutasta aureola Boga Oca te križ na kugli koju u ruci drži Bog Otac. Dok je golubica izvorno bila mjedena i posrebrjena, ostali su navedeni dijelovi bili od bakra te pozlaćeni. Kao što je ranije spomenuto, golubica je tijekom konzervatorsko-restauratorskih radova sedamdesetih godina 20. stoljeća zbog velikoga stupnja oštećenosti zamijenjena kopijom od pozlaćenoga armiranoga poliestera, a original je pohranjen u muzej. Prilikom posljednjih je restauratorskih radova odlučeno da se na vrh spomenika postavi nova metalna kopija golubice zbog boljšeg uklapanja u cjelinu te zbog postojanosti materijala, a da se ostali bakreni dijelovi kompozicije restauriraju. Restauriranju je prethodila prirodosnanstvena analiza svih metala i proizvoda korozije te restauratorska analiza svih metalnih dijelova te načina njihova povezivanja i montaže. Nakon izrade, galvanska je kopija posrebrjena



Restauratorski radovi na krilu izvorne golubice
Restoration work on the wing of the original dove

te u svrhu trajnije zaštite premazana transparentnim akrilnim premazom. Bakreni su elementi s vrha spomenika očišćeni, materijal je stabiliziran, izvedene su djelomične rekonstrukcije nedostajućih dijelova ukoliko je bilo potrebno, te su elementi ponovo pozlaćeni. Sačuvani su dijelovi izvorne golubice učvršćeni, konzervirani te pripremljeni za muzejsku prezentaciju. Rekonstrukciju golubice i restauratorske radove na bakrenim elementima izvela je restauratorica metala Valentina Ljubić. APART FROM THE METAL parts of the monument such as the pins, pegs, and cramps utilized to join and reinforce the structural elements and mostly hidden from view, originally, copper

and brass elements of the sculpture existed on the monument top: the dove depicting the Holy Spirit bearing a halo with rays, Christ's halo with rays, the triangular halo of God the Father and the cross on the sphere held in the hand of God the Father. Whereas the dove was originally made of brass and silver plated, other metal parts were made of copper and coated in gold leaf. As noted earlier, during the restoration work in the 1970s, the dove was replaced with a replica made of reinforced polyester coated in gold-leaf due to its highly damaged condition, and the original was deposited in a museum.

In the course of the last performed restoration work, a decision was made that a new metal replica of the dove should be fitted on the monument top to better fit into the composition, and also due to the durability of the material, whereas other copper parts of the composition would be restored. The restoration was preceded by a scientific analysis of all the metal, and the products of corrosion, as well as the restoration analysis of all the metal parts and the method of their joining and assembly. After it was manufactured, the galvanic replica was silver-plated, and treated with transparent acrylic coating to provide more permanent protection.

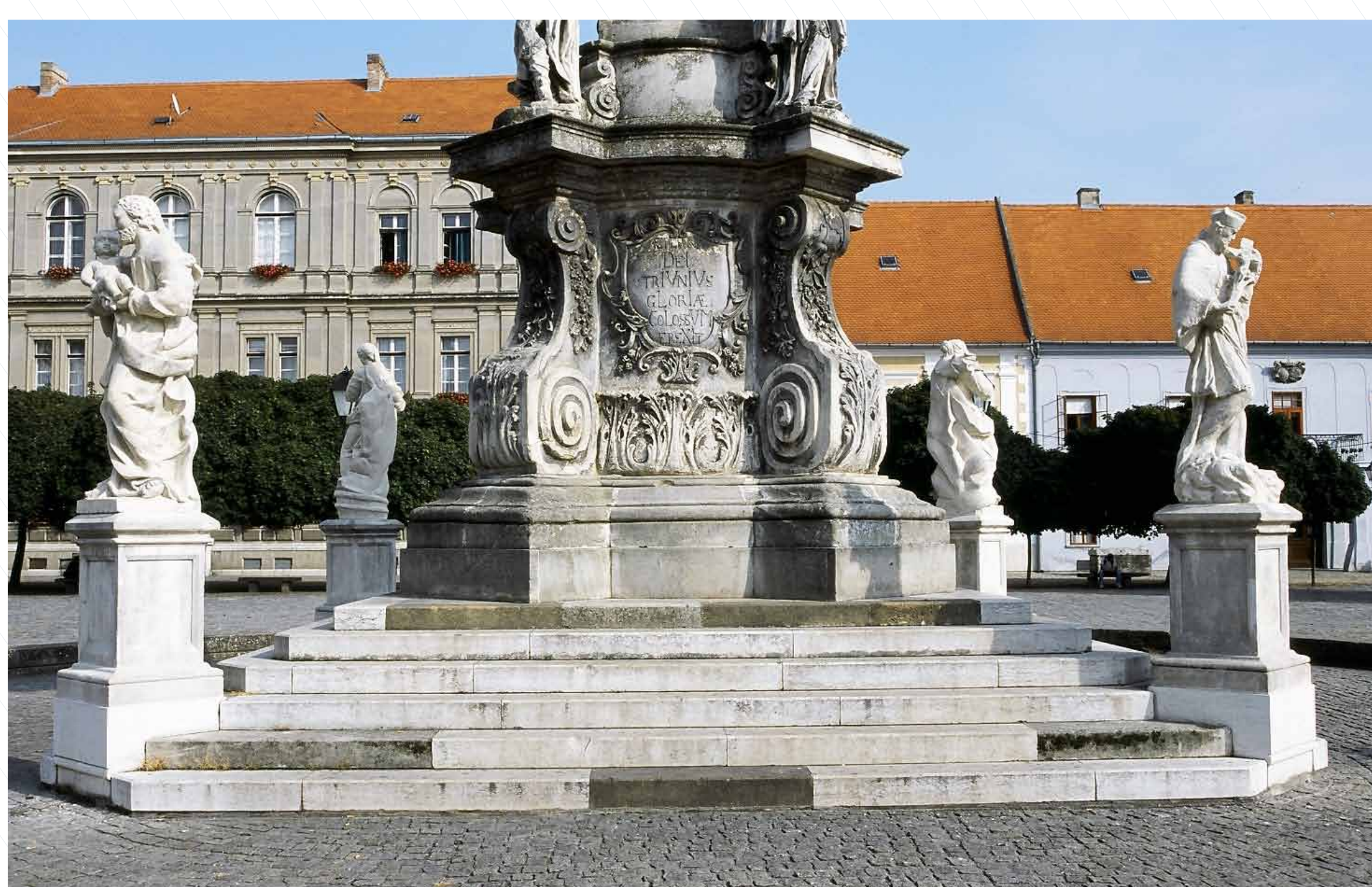
The copper elements from the top of the monument were cleaned, the material stabilized, partial reconstruction of the missing parts was carried out where necessary, and the elements were coated with a new layer of gold leaf. The preserved parts of the original dove were tightened, conserved and prepared for the museum presentation. The reconstruction of the dove and the restoration work on the copper elements were performed by the metal restoration expert Valentina Ljubić.

Korozija na dijelu zrakaste aureole
Corrosion on part of the halo with rays



izrada replika skulptura

CREATING THE
REPLICAS OF
THE STATUES



Replike četiri lateralne skulpture nakon postavljanja na pil
Replicas of four lateral statues after assembly



Original skulpture sv. Katarine
Original of the statue of St. Catherine



Replika skulpture sv. Katarine
Replica of the statue of St. Catherine



Izrada replike u radionici
Making of replica in the workshop

NAKON ŠTO SU JU vandali srušili sa postolja, kip sv. Katarine je razlomljen u dijelove i teško oštećen dopremljen u radionicu Hrvatskoga restauratorskoga zavoda 2001. godine. Nakon spajanja odvojenih dijelova izvedena je djelomična rekonstrukcija nedostajućih dijelova kako bi se skulpturi vratila forma. Prilikom restauratorskih je radova ustanovljeno da je skulptura, kao i ostale tri lateralne skulpture, u tako lošem stanju da ih je potrebno pohraniti u kontrolirane uvjete kako bi ih se zaštitilo od daljnjega propadanja, a na pil postaviti kopije. Nakon demontaže ostale tri skulpture, na svima su izvedene rekonstrukcije nedostajućih formi i dijelova plastelinom te su napravljeni otisci, odnosno kalupi. Prilikom izrade kalupa površina kamena je izolirana posebnim sredstvom,



Replika skulpture sv. Ivana Nepomuka
Replica of the statue of St. John of Nepomuk

starih fotografija iz fundusa Muzeja Slavonije u Osijeku.

AFTER IT HAD been toppled from its base by vandals, the statue of St. Catherine, broken into pieces and badly damaged, was transported to the workshop of the Croatian Conservation Institute in 2001. After the joining of individual parts, a partial reconstruction of the missing parts was carried out in order to return the form to the statue. During the restoration work it was established that the statue, as well as other three lateral statues, were in such a bad condition that it was deemed necessary to store them in a controlled environment, in order to prevent further decay, and use replicas on the monument.

After the dismantling of the remaining three statues, they all underwent reconstruction of the missing forms and parts in plasticine, and casts and moulds were made. During the production of the moulds the surface of the stone was insulated with a special agent, the separator, to prevent the bottom layer of the rubber applied to the surface of the sculpture from attaching to the original

Izrada kalupa
Making of the mould



odjeljivačem, kako se guma koja se nanosi na površinu skulpture prilikom izrade kalupa u najdonjem sloju ne bi zalijepila za izvornik. Na gumu se nanosi gipsana kapa te, ukoliko je potrebo, drvena konstrukcija kako bi kalup bio čvršći. U kalupe se potom ulijeva masa od umjetnoga kamena. Na taj način izvedene kopije skulptura postavljene su na spomenik, a originali su izloženi u zgradi rektorata Sveučilišta u Osijeku. Rekonstrukcije nedostajućih formi i detalja izvedene su na osnovu arhivske dokumentacije,



Original i replika skulpture sv. Josipa u radionici
Original and replica of the statue of St. Joseph in the workshop

during the making of the mould. A plaster cap was placed on the rubber, and where necessary, a wooden construction, in order to reinforce the mould. Artificial stone mix was next poured into the moulds. The replicas of the statues produced in this manner were fitted onto the monument, and the originals were exhibited in the building of the University of Osijek Rector's Office. Reconstruction of the missing parts was carried out according to archival documentation and old photographs from the Museum of Slavonia in Osijek.

zaštita i održavanje

PROTECTION AND
MAINTENANCE



ISTRAŽIVANJA SPOMENIKA su pokazala da je izvorno čitava površina svih kamenih dijelova pila bila premazana vapnom radi zaštite od atmosferskih utjecaja te obojana. Nakon završetka konzervatorsko-restauratorskih radova spomenik je ponovno zaštićen zatvaranjem mikropukotina na kamenim površinama kako bi se izbjeglo prodiranje vlage i prljavštine u strukturu materijala. Za ispunjavanje mikropukotina je korištena smjesa od vapna, kamene prašine i vezivnoga materijala u koju se dodao pigment kako bi smjesa bila tonski ujednačena sa kamenom od kojega je pil napravljen. Nakon popunjavanja

mikropukotina sve su površine premazane hidrofbnim sredstvom kojime se povećava površinska napetost te sprečava zadržavanje vode na površinama skulptura i arhitektonske plastike. Donji su dijelovi pila dodatno zaštićeni antigrafitnim premazima koji omogućavaju lakše uklanjanje grafita. Svi navedeni materijali imaju rok trajanja te ih je potrebno redovito periodički obnavljati. Također, svi su opisani zahvati na površinama kamena podložni oštećenjima (mehaničkim i kemijskim) zbog čega je potrebno provoditi kontrolu stanja spomenika svakih pet do sedam godina, prema preporuci proizvođača korištenih materijala.

EXAMINATIONS OF THE monument showed that originally, the entire surface of all the stone parts of the monument were coated with lime as protection against weathering, and painted. After the completion of the conservation and restoration work, the monument was protected again by closure of the micro-fissures in the stone surface, in order to prevent the penetration of damp and dirt into the structure of the material. To fill in the micro-fissures, a mix of lime, stone dust and binder was used, to which pigment was added to make the colour tone of the mix blend in with the stone used for the construction of the monument. After filling in the micro-fissures,

all the surfaces were coated with hydrophobic agent which increases the surface tension and prevents water retention on the surface of the statues and the architectural elements. The lower sections of the monument were additionally protected with anti-graffiti coating, enabling easier removal of the graffiti. All the listed materials have an expiry date, therefore, a regular periodical renewal is necessary. Furthermore, all the described procedures on the stone surfaces are prone to damage (mechanical and chemical) which is why it is necessary to conduct regular status check-ups every five to seven years, as recommended by the manufacturers of the materials used.



IMPRESSUM

Projekt / Project

Konzervatorsko-restauratorski radovi na pilu Sv. Trojstva u Osijeku / Conservation and Restoration Work on the Holy Trinity Votive Monument in Osijek

Financijska sredstva za konzervatorsko-restauratorske radove iz državnoga proračuna osiguralo je Ministarstvo kulture Republike Hrvatske uz participaciju Agencije za obnovu osječke Tvrđe

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Provedba projekta / Project completed by

Hrvatski restauratorski zavod / The Croatian Conservation Institute

Ferdinand Meder, ravnatelj / Director

Konzervatorski nadzor / Conservation supervision

Ministarstvo kulture Republike Hrvatske, Uprava za zaštitu kulturne baštine, Konzervatorski odjel u Osijeku / Ministry of Culture of the Republic of Croatia, Directorate for the cultural heritage protection, Osijek conservation department

Konzervatorsko-restauratorski radovi / Conservation and restoration work

Alan Vlahov, voditelj programa / head of the project;

Josip Velnić, pročelnik Službe za nepokretnu baštinu / head of the Division for Immovable Heritage;

Eduard Hudolin, voditelj Restauratorskog odjela Osijek / head of the Osijek restoration department;

Ivan Jengi, voditelj Odjela za kamenu plastiku / head of the Stone sculpture department;

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Konzervatorski-restauratorski radovi na metalnim dijelovima / Conservation and restoration work on the metal elements

Valentina Ljubić

Vakuumsko učvršćivanje kamena / Vacuum stone reinforcement: Atelier Erich Pummer (Austrija), Remmers (Njemačka), Arp d.o.o. (Sv. Ivan Zelina)

Lasersko čišćenje kamena / Laser stone cleaning: Neir d.o.o. (Split)

Ispitivanje stanja konstrukcije / Construction examination: SER.CO.TEC. (Italija)

Čišćenje stuba „Rotec“ tehnologijom / Cleaning of the stairs with „Rotec“ technology: Niteo d.o.o. (Osijek)

Konzervatorsko-restauratorska istraživanja i izrada elaborata / Conservation and restoration research and documentation

Mario Fučić (HRZ), Dario Almesberger (SER.CO.TEC.), Milko Jakšić (Institut Ruđer Bošković), Dragica Krstić (HRZ), Hrvoje Malinar (vanjski suradnik HRZ-a), Iva Marić (HRZ), Domagoj

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Organizacija izložbe / Exhibition organized by

Hrvatski restauratorski zavod u suradnji s Arheološkim muzejom Osijek / Croataian Conservation Institute in cooperation with the Archaeological Museum of Osijek

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