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HERKULOVA VRATA U PULI KONZERVATORSKO-RESTAURATORSKI OSVRT HERCULES' GATE AT PULA A CONSERVATION-RESTORATION REVIEW

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S obzirom na zapuštenost pulskih spomenika u konzervatorsko-dokumentacijskom smislu, 2010. godine počeo je njihov obilazak te dokumentiranje zatečenog stanja. Nakon prvog obištenog spomenika, Dvojnih vrata, sljedeća su u nizu Herkulova vrata. Jednostavnija su, kako građevinski, tako i u odnosu na postojeće zabilježene degradacije. Početkom 2012. godine fotografski su i grafički dokumentirane sve primijećene degradacije, čime i Herkulova vrata ulaze u bazu podataka u kojoj je prikazano njihovo stanje s konzervatorsko-restauratorskog gledišta.

Bearing in mind the neglected state of Pula's monuments in a conservation-documentation sense, in 2010 a tour of these monuments was started in order to document their present condition. After a visit to the Double Gate that was the first in a series of monuments to be inspected, we continued the tour with Hercules' Gate which is simpler both from a construction standpoint as well as with regard to the observed and recorded degradations. At the beginning of 2012, we documented all of these degradations, both photographically and graphically, including in this manner Hercules' Gate in the data base that shows the state of these monuments from a conservation-restoration viewpoint.

KLJUČNE RIJEČI: Herkulova vrata, degradacije, grafička dokumentacija, restauratorsko-konzervatorski prijedlozi

KEY WORDS: Hercules' Gate, degradations, graphical documentation, restoration-conservation proposals

1. UVOD

Tijekom 2010. i 2011. godine, u želji da se pulskim spomenicima pruži primjerena skrb, počeo je njihov obilazak, ne bi li se zabilježilo u kojem se stanju nalaze te obratila pozornost na sve uvjete i moguće probleme, kao i na sve eventualno potrebne radove i zahvate.

Prva u nizu analiziranih spomenika bila su pulska Dvojna vrata (Gobić-Bravar, 2011, str. 177-204). Nastavljajući duž gradskih zidina, sljedeća antička vrata kojima kroz povijest nije davano dovoljno pažnje jesu ona Herkulova.

1.1 Povijesni osvrt

“Prossima a questa si e’ la Porta d’Ercole, delle secondarie e minori, di semplice costruzione, la quale ai tempi più antichi della colonia rimonta. Vi si vedono rozzamente scolpiti la testa d’Ercole e la clava, ed i nomi dei duumviri, supremi magistrati di Pola, durante il regimento dei quali venne aperta.”¹ (Kandler, 1845, str. 40)

Herkulova vrata izgrađena su u I. st. pr. Kr. na mjestu starog gradinskog ulaza koji je povezivao pulsku gradinu s Nezakcijem. Iz masivnih blokova kamena vapnenca postavljena su zakošeno, pod kutom od 68 stupnjeva u odnosu na gradski bedem. Ime su dobila zbog reljefnog prikaza toljage i Herkulove bradate glave s vratom, uklesane u kamene blokove s lijeve i desne strane zaglavnog kamena. (Starac, Mihovilić, 2001, str. 21)

Mlakar ih ističe kao “najstariji objekat iz sastava gradskih obrambenih zidina antičko-rimske kolonije Pule...” (Mlakar, 1978, str. 21, 28)

Kao i svi pulski spomenici, kroz skoro dva tisućljeća povijesti Herkulova vrata doživjela su mnogobrojne promjene koje su utjecale na nastanak raznovrsnih oštećenja. No, gotovo je nemoguće pronaći podatke o događajima koji se vezuju uz ovaj spomenik i koji bi mogli biti važni za shvaćanje njegovog današnjeg stanja.² Poznato je da su pulske zidine u više navrata rušene, građene i ponovno rušene. Godine 1299. građanstvo Pule obnavlja zidine, ali već 1300. obećava da će obnovljene zidine srušiti (Kandler, 1986, str. 844). Ovakvi su radovi zasigurno utjecali i na stanje Herkulovih vrata, ali ona se u dokumentima ne spominju.

¹ “Odmah nakon njih nastavljaju se Herkulova vrata, sporedna i manja, jednostavne gradnje, koja potiču iz najstarijeg perioda kolonije. Vide se na njima grubo isklesana Herkulova glava i toljaga te imena duumvira, vrhovnih pulskih magistara, za čijeg su vladanja otvorena.”

² Tijekom 2010. godine, a vezano za bolje upoznavanje povijesnog konzervatorskog stanja pulskih spomenika, provedeno je pretraživanje svih Kandlerovih spisa koji se čuvaju u Sveučilišnoj knjižnici u Puli; Herkulova su vrata u potpunosti zanemarena.

1. INTRODUCTION

Wishing to bestow upon the monuments of Pula the care they rightly deserve, in the course of 2010 and 2011 we decided to inspect them and to record the circumstances they are in, so that we can focus on the conditions, potential problems and on all the eventually required works and interventions.

The first in a series of analyzed and published monuments was the Double Gate at Pula (Gobić-Bravar, 2011, pp. 177-204). Continuing thus along the town wall, we come to the next Roman gate that in the course of history failed to get the attention it rightly deserves, which is Hercules’ Gate.



Sl. 1 Herkulova vrata 1887. godine
Fig. 1 Hercules’ Gate in 1887.

1.1 A historical review

“Prossima a questa si e’ la Porta d’Ercole, delle secondarie e minori, di semplice costruzione, la quale ai tempi più antichi della colonia rimonta. Vi si vedono rozzamente scolpiti la testa d’Ercole e la clava, ed i nomi dei duumviri, supremi magistrati di Pola, durante il regimento dei quali venne aperta.”¹ (Kandler, 1845, p. 40)

Hercules’ Gate was erected in the 1st century BC in the area where the old hillfort entrance stood, which connected the hillfort at Pula with Nesactium. It was built with massive limestone blocks, and placed at an angle of 68 degrees with respect to the town wall. This gate got its name from the depictions in relief showing a bludgeon and the bearded head of Hercules with his neck, which were hewn out of the stone blocks on the left and right side of the keystone. (Starac, Mihovilić, 2001, p. 21)

¹ “Immediately after it comes Hercules’ Gate that is of minor importance and smaller, built in a simple manner, which originates from the oldest period of the colony. Visible on this gate is the coarsely hewn head of Hercules and bludgeon, as well as the duumviri, Pula’s top magistri, during whose rule it was erected.”

Godine 1818. Pietro Nobile obavlja iskopavanja u amfiteatru, a tom prilikom radnike šalje i da iskopaju luk ovih vrata, koji se 1816. tek nazirao. U nekoliko dana u potpunosti su otkopana gotovo do tla i Nobile ih opisuje kao "...rustična, iz velikih kamenih blokova, u potpunosti očuvana. U ključnim blokovima luka vidi se glava u visokom reljefu, ali i izuzetno istrošena, i toljaga. Obzirom na način na koji su postavljena vrata, vjerojatno gradska, u smjeru glavne osi amfiteatra, navodi nas da su nekako povezana s cestom koja je vodila do glavnog ulaza u amfiteatar. Dodatna iskopavanja samih vrata mogla bi ponuditi rasyjetljavanje situacije i biti izuzetno zanimljiva." (Rusconi, 1926, str. 357). Otkrivanje Herkulovih vrata bilo je od velikog značaja za poznavanje povijesti nastanka pulske kolonije. Naime, tada je otkriven i po prvi put pročitani (Pavan, 1998, str. 394) natpis koji se proteže duž dva gornja kamena bloka luka, a koji preciznije datira izgradnju bedema novoosnovane kolonije Pole (Starac, Mihovilić, 2001, str. 21-22).



Sl. 2 Herkulova vrata na staroj razglednici, 1903. godine
Fig. 2 Hercules' Gate on an old postcard from 1903.

Mlakar points out that this is "the oldest structure of the defensive town wall complex in the ancient-Roman colony of Pula..." (Mlakar, 1978, pp. 21, 28)

As was the case with all monuments at Pula, this gate also underwent numerous changes in the course of nearly two thousand years of its history, which detrimentally affected it, being responsible for scores of different damages. However, it is well-nigh impossible to discover any data about occurrences tied with this monument, which could shed some light upon it, in order to better comprehend its present condition.²

It is known that Pula's defensive wall was on several occasions demolished, re-built and demolished again. In 1299, the inhabitants of Pula renewed the town wall, but already in 1300 they promised to tear down the newly erected wall (Kandler, 1986, p. 844). Such works surely had an effect on the overall state of Hercules' Gate, but the gate itself was never mentioned in any documents.

In 1818, Pietro Nobile carried out the excavations in the amphitheater, and it was on this occasion that he sent a group of workers to excavate the arch that was barely visible in 1816. In a few days the gate was excavated in its entirety, almost to ground level, and Nobile described it as "...rustic, made of large blocks, and thoroughly preserved. Visible on the voussoirs that flank the keystone of the arch, is a head hewn in alto relievo, which is extremely worn out, and a bludgeon. The positioning of this gate that was probably an entrance into the town proper, in the direction of the main axis of the amphitheater, leads us to the assumption that it was in some way connected with the road that led to the main entrance of the amphitheater. Additional excavations of the gate itself could perhaps offer some more insight into the situation, and they would surely be extremely interesting." (Rusconi, 1926, p. 357). The discovery of Hercules' Gate contributed a great deal towards a better understanding of history in conjunction with the founding of the colony of Pula. Namely, it was on that occasion that an inscription, extending across the upper two voussoirs of the arch, was unearthed and read for the first time (Pavan, 1998, p. 394). This inscription gives a more precise date for the erection of the defensive wall of the newly founded colony of Pula (Starac, Mihovilić, 2001, pp. 21-22).

Out of all the activities that went on around Hercules' Gate, the erection and demolition cycles of the town wall surely had the greatest impact on the gate itself. It was thus that the defensive wall on the eastern edge of

² In the course of 2010, in conjunction with an effort to get better acquainted with the historical conservation state of Pula's monuments, all documents written by Kandler, which are currently kept in the University Library at Pula were researched, but it was soon apparent that Hercules' Gate was completely neglected.

Od svih događaja koji su se oko Herkulovih vrata odvijali svakako su na sama vrata najviše utjecala rušenja i obnavljanja gradskih zidina. Tako su godine 1857./58. porušeni i zatrpani bedemi istočnog ruba urbane jezgre (Starac, Mihovilić, 2001, str. 15). Početkom XX. stoljeća Gnirs nadzire iskopavanja oko Herkulovih vrata, kada se ponovno otkrivaju i stari bedemi te se probija nivo antičke ceste i prolaz ispod vrata spušta oko 80 cm ispod originalne razine tla u rimsko doba (Gnirs, 1902, str. 51-52). Još je opsežnih pothvata otkopavanja gradskih bedema s obje strane Herkulovih vrata provedeno 1932./33. godine (Starac, Mihovilić, 2001, str. 16).



Sl. 3 *Herkulova vrata 1925. godine*
Fig. 3 *Hercules' Gate in 1925.*

Svi navedeni događaji koji se vezuju uz Herkulova vrata uglavnom su doprinijeli njihovom očuvanju. Višestoljetna zatrpanost onemogućila je njihovo rušenje, a posebice ih je spasila od stanovništva, koje je imalo praksu sa starih građevina uzimati kameni materijal te ga ponovno koristiti u građevinske svrhe. Od njihovog otkrivanja do danas prošlo je gotovo dva stoljeća, period u kojem su na vratima sigurno obavljani zahvati. Na četvrtom kamenom bloku južne vanjske strane vrata prisutna je kamena zakrpa. Iako bi ovakva zakrpa mogla biti i originalna, vrsta i način obrade kamena sugeriraju noviju dataciju, a tu činjenicu potvrđuje razglednica iz 1902./1903. godine na kojoj je zakrpa vidno bijela u odnosu na ostatak spomenika. Drugi značajniji zahvat na vratima jest zatvaranje sljubnica luka cementnim mortom.

U arhivu Grada Pule postoji dokument koji svjedoči o manjem zahvatu obavljenom uz Herkulova vrata. Vlasnik restorana Arco Romano kojemu se pristupa

the urban core was demolished and covered with fill in 1857-58 (Starac, Mihovilić, 2001, p. 15). At the beginning of the 20th century, Gnirs supervised the excavations carried out around Hercules' Gate, and it was on this occasion that the old defensive wall was re-discovered, and the Roman road excavated, which resulted in the lowering of the ground level in the passage underneath the gate for approximately 80 cm below the original level of the ground in the Roman period (Gnirs, 1902, pp. 51-52). There were other instances of massive excavation works of the town wall on both sides of Hercules' Gate in 1932-33 (Starac, Mihovilić, 2001, p. 16).

All the above mentioned occurrences tied with Hercules' Gate had on the whole a positive effect for its preservation. The fact that the gate was covered with earth for centuries certainly prevented the local population from devastating the monument by using it as a source of ready-made building material. Nearly two centuries have passed since the gate was discovered, and we can be sure that in this period several interventions were carried out on this monument. A stone patch is located on the fourth stone block of the southern exterior side of the gate. Although a patch like this could also be original, the type of stone and the manner in which it was dressed indicate a more recent dating, and this fact is corroborated by a postcard from 1902-1903, where this patch is shown as being visibly white in comparison with the rest of the monument. Another important intervention performed on Hercules' Gate is the grouting of the arch joints with cement mortar.

There is a document in the archives of the town of Pula, which corroborates that a small-scale intervention was carried out alongside Hercules' Gate. The owner of the Arco Romano restaurant that was accessed through Hercules' Gate requested from the municipal administration a permission to alter this approach. He went on by suggesting the removal of three exterior access-stairs, which were to be replaced with six new ones to be placed within the gate itself. He also proposed the erection of a wooden paneling in order to close the corner between the circular tower and the town wall, in order to transform this area into a public toilet. This conceptual design was accompanied by a series of plans showing the conditions that existed in the field at the time and the appearance of the area after the completion of the suggested works. The municipal administration allowed him to carry out these works, imposing upon him the duty to hand over the removed stairs to the pertinent authorities, and to erect the wooden paneling in such a manner that it can be removed at any given time. This document not only explains why on a photograph from 1887 these stairs can be seen and on those from 1903

kroz Herkulova vrata traži od gradske uprave dozvolu za preuređenje prilaza. Predlaže da se uklone tri vanjske prilazne stube te da se novih šest stepenica smjesti unutar samih vrata, kao i da se drvenom oplatom zatvori ugao između kružne kule i gradskih zidina, a sve zato što se prostor pretvara u javni toalet. Idejni projekt upotpunjuje nacrtima postojećih stanja i projekcijom izgleda nakon planiranih radova. Gradska uprava odobrava radove te mu nalaže da odstranjene stube deponira pri upravi i da drvena oplata bude u potpunosti odstranjiva u bilo kojem trenutku. Osim što ovaj dokument objašnjava zašto su na fotografiji iz 1887. stube prisutne, a na onima iz 1903. i 1925. nisu, on nam pokazuje da je gradska uprava krajem XIX. stoljeća ozbiljno pazila na očuvanje spomenika namećući obavezu traženja odobrenja za obavljanje radova i konzervatorski ih prateći.

2. DEGRADACIJA HERKULOVIH VRATA

Danas je na Herkulovim vratima moguće vidjeti paletu degradacija tipičnih za antičke spomenike smještene u urbanim sredinama. One su uglavnom vezane uz atmosferske utjecaje, zagađenje i ljudsku ruku. Srećom, u odnosu na druge pulske spomenike, vrste degradacija kao i njihova statička opasnost nisu zabrinjavajući.

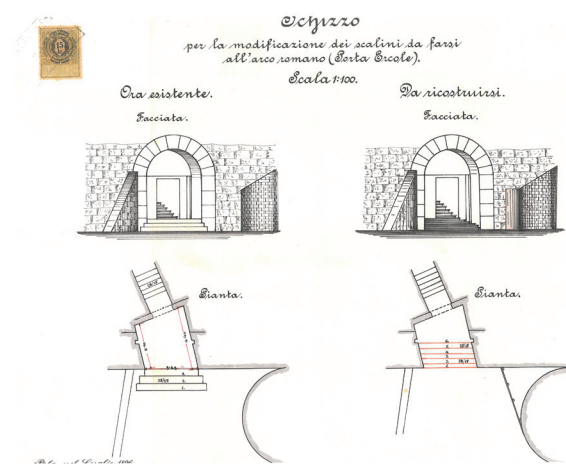
Degradacije je moguće podijeliti u dvije grupe – one koje su u širokom opsegu prisutne na svim površinama spomenika te one koje su prisutne tek na nekoliko pozicija. Široko su prisutne: alveolizacija, sive patine, lišaji (nekoliko vrsta), vegetacija, cementne zakrpe i površine prekrivene rekristaliziranim kalcitom. Manje su prisutne crne kruste, željezni elementi i mrlje.

U slučaju Herkulovih vrata pri izradi nacrti koji prikazuju mapiranje degradacija odlučeno ih je prezentirati tek nekoliko vrsta, dok su ostale dokumentirane samo fotografski. Tako na primjer sive patine (koje tvore osušene kolonije lišaja) nisu dokumentirane na tematskim nacrtima, s obzirom da one prekrivaju gotovo sve površine spomenika, kao ni metalni elementi i mrlje, jer su izuzetno slabo zastupljeni i ne predstavljaju opasnost za njegovo očuvanje.

2.1 Mrlje

Mrlje na Herkulovim vratima u većini slučajeva uzrokovane su ljudskom djelatnošću. Na jednom se mjestu radi o ostacima boje koja je vjerojatno korištena pri bojanju obližnjeg zida. Na više su mjesta prisutni ostaci silikonskog kita, koji na kamenu ostavljaju mrlje, te ostaci plastične mase, pretpostavlja se epoksidnog ljepila, koji su također umrljali kamen. Pretpostavka je da su i ostaci silikona i oni plastične mase služili

and 1925 that is no longer the case, but it also shows us the great care that the municipal authorities bestowed on the preservation of monuments towards the end of the 20th century, demanding a written permission for any intended works, making sure that the approved works had been correctly executed as far as the conservation of the monument is concerned.



Sl. 4 Nacrt koji prikazuje postojeću situaciju Herkulovih vrata te predloženo pomicanje stepenica i zatvaranje ugla između zidina i kružne kule
Fig. 4 A plan showing the existing situation around Hercules' Gate, the proposed transfer of the stairs, and the closure of the corner between the town wall and circular tower.

2. THE DEGRADATION OF HERCULES' GATE

Nowadays it is possible to observe a whole series of degradations on Hercules' Gate, which are typical for ancient monuments located in urban environments. These are predominantly connected with atmospheric influences, pollution and man-made damages. Fortunately, in comparison with other monuments at Pula, these kinds of degradations and the threat they pose to the static stability of the monument are not worrisome.

These degradations can be included into two groups, i.e., those that are present everywhere on the monument on a grand scale, and those that are only sporadically present in some areas. The degradations present on a broad section of the monument's surface are: alveolization, gray patina, lichens (several types), vegetation, cement fillings and surfaces covered with recrystallized calcite. Present on a lesser scale are black incrustations, metal parts and stains.

When making the charts showing the mapped degradations in the case of Hercules' Gate, it was decided to show but a few kinds of degradation, whereas the others were documented only by way of photographs.



Sl. 5 i 6 Herculova vrata danas - pročelje i stražnja strana
Fig. 5 and 6 Hercules' Gate at present. The façade and the back side.

Thus, for example, gray patinas (that constitute the dry lichen colonies) are not documented on the thematic charts because they cover almost all the surface of the monuments, and likewise, metal elements and stains are not documented because these degradations are poorly represented and do not pose a threat to the preservation of a monument.

2.1 Stains

The stains found on Hercules' Gate were in the great majority of cases caused by human activities. At one such spot we have the remains of a color that was probably used to paint a nearby wall. On several other spots there are remnants of a silicone sealant that leaves stains on stone, and there are also remains of a plastic substance, presumably epoxy glue, which likewise stains stone. It is assumed that both the sealant and the glue were used to fasten a sign or inscription on the stone blocks of the monument. The selection of these means of fastening is not such a bad one, as it does not entail the drilling of the stone blocks in order to affix the signs; however, it would be desirable to give the stone surface a protective coating before the use of such substances, and to clean these surfaces once the signs are removed.

2.2 Black incrustations

Every monument that is located in an urban environment and exposed to atmospheric influences will in the course of time be covered with dirt of various kinds, which will adhere with more or less intensity to the stone surface. These deposits are mainly gray to black in color and are located in areas that are protected from rainfall.

Generally speaking, black incrustations represent one of the most widely spread types of degradation on stone monuments located out in the open. However, black incrustations on Hercules' Gate managed to spread in a very limited area and are only present in thin layers on the inner edge of the arch roof.

2.3 Presence of vegetation

Vegetation develops in crevices with the help of water, in which there are dust and earth accumulations as a result of wind.

There is a large amount of vegetation present on this monument. Fortunately, these are smaller plants but they too impact the stone in a detrimental way. On Hercules' Gate, vegetation is spread along the joint between the gate and the town wall, whereas in between the stone blocks of the monument itself it is present on a much smaller scale.

za učvršćivanje ploče ili natpisa na kamene blokove spomenika. Odabir ovog sredstva nije toliko loš, jer se na taj način vjerojatno željelo spriječiti bušenje kamena u cilju postavljanja ploča, ali bilo bi poželjno da se prije aplikacije ovakvih sredstava kamen premaže nekakvom zaštitom te da se nakon odstranjivanja ploča njegova površina očisti.



Sl. 7 Primjer mrlja
Fig. 7 An example of stains.

2.2 Crne inkrustacije

Svaki spomenik koji se nalazi u urbanoj sredini i izložen je atmosferskim utjecajima bit će s vremenom prekriven raznim nečistoćama koje će manje ili više prionuti uz kamenu površinu. Ovi su depoziti uglavnom sive do crne boje i obično se nalaze na mjestima koja su zaštićena od kiše.

Crne su inkrustacije, općenito gledajući, jedna od najzastupljenijih i najopširnijih vidova degradacije kamenih spomenika na otvorenom. No, kod Herkulovih su vrata vrlo malog opsega te su prisutne tek u tankim slojevima s rubne unutarnje strane svoda luka.

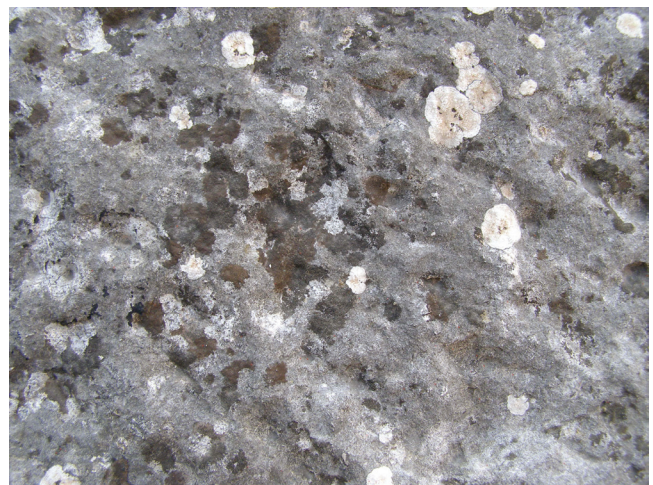


Sl. 8 Crne inkrustacije ispod reljefa glave Herkula
Fig. 8 Black incrustations underneath Hercules' head in relief.

2.4 Biological patina

Biological patina is represented by layers of active lichens. With their hyphae lichens form small cavities that in the course of time become a true net of small interconnected cavities in the stone, which grow ever larger. Likewise, the acid substances that are created as a result of their metabolism damage the surface of the stone by melting the limestone (Malinar, 2001, pp. 38–42).

Active biological patinas on Hercules' Gate are present mainly on its high sections where they cover broad surfaces of the monument. If we compare Hercules' Gate with the Double Gate or the Amphitheater, it is interesting to note the different colors, i.e., types of lichens present. Whereas on the Double Gate and Amphitheater we encounter mainly yellow-brown lichens, on Hercules' Gate it is possible to discern at least three different colors that stand presumably for three different kinds of lichens: white, yellow-brown and black.



Sl. 9 Fotografija detalja lišajeva prisutnih s gornje strane luka
Fig. 9 A detail showing lichens present on the upper side of the arch.

2.5 Alveolization

Alveolization is a form of mechanical degradation that is connected directly with the structural characteristics of the stone, its porosity, the amount of soluble salts on the surface or immediately below the surface of the stone, and atmospheric conditions (a high relative degree of humidity and windiness coupled with the creation of micro twisters in zones near the surface of the stone) (Lazzarini, Laurenzi Tabasso, 2012).

On Hercules' Gate, alveolization covers almost the entire surface of the façade. The most conspicuous aspect of alveolization is marked on the degradation tables, where alveoli are extremely dense and/or large and deep. This aspect of degradation is present on the majority of Pula's monuments on a large scale. Moreover,

2.3 Prisutnost vegetacije

U pukotinama, gdje se zbog vjetrova nakuplja prašina i zemlja, uz prisutnost vode razvija se i vegetacija.

Vegetacija je na spomeniku prisutna u velikom broju. Srećom, radi se o manjim biljkama, no i one imaju negativan učinak na kamen. Kod Herkulovih vrata očigledno je širenje vegetacije duž spoja s gradskim zidinama, dok je ona u puno manjem broju prisutna između samih kamenih blokova spomenika.

2.4 Biološka patina

Biološku patinu predstavljaju slojevi aktivnih lišajeva. Oni svojim hifama stvaraju sitne rupice koje s vremenom postaju prava mreža povezanih i sve većih rupica u kamenu. Također, kisele tvari koje nastaju kao produkt njihova metabolizma oštećuju površinu kamena topeći vapnenac (Malinar, 2001, str. 38-42).

Aktivne su biološke patine na Herkulovim vratima uglavnom prisutne na njegovim visokim dijelovima, gdje prekrivaju široke površine. Uspoređujući Herkulova s Dvojnimi vratima i amfiteatrom zanimljivo je obratiti pažnju na različitu boju, odnosno vrstu prisutnih lišajeva. Naime, dok su kod Dvojnih vrata i amfiteatra najzastupljeniji žuto-smeđi lišajevi, na Herkulovim vratima moguće je izdvojiti barem tri različite boje pa slijedom toga, pretpostavlja se i vrste lišajeva: bijeli, žuto-smeđi i crni.

2.5 Alveolizacija

Alveolizacija je vid mehaničke degradacije koja se direktno povezuje sa strukturalnim karakteristikama kamena, njegovom poroznošću, količinom topivih soli na površini ili odmah ispod površine kamena te atmosferskim uvjetima (visoka relativna vlaga i vjetrovitost uz stvaranje mikrovrtloga zraka u zonama blizu kamene površine) (Lazzarini, Laurenzi Tabasso, 2012).

Na Herkulovim vratima alveolizacija pokriva gotovo čitavu površinu pročelja. Na degradacijskim je pločama označen najizraženiji vid alveolizacije, gdje su alveole izuzetno guste i (ili) velike i duboke. Ovaj je vid degradacije prisutan na većini pulskih spomenika u širokom opsegu. Ipak, optičkim pregledom čini se da je na Herkulovim vratima izuzetno izražen te pokriva opsežnu površinu. Uzrok ovakvoj situaciji mogao bi biti sličan onomu za crne kruste. Naime, vrata se nalaze u zaštićenom kanalu kroz koji vjetar prolazi pojačanim ritmovima, a pri ulasku s ulice sudara se sa stubištem, pri čemu se dio zraka vraća prema vratima te tako može stvarati male zračne vrtloge. Kako je naglašeno, alveolizacija je prisutna na svim površinama

after an optical examination it seems that this problem is particularly acute on Hercules' Gate, where it covers a sizable portion of the monument's surface. The reasons for this might be similar to those that are responsible for black incrustations. In other words, the gate is located in a protected channel through which the wind passes in strengthened rhythms, but upon entering from the street it collides with the staircase, which causes part of the air mass to return towards the gate, creating small twisters as it does so. As was already stressed, alveolization is present on all surfaces of the monument, but the most conspicuous parts suffering from it are the blocks of stone just above the ground, where it forms a straight line that probably accentuates the direction of the most frequent passage of the wind.

There can be multiple negative effects that alveolization can cause on the structure of a monument. The small cavities (alveoli) represent spaces where earth and water can accumulate, facilitating thus the creation of vegetation. Likewise, in winter the water in them can freeze, causing the stone to burst.



Sl. 10 Kameni blok zahvaćen alveolizacijom
Fig. 10 A block of stone beset with alveolization.

2.6 Crevices

Mechanical breakages are often amongst the degradations found on historical monuments. Hercules' Gate is no exception although there are not many crevices on it. A visual inspection does not suffice to determine the depth of the crevices, or the danger they pose for the structural stability of the monument. At any rate, crevices represent a major degradation as they pave the way for major subsequent damages. As was the case with alveolization, they could harbor dust and water which in turn would result in vegetation, or else they could cause the creation of new crevices due to the freezing of water in wintertime.

spomenika, ali najizraženija je na blokovima uz tlo, gdje tvori pravilnu crtu koja vjerojatno naglašava smjer najučestalijeg prolaska vjetra.

Štetnost alveolizacije za strukturu spomenika može biti višestruka. Rupe (alveole) predstavljaju prostore u kojima se može nakupljati zemlja i voda te dovesti do razvoja vegetacije. Također, u njima se zimi može zalediti voda i tako prouzročiti pucanje kamena.

2.6 Pukotine

Mehanička puknuća često su dio degradacije povijesnih spomenika, a zabilježena su i na Herkulovim vratima, iako u manjem broju. Vizualnim pregledom nije moguće utvrditi dubinu pukotina, odnosno njihovu opasnost za statiku spomenika, no one u svakom slučaju predstavljaju bitnu degradaciju jer su uvođu u veća oštećenja. Kao i kod alveolizacije, u njima se može nakupiti prašina i voda te omogućiti razvoj vegetacije ili uzrokovati nastanak novih pukotina uslijed smrzavanja vode zimi.

2.7 Cementne ispune

Tijekom godina na Herkulovim su vratima obavljena razna "krpanja", prilikom čega je korišten i cementni mort. Cement je korišten za tri glavne vrste popravaka: kao ispuna velikih rupa nastalih alveolizacijom, za zapunjavanje sljubnica kamenih blokova luka, vjerojatno radi učvršćivanja i sprječavanja prodora vode, njenog otjecanja kroz blokove i uzrokovanja kalcitnih krusti, te za površinsko premazivanje čitavog bloka koji je vjerojatno bio zahvaćen visokim stupnjem ispućnosti i ljuskanja. Tehničke karakteristike cementa, vezane uz elastičnost i termičko širenje, jako se razlikuju od karakteristika kamena. Također, cement se izuzetno čvrsto veže za kamen. Stoga se događa da se nakon određenog broja godina, tijekom kojih dolazi i do različitih mehaničkih pomaka kamena i cementa, potonji odvaja od kamene površine i otpada, ali budući da se čvrsto veže za kamen, "povuče" za sobom i njegov površinski sloj. Čak i da se cement ne odvoji sam od kamene površine, problem je što ga je u slučaju bilo kakve potrebe za radovima na spomeniku gotovo nemoguće odstraniti bez oštećenja površine kamena. Posljednji, ali ne manje važan problem jesu topive soli koje su prisutne u cementu i koje s vremenom ulaze u strukturu kamena (Malinar, 1996, str. 37-40).

2.7 Cement fillings

In the course of the years, numerous repair works were executed on Hercules' Gate, and for some of these works a cement mortar was employed. Cement was used for three main kinds of repair work: as fill for the large cavities created as a result of alveolization, to grout the joints of the stone blocks on the arch, which was probably done in order to strengthen it and to prevent the penetration of water, its flow through the blocks and creation of calcite crusts, as well as to coat a whole block of stone that was probably beset with a large number of crevices and threatened with flaking. The technical characteristics of cement, as regards elasticity and thermal spreading, differ greatly from those of stone. Furthermore, cement adheres exceptionally well to stone. A consequence of this is that after a certain number of years, during which different mechanical shifts of both stone and cement occur, the latter separates itself from the stone surface and falls off, taking with it a superficial layer of stone because of its extraordinary adherence to it. Even if the cement does not fall off from the stone surface by itself, the problem is that in case of any needed repair works on a monument, it is well-nigh impossible to remove it without damaging the stone surface. The last but by no means less important problem is the presence of soluble salts in cement, which with time enter into the structure of the stone (Malinar, 1996, pp. 37-40).



Sl. 11 Primjer velikih alveola zapunjenih cementnim mortom
Fig. 11 An example of large alveoli filled with cement mortar.

2.8 Metalni dijelovi

Uvidom u stanje Herkulovih vrata nije zamijećeno postojanje metalnih klinova i spona, što naravno nije pokazatelj da one ne postoje unutar samoga spomenika. Metalni elementi koji se pojavljuju na degradacijskim kartama uglavnom su željezni čavli koji su (osim na jednoj nadogradnji) umetnuti u sljubnice između blokova.



Sl. 12 Primjer željeznog čavla između dva kamena bloka
Fig. 12 An example of an iron nail between two blocks of stone.

3. PRIJEDLOZI RADOVA

3.1 Dokumentacija i analiza stanja

Za početak radova na Herkulovim vratima svakako je potrebno izraditi novu tehničku dokumentaciju. Naime, postojeći arhitektonski nacrti su u mnogim detaljima netočni, nepotpuni pa čak i pogrešnih dimenzija. Za potrebe izrade degradacijskih karata korišteni su nacrti Zavoda za katastar i geodetske poslove grada Zagreba, koji su prerađeni ne bi li odgovarali realnom stanju spomenika. Za izradu razvedenog pogleda luka iznutra korištene su fotografije, temeljem kojih je izrađen nacrt. Svakako bi bilo zanimljivo izraditi 3D snimku spomenika, ali ono što je najpotrebnije jesu nacrti i presjeci postojećeg stanja u prikladnom mjerilu, uz razvedeni pogled na luk iznutra i izvana. Također bi bilo poželjno nove nacрте dopuniti degradacijskim kartama koje su izrađene tijekom 2012. godine ili novijima.

S ciljem uvida u strukturalno stanje spomenika moguće je načiniti nekoliko različitih testova i analiza, poput termografskog snimanja, magnetometrijskog testa, ultrazvučnog testa i dinamičkog testa akcelometrima. Ovi testovi omogućili bi kvalitetnije predviđanje načina ponašanja spomenika u statički opasnim situacijama poput potresa.

2.8 Metal parts

An inspection of Hercules' Gate revealed no metal parts on this monument, which does not mean that they don't exist in the interior of the monument itself. The metal elements shown on the degradation charts represent mostly iron nails that were (except in one instance) driven into the joints between the blocks of stone.

3. PROPOSED WORKS

3.1 Documentation and situation analysis

A new technical documentation must be compiled prior to the beginning of any works on Hercules' Gate. In other words, the existing architectural drawings are outdated and many details are incorrect, incomplete and even feature wrong dimensions. To make the degradation charts, plans made by the City Office for Cadastre and Geodetic Activities from Zagreb were used, which had to be re-worked in order for them to match the present-day state of the monument. Photographs were used to present a view of the expanded arch from the inside, based on which a plan was drawn. It would certainly be interesting to create a 3D image of the monument, but what is needed most are plans and cross-sections of the existing situation in the appropriate scale, including a view of the expanded arch, both from the inside and outside. It would also be desirable to include in these new plans the degradation charts that have been compiled during 2012 or later.

In order to inspect the structural condition of the monument it is possible to make a few different tests and analyses, like thermographic imaging, a magnetometric test, an ultrasound test, and a dynamic test using accelerometers. These tests would give us a better insight into the way the monument would react in statically dangerous circumstances, like during an earthquake.

The afore mentioned tests are by no means destructive; however, to get a better insight into the state of the monument it would be desirable to perform several tests that necessitate the taking of material samples of the stone from the monument, as well as samples of the recorded degradations. These tests include:

- A petrographic analysis of the stone type, with a possibility of determining the quarry from where it was taken.
- A definition of basic parameters of the stone material: porosity and type of porosity (open or closed), and its mechanical characteristics.
- Quantitative chemical analyses of salts present within the stone structure and on its surface.
- An analysis of the transverse micro-cross-section and surface of the stone, in order to get an insight into the

Ovi testovi nisu destruktivni, no zbog kvalitetnijeg uvida u stanje spomenika bilo bi poželjno učiniti i nekoliko testova za koje treba uzeti uzorke kamenog materijala spomenika i uzorke zabilježenih degradacija. To su:

- petrografska analiza vrste kamena uz mogućnost determinacije kamenoloma porijekla
- definiranje osnovnih parametara kamenog materijala: poroznost i vrsta poroznosti (otvorena ili zatvorena), mehaničke karakteristike kamena
- kvantitativne kemijske analize soli prisutnih unutar kamene strukture i na površini kamena
- analiza poprečnog mikropresjeka i površine kamena, ne bi li se dobio uvid u površinsko stanje kamenog materijala te tako nakon izvedenih radova mogao vidjeti utjecaj koji su zahvati imali na kamenu
- analiza presjeka površine zahvaćene lišajevima i biološka determinacija vrsta lišajeva

S obzirom da su ovi prijedlozi tek uvodnog karaktera, ne definiraju se mjesta uzorkovanja. Ona bi se trebala odrediti pažljivom usporedbom postojećih degradacija i okolnih pojava koje na degradacije utječu, ne bi li se dobiveni podaci mogli kvalitetno povezati s planiranjem budućih konzervatorsko-restauratorskih zahvata.

Uz sve ove analize koje se vezuju uz spomenik bilo bi korisno imati uvid u podatke o kvaliteti zraka u području Herkulovih vrata, uz poseban osvrt na čestice ugljika i kristale soli, te u podatke o vjetrovitosti na tom području. Ove su informacije bitne za razumijevanje procesa nastanka crnih krusti i alveolizacije.

3.2 Prijedlog konzervatorsko-restauratorskih zahvata

Za konzervatorsko-restauratorske zahvate moguće je koristiti raznovrsne metode, za čiji se sažeti opis osvrćemo na članak o Dvojnim vratima (Gobić-Bravar, 2011, str. 190-196).

Konzervatorsko-restauratorski zahvati koje bi trebalo planirati za ovaj spomenik jesu čišćenje crnih krusti i sivih površina prekrivenih odumrlim lišajevima, odstranjivanje cementnih ispuna, zakrpa i premaza, odstranjivanje štetnih soli akumuliranih na površini i pod površinom kamena, učvršćivanje pukotina, uklanjanje vegetacije i bioloških kolonija te konsolidacijski i zaštitni premazi. U slučaju Herkulovih vrata posebna bi se pažnja trebala posvetiti tretiranju alveola. S obzirom na njihovu izuzetnu rasprostranjenost po čitavom spomeniku, bilo bi korisno provesti testiranje nekoliko varijanti njihova zapunjavanja, ne bi li se postigla ravnoteža između konsolidacijskog i estetskog učinka.

state in which the surface of the stone material is in, and to observe how the interventions influenced the stone after the works had been completed.

- An analysis of the cross-section of the surface beset with lichens, and a biological determination of lichen types.

Bearing in mind that these suggestions only have an introductory character, we do not define the sampling areas. They should be determined, though, by a careful comparison between the existing degradations and other fringe occurrences that influence these degradations, in order to interconnect the thus obtained data and use the results to plan future conservation-restoration interventions.

Besides the afore mentioned analyses tied with the monument itself, it would also be beneficial to have data regarding air quality in the area of Hercules' Gate, with particular attention paid to carbon particles and salt crystals, as well as information regarding winds in this area. This information is essential for the understanding of the process of creation of black incrustations and alveolization.

3.2 Proposed conservation-restoration interventions

Different methods can be used for conservation-restoration interventions; for their concise description we refer to the article about the Double Gate (Gobić-Bravar, 2011, pp. 190-196).

The conservation-restoration interventions that should be planned for this monument include the cleansing of black incrustations and gray surfaces covered with lichens that have died off, the removal of cement fillings, patches and coatings, the removal of harmful salts that accumulated on the surface and underneath the surface of the stone, the reinforcement of crevices, the removal of vegetation and biological colonies, and the application of consolidating and protective coatings. In the case of Hercules' Gate, special attention should be paid to the treatment of alveoli. With regard to their extraordinary diffusion all over the monument it would be of benefit to test several variants for their filling in order to obtain a balance between the consolidating and aesthetic function.

At any rate it is important to stress that before the beginning of any works, a series of tests in conjunction with the cleaning, consolidation and protective coating of the monument should be performed, in order to establish the methods and products that best suit both the type of stone and monument.

Svakako je bitno naglasiti da prije početka radova treba provesti testove čišćenja, konsolidacije i zaštitnog premaza, da bi se utvrdile metode i proizvodi koji najbolje odgovaraju vrsti kamena i spomenika.

4. MONITORING

Nakon samih konzervatorsko-restauratorskih zahvata bitno je ne zaboraviti na spomenik, kao i ne smatrati da je njihovim okončanjem ova problematika zauvijek riješena. Praćenje stanja spomenika (monitoring) od jednake je važnosti za njegovo očuvanje kao i prethodni zahvati.

Spomenik valja redovito obilaziti te sustavno bilježiti sve primijećene promjene. Na taj je način moguće pravovremeno reagirati i zaustaviti ili ublažiti nastanak degradacija.

Redovitim praćenjem stanja spomenika on ne pada u zaborav i dobiva svoje vrijedno mjesto kao kulturno dobro, simbol povijesti.

5. ZAKLJUČAK

Ne bi li se prikazalo stanje Herkulovih vrata, pažljivo su promatrani svi dijelovi spomenika. Zabilježene su i na tematskim nacrtima mapirane sve degradacije bitne za očuvanje spomenika. Odlučeno je da će se koristiti boje (nasuprot normiranom grafičkom sistemu obilježavanja) za obilježavanje degradacija, ne bi li ih se jače istaknulo kad mapirani nacrti postanu dijelom članka. Prijedlozi budućih aktivnosti i mogućih zahvata tek su informativnog karaktera, ali jasno ukazuju na potrebe spomenika i eventualni vremenski redosljed zahvata.

Neovisno o nastavku aktivnosti i radova, od velike je važnosti postojanje grafičke, pisane i foto dokumentacije o realnom stanju ovog antičkog spomenika u 2012. godini.

4. MONITORING

After the completion of conservation-restoration works it is important not to forget the monument, nor to consider that these issues had been resolved forever. The monitoring of the monument is equally important for its conservation as were the previous interventions.

The monument should be inspected on a regular basis, its condition should be monitored, and all observed changes systematically recorded. In this way it is possible to react on time in order to stop or lessen the creation of degradations.

Regular monitoring of the monument prevents it from falling into oblivion. The monument thus takes its valuable position as part of the cultural heritage and a symbol of history.

5. CONCLUSION

In order to show the state of Hercules' Gate, we carefully inspected all the sections of the monument. The observed degradations that are important for the preservation of the monument were recorded and mapped out on thematic charts. We decided to use color to mark the degradations (as opposed to the standardized system of graphical marking), in order to further accentuate them when these charts are included with the article. The expressed suggestions for future activities and possible interventions are only informative, but they nonetheless clearly indicate what needs to be done with this monument, and offer an eventual timeline for these interventions.

The existence of graphical, written and photographic documentation that presents a realistic image of this Roman monument in 2012 is of paramount importance, regardless of whether any of these activities and works will be continued.

Tabla 1 Pogledi na pročelje Herkulovih vrata - alveolizacija, biološki film i vegetacija, cementne ispune
Table 1 Views of the façade of Hercules' Gate - alveolization, biological film and vegetation, cement fillings.

Tabla 1

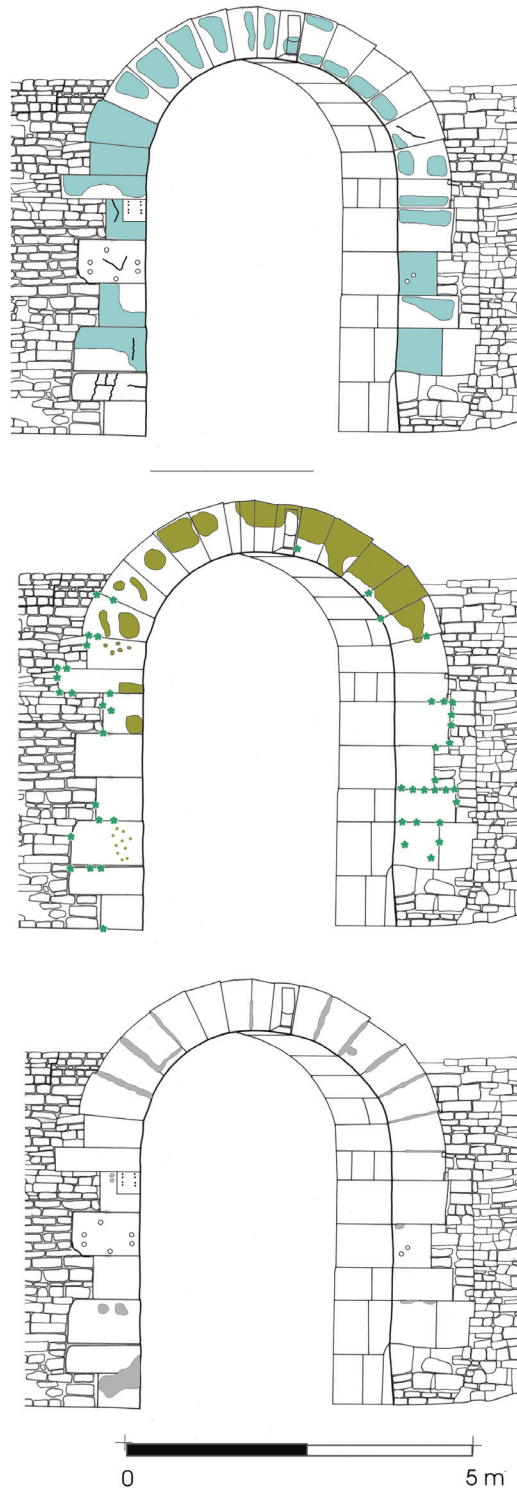


Tabla 2 Presjeci s pogledima na Herculova vrata - alveolizacija, biološki film i vegetacija, cementne ispune i mrlje
Table 2 Cross-sections with views of Hercules' Gate - alveolization, biological film and vegetation, cement fillings and stains.

Tabla 2

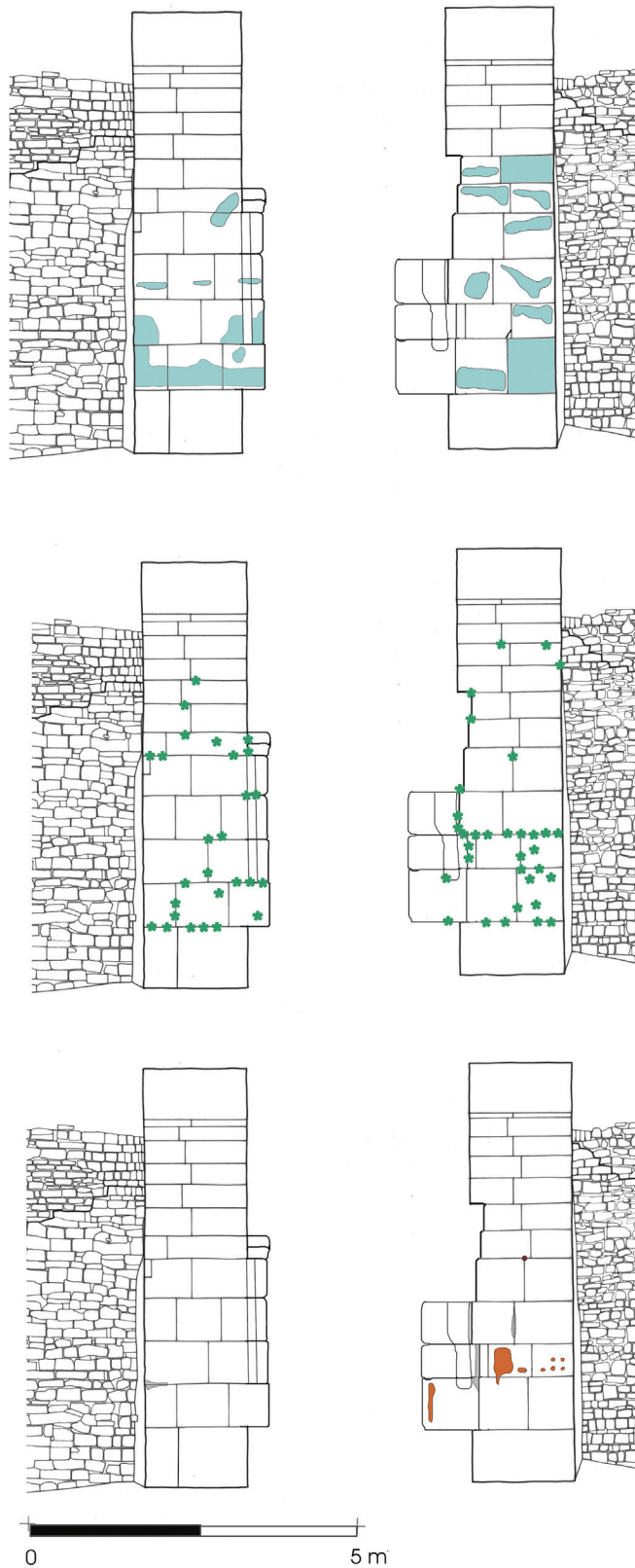
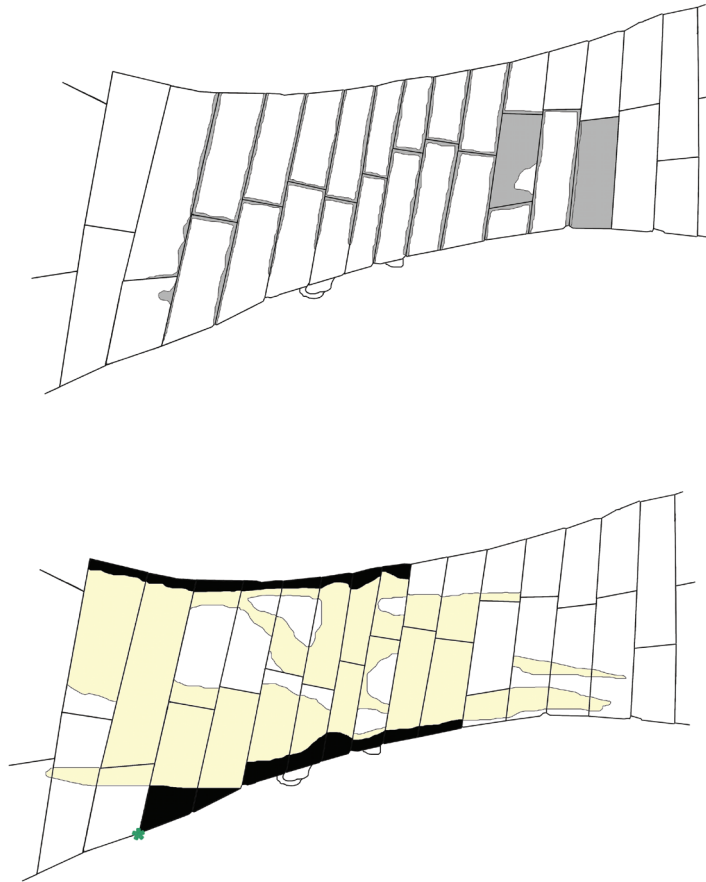


Tabla 3 Pogled na unutrašnji svod luka Herkulovih vrata - cementne ispune, crne inkrustacije i kalcifikacije
 Table 3 A view of the interior arch roof of Hercules' Gate - cement fillings, black incrustations and calcifications.

Tabla 3



Legenda degradacija / Degradations legend

	Mrlja / Stains
	Crna krsta / Black incrustations
	Vegetacija / Vegetation
	Biološka patina / Biological patina
	Alveolizacija / Alveolization
	Kalcifikacija / Calcification
	Pukotina / Crevices
	Cementna ispuna / Cement fillings
	Metalni dio / Metal parts

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