



Kolodvar, 13. st. – pogled s istoka na utvrdu Kolodvar, 13th century. - View of the fortress from the east



Kolodvar, 13. st. – zidina, način slaganja opeka u zidu (1 red vežnjak, 1 red dužnjak i 1 red vežnjak) Kolodvar, 13th century – method of bricklaying within the wall (1 course stretcher, 1 course header, 1 course stretcher)



Šarengrad, 15. st. – ulazna kula, ostaci pročeljne žbuke oko prozora Šarengrad, 15th century – gatehouse, remains of plaster around the window



Ilok, 15. st – zidina, ostaci braništa Ilok, 15th century – walls, remains of the battlements

## Formati opeka

Formati srednjovjekovnih opeka različiti su i čini se da su uvjetovani debljinom zida u koji se ugrađuju, a vjerojatno i običajima zidara koji su dolazili sa strane. Opeke manjih formata 4/11/21,5 cm, 5/9,5/20,5 cm, 5/11/22 cm, 5/10/23 cm najčešće su tijekom 13. st. Može se uočiti da stranice imaju omjer 1:2:4. Poneke opeke imaju odstupanja u omjeru stranica 5,5/9,5/24 cm. Kasnije u razdoblju gotike prevladavaju opeke srednjih veličina 6/12 – 13/26 cm i 5/13/27 cm. Oko 1500. godine u uporabi su veliki formati opeka 32 – 38/16 – 18/6 – 7 – 8 cm. Takvim opekama velikoga formata zidane su utvrde Iloka, Šarengrada, Erduta, Đakova, Bača (Srbija), Đurđevaca.

## Profilirane opeke

Najčešća uporaba opeke u kombinaciji je s kamenim profiliranim detaljima, no ima primjera da su umjesto kamena izrađivane profilirane opeke koje su rijetke ili bolje rečeno slabo sačuvane na utvrđama (ulomak kapitela kaštel Ivankovo). Profilirane opeke korištene su i na sakralnoj arhitekturi (crkva sv. Luke u Lipovcu, crkva u Tomašu kod Bjelovara, neki detalji zvonika u Šarengradu, neki ulomci pronađeni kod Gorjana i u Čazmi). U srednjovjekovnoj fortifikacijskoj arhitekturi opeke su često korištene u opločanju podova. Podovi stambenih i pomoćnih prostorija oblagani su posebno u kalupu pečenim opekama, *tavelicama*, kvadratnoga ili šesterokutnoga formata (šesterokutna podna opeka *tavelica* utvrde Bijela Stijena 26/22/5 cm). Prosječna veličina podnih opeka *tavelica* iznosila je od 20 – 22/20 – 22/ 4 – 5 cm. Za opločenje podova koristile su se i obične opeke (Ilok – palas Nikole Iločkoga), kao i rimske cjelovite opeke zbog velikoga formata i izrazite kvalitete (templarska utvrda Račeva).

## Vanjska i unutrašnja obrada ziđa od opeka

Srednjovjekovni zid od opeka, kao i onaj od kamena završno je bio ožbukani. Pored žbukanja radilo se i *fugiranje* kao što je to primjer palasa Nikole Iločkoga iz druge polovice 15.st. koji je imao fugirana pročelja. Prednost je takvoga načina u brzini gradnje i jeftinijem izvođenju. Pročeljna vapnena žbuka sačuvana je samo u tragovima, na nekim fortifikacijama u Slavoniji i zapadnome Srijemu. U blizini Iloka na utvrđi Šarengrad iz 15. st. sačuvani su ostaci tankoslojne pročeljne žbuke na ulaznoj kuli, oko prozorskoga otvora te djelomično na istočnoj strani, na spoju ulazne kule i zidine, gdje su sačuvani ostaci vertikalne lezene izvedene zaglađenom vapnenom žbukom. Svi otvori na pročelju imali su žbukane okvire nešto debljom zaglađenom žbukom, dok su preostale površine ziđa bile žbukane tankoslojnom vapnenom žbukom otprilike 3 – 5 mm. S obzirom da se radilo o tankoj žbuci, koja je prekrivala u debljem sloju fugu, a u tanjem sloju opeku, vizualno se dobio efekt neravne treperave površine zida. U kasnijem razdoblju srednjega vijeka krajem 15. i početkom 16. st. dolazi do oslikavanja pročelja slikanim detaljima, slikanim vijencima, slikanim uglovnim kvadrima čime je postignuta estetska vrijednost pročelja.

## ZAKLJUČAK

Na razvoj fortifikacijske arhitekture na našim prostorima utjecala je provala Tatara 1242. od kada započinje intenzivnija izgradnja utvrđenih plemićkih gradova, utvrda, kaštela radi bolje zaštite i obrane od eventualnih budućih provala. Od druge polovice 13. st pa sve do kraja 15. st. možemo ustvrditi da se gradilo manje više kvalitetno, uz napomenu da je izgradnja reprezentativnijih fortifikacijskih sklopova ovisila o finacijskoj moći plemstva i mogućnostima vlasnika i investitora, kao i o izboru kvalitetnih srednjovjekovnih cehovskih majstora. U tom razdoblju više pažnje posvećuje se izboru materijala, zidarskoj i klesarskoj obradi materijala za zidanje, a samim time i čvrstoći i izdržljivosti zida i jezgre zida. Znanje i cehovske vještine srednjovjekovnih majstora graditelja kamenoklesara, zidara, kovača, tesara, njihova sinergija na gradilištu utjecale su na razinu kvalitete fortifikacijske arhitekture, bilo da je riječ o jednostavnijim i skromnijim ili kompleksnijim fortifikacijskim sklopovima. Načini i tehnike zidanja, koje su preuzete iz razdoblja antike, prilagođavaju se novim uvjetima i nizu faktora koji su djelomično izmijenili pristup i sam rad graditelja na izgradnji fortifikacijske arhitekture. U razdoblju kasne gotike i renesanse starije utvrde pojavom artiljerije, promjenom sustava obrane dodatno se utvrđuju i proširuju, izvode se novi fortifikacijski sklopovi za obranu kao što su polukružne, poligonalne kule na zidinama. Pored izgradnje novih obrambenih sklopova, javlja se potreba za višom razinom stanovanja i opremanja stambenih prostora, *palasa*, što je doprinijelo većoj graditeljskoj djelatnosti koja je često angažiranjem stranih majstora bila na najvećoj mogućoj cehovskoj i umjetničkoj razini (primjer dvora i palasa Nikole Iločkoga). Pored stroge funkcionalnosti i vojno obrambenih karakteristika pojedinih sklopova u oblikovanju te arhitekture izražena je i estetska komponenta u vidu oslikavanja vanjsne zida i interijera pojedinih sklopova, kao što su palasi i kapele. Oko 1500. godine zbog opasnosti od Osmanlija razina kvalitete zidanja opada, struktura zida je slabija, zbog jeftine i brze gradnje, što je u konačnici dovelo do nekvalitetne i manje trajne arhitekture koja nije mogla pružiti trajniju zaštitu u obrani od neprijatelja.

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## Brick Dimensions

The dimensions of medieval bricks vary considerably and it seems that they are adapted to the required thickness of the wall in which they are installed, but are also influenced by the customs of masons, who were drawn from a wide geographic area. Bricks of a smaller format 4 / 11 / 21.5 cm; 5 / 9.5 / 20.5 cm; 5 / 11 / 22 cm; 5 / 10 / 23 cm are more common during the 13<sup>th</sup> century. Sides generally had a ratio of 1:2:4. Some brick sizes do not conform to this ratio, however (5.5 / 9.5 / 24 cm, for instance). Later in the Gothic period, medium-sized bricks 6 / 12–13 / 26 cm; 5 / 13 / 27 cm dominate. Around 1500, larger bricks 6-8 / 16-18 / 32–38 cm came into use. Bricks of such dimensions were used in the forts of Ilok, Šarengrad, Erdut, Đakovo, Bač (Serbia), and Đurđevac.

## Decorative Bricks

The most common use of brick is in combination with carved stone elements, but there are some cases where decorative brick is used instead of stone, although these are rare or rather poorly preserved on fortifications (such as a fragment of the capital at Ivankovo Castle). Decorative brick was also used on religious architecture (Church of St. Luke in Lipovac, church in Tomaš near Bjelovar, some details of the bell tower in Šarengrad, some fragments discovered at Gorjan and in Čazma). In medieval fortifications, bricks were often used for interior floor paving. The floors of residential and utility rooms were paved with specially moulded baked bricks, *cotto*, of square or hexagonal form (*cotto* hexagonal floor tiles from Bijela Stijena fortress, 26 / 22 / 5 cm). The average size of cotto floor tiles ranged between 20–22 / 20-22 / 4-5 cm. Ordinary bricks were also used for paving (Ilok – palatial residence of Nikola Iločki), as well as recycled whole Roman bricks, due to their large size and outstanding quality (Templar fortress, Račeva).

## Exterior and interior finishing of brick walls

Medieval brick walls, like their stone counterparts, were finished with a layer of plaster or render. Besides plastering, *grouting* was also done, as is shown by the example of the palatial residence of Nikola Iločki from the second half of the 15<sup>th</sup> century. The advantages of this include increased speed of construction and cheaper execution. Facade lime mortar has only been preserved in traces on a small number of fortifications in Slavonia and Western Syria. On Šarengrad fortress, near Ilok, there are preserved remains of thin facade plaster on the entrance tower, around the window opening, and partly on the east side, at the junction of the entrance tower and wall, where remains of vertical pilasters executed in smooth lime mortar are preserved. This is all dated to the 15<sup>th</sup> century. All openings on the facade had plastered frameworks with somewhat thicker smooth plaster, while the remaining surfaces of the walls were plastered with a thin layer of lime mortar, 3-5 mm in thickness. Because a thick layer of plaster was used to cover the joint, and a thin layer the bricks, the visual effect obtained was an uneven and vibrant wall surface. In the later Middle Ages, in the late 15<sup>th</sup> and early 16<sup>th</sup> centuries, facades began to be painted with details, and cornices and corner blocks were also commonly painted, thereby improving the aesthetic value of the facade.

## CONCLUSION

The development of fortification architecture in our region was heavily influenced by the Tatar invasion of 1242, when the intensive construction of fortifications and defensive features to offer protection and defence against possible future invasions began. From the second half of the 13<sup>th</sup> century to the end of the 15<sup>th</sup> century, one can say that construction was more-or-less of a reasonably high quality, noting that the construction methods employed in fortifications were largely dependent on the financial power of the nobility, and the technical capabilities of owners and investors, as well as on the quality of work of medieval craftsmen. During this period, more attention was paid to the choice of materials, masonry and dressing methods employed in masonry, and thus to the strength and durability of the facades and wall cores. The knowledge and skills of medieval master builders, masons, blacksmiths, and carpenters, and their synergies at the site, affected the quality of fortification architecture, regardless of the size of the unit or ensemble. Methods and techniques of building, drawn from ancient times, and adapted to new conditions, partially modified the approach and work of builders on fortification architecture. During the late Gothic and Renaissance periods, older fortifications were expanded, and new fortifications were added. Due to the introduction of gunpowder and changing defensive tactics, new defensive fortifications were introduced, such as semi-circular and polygonal towers added to walls. In addition to the construction of new defensive features, there was a need for higher quality residential areas and furnishings, culminating in the *palatial residences*. This contributed to increased building activity, which was quite often on the highest artistic level, thanks to the engagement of foreign masters (see, for example, the court and palatial residence of Nikola Iločki). In addition to the stringent functionality and military defensive characteristics of particular complexes, in the design of this architecture the aesthetic component is also expressed, through the painting of exterior walls and the interior of some architectural elements, particularly palatial residences and chapels. Around 1500, due to the threat of the Ottomans, the level of quality of masonry fell, with wall structures becoming weaker, due to cheap and rapid construction, which finally led to poorer quality and less durable architecture that could not provide long-lasting defensive protection.

# SREDNJOVJEKOVNA FORTIFIKACIJSKA ARHITEKTURA

## strukturne odrednice (materijal kamen i opeke)

Srednjovjekovni plemićki gradovi, utvrde, kašteli, i drugi fortifikacijski sklopovi, gledajući u cjelini, uslijed niza faktora najugroženija su i najranjivija skupina naše graditeljske baštine. Danas su to većinom ruševni ostaci nekada arhitektonskih i fortifikacijskih cjelina i sklopova koji su građeni na našim prostorima u razdoblju od 13. do 16. st. Za srednjovjekovnu fortifikacijsku arhitekturu pored morfoloških i tipoloških karakteristika, s kojima određujemo tipove fortifikacija, u odnosu na položaj u prostoru, točne oblike i stilske karakteristike, jedan od bitnih elemenata za njezinu valorizaciju analiza je materijala, načina zidanja na temelju kojega možemo odrediti dataciju izgradnje i graditeljsku slojevitost. Srednjovjekovna fortifikacijska arhitektura određena je svojim vremenom, finacijskom moći investitora, znanjem arhitekata graditelja i srednjovjekovnih cehovskih majstora, ali ponajprije gradivnim materijalima, bilo da je riječ o kamenu, opeci ili drvetu.



Bedemgrad, kraj 13. početak 14.st. – ulazna kula Bedemgrad, late 13th and early 14th centuries – gatehouse



Erdut, 15. st. – ugaona kula Erdut, 15th century – corner tower

Medieval aristocratic cities, forts, castles, and other fortifications are, generally speaking, the most endangered and vulnerable component of our architectural heritage, due to a number of factors. Today such fortifications exist primarily as the ruins and remains of architectural units and ensembles that were built in this region during the period between the 13<sup>th</sup> and 16<sup>th</sup> centuries. In addition to morphological and typological characteristics, necessary for the determination of types of fortifications in relation to their position in space, layout forms and stylistic features, one of the essential elements for the valorization of medieval fortification architecture is the analysis of its material and methods of construction, which can allow us to determine the date of building and architectural classification. The medieval fortification architecture is classified by its date, by the financial power of the benefactors, by the knowledge of the builder-architects and medieval tradesmen involved, but primarily by building materials, whether these be stone, brick or wood.

## GRADIVNI MATERIJALI (kamen)

### Vrste kamena

Upotreba kamena u srednjovjekovnoj fortifikacijskoj arhitekturi raznolika je s obzirom na sve raspoložive vrste kamena i njihove karakteristike. Izbor kamena za zidanje često je ovisio o vrsti kamena koji se nalazio u blizini gradilišta. Kamen se nabavljao s obližnjih brdskih kopova i brdskih nabujalih potoka koji su bili najbliže gradilištu. Ovisno o čvrstoći, podatnosti za obradu i oblikovanju postoji nekoliko vrsta kamena koji se koristio u izgradnji: *kamen pješčenjak*, *vapnenac* i *eruptivni kamen*. Vrsta kamena određivala je konačni izgled, način zidanja i u konačnici njegovu završnu obradu.

### Vrsta ziđa od kamena po izgledu i materijalu

Kamen kao gradivni materijal svojim osobinama daje velik broj mogućnosti izvedbe različitih tipova ziđa i oblikovanja profiliranih klesanih detalja, kao i funkcionalnih arhitektonskih elemenata pročelja kao što su portali, doprozornici, vijenci, strijelnice, puškarnice, stubišta, popločenja podova i dr. Ono što je karakteristično za srednjovjekovnu fortifikacijsku arhitekturu jest da svako razdoblje ima svoje ne samo oblikovanje, komponiranje, izvedbu detalja, nego i način slaganja kamena u zidovima. Od najjednostavnijega ziđa od kamena lomljenjaka, kod kojega imamo nekoliko varijanti, pa sve do fortifikacijske arhitekture čije je zide građeno izrazito kvalitetno, klesanim blokovima *klesancima* od kamena pješčenjaka.

# MEDIEVAL FORTIFICATION ARCHITECTURE

## structural determinants (material stone and bricks)



## CONSTRUCTION MATERIALS (stone)

### Types of stone

The use of stone in medieval fortification architecture varies, with construction methods utilizing all available types of stone and their characteristics. The choice of stone for masonry was often dependent on the types of stone in the vicinity of the construction site. Stone was commonly obtained from hillside quarries and riverbeds nearby. Several types of stone were employed in construction, depending on the strength and suppleness for working and shaping: *sandstone*, *limestone* and *volcanic (igneous) rock*. The type of stone used determined the method of construction, and, ultimately, the final appearance.

### Type of stone wall by appearance and material

Stone as a building material, through its characteristics, provides a wide range of possibilities for the execution of various types of walls and profiled carved details, as well as functional architectural elements upon the facade, such as portals, window frames, cornices, and loopholes, as well as staircases, paved floors and other features. One characteristic of medieval fortification architecture is that each period has its own design, composition, details of execution, and also method of arranging stones for wall construction, starting with the simplest *quarry-faced stone* masonry, with several variants, up to fortification architecture with exceptionally high quality masonry, from *ashlar* sandstone blocks.





Račesa, 13. st. – zid od klesanaca kamena pješčenjaka, veličina klesanaca 40 – 80 cm Račesa, 13th century – wall of sandstone ashlar blocks, 40-80 cm in size

#### Bedemgrad, kraj 13. početak 14. st. – prizemlje zapadnoga zida ulazne kule, lice zida od klesanaca kamena pješčenjaka, cjelovitih i prelomljenih opeka

### Zide od klesanaca kamena pješčenjaka, 13. st.

Struktura zida sastoji se od klesarski pomno obradenih kvadratnih i pravokutnih blokova *klesanaca* od kamena pješčenjaka (utvrda Račesa, zapadno pročelje ulazne kule utvrde Bedemgrad kod Našica, Voćin, Veliki Kalnik).

*Zide od priklesanoga kamena* po obradi fature zida svrstava se između zida od klesanaca i onoga od kamena lomljenjaka (Medvedgrad, Veliki Kalnik, Vrana, Okić).

### Zide od kamena lomljenjaka, 13 – 15. st.

Zide od kamena lomljanjaka ima više mogućnosti, prema obradi i slaganju kamena.

- romanički način zidanja kamenom lomljenjakom male veličine 25 – 30 cm (Viškovci 13. st.)
- zidanje kamenom lomljenjakom s izravnavanjem redova na svakih 65 cm (Velika, 13. st.)
- zidanje kamenom lomljenjakom veličine 60 – 80 cm u horizontalnom redovima ( zide branič kule Bijela Stijena, kraj 13. početak 14. st.)
- gotički način zidanja u 15. st. kamenom lomljenjakom oko kojega se međuprostor ispunjava sitnim kamenom (Ribnik, Čaklovac kod Pakraca, Podvrško, Gračanica)

### Mješovito zide oko 1500. od različite vrste kamena, ulomaka opeka, recikliranih opeka, spolija.

Karakteristika zidanja oko 1500. činjenica je da se gradnja izvodi na brzinu zbog prijeteće turske opasnosti. Manje pozornosti obraća se kvaliteti zidanja, izgledu lica zida pa možemo ustvrditi da se radi o manje kvalitetnom zidanju u odnosu na ranija razdoblja srednjeg vijeka. Radi se o jeftinoj gradnji nezamislivoj u 13. i 14. st. Takvi zidovi osim što su manje kvalitetni, djelovanjem atmosferilija brže stradavaju nakon razaranja. Postoje razne varijante takvoga zida ovisno o količini dostupnoga materijala na gradilištu. U zidanju mješovitoga zida koristila se različita vrsta materijala: kamen lomljenjak, kamen iz bujičnih brdskih potoka *oblutci*, ulomci opeka, reciklirane opeke, razni profilirani kameni detalji sa starijih građevina (dovratnici, doprozornici, vijenci, svodna rebra, zide kaštela Cernik, zide rondela Ružice grada kod Orahovice) oko 1500.

#### Profilirani detalji

Za profilirane kamene detalje srednjovjekovnoga zida koristio se mekši kamen kao što je pješčenjak, i to za izradu dovratnika, doprozornika, svodnih rebara, vijenaca, stubišta, podova i drugih elemenata u strukturi zida. Ovaj je kamen bio izrazito podatan za klesarsku



Ružica grad, kraj 15. st. – portal s polukružnim nadvojem Ružica town, late 15th century – portal with semicircular lintel



Bedemgrad, kraj 13. početak 14. st. – prizemlje zapadnoga zida ulazne kule, lice zida od klesanaca kamena pješčenjaka, cjelovitih i prelomljenih opeka

Bedemgrad, late 13th and early 14th centuries – ground floor of the western wall of the gatehouse, wall face made of sandstone ashlar blocks and whole and broken bricks

#### Ashlar stone masonry – sandstone, 13<sup>th</sup> century.

The structure of the walls consists of carefully carved cuboidal sandstone ashlar blocks (Račesa fortress, the west facade of the entrance tower of Bedemgrad fortress, near Našice, Voćin, Veliki Kalnik).

*Pitch-faced stone masonry*, falls somewhere between *ashlar* and *quarry-faced* stone, and involves some basic finishing of the block using a pitching chisel (Medvedgrad, Veliki Kalnik, Vrana, Okić).

#### Quarry-faced stone masonry, 13<sup>th</sup> - 15<sup>th</sup> century.

*Quarry-faced stone* has greater possibilities regarding carving and composition.

- Romanesque style of masonry with *quarry-faced* stone of small size, 25-30 cm (Viškovci, 13<sup>th</sup> century).
- Masonry with *quarry-faced* stone, with levelling of rows every 65 cm (Velika, 13<sup>th</sup> century.)
- Masonry with *quarry-faced* stone of size 60-80 cm in horizontal courses (masonry of guard tower on Bijela Stijena, late 13<sup>th</sup> - early 14<sup>th</sup> century)
- Gothic style of masonry from the 15<sup>th</sup> century with *quarry-faced* stone, where the space between blocks is filled with small stones (Ribnik, Čaklovac near Pakrac, Podvrško, Gračanica).

### Mixed masonry from around 1500 – different types of stone, brick fragments, recycled bricks, spoils.

A major characteristic of fortification construction from around 1500 is the fact that it is undertaken in a hurry, due to an increased threat from the Ottoman Empire. Less attention is paid to the quality of the masonry and the aesthetics of the facade, so one can say that this masonry is of a lower quality compared to earlier periods of the Middle Ages. Fortifications are generally cheap constructions, unimaginable in the 13<sup>th</sup> and 14<sup>th</sup> centuries. Partly due to this lower quality, such walls are subjected to quicker deterioration due to weathering, especially if the facing stones are damaged or removed. Such walls incorporate different materials and construction methods, wholly dependent on the quantity and quality of material available at the site.

Different types of materials were combined in *mixed masonry*: *quarry-faced stone*, stone from fast-flowing river beds – *boulders*, fragments of brick, recycled bricks, various ornamental stone details from older buildings (door jambs, window frames, cornices, vault ribs, the masonry of Cernik castle, the roundel masonry at Ruzica fortified town, near Orahovica).

#### Profiled details in stone

For the profiled carved stone details of medieval masonry, softer stone, such as sandstone, was used. This was primarily for the production of door frames, window frames, vault ribs, cornices, staircases, pavements and other elements of a wall. This stone was extremely pliable for processing, and even could be sawn. In addition to sandstone, other types of stones, such as travertine, were in use, but on a smaller and more modest scale in the execution of fortification architecture.

#### Binders

Special attention was given to the connection between face of the wall and its core in the medieval period, with an aspiration for the core to be strong, durable and made to a higher quality. The interior of the wall was made of amorphous crushed stone pieces of *quarry-faced stone*, *boulders*, and sometimes of a flat stone, like *slate* or *schist*, that could be utilized in a *fishbone* manner, which contributed to a greater sustainability and strength of the wall in the event of impact by siege weaponry, *rams*, and missiles. A significant element of sustainability and strength of the medieval wall is its binder or mortar, the quality of which was dependent on the process of manufacture, method of slaking, the amount of



Viškovci, 13. st. – zid od kamena lomljenjaka, veličina kamena 20 – 35 cm

Viškovci, 13th century – wall of quarry-faced stone, 20-35 cm in size



Bijela Stijena, kraj 13. početak 14. st. – ostatci zida branič kule, zid od priklesanoga kamena veličine 40 – 60 cm u horizontalnim redovima

Bijela Stijena, late 13th and early 14th centuries – remains of the wall of the guard tower, wall of pitch-faced stone, 40-60 cm in size, arranged in horizontal rows



Ružica grad oko 1500. – zid rondela, mješoviti zid od kamena lomljenjaka, kamena oblutaka, cjelovitih i prelomljenih opeka

Ružica town, c.1500 – wall roundel, mixed wall of quarry-faced stone, boulders, whole and broken bricks

obradu pa se čak mogao piliti. Pored pješčenjaka za doprozornike, dovratnike, strijelnice, svodna rebra koristila se i druga vrsta kamena kao što je sedra, ali na jednostavnijoj i u izvedbi skromnijoj fortifikacijskoj arhitekturi.

#### Vezivno sredstvo - žbuke

Prilikom zidanja srednjovjekovnoga zida osobita pažnja posvećivala se povezanosti lica zida s jezgrom, s težnjom da jezgra bude što jača, trajnija i kvalitetije zidarski izvedena. Unutrašnjost zida izvedena je od amorfnih usitjenih komada kamena lomljenjaka, *oblutaka*, ponekad od pločastog kamena *škriljevca* koji je mogao biti slagan na *riblju kost*, što je doprinosilo većoj trajnosti i čvrstoći zida na udarce, opadnim oruđima *ovnovima* i na gađanje projektilima. Značajni element trajnosti i čvrstoći srednjovjekovnoga zida je vezivo, odnosno žbuka čija je kvaliteta ovisila o samom postupku izrade, načinu gašenja i količini vapna, ali i izboru pijeska. Žbuka se pripremala od pijeska različite granulacije 3 – 5 mm i gašenoga vapna s dodatkom drobljene opeke koja je regulirala vlagu u žbuci prigodom vezivanja i sušenja, da žbuka u jezgri zida ne izgori, odnosno da bolje veže. Općenito zide 13. i 14. st. trajnije je i otpornije na atmosferilije nego ono kasnije s kraja 15. i 16. st. Vanjska obrada, odnosno žbukanje lica zida bila je različita tijekom srednjega vijeka. U ranijem razdoblju srednjovjekovno zide ožbukano je vapnenom žbukom, *dersano*, tako da su veće površine kamena bile vidljive. Kasnije potkraj 15. i početkom 16. st. srednjovjekovno zide od kamena žbuka se u cijelosti pročeljom vapnenom žbukom grube i zagladene teksture. Pročeljna žbuka ponegdje se oslikavala slikanim detaljima (uglovnim kvadrima, vijencima, okvirima oko prozora). Žbuka uz klesane detaljirane detalje i pojedinositi završavala je *na nulu*, tako da je kamen ostao neožbukan, češće obojan i apstraktan. Unutrašnja strana zida žbukala se finom zaglađenom vapnenom žbukom.

## GRADIVNI MATERIJALI (opeke)

#### Gradnja opekama

U izgradnji srednjovjekovne fortifikacijske arhitekture paralelno s kamenom koristila se i opeka čija uporaba kao gradivnoga materijala potječe još iz razdoblja Rima. Lokaliteti rimskih naselja, vila i ostalih rimskih građevina na našim prostorima pružali su velike količine dostupnoga gradivnog materijala (rimskih opeka) koji se sekundarno koristio u izgradnji fortifikacijske arhitekture. Rimske opeke veličina 42 – 47/19 – 34/5 – 8 cm koristile su se ponegdje kao cjelovite, prelomljene na dva, tri ili četiri djela, ovisno o strukturi i debljini zida. Srednjovjekovni zid od opeka prepoznaje se po svojim dvjema karakteristikama: načinu slaganja opeka u zidu, *uzdužnjak*, *vežnjak*, *uzdužnjak*, i raznolikosti boja opeka koje su korištene za zidanje. Pored uobičajenih opeka raznih tonova crvene boje, korištene su i *sinterirane* opeke, staljene zbog nesavršenosti srednjovjekovne opekarske tehnologije. Te su opeke tamnoplave do skoro crne boje, trajne su i otporne na atmosferilije.

#### Lice zida – način slaganja opeka u zidu

Lice srednjovjekovnoga zida bilo je pravilno slaganu u ritmu nizanja opeka *uzdužnjak* – *vežnjak* – *uzdužnjak* – *gotički vez opeka* pri čemu je uloga vežnjaka bila povezivanje lica zida s jezgrom. Ovaj ritam nizanja opeka prisutan je u izgradnji kada se koristio većim dijelom jedan format opeke. Osim uobičajnoga gotičkog veza opeka, na nekim fortifikacijama primijenjen je drugačiji način slaganja opeka u zidu. Na primjeru kružne utvrde Kolodvar iz 13. st. u prizemnoj zoni zida prisutna je izmjena redova opeka *uzdužnjaka*, *vežnjaka*, *uzdužnjaka*.

U drugoj polovici 15. i početkom 16. st. uporabom različitih formata opeka, romaničkih, rimskih i gotičkih opeka, napušta se pravilnost ritma nizanja opeka u zidu, zidanje je neurednije i manje kvalitetno. Tijekom čitavoga razdoblja srednjega vijeka čest je slučaj da je jezgra zidana nepravilno bez veza opeka. Na to ukazuju ruševni ostatci zida Iloka, Šaregrada, Kolodvara gdje se jezgra zida sastoji od prelomljenih, deformiranih opeka povezanih vapnenom žbukom.

lime, and also the choice of sand. Mortar was prepared from a variety of sand grit, 3-5 mm in diameter, and slaked lime, with the addition of crushed brick powder to regulate moisture during tying and drying, and to prevent the core of the wall from overheating during setting, or for better tying. Generally, masonry of 13<sup>th</sup> and 14<sup>th</sup> centuries is more durable and more resistant to weathering than later masonry dated to the late 15<sup>th</sup> and early 16<sup>th</sup> centuries. The external processing or plastering of facades was different during the Middle Ages. In the earlier period, medieval masonry was plastered with lime render, *roughly and unevenly applied*, so that large areas of the stone surface were visible. Later, in the late 15<sup>th</sup> and early 16<sup>th</sup> centuries, medieval stone walls were completely rendered with lime mortar. Render sometimes incorporated painted details (such as corner blocks, cornices, or frames around the windows). Plaster near to the carved profiled details ended *to point*, so that the decorative stone remained unplastered, and often painted. The interior walls were plastered with fine smoothed lime mortar.

## CONSTRUCTION MATERIALS (bricks)

#### Building with bricks

In medieval fortification architecture, bricks were used in parallel with stone. Their use as a building material in this region dates back as far as the Roman period. Sites of Roman settlements provided large amounts of this building material that were reused in the construction of fortification architecture. Roman bricks with dimensions of 42–47 / 19–34 / 5-8 cm were sometimes used as a whole, or broken into two, three or four fragments, depending on the structure and thickness of the wall. A medieval brick wall is identified by two features: the method of laying bricks within the wall, *stretcher*, *header*, *stretcher* and the diversity in the colour of bricks used. In addition to the usual bricks in various shades of red, *sintered bricks* were also used, melted due to imperfections in medieval brick technology. These bricks range from a dark blue to almost black in colour, and are durable and resistant to weathering.

### The face of the wall – the way of composing bricks into the wall

The face of the medieval wall was composed in a *stretcher*, *header*, *stretcher*, where the role of the *header* was of connecting of the face of the wall with its core. This bond style is present in constructions where bricks of regular dimensions were primarily employed. In addition to this standard bond, other bond types were also used. For example, the ground floor wall of the circular fortress at Kolodvar, dating to the 13<sup>th</sup> century, was constructed in alternating courses of stretcher and header bricks.

In the second half of the 15<sup>th</sup> century and in the early 16<sup>th</sup> century, due to the (re-)use of bricks of differing dimensions, Romanesque, Gothic and Roman, regular bonding sequences are abandoned, and brickwork is messier and of a lower quality. Throughout the Middle Ages, it is often the case that the core of the wall was constructed irregularly, without bonding. Evidence of this can be seen in the remains of walls at Ilok, Šaregrad, and Kolodvar, where the walls' cores consist of broken, deformed bricks, cemented by lime mortar.



Šaregrad, 15. –16. st.

Šaregrad, 15th – 16th century.