

WP4

Platy limestone as cultural heritage

Supplement 3.I

Cultural heritage and limestone

General overview

Authors:

Filip Bubalo, Neža Čebren Lipovec, Radoslav Dodig, Mitja Guštin,
Branko Orbanić, Fabiana Pieri, Silvije Pranjić, Božidar Premrl, Ana
Šverko, Aleksandra Torbica, Ivo Vojnović, Tea Zubin Ferri

Mitja Guštin, Katarina Šmid (eds.)

February 2015

1. Introduction about the project area

Under the project leadership of Geološki zavod Slovenije (Geological Survey of Slovenia) from Ljubljana have the partners from (from north to south): Regione del Veneto (Veneto Region, Italy); Comune di San Dorligo della Valle/Občina Dolina (Municipality of San Dorligo della Valle/Dolina, Italy); Dipartimento di Matematica e Geoscienze (DMG_UniTs) dell'Università degli Studi di Trieste (Department of Mathematics and Geosciences (DMG_UniTs) of University of Trieste, Italy); Javni zavod Park Škocjanske jame (Public Agency Škocjan Caves Regional Park, Slovenia); Univerza na Primorskem, Znanstveno-raziskovalno središče (University of Primorska, Science and Research Center, Slovenia); Istarska razvojna agencija d.o.o. – IDA (Istrian Development Agency Ltd. - IDA, Croatia); Razvojna agencija Zadarske Županije (Zadar County Development Agency, Croatia); Javna ustanova RERA S.D. za koordinaciju i razvoj Splitsko-dalmatinske županije (Public Institution RERA S.D. for coordination and development of Split-Dalmatia County, Croatia); DUNEA d.o.o., Regionalna Razvojna Agencija Dubrovačko-Neretvanske županije DUNEA llc (Regional Development Agency Dubrovnik Neretva County, Croatia); Javna ustanova Razvojna agencija Županije Zapadnohercegovačke – HERAG (Development Agency of West Herzegovina County – HERAG, Bosnia and Herzegovina) approached to the research of use of platy limestone in cultural heritage, as building material.

The project area covers geographically the eastern coast of Adriatic Sea, the Italian and Slovenian Karst (Carso, Kras), the Istrian peninsula, the Zadar area, Herzegovina and the central part of Dalmatia, between Split and peninsula of Pelješac. The area of the research is limited with the working field of each partner.



Figure 1
Project area map.

This specific karstic area is a morphological distinctive geographical unit, where the relation between the nature of the rocks and the landscape, the hydrogeological conditions, productivity and human settlements are very close to each other.

The long-term use of the platy limestone represents one of the most significant characteristics of the East Adriatic coast and its hinterland. In all karstic area stones have gradually been cleared off, in order to get more cultivable land. Pieces of land were fenced with dry walls (*meje, ograde*), built from larger stone slates, while smaller rocks were deposited in large piles, known as *griže, gromače, mocire* or *gomile/gromile*. This centuries-old process created a specific karstic landscape covered with a net of dry stone walls - all landscape is consequently carefully crisscrossed with built dry stone walls.

With that sort of limestone modest, but beautiful living spaces were created; one of the key features of coastal landscape are buildings, which are completely built of stone and are covered with slate roofs. Limestone was also largely used for several details like eaves, gutters, pavements, scarps of cistern, chimneys, benches, tables, etc.

In the frame of the project RoofOfRock the historic presence of platy limestone materials, the quarries in the Adriatic karstic area and consequently an impact of their presence on the development of the cultural landscape and on different crafts, related to the stone extraction, were investigated. The research was based not only on historic documents and field work, but also on scientific and professional literature. We focused mainly on commonalities and also on regional specifics of the excavation, manufacturing and uses of platy limestone, on the presence and the impact of the quarries on the life of the community through centuries and their influence on the development of the landscape.

Since Roman Period, in some regions even since the later Prehistory to the early years of the 20th century, limestone has been the dominant building material in secular architecture in cities as well as in the countryside.

In the long and intense Mediterranean history limestone was the dominant building material to which Mediterranean owes its distinctive appearance, characteristic features and life. Not only for Eastern Adriatic coast, but also for most of the Mediterranean area could be said that it is practically made of stone. It was the stone that enabled building constructions in the urban area and in the countryside from early Christian era to the luxuriant 19th and 20th centuries. Coastal cities, villages, homesteads with outbuildings, barns, storages, pasture fences, etc. in hinterland and settlements on the islands were built of limestone. The eastern coast of the Adriatic Sea is marked by the continuous use of limestone in construction.

Until present a great number of the most representative limestone buildings were preserved, especially churches within the historic nucleus of the Eastern Adriatic towns, which are mostly protected by conservation legislation.

At the earliest beginning, during the late Neolithic and Eneolithic, the Prehistoric inhabitants moved their settlements from flat fields to hill slopes - to sublime and easily defended sites. These settlements (*castelliere, kaštelir, gradišče, gradina*) as those from Iron Age were generally built on the top of the hills and encircled with large and high dry stonewalls. The walls were circularly planned after the configuration of slopes and were built

of irregular stones. The most important settlements were fortified with more massive stone blocks.

One of the first known uses of platy limestone is attested in the interior of Illyrian burial mounds (*tumuli* or *gomile*). Burial chambers, constructed with larger plates of platy limestone, were located in the middle of *gomila*, mostly they were built from irregularly shaped stones collected in surroundings. The grave constructions, which were built of large platy limestone plates, were in those regions in use until the Modern Age.

With the founding of Roman Empire the Roman urban pattern with the economical, administrative and religious centers was also defined on Eastern Adriatic and its hinterland. In these city centers the whole buildings together with corresponding city's infrastructure were built of stone material or bricks and were usually covered with ceramic plates (*tegulae*). For the purpose of building needs in the vicinity of every Roman settlement along the coast a quarry (for example Aurisina/Nabrežina, ...) was opened.

The roots of nowadays still existing traditional stone buildings are in the area of Eastern Adriatic coast traced mostly to the 9th century; from that century many sacral buildings have been preserved. Also from the following centuries many buildings (like churches, fortresses, profane architectural objects and city walls), which were made of solid stone still exist. There are some exceptions where much older roots - the most prominent examples are Diocletian's palace in Split (rebuilt in medieval period) and Euphrasian Basilica in Poreč (in continuous use since 6th century until present) are traceable. But in the majority of the coastal Eastern Adriatic towns we can unceasingly follow the urban development set on the same fundament ever since the Carolingian period. In the countryside, on the other hand, the rural peasants' stone architecture originates mostly from the 16th century onwards.

There are several scientific disciplines that deal with the stone built architecture; therefore countless written sources like scientific or professional literature, archival documents and reports are available.

The oldest descriptions of karstic rural houses on Karst are given in two texts: *Descrizione della patria del Friuli*, dating back to 1502-1503 and written by Marin Sanudo il Giovane, who precisely describes the Isonzo/Soča settlements. The second document belongs to the miscellaneous writings of Bishop Tommasini. Later, in 1689, *Die Ehre des Herzogthums Krain* was published, a comprehensive work of Janez Vajkard Valvasor [Johann Weikhard Valvasor].

In the last two decades of the 19th century some scientific studies about the homesteads in rural lands of Friuli-Venezia Giulia were published. A work of Gustavo Bancalari, *L'abitazione rurale nelle Alpi meridionali* (1895) describes Postojna-Vipava-Idrija zone. Study by Arrigo Lorenzi (*Studi sui tipi antropogeografici della pianura padana*), from 1914, includes two chapters on housing and settlements of eastern Friuli and Agro of Monfalcone.

In 1905-1906 a paper *Per la storia della casa nazionale degli Slavi del sud*, written by Matija Murko, dealt with rural housing in the Slovenian portion of Friuli-Venezia Giulia. The extensive work of Jovan Cvijić on the Balkan Peninsula at the end of the World War I (*La péninsule balcanique*, 1918) in the anthropogeographical part contains a brief description

of the typical dwellings on Balkan Peninsula: "carsico-mediterranea", a two-storey house that is presented in Dalmatia, Istria and Karst.



Figure 2

The prehistoric hill fort of Volčji Grad, SLO (1), Roman Diocletian's palace at Split, CRO (2) and Early Medieval fortified church of St. Nicholas at Nin, CRO (3).

2. State of the art in the research on limestone and cultural heritage in the area

The comprehensive list of bibliography is added in the supplement (see Annex 4); therefore this chapter contains only brief relevant historic references to the state of the art in the research on limestone and cultural heritage in the area.

For the northern part of Carso/Kras and its surroundings like Istrian peninsula one of the first notable works about Istrian “primitive” house is a book *Ricerche paleoetnologiche e folkloristiche sulla casa istriana primitiva* written by Raffaello Battaglia (1926). In *Guida alla Carsia Giulia* (1929) Gustavo Cumin established a classification of house types, distributed in the karstic area. He mentioned also the house type with the roof, made of stone slates, and other houses of "Slavic-alpine" type.

In the second half of the 20th century numerous books dealing with *casite*, karstic houses and churches and morphological analyses of various karstic villages were published. We have to mention *Umile Carso* by Alfonso Mottola and Lucia Ruzzier from 1967, and the study *Il Carso triestino - Santa Croce* on Santa Croce by Luciano Semerani and others (1970) or the one about *Aurisina* (1984) by Antonio Guacci. Josip Miličević published several books or studies about Istrian house (for example *Primjer seoskog doma srednje Istre i njegovo funkcioniranje u užoj okolici* (1980)).

One of the most comprehensive studies about local houses in this region was written by various authors and published in 1984 in Trento under the title *La casa di Pietra. Tipi e forme*.

A detailed study about buildings in stone, especially walls and *casite*, from the discussed region was made by Luciano Lago (1994) and Borut Juvanec (2005, 2006). About the maintenance of the walls recently few manuals like *Priročnik kraške suhozidne gradnje* (2012), *Priročnik za suhogradnjo* (2014) and proceedings *Zid na Suho/Muro a secco* (2014) were published.

To the vernacular house architecture of Carso/Kras some monographs like *Pietra d'Istria. Architetture e territorio* (2007) and some other monograph works by Stanislav Renčelj and Ljubo Lah (2000, 2008) were dedicated. The public interest for the maintenance is comprised in manuals like *Kraška hiša* (2012) and *Revitalizacija kulturne dediščine istrskega podeželja* (2012).

We owe a special thank for the professional elaboration of quarries in Karst to Bogdan Jurkovšek, who together with his collaborators published the monograph *Geologija Krasa/Geology of Kras* (2014). No lesser thank goes to Božidar Premrl, who has for the needs of *Institute for Protection of Cultural Heritage in Slovenia* (beside the in-depth elaborations of singular churches and stonemasons' families) made the first detailed list of local quarries of platy limestone in Karst (2003, 2005, etc.).

Quite comprehensive is also bibliography, dedicated to the quarries in Dalmatia with surroundings, which were opened in classical antiquity, especially during Roman period. Moreover, there are also some primary classical sources that mention those quarries and stone extraction (cf. Plinius, *Naturalis Historia*).

Quarries, which were opened in classical antiquity in Croatia – especially along the Croatian coast –, were elaborated by Rajka Makjanić (1981); about the quarries and stone processing in Middle Dalmatia writes Marin Zaninović (1996). Several other authors have contributed the data for individual Roman quarries: in Prozor (Šarić 1976), Brač (Didolić 1957; Bužanić 2002), Korčula (Marinko 1970) and in Vis (Biličić, Radić 1990; Katić 2009).

A study, written by Ante Šonje *Iz kojeg istarskog kamenoloma potječe kupola Teodorikova mauzoleja u Raveni* (1980), shows us how successful the Istrian quarries and how skilled the stonemasons that provided and elaborated the quality stone for quite important objects and monuments were. Furthermore, Nikola Džaja (1999) and Marin Zaninović (1980) devoted their attention to the stone processing with traditional stonemason's tools and using ancient techniques. A work by Ivan Pažanin *Kamenolomi i kamenarska kultura Vinišća* (1996) noted the important stonemason's activity of the inhabitants in the villages within the Trogir area.

Several works have dealt with the rural architecture of eastern Adriatic coast and hinterland. For example: the work of Aleksandar Freudenreich, *Narod gradi na ogoljenom krasu* (1962), study by Mirko Miličić, *Nepoznata Dalmacija: studija o seoskoj arhitekturi* (1955). One of the last important overviews in larger context was written by Zdravko Živković, *Hrvatsko tradicijsko graditeljstvo/Croatian traditional architecture* (2013). To this list of authors we have to add Branko Crković and his studies *Arhitektonski kamen našeg Mediterana* (1994), *Gradenje prirodnim kamenom* (2003; 2012) as well as the manual *Gradimo u kamenu. Priručnik o suhozidnoj baštini i vještini gradnje* (2013).

The hinterland of Adriatic, which is within our project covered by the area of Herzegovina, was well documented by the scholars, active in the main Bosnian museum institution, in *Zemaljski muzej Bosne i Hercegovine* [National Museum of Bosnia and Herzegovina], who have in *Wissenschaftliche Mitteilungen aus Bosnien und der Hercegowina* at the end of the 19th century and in the latter century in the serial publication *Glasnik Zemaljskog muzeja Bosne i Hercegovine*, published also the Roman and post-Roman architectural heritage. The high value is given also to the monumental grave stones, named *stečki* (Benac 1950; Bešlagić 1982) or to some typical objects like mills (Bugarski 1968).

In recent times, due to the issues, regarding renovations, conservations, reconstructions and maintenance of the traditional stone architectural buildings in Herzegovina, the professional literature has rapidly increased. It was mostly produced in the frame of Commission to Preserve National Monuments in Sarajevo.



Figure 3
Roman *Asseria*, built of platy limestone (CRO). A fine example of the limestone layers of different thickness.

3. Glossary of jargon terms

In frame of the project RoofOfRock we collected the jargon and dialectal terms about stonemasonry, quarries and stone buildings, which were or still are in use within the researched area of the Eastern Adriatic coast.

Most of the terms are untranslatable to English, as well as to other languages, as they describe quite a specific expression or technical term, connected with stone. The glossaries were made for Croatian Adriatic coast, for the island of Brač, for Slovenian Karst and for Herzegovina.

Because this chapter encompasses only a short list of typical expressions and technical terms, we have added to the chapter the Italian and Slovenian adequate terms in order to show the similarities or dissimilarities between these adjacent language groups.

In Annex 1 we represent the whole glossary, collected from the Italian Karst, Slovenian Karst, central Dalmatia and Herzegovina. Although the areas have been through the centuries strongly tied to Latin or German state formations and divided into smaller feudal authorities, the comparison between professional or jargon terms, connected with stone, stone processing or stone extraction, provides an interesting picture of the different or similar word formation and crisscrossing of various traditions.

Some of the expressions:

CROATIAN	ITALIAN	SLOVENIAN	ENGLISH
Avlija	Cortivo/Cortile	Dvorišče	Courtyard
Baladur	Baladur/balador/ballatoio	Baladur	Gallery
Basamak	Scala	Stopnišče	Staircase
Borjač	Borjač	Borjač	Walled courtyard
Bunja		Hiška	Small house
Ćapadur	Drog/Scarpài/scalpello	Dleto	Kind of chisel
Čatrnja	Štirna/cisterna	Štirna/cisterna	Cistern
Ćemerjenje	Archi in pietra		Stone arches
Ćošak	Cantòn	Vogal	Corner
Ganjak		Hodnik	Corridor
Gank	Gank/balcòn	Gank/balkon	Balcony
Hiša/kuhinja	Hiša/kuhinja/cusina	Kuhinja	Kitchen
Hram	Hram	Shramba	Cellar
Jara	Stala	Hlev	Stable
Jeplenice/frnaže	Jeplenice/frnaže	Frnaže	
Jerte	Jerte	Okenski okvir	Window frame
Kal	Kal	Mlaka	Pond

Kaldrma (tur.)	Acciottolato		Cobble pavement
Kaluna	Kaluna	Kaluna	Stone portal gate
Kambre/sobe	Kambre/sobe	Spalnice	Bedrooms
Kamen	Pietra	Kamen	Stone
Kamenar	Scarpelin/Scalpellino /picapiere	Kamnosek	Stonemason / Stonecutters
Kamenica	Jave	Kamnlom	Small quarry
Kamenolom	Cava	Kamnlom	Quarry
Krov na dvi vode	Tetto a capanna	Dvokapna streha	Gable Roof
Krov na jednu vodu	Tetto ad una falda	Enokapna streha	Mono-pitched roof
Kuk	Scogliera	Klif	Cliff
Kužina	Cusina	Kuhinja	Kitchen
Lajter	Lajter	Svečnik	Candle holders
Macola (rom.)	Mazzetta/Kladivo	Kladivo/Macola	Hammer
Majdan	Cava	Kamnlom	Quarry
Mala (mahala, tur.)	Villaggio	Vas	Hamlet
Mašklin	Kramp/piccone	Kramp	Pickaxe
Mortar	Travetti	Strešni tram	Rafter
Napa	Napa		Hood
Naplov	Acqua piovana	Deževnica	Rainwater
Nastrešnica	Cornicione	Nadstrešek	Eaves
Odlito	Scalpél/Scalpello	Dleto	Chisel
Ograda	Ograda	Ograda	Fenced fields
Okamina	Fossile	Fosil	Fossil
Petrali			Surface quarries
Pločasti vapnenac	Calcare tabulare	Ploščasti apnenec	Platy limestone
Plova	Ciottolo	Kamenček	Thin flat pebble
Poduminta	Fondazioni	Temelji	Fundament
Pojata, štala	Stala	Hlev	Stable
Pola, litica	Rupe	Pečina	Crag
Pritorak		Ograda	Constraint
Remelni	Listelli		Laths
Šaloš	Graner/granaio	Kašča	Granary
Šamatorje (rom.)	Cimitero	Pokopališče	Cemetery
Sedra	Škrle	Škrle	Calcareous sinter
Šeliž	Šeliž	Tlak	Outside pavement
Skedenj	Skedenj	Skedenj	Barn

4. Limestone quarries, materials and craftsmanship

The eastern Adriatic coast was built almost entirely out of sedimentary limestone slates. The most common rocky materials are the following: white rudist limestone in blocks, platy limestone and colored limestone *breccia*.

White rudist limestone is common in the research area and different architecture elements are carved out of it due to its good workability (and density). Valuable structural and decorative building elements (columns, capitals, architrave, portals, profiled cornices, massive rectangular blocks on façade, ashlar) are carved out of it. Coloured limestone *breccia* was used for decorative elements of buildings in the middle area of Dalmatia. In Zadar region, reddish *breccia* from the island Rab was mostly used. Quite interesting geological terrain has island Korčula, which is mainly composed of rudist limestone, dolomite and marl. Geological structure of Pelješac is dominated by Cretaceous limestone, dolomites and Eocene flysch. The mountainous massif of western Pelješac is extremely rich in karst caves just underneath its highest peak.

Platy limestone can be – because of its natural layering – easily separated from the rock mass and chopped to the desired size. Thickness of the platy limestone layers can vary from one meter to only few millimeters. Layered rock emerges very often on the surface and does not need expensive quarries exploitation processes.

Today, platy limestone represents an almost forgotten building material. Through history platy limestone was closely connected with very narrow local area. All new settlers were fully aware of the fact that the stone layers were lying everywhere and have promptly exploited it. Therefore the stone and its rich findings as well as its exploitation influenced in a great extent on the building activities and on karstic morphological features.

According to their origin stones are classified in field stones (stone from fields and pastures) and stone quarry (stone with visible traces of pickaxe or wedges).

Karstic limestone is very pure, over 99%, of calcium carbonate, homogeneous, very compact, with background colour ranging from very light grey to dark grey. Among the karstic limestone several fossilized animals or plants were found and those fossils help us to determine where that building stone material comes from, precisely from which quarry it originates.

Quarries in the southern part of Adriatic are mostly dating from upper *Cretaceous* age and are of rudist limestone with some dolomite exceptions. A typical example of that morphology is still active Humac quarry on Korčula Island, with highly valued limestone (due to its bright white colour with yellow patina) and it is also relatively easy to process.

Between 18th and 19th centuries there were more than 400 limestone quarries only in Karst area. The oldest traces of the stone extraction are present, for example, in the basin of Aurisina/Nabrežina in the top portion of the walls of the “Roman Quarry” and in the nearby – in now non-active – quarry.

Smaller quantities of *skrile*, *škrile* (platy limestone for profane architecture) were practically excavated all over Karst. About those excavations/extractions we have learnt mainly from the local oral tradition, since there are mostly no traces left, due to the filling up, overgrowth or the human activities.

The stone slabs for roofs (on Karst called *libra*) were excavated near Rupingrande/Repen. In Lipovnik and on the slope of Sedovnik in the wider area of Komen the stone, known as *komenski skrilavec*, is excavated. Lithological quite similar stone blocks were found also in the surroundings of Dutovlje, Tomaj, Dobravlje and Kazlje and in the valley of Raša.

In Dalmatia, the most prominent stone has been extracted in the quarries in Brač, Korčula and Trogir. During roman period the quarries in Plate, Oklade, Zastrazišće and Rasohe were active in Brač Island. In Korčula Island, the best kind of stone for the distinctive architectural elements and decoration has been extracted from the quarries on the islands Vrnik and Sutvara, cape Kamenjak, on the southeastern part of Korčula Island and in Pelješki kanal. Stonemasons' workshops from Korčula worked and led the construction works from the 14th until the 19th century; within their reach were Kotor, Dubrovnik, Hvar, Split, Zadar, Venice, ...

In the central Dalmatia, the largest quarries were situated in the islands Lavdara, Sestrunj, Dugi otok, Kornati, Žut, Rava, etc. Resistant rock of high quality was excavated on Lavdara. In Žut, Roman quarry was located at *Petrara*. Quarries on Sestrunj are the largest platy limestone quarries from the Roman period in Zadar. Quarries from the islands around Zadar were not under direct imperial, but were under the municipal rule. Mostly, platy limestone in Zadar was extracted from Lavdara-quarries. During the centuries the former Roman quarries in the islands around Zadar (Lavdara, Sestrunj Dugi Otok, Ugljan) were re-opened and some new quarries were also opened (Zapuntel, Kamenjak, Zagračina on island Molat).



Figure 4
Drinovci (Grude), an old, out-of-use quarry (BiH).

The Roman writer, naturalist Plinius the Elder mentioned in *Naturalis Historia* the Trogir stone (“Tragurium marmore notum“ – Trogir, known for marble). The latter is an Eocene limestone, which can be easily chiseled and polished. It was used for the most prominent architectural buildings (for example: in Diocletian's Palace on the Golden Gate, in the portals of the imperial mausoleum and on the Temple of Jupiter in Split, in Radovan's portal in Trogir,...).

Several platy limestone quarries are located in the Dinaride in Herzegovina: Mostarska Vrata with ancient and abandoned quarries of platy limestone, Crnopod with small private quarries. The limestone is brighter as the limestone from Mostarska Vrata; Zvirovići and Dretelj with limestone extraction for local needs only; Podveležje with the most known and widespread platy limestone in Mostar with surroundings, widely used for its architecture; Žovnica and Miljkovići with extraction for local needs; Dobrič with a small quarry; in Kolojanj, Tepčiči and Grabova Draga limestone is extracted for local needs in a very small area.

Cultural ties with Greeks in Dalmatia began as early as in the 4th century B.C. This “contact space” enabled cultural exchange between local tribes Dalmatian, Liburni, Daorsi etc. and colonizers, resulting in adopting some of the techniques of stone processing and building techniques, like partly hewn stone blocks (Cyclops style), or even polygonal, which were used by Hellenistic craftsmen during the fortification of towns *Pharos* (Stari Grad on island Hvar), *Issa* (Vis), *Daors* (Ošanići), etc.

With the Roman conquest of the eastern Adriatic coast in the 1st century B.C. not only exploitation of quarries were brought to a greater extent the but also more complex use of limestone as a building material for constructions like bridges, aqueducts, *villa rustica* (capitals, columns, sculptures, etc.). The techniques of limestone extraction, masonry and stonework have not changed since the Roman period and only after Europe’s industrialization the process started to change and has become more “industrialized” and machine operated.

Zadar area, for example, is relatively rich with platy limestone and stone exploitation has been one of the most developed and widespread industry branches since the classical antiquity. Tools were quite simple: wooden wedges, generally made of precious hard oak wood, were beaten with stone or iron hammers, or layers were separated by a pickaxe (see Annex 2). The tools allowed Illyrians to build their fortified settlement and necropolis as quick and as efficient as possible. Wherever it was possible, the drywall structures were built directly in the natural stone barriers and cliffs, so Liburnian masons and builders turned the Karstic landscape to their own advantage. Stone was extracted from the nearest area possible; at the beginning there was no systematic exploitation - mining, processing and stone constructions were limited to every tribal community that lived in an area.

In Zadar region, for example, platy limestone has been variously used:

- Irregular broken stones and stone rubble were used in masonry mortars.
- Homogeneous, less layered, limestone was cut by mason tools in completely regular geometric forms, semi ashlar and ashlar (*priklesanci* and *klesanci*).

- Proper, chipped by layers, slabs for paving and roofing.
- Slates of stone were used in the construction of dry walls construction

Traces of an extensive extraction of limestone in the Roman era are still visible in several hand drilled (vertically on layers) paths called *tagliata romana (pašarini)*. Limestone was processed with V-shaped undercuts, where wooden wedges were inserted– over them a mason poured water. The wedges gradually expanded and separated stone block from stone mass. The same processes, only with the use of various modern tools, such as hydraulic drill, water cushion and other mechanical tools, are conducted in modern stone exploitation. In Roman times, it has been already known that this type of discussed stone is slightly porous and the easiest way to process it, was to do it underneath the surface. Because underneath the soil was more humid, the Romans dug underground tunnels through which stone blocks were extracted. Blocks of stone were saturated with stone water so they could not dry out so fast. Quarries in Roman Empire were of a great importance; they were generally dedicated to gods or half-gods (mostly to *Hercules*) and were under strict military administration and jurisdiction.

Several studies, accompanied by mineralogical and petrographic investigations, have clearly demonstrated that the Karstic stone in Roman times reached (along the ancient waterways) the Roman cities along the valley of Po (Milan - *Mediolanum*, Bologna - *Bononia*, Padua - *Patavium*) and the coast of Emilia Romagna and Marche. In the reference to Roman quarries a comprehensive database *The Stone Quarries Database* (http://oxrep.classics.ox.ac.uk/databases/stone_quarries_database/), compiled by Ben Russel as a part of his research project titled *Sculpted Stone and the Roman Economy*, should be mentioned.

In the Roman era, the excavation and exploitation of limestone were in progress and stone production was one of the most profitable industry branches in the Roman Empire. The work procedure in the Roman period is precisely described in *The Oxford Handbook of Engineering and Technology in the Classical World* (2008):

“To free a block or a monolithic column, the quarryman used a quarry pick, shaped like a modern sledgehammer but with a longer handle and with a lighter iron head. The pick crushed the crystals in a small area, allowing precise work with a minimum of waste. Because the point of the pick did not penetrate very deeply at each stroke, the quarryman had to edge back constantly. The effect, in skilled hands, was to create a very shallow trench in a straight line, leaving a tool mark on the quarry wall resembling that created by a point chisel driven across a flat surface.

Once a block was isolated, it was separated by splitting it free from the bedrock base. From the beginning of Greek quarrying, the standard tool was the iron or wooden wedge, but there is greater variation in this specific technique than in trenching around blocks. Splitting the block off was one of the riskiest moments in quarrying, and several means were devised to provide better control of the direction and angle of the break. Another method was to place the wedge holes within a continuous chisel-cut groove, which would weaken the stone along the intended break line prior to hammering on the wedges themselves.

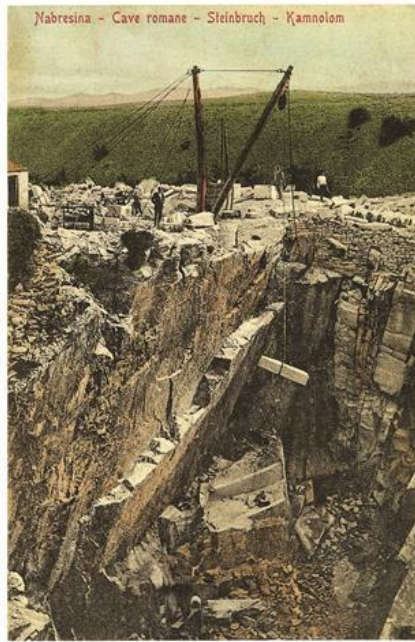


Figure 5

Limestone quarries Aurisina/Nabrežina, Zolla/Col (IT).

The introduction of a heavier quarry pick at the end of the first or beginning of the second century A.D. was really technological change, first noticed by Waelkens. The thicker iron point of this pick could penetrate farther at each blow; consequently the quarryman could execute many blows before having to move his feet, and this speeded trenching. The cost was greater waste and, to some extent, less precise work. The characteristic tool marks left by this pick are tracks forming segments of circles, rather than the nearly horizontal lines of the light pick. To counteract the tendency of the heavy pick to stray to the outside as it cuts downward, the workmen often reversed direction, leaving alternating bands of marks resembling festoons. The heavy pick also contributed to the typical visual impression of a Roman quarry with its huge hills of debris.

Preliminary shaping could still be done with the quarry pick or with a chisel with a heavy point. The point chisel was the chief tool for all rough shaping work in architecture as well as sculpture. With the chisel held at about 70 degrees, large volumes of stone can be removed quickly. At 45 degrees, strokes producing splits with less propagation are used to approach the final surface. Fine dressing, however, was the task of the flat chisel; a flat chisel with teeth, essentially a row of very small flat chisels, was apparently a Roman innovation. Very fine shaping was done with abrasive tools, rasps, files, and at the end, emery and pumice if a reflective surface was wanted (rare until Antonine times). The last category of tool was the drill, of no great significance until horizontal motion was introduced; then the deep

continuous channels of the running drill become characteristic of the chiaroscuro effects of Roman sculpture from the second century A.D. on.“

Through the history the whole population of the karstic area was involved in extraction of that stone building material and the construction of stone structure. Some of them specialized for the work in quarries or for stone cutting of building elements. In these regions, until the beginning of the 20th century practically from every family at least one member was involved in one of the stone-related activities and gained one of his modest income from these activities.

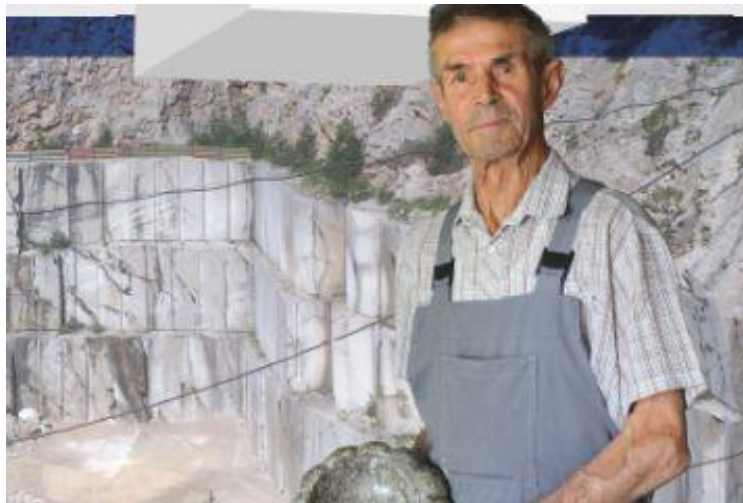


Figure 6
Stone-cutter-master Jeram from Štorje (SLO).
One of the author of the map of quarries on Kras.

The workers, in charge for the separation of stone slabs in quarries, were called *smaratori*, while the masters, who paved streets, were called *salizator stratorum*. The stonecutters were also organized in some sorts of associations. For example, many stonecutters from Korčula, who settled in Dubrovnik, formed there a brotherhood – *fraternitas camenariorum*, which was last mentioned in 1478. On the only inhabited islet around Korčula, islet of Vrnik, a stonemasons' guild of St. Matthew was established. As it is clearly attested in notary records from the beginning of the 14th century, stone masonry was (apart from shipbuilding) the most widespread and desirable occupation. Unfortunately, until present time, only a scarce number of archival documents from Middle Ages that would enable a wider insight in the development of stone masonry on Korčula has been preserved.

In Dalmatia, the prominent stone masons, known under the name *proto*, owned the quarries (*vele kave*), overtook the business affairs and employed the labour force (as well as their own relatives). The amount of the wages depended strictly on owner's personal

assessment, regarding worker's efficacy and abilities. The employees had to be loyal and obedient to their employer.

An important activity was of course the transport of stone, especially of the stone blocks of greater quality, which originated from the larger and important quarries. The stone was transferred by carts, in which was generally yoked a pair of oxen. Presumably the peasants transferred the material for their own use by themselves, using their carts and yokes. For public buildings, like churches, the building material was transported by the paid drivers or by the villagers with forced labour (*rabuta*).

In all Karstic area stones have gradually been cleared off, in order to get cultivable land. Pieces of land were fenced with dry walls - *ograde*, built from larger stone slates, while smaller rocks were deposited in large piles, known as *gromače*, *močire* or *gromile*. This centuries-old process created a specific Karstic landscape characterized through a net of dry stone walls.

Since the second half of the 9th century, especially in the quarries of rubble, the stone was extracted with the help of explosives and gunpowder. Since the beginning of the 10th century the workers in the quarries used the compressed air drillers and the helical wire - that technology had been abundantly used in Karst until the beginning of 1980's. Depending on the type of a quarry, of upstream or pit/well, the manner of handling the stone blocks has significantly changed. The blocks (but also waste) were transferred only with the help of powerful lifting equipment (derrick crane). Since the last decade of the former century derrick crane has become indispensable in quarries. The most modern techniques require the use of a quarry diamond wire or a diamond chain cutting machine. These methodologies allow a yield increase and a powders decrease. Nowadays lifting of the blocks from lower quarry forecourts is managed through powerful mechanical shovels instead of the derrick crane. The most significant moment of the mining activity in the Karst region is related to the construction of the Southern Railway, the line that connected Vienna with Trieste. With the railway the karstic stone was quickly distributed all over the territory of the Austrian empire.

According to the form and the level of their treatment, the stones are classified in several subgroups:

- a) field stones (stone from fields and pastures);
- b) stone quarry (visible traces of pickaxe or wedges);
- c) splinted elements (visible small crate-like of minced rock);
- d) drafts (elements elaborated with hammer that leaves typical nicks);
- e) dressed stone (building elements with straight and sharp edges, treated with inclined chisel and hammer and with perfectly flat contact points) present only in the building elements or in the manufactured products (window doorpost, architraves, etc.).

Regarding the nature of the materials, their form and their position in masonry walls (thickness, contact points, etc.), we differ several types of masonry:

- *Totally irregular masonry*; realized through stones of different form (rectangular, triangular or pentagonal) and size.

- *Irregular size masonry*; compact limestone and other materials; bricks and tiles scattered into small fragments are introduced in the interstices walls. Bricks are placed in the wall without any order.

- *Irregular size masonry*; re-used stones originating from other buildings.

- *Irregular size masonry with horizontal line*; consists of several pieces of compact limestone, coated with lime mortar and limestone aggregates. The horizontal adjustment is carried out at regular lines.

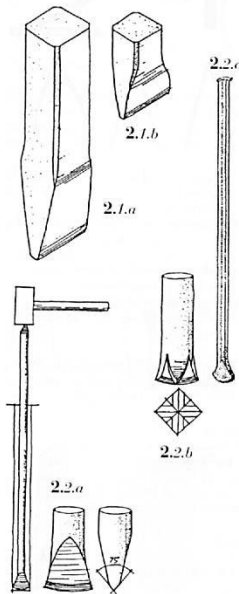
- *Rowned masonry*, the linear arrangement of stones. A combination of the elements made of various material within the same row.

The plaster consists mainly of dough made of water with a bit of lime, often mixed with manure and fertile soil. This soil is typically red and adds its almost pink colour to masonry.

In Dalmatia, the wood has remained a popular material for construction works for centuries. From numerous historical sources, we can learn that even at the beginning of the 15th century there were plenty of wooden houses in Dubrovnik, Split, Trogir, Šibenik, Zadar, ... After several devastating fires (for example in 1296 and 1370) wooden houses were gradually replaced with stone buildings and Dubrovnik, for example, was turned into a city of stone. However, also in other medieval cities on Croatian coastline wooden houses were gradually substituted with stone houses.

In the Early Modern time (as a result of continuous wars between Venetian Republic and Ottoman Empire) Dalmatia was pushed in the economic decline. Stonemasonry was slowly decreasing and was merely applicable in defense system. For example, military engineers in the 16th and the 17th century transformed medieval walls in modern fortification. During the attacks, many churches and buildings were destroyed and their building material was used to strengthen the

Risbe 2
 2.1.a: Dolgi klin
 2.1.b: Kratki klin
 2.2.a: Dletasti sveder
 2.2.b: Križni sveder
 2.2.c: Dletasti ročni sveder

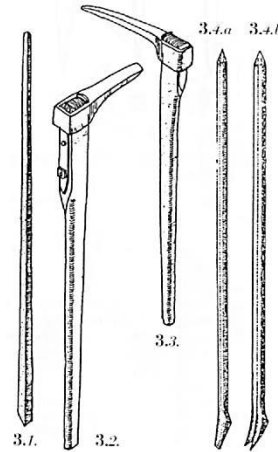


ROČNO ORODJE ZA PREMIKANJE,
 DVIGOVANJE IN NAMEŠČANJE
 SUROVCEV ZA KONČNO OBDELAVO

Surovec nameštimo na delovno mizo *kam-narsko kozo*, to je 50 do 70 cm visok zaboj, napoljen z jalovino.

Risbe 3

- 3.1: Navor klasične izvedbe (veliki navor - *štanga*, mali navor - *štangulica*)
- 3.2: Ravnica
- 3.3: Kljunača
- 3.4.a: Navor iz naših krajev (*marjana*)
- 3.4.b: Navor iz naših krajev s parkljem (*pejde de poroko*)



147

Figure 7
 Stonemasonry tools.

fortification system. Since the mid-16th century the use of imported stone from quarries in Trogir, Korčula and Brač has increased, whereas in Zadar stonemason' workshops were in decline. Venetian and late Hapsburg administration, introduced a work obligation (*per servizio pubblico*) for public works (like repairing the walls, harbours and docks, communal maintenance) as well as for extracting and breaking of stone. The workers got no payment; they worked at their own expense - *a spese proprie*, ship owners were obliged to transport platy limestone to Zadar.

After World War I active quarries of Zadar were concentrated on the islands and were in decline. In the sixties, stone extraction was completely stopped and until present there is no active quarry on the Zadar islands. Since the second half of the 20th century the stone from Benkovac area has become "a symbol" of the platy limestone for entire Croatia and has totally prevailed over other platy limestone quarries in Croatia.

By the end of the 19th century, the stone carving has been implemented in the educational program in Croatia; in so-called first high school (*prva gimnazija*), Croatian civil school, and in the form of one-year courses of stone carving and shipbuilding. According to statistical documents, stonemasonry courses have been four times more attended than any other courses and are obviously still desirable and profitable occupation. In 1913 the first professional stone carving school in Croatia was opened.

In Slovenia, the stonemasonry skills are learnt in vocational school (*višja strokovna šola*) in Sežana in the area of Karst (Šolski center Srečka Kosovela Sežana) as a special module of the school program.

In the province of Trieste, on the other hand, twenty stonemason craftsmen with quite big workshops are active, which produce serial products, but only five or six stonemason craftsmen still work in traditional techniques. Interestingly, Duino-Aurisina Municipality tried several times to open a stonemasons' crafts school, but until present unsuccessfully.

5. Main types and characteristic architecture

Outdated stone roofs of platy limestone have been in most of the rural and especially in urbanized coastal areas in the 19th century in the course of time replaced with new ceramic barrel tiles roof or later with other kinds of roofing tiles. Through this change the villages have lost their traditional stone-roof landscape architecture and from the original greyish outlook they have become more reddish. Roof is the fifth façade, what we can clearly see in the case of Blaca monastery, Brač.

In the Carso/Kras the majority of villages were destroyed during the World War I and some villages have been badly reconstructed after the war, a part of traditional buildings and profane architecture has totally disappeared.

The earthquakes in the 1970's caused in the areas, lying on the edge of the project (Posočje valley in Slovenia in 1976 and Montenegro in 1979) huge damages and the inhabitants had to renovate their houses quickly by using new materials, techniques and also by imitating modern town architecture. A different approach was chosen in the latter earthquake, where the heritage office proposed a joint solution for the salvage of the traditional architectural heritage. Good practice of the documentation of the earthquake damages was shown in 1998, when students and professors (under the supervision of Peter Fister) went to Posočje valley and helped to prepare the corresponding plans for the destroyed architecture in order to keep the traditional identity and to propose suitable restoration solutions.

In Carso/Kras and along entire eastern Adriatic coast the use of platy limestone as a roof-cover of churches and peasants' houses is still traceable on traditional buildings and it gives us a good insight in the traditional use of platy limestone in the vernacular architecture.

Today, many old, traditionally built rural countryside houses, have been greatly modernized or are now abandoned and mal-preserved out of very different reasons: from reviving the rural countryside without any economical background to ignorance of the owners or responsible public institutions.

As a building material, the platy limestone was reserved for some auxiliary buildings and outbuildings, such as summer kitchen, wine cellar, bread oven, stable, and corbelled pasture structures. The flooring was mostly made of wooden boards or stone slates or it was paved with soil.

Cities and Villages

With the special regard on traffic, strategic or defensive position and especially the opportunity of the agricultural assets, in centers and in the countryside the villages and the settlements with dispersed urbanistic structure have developed. They have often remained unchanged for centuries and have preserved their medieval nucleus.

Larger centers – coastal cities, such as Zadar, Split, etc., are built on ancient Roman founding and in most cases their integral part is the preserved Roman architecture (Fig. 2: 2). Through centuries we can follow their importance, which is based on their economic or

strategic position. They have mostly preserved their medieval urban floor raster, which has strongly influenced on their later development.

In economically developed cities, the use of a quality platy-limestone material was in last century generally reserved for decorative elements and not for basic building parts like roof, walls etc.

In the past, rural villages have mostly developed in the areas, where the limestone outcrops and the inhabitants were able to pick it from the ground or dig it from the soil and consequently out of that primary need emerged the quarries. In the local quarry worked particularly the local population and sooner or later have developed the workshops of stonecutters and stonemasons.

Villages are in general divided in two types: a) villages of dispersed shape, strongly connected to the fertile soil of countryside, or b) villages that have developed around the main square and consist of few or plenty of farmsteads (Figure 7).

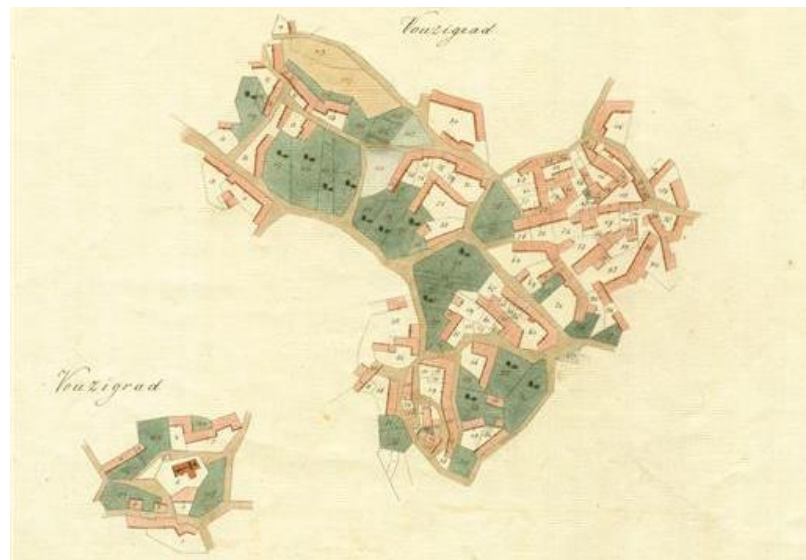


Figure 8
Volčji Grad (SLO), Franciscan cadaster 18

Churches and monasteries

In towns and villages churches and buildings, concentrated around main squares, have ever since the end of medieval period represented the most important center of the social life in the community. They are located whether in towns (Trogir, Zadar, Split, Korčula) whether in village centers or in narrower surroundings of the village together with adjacent cemetery (cf. Volčji Grad). A great number of small churches/chapels and the monasteries are located in the countryside and were most often built in remoteness.

In Herzegovina, the medieval sepulchral steles (*stećci*) cut out of thick special massive layers of limestone, and Islamic religious buildings (mosques), which were built in the center of the settlements, are preserved. From the Ottoman period we have a great number of stone

bridges (Višegrad, Mostar, etc.), where the platy limestone was an important building element.

Churches, mosques and bridges were, due to their important religious role, built after the plans of the most experienced stonemasons. The portal gates, church or mosque tower or only little belfry were the masterpieces and the most quality stonemason's work of art. The cathedrals (Trogir, Zadar, etc.) and other important churches (sv. Križ [Church of the Holy Cross] in Nin), were the results of the ambitions and financial efforts of the whole community and have in the quality and stonemason's work heavily surpassed the numerous small, single-nave churches in the countryside. In the case of the more complicated church buildings the whole building was a result of more experienced and widely recognized building team with specialized stonecutters for the production of bearing and decorative elements and stone sculptures.

Other stone elements, like doors and window frames, were mostly a routine work of stone masonry craft, what was notable especially for the auxiliary buildings in the countryside. These architectural stone elements needed not only the suitable stone from the quarry, but also the skills of local stonemasons' workshops or stonemasons.



Figure 9

Kolari, sv. Petka, CRO (1); Posedarje sv. Duh, CRO (2); Savar, sv. Pelegrin, CRO (3); Nin, sv. Križ, CRO (4).

Farmsteads

In the villages the post-medieval tradition of farmsteads is still alive, whose main feature is a courtyard, closed with high walls (Figure 7). The farmstead model in Karst is in its concept quite similar to the farmstead-types with closed courtyard in other areas of Adriatic hinterland, where the safeness of family and the herd are on the first place.

The size of the courtyard in karstic farmsteads can reach about several hundred square meters. Entrance to the courtyard and to the units behind it is stressed by an impressive stone portal. The main housing building was built on the northern part of the courtyard.

The outbuildings were located to the west or southwest of the main building.



Figure 10

Kras/Carso, typical view of farmstead with *borjač* (courtyard wall) and main portal in Volčji Grad no. 26, SLO.

Houses

A typical rural traditional house is in the area of Eastern Adriatic coast and its hinterland entirely made of stone, mostly of limestone; in northern Istria (Glinščica valley near Trieste, etc.) for the building material the sandstone is used.

Regarding the typology of the traditional house and churches in Istria in the 17th century Giacomo Filippo Tommasini wrote:

“...they (the population in the rural Istria) used to plate the floors inside the houses with planks almost everywhere, and cover the roofs with tiles only recently, previously they covered them with thin slabs of stone quarried in some places, and you can see them on the old houses and also the roofs of the churches were covered in these stone plates”.



Figure 11
Križ, SLO (1), Mostar, BiH (2), Dalmatia, CRO (3).

Houses were located whether in the edges of fertile fields or pastures whether in the middle of them, mostly they were integrated into the villages, lying in the larger fertile areas. Their main façade was regularly oriented to the south or southeast, the windows were facing mainly the west or south-west, only seldom were they viewing north and south. The buildings are mostly built after the additive principle – they have been often adapted, according to the family needs, mostly they were elevated in one or two stories.

If houses had a courtyard, encircled with walls, the importance was given to the main entrance – portal – the gates of the farmstead, which separate the private property from the public domain. The portals (of the entrance gates or of the house) were made of stone and were always decorated, mostly with owner's name, with some sacral symbols (like IHS or *Agnus Dei*) and vegetal motifs.

Plastering of the house was not obligatory. Rural houses in the northern part of the Dalmatia, particularly in Bukovica, are not plastered.

In the Italian Karst, plasters are made of water and a bit of lime dough, often mixed with the manure and fertile soil. This soil, typically red, is responsible for almost pink colour of the masonry.

In the interior is a shallow niche (*ponara*), which is used for storing small supplies or candles. In the center of the interior is an open fireplace (*ognjište* or *komin*), made of stone. Some houses have a primitive chimney (*badža*). In farmstead some small outbuildings, as barns, warehouses, pens for cattle, etc, were added.

The roof is covered with thin stone plates from platy limestone.

»Single cell« home / a Mediterranean stone house

The main building type, wherefrom have arisen several different types of the karstic stone architecture, is the simplest house form – a “single cell” household (only ground floor), covered with gabled roof or in the past with straw, rye sorghum, later mostly with platy limestone, without a chimney. It is called also a Mediterranean stone house – a stone house oriented towards the south and covered with stone roof.

The walls of all buildings were built of raw or semi-worked stone. Only stones in the corners were processed. Doors and window frames were carefully carved. In the residential buildings, the slabs were coated mainly with lime mortar and the slab surface was coated with lime wash. This whitewashing offers the protection of stone.

That simple type could later be extended with some upper floors: on the ground floor is a kitchen, bedrooms are on the upper floor. Usually the extended house has an external staircase made of stone and a wooden gallery covered with a jutting roof. Commonly, the gallery consists of two wings and is built above the external staircase.

The kitchen is located in the interior as an open fireplace, only later a chimney and different types of stoves (for cooking, for bread oven, heating) were built.

Spahnjenca, crna kužina, vatrenica

Spahnjenca is an independent kitchen structure, which was added to the house in the lateral façade (Figure 10:1). Only in few cases the kitchen is located in the interior. The slabs on the external kitchen usually had no mortar. *Spahnjenca* was made of limestone and its roof was covered with slates of platy limestone.

Quite often the kitchen was constructed as an independent building with chimney and was located few steps from the house (Figure 11).

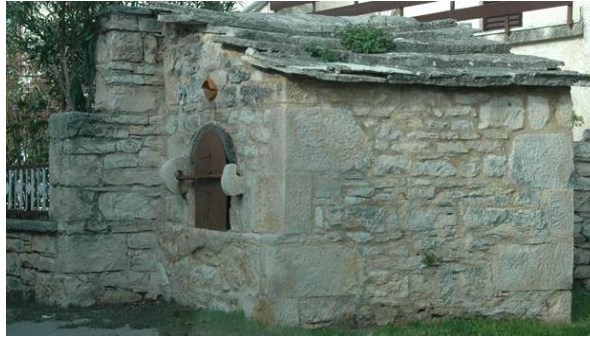


Figure 12
Rakalj (CRO)

Casite, hiška, kažun, bunja, trim, torete

Specific structures with circular layout and a corbelled roof (Figure 12) have developed on the whole Eastern Adriatic coast and on the great part of Mediterranean. These building constructions are known under different name: *casite* (Italian Karst), *hiška* (Slovenian Karst), *kažun* (triangle Kanfanar-Rovinj-Bale), *bunje* (between Zadar, Šibenik and Brač), *trim* (around Stari Grad on the Hvar Island) and *toreta* (Korčula). They were used as a shelters for the field tools and farmers or shepherds.



Figure 13
Kažun (casite, hiška, bunja) from Istria, CRO.

6. Architectural elements and decoration

Roof

The stone was in the past available in the village surroundings and was therefore cheaper, but due to the weight were the vaulted parts (apse, dome) covered with flat wooden roof. The slabs and the roofs were not lathed. Roof maintenance was easy – damaged stone slabs were replaced with new.

One of the most widespread use of the platy limestone is (due to its cheapness and availability) the roof covering.

Roofs were in the course of time restored or even enlarged, by replacing the stone slabs with tiles. Especially the roofs of warehouses and stables were renovated for several times, most often by using the original stone or by replacing the worn slates with some new stone slabs, occasionally together with some “new” materials, as concrete, plastic, asbestos panels etc.

A typical Karstic house has gabled roof and no gutter. Roofing is made of oak beams. The secondary structure is composed of strips of oak trees (15-20 cm thick), which were with wooden nails fixed to the roofing and to each other.

The roof is covered with thin or massive stone slabs (2-8 cm). The traditional roofing system is very simple: on the wooden rafters the stone slabs were laid and the roofs were not lathed. The rafters have to be at a rather small distance from each other (about 40 cm). Every slab covers two to three rafters. One of the most undesirable modern uses of platy limestone is for the covering of concrete structure with hewn platy slates, mimicking the vernacular heritage in the most dreadful way.

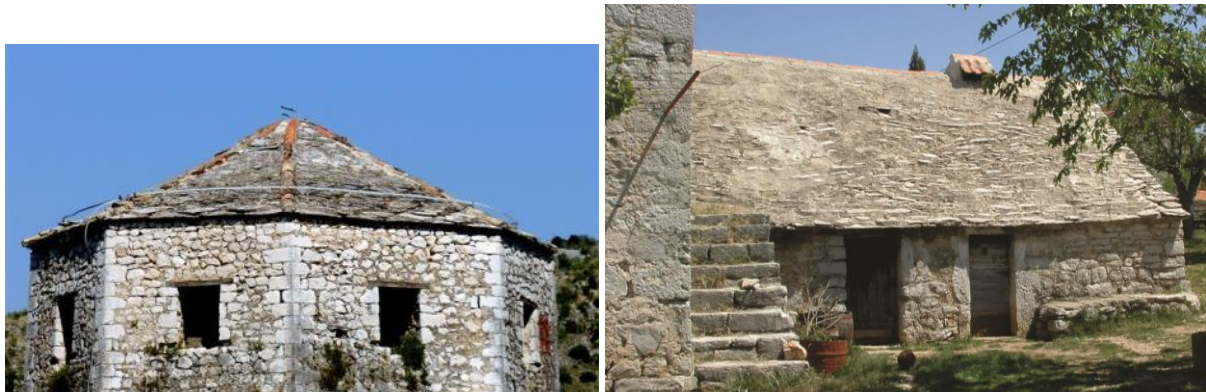


Figure 14
Počitelj, BiH (1), Lovreć, CRO (2).

In Dalmatia, one of the key features of coastal landscape is the roof, covered with thin stone slabs (2-3cm). Limestone was also largely used for several details like eaves, gutters, pavements, scarps of cistern, chimneys, benches, tables, etc. On some houses there are also stone chimneys (*fumar*), which are (in comparison to the chimneys made of other material) in

minority. Several churches in Korčula, for example, have preserved original roofing with the platy limestone and some of them (like Church of Our Lady of the Field) are built on ancient Roman founding.

In Herzegovina, platy limestone is mainly used for coverings of the different buildings. According to the roof form, we differ between pent roof, gable roof, pavilion roof and helm roof. In Herzegovina, there are examples of rotated stone plates on the roof. Helm roof is characteristic for Istria and coastal Croatian area, but is, on the other hand, uncommon in Herzegovina. Beside the roofs, platy limestone is used for chimney top, architrave of portal gates and for flooring.

The construction of the roof includes also the cornices, which are normally made of large plates of platy limestone, but are occasionally also constructed of a plurality of thinner plates, placed in several lines under the roof covering.

House frame

House frame is constructed of two stone types with externally and internally elaborated front. The joints are filled with debris. Usually the stones on the façade are not plastered. In the late Baroque period came to the plastering of the whole wall. In the case of roughly elaborated stone, the filling was filled-in with plaster. The plaster also served as the protection against the bad weather conditions. In the cases, where the stone was of mal-quality, which is especially obvious in stone houses made of sandstone (for example in the Community San Dorligo della Vale/Dolina and in Slovenian part of Istria) the protection with lime coating and plastering was compulsory.

Courtyard portal

An entrance to the closed courtyard (*borjač*) as a traditional rural homestead feature, is stressed by an elaborately made portal with large stone frames. On its architrave in a bas-relief often the name or the initials of the owner, a year of the construction, religious symbols (like an abbreviation IHS or a cross), flowers or hearts are chiseled.



Figure 15

Elements of courtyard portals, one bears an inscription, from Podgrade (CRO).

House portal

An entrance into traditional rural house is stressed by an elaborately made portal with stone frames. On its architrave in a bas-relief the name or the initials of the owner, a year of the construction, religious symbols (like an abbreviation IHS or a cross), flowers or hearts are often chiseled.



Figure 16

Volčji Grad, no. 24 (SLO); one of the most beautiful house portals on Karst with the chiseled year 1860 and letters A. J. – the initials of the stonemason and the house owner Anton Jurc.

Balconies or galleries

The balconies or galleries are used as a storage room for agricultural products and as the entrance to the living rooms. They are oriented to the southwest and west and are usually situated on the longer side of the building.



Figure 17

Repen no. 31 (IT); Divača no. (SLO).

Windows

Karstic windows are generally very small. The most archaic and elemental version consists only of one small opening in the stone wall, topped by an architrave made of wood or stone.

Staircase

Several Karstic houses have in common an external staircase, made of stone or wood (Figure 17). The steps are leading to the gallery and from the gallery to one or more rooms in the upper floor. The staircase is usually linearly shaped, although (when the courtyard is too small) there are some buildings with the external staircase in the form of a letter L. Inner staircase plays in comparison to the external staircase only a marginal role. Mostly it is L-shaped and made of stone or wood.

A characteristic element for the whole Dalmatia is *balatura*, the stone staircase which leads to the first floor, above the stall or *konoba*.

Flooring

The floorings in the karstic houses are generally covered with wooden boards: the ground floor is built of large irregularly shaped stone blocks, laid directly on the clay and covered with wooden boards. The flooring on the stories is made only of wooden boards. In Dalmatia, flooring in the interior is made of stone.

The limestone slabs are used not only for flooring, but also for a pavement, especially around the church, also in the houses and *gumno*.

Cistern

The water supplies in karstic areas were always problematic; therefore the inhabitants built ponds (*kal*), cisterns, or dug the fountains. The *kal* were situated on the village entrances for the cattle and sheep or goats when they were leaving for the pasture or returning in the pens.

The cisterns in the village center or near the houses, stored the water from the roofs with the help of stone gutters (Figure 17: 1). Those cisterns were made of platy limestone.

In several places in villages public cisterns are still preserved. They are situated in the center or in the suitable area, like the example from Tupeče (Fig. 17: 2). The public cisterns are often decorated with an inscription.



Figure 18
Štanjel (1), Tupelče (2) (SLO).

Shelves, junction between two elements

Out of platy limestone several architectural elements in the rural Istrian house, like shelves or junctions between two or more building elements, were made. Specific architectural elements made of platy limestone slabs are found practically all over Istria, which is an evidence of its widespread and well-established use. Techniques are quite similar, but especially in the roof covering there are some features, limited on the specific area.

Diversities

Between architectural elements on the façades little niches, constructed for domestic pigeons (Figure 18: 1, 2, 4) are common. For other purposes of daily use similar niches are located in the inner walls (Figure 18: 3, 5). They are constructed of the small plates of platy limestone. Thin plates were also used as protection above the frames (window and door frames).





Figure 19
Podgrađe (1), St. Drušković (2), Nakovana (3), Debeljuhi (4), Nakovana (5) (CRO).

In many cases the peasants have stored the stone slates from the former roofs of the collapsed architectural objects especially in order to reuse them for the potential pavement around the newly built or better preserved homesteads. Definitely these slates are an important raw material for the renovation of the stone roofs from the nearby, as they fit not only according to the dimensions, but are also of the same local origin.



Figure 20
Nakovana (CRO).

7. Catalogue of documented objects

Within the project RoofOfRock several historic buildings were documented. Beneficiary partners from Karst, Istria and Dalmatia have documented and evidenced several buildings from their researching area made in whole or only partially from platy limestone. In order to propose a detailed description, which could be helpful also for the future research of the architecture heritage, the Description Sheets (*vedi infra*) were fulfilled. All description sheets are an integral part of an elaborate of each partner.

Evidenced were buildings in the project area on Eastern Adriatic Coast and hinterland between Italian Karst and Pelješac.

From Slovenian Karst 45 buildings were documented: 2 from Gorenje pri Divači, 3 from Povir, 1 from Merče, 3 from Šmarje pri Sežani, 3 from Križ pri Sežani, 4 from Štanjel, 1 from Lokev, 2 from Žirje, 1 from Tomaj, 2 from Dutovlje, 2 from Skopo, 3 from Kopriva, 1 from Tupelče, 1 from Volčji grad, 4 from Divača, 1 from Škocjan, 3 from Vrhovlje, 2 from Voglje, 4 from Kazlje, 1 from Filipčje Brdo, 1 from Plešivica pri Povirju (“Gura pri Povirju”).

From Italian Karst 148 buildings were documented: 23 from Aurisina, 11 from Basovizza, 3 from Borgo Grotta, 3 from Bristie, 4 from Ceroglie, 5 from Zolla, 3 from Colludrozza, 7 from Gabrovizza, 2 from Malchina, 7 from Precenico, 2 from Prepotto, 23 from Rupingrande, 3 from Rocca of Monrupino, 11 from Rupinpiccolo, 5 from Sales, 1 from Samartozza, 1 from San Giovanni, 1 from San Lorenzo, 4 from San Pelagio, 14 from Santa Croce, 5 from Sgonico, 6 from Silvia, 4 from Trebiciano.

From Bosnia and Herzegovina were documented 24 buildings: 5 from Mostar, 4 from Počitelj, 5 from Blagaj, 5 from Stolac, 5 from Ljubuški.

In the community of San Dorligo della Valle/Dolina on the western edge of the project area specific morphologic stone sections are linked to surprisingly vast variety of solutions in using the local sandstone in traditional, mostly rural architecture. The research in the community of San Dorligo della Valle/Dolina, best described as the area “in transition”, discovered mostly houses and other structures built in local sand stone, with an interesting mixture of Karst and Istrian typology. Three most interesting monuments of cultural heritage have been documented in detail: house in Caresana/Mačkolje, watermill in Bottazzo/Botač, ice pits (*ledenice*) between Pese/Pesek and Draga Sant’Elia/Draga.



Figure 21

Mačkolje (Dolina), the case of stone house built with sand stone. The wall should be covered with plaster, because of sleek stone quality (IT).

From Istria 22 buildings were documented: 1 from Bačva, 5 from Bale, 1 from Barban, 1 from Draguč, 1 from Fažana, 2 from Kanfanar, 2 from Mednjan, 1 from Sv. Petar u šumi, 1 from Škitača, 1 from Višnjan, 5 from Vodnjan, 1 from Beram.

From Dalmatia 23 buildings were documented: 1 from Benkovac, 2 from Zadar, 1 from Vrgada, 1 from Posedarje, 1 from Parčić, 1 from Medviđa, 1 from Rovanjaska, 2 from Nin, 1 from Iž, 1 from Pridraga, 1 from Poveljana, 1 from Savar and 1 from Kolarina, 1 from Duće, 1 from Hvar, 1 from Slatina, 2 from Ume (village Tugare), 1 from Trogir, 1 from Brač and 1 from Šolta.

From the region of southern Dalmatia, on the island of Korčula the buildings from Donja (3) and Gornja Nakovana (1), Vela Luka (2), Blato-Gospe od Polja (1), Miletić (2), Postrana (2), Pupnat (1), Salapućeve nživica (1), Smokvina (1), Dub (1), Gornja Nživica (1) and Zanavlje (1) were documented.

All the partners had to fulfil the following table in order to provide a detailed description of the platy-limestone objects:

Descriptor:					
Date of fieldwork:					
NUMBER OF OBJECT IN RoR DATABASE:		Status* as heritage:		Evidence number in Register CH:	
NAME OF BUILDING (OFFICIAL AND LOCAL):	/				
ADDRESS AND LOCATION:					
TYPE:					
SHORT DESCRIPTION OF BUILDING (GROUNDPLAN, ELEMENTS, CHRONOLOGY) :					
USE (ORIGINAL):		USE (CURRENT):			
PLATY LIMESTONE PRESENT IN: (AND THEIR STATE OF CONSERVATION):					
SPECIFIC OBSERVATIONS:					
QUARRY/EXTRACTION SITE IN THE AREA:					
CONTACT/OWNER:					

*National monument; local monument; only in register; not registered.

Figure 19
An example of a description sheet

8. Selected case studies

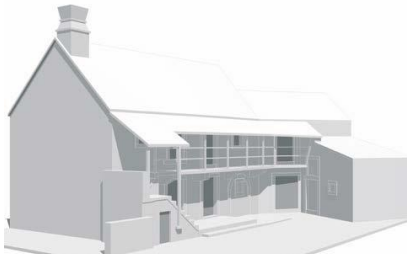
Within the RoofOfRock project 26 historic architectural structures were in-depth represented and documented. In order to thoroughly investigate the above mentioned buildings, the data collected during desk activities and field works were summarized and implemented in the description sheets (*vedi infra*). These sheets have enclosed also photos, architectural plans, sketches, outlines, historic photos, ... All description sheets and other enclosed material are an integral part of the elaborate of each partner.

As representative case studies all together 26 buildings were selected: 5 from Italian Karst, 5 from Slovenian Karst, 11 from Dalmatian coast and 5 from Herzegovina (see Annex 3).

<i>RoR description number</i>	
CULTURAL HERITAGE	
<i>Name (official and common):</i>	
<i>Address (location):</i>	
<i>Cadastral number, community:</i>	
<i>Coordinates:</i>	
<i>Owner / contact:</i>	
<i>Heritage status / protection:</i>	
<i>Use (original):</i>	
<i>Typology:</i>	
<i>Short description (ground plan, architectural elements, chronology):</i>	
<i>Special features:</i>	
<i>Platy limestone in elements / state of conservation:</i>	
<i>Notes:</i>	
<i>Descriptor:</i>	
<i>Date of fieldwork:</i>	
GEOLOGY	
<i>Selected limestone elements:</i>	
<i>Quarries/excavation sites in neighbourhood:</i>	
<i>Notes:</i>	
<i>Descriptor:</i>	
<i>Date:</i>	

Figure 20
An example of a description sheet of a selected show case

1. »Kraška hiša«/karstic house museum, Rupingrande/Repen 31, Monrupino/Repentabor (Trieste), Italy



Short description:

Typical karst homestead with walled farmyard (“borjač”). It's a courtyard house with stone portal gate (*kaluna*) and well in the courtyard.

Homestead is visible already on the Franciscan cadastral map from 1819 (State Archive of Trieste, signature: 679 b 03). The house, with its auxiliary buildings and the “borjač” cannot be precisely dated, but most probably date back to the end of the 18th century. Its present appearance dates back to 1831, when the last additions were made and it was renovated. Subsequent building work was exclusively aimed at its conservation.

The NAŠ KRAS cooperative society bought the building on 29th April 1968 and restored the house. The museum was opened in September 1968. During the project of architect Marjan Loboda from Ljubljana built the outside pavement, the cistern and the high yard wall.

Some restoration works were done in 1999.

2. Karstic house, Rupingrande/Repen 20, Monrupino/Repentabor (Trieste), Italy



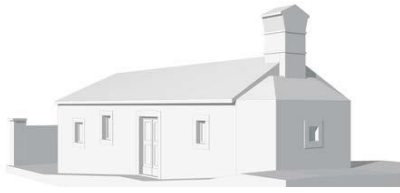
Short description:

Typical karst house with walled farmyard (“borjač”). It's a courtyard house with stone portal gate (“kaluna”).

House is visible already on the Franciscan cadastral map from 1819 (State Archive of Trieste, signature: 679 b 03). The house, with its auxiliary buildings and the “borjač” cannot be precisely dated, but very probably dates back to the end of the 18th century. Its present appearance dates back to 1800, when the last additions were made and it was renovated.

The Trieste Province bought the building on 8th March 1974 and restored the house in 1977.

3. Ljenčkica's house, Trebiciano 107, Trieste, Italy



Short description:

Typical “single cell” karst home with added kitchen (*spahnjenca*) and interior oven.

House is visible already on the Franciscan cadastral map from 1822 (State Archive of Trieste, signature: 693 a 05). The house cannot be precisely dated, but very probably dates back to the end of the 18th century. In a “building protocol” from 1838 it is described as a stable with courtyard (“hlev in dvorišče”). In 1924, according to the “Status animarum” for the Trebiciano parish the family Ljenčkica-Slavce lived in the house. Perhaps it was initially a stable and was at the end of 1800s transformed in a dwelling house.

The Slovensko kulturno društvo Primorec bought the building in 1999 and restored the house.

4. Chiesa di San Rocco e San Sebastiano, Santa Croce 1013, Trieste, Italy

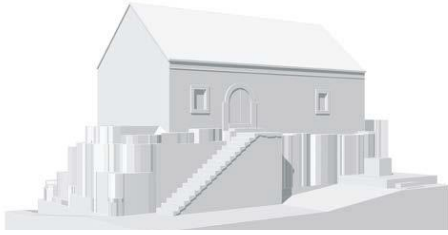


Short description:

It's a simple small building following a rectangular plan with a stone belfry above the gateway. The presbytery has a ribbed vault. Near the gateway there is a stone statue showing a *Mendico*, made by a local stone mason named Dusak.

The church was built in the 17th Century (1646), as a vow for escaping the plague.

5. Chiesa di Beata Maria Vergine Assunta - community's house, Col 2 - Monrupino/Repentabor, Trieste, Italy



Short description:

Typical “single cell” karst building, built on a rock with external stone staircase and interior kitchen fireplace.

It was restored rather poorly between 1983 and 1990 and after a few years stone roofs collapsed. The roof was rebuilt.

6. Cerkev sv. Elije, Kopriva, Slovenia



Short description:

Church with the single nave and 3/8 presbytery. It was built in post-baroque style. The construction works began in 1802 and ended in 1823 (constructor Matija Gulič). Bell tower added in 1852-53. High altar from 1751, pulpit from 1st half of 19th century.

7. Cerkev Marijinega vnebovzetja, Šmarje pri Sežani, Slovenia



Short description:

The single nave church with long presbytery, build in 1502 in late gothic style. Later baroquised, with remodelled bell-gable (1668) and added entrance shed. Above entrance is the inscription: M₁CCCCC₁Y = 1502 (Y is not “V” (five), but two “I” = II = 2)

Complex is surrounded by walls and *porton* (with year 18M?8)

8. Cerkev Marijinega vnebovzetja na Guri, Plešivica pri Povirju, Slovenia



Short description:

Built in the 16th century. First renovation and construction of the new presbytery and entrance shed between 1642-1647. Baroque modernisation at the end of the 17th and in 18th century. Bell tower from 1836.

9. Domačija »Pri Blaževih«, Gorenje pri Divači, Slovenia



Short description:

Typical karstic home with walled farmyard (“borjač”). House has two drips, added kitchen (*spahnjenca*) with partly hexagonal ground plan and oven with triangular drip. Homestead is visible already on the Franciscan cadastral map from 1818, while some other buildings in village have cut/built in dates from beginning of 18th century.

10. Domačija »Škrateljnovi«, Divača, Slovenia



Short description:

Typical karstic farmer house. Ground plan is L-shaped, *spahnjenca*, renovated stable and barn, cistern, gutters are made of stone.

House is visible already on the Franciscan cadastral map from 1818, while some other buildings in village have cut in dates from beginning of 18th century. Preserved original volume and construction, preserved historic arrangement of rooms.

11. Crkva sv. Nikole, Nin, Croatia



Short description:

Church was built in the 9th century over the remains of prehistoric and ancient Roman residential buildings. It is a sacral building of central type. It has a floor plan of a Greek cross. The cross arms are arched with hemispheres on trompes that support high drum on which is the dome constructed using a trompe. On the east side are three semicircular apses. Over the portal, on the western front of the church, is inscription on the lintel with a dedication of the county prefects Godečaj. Lintel is decorated with ornamental carvings. Around the church is a cemetery.

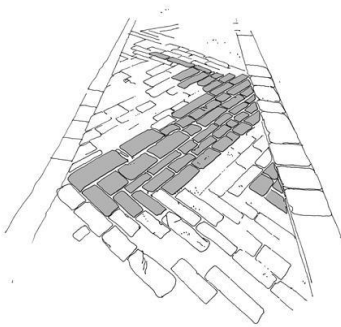
12. Crkva sv. Ivana Krstitelja, Medviđa, Benkovac, Croatia



Short description:

Church of St. John the Baptist is a cemetery church in the village Medviđa. It was built in the 13th or 14th century. The building is very picturesque because of its location at the foot of the rock, which rises above the tall tower in front of the church. The church has an elongated rectangular floor plan with a rectangular presbytery, typical for the area, on the eastern side. It was built of stone plastered on the outside. There is no portal in the main façade because it is close to the stone cliff. The supporting roof structure of the nave is wooden; a vaulted apse is slightly broken vault made of stone.

13. Stone sidewalks in Zadar old town, Croatia



Short description:

Through history, streets and squares of Zadar were covered with stone slab – through ancient Roman times, the Middle Ages until today. The most of the today's pavement is from the time of Austro-Hungarian administration (late 19th century). They used the stone from the island Lavdara. This reddish limestone was chosen because of strength and resistance to foot traffic. Stone slabs were 5-15 cm thick.

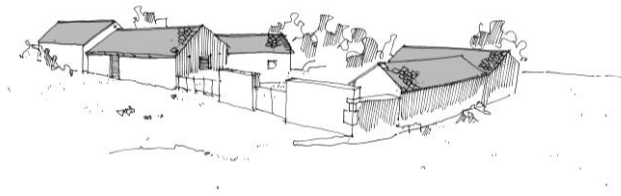
14. Crkva sv. Pelegrina, Savar, Dugi otok, Croatia



Short description:

Church of St. Peregrine at Savar is built on a small island connected to the mound on the Dugi otok Island. This is the most valuable early medieval monument in archipelago of Zadar. The church consists of nave and presbytery. Once there was a small sacristy next to the presbytery, but it was demolished in 1958. Square presbytery (2 x 3.35 m) is domed and represents the core of the church. Originally it was a small Romanesque church, to which nave and sacristy were later attached. The church was extended in the 15th century with a rectangular vessel (6.7 x 5.8 m). The last major remodeling dates back to the 1747. A belfry above the church entrance and the sacristy were added.

15. Homestead “Čerina dvori”, Podgrađe (near Benkovac), Croatia



Short description:

The complex of family houses represents a typical example of traditional architecture of Dalmatian Zagora, type Bukovica. The complex of house objects is grouped around a central walled courtyard, and consists of three residential houses, *vatrenica* and two barns for livestock. Front yard is paved threshing floor. All objects were built in extruded or roughly shaped stone and are covered with stone plates of thickness of 1-5cm. The buildings corners, window frames and doors were built out of stone chiseled blocks.

16. Trogir (katedrala), Croatia

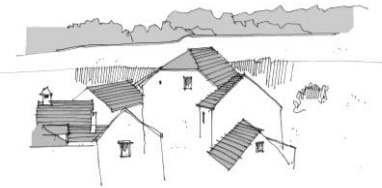


Short description:

The Romanesque cathedral is a three-nave basilica. The lunette of the southern door bears an inscription 1213, mentioning Bishop Treguan “of Tuscan line” and city rector Ilija.

A bell tower rises over the forecourt of the cathedral. The portal was made by Master Radovan; his signature is on the main portal as “the best of all in this art” (*cunctis hac arte preclarum*). The northern arch of the early Gothic forecourt and the passage through it is closed by the baptistery.

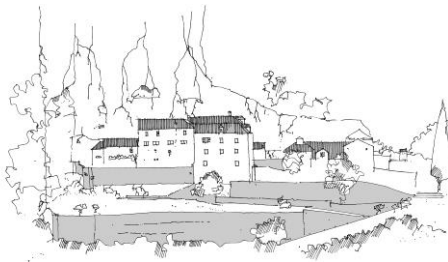
17. Grohote village (Šolta). Ruića dvori, Croatia



Short description:

The settlement of Grohote was obviously created in classical antiquity, as is shown by the findings from Roman period. Village is divided by one longitudinal and one transversal street. The houses have two floors, the upper floor is residential and is accessed through the external staircase. Their roof was made of stone slabs, which gave to village its uniform appearance.

18. Monastery-museum, Blaca, Brač, Croatia



Short description:

The complex has developed through the 18th and 19th century, its spirit is best reflected by the fireplace in which the flame was put out and rekindled again on Holy Saturday, when the fire is blessed. There are 11.000 books in the library. The inventory of the monastery is exhibited in a museum display.

19. Kućice Pod Veli vrh, Korčula, Croatia

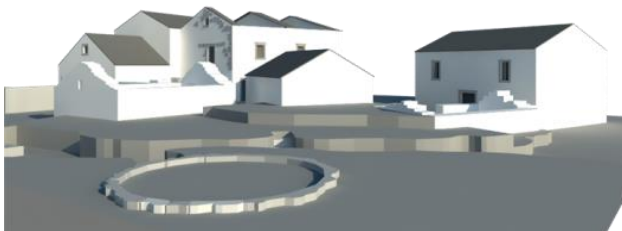


Short description:

Partially buried in terrain, set of three houses built in traditional karstic style are interconnected together, forming a small courtyard which is enclosed by boundary wall. Few meters near the objects there is a small quarry inside a parcel, where all stone material was extracted. Except for the preserved interlaced roofs with fine carved gutters, a roof ridge covered with platy limestone is still visible.

On cadastral map 1836 (revision 1880) objects are not visible, although near the parcel there is a significant widening of the road, probably indication that quarry was exploited at the time.

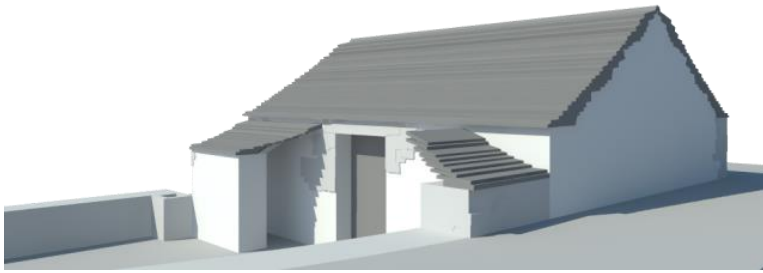
20. Donja Nakovana / “U Cvitka”, Korčula, Croatia



Short description:

Complex of six traditionally built houses with rectangular ground plan. Most of the buildings have been elevated in the course of time and some of them were gradually extended on each other. This type of constructions resulted in block type of housing, and with such spatial organization it was possible to form small enclosures -“dvori”, composed from storey housing with attached auxiliary/economic structures such as kitchen, cistern, threshing floor, etc.

21. Štala - Bobana lazi, Aleja kod Groblja, Vela luka, Korčula, Croatia



Short description:

Typical dry stone agricultural house with rectangular ground plan and inner concrete divider wall for donkey (stable).

By the side wall there was a smaller annex (demolished), and in front of the house there are two small eaves, and a vaulted water cistern. Such eaves with platy limestone are not present in area.

This object is one of the 20 almost identical dwellings that were built certainly after 1880, because they are not present on Austrian Empire cadastral map.

22. Lalića kula, Ljubuški, Bosnia and Herzegovina



Short description:

The tower is a tall building with a ground floor and two upper floors. Its ground plan is of rectangular form (6.00 x 6.35 m). The tower is 10.35 m high.

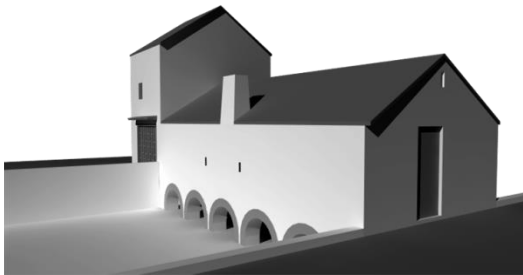
23. "Bišćević House"/Bišćevića kuća, Mostar, Bosnia and Herzegovina



Short description:

The complex has remained relatively unchanged from 17th until 20th century and consists of two parts: *selamluk* (male yard or part of the house for the reception of guests and business talks) and *haremluk* (women's or family's courtyard, an intimate part of the building). The main building material is a local stone. The wood is used for the pillars, floor and roof construction, as well as for doors and windows.

24. Velagića mlinica, Velagićevina, Blagaj, Bosnia and Herzegovina



Short description:

Facility mill has an irregular rectangular shape with dimensions: width on the north side is 6.83 m and 6.15 m in the south, while the length of 17.62 m. The walls are made of crushed stone thickness of 55-60 cm. The first part was miller's living, while the second part contained properly distributed five mills.

25. "Gavrankapetanović Tower"/Gavrankapetanovića (Glavna) kula, Počitelj b.b., 88305 Počitelj, Bosnia and Herzegovina



Short description:

The fort of Počitelj was built in the 15th century. Central tower has an octagonal base with additions from the Ottoman period, 17th-18th century.

26. "Čaršijska mosque"/Čaršijska (Careva) džamija, Ada b.b., 88360 Stolac, Bosnia and Herzegovina



Short description:

The mosque complex consists of a mosque, cistern, and the harem of the mosque, a fountain in the portal axle, gusulhana and harem walls. It was built in 16th century and is one of the largest mosques in Bosnia and Herzegovina. Its size is 18.30 x 15.30 m.