WP4

Platy limestone as cultural heritage

Supplement 3.I

Cultural heritage and limestone. – General overview

Appendix 3.I.1

Final report for the project area in Italy (Carso)

Authors:
Arch. Fabiana PIERI
Geol. Santo GERDOL

Photos and drawings by Fabiana PIERI

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1. INTRODUCTION TO THE PROJECT AREA IN ITALY

Karst is a distinct geographical unit, where the relationship between the nature of the soil and the landscape, the hydrogeological conditions, productivity and human settlement are very close.

View of Slivia

Today, many rural homes of ancient tradition have been greatly transformed with modernizations and additions, others are in abandonament state, only few have been kept in good condition by preserving traditional features.

Gorizian karst villageve has almost lost their traditional architecture, as they have been reconstructed after the first word war distructions.

It was therefore necessary to identify the most conservative and recognize situations beyond the modifications made to the original structure.

Buildings that preserve traditional features are usually concentrated in the part of the Italian karst closest to the border. Restoring and enlarging houses during the middle of the last century, Karstic inhabitants didn't take care of the traditional features and construction techniques. Buildings with stone roofs were usually transformed with a new tiles roof, which needs less maintenance.

Buildings with stone roofs that we can find nowadays were all abandoned – some of them still are. Many of them have been recently restored with a new sensibility on preserving traditional features.

2. STATE OF THE ART IN THE RESEARCH ON LIMESTONE AND CULTURAL HERITAGE IN ITALY

The most ancient karstic rural houses descriptions are from two general works. The first, Descrizione *della patria del Friuli*, dates back to 1502-1503 and was written from Marin Sanudo il Giovane[1], who describes the Isonzo settlements. From Sanudo we learn that at the beginning of the sixteenth century probably all the Soca Valley was characterized by wooden houses.

The second document belongs to the miscellaneous writings of Bishop Tommasini[2]:

"...sopra li coperti da poco in qua hanno introdotto gli coppi di terra cotta, che prima facevano con lastre di pietra viva cavate sottili in alcuni luoghi, e se ne vedono tutte le case antiche, ed anco le chiese coperte di queste tegole di pietra..".

[1] M. Sanudo, *Descrizione della Patria del Friuli di M. S. fatta l'anno MDII-MDIII*, Venezia 1853.

[2] The passage is reported in B. Nice, *La casa rurale nella Venezia Giulia*, Bologna 1940 (pag. 6).

"Le case di Pinguente sono coperte di tegole o coppi di terra cotta, eccetto il duomo, quatro chiese e due case private che sono coperte di lastre sottili di pietra viva. Le case di fuori dei contadini, sono per lo più coperte di paglia di sorgo o segala".

Only churches and some Karstic rural houses had limestone roof; farmers' houses were covered with straw or rye sorghum.

A third work, dating to the end of the seventeenth century, is *Die Ehre des Herzogthums Krain*[3].

Over the last two decades of the nineteenth century, some scientific studies were developed on the houses of Julian rural lands, which were under the rule of the Habsburgs.

A work of Gustavo Bancalari, *L'abitazione rurale nelle Alpi meridionali*[4], despribes Postumia-Vipacco-Idria zone. The author notes what he calls "the island of the Italian type" of Vipacco and the peculiar shape of the roofs, comparing to Padua lodges.

An Arrigo Lorenzi study, dated 1904, on the Po valley[5], contains two chapters on the housing and settlements of eastern Friuli and Agro of Monfalcone.

In 1905-06 a work by M. Murko was published entitled *Per la storia della casa nazionale degli Slavi del sud*[6], on rural housing in the Slovenian territory of Venezia Giulia.

In the karstic area rustic buildings have various cultural features: the "Rauchstubenhaus" (house of only two rooms, lobby and kitchen, no fireplace), which is the oldest type, next to the German language border; the alpin house from Wochein valley; the high-german house which is the prevalent; and the house with chimney (Kaminhaus), roman or italian house, typical Karstic house.

In 1907 Krebs published a book on the Istrian peninsula[7], containing information on the rustic house shapes of settlement.

The extensive work of Cvijic[8] on the Balkan Peninsula, which appeared at the end of WWI, contains, in the anthropo-geographical part, a brief description of the types of Balkans dwellings, including the variety of stone "carsicomediterranea", often two-story house present as well as in Dalmatia, Istria and the Karst own.

[3] J. W. Valvasor, *Die Ehre des Herzogthums Krain*, Laibach, Norimeberga 1689.

[4] G. Bancalari, *Das lundliche Wohnhaus in den Sudalpen*, Globus, Braunschweig 1895.

[5] A. Lorenzi, *Studi sui tipi antropogeografici della pianura padana*, Rivista Geografica Italiana, Firenze 1914.

[6] M. Murko, *Zur Geschichte des volkstumlichen Hauses bei den Sudslaven*, Mitt. Anthr. Ges. In Wien, 1905- 1906.

[7] N. Krebs, Die Halbinsel Istrien, Lipsia 1907.

[8] F. Cvijic, La péninsule balcanique, Parigi 1918.

The first notable work of the post-war period is that of Raffaello Battaglia[9] on the Istrian primitive house, which also considers the contemporary dwelling, examining characters and genesis of the typical "Casite" in southern Istria.

In his *Guida alla Carsia Giulia* Cumin[10] he established an initial classification of types, representing the distribution on a Karstic map.

He described an "Italic type house" which has two variants: one in the flat area of the lower valley of the Isonzo and Frigid, the other on the Karst plateau and Istria foothills.

The second one should be a reduction, in part transformed, of the plain house, and this primarily due to lower agricultural activity and to characteristic shape of small possession dominating in the area. Cumin describes, on the Trieste-Gorizia Karst, the house roofed with stone slates, usually composed of only the ground floor (more rarely also from a first floor), with a detached stable. The forth type in the Carsia Giulia, the most oriental one, has the roof with four slopes. If the building has only the ground floor, there is a trap door to reach the attic. If the building has the first floor, there is an internal staircase to reach the attic. This type corresponds to the "Slavic-alpine of other authors".

In 1940 Bruno Nice[11] published the book *La Casa Rurale nella Venezia Giulia* in the context of studies on rural house by the CNR directed by Prof. R. Biasutti. The study of Nice consists of four chapters on housing Julian corresponding to the provinces of Gorizia, Trieste, Rijeka and Pula, and a chapter on “Malghe”.
The text structure follows the pattern desired by Renato Biasutti, for which the study of the rural house is always preceded by a detailed description of the geographic reality under consideration, according to the parameters of geomorphology, climate and vegetation aspects. The survey of rural dwellings was carried out fraction by fraction by bringing together those municipalities that have affinity in environmental connotations, and especially homogeneity of rural construction.
The study is concluded with a classification of the main types of Julian rural hoses. It is based on a method of classification that Biasutti defines "structural" and "stylistic": the first method concerns the placement of the most important rooms of the house, or the plan distribution of the buildings when the dwelling is not constituted of only one property (he considers especially the interior of the house); the second is based on the formal characteristics (eg. shape of the roof slope, building materials, etc.) and considers, therefore, mainly the outside shape of the house.

In the second half of the 20th century many books have been published on “casite”, on karstic houses and on morphological analises on the different karstic villages, as the study on Santa Croce by Semerani[12] and the one on Aurisina by Guacci[13].

[9] R. Battaglia, Ricerche paleoetnologiche e folkloristiche sulla casa istriana primitiva, Parenzo 1926.

[10] G. Cumin, Guida della Carsia Giulia, Trieste 1929.

[11] Nice B., *La casa rurale nella Venezia Giulia*, Bologna, 1940

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3. GLOSSARY OF JARGON TERMS

walled farmyard – borjač
added kitchen – spahnjenca/ispahnjenca/kura
stone portal gate – kaluna
window frame – jerte
balcony – gank
gallery – baladur
inside pavement – škrle
outside pavement – šeliž
laths – remelni
gallery shelves – medjoni
cistern – štirna
kitchen – hiša/kuhinja
bedrooms – kambre/sobe
loft – na podu/kašča
hood – napa
wooden shelving and decorative curtain around the hood – tornakamin
niche in the kitchen wall with a shelf for vased and a water container – škafenca
cellar – hram
stable – stala
hayloft – na štali
shed – skedenj
candle holders – lajter
bucket – štenjac/stagnaco
wooden tub – orna
mattress of straw or maize leaves – stramazzo/paieriz/pajeric
pond – kal
small quarry – jave
fenced fields – ograda
calcar – jeplenice/frnaže

4. LIMESTONE QUARRIES

Karstic geographical and cultural characteristics are related to its stone. Until WWI, every family had at least one of its members employed in the stone quarries.

PLATY LIMESTONE QUARRIES
There are no “platy limestone” historical quarries in the counties of Trieste and Gorizia. This type of excavation, in the past, didn’t create a business.
We only have “massive limestone” Quarries, like the “Roman quarry”.

During the 19th century karst landscape was completely different than now. The vegetation cover was definitely poor and, therefore, identification of limited and discontinuous outcrops of platy limestones was certainly easy enough.

Saint John on the Timavo river after the second world war.
We can see the poor vegetation cover (AcegasApsAmga S.p.A. Archive)

Especially in the area of Aurisina there were large amounts of waste material of the "Roman" period. It is not unreasonable to suppose that Karstic people have drawn the slates suitable for covering their houses from these old dumps.
Often massive horizons, especially in the basin of Aurisina, are dominated by a few meters of stratified net limestone, from decimeter to pluridecimeter: this situation was also checked during inspections focused on small quarries (jave) now abandoned. It is plausible that layers of the uncovered positions of the quarries from major and/or smaller jave yielded necessary slates by the separation along the planes of "cleavage". These splitting operations along the preferential surfaces couldn't have been too complicated for the skilled masons of that time. It was even easier with picks, chisels, levers etc. to get the more or less appropriate forms for the roof covering.

A small quarry (jave) in Col, now abandoned

HISTORICAL QUARRIES

The tradition of the quarries and stone processing has ancient roots and is a key element in the cultural and historical Karstic heritage. Karstic settlements, which developed mainly from around 800, are directly linked to the growth of the mining and the consequent need for new labour.

The marble quarries (in the sense of goods) exploit horizons that develope in the limestone rocks of Upper Cretaceous age, with lithological and physical-mechanical favorable and outcropping on the karstic plateau. Limestones are very pure, over 99% of calcium carbonate, homogeneous, very compact, with background color ranging from very light gray to dark gray. The varieties depend on the size, clastics and on fossil fragments amount and distribution.

There are more than 150 limestone quarries in the Italian karst but only fifteen are still active. The wide use of karst limestone over the course of more than 2000 years should be emphasized. The local use is only a minimal part. The distribution is mainly concentrated on the municipalities of Duino-Aurisna (eighty) and Monrupino (thirty), but quarries (abandoned and active) are also present in other municipalities.

Ornamental stone quarries are the most numerous ones; those created for rubble or for the concrete production are larger.

The size and typology are extremely differentiated: there are some quarries measuring several acres while there are also smaller exploitations related to a local use (Jave).

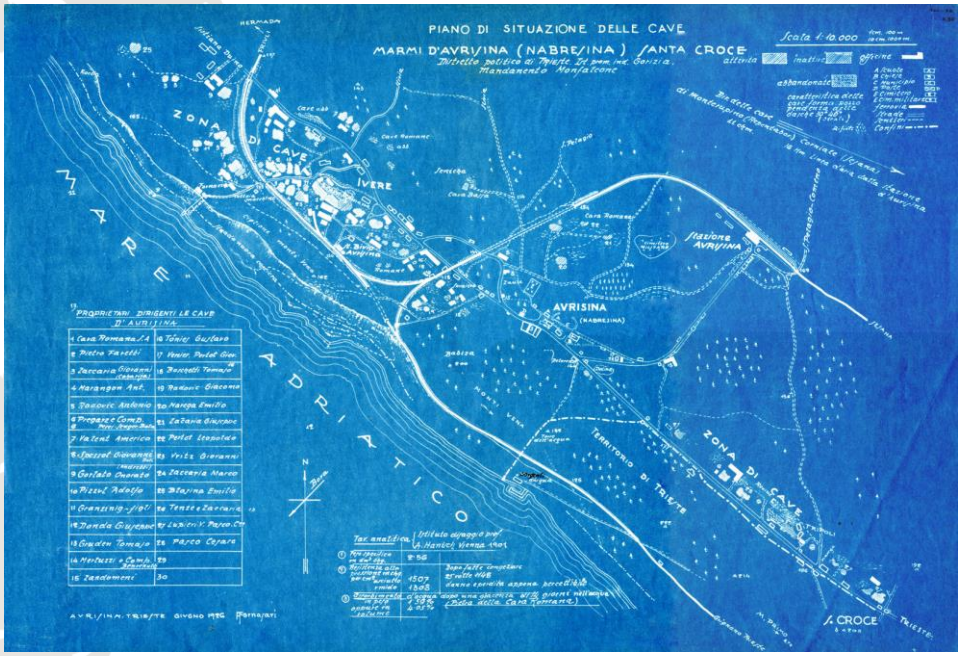
Many traces in the area indicate the quarries significant activity in the Roman period.

We can see exploitation traces on the ancient walls of the quarry. Ancient rough-hew stone artifacts have been found near the ancient quarries and in some buildings located located near them.

During the roman period, stones coming from “Roman quarries” have been used in Tergeste and Aquileia.

Several studies, accompanied by specific mineralogical and petrographic investigations, demonstrated that the Karstic stone in Roman times reached, through the ancient waterways, the major Roman centers of the valley of the Po (Milan, Bologna, Padua) and the coast of Romagna and Marche.

Nowadays, on some of the vertiginous quarries walls, you can often "read", by a succession of cutting, the story of the centuries-old activity. The oldest traces are present in the basin of Aurisina in the top portion of the walls of the “Roman Quarry” and in the nearby quarry, located to the east that is no longer active. Some of the tracks along the walls of Aurisina are bimillenary. Centuries-old excavation signs have been found in many other Karstic quarries. Several still active quarries were considered to be of historical interest by the Friuli Venezia Giulia region.



Plan of quarries in Aurisina and Santa Croce on 1926 (Gerdol S. Archive)

The most historically significant moment for the mining activity in the Karst region is related to the construction of the Southern Railway, the line that connected Vienna with Trieste, which was the Habsburg Empire port. Karstic stone use quickly spread all other the territory of the empire. Aurisina suddenly became the most important processing and distribution reference for stones coming from a much wider area, from the Istrian region and from the innermost part of the Karst.

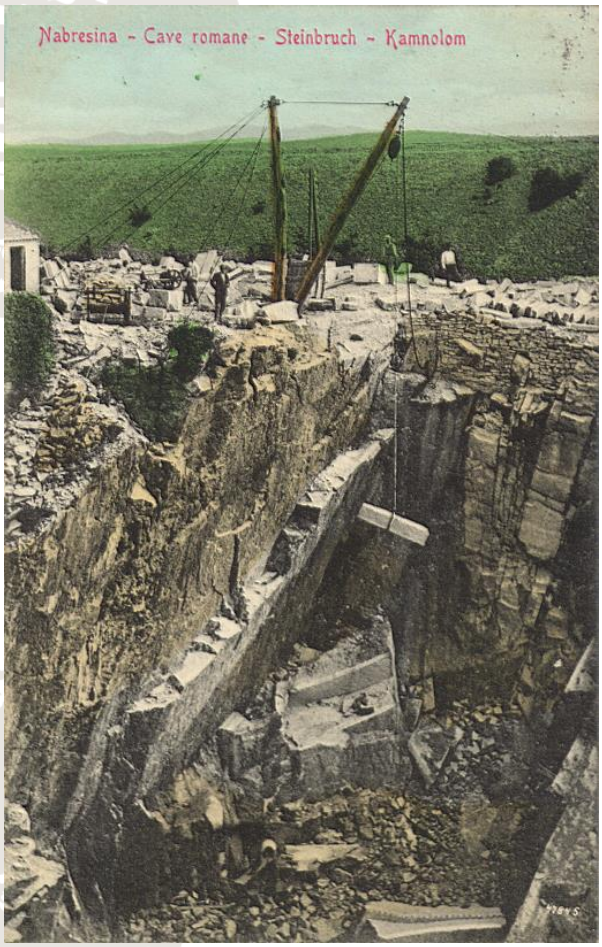
Between the late 1800’s or early 1900’s, in just the municipalities of Duino, Sgonico and Monrupino, there were more than 120 quarries.

S. Ruter, in 1893, reports that there were almost 3.000 people engaged in marble industy, without taking into account the teamsters, traders, industrialists and financiers who were also linked to this industry.

Vierthaler[14], in 1882, reports that the number of workers employed in the Roman quarry, varies from 250 to 300: miners, clutches, stonemasons, manuals, and leaders of art smiths, carpenters, machinists, turners, etc. sawyers. In full activity it can supply 500 workers.

EXPLOITATION

In the ancient times the work was progressed both in the open air and indoor (sottecchia). The separation of the blocks was done by hand with the use of the pick, the chisel and with the aid of metal levers and wedges.



From the second half of the 1800's, especially in the quarries of rubble (but not only), explosives and gunpowder began to be used. At the beginning of the 1900's compressed air drillers and the helical wire came into use. This has been abundantly used in Karst until the beginning of 1980. Even today, in some old karstic quarries, we can observe the pulleys in which the steel strands ran. With their motion and abrasive silica sand and water friction allowed the separation of banks from the quarry front.

In the quarry squares, the cylinder banks were overturned in boxes, especially through drills, to produce marketable blocks. Depending on the type of quarry, of upstream or pit / well, the manner of handling of the blocks changed significantly. In the first type they proceeded with the ancient streets of "lizza", inclined planes, the winches and "doucaville" (used abundantly above all for the removal of waste). In second type the blocks (but also waste) movement could only occur through the use of powerful lifting equipment (derrick crane) that were indispensable in quarry operations up until about twenty years ago.

In the last a few decades the most modern techniques require the use of the quarry diamond wire or a diamond chain cutting machine. These methods allow for a yield increase and powder decrease. Nowadays the block lifting from lower quarry forecouts is done with

[14] Catalogo ufficiale preceduto da un riassunto storico e da indicazioni statistiche / compilato dal Comitato esecutivo dell'esposizione e da Rodolfo Mosse ; redazione del catalogo: Augusto Vierthaler, Trieste 1982

powerful mechanical shovels instead of the derrick crane that is, however, left in place at times, to define the " quarry landscape."

Texts on Venezia Giulia quarries

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5. MAIN TYPES AND CHARACTERISTICS OF KARSTIC ARCHITECTURE

Classic Karst (Italian and Slovenian karst) villages exhibit a tight relationship between space and its defining materials. Urban morphology is in perfect harmony with the needs dictated by the specific orographic conditions, climatic, economic and social issues. There are centralized and small settlements (except for the villages of Opicina and Aurisina).

In the villages certain recurring elements systematically occur. The settlements follow aggregation and growth methods established in the tradition of folk-houses coming from medieval culture and, not infrequently, the origins of property management of land and water resources are much older.
The karst settlement system an unchanged medieval matrix formed by a very tight weave of small villages equally distributed on the territory, in which we can distinguish some reference centers of particular importance. These are centers that have historically been the site of important feudal estates or villages located on junctions of communication routes that, in Roman period, linked the Italian peninsula with Noricum in the north and Pannonia in the east. In the fifteenth and sixteenth century, while the Patriarchate of Aquileia was developing and the settling of foreign lords on the territory took place, the rural villages types define their structure that is still detectable in the nineteenth century maps.

The public spaces of aggregation do not belong to the culture of the Karst villages settlement. Churches, usually at the center of the country, but often located in high places at the edge of town, is the most important center in the social life of the community and it is always associated with a small common area.

Franciscan cadastral map (1819)

In general, the reference schemes depend on the particular orographic conditions with filiform or "cluster" configurations, with developments stretched halfway, or more compact and geometrically regular in the plain.

The systematic, iso-oriented arrangement and the aggregation of residential buildings in “filiform” – longitudinal housing estates are invariant elements of the rural settlements.
The buildings are oriented to the south or south-east, and consequently the court is always maintained on the southern or western side.

The village morphology is quite simple. Buildings are structured on a road system very essential with blocks on double facing lot. The logic of urban alley is common over the entire area and is due to separations for inheritance of the large courtyard houses that constitute the oldest building fabrics. The progressive necessity of enlargements bring to occupy different sides of the coutyard, sometimes on the south or south-westerly and then on the other, so as to give a spatial definition and appearance of a real court.
Sometimes, the sharing among multiple owners of an initially private area, transform this space in an interesting neighborhood area and often up to its complete evolution into a true public space.

The dry-wall is a separation element between roads and private spaces. Portal gates to get inside private courtyards are a very important element. The portal gates mark the private property on the road and, in accordance with their arrangement on it, implicitly tell

the system of relations and combinations that exist between contiguous houses.
They are always decorated, often with the owner's name and sacral symbols.

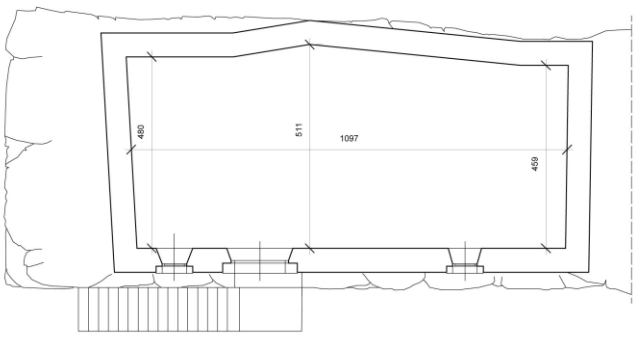
TYPES

The house is a place of living but also work. Most of the activities of processing and storage of agricultural goods take place inside the house. So, as a rule, it has a series of variously specialized outbuildings (wineries, hayloft, stable, etc ...) distributed within the property, as well as in purely residential areas.

The original settlement types are shelters for men, tools and animals on open spaces organized and protected by walls. Then we can identify the "filiform" – longitudinal housing estate and courtyards. The shape, volume, access, openings, finishing are conditioned by the use. Houses comprise small volumes with openings mainly to the west or south-west, rarely to the north and south, very small in the east or north-east, mainly in relation to the prevailing winds and the proper sunlight.

The most common building types are built in one or two levels. The planimetric layout is due to two or three cells simply juxtaposed, arranged in the head or at the bottom of the lot, usually on bedrock, suitably modeled according to the depth of the single cell.
The Karst housing model coincides with the type of the house with closed yard.
The courts size is normally consistent, easily reaching extensions of several hundred square meters to witness a community devoted entirely to the agricultural and pastoral activities.
The transition from the flat area of the plateau to the mountainous areas, however, marks a substantial reduction in the size of the courts and an increase in building density with respect to the centers of most southern areas.

The simplest house is the »single cell« karstic home (only groundfloor) without chimney. The smoke came out from the entrance or from a hole above it. They were covered with straw or rye sorghum. Some were covered with platy limestone. An example of this type is the community house (1005) in Monrupino/Repentabor (the chimney that we can see has been recently built). Originally there was a hole on the limestone roof to let smoke to come out.



The »single cell« karstic home in Repentabor

A »single cell« karstic home (only groundfloor) with chimney is present in Aurisina (1016).

The »single cell« karstic home in Aurisina

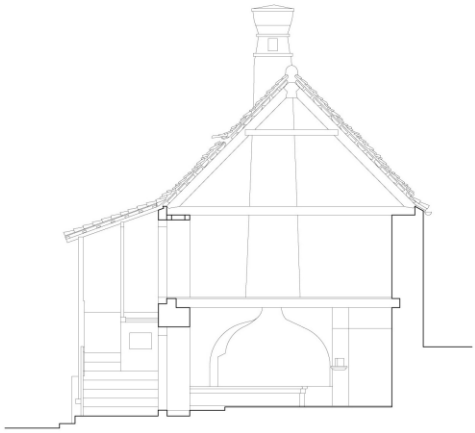
A »single cell« karstic home (only groundfloor) with added kitchen (*spahnjenca*) is present in Trebiciano (1003).
The width of the house depends on the size of the roof oak beams and therefore never exceeds six meters. The house had a two sloping roof and no gutter. The slope of the roof was determined by the roofing material.
Originally the house had two rooms, a bedroom and a kitchen. The partition wall was made of hazel and dogwood sticks intertwined and covered with lime mortar.

The »single cell« karstic home in Trebiciano

The »single cell« house is called by many authors the »karstic-mediterranean« house (Cvijc stated the term for the first time, reused by Nice[15]).

[15] F. Cvijic, *La péninsule balcanique*, Parigi 1918, Nice B., *La casa rurale nella Venezia Giulia*, Bologna, 1940.

The need to expand the living space leads to the one-storey house. The kitchen is still on the ground floor, bedrooms are on the first floor. Usually it has an external stone staircase, a wooden gallery covered with a jutting roof. In other cases they have inner stairs and no gallery.



A one-story house with an external stone stairs and a wooden gallery covered with a jutting roof.

Houses in Repen and in Aurisina. An external stone staircase reaches a landing.

In few buildings, an external stone staircase reaches only a landing, like a house in Repen (1086). Sometimes the landing is covered with a jutting roof – a case in Aurisina (1013), one in Rupinpiccolo (1100) and 3 in Repen (1077 – 1080 - 1993). In a case, in Rupinpiccolo (1107), there is a jutting roof covering the gallery and stairs too.

The position of the fire-place kitchen is also important. In some cases (probably the most ancient) it was added to the house (*spahnjenca*), in others we have inner fire-place kitchen and inner chimney. Usually the fire-place kitchen is added in the lateral facade. In a few cases it's added on the principal facade. Some times the added fire-place kitchen is very big and has one or more windows (capodistian type). We have some examples in Italian Karst: one in Ceroglie (1047), one in Rupinpiccolo (1104), two in Santa Croce (1123 - 1125), one in Slivia (1143).

- Type with external stone stairs, wooden gallery covered with a jutting roof, added fire-place kitchen: one in Aurisina (1007), two in Gabrovizza (1059 - 1062), one in Slivia (1143).
- Type with external stone stairs, wooden gallery covered with a jutting roof, inner fire-place kitchen: 4 in Aurisina (1019- 1028 – 1046 -1069), 2 in Zolla/col (1052 – 1053), 1 in Gabrovizza /1063), 7 in Repen (1001, 1002, 1076, 1080, 1082, 1083, 1095), one in Slivia (1142).
- Type with inner stairs and added fire-place kitchen: one in Rupinpiccolo (1102).
- Type with inner stairs and added fire-place kitchen on the principal facade: one in Gabrovizza (58), one in Sales (1113), one in San Pelagio (1118).
- Type with inner stairs and inner fire-place kitchen: one in Borgo Grotta (1040), one in Bristie (1045), one in Repen (1078), one in Repentabor (1097), one in San pelagio (1120), one in Sgonico (1135).

The most common gallery covers all principal facade and the external stone stairs, with two flights, built on one side of the facade. Usually under the stairs there was the pig-sty.
The gallery is usually held up by stone shelves, sometimes decorated.

In some cases the added fire-place kitchen has near an added oven: one case in Aurisina (1007), one in Ceroglie (1047), one in Santa Croce (1123), one in Slivia (1143).

TYPES OF COURTYARD

One of the most striking peculiarities is that the courtyard has the capacity to adapt to the changing needs of the family, either through the processes of development and growth for diachronic addition and juxtaposition of new rooms, or by fractionation related to inheritance. It is precisely because of this phenomenon that the centers of the plateau increase the density of building from generation to generation without modifications to the outline of the village.

CHURCHES

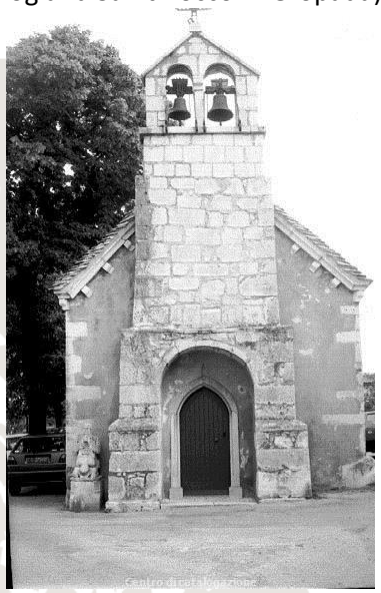
Churches, usually at the centre of the country, but often located in high places at the edge of town, are the most important centres in the social life of communities and are always associated with a small common area.

Churches located at the center of the country: St. Michael the Archangel church in Sgonico (1138). Other churches are located at the centre of the village, for example in Slivia and San Pelagio but they are not in our catalogue because they have been restored and their stone roofs have been replaced with tile roofing.

Churches located at the edge of town: Saint Rocco and Saint Sebastiano church in Santa Croce (1004), Saint Ulderico church in Samatorza (1115), St. John's along Timavo church (1116), San Lorenzo church in San Lorenzo (1117).

Churches located in high places: Assumption of the blessed Virgin parish in Monrupino (1098). This is the only church in Monrupino municipality.

They are usually simple and small buildings with a rectangular floor plan with a stone belfry above the gateway (this is the case of Saint Rocco and Saint Sebastiano church in Santa Croce and San Lorenzo church in San Lorenzo, but also Our Lady of the sage in Contovello, Saint Orsola in Log and Saint Rocco in Gropada).



Saint Rocco and Saint Sebastiano church in Santa Croce and San Lorenzo church in San Lorenzo

St. Michael the Archangel church in Sonico has a tall bell tower made in stone that goes on top of a belfry with mullioned and octagonal drum dating back to 1500, probably at the time of the erection of the first church, located next to the main entrance of the temple. A similar solution is taken in Holy Cross church in Santa Croce.

Assumption of the blessed Virgin parish in Monrupino has a massive bell tower high on four arches in the middle of its façade. A similar solution is taken in Saint Antonio Abbot church in Prebenico and in Saint Martino church in Prosecco.
The bell towers leaning against the facade come from the Carolingian and Ottonian tradition and are reflected in the architectural tradition of the Slovenian tabor of the fifteenth and sixteenth centuries.

The presbitery usually has a ribbed vault. (Saint Rocco and Saint Sebastiano church in Santa Croce, Saint Antonio Abbot church in

Prebenico, Saint John the baptist church in Bagnoli della Rosandra, Saint Martino church in Prosecco).

Many churches enlarged in the eighteenth century, like Assumption of the blessed Virgin parish in Monrupino, have an apse with a barrel vault.

The ribbed vaults in Saint Rocco and Saint Sebastiano church in Santa Croce and in Saint John the baptist church in Bagnoli della Rosandra

In one case, a farm house in Repen (1076), is present an old chapel dated 1850 in the back side of the building.

6. ARCHITECTURAL ELEMENTS AND DECORATION IN KARSTIC ARCHITECTURE – TYPICAL FEATURES

Karst limestone rock formations of the most superficial part of the earth's crust that can be reached directly or through excavations have determined the variety of building materials available. With regard to the economic realities of the area investigated that could not base the procurement of building materials through trade with the outside world is evident predominance of materials erratic or quarries next to the construction site by limiting the intake of exogenous materials.

WALLS
The geometric shape of the elements used can be classified into six categories:
a) quadrangular/semidressed (at least in part with not squared corners, but with two faces parallel to each other);
b) squared (with all right angles);
c) squared in L (like the other, but with one or more sides that have an orthogonal offset)
d) polygonal (with more than four corners);
e) rounded (prone to spherical, ellittico or multiradiale);
f) chips/slates (existing vestments made with slates of stone collected in fields or from other processes).

The processed form, that is determined by the preparatory work in which the elements have been subjected, is variable:
a) field stones (stone gathered in the fields and pastures);
b) stone quarry (traces of pickaxe or whedges);
c) elements splitted (a long run 'to' or 'hair' with the mallet used to edge that leaves a small crate-king of minched rock);
d) drafts (elements sketched-out with hammer or thick toe and mallet, that leave typical nicks);
e) dressed stone (elements with straight sharp edges, obtained with inclined chisel and hammer and with perfectly flat contact faces) present only in the elements or in the cantonal finishing elements (window doorpost, architraves, etc ...).

With reference to the nature of the materials, their geometry and the arrangement in masonry walls (thickness, extending the contact between the stones, etc ...) are classified as the following types masonry:

- *Totally irregular masonry*; realized with sketch-out stones with different form and size, with mainly rectangular, triangular or pentagonal on view stone surfaces; sketch-out stones are sometimes regularized so as to allow good adhesion and proper transmission of loads and, in some cases, are accompanied by a reduced number of flakes.
- *Irregular size masonry associated with compact limestone and other materials*; bricks and tiles reduced into fragments of size rather minute, are introduced in the interstices walls to patch them up, in order to reduce the areas filled with only mortar. Bricks are used in both the on view wall and the core wall, with no apparent order.

- *Irregular size masonry associated with reused stones coming from other buildings;* the new processing material and the reused one are assembled in a casual way.
- *Irregular size masonry with horizontal line;* consists of pieces of compact limestone with lime mortar and limestone aggregates. The horizontal adjustment is carried out at intervals more or less regular in height.
- *Rowned masonry,* the arrangement of the stones takes place in a linear way, treating especially the combination of the material within the same row.

The plastering is made from dough made with water and little lime, often mixed with the manure and abundant earth. The earth, typically red, gave the almost pink colour to masonry.

FOOTING AND ANGLE-IRON

It's very difficult to find real foundations. Houses were usually built on outcrop ridges of rock or on compact land.

The strength of the cell walls is based on solidarity and cooperation between the two by two orthogonal walls. The corner solution is one of the most important structural problems of the whole stone building. The most common technique was to align the intersections with large and well-squared angle-iron stones, making sure to overlap alternately along the length or key, thereby obtaining co-penetration between masonry bodies and the appropriate staggered joints.

The most relevant problem arose at the juxtaposition of new cells building to the existing ones. Already during the construction of the original cells, when they foresaw a subsequent extension, or if they wanted to reserve the possibility,

protruding - from the outer side of the wall -stones were arranged (waiting toothing), useful later for clamping the wall of the new cell.

DOORS, WINDOWS AND PORTAL GATES

Windows are generally very small to reduce the heat exchange between the outside and the inside of the house as well as to shelter from strong winds.

The most archaic opening is the elementary one represented by a small opening built on the stone wall topped by a stoned or wooden architrave and no special treatment of the shoulders. We rarely find this type in the centre of villages, it's often used in stables or haylofts located at the edge of town. The hole punching, often squared, keeps a rather small size that rarely exceed one meter in width.



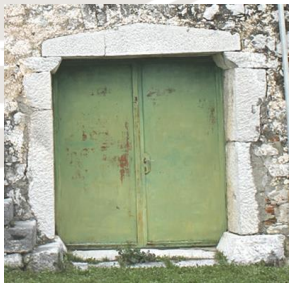
One of the most technically advanced scheme is the opening with a homogenous and regular trilithic structure. The central beam is made from a single block of stone roughly squared, sometimes resulting from the plunder of the oldest and most important factories, laid on grossly worked doorposts. The construction scheme is often completed with a fourth monolith used as a windowsill.


Absent, except in certain portals or in some portico passing the buildings, is the arch type for small openings. The use of the arch in the big openings is almost always characterized by the presence of several square blocks. It's very difficult to find portals with two or four key elements monolithic above. Arches are quite common in Gorizia Karst.


An old house in Visentini and a underpass in Devetachi (photo Bonassi P.)

Typical of the karstic buildings is the window top frame in platy limestone.


Doors are made with a homogenous and regular trilithic structure, like windows.



Portal gates leading to the inside private courtyards are a very important element. The portal gates mark the private property on the road and, in accordance with their arrangement on it, implicitly tell the system of relations and combinations that exist between contiguous houses. Generally, the architrave was decorated by the bas-relief or engraving of the name of the owner, of religious symbols such as the inscription JHS or a cross, flowers or hearts stylized, with a precise work of stonemasons.

We can find arched structures, especially in the plains and in particular in the most recent constructive examples.

GALLERY

The balconies were once architectural elements with a double use, as a distributing element to rooms and as a deposit for agricultural products. Oriented to the south-west and west, sheltered from the bora, usually occupy the longer side of the building. They were reached by an external staircase usually made of stone or wood. The galleries are often based on the extension of the beams that support the ceiling of the first floor and have a vertical structure made entirely of wood. Older ones and not reworked maintain a wooden frame supported on protruding stone corbels.

The gallery is sheltered by an extension of the roof or by a small shelter that comes out in the attic. In this case the practicable attic is ventilated with small round or squared openings surrounded in stone.

ROOFS

The width of the house depends on the size of the roof oak beams and therefore never exceeded six meters. The house had a two sloping roof and without gutter. The slope of the roof was determined by the roofing material.

The primary carrying structure is in oak beams, made from a single tree and can support a weight four times higher than that of a tiled roof. The secondary structure is composed of strips obtained by hand from oak trees, with a 15-20 cm thickness, which were generally fixed with wooden nails to the primary structure and connected one with the other.

The stone slates, thick 5-8 centimetres, are connected one to each other in a horizontal way and they cover each other almost completely. That's why it needs a high roof slope (45 degree).

A line of limestone slates rests along the roof edges, at the contact points between the perimeter walls and the coverage to prevent the rainwater infiltration. In a second time they used gutters. The gutters were made of stone slates appropriately shaped in cross-section running along the long wall of the house from the upper side to fall away, thus moving away from the neat hedges. The slates, that constitute the channel, were superimposed on each other, sometimes inserted in the masonry, but mainly supported by stoned shelves. In the lower end of the canal was prepared a further stone element shaped to accommodate the incoming water and drive it away from the wall.

Gutters in a house in Repen and in Prepotto

Roof of protruding fire-place kitchen is built directly on a stone arch.

On tiles roof, small wooden boards are fixed on the beams. Above they put the hollow flat tiles and then the tiles. The follow flat tiles used for the attic or in visible parts are usually decorated and painted with lime.

THE STRUCTURES OF VERTICAL CONNECTION

In Karst planimetric development of the buildings is denied by small open spaces needed for farming inside the courtyard. In this context, the home tends to grow in height needing a connecting vertical scale, which takes on a central role as a distributor between the different rooms and sometimes between the various building units.

External stairs

The most simple and widespread staircase is the one leaning against the body of the building. In this case is often made by a few steps leading to a landing from which develops a further ramp which allows reaching the gallery that serves one or more rooms.

When the space in front of the house is larger or in the presence of a closed court, the staircase can assume different configurations. The most common is a linear stair orthogonal to the building body by the wall side of the court. The L-shaped generally occurs when the court is not deep enough to allow a linear development.

The elementary schemes change when new living cells are created on the upper floors housing of the court itself. For each addition on several floors follows the enlargement of the balcony or the addition of a further stair, or the branching of an existing one starting from intermediate landing.

Inner staircases

Inside the house the staircase has a configuration closely linked to the wooden beam floor's plot to reduce the break on it.

The staircase without an own compartment and placed in a marginal position, with a rectilinear development such as to occupy a small space, is the most ancient solution.

With the evolution of the building type, the separation between the rustic and the housing, and the specialization of the housing rooms, led to the solutions in which the scale has assumed a specific role such as to be enclosed in a special compartment.

The further development has led to a progressive reduction of the slope, solving the increase of the development of the ramp with the rotation of the initial part as to come at an "L" configuration. It could be made by wood (the most ancient one) and in stone.

FLOORS

Karstic houses usually have wooden beam floors. The deck is made with planks nailed directly on the main beams.

The pavement of the courts is usually made in absolute consonance with that of the streets, with stone slates of small and medium-sized or homogeneous and regular river pebbles. The stone elements are mostly laid directly on clay and arranged in such a way as to convey the water to the natural lines of the gutter, which are directed towards the road, in the direction of the access portal.

The solutions adopted for the interior floors of the house are essentially limited to the ground-floor rooms in which stones were used in large irregular boulders or blocks hewn or squared, laid directly on the clay. The upper levels were almost always made directly with the planks of the wooden beam floor.

WELLS AND CISTERNS

As in all the Karst the water has always been a problem, karstic inhabitants built ponds at the edge of villages and sometimes (in Repen and in Opicina) in the centre of them.
Many courtyards had a well in the centre. It's not a real well but it's collected to a cistern directly carved in the repen rock. The top of the cistern was lined with lime plasters.
An interesting one is still preserved in Prepotto (see photos).

Public cisterns are conserved in some Villages. To emphasize their importance, some of them were decorated.

Public cistern in Basovizza

Public cistern in Aurisina

Cistern in Repen Tabor

7. ARCHITECTURAL ELEMENTS AND DECORATION IN KARSTIC ARCHITECTURE – TYPICAL FEATURES

Platy limestone is used for roofs, roof cornice, chimney tops, roofs of portal gates and for floors. See chapter 6.

8. LIMESTONE AND CRAFSTMANSHIP

In the province of Trieste we have twenty stonemasons' crafts with quite big workshops with 40 employees (average). They have a serial production.
We can find only five or six stonemasons' crafts working with traditional techniques.
Duino-Aurisina Municipality tried many times to open a stonemasons' crafts school but didn't manage to do it.

9. CATALOGUE OF REPRESENTATIVE OBJECTS

We have studied 148 buildings.
In the Duino-Aurisina municipality we have studied and catalogued 49 buildings.
23 buildings in Aurisina, 4 in Ceroglie, 2 in Malchina, 3 in Precenico inferiore, 4 in Precenico Superiore, 2 in Prepotto, 4 in San Pelagio, 6 in Slivia, 1 in San giovanni al Timavo.

In the Sgonico municipality we have studied and catalogued 38 buildings.
3 in Borgo Grotta, 3 in Bristie, 3 in Colludrozza, 7 in Gabrovizza, 11 in Rupinpiccolo, 5 in Sales, 1 in Samatorza, 5 in Sgonico.

In the Monrupino/Repentabor municipality we have studied and catalogued 31 buildings.
8 In Zolla/Col, 23 in Rupingrande/Repen.

In the Trieste municipality we have studied and catalogued 29 buildings.
11 in Basovizza, 14 in Santa Croce, 4 in Trebiciano.

In the San Dorligo della Valle/Občina Dolina municipality we have studied and catalogued only one building.

ROOFS

In 35 is conserved the roof in platy limestone of main part of the house.
In the Duino-Aurisina municipality we have 10 cases.
3 in Aurisina, 1 in Prepotto, 3 in San Pelagio, 3 in Slivia.

In the Sgonico municipality we have 7 cases
3 in Borgo Grotta, 1 in Gabrovizza, 2 in Rupinpiccolo, 1 in Sgonico.

In the Monrupino/Repentabor municipality we have 16 cases
5 In Zolla/Col, 11 in Rupingrande/Repen.

In the Trieste municipality we have 2 cases
1 in Basovizza, 1 in Santa Croce.

In the San Dorligo della Valle/Občina Dolina municipality we have one building (recently restored with Trani stone).

In 2 buildings is conserved part of the roof in platy limestone
In the Sgonico municipality we have 2 buildings.
1 in Samatorza, 1 in Sgonico.

SPAHNJENCA
In 13 is conserved the spahnjenca with a roof in platy limestone.
In the Duino-Aurisina municipality we have 4 buildings.
1 building in Aurisina, 1 in Ceroglie, 1 in San Pelagio, 1 in Slivia.

In the Sgonico municipality we have 6 buildings.
3 in Gabrovizza, 2 in Rupinpiccolo, 1 in Sales.

In the Trieste municipality we have studied and catalogued 3 buildings.
2 in Santa Croce, 1 in Trebiciano.

Four of them have a protruding oven covered with platy limestone near the spahjenka.

Almost all buildings have roof cornice and window top frame in platy limestone.

10. SELECTED CASE STUDIES

1. »kraška hiša«/karstic house museum in Repen: the most integrity karsical court-yard house.
2. »karstic house« in Repen 20 – Owned by Trieste Province - representative of the opened court house.
3. »single cell« house – »Ljenčkica's house« in Trebiciano: very rapresentative about the »single cell« tipe with added kitchen (*spahnjenca*).
4. San Rocco and San Sebastiano church in Santa Croce – owned by Trieste Municipality.
5. Repen Tabor: an exceptional sacral fortress with the church, the community's house and the rectory. We established to study the "community's house", a »single cell« house without chimney.

They are interesting also for their state of conservation and type of restoration work done on them:
1. It has been quite well restored in 1968 but now needs some restoration works on roof, wooden gallery and northern façade.
2. It has been "restored" in 1977 in a terrible way, building the concrete floor behind the portal gate and changing the arrangement of rooms. The stone roof has been reconstructed on a brick and concrete roofing.
3. It has been quite well restored in 1999 and it's quite well preserved.
4. It has been restored in 1990 putting a bituminous layer between wooden roofing and *skrle* and now it has structural problems. Trieste Municipality is waiting for our restoration issues.
5. It has been restored between 1983 and 1990 in a bad way and after a few years stone roofs collapsed. Roofs have been rebuilt.

DESCRIPTION

1. Typical karstic home with walled farmyard ("borjač"). It's a court-yard house with stone portal gate (»kaluna«) and well in the court.

Typology: One floor farm house with external stone stairs, wooden gallery, jutting roof and inner fire-place kitchen.
Home is visible already on Franciscan cadastral map from 1819 (State Archive of Trieste, signature: 679 b 03). The house, with its agricultural buildings and the "borjač" cannot be precisely dated, but very probably dates back to the end of the XVIII century. Its present appearance is that of 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 29.04.1968 and restored the house. The museum opened in September 1968. The project of architect Marjan Loboda from Ljubljana established to put the outside pavement, the cistern and the high yard wall.
Some restoration works were done in 1999.
Preserved original volume and construction, preserved historic arrangement of rooms.

The living quarters include the kitchen (“hiša”) on the ground floor and, on the upper floor, the bedroom and the loft “na podu”, where often the older members of the family or the children used to sleep, although the use of this room was twofold: in fact, agricultural produce, such as wheat, barley, potatoes and walnuts was also kept in it. The kitchen is paved with a chiseled stone floor, a large part of it being occupied by the raised hearth, which is open, typical of the Mediterranean style, overhung by the hood (“napa”), with its characteristic wooden shelving and decorative curtain around the hood (“tornakamin”).
Next to the hearth we also find the wooden oven. The karstic kitchen has two characteristic niches, one next to the window and another in the wall (“škafenca”) with a shelf for vased and a water container. The crockery and the utensils on display are all original. The same is true for the interiors of all the rooms, such as the bedroom, where next to the small double bed (“za poldrugo peršono”) we find the typical cot and, next to the wall, there is the karstic bottom drawer. On the bed we can see the characteristic mattress of maize husks (“Iubenca”). In the farm buildings (the cellar – “hram” / the stables – “stala” / the loft – “na podu”), the visitor will see the activities of the karst inhabitants of the past which enabled them to survive; the tools and objects on display represent a cross-section of some of the more frequent occupations: viticulture, animal husbandry, agriculture. The old hayloft – “na štali” located above the stable is nowadays used as a space for temporary exhibitions. In the courtyard there is also the shed - skedenj, in which the peasant trimmed and sorted his produce collected from the fields. The carriage and several other agricultural implements were also kept in the shed. Under the stairs there was the pig-sty.

Roofs of main part, pavement (inside »škrle«; outside »šeliž«), roof cornice and roof of portal gate.
The roof, wooden gallery and northern façade need some restoration works.

2. Typical karstic home with walled farmyard (“borjač”). It's a court-yard house with stone portal gate (»kaluna«).

Typolology: One floor farm house with external stone stairs, wooden gallery, jutting roof and inner fire-place kitchen.

Home is visible already on Franciscan cadastral map from 1819 (State Archive of Trieste, signature: 679 b 03). The house, with its agricultural buildings and the “borjač” cannot be precisely dated, but very probably dates back to the end of the XVIII century. Its present appearance is that of the middle of 1800, when the last additions were made and it was renovated.
The Trieste Province bought the building on 8.03.1974 and restored the house in 1977.

Preserved original volume and construction, not preserved historic arrangement of rooms.

The project of architect Giorgio Berni from Trieste, on 1977, established to build the concrete floor behind the portal gate and changed all rooms arrangement. The stone roof has been reconstructed on a brick and concrete roofing.
Originally the living quarters include the kitchen ("hiša") on the ground floor and, on the upper floor, the bedroom and the loft "na podu". Under the stairs there was the pig-sty. In the farm buildings there was the cellar – "hram", the stables – "stala" and the loft – "na podu".

It has the roof of main part, roof cornice and portal gate shelf in platy limestone.
The wooden gallery need some restoration works, many elements not related to the house should be removed.

3. Typical »single cell« karstic home with added kitchen (*spahnjenca*) and inner oven.

Home is visible already on 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 XVIII century. In a 1838 "building protocol" is described as a stable with court-yard ("hlev in dvorišče"). In 1924 "Status animarum" of Trebiciano's church the family Ljenčkica-Slavec live in this house. So perhaps it was first a stable and then, at the end of 1800 transformed in a dwelling house (with stable?).
The Slovensko kulturno drustvo Primorec bought the building on 1999 and restored the house.

Preserved original volume and construction. Originally the house had two rooms, a bedroom and the kitchen. Now it has only a room.

Platy limestone elements: the spahnjenca is covered with *skrle* both in platy limestone and sandstone.
State of conservation: all well-preserved since recently restored.

From a geological point of view it's quite interesting, as we can find both platylimestone and sand stone. We have aurisina stone, alveolines and nummolites stones and also rudist shells, locally parallel oriented (laminated structure).

4. San Rocco and San Sebastiano church in Santa Croce. It was built in XVII century (1646), as a vow of escaping plague.

It's a simple small building with 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 in 1895.

It has a wooden roofing covered wit skrle. It has structural problems.

5. Community's house on Repen Tabor.

It's a »single cell« karstic building, built on a rock with external stone stairs and inner kitchen. It was built at the beginning of the sixteenth century in response to the Turkish raids on "karst plateau". It has been restored between 1983 and 1990 in a bad way and after a few years stone roofs collapsed. The roof have been rebuilt.

Preserved original volume and construction, preserved historic arrangement of rooms.

Platy limestone elements: roof and roof cornice in platy limestone.
State of conservation: all well-preserved since recently restored.