IZRADA TRADICIONALNIH KROVOVA POKRIVANJEM PRIRODNIM PLOČASTIM KAMENOM

MAKING TRADITIONAL ROOFS WITH NATURAL STONE SLABS

Ovakvi krovovi obično se izvode na manjim kućama ali postoje primjeri krovova većih raspona.

Obično ovakve kuće imaju zidove od grubo klesanog kamena zidani sa ili bez upotrebe morta.

Krovovi se izvode kao jednostrešni i dvostrešni, ali i kao višestrešni.

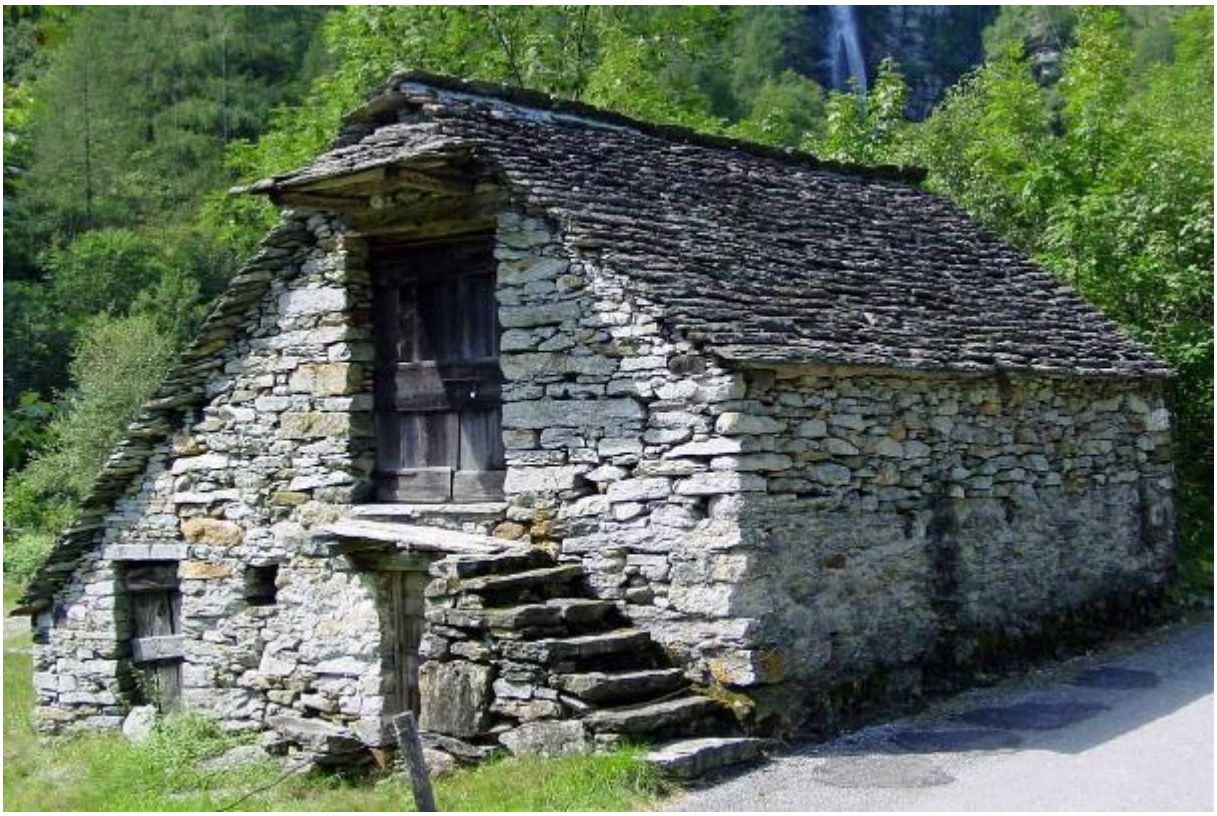
Roofs of this type are usually built on smaller houses, but there are also examples of larger span roofs. Usually, such houses have walls made of rough-hewn stone and are built with or without the use of mortar.

The roofs are also made with or without the use of mortar.

In this paper they are described as traditional roofs in theDalmatian region without the use of mortar.

The roofs are made as single or double slope roofs, but also as multi slope roofs.

Single slope roof



Double slope roof

Multi slope roof

Example of a bigger roof

Example of a bigger roof

Multiple roofs

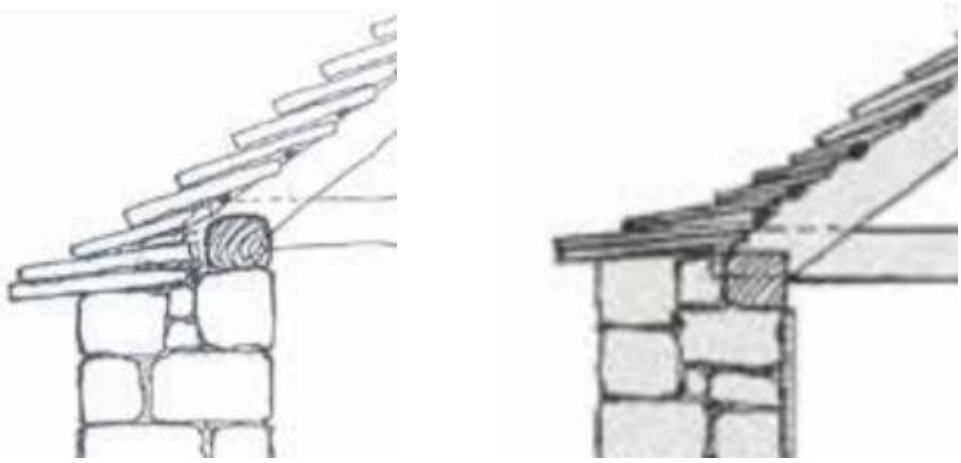
Postupak izrade krova:

1) Na zidove se s njihove unutarnje strane postavljaju uzdužne grede tzv. Bankine. Bankine su poprečnog presjeka cca 15/15cm i beru se od lokalnog drveća: smriča, gluhača ili čempresa.

Moguća je izrada krovova i bez bankini.

Roofing procedure:

1) Longitudinal beams are installed on the walls from the inside. The beams are approximately 15 / 15cm in cross-section and are harvested from local trees: spruce, deaf or cypress. It is also possible to make roofs without them.



Roof made with longitudinal beam along the wall

Roof made without longitudinal beam along the wall

2) Na gotove zabatne zidove se po sredini s unutarnje strane polaže stropna greda (štrop) tako da naliježe na zidove minimalno 20-ak cm.

Stropna greda se bere od većih stabala smriča, gluhača ili čempresa tako da joj poprečni presjek na najužem dijelu bude barem 15ak cm.

Stropna greda izvodi se kao nosiva greda. Ona preuzima veći dio opterećenja krova i prenosi ga preko svojih oslonaca na zabatne zidove. Ovako se smanjuju naprezanja na uzdužnim zidovima uzrokovana horizontalnom komponentom opterećenja. Ovo je važno pošto se zidovi izvode kao suhozidi, te nemaju horizontalni serklaž koji ima funkciju preuzimanja horizontalnih sila. Ovakve zidove nam je u interesu opteretiti ako je moguće što više na verikalna tlačna naprezanja a smanjiti horizontalna te se zbog toga rade krovovi nešto većih nagiba. Veći nagibi također se izvode i zbog sprječavanja prokišnjavanja krova, pošto ovakvi krovovi imaju dosta fuga, ali do maksimalno 45° radi sprječavanja proklizavanja ploča.

Ukoliko je raspon veći od 5,6 metara, zavisno o poprečnom presjeku stropne grede, potrebno ju je poduprijeti vertikalnim kolcem (šćapinom) obično po sredini raspona, ako je poprečni presjek grede svugdje isti. Međutim ako je pop. presjek stropne grede varira iz većeg u manji, onda se podupire na trećini udaljenosti od zida na tanjem dijelu grede.

On finished gable walls, ceiling beam is laid in the middle from the inside so it is attached onto the walls for at least 20 cm.

The ceiling beam is harvested from larger trees in the way that its cross-section at the narrowest part is at least 15 cm.

The ceiling beam is made as a supporting beam. It takes most of the roof load and transferring it to the gable walls. This reduces the stresses on the longitudinal walls caused by the horizontal load component. This is important because the walls are constructed as dry walls, and do not have a reinforced concrete cornice which has the function of assuming horizontal forces. It is in our interest to load such walls as far as possible to the vertical compressive stresses and to reduce the horizontal ones, which is why roofs are made of slightly higher slopes. Higher slopes are also performed to prevent leakage of the roof, since such roofs have plenty of joints, but up to a maximum of 45 ° to prevent the slabs from slipping.

If the span is larger than 5 - 6 meters, depending on the cross-section of the ceiling beam, it must be supported by a vertical pole (stick) in the middle of the span, if the cross-section of the ceiling beam is the same in each spot. If the cross-section of the ceiling beam varies from larger to smaller, then it is supported at a third of the distance from the wall on the thinner part of the beam.

Bottom of the ceiling beam

Bottom of the ceiling beam

3) Sada se postavljaju kolci (kaprijuni) koji se na donjoj strani upiru u bankinu a s gornje strane se naslanjaju na štrop.

Kolci se beru od čempresa, smriča ili gluhača.

Postavljaju se na razmaku od otprilike dva pedlja.

U slučajevima kada se želi malo rasteretiti stropna greda (ako su veći rasponi) koriste se kolci koji s gornje strane imaju dio gdje se granaju grane (roge) koji posluži kao uporište stropnoj gredi. Na ovaj način dio opterećenja preuzimaju kolci i prenose ih preko bankine na zidove. Ovo se preporuča raditi jedino u slučaju izvedbe bankine koja raspodjeljuje opterećenje na zid.

Now the wooden stakes are being installed, which are supported on the underside on a longitudinal beam and on the upper side are resting on the ceiling beam. The stakes are also harvested from cypress, spruce or deaf. They are spaced approximately two spans apart.

In cases where the ceiling beam is to be slightly relieved (larger spans), the stakes are used which, on the upper side, have a part where the branches (horns) branch, which serves as a support for the ceiling beam. This way, a part of the load is taken by the stakes and carried over the longitudinal beam onto the walls. This is recommended to be done only in the case when the longitudinal beam is made because of the load distribution to the wall.

Wooden stakes

4) Nakon postavljanja kolaca slijedi postavljanje skudli (u novijoj gradnji letvi) na koje se oslanjaju kamene ploče.

Skudle se postavljaju na razmaku od jednog pedlja, a za kolce (kaprijune) se pričvršćuju čavlima. Radi lakšeg čavlanja poželjno je da kolci i skudle ne budu sasvim suhe.

Skudle se također beru od smriča ili gluhača te jasena.

Setting up of the stakes is followed by the installation of thin longitudinal stakes on which the stone slabs rely. These stakes are placed at a distance of one span above each other attached by nails. For easier nailing, it is advisable that the stakes are not completely dry. These stakes are also harvested from spruce or deaf and ash.

Moguća je izvedba krovova bez skudli. U ovom slučaju se kaprijuni postavljaju na međusobnom razmaku od jednog pedlja.

Roofing without longitudinal stakes is also possible. In this type of roofing, the stakes are placed at a distance of one span and the stone slabs lie on it.

Longitudinal stakes

Longitudinal stakes

Longitudinal stakes

Važno je skinuti koru sa sve drvene građe (obrubi) i sva se drvena građa prethodno izlaže vatri kako bi se zaštitila koliko je moguće od napada insekata.

It is important to remove the bark from all timber and to previously expose timber to fire to protect it as much as possible from insect attack.

5) Postavljanje kamenih ploča

Za 1m^2 krova potrebno je nešto više od 3m^2 ploča.
Kamene ploče dobivaju se čišćenjem zemljišta i uglavnom ih na krševitom području Dalmacije ima u izobilju.
Postavljanje ploča kreće naslanjanjem na zid, tako da se izbacuju van zida cca 5 cm u slučaju kad postoji odvodni kanal, te najmanje 10 cm ako nema kanala.
Za prvi se red odabiru veće ploče koje su što pravilnijeg oblika. Vidljivi prednji rub i bočni rubovi ploče morali bi biti ravni te se u tu svrhu mogu i malo dotjerati ručnim alatom (tajentom). Razvuče se zidarski konopac tako da donji red prati pravac.
Slijedi postavljanje drugog reda također sa pločama većih dimenzija, tako da se uvuče u odnosu na prvi red 2-3 cm ili se poravna sa prednjim rubom prvog reda. Drugi red se postavlja iznad sudarnica prvog reda.
Treći red opet ide preko sudarnica drugog reda povlačeći se nazad za cca 1/3 duljine donjeg reda ploča.
Prva tri reda postavljaju se pod blagim nagibom kako bi se teret iznad efikasno prenio na zid te da ploče iznad ne bi sklizle sa drvene konstrukcije.
Svakim slijedećim redom se ide sve strmije dok se ne počne pratiti nagib drvene krovne konstrukcije i zabatnih zidova.
Ovakvi krovovi su dosta masivni zbog težine kamenih ploča i gustih preklapanja redova, osobito u donjem dijelu na spoju krova i zida. Masivnost prvih redova povoljno utječe i na djelovanje vjetra.

5) Laying stone slabs

A little more than 3m^2 of panels is needed for 1m^2 of roof.
Stone slabs are obtained by digging and clearing the land and are abundant in the karstic Dalmatia region.
Roofing starts by placing the slabs lean against the wall so that they are put out of the wall approximately 5 cm when there is a drainage channel and at least 10 cm if there isn't a channel.
For the first row, larger slabs of the rectangular shape are selected. The visible front edges and side edges of the slab should be straight and for that reason they can be hewn slightly with a hand tool. The masonry rope is pulled out so that the bottom row follows the direction.
This is followed by the placement of the second row also with larger slabs making them indrawn 2-3 cm in regard to the first row or aligned with the leading edge of the first row. The second row is placed above the joints of the first row.
The third row again goes over the second row joints, pulling back about 1/3 of the length of the bottom row of slabs.

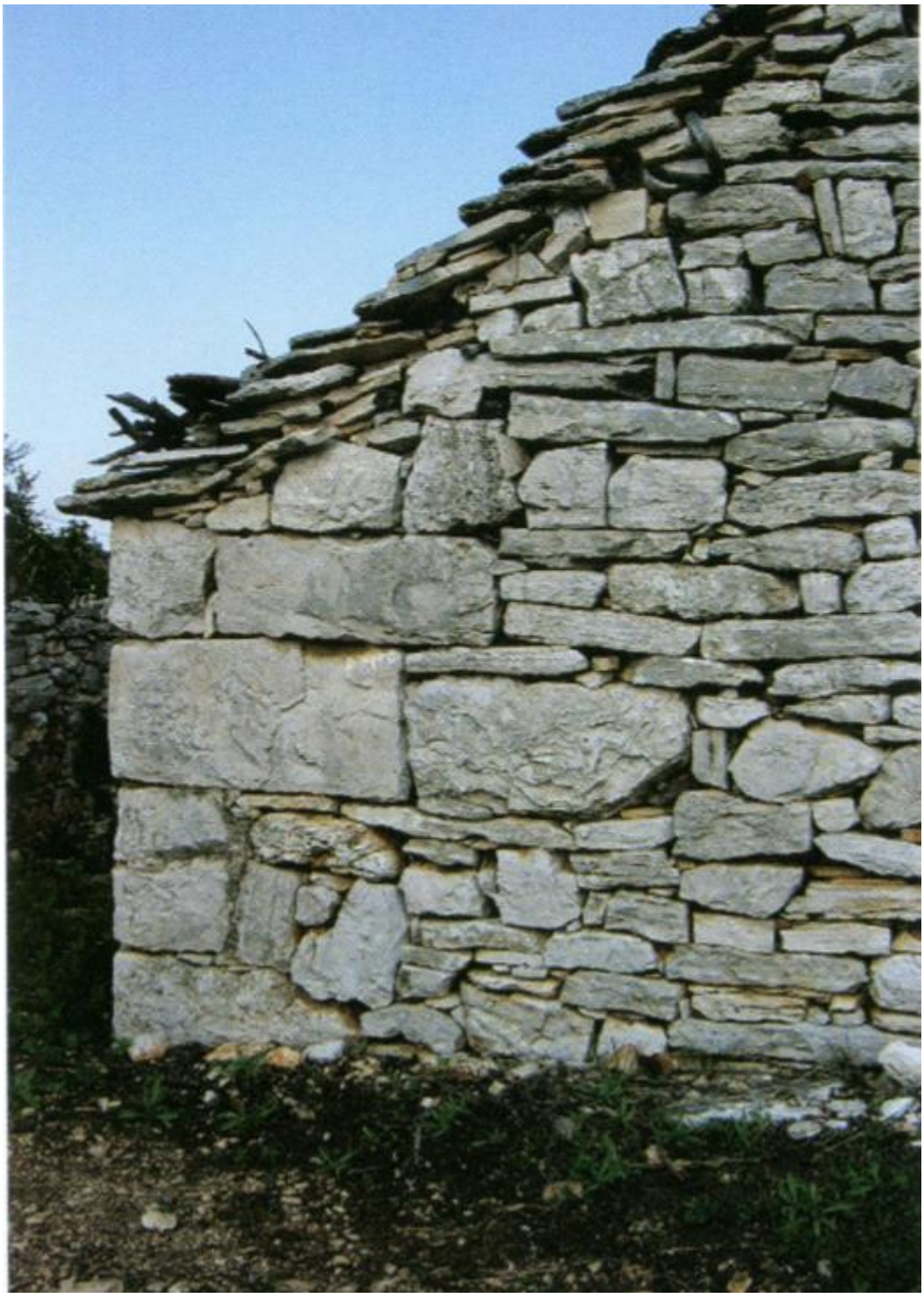
The first three rows are placed under a slight inclination assuring the load above is effectively transferred onto the wall and to prevent the above slabs from slipping off the wooden structure.

With each successive row it gets steeper until the slope of the wooden roof structure and gable walls begin to align.

Roofs of this type are quite massive due to the weight of the stone slabs and the dense overlaps of the rows, especially in the lower part at the roof and wall junction. The massiveness of the front rows also favorably counteracts the effects of wind.

The second row of stone slabs

Junction of the wall and the roof – inclination change

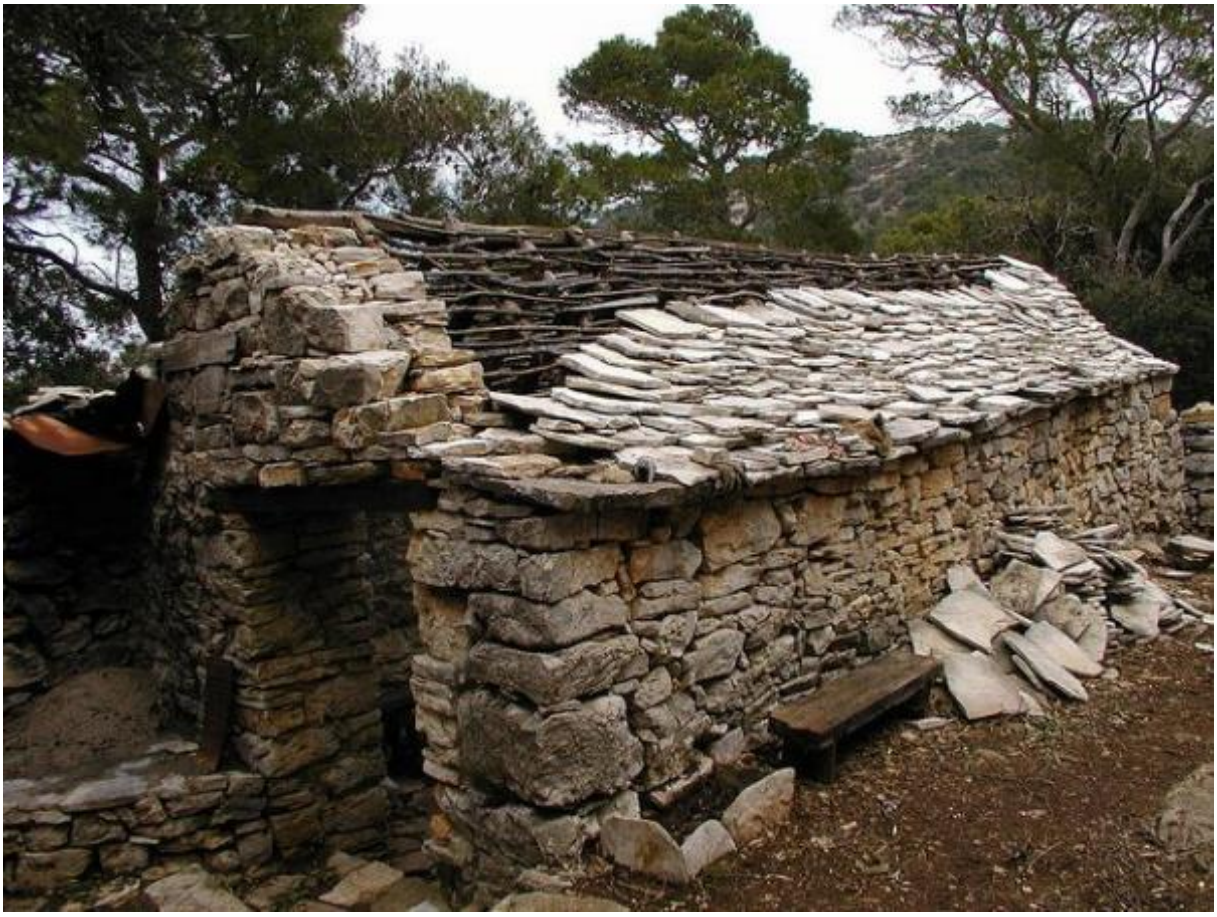


Junction of the wall and the roof – inclination change

Junction of the wall and the roof – inclination change

Svaki red ploča treba preklapati spojeve prethodnog reda za otprilike 2/3 njegove duljine i to tako da što više preklopi stražnji dio ploča ispod tih spojeva.
Obavezno je da stražnji dio svake ploče mora ležati na skudlu (letvu) ili kolac (kaprijun).
Bitno je da ploče što više prianjaju jedna uz drugu.
Praznine se popunjavaju manjim komadićima ploča (škajima) koje se ujedno koriste i za podmetanje ispod ploča radi boljeg oslanjanja, odnosno tamo gdje ploča ne naliježe kvalitetno (kampanizo), jer im debljina varira. Škaje se koriste i za umetanje iznad ploča nepravilnog oblika kako bi se popunile praznine da se ne uvuče voda i da gornji red pravilnije naliježe na donji.
Ovako se ploče slažu do spoja ploča sa suprotne strane.

Each row of slabs should overlap the joints of the previous row by approximately 2/3 of its length by folding the back of the slabs which are below those joints, as far as possible.
It is important that the back of each slab must rest on a stake or on a thin longitudinal stake if the roof is made this way.
It is also important that the slabs adhere to each other as much as possible.
Each gap is filled with smaller pieces of stone slabs which are also used for underlaying for better support, or where the stone plate does not fit well, because their thickness varies. Smaller pieces are also used to insert irregularly shaped plates above them to fill the voids to prevent water from drawning in and to assure that the upper row fits more properly into the lower one.
This is how the plates stack up to the plates' junction on the opposite side.



The rows overlapping each other for about 2/3 length of the previous

Dva su načina završavanja spoja u sljemenu.

1)

Zadnji red ploča se izravnava sa stražnjim dijelom prethodnog reda u razini vrha stropne grede.

Spoj se završava postavljanjem ploča iznad stropne grede, uzduž nje, tako da ploče što bolje prianjaju jedna do druge i iznad se postavlja još jedan red ploča da se prekriju spojevi donjeg reda. Ovakvo sljeme je masivno i relativno otporno na vjetar i prokišnjavanje.

2)

Zadnji red ploča one plohe krova koja je okrenuta prema smjeru dominantnog vjetra na tom području i učestalom smjeru padanja kiše, produžuje se iznad spoja sa pločama sa suprotne strane krova za otprilike jedan pedalj.

There are two ways to complete a joint in the ridge.

1) First way

The back of the last row of slabs is aligned with the back of the previous row at the level of the ceiling beam top.

The joint is finished by placing the stone plates above the ceiling beam, lenght-wise, so that the boards adhere to each other as closely as possible, and another row of stone plates is placed above to cover the lower row joints. This type of ridge is massive and relatively resistant to wind and rain conditions.

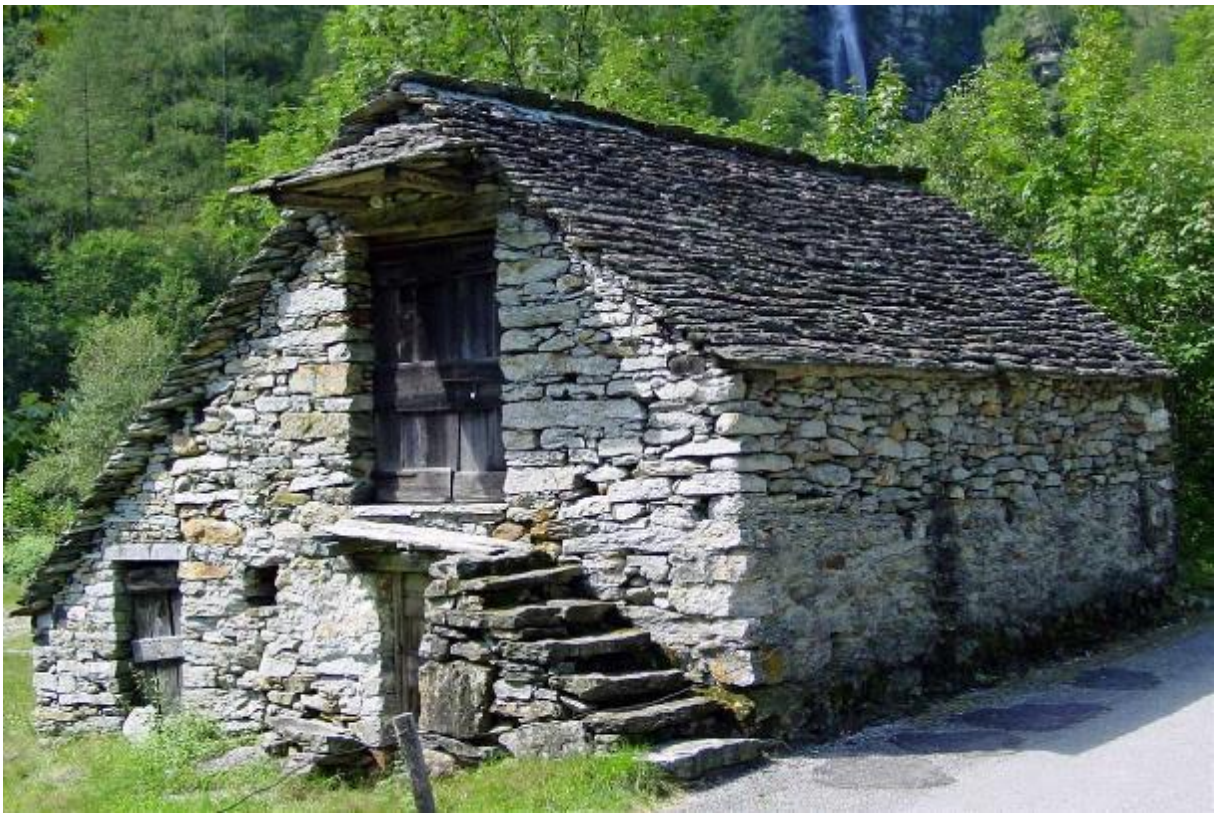
2) Second way

The last row of plates of a roof surface facing the direction of the dominant wind in certain areas and the frequent rainfall direction, extends beyond the joint with the plates on the opposite side of the roof by approximately one span.

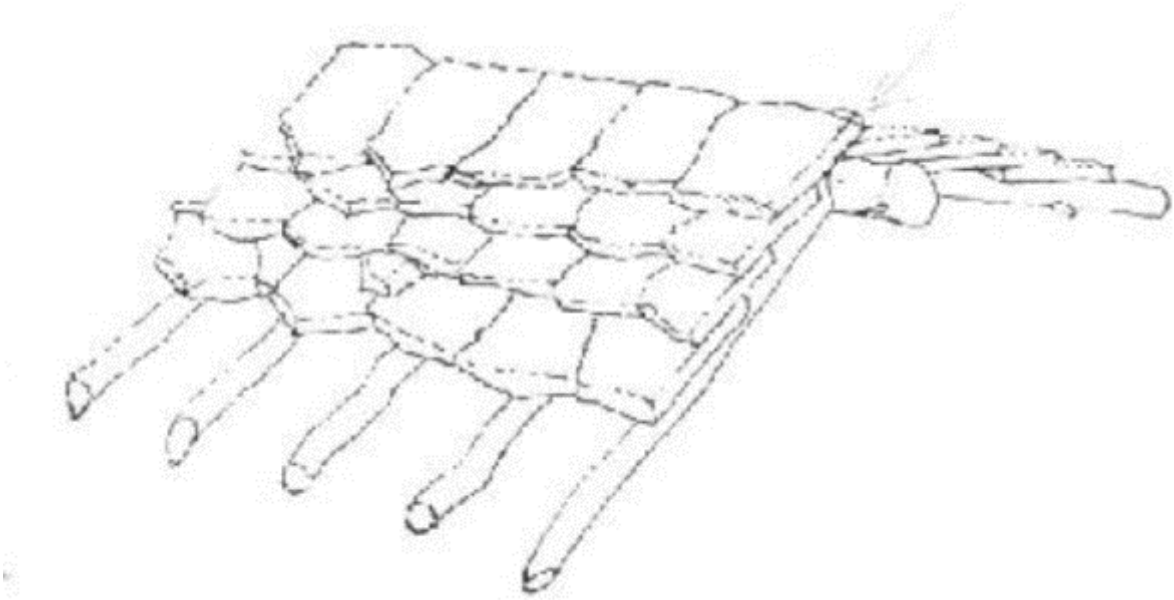
First way of making ridge (Ivica Šćepanović Truto)

First way of making ridge (Ivica Šćepanović Truto)

Second way of making ridge



Second way of making ridge



Second way of making ridge

Restaurated roof