

**11th Conference on Vernacular Architecture
ALPS - ADRIATIC**

Results of Ten Conferences

Special programme: *The World of Stone*

**11th and 12th October 2001
Hotel Špik, Gozd Martuljek, Slovenia**

**11. konferencija o vernakularnoj arhitekturi
ALPE - JADRAN**

Rezultati deset konferencija

Posebni program: *Svijet kamena*

**11. i 12. listopada 2001.
Hotel Špik, Gozd Martuljek, Slovenija**

dr Berislav Horvatić, Institute of Physics, Zagreb - Croatia
dr Borut Juvanec, Faculty of Architecture, Ljubljana - Slovenia

Water-permeable (!) Corbelling - the Shepherds' Cisterns (*bunari*) of the Village of Draga Baščanska on the Island of Krk in the Northern Adriatic

For at least 6000 years **corbelling** has been the ingenious way of building a **rainproof** roof in **dry stone**, producing a **false dome** to cover e. g. a dry stone shelter. A corbelled roof deliberately constructed to be **water-permeable** does not make much sense, unless it covers a cistern for collecting and storing rainwater.

A fine and rare example are the shepherds' cisterns of the village of Draga Baščanska on the island of Krk in the Northern Adriatic. Sixteen of them are scattered over the common grazings (*komunada*) on the barren northeastern plateau of the southern part of the island. They have been built, maintained and used by the local shepherds who graze their sheep in the corresponding "patches" (*pajiz*) of the common grazings during the summer half of the year.

These cisterns are exceptional for having an above-ground dry stone shelter with a water-permeable roof, usually corbelled or partly corbelled, built above the underground storage tank. The flat outside surface of the roof is the (only) rainwater catchment area, while the false dome lets the harvested water permeate down into the reservoir. The shelter protects drinking water from pollution and ensures natural cooling due to constant streaming of air through the dry walling, driven by sunshine which heats one side of the building at a time. Since the water inside is only for people, the building usually has a narrow entrance, a squeeze stile (*škatica*), impassable by sheep. A small vestibule follows, from which a stone staircase leads down and inside to the water.

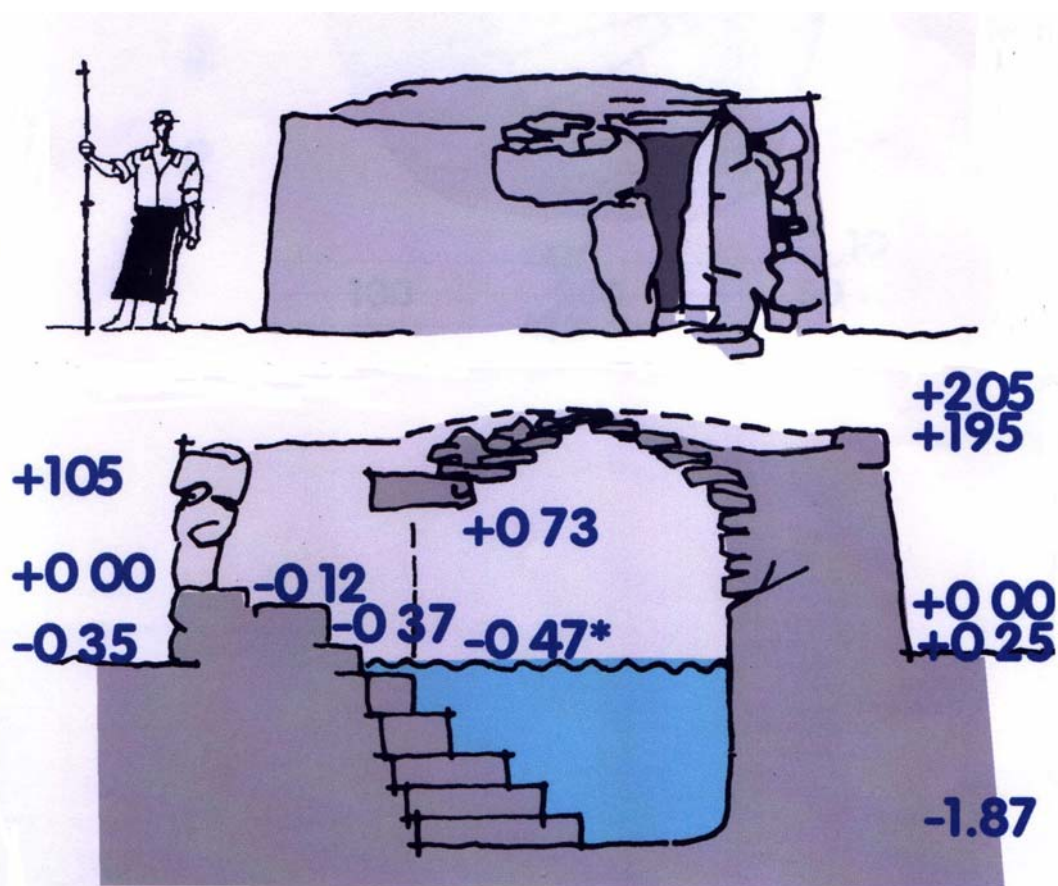


Vodopropusno (!) nepravo svodenje - pastirske cisterne (bunari) sela Draga Baščanska na otoku Krku na Sjevernom Jadranu

Već barem 6000 godina je **nepravo svodenje** domišljat način građenja **vodonepropusnog** krova u **suhozidu**, čime nastaje **neprava kupola** koja pokriva npr. suhozidno sklonište. Namjerno konstruirati **vodopropusan** nepravo svoden krov nema puno smisla, osim ukoliko ne pokriva cisternu za sakupljanje i pohranjivanje kišnice.

Lijep i rjedak primjer su pastirske cisterne sela Draga Baščanska na otoku Krku na Sjevernom Jadranu. Šesnaest ih je razasuto po komunalnom pasištu (*komunadi*) na krševitoj sjeveroistočnoj visoravni južnog dijela otoka. Grade ih, održavaju i koriste domaći pastiri koji napasaju ovce po odgovarajućim "krpama" (*pajiz*) komunalnog pasišta u ljetnoj polovini godine.

Te su cisterne izuzetne po tome što iznad podzemnog spremišta za kišnicu imaju sagrađeno nadzemno suhozidno sklonište s vodopropusnim pokrovom, potpuno ili djelomično nepravom svodenim. Zaravnjena vanjska površina pokrova je (jedini) naplav za hvatanje kišnice, dok neprav kupola propušta sakupljenu vodu do spremišta. Sklonište štiti pitku vodu od zagađenja, te joj osigurava prirodno hlađenje zahvaljujući stalnom strujanju zraka kroz suhoziđe, izazvanom osunčanošću građevine samo s jedne strane. Budući da je voda namijenjena za piće samo ljudima, građevina u pravilu ima tijesan ulaz, *škalicu*, koji sprečava pristup ovcama. Slijedi malo predvorje, od kojeg se kameno stepenište spušta unutra do vode.



For at least six thousand years **corbelling** has been the ingenious way of constructing a top covering of a dry stone building that is **in dry stone** itself, i.e., using only stones and no binding material, no mortar or concrete, as well as **no truss** to support it. The problem was brilliantly solved in the late Stone Age or early Bronze Age, yielding the so-called **false dome**. If the stones are laid properly, the dome comes out **rainproof**, as it should be.

A corbelled dry stone roof deliberately constructed to be **water-permeable** does not make much sense, unless it covers a cistern for collecting and storing rainwater.

A fine and rare example of the latter unusual building technique are the shepherds' cisterns of the village of Draga Baščanska (locally: *Baška Draga* or just *Draga*) on the island of Krk in the Northern Adriatic. Sixteen of them are scattered over the unenclosed, communal grazing ground (= common grazings = rough pasture, *komunada*, pl. *komunade*) on the barren northeastern plateau (*Gornji/Gorinji Vrh*, 'The Upper Plateau') of the southern part of the island. They have been built, maintained and used by the local shepherds who graze their sheep in the corresponding 'patches' (*pajiz*, pl. *pajizi*) of the common grazings during the summer half of the year. The names of the localities are the following: (1) *Za Vodinami*, (2) *Za Kijcen*, (3) *Na Ohodu*, (4) *Semjuni*, (5) *Pod Maričini*, (6) *Pod Franičevi*, (7) *Pod Ostri*, (8) *Na Trnovici*, (9) *Navrh Vala*, (10) *Pod Prodanjen*, (11) *Pod Zminu*, (12) *Va Kalu (Na Guvninah)*, (13) *Na Glogovi*, (14) *Na Graci (Va Grdini)*, (15) & (16) *Pod Habdenami*.

The cisterns are named *bunar* (pl. *bunari*) by the villagers of Draga Baščanska, while the term *zdenac* (pl. *zdenci*) is in much wider use by other inhabitants of the island of Krk. Both dialectal terms literally mean 'well', but locally they refer to cisterns rather than wells in the usual sense of the word. Also, both denote only the cisterns in the field, while another word (*gušterna*, pl. *gušterne*) has been reserved for a classical, fully closed and mortared cistern one has at home as the source of water for the household.

The cisterns built by the shepherds of Draga Baščanska are exceptional for having an **above-ground dry stone shelter with a water-permeable top covering**, usually corbelled or partly corbelled, built above the underground storage tank. The shelter serves several purposes:

(i) The outside surface of the covering, flattened with packed small stone (*gruh*), is the (only) rainwater catchment area. Unlike an ordinary house roof, the dry stone covering of the shelter has no gutter to collect and carry away rainwater, as well as no downspout to convey roof runoff to the storage tank. Both of these functions are fulfilled by the **flat** and **porous** outside surface of the covering which prevents rainwater from running aside, absorbing it instead and letting it soak through.

(ii) The **permeable** false dome allows the harvested rainwater to leak through the interstices among the loosely laid stones directly down into the reservoir.

(iii) The shelter protects drinking water from pollution.

(iv) Last but not least, it ensures **natural cooling of water** due to constant streaming of air through the dry walling, driven by the difference in temperature between the sunlit side of the building and the shady one. It is the ancient solar refrigerator, with the cooling proportional to the intensity of sunshine, being most efficient on a hot day with a baking sun - just when most needed! A thirsty person who comes across a cistern like that will certainly appreciate the refreshing coolness of both the shelter and the drinking water inside.

Since the cistern water is only for people, the building usually has a narrow entrance impassable by sheep, a squeeze stile or through stile (*škatica*), consisting of two wall heads built close together, forming a narrow vertical slit to edge one's legs through. An adult sheep is too corpulent to squeeze through, but a question naturally arises whether a little lamb could make it. Presumably it could, but shepherds maintain that it would not venture through without its mother, leaving her out of sight on the other side. Until proven or disproven experimentally, this thesis should be taken at its face value.

Preventing sheep from entering a cistern is not just a minor matter of hygiene. The problem is that sheep are "unable" to walk backwards - in order to move back, they "have to" turn round first. So a sheep that somehow manages to enter a cistern and gets stuck in the narrow inner space simply does not know how to get out since it has no space to turn round. It will sooner drown and contaminate the cistern than pull out going backwards. That is why the entrance has to be carefully constructed to be either 100% "sheepproof", which is the prevailing solution, or, quite the opposite, wide enough for a sheep to get both in and out (e.g. (3) *Na Ohodu*, (11) *Pod Zminu*, (13) *Na Glogovi*). May this be understood as a tiny contribution of ethology (not ethnology!) to architecture, aiming at a possible influence of the behavior patterns of animals on the structure of a building.

The squeeze stile is followed by a small uncovered vestibule, from which a stone staircase leads down and inside the shelter to the water. The staircase is often curved, i.e., descending sideways, since the entrance to the roofed part of the cistern is preferably made at an angle with the main axis of the squeeze stile and vestibule, which renders it better sheltered from the unfavourable outside influences (e.g., wind bringing litter, direct sunshine to warm the water.)

The dry stone shelter itself is usually oval-shaped in the ground plan, with perimeter walls almost vertical on the outside, and relatively low. The entrance of the shelter is constructed in the usual manner, with a massive stone slab as a lintel.

The whole building is in uncoursed, rough dry stone masonry (= random rubble) except for the underground storage tank (pit), which is partly hewed in stone and partly dug in the ground and constructed with half-dressed stones, plastered over with concrete (nowadays). In the "old days" when there was no concrete, cisterns were built only in places with impermeable, loamy soil. The pit was constructed in dry stone that was **not** plastered over, and it was the surrounding loamy soil that held the water to some extent. Cisterns like that are termed *na jilo*, *na zemlju*, *na blato*, *na teren* ('on loam, on earth, on mud, on terrain'), and are less reliable than those *na beton* ('on concrete'), since their pits are not absolutely watertight. Of the extant sixteen cisterns, only five of them are still 'on earth': (5) *Pod Maričini*, (8) *Na Trnovici*, (13) *Na Glogovi*, (14) *Na Graci (Va Grdini)*, and (15) *Pod Habdenami*. The first four of them are the farthest away from the village and the least used ones, while the fifth one was presumably abandoned in favour of its "Siamese twin brother" (16) *Pod Habdenami* (see below.)

Apart from these general, systematic features, each of the cisterns has a peculiarity of its own, reflecting the individuality and creativity of a particular builder or builders. Not two of them are completely alike. The cistern (4) *Semjuni* has two separate chambers connected with a short tunnel. The one (12) *Va Kalu (Na Guvninah)* has two pits in two levels, which makes it effectively bicellular. The one *Za Kijcen* has a kind of dry stone gutter on the rim of its roof (rather as an ornament), a beautifully carved pit bordered by a 50 cm wide shelf sloping slightly inside to

collect rainwater, as well as an ingenious double staircase which facilitates the access to water keeping the feet dry. The cisterns (15) & (16) *Pod Habdenami* are “Siamese twins”, two buildings with coalesced back elevations and entrances facing opposite directions. Moreover, one of them is (still) ‘on earth’, while the other one is ‘on concrete’.

Geomorphologically the southern part of the island comprises two barren and dry plateaus rising to some 500 metres above sea level, made up of Upper Cretaceous limestones, and a flysh valley between them, carved by a small stream with an imposing name of *Vela Rika* (‘Big River’). Of all the islands of the Adriatic Sea the island of Krk is the only one that has running water, and two of them at that: *Veli potok* (‘Big Brook’) in the central part and *Vela Rika* in the south. Unfortunately for the villagers of Draga Bašćanska they settled in the valley of *Vela Rika* “too late”, presumably in the 16th century, when most of the arable ground in the valley had already been taken by the earlier settlers. Therefore they were forced to take to the stony and dry plateaus, away from the village and running water, not only for their sheep rearing, but for their tillage as well. Most of their farming was restricted to ‘newtakes’, small areas of the communal grazing ground enclosed for private use as fields (with the permission of local authorities, occasionally even without one.) These unfortunate circumstances seem to have greatly fostered their diligence and creativity in dry stone architecture and earned them (deservedly!) the local fame of extraordinary builders on the island, as regards both quantity and quality. One gets mixed feelings while inspecting their exceptional accomplishments enforced by sheer necessity.

Although traditional small-scale farming on the plateaus was mostly abandoned soon after the 2nd World War, traditional sheep rearing remained and even expanded in quantity. The villagers of Draga Bašćanska alone graze some two thousand plus sheep, which is by no means exceptional either on the island of Krk or on the remaining four big Northern Adriatic islands of Cres, Lošinj, Rab and Pag.

The problem of drinking water on the dry plateaus is solved by harvesting rainwater. Water holes (*lokva*, pl. *lokve*) are for sheep, dry stone cisterns for people. Both are a necessity for traditional sheep rearing in dry, stony areas without running or underground water.

Water holes are small ponds formed naturally in shallow dips in the surface of the ground with impermeable, loamy soil, in which rainwater collects and remains for a longer time. They range from a few metres to some fifteen metres in diameter and up to a few metres in depth. What nature conceives is then supplemented and maintained by human hand. Water holes are deepened and cleaned from time to time by local shepherds.

As communal, public sources of drinking water, the shepherds’ cisterns of Draga Bašćanska are located in the open, on the unenclosed, communal grazing ground. The only exception is the one *Na Ohodu*, which is situated within a dry stone paddock (*graja*, pl. *graje*), but is also easily accessible through a gap in the dry stone wall bordering the paddock, closed only by an inserted bunch of thorny branches.

Most of the extant cisterns were built (or at least substantially rebuilt) in the period between 1921 and 1933. Some of them have the date (year) engraved on stone (lintel or “door post” = “door jamb”) or incised in a pasted patch of concrete:

- (1) *Za Vodinami* 192? (patch of concrete on the lintel)
- (2) *Za Kijcen* 1931 (engraved on the lintel)
- (5) *Pod Maričini* 1925 (engraved on the lintel)

- (8) *Na Trnovici* 1921 (engraved on the right door post)
- (9) *Navrh Vala* 192? (engraved on the lintel)
- (10) *Pod Prodanjen* 1930 (engraved on the right door post)
- (12) *Va Kalu (Na Guvninah)* 1927 (patch of concrete inside)
- (15) *Pod Habdenami* 193[3] (engraved on the right door post)

Question marks here stand for illegible and [] for barely legible numerals. We see no explanation why the last figure is always the one that suffers damage.

What about other, more standard corbelled dry stone buildings, like dry stone shelters (for people) or sheepcotes (for livestock), constructed by the same builders? There are almost none! The strong pressure of the local building tradition of the village has had it otherwise: covering with stone, corbelled or not, was for cisterns only, while all other dry stone buildings had to have thatched roofs. A typical dry stone shelter for people (*hramac*, pl. *hramci*) is rectangular in the ground plan, both inside and outside, and covered with a thatched roof (*slon*) supported on a wooden frame, mostly a gabled double-slope one. Sheepcotes (*mošuna*, pl. *mošune*) are of two types: either rectangular, being just the enlarged versions of shelters for people, or oval, with an oblong opening (*zjalo*) along the middle of the roof.

Some of the shelters and sheepcotes are real masterpieces of dry stone masonry, built in dressed or half-dressed stone with much care and skill, but gaping desperately roofless nowadays. A thatched roof requires regular maintenance, at least once in five years or so. As the vast majority of these buildings were abandoned a few decades ago, their thatched roofs have gone with the wind (literally!)

Not that builders from Draga Baščanska were ignorant of the much more durable possibility. Their neighbours from Punat have built a multitude of corbelled dry stone shelters, and indeed, the only two ones built by the shepherds from Draga Baščanska stand near the “border” with the common grazings of Punat. Also, they did use a specific kind of corbelling to cover their cisterns. The point is that the dictates of a local tradition often prove much stronger than any pragmatic reasons, turning sometimes into a **tyranny** of local tradition. The “refusal” to corbel a dry stone shelter is just a tiny example.

An opposite one is the “refusal” of the shepherds from neighbouring villages to copy the obviously advantageous cisterns of Draga Baščanska, with their above-ground leaky dry stone shelters serving as solar refrigerators. Those that have seen them are full of praise for the refreshing coolness of the drinking water inside, they sincerely admire their ingenious construction, but have shown no inclination to build them themselves. At the same time they do build corbelled dry stone shelters for people, rainproof, of course, and are aware of their cooling capability.

Back to the concept of **water-permeable corbelling**. Historically the problem was posed in just the opposite way: how to construct a **rainproof covering in dry stone**. Anyone could make a dry stone roof that leaks, but it takes a lot of creative effort to construct a rainproof one! It probably takes no less creativity to turn the problem the other way round and undo the established “normal” concept, constructing a corbelled dome that is as leaky as possible.

When I (B. H.) first entered one of these cisterns, and the finest one at that (*Navrh Vala*), I was surprised and rather disappointed by the “poor” job I encountered inside. The stones of the false dome were not flat and they seemed to have been laid rather “sloppily” and in the “wrong” way - decent corbelling just isn't done like that!

It took some time for me to realize, and get confirmation from local shepherds, that what seemed like “sloppiness” is indeed intentional - the builders did **not** want the corbelled dome to be rainproof, on the contrary, they wanted it to come out as leaky as possible, and they did their best.

FIGURES:

1. The zoom-in map showing the position of the village of Draga Baščanska and its *bunari* in Europe and further down.
- 2.- 6. The cistern (9) *Navrh Vala*, the largest and the finest of all, a textbook example.
 2. The front elevation with the squeeze stile or through stile (*škatica*)
 3. The leaky corbelled false dome above the pit
 4. A cross and the year 192? engraved on the lintel stone of the entrance
 5. and 6. architectural documentation
7. – 9. The cistern (3) *Na Ohodu*, a beautiful white birthday cake on a green tablecloth of grass
10. – 15. The cistern (2) *Za Kijcen*, a serious rival for the top of the list as regards architectural qualities.
16. – 18. The cistern (4) *Semjuni* has a beautiful squeeze stile made up of two monoliths, as well as two separate chambers connected by a short tunnel.
19. The cistern (16) *Pod Franičevi* has been abandoned to the sheep, as shown by its deliberately dismantled squeeze stile.
20. The cistern (1) *Za Vodinami*
21. The water hole (*lokva*) and the cistern (8) *Na Trnovici*, which is still ‘on earth’

LITERATURE:

There isn't any. “We were the first that ever burst into that silent sea.” (Coleridge, of course.)