

CONSTRUCTION OF TEMPORARY WOODEN AGRICULTURAL STRUCTURES INSPIRED BY THE TRADITIONAL ARCHITECTURE OF BOSNIA AND HERZEGOVINA

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Abstract

On agricultural land, construction is permitted only for agricultural purposes, and within a very limited scope - most often as small auxiliary structures used in agriculture (greenhouses, barns, storage facilities for tools and equipment, etc.). To enable the construction of permanent structures on agricultural land, it is necessary to carry out a land-use conversion process, which is quite complex and often results in the permanent and irreversible degradation of this natural resource. Under certain conditions and in accordance with relevant regulations, it is possible to temporarily convert agricultural land for a defined period, thereby allowing the construction of temporary, prefabricated, and demountable structures for agricultural production, provided that after their use, they are removed and the land is restored to its original state.

In Bosnia and Herzegovina, temporary structures have historically been built using natural construction materials available on-site, most commonly in mountainous areas for livestock production.

These structures were mainly used for seasonal habitation, housing animals, supporting agricultural activities, and storing tools and equipment.

They were of a temporary nature and not constructed from permanent materials, primarily because they were usually located on state-owned agricultural land, where the construction of permanent structures was not permitted, and the land was used seasonally, mainly for grazing livestock.

The construction of prefabricated structures primarily made of wood can offer an adequate solution for the use, temporary development, and eventual exploitation of agricultural land in a way that prevents the permanent destruction of this natural resource.

Keywords: *Traditional architecture, wooden structures, agricultural buildings, prefabrication, barn, temporary structures, „torarica“, „povozača“, „koliba“*

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INTRODUCTION

Agricultural buildings used for livestock breeding must be located in close proximity to larger open areas outside urban and residential zones, where it is possible to provide both sufficient food and space for animals, ensuring more humane living conditions and minimal environmental impact. However, in areas where such large open spaces exist, typically classified as agricultural or forest land, the construction of permanent buildings is generally not permitted. On agricultural land, in addition to its primary purpose (agricultural production), other activities are permitted, such as the construction of temporary, prefabricated, and demountable structures, which must be removed after use and the land restored to its original condition. Legislation allows for the temporary change of land use for the construction of modular prefabricated structures of a temporary nature, which are dismantled and removed after use. In this way, the temporarily occupied land is released and can be restored to its original condition without significant difficulty or cost. In the past, in our region, temporary structures were frequently built in various forms and from different materials, such as small shelters, huts, and cabins made of wood or other locally available materials. The construction of modern prefabricated, demountable, modular buildings - primarily made of wood and inspired by traditional temporary structures can offer a solution for the development of temporary (transient) buildings on agricultural land. Agricultural land is a limited and difficult-to-renew natural resource, which represents both natural wealth and a good of general interest, and as such should be subject to special protection. Buildings intended for housing animals on farms must be designed in accordance with regulations governing this field (Pravilnik o uslovima koje moraju da zadovoljavaju farme i uslovima za zaštitu životinja na farmama, 2009).

MATERIAL AND METHODS

Characteristic examples of the earlier construction of temporary agricultural prefabricated structures in the territory of Bosnia and Herzegovina have been analysed, followed by a review of the potential for modern modular construction across various uses. In the past, various simple forms of rural dwellings were used across Bosnia and Herzegovina, most often as seasonal housing or auxiliary economic buildings for the temporary shelter of people, domestic animals, tools, and other production needs. The need for such temporary structures arose when shepherds, due to the lack of their own pastures, especially during periods of drought, moved with their livestock far from their homes into mountainous regions, where they would remain temporarily until returning home. Since these structures were built on land not owned by the shepherds, they had to be temporary and were most often mobile in nature. In the past, construction systems using simple, portable modular elements were frequently used, offering the fastest and simplest solution for creating shelter or auxiliary structures for animals and equipment.

From a functional perspective, these were structures that provided only minimal shelter, ensuring basic conditions necessary for human survival. Many such examples exist, especially among nomadic communities, where entire families travelled with their livestock across different regions, carrying their homes with them in search of better grazing conditions and essential resources. Because these temporary structures were built from perishable materials, they had a limited lifespan and have almost completely disappeared today. “Some of them have already completely disappeared or can very rarely be found in remote areas. Their spatial and structural elements reflect the initial concepts of more advanced developmental types. At the same time, they demonstrate the ability of rural people to improvise and to utilise the basic opportunities offered by nature” (Kadić, 1967). The following section presents examples of structures from our region that were mobile or temporary.

„Savardak“

A round volume, such as the most basic human shelter „Savardak (dubirog, šilja, krivača, busara), found in the border mountainous regions of Bosnia and Herzegovina and Montenegro, represents one of the most elementary, and probably the oldest, human shelters. It is a pointed, conical structure made of roundwood logs joined at the top, about two meters wide, covered with branches, fern, straw, and sometimes turf” (Kadić, 1967).

„Torarica“

Mobile wooden huts, locally known as “kreve”, “pružina”, “kućer”, and most commonly “torarica”, in which shepherds stayed and slept during periods when they needed to remain close to their livestock for safety and protection (Figure 1).



Figure 1. „Torarica - kreve“ at Crepoljsko area, Sarajevo (Kadić, 1967)

In traditional practice, the “torarica” represents “the smallest form of shelter, intended for a single person - a wooden tent placed on sledge-like supports to allow easier movement across grass. The very principle of transport by sliding is reminiscent of the earliest human transport methods before the invention of the wheel” (Kadić, 1967).

This simple portable hut with sledge runners consists of structural elements such as wooden beams, posts, and rafters, with a final cladding of wooden planks on the gable walls and a roof covering made of wooden shingles.

„Povozača or povožnjača“

The *povozača* is a multifunctional hut, most often mobile and temporary in nature, transported from one location to another.

It is a larger hut with a wooden frame filled with wattle, covered with straw, bark, or shingles, and moved on sledges, similar to the „*kreve*“. It serves as shelter for shepherds, for processing and curdling milk, and as storage for dairy products (Figure 2).

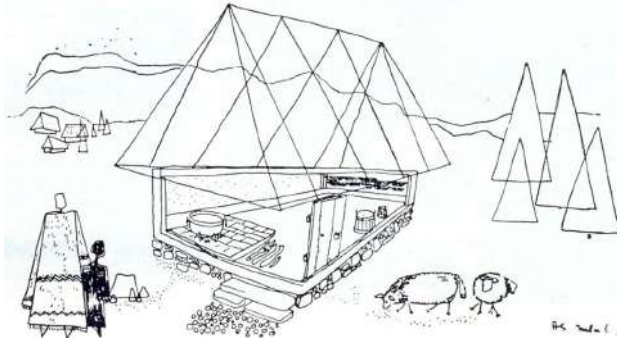


Figure 2. „Podzidna koliba – povozača“ from the Gacko area (Kadić, 1967)

Due to its lightweight structure and mobility, the „*povozača* is considered one of the most ingenious historical constructions, reflecting the builder’s intention to create a mobile dwelling, likely originating from nomadic times“ (Kadić, 1967).

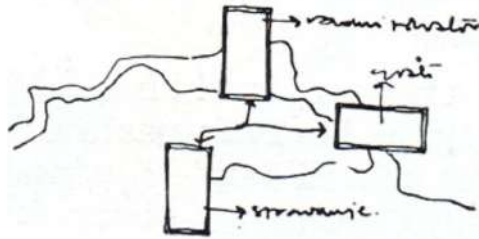


Figure 3. Layout of temporary „podvozača“ (Kadić, 1967)

„In some cases, *povozača* structures are temporarily supported by masonry bases, forming small temporary agglomerations in which each unit has a specific function: work, sleeping, storage, etc.“ (Figure 3, Kadić, 1967).

„Kolibe“

„Kolibe“ In addition to mobile, portable shelters, livestock breeders often constructed simple structures-wooden huts known as “summer huts”—used primarily during the summer months when, due to a lack of grazing space, they were forced to stay for extended periods far from their homes. These huts were used primarily for living, but also for processing and storing milk and dairy products. In terms of layout, the hut typically consisted of a single room without partitions, forming a unified multifunctional space for living, cooking, and working (Figure 4).

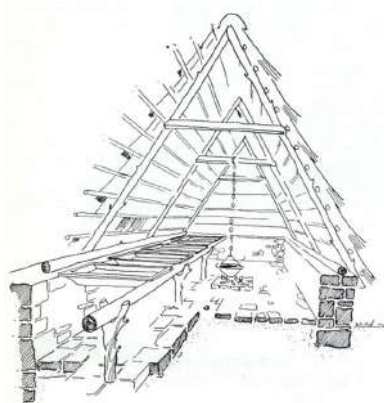


Figure 4. Shepherd's cottage „ljetnica“ (Kadić, 1967)

„Shepherds’ huts were built in prominent locations in the mountains. The essential conditions were the presence of pasture, forest, and fresh water“ (Mihić, 1985).

„Stan“ or „kolibe“ huts made of hewn wooden planks

In cases where quality stone was not available for construction, hewn wooden planks and timber were used instead, with structures assembled directly on-site. Wooden elements were often prepared elsewhere, transported, assembled, and, if necessary, dismantled and reused at the same or another location. “In the entire structure, there is neither stone nor iron. The walls are assembled from planks fitted together using grooves. The roof is made of planks arranged so that each board is slightly inclined along its length and supported by wooden beams, resting at the lower end on the ‘žliba’ and at the upper end on the ‘slime’. The structure consists of two parts: one with the hearth (the living space), and the other used for storing milk and dairy products, called the mlikar“ (Figure 5, Mihić, 1985).

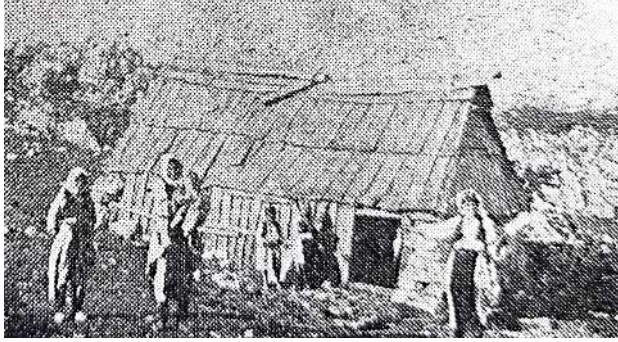


Figure 5. „Stan - koliba“ made of Wood (Mihić, 1985)

„The length of the hut is 4–5 m, and the width is 2 m. The interior height of the rooms is 2 m. The entire structure has no other openings except doors, which are made of wood and always located on the front wall. Neither the hut nor the dairy room has a ceiling. The ground is compacted earth. At the rear wall, in the centre of the hut, there is a fireplace. On both sides of the fireplace, there are sleeping areas made of thick wooden boards. Before leaving the mountain, the shepherds dismantle the dwelling and store the boards. They do this because heavy snow and winds would otherwise collapse and scatter the structure due to its light construction“ (Mihić, 1985). Huts constructed exclusively from wooden elements provided almost the same living and working conditions for shepherds as huts made from more durable and solid materials, such as stone.

„Kolibe“ Huts built from wooden materials, partially embedded in the ground

In addition to stone and above-ground wooden structures, huts were also built partially dug into the ground, with a wooden structure and cladding made of boards and turf. „The side walls of the hut are made of boards only about one meter long. These boards are embedded in the ground and inclined inward. On top of them, beams are placed, and above that, a roof made of boards. The side walls are covered up to the roof with turf, in order to protect the hut from wind and cold. The front and rear sides of the hut are closed with boards. The hut serves only as a shelter from bad weather and as a place for a fireplace“ (Figure 6, Mihić, 1985).



Figure 6. „Stan – koliba“ wooden structure with turf cladding (Mihić, 1985)



Figure 7. „Mlikar“ wooden structure with turf cladding (Mihić, 1985)

„For storing milk and other dairy products, there is a ‘mlikar’ (dairy room), built in the same way as the hut, except that it does not have a fireplace. Milk is processed, and dairy products are stored in the mlikar” (Figure 7, Mihić, 1985).

After seasonal use, the main wooden elements and the structure could be dismantled, stored, and protected from deterioration, and then reassembled later at the same or another location.

„Sojenica – brvnara“

An old pile dwelling, also known as a log cabin or *sohanica*, is a wooden house raised on piles (*sohe*) above flood-prone ground. The earliest findings of pile dwellings date back to prehistoric times, although they were built much later for various purposes (Figure 8).

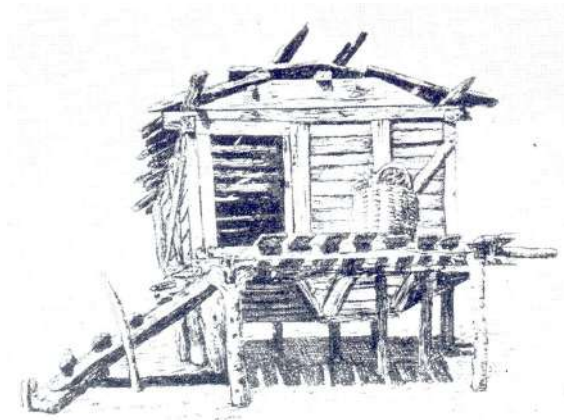


Figure 8. „Sojenica – brvnara“ (Kadić, 1967)

“In the Sava River valley, pile dwellings appeared as early as prehistoric times, as evidenced by excavations in Donja Dolina“ (Kadić, 1967). They were used by people who lived from the river and its resources, and also served as mills, fulling mills, and stamping devices, but also as very primitive shelters for fugitives who found safety in such structures.

RESULTS ND DISCUSSION

Construction of modern prefabricated–demountable buildings inspired by traditional wooden temporary structures

Prefabricated and demountable wooden structures, inspired by earlier temporary buildings and based on traditional construction materials, can be assembled from individual lightweight modular elements. Such structures can be temporarily built on agricultural land, even on land not owned by the investor, provided that they are temporary in nature and can later be dismantled and removed (Figure 9).

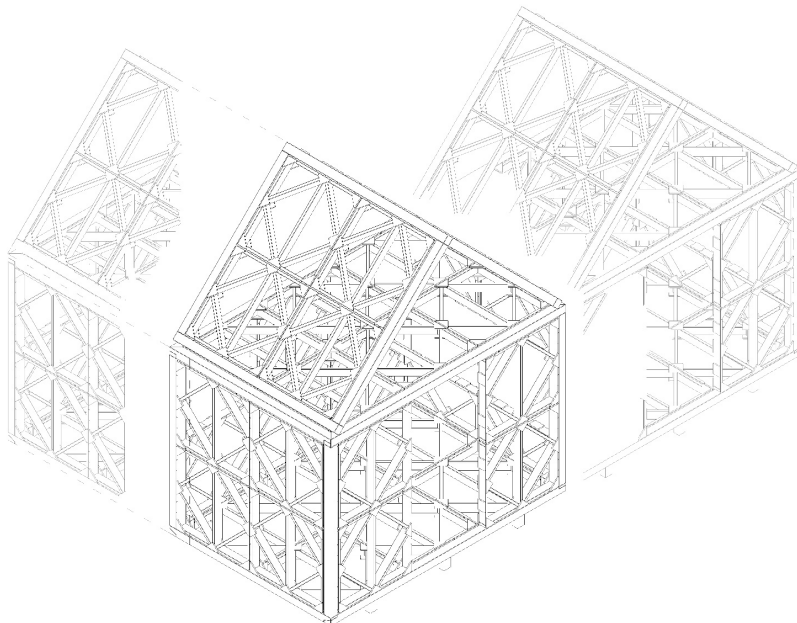


Figure 9. 3D view of the basic module

Different variations of two basic components-one with dimensions 160×160 cm and a smaller derived component of 160×80 cm-can be used in façade, roof, floor, or ceiling configurations to provide multiple design solutions. By combining components in different ways, it is possible to obtain solid planes or surfaces with openings (Figure 10).

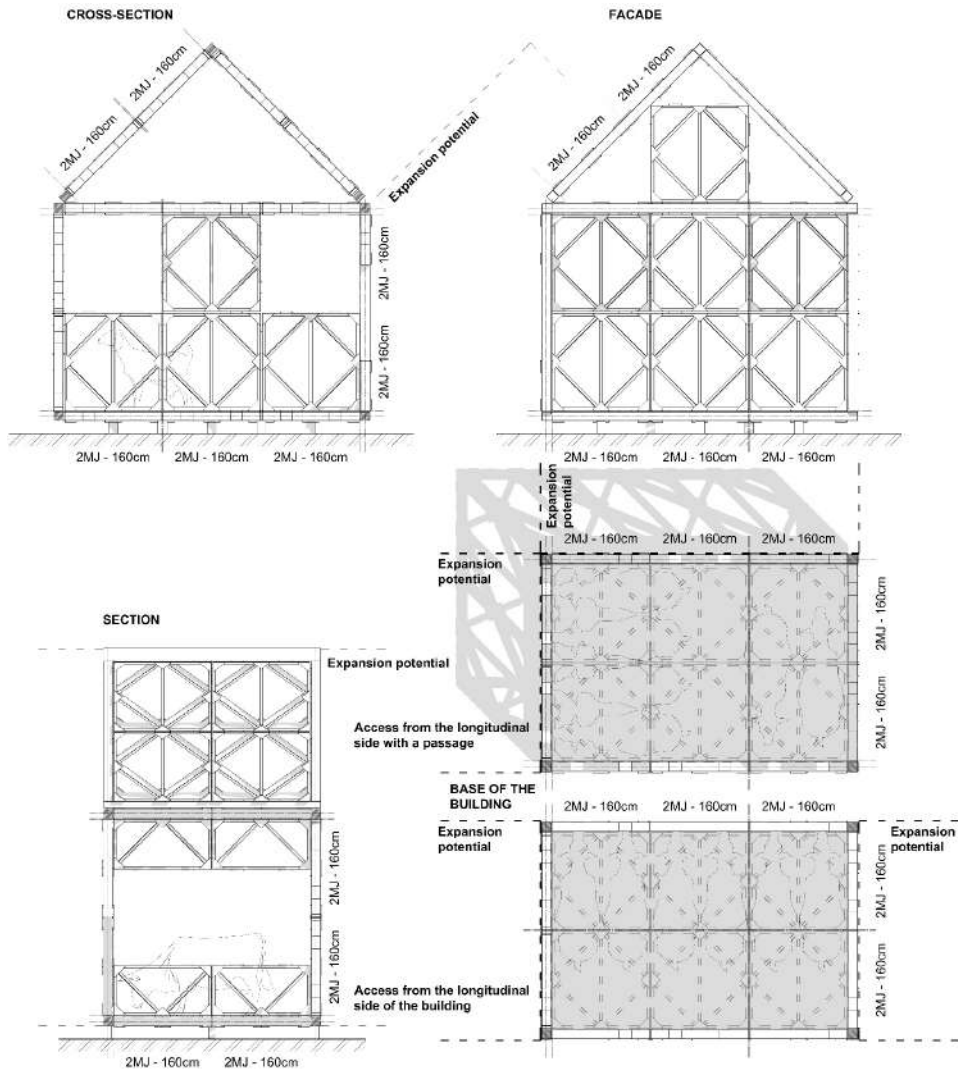


Figure 10. Basic module - plan, sections and facade

By connecting individual components, a module is formed, and by repeating multiple modules, various building sizes for housing animals can be achieved.

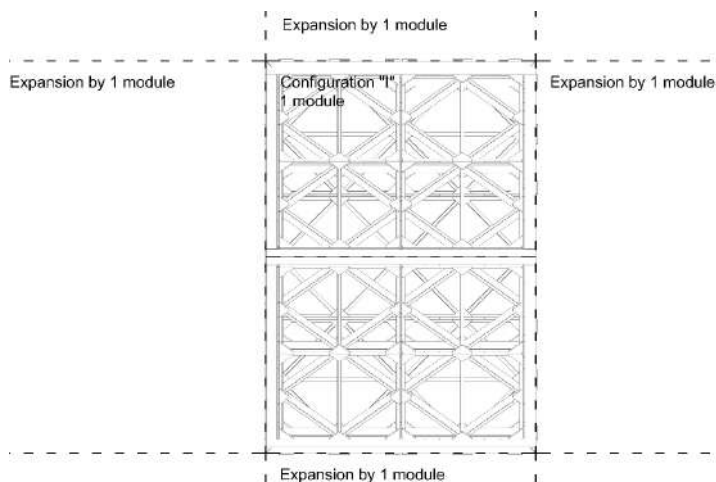


Figure 11. Basic module – expansion potential

Buildings can be easily adapted to actual needs and functions by simply adding or removing modules (Figure 11). These structures can primarily be used for housing and feeding animals, or only for feeding when animals remain outdoors. They can also serve as storage for feed, residential spaces for people, accommodation units in tourism, equipment storage, or combined uses. Modular animal housing structures should be open and adaptable for expansion or reduction of capacity, enabling easy construction and extension of standardised units within a short time frame.

Dimensioning of animal housing structures

The dimensioning of animal housing structures was carried out in accordance with the standards of the International Commission of Agricultural and Biosystems Engineering – CIGR (Commission Internationale du Génie Rural), as well as standards adopted from domestic literature.

According to CIGR (Commission Internationale du Génie Rural) standards for dimensioning parts of a barn for free-stall housing systems:

- Stall length „(Stall length $SL = 0.92 L + 0.3$) (Faba i sar., 2014);
- Individual space required by a standing by a standing cow (feeding area) „Individual space required by a standing cow $1.3 \times W$ “ (Faba i sar., 2014);
- Feeding area surface $Phran = Dh_{ran} \times \check{S}h_{ran} = 1.91 \times 0.78 = 1.49 \text{ m}^2$ (adult cow weighing 650-749 kg $Phran = 1.49 \text{ m}^2$)
- Living area „(Living area $LA = 1.65 \times H \times (0.85 \times (L + H))$ “ (Faba i sar., 2014);

Dimensioning of housing for cows 650-749 kg:

Plež = 6.44 m^2 and feeding area $Phran = 1.49 \text{ m}^2$.

Total area per head is Plež + Phran = 7.93 m²

„living space per animal from 5 to 7 m², total area per cow from 6 to 10 m²“ (Brka i sar., 2015);

Dimension of the facility for goat, average weight of 45-75 kg:

„Single room: 1.3–1.7 m² / head, feeding space width: 0.35–0.4 m'.“ (Brka i sar., 2015);

Total area P = 1.55 – 1.85 m² (Magdić, 2002)

Building dimensions for stable planning 5.2x3.6 m

Configuration I

The building's layout dimensions are 5.2 x 3.6 m. Total net area of Configuration I is 16.0 m², designed to accommodate 2 cows and 9 goats.

Dimensioning of the facility for the 2 cows

The total barn 2 cows (650-749 kg) is 15.86 m² < 15.9 m².

Feed bunk length is 0.78 m' x 2 cows is 1.56 m' < 3.2 m'.

Table 1. Cattle housing dimensioning

	Number of modules	Area	Number of animals feeding + lying area	Number of animals feeding area
Configuration I	1 - MODULE	16 m ²	2	6
Configuration II	2 - MODULES	32 m ²	4	12
Configuration III	3 - MODULES	48 m ²	6	18
Configuration IV	4 - MODULES	64 m ²	8	24

Dimensioning of the facility for goats (9 goats)

Configuration I for 9 goats: floor area per head, lying area + feeding area 1.70 m² (9 x 1.7m² is 15.3 m²).

Feeding space per goat 0.35 m' x 9 goats is 3.15 < 3.2 m'.

The total barn 9 goats is 15.3 m² < 16.0 m².

Table 2. Goat housing dimensioning

	Number of modules	Area	Number of animals feeding + lying area	Number of animals feeding area
Configuration I	1 - MODULE	16 m ²	9	14
Configuration II	2 - MODULES	32 m ²	18	28
Configuration III	3 - MODULES	48 m ²	28	42
Configuration IV	4 - MODULES	64 m ²	37	56

CONCLUSION

Based on the analysis of past construction practices on agricultural land, it is evident that people in this region most often built temporary structures used seasonally for agricultural purposes. They were of temporary transitory character because they were mostly positioned on a location that was not intended for construction and most often on land that did not belong to the builder and that was used exclusively for livestock grazing. Thus, in the past, buildings were built, such as "savardak" made of wooden shapes, mobile "torarice" made of wood placed on sledges, slightly larger and more complex "carriers" which were also most often transported from location to location by cart, various types of huts, etc. Even today, agricultural producers also face the same or very similar problems, and one of the basic ones is how to build buildings on agricultural land that was not originally planned for construction without permanently destroying the natural environment. And because of this, to solve the problem of the construction of buildings on land that is not for construction, it is very important to design or choose the most suitable system for the construction of temporary buildings.

Temporary - temporary buildings made of ready-made prefabricated components offer many advantages over classic construction, but the most important thing is that this construction system ensures simple construction, use, and ultimately the possibility of removing the building without permanently destroying agricultural land.

Configurable modular prefabrication systems based on the principles of traditional Bosnian architecture, basically made of wood, offer an optimal solution for the construction of temporary-transitory buildings built on agricultural land.

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IZGRADNJA PRIVREMENIH POLJOPRIVREDNIH OBJEKATA OD DRVETA PO UZORU NA TRADICIONALNU ARHITEKTURU NA PROSTORU BOSNE I HERCEGOVINE

Sažetak

Na poljoprivrednom zemljištu gradnja je dozvoljena isključivo u poljoprivredne svrhe i to u vrlo ograničenom obimu, najčešće kao manji pomoćni objekti koji služe poljoprivredi (staklenici, štale, spremišta za alat i opremu, itd.).

Kako bi se omogućila gradnja stalnih objekata na poljoprivrednom zemljištu, neophodno je provesti postupak prenamjene zemljišta, koji je prilično složen proces i često rezultira trajnom i nepovratnom degradacijom ovog prirodnog resursa.

Pod određenim uslovima i u skladu s relevantnim propisima, moguće je privremeno prenamijeniti poljoprivredno zemljište na određeni period, čime se omogućava gradnja privremenih, montažnih i demontažnih objekata za poljoprivrednu proizvodnju, uz uslov da se nakon njihovog korištenja oni uklone, a zemljište vrati u prvobitno stanje.

U Bosni i Hercegovini su se privremeni objekti u proteklom periodu gradili od prirodnih građevinskih materijala dostupnih na licu mjesta, najčešće u planinskim predjelima isključivo za potrebe stočarstva. Ovi objekti su se uglavnom koristili za sezonski boravak, smještaj životinja, podršku poljoprivrednim aktivnostima te skladištenje alata i opreme. Bili su privremenog karaktera i nisu građeni od trajnih materijala, prvenstveno zato što su se obično nalazili na državnom poljoprivrednom zemljištu gdje gradnja stalnih objekata nije bila dozvoljena, a zemljište se koristilo najčešće za ispašu stoke.

Gradnja privremenih montažnih objekata izrađenih primarno od drveta može ponuditi adekvatno rješenje za korištenje, privremeno uređenje i eventualnu eksploataciju poljoprivrednog zemljišta, čime se izbjegava trajno uništavanje ovog prirodnog resursa.

Ključne riječi: *Tradicionalna arhitektura, drveni objekti, poljoprivredni objekti, prefabrikacija, privremene građevine, torarica, povozača, koliba*