

Article

Design of Sustainable Modular Wooden Booths Inspired by Revitalization of Croatian Traditional Construction and New User Needs Due to COVID-19 Pandemic

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Abstract: The paper presents the results of the first phase of the student project CROSTAND2, whose main goal is to revitalize the traditional construction techniques of vernacular architecture in the Republic of Croatia by developing modern sustainable prefabricated modular wooden buildings/public booths in accordance with users' needs and habits. To incorporate conceptual design, the literature on Croatian construction and wood protection, prefabricated modular construction, and public urban spaces was analyzed and field research was conducted. Photo documentation was also collected in the village of Donja Kupčina, Zagreb County, Croatia. An online survey questionnaire on socializing habits in public spaces, before and during the COVID-19 pandemic, additionally analyzed new requirements for user-centered design. The obtained results, as well as results from previous project research, were used as a basis and inspiration for the design of a conceptual modular building inspired by traditional wooden joints, modular construction, and the emerging needs of users to socialize safely in a healthy environment. Conceptual solutions for a sustainable modular prefabricated wooden building for public use, intended for public urban and rural areas, have been proposed. Such constructions would ensure the sustainability of enjoying the natural environment for personal, tourist, and commercial purposes with the perpetuation of Croatian heritage building traditions.

Keywords: croatian traditional construction; revitalization of heritage; modular wood construction; prefabricated buildings; sustainable environment; user-centered design; COVID-19; well-being



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1. Introduction

Croatia is a small country, but it is rich in different designs of wooden buildings that are part of its traditional heritage [1]. The main reason for the variety of traditional construction is the specific geographical location and the availability of wood for the construction of residential and commercial buildings [2]. However, at the same time, the traditional vernacular architecture of the Republic of Croatia is a neglected topic [2,3] that needs to be protected and revitalized. There are not many examples in Croatia where traditional knowledge has been utilized in modern design solutions for the construction of public buildings.

Addressing this shortcoming was the main goal when launching the student project “Designing prefabricated buildings inspired by the tradition and heritage of the Republic of Croatia—CROSTAND” at the University of Zagreb, Faculty of Forestry and Wood Technology (2019–2020). The initial goal of the project was to design a modern prefabricated building for commercial purposes that would revitalize Croatian traditional wood construction and enrich the tourist offering at public events (art festivals, concerts, Advent fairs, etc.). With the start of the COVID-19 pandemic, the facility's planned functionality gave the project new relevance.

The new situation post-COVID-19 on a global level has changed the way of life of many citizens and the question of future modes of socializing has been raised. Accordingly,

a new project, CROSTAND2 (2021), was launched with the same goal of reintroducing Croatian traditional wooden construction in modern prefabricated buildings but with the addition of necessary analysis of new requirements for user-oriented design, due to the changing habits of socializing in public environments in urban and rural sustainable areas, by which the individual can enjoy peace and well-being.

This paper presents the first results of the CROSTAND2 project. The aim of this paper is to present the development of a conceptual solution using elements of Croatian architectural traditions and heritage, to design modular buildings that would be located in both urban and rural areas (e.g., urban and national parks, forests, meadows, or shores, rivers, lakes, etc.) and which would serve users as a wellness and/or fitness zone for recreation, socializing and gathering with family and friends or simply as an oasis of relaxation and peace. This would enrich the content of the sustainable environment according to the new needs of users created as a result of the COVID-19 pandemic.

As an introductory part of the research, a review of relevant literature in the field of Croatian traditional architecture and the use of wood in construction is given, and the needs of public spaces and modern trends in methods of application are analyzed, as well as user-oriented design issues and the consequences of human behavior due to the COVID-19 pandemic. We also refer to the results that have already been collected and published in previous project field research in the period 2019–2021.

1.1. Current Problem Analysis

1.1.1. Croatian Traditional Architecture vs. Construction

The term “traditional architecture” is often used in the literature, although some authors consider it more appropriate to use the term “traditional construction” [2]. The reason for this is that traditional construction is a folk style because the builders were peasants themselves or semi-professional groups of village masters; construction knowledge and skills were passed on from craftsman to craftsman, without the mediation of the architectural profession and without practice drafts. The builders and creators of traditional houses were, and still are, anonymous; they were carpenters, masons, and trained peasants, taught by tradition and guided by the functional requirements of living and aesthetic understandings of the rural environment. There are many specific details and solutions on such old buildings that emphasize the creative power of individual builders [4]. In what follows, we will use “traditional construction” in further terminology.

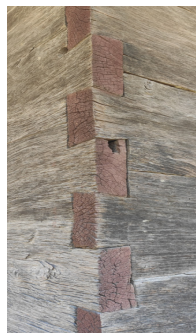
The richness and diversity of traditional buildings are manifested not only in the multitude of building forms but also in the way materials are applied, in functional solutions, and especially in the breakdown and location of farm buildings. Diversity stems largely from geographically determined, unchanging natural circumstances since similar environments necessitate largely the same or similar construction styles [1]. In order to take a closer look at the specifics of Croatian traditional architecture, the following exemplify the basic characteristics of wooden buildings, already analyzed at sites in central Croatia, Sisak-Moslavina County, Posavina, the locality of Lonjsko Polje, the villages of Krapje and Čigoč; in Northern Croatia, Krapina-Zagorje County, the locality of Hrvatsko Zagorje, the village of Kumrovec; and in eastern Croatia, Osijek-Baranja County, the locations of Slavonia, Srijem and Baranja, all of which were included in the CROSTAND project during the years 2019–2020 [5,6].

Sisak-Moslavina County, Lonjsko Polje, the villages of Čigoč and Krapje

The Croatian national park Lonjsko Polje is a small area in Posavina, Sisak-Moslavina County, in continental Croatia. In the park, several old locations still exist, exemplifying the cultural heritage of Croatian traditional wooden construction. The most famous spots are the villages of Čigoč and Krapje (Figures 1–4). Posavinan wooden houses are characterized by excellent artistic design, which is especially evident in the decorations made by a “jour” carving or cutouts painted with regular or stylized geometric motifs. Decorations most often embellish porches, gables, window frames, and the main longitudinal beam (the so-called “sleme”) (Figure 1) [5].



Figure 1. Traditional house in the village of Čigoč. Reprinted with permission from Ref. [5]. 2021 Robert Roginić.



(a)



(b)

Figure 2. Traditional types of corner construction joints at the villages of Čigoč and Krapje: (a) “German” joint; (b) “Croatian” joint. Reprinted with permission from Ref. [5] 2021 Robert Roginić.



Figure 3. Longitudinal joining of wooden planks. Found in the villages of Čigoč and Krapje. Reprinted with permission from Ref. [5]. 2021 Robert Roginić.



(a)



(b)

Figure 4. Traditional houses in the Old Village, Kumrovec: (a) brick house, made from “lomljenica”; (b) coated wooden house or “mazanka”. Reprinted with permission from Ref. [6]. 2021 Luka Janković.

In the area of Lonjsko Polje, the buildings are made of pedunculate oak (English oak, *Quercus robur*). This wood raw material was sourced from the forests that stretch in

flood-prone areas along the Sava, Lonja, and Odra rivers and other nearby streams. In the past, a local peasant had certain rights regarding the exploitation of forests; he could cut as much construction wood as he needed to build a house [1].

The basic building elements are oak “planks” (uncut, semi-trimmed, or trimmed sawn timber with a thickness of at least 48 mm (headword: Planka [7])) that are stacked horizontally and joined with wooden wedges. The planks were previously sawn and then processed with a hand planer. Angular joints are made in two ways, known as either “Croatian” or “German” joints (also called “hrvatski sjek” or “njemački sjek”) (Figure 2a,b). If the planks were not long enough, which was often the case, then the elements were joined lengthwise using the oblique fold shown in Figure 3 [5].

Krapina-Zagorje County: Hrvatsko Zagorje, the village of Kumrovec

Hrvatsko Zagorje is part of north Croatia, in Krapina-Zagorje County, a peripheral area of the Pannonian cultural zone. Every form of traditional construction reflects the circumstances of the region (including Zagorje), such as overpopulation and poverty [6]. Those circumstances arise from events, such as deforestation, that have caused soil erosion, carrying away the fertile humus from that hill area, leaving behind an infertile and loamy soil [2].

Examples of typical Zagorje houses can be seen in the museum cultural heritage site of the Old Village in Kumrovec (also called “Staro Selo Kumrovec”). Typical wooden traditional building, so-called “hiža”, is known for four basic types: wooden single-story houses, “mazanka” houses, multi-story brick houses and single-story brick houses or “zidanice” [8]. Brick houses made from stone were called “lomljenca” houses (Figure 4a), and “mazanka” houses (Figure 4b) were made from wood [6].

Houses were often coated with loam for aesthetic reasons, but this was mostly to protect their wooden structural elements from being affected by atmospheric conditions (temperature, moisture, rain, and other events) and pests (insects, fungi, and bacteria). As is found in the region of Posavina, wooden houses in Kumrovec were built with the strongest main beam, called the “pocek”, laid along the length of the house [6]. Hewn secondary beams were laid across the main beam and were most often connected at the corners by notch joints, the so-called “hrvaški vuger” (or “Croatian zagvozda”). Beams were assembled in such a way that parts of them extended beyond the corners of the house. That type of corner construction is one that we have already seen in Lonjsko Polje, Posavina; these are the traditional construction joints used in these regions (Figure 2).

Of particular interest in the Old Village, Kumrovec is the outbuildings. Outbuildings that were used as stables or barns were not coated with a mixture of loam as on the houses; instead, the wood was left exposed to atmospheric impacts without an exterior coating (Figure 5).



Figure 5. Wooden outbuilding in the Old Village, Kumrovec. Reprinted with permission from Ref. [6]. 2021 Luka Janković.

Osijek-Baranja County/Slavonija and Baranja

Osijek-Baranja County (Slavonia, Baranja, Srijem) is located in the eastern part of Croatia. This area is characterized by the architectural heritage of two types of buildings—residential buildings, built of brick, adobe, charge, and wicker, and outbuildings that are

mostly built of wood [9]. A typical traditional residential house is usually in three parts, with a narrow facade oriented to the street. Behind the residential building, there was usually a cornfield (also called a “čardak”), built in the lower part with bricks, above the timber, barn, and other buildings. In most of Slavonia, barns (also called “ambar”) are separate wooden buildings with a covered entrance, a small porch, or, if without it, richly decorated load-bearing pillars (Figure 6).



Figure 6. Detail of the “ambar” in the village of Bijeli Brod, Baranja. Reprinted with permission from Ref. [9]. 2021 Dina Stober.

Although this paper deals with an analysis of Croatian traditional wooden construction, similar architectural expressions can certainly be found in other neighboring countries. Numerous authors point to similar problems of the revitalization of rural traditional heritage, sustainable design, vernacular architecture, and construction in other areas [10–15], but there are also new efforts being made by creative forces that bring contemporary conceptual examples, which find inspiration in the heritage of traditional architecture, inspirational historical stories, sustainable materials, ecology, and traditional building principles [16–28].

1.1.2. Prefabricated Buildings and Construction

Prefabricated construction describes a building process in which elements are most often produced in a stationary plant, according to industrial principles, and then transported to the construction site where they are assembled and finalized into a finished object. The lack of interest or misunderstandings of builders, poor social perception, insufficient investment in research, and the development of prefabricated construction methods have been identified as the biggest reasons for the insufficient application of such construction techniques [29].

One of the most important characteristics of traditional construction in Croatia is that most of the buildings were built according to the principles of prefabricated construction. The raw material was regularly prepared in the forest, and the ready-cut beams were transported to the construction site. Angular corner joints (Croatian and German joints, Figure 2) enabled the easy assembly and disassembly of building elements.

Modern challenges and technological development inevitably encourage changes in the way public and private spaces are designed and built. When building classic buildings on a construction site, the construction process is much more expensive and longer, while with a prefabricated house, it is much faster [30]. Prefabricated parts are delivered ready-made, so there is no need to consider the weather conditions during their manufacture [31]. In recent years, prefabricated construction is increasingly used worldwide because it meets the parameters of economical, sustainable, technologically optimized, time-saving and aesthetically very acceptable construction [32–35].

Considering the possibility of the revitalization of traditional construction, based on prefabricated manufacture, is a challenge for the revitalization of the old typology

of buildings and provides a basis for the development of sustainable new concepts, as presented in this paper.

1.1.3. Wood in Construction

Wood is a material widely used in human everyday life. The use of wood for building construction is cited as a demanding form of wood utilization, due to the high aesthetic, thermal, and other physical and technical requirements over a long period, often for centuries [36]. Wood is recognized as a sustainable and safe building material of today, one that, with the above characteristics, provides healthy and environmentally friendly surroundings [37,38]. However, in outdoor conditions, wood is exposed to several chemical and physical changes that reduce its aesthetic value and durability. In that sense, appropriate surface protection and careful construction are needed to maintain and revitalize wooden buildings [39]. Wood as a building material should be utilized appropriately and correctly, and the basic rules in the application of structural and surface protection should be respected [38,40–42].

Renovation, periodic inspection, and the maintenance of built-in wood in buildings are inevitable if you want to maintain the long-lasting beauty and technical functionality of the wooden parts of a building. To build a functional facility, one should return to traditional ways of building [37,40].

1.1.4. Understanding the Concept of Public Space

Public space is any area that is accessible and free to all, any physical area in which any person may be found, any area of particular importance for meeting the needs of its inhabitants and for improving their quality of life, and any area favorable for establishing social contacts due to its position and functional and spatial characteristics [43]. A good public space is accessible and open; it is significant in its design and the activities it supports, it provides a sense of security, physical and environmental comfort and convenience, as well as a feeling of control and sensory pleasure [44]. The design of public spaces should be of high quality and adapted to their users [45,46]. Public space should encourage the strengthening of human interactions and the creation of social relationships and provide people with a reason or incentive to visit it frequently; it should also ensure the unimpeded movement of people. Public spaces should also be an integral part of a town or village and should highlight its values (both historical and cultural).

In recent times, the quality of life in public spaces has been associated with the idea of designing “15-min cities” [47], a concept that is functioning as a model for reconnecting people to their neighborhoods and localizing city life. Examples of 15-min cities can already be seen in Sweden [48]. The idea is that a range of modules used in different configurations realizes different functional content, such as seating and eating places, urban gardens, playgrounds, outdoor gyms, bicycle storage and charging stations for electric scooters, etc.

This idea of inclusion should be considered for the design of new conceptual solutions.

1.1.5. The Impact of the COVID-19 Pandemic on the Use of Public Spaces

With the onset of the COVID-19 pandemic, many aspects of our lives ceased to be as they were before. We have been forced to adapt to the current situation, in order to protect ourselves and our loved ones, following various measures that help us to do that in our daily lives.

The COVID-19 pandemic has greatly changed interior design, and our homes have become the place where we perform all our work and leisure tasks [49]. As the interiors have changed, so will the exteriors and the location of the dwelling itself. There are more and more debates suggesting that cities with a high concentration of inhabitants will no longer be popular, but that people will instead turn to smaller places surrounded by nature, or to living within nature itself [50]. There have already been huge impacts from COVID-19 on cities, and this should be reflected in major changes to urban planning, design, and management [51].

Some consideration should be given as to whether the problem is in architecture that fails to offer adequate conditions within cities to keep its population indoors, or whether such behavior could be attributed to a more complex archetypal reason [52]. Humans have lived longer in nature than indoors during the entire period of human existence, and this could be one of the reasons why some flee toward nature in times of crisis. Designers, urban architects, and landscape architects as well as journalists are already writing about how this current crisis will transform our relationship with public spaces [53–57]. Or, optimistically, this global experience may lead us to rethink the way we develop and (re)design our cities [58]. Regardless of the conditions that surround us, it is inevitable that space changes over time because, during our lifetimes, space does not always play the same role [59].

The question is, how can a domestic or public space, i.e., the contents within it, be changed to enable the healthy and safe life of the inhabitants and to ensure the needs of people for well-being in a specific environment?

1.1.6. User-Centered Design

Following the new changes in society necessitated by the COVID-19 pandemic, the design of new facilities can fall into the traps of functionality and sustainability. To avoid this, it is necessary to think carefully about whom the user is intended to be, and how to involve them in the process of designing a given object (a user is a person who will use the final product for the purpose of achieving some useful function).

User-centered design (UCD) is a broad term that describes the design process in which end-users influence product design [60]. User-centered design has become a widespread philosophy that applies a variety of methods to involve users in a particular design process. The term “customer-centric design” originated in Donald Norman’s research lab at the University of California, San Diego, in the 1980s, and became widely used after the publication of a co-authored book [61].

Therefore, within the CROSTAND2 project, a user-oriented design method was used as one of the models employed in order to design new conceptual solutions.

2. Materials and Methods

Several types of respondents and one location participated in the research; several different methods were used that enabled the definition of problems, setting requirements and formulating conceptual solutions, and proposing guidelines for a detailed elaboration of the implementation solution. The research was conducted in the period from February to June 2021.

2.1. Materials

2.1.1. Respondents in the Survey Questionnaire

Respondents in the survey questionnaire were selected via the method of random sampling, where no gender, age limit, or type of occupation was given since the survey was distributed through an open-source online application. The survey was anonymous and intended for the public, to obtain as many and varied samples as possible.

2.1.2. Respondents in an Informal Interview

The unstructured interview (conversation) was attended by museum curators and residents of the observed site.

All survey respondents voluntarily participated in the survey and interview. At the beginning of the research (both online and face-to-face), it was explained that they were free to cease further participation at any time.

2.1.3. Location

Considering that the field research in the project has already been processed and the sites described (see Section 1.1.1), this paper explores a new site, selected according to the criteria of attractiveness and the preservation of Croatian traditional buildings, the

possibility of safe field trips with competent expert guidance, and the possibility of free collection of photo documentation. We found such a location in the central continental part of the Republic of Croatia in Zagreb County, in the village of Donja Kupčina.

2.2. Methods

2.2.1. Field Research, Observation, and Photography

During the field research, we observed and photographed the existing buildings in the village of Donja Kupčina. This, with the previously collected field research data [5,6], enabled a comprehensive analysis of the details of Croatian heritage buildings and traditional construction. The collected photo documentation obtained the sources of aesthetic and construction characteristics of each building, applied materials, and methods of processing for possible future application in the design of conceptual solutions.

2.2.2. Survey Questionnaire

The conducted survey questionnaire was compiled to collect the views of users on leisure habits before and during the “new normal” pandemic environment. This research implicitly sought to arrive at the requirements that would be set for the final product. The questions were of an open and closed type, were in the form of a binary scale, and consisted of a total of five parts (Table 1).

Table 1. Structure of the survey questionnaire.

Section No	Type of Questions	Number of Questions
0	Survey description	n/a
1	General questions	6
2	Habits and behaviors before the COVID-19 pandemic	6
3	Habits and social opportunities during the COVID-19 pandemic	10
4	The quality of space and facilities for socializing, regardless of the COVID-19 pandemic	10
5	Questions about future forms of socializing and the content of the new facility	8
Optional	Description of the ideal space for socializing	1
Total		41

This paper presents the five selected responses that were used as key guidelines in conceptualizing the new facility. The presentation of this Table serves only as an insight into the extent of the entire project. Complete data processing of the entire questionnaire is not the object of this paper.

2.2.3. Informal Interview

An unstructured interview is one in which the questions asked to the respondents are not posed in advance but are included in a spontaneous conversation. In this way, an interview was conducted with experts and curators of the museum and the residents of the observed locality who helped us to deepen our knowledge of traditional construction.

2.2.4. Cyclic Method of Creative Design Process

In order to achieve a harmonious balance between the growing number of factors and product requirements, it is necessary to ensure the application of a proper design methodology within the design process. One such method is the cyclical method of the creative process, which originated in the 1960s at the University of Waterloo in Canada [62] and is, in some ways, a precursor to today’s design theory and creative process design, as addressed by numerous authors [63–66].

The emphasis in this cyclic method (as in all design methods) is on the iterative (cyclic) process of conception, which returns to the beginning or continues on to individual

stages to verify a particular solution. Attention is paid to the stages preceding research of the solution and no research is undertaken before the problems, criteria, objectives, and requirements have been identified. Special attention during the whole process is focused on the user.

The cyclic method consists of the following stages: (1) discovering needs; (2) product environment analysis and needs; (3) problem identification; (4) determination of criteria, goals, and requirements; (5) developing several solutions (design concept); (6) feasibility analysis; (7) concept optimization; (8) verification of one solution; (9) communication of the solution; (10) detailed development and prototyping.

This paper presents the results of the first phase of the project and includes phases 1–7 of the method.

2.2.5. Statistical Data Processing

To process the data of the results of the survey questionnaire, a spreadsheet in Microsoft Excel was used by which graphical representations of five selected answers to the questions were created. It should be noted that this paper does not aim to present the results of pure empirical research but instead the design process and development of a particular product. Therefore, the results of our statistical and numerical analysis are not presented in detail. The statistical data in this paper represent and process only a few selected answers as a guideline for further development of the concept within the project.

3. Results

The results are divided into two phases:

1. The first phase presents the results in the form of inspiring details of traditional construction, collected at the location of Zagreb County and the village of Donja Kupčina, and the answers of the respondents in the conducted surveys. Both results can be considered as the first two stages of the cyclic method of the creative design process—(1) discovering needs, and (2) product environment analysis and needs—and enabling the next stage, (3) problem identification.
2. The second phase builds on the first and applies the next stages of the cyclic method of the creative process (stages 4 to 7), where the requirements were set for designing conceptual solutions of the object and environment and conceptualizing the context of application, after which the project task was defined. After setting the terms of reference, several sketches of conceptual solutions were made, which in this phase of the project enabled the further elaboration of the concepts and discussion and conclusions regarding the obtained solutions.

3.1. Results of Field Research—The Village of Donja Kupčina

Donja Kupčina is a village that is part of the municipality of Pisarovina in Zagreb County. The village is located in Pokuplje, in a plain near the left bank of the Kupa. Due to frequent flooding, the village is located on slightly elevated terrain a short distance away from the shore, near the mouth of the River Kupčina in Kupa. From ancient times, due to its natural position, this area has been rich in flat, fertile fields and lowland centuries-old pedunculate oak forests, which environment has manifested itself in the traditional architecture of the village throughout history.

In a conversation with the curator of the native museum, “Zavičajni muzej Donja Kupčina”, we learned about the history of the village and the context of the creation of buildings in that locality. To this day, the village has retained an archaic structure, with recognizable hamlets that were created in the 18th century by dividing the property of large clan cooperatives. The museum exhibits consist of several preserved houses and the oldest dates from 1782.

Houses in the village of Donja Kupčina were often built as two-story buildings, due to the many families who lived in them (Figure 7). When enlarging a family (e.g., through marriage), the elements of a particular floor would be disassembled, numbered, and

arranged in a different location as a new object. The roof of the old house would then be reassembled. This is an important feature of prefabricated houses, not only in Donja Kupčina but also in any observed Croatian area where houses were built of wood.



Figure 7. Traditional two-story houses in the village Donja Kupčina: (a) ground floor (“potiža”) incorporated in the floor plan of the house (b) “potiža” with additional roof.

Traditional two-story houses (Figure 7) consist of a ground floor, with a first floor above that acts as a roof. The ground floor served as an economic area in which the central zone (called the “potiža”) is located. From the “potiža”, wooden stairs lead to the upper living space of the house. There was always earth piled on the floor of the “potiža” and on the left and right sides of the walls, doors lead to the so-called “šuta”. The most important “šuta” was always to the left side of the main door (called the “first šuta”), covered with a wooden floor, and with only one small window (Figure 8) that allows daylight to illuminate the space and prevent theft. In this room, the family kept the “weight” or “grain”, i.e., all the annual grain yield stored in wooden chests of different sizes. Various tools were often hung on the facades (Figure 9). Additional farm buildings, such as stables for keeping animals or storing hay, were separated from the main house (Figure 10) and are also an example of Croatian traditional wooden construction.



Figure 8. Window of the “first šuta” room in the village of Donja Kupčina.



Figure 9. Facade detail showing the traditional “Croatian” joint and the still functional wooden tool for collecting and disposing of food in the village of Donja Kupčina.



Figure 10. Chicken coop in the village of Donja Kupčina.

3.2. Results of the Survey Questionnaire

This paper presents the results of selected answers to questions that are most important for directing requests regarding the design of a new, prefabricated building containing revitalized elements of traditional construction, one that is based on the wishes and needs of users as part of the user-oriented design method.

In total, 209 respondents answered the survey questionnaire, of whom 132 were female (Nf) (63%) and 77 were male (Nm) (37%). The age range of the respondents was 15–65 years, of whom the largest number of respondents belonged to the age group (Ar2) of 19–32 years (67%) and who had the status of further education students and employees (54%); the fewest were in group Ar1 (15–18 years) (3%), with the status of school students and unemployed (5%). In terms of their place of residence, most respondents lived in a place with more than 100,000 inhabitants (62%) or 100–10,000 inhabitants (20%) and lived in houses (50%) and apartments (44%).

The original idea for our design of the building was to serve a catering purpose, for holding public events in urban areas. For this reason, the answer to the question of whether respondents attended public events before the pandemic (Figure 11), and how much the pandemic affected their lives and the habits they had until the outbreak of the COVID-19 virus (Figure 12), was considered significant.

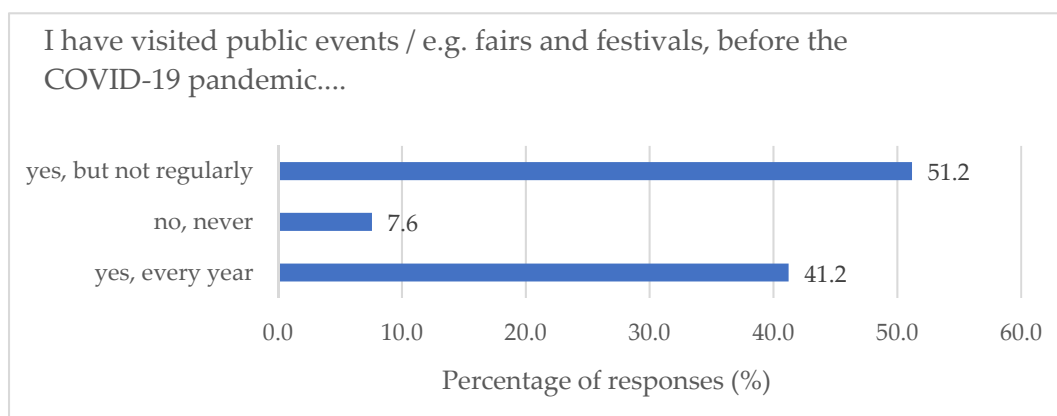


Figure 11. The attending of public events before the COVID-19 pandemic.

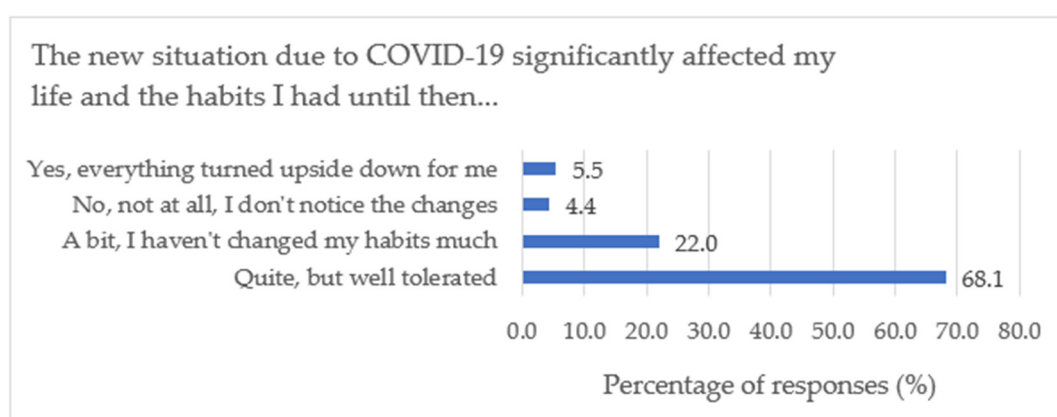


Figure 12. The impact of the situation due to COVID-19 on everyday life.

It is evident that among all activities that people used to conduct before COVID-19, the respondents are missing socializing (“hanging out with friends”) and meeting new people (Figure 13).

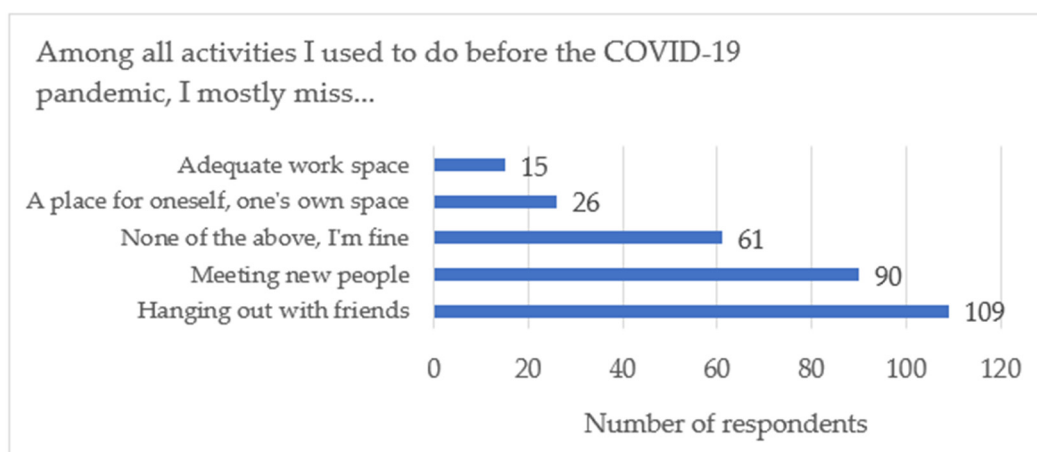


Figure 13. Activities missed during the COVID-19 pandemic.

By asking respondents how they spent time with friends and family, we wanted to find out what kind of spaces the respondents would prefer. The highest number of points was given to outdoor space, i.e., terraces, gardens, and parkland. The diametrically opposite answer is “in a crowd”, i.e., in the center of the place where they are located, which is the

highest-rated with a grade of 1, followed by the lowest-rated answer, “I like to be alone”. The rest of the possible answers were to be indoors (inside a catering facility), surrounded by nature and silence, or surrounded by other people and music (Figure 14).

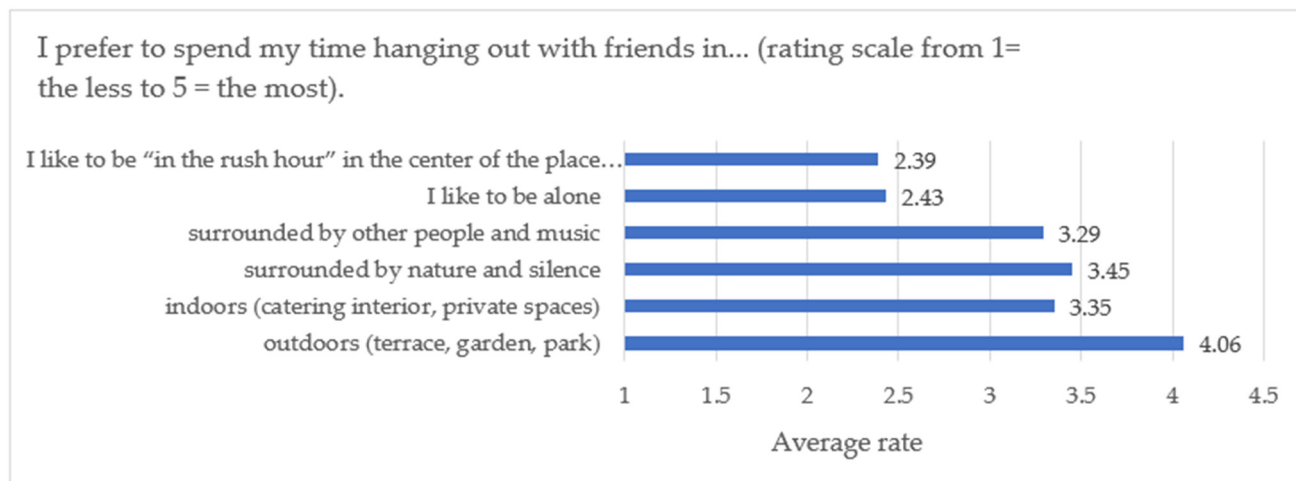


Figure 14. Preferences about the environment while spending time with friends (regardless of the “new normal”).

One interesting result in the respondents’ answers was obtained to the question of which new habits they would like to keep even after the pandemic ends (Figure 15). Going out into nature has become the highest priority.

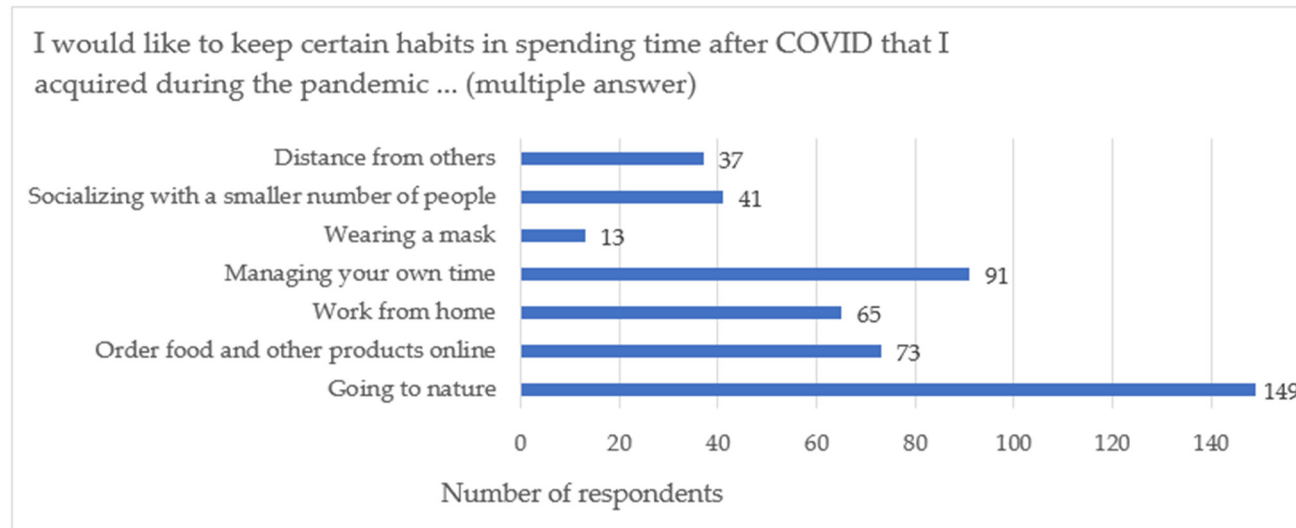


Figure 15. Willingness to keep certain habits after the COVID-19 pandemic has ended.

Respondents’ answers to questions related to people’s habits before and during a pandemic revealed those activities that respondents most often engaged in during their free time, such as spending time with friends and family and time spent on the computer, (noting that during a pandemic, time with friends was limited, due to COVID-19 restrictions). Before the pandemic, gatherings were mostly held in public enclosed spaces (cafes, clubs, college, school ...) but during the pandemic, due to an inability to use public spaces, habits changed, so that people mostly met up in open areas or private spaces (parks, forests, playgrounds, private apartments). Additionally, the answers showed us that the respondents’ most integral part of everyday life was spending time with friends and

attending entertainment and cultural events; their freedom of movement was of great importance but this was greatly reduced during the pandemic.

Based on the presented answers, the requirements for the product were defined, according to which findings conceptual solutions would be formed. The requirements refer to design–construction, psychological–social, ecological, economic, aesthetic, technical–technological, functional, and ergonomic–anthropometric determinants that should be included (respected) by the future product in further stages of development.

3.3. Project Assignment and Concept Development

The first three stages of the cyclic method of the creative process were: (1) discovering needs; (2) product environment analysis and needs; (3) problem identification. These were analyzed through the questionnaire and field research, which enabled: (4) determination of the requirements.

Some problems have been identified that have enabled the definition of concept design requirements:

- Traditional architecture is autochthonous but preserved only in certain localities of Croatia;
- Old, traditional houses have often been turned into open-air museums;
- There are not many traditional buildings that serve the function of facilities for rest and relaxation in the open;
- The preservation of traditional buildings is difficult and there is a problem of revitalization;
- New wood materials (such as prefabricated laminated beams) have not been used too much until recently;
- With the appearance of a pandemic, there is a fear of people being indoors, as well as a reluctance to be in a crowd;
- People do not like to be alone and they need to socialize;
- Since the outbreak of the COVID-19 pandemic, people need more socializing outdoors, in nature, and in the fresh air.

These problems have enabled the definition of design requirements for new concepts.

3.3.1. Design Requirements for a New Concept

The new concept should satisfy the following design requirements, and should:

- Be aesthetically simple and contemporary;
- Be modular and prefabricated;
- Revitalize the traditional knowledge of wood in construction;
- Preserve nature by using sustainable materials—wood (fir, spruce, beech, ash);
- Use laminated wooden beams if possible;
- Be set in nature, in a public area, such as parks in the city, forests and other natural areas;
- Be open and accessible to all kinds of people;
- Be resistant to potential vandalism;
- Allow different types of use (resting, dancing, yoga, reading, music . . .);
- Allow users to enjoy nature and enjoy socializing;
- Enable comfortable sitting/lying in various free body positions;
- Be adapted not only to groups but also to individuals;
- Enable children's play;
- Enable shelter from the sun/rain and adverse weather conditions, or providing at least psychological shelter;
- Be open and transparent but must provide (physical and psychological/mental) shelter;
- Apply the elements of Croatian traditional construction;
- Apply the knowledge of utilizing wood in construction, especially in terms of protection and resistance to weathering.

3.3.2. Conceptual Sketches

Initial conceptual sketches (Figures 16–18) represent the basis for the further conceptualization and selection of the optimal solution.

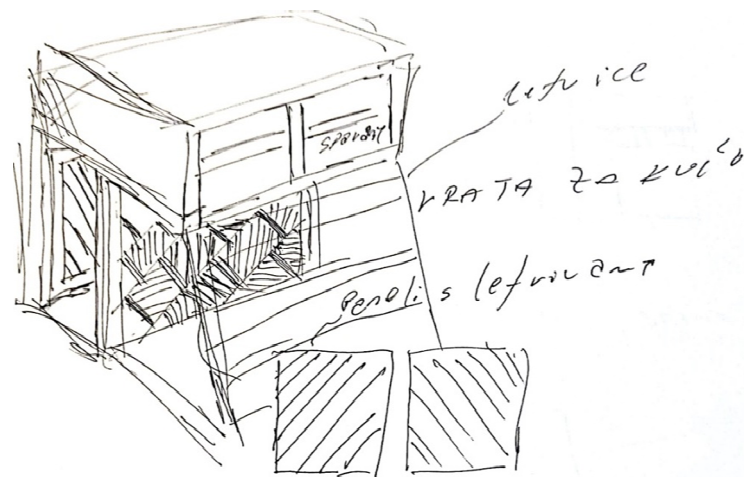


Figure 16. Sketch 1, showing the inspiration of the wooden slats on the doors and the orientation of the slats.

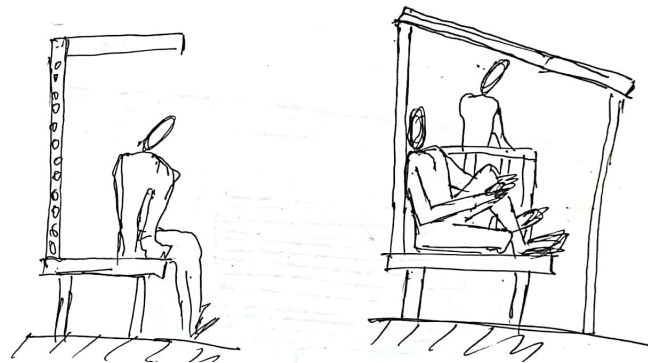


Figure 17. Sketch 2; ergonomics, anthropometry and different body position are considered.



Figure 18. Sketch 3; wooden slats on doors or the facade are considered.

After the conceptual sketches were made, the creative process focused on the 3D drawing models of a few concepts and the application of wood in construction. Concept V-1 went in the direction of using horizontal and vertical beams, stairs, and two possible platforms (Figure 19). The inspiration came from the photos shown in Figures 5, 9 and 10. Using the designers' freedom and respecting constructional requirements, the entire facade was rotated by 90 degrees to obtain vertically arranged laminated beams, instead of the traditional horizontal planks on the facades. Additionally, this enabled a larger distance between the individual laminated beams, which led to material savings and a lighter

modular construction of one module. One potential remark was in the direction of not using the roof as a common “trademark” of any traditional house. The idea of modernizing traditional expression into modern speech includes modifying the roof features. In this concept, the inspiration came from the story of “raising a family”, in which the first floor of the house, along with the roof, is moved to a new location. In this case, the ground floor is seen as a modular unit that can be architecturally extended in height and width and, ultimately, the finalization of the building with a roof structure, if the natural environment, terrain, or the idea of traditional features requires it. By removing the roof, the user’s view of the sky is opened up, thus emphasizing the user’s feeling that they are truly surrounded by nature. Additionally, the idea of stairs could potentially be further developed to inspire consoles and corner joints on the facade (see example in Figure 9).



Figure 19. Concept V-1, inspired by stairs, facades, traditional joints, and wooden construction from photos in Figures 5, 9 and 10.

These and other ideas, such as the rotation of the visual direction of the lines on the facade, cantilever beams instead of stairs/landings, as well as “moving the first floor and roof” enabled a visual transposition from the historical and traditional visual values of wooden architecture into modern architectural language.

Some constructional details were considered, such as the cross-section of the horizontal beam, which would be chamfered at 45 degrees to ensure water drainage. It is necessary to ensure the flow of air through the construction, in order to allow the wood to “breathe”, i.e., possible dimensional changes that occur due to atmospheric influences (Figure 20).

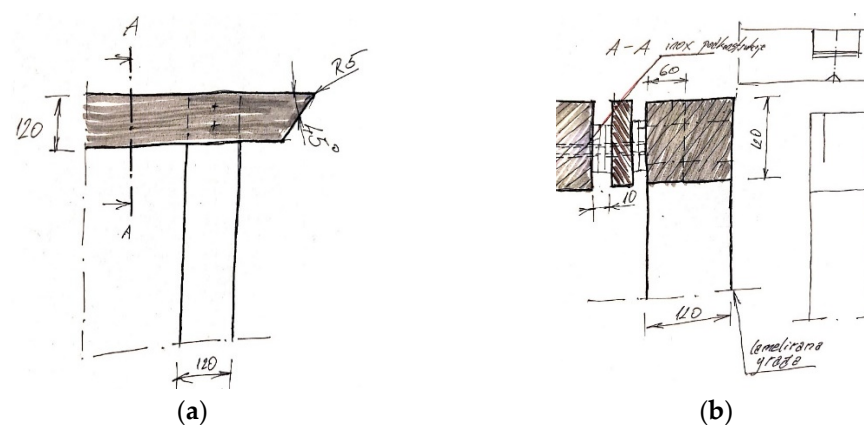


Figure 20. Sketches of the angular-lateral joint: (a) view; (b) cross-section; the proposal is of construction and the joining of vertical with horizontal laminated beams, which, when thus joined, form the ceiling frame.

The further development of the conceptual design continues in optimizing the idea of modularity, simplifying the construction, and improving the stability and safety of the cantilever surfaces.

3.3.3. Concept Optimization

The optimization of the concept imposes the manner and context of using the conceptual solution, whereby variant V-1 is modified and variant V-2 is further considered and developed. Variant V-2 (Figure 21) represents the optimization of conceptual solution V-1, which considers the possibility not only of the modularity of the building but also the safety requirements that the previous solution V-1 did not meet, due to the potential dangers of climbing stairs and possible falls. The stacking of the module is proposed to be offset in relation to the width of the object. Thus, a playful form was established, in which the functions of sitting and lying down outdoors are even more emphasized (Figure 22).

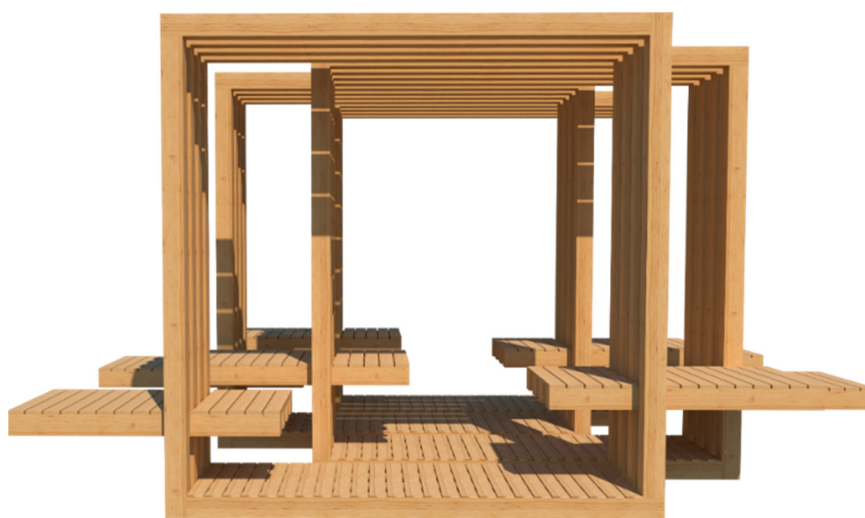


Figure 21. Optimized concept V-2; inspired by the facade, traditional corner joints, and wooden construction seen in the photos in Figures 7, 9 and 10.

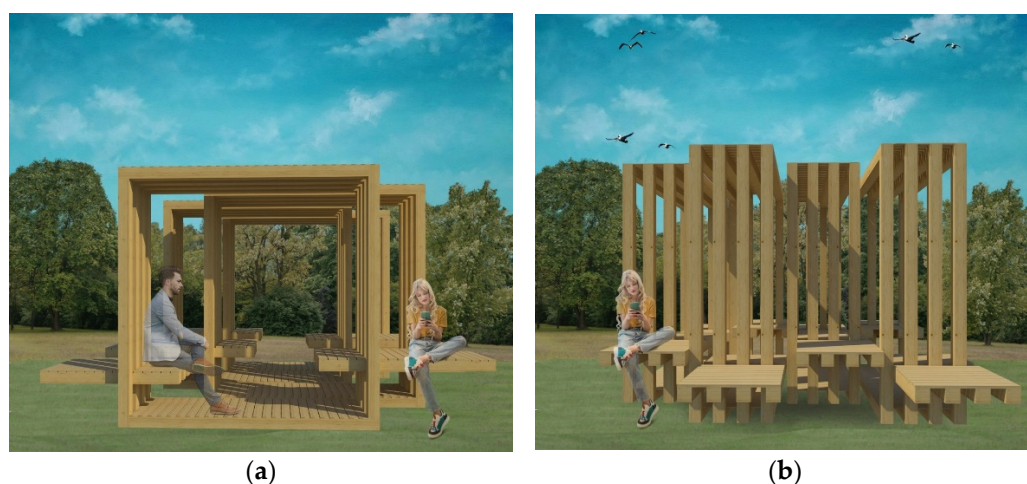


Figure 22. Spatial application of the V-2 concept: (a) front view; (b) side view.

The improvement of the construction of the conceptual design was made for the purpose of structural protection of the building. Figure 23 shows the relationship between the object and the ground. The entire building was lifted from the ground and placed on concrete feet that imitate the traditional “babak” from vernacular construction. A rubber

pad of ethylene propylene diene monomer was placed between the load-bearing beams and the concrete so that they would not be in direct contact.

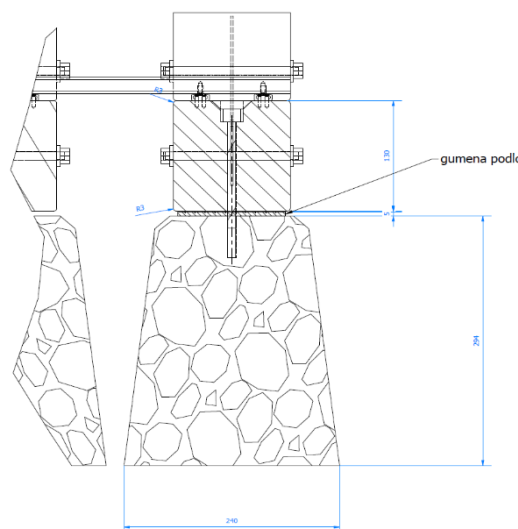


Figure 23. Elevated construction on concrete feet imitates installation on the so-called “babak” in traditional construction.

The facility is designed to be temporarily mounted in a public area and is to be used during one specific season (e.g., during spring, summer, or autumn) when people leave their homes more often and can stay outdoors for longer. Fir or spruce wood (laminated beams) is proposed as a building material, primarily because of its price, and since it is a temporary seasonal facility, wood can withstand external influences. The surface protection is a thick layer of wood stain with sufficient pigmentation.

4. Discussion

The paper presents the requirements for the design of a modern modular prefabricated wooden building and provides an overview of traditional construction, the basic postulates of wood in construction, prefabricated construction, and the concepts of public space. The paper includes theoretical thematic units related to traditional heritage as an inspiration, while field research has shown that tradition is not forgotten, and it is carefully preserved in museum exhibits or cultural heritage-protected villages.

The presented concepts of conceptual solutions are also derived from the results of the survey, which, in separate answers presented in this paper, confirmed the assumption that the COVID-19 virus pandemic changed our use of free time and perception of our everyday life. In total, 209 respondents answered the survey questionnaire ($N_f = 132$, $N_m = 77$). It is evident that among all activities that respondents used to enjoy before COVID-19, they are missing socializing ($n = 90$) and meeting new people ($n = 109$). Preferences for being in the natural environment while hanging out with friends (regardless of the “new normal”) show that most respondents prefer socializing outdoors (average rate = 4.06) and being surrounded by nature and silence (average rate = 3.45); (rating scale: 1 = the least to 5 = the most). Returning to nature after the pandemic will probably remain the highest priority ($n = 149$). Based on the presented separated answers, the requirements for the product have been defined, according to which findings the conceptual solutions have been formed.

This work encourages the creation of a modular space inspired not by the visual-aesthetic determinants of tradition but instead by the idea of the modularity and multifunctionality of the building and the revitalization of wood in traditional construction. In this paper, we wanted to remain focused on the national heritage of the Republic of Croatia, which emphasized modular construction through the use of traditional building joints (folding joints), while deliberately neglecting the visual indigenous expression. We are

aware that the visual patterns of Croatian architecture were not sufficiently applied at this stage, but this “naked” solution enables a new process of creative conceptualization that will be oriented toward the application of visual elements of Croatian architecture (such as the roof, lattice facade or fence), designing new solutions. The emphasis in the concepts presented here is on traditional wooden construction, transparent and lightweight modular buildings, easy installation in the natural environment, and the various possibilities for use listed in Section 3.3.1. A detailed construction of elaborations is needed, as well as further reflections and testing of the facility for durability, safety, and functionality.

When designing conceptual solutions of products (objects) in this paper, the emphasis is on listening to the views of users and the application of the main features of wood in construction, while a more detailed design and application of visual elements of heritage is left for the next phase. Additionally, the detailed processing of all answers in the questionnaire, which will use statistical and numerical analysis, is not the subject of this study and will be presented in a separate paper.

5. Conclusions

The results of field research and selected answers of the survey presented in this paper, as well as the results of previous project research, served as the basis and inspiration for designing a conceptual modular stand inspired by traditional wooden joints and construction, and for meeting the new needs of users to socialize in a healthy environment due to the COVID-19 pandemic. As a result, the conceptual solution of sustainable modular prefabricated wooden booths, intended for use in public urban and rural areas, has been proposed. This student project has the potential to continue, with the interdisciplinary collaboration of architects, wood engineers, designers, art historians, and other professionals who can answer questions about environmental protection, urban plans, setting up such facilities in rural and urban areas, and dedicated tourist heritage. This would enable the sustainability of the application of the natural environment not only for personal but also for tourist and commercial purposes, with the application of Croatian traditional architectural heritage and culture in the next phase of the project.

This paper points to two potential conclusions:

(1) The COVID-19 pandemic has changed the perception of users toward a greater need to spend their free time in quieter natural environments. This knowledge should be used for more intensive design and utilization of wood products (buildings) in exteriors, in order to revitalize knowledge about wood in construction and enable the sustainability of designed buildings, in the context of preserving traditional culture and construction.

(2) The Republic of Croatia is rich in traditional architectural heritage, but buildings that have emphasized traditional elements are often not visually contemporary or attractive. This suggests the need for further study of the design and construction details of old timber buildings. The aim is to encourage further revitalization, modernization, and a subtle transfer of knowledge from heritage buildings to new contemporary expressions that will shape unobtrusive visual and aesthetic elements and functional recognizability with the appropriate application of knowledge regarding wood usage in construction.

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