CONTEMPORARY ARCHITECTURE APPROACH TO THE PREFABRICATED WOOD HOUSES

Vladana Petrović [1]
Nataša Petković [2]
Branislava Stoiljković[3]
Milica Živković[4]
Aleksandar Keković[5]

UDK: 72:624.011.1
DOI: 10.14415/konferencijaGFS2018.055

Summary: *The architectural aesthetics of today is conditioned by renewable, ecological materials and turned to a contemporary, sustainable architecture. One of the most complex problems of today is the integration of contemporary architecture with nature, where the object is defined as an inherent energy system that uses local natural resources and energy from renewable sources. The answer to the contemporary architectural and construction requirements provides sustainable, ecological, prefabricated construction which uses wood as the main structural element, as a renewable, recycling possible and provides high thermal performance of the building. Prefabrication is a modern, inexpensive and fast way of constructing in which the construction time is shortened, materials are used in accordance with the principles of sustainable development and reduces the emission of CO_2, which as a final product has modern assembly houses.*

Keywords: *prefabrication, sustainable architecture, contemporary architecture, ecological materials, renewable energy*

1. INTRODUCTION

Sustainability in the building has become the primary issue in modern construction. The technology of sustainable materials from which housing can be built is progressing on a daily basis, but primacy takes wood as one of the oldest materials used for construction as CO_2 neutral and which has a full life cycle, is renewable, easy to recycle and it is

[1] Vladana Petrović, PhD student, University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, Niš, Serbia, tel: +381 18 588 200, e – mail: arch.vladanapetrovic@gmail.com
[2] Nataša Petković, PhD student, University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, Niš, Serbia, tel: +381 18 588 200, e – mail: natasapetkovic83@gmail.com
[3] Branislava Stoiljković, Assistant Professor, University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, Niš, Serbia, tel: +381 18 588 200, e – mail: branislava.p.stoiljkovic@gmail.com
[4] Milica Živković, Assistant Professor, University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, Niš, Serbia, tel: +381 18 588 200, e – mail: dia.milica@gmail.com
[5] Aleksandar Keković, Associate Professor, University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, Niš, Serbia, tel: +381 18 588 200, e – mail: aleksandar.kekovic@gaf.ni.ac.rs

possible to use it again as well as to build the tree should not cause harmful emissions. On the other hand, in the the construction sector, 40% of the total energy is consumed. [1] The design of the object itself rarely focuses on the environmental impact during the entire life cycle of the building. Wood as a building material can respond to the demands of modern construction, especially since the system of wood construction has progressed and enables the construction of residential buildings of different designs, types, and even multi-story buildings. On the other hand, the prefabricated construction of wooden elements gives the greatest potential for improving productivity and quality of construction. The preparation of building components in the factory that is installed on site can provide better energy performance and more economical use of resources than when the facility is built on site. In addition to preserving the environment, the efficiency of prefabricated construction is the ability to control the time that in traditional construction is dependent on external influences, which is one of the demanding demands of markets and customers.

2. PREFABRICATION IN ARCHITECTURE

Prefabrication is not a new idea for architects. It was a staple of the post-war modernist ideal, a great dream that precise modern structures would be created in clean factories and then shipped to the site. However, the realities of post-war prefab were far from this ideal; buildings were often poorly designed or poorly constructed, and by the end of the century prefabrication was merely a footnote in the catalog of construction methods. In the 21st century though, prefabrication is experiencing a resurgence. [2]. In the architecture of the 20th century, the prefabricated house was a constant theme and often described as the “oldest new idea” of modern architecture. Modernist had seen the concept of prefabricated homes as a natural and logical result of the industrialization. After I and II World War, mass production of prefabricated houses and flats had the opportunity for a quick solution for the housing problems in mass demand and high poverty. Postwar mass housing construction in the settlements of social housing, wouldn’t be possible without the use of prefabrication; on the other side of the mass production of prefabricated houses in the variations of the traditional styles, led to a negative reputation of the idea of the prefabricated house [3]. The evolution of today's prefabricated building has could be observed through the gradual increasing application of prefabrication architectural elements — wood frame construction, doors, windows, wall panels finished, finished facade panels. In broad terms the demands of modern construction in the first place sets the environmental aspect in which the timber takes precedence as a material for construction, wood is a totally renewable, recyclable, biodegradable and burning wood is CO_2 neutral.

3. ADVANTAGES OD PREFABRICATION

Considering the main advantage of the prefabricated building and it represents the speed of construction, reduction of costs and time, it can be concluded that the average duration of production of prefabricated houses is less by 70% compared to conventional construction, and that financial savings are about 25-30% compared to conventional

construction in benefit of assembly [3]. Due to technologically efficient production, reduced energy and material consumption and reduction of waste to a minimum. The factory becomes the place of "construction", the finished items are delivered and assembled on site, and the site is protected from air pollution and soil contamination, which is not the case with conventional construction. With prefabricated construction, the elements that are easy to mount, easy to dismantle and ultimately sort and recycle. Also, prefabrication allows changing location and reuse with full energy independence enabled by built-in photocells or solar collectors, while walls or panels are already pre-built with good insulation. Apart from the advantages of building construction itself, prefabricates and construction site conditions are better than traditional construction methods, in a factory-controlled environment, each worker is usually assigned to a work station that is supplied with the appropriate equipment necessary to provide the safest working environment. Outside construction eliminates the dangers associated with materials, equipment and incomplete building processes typical of buildings that can attract interesting and undesirable "visitors" [4].

Figure 1. Transport of the elements site

Figure 2. Elements on the construction

Figure 3. Construction of the object in the factory
Figure. Construction of the object in the site

4. CONTEMPORARY ARCHITECTURAL APPROACH TO BUILDING PREFABRICATED BUILDINGS

The architectural approach in designing and constructing prefabricated houses still has a traditional approach that involves hair roofs, wooden windows and additional elements that are not inherent in modern construction.

Thanks to modern prefabrication technologies, the design boundaries have been shifted and it has succeeded in reaching very attractive modern forms in which environmental aspects are taken into account. The only constraints that can occur in prefabrication are in the transport of elements to the site. The first case study is a house built in Exaltación de la Cruz, Argentina, Estudio Borrachia Architects and area-174.0 m2. Which is designed as a modular system in accordance with the technological possibilities allowed by wooden construction. This house was built within five months without the change of ecosystem, which enables the preservation of the natural state. Even if necessary, it can be removed in a few days, and the environment is left behind. With this object, the wood used for construction, coating, division and deck, playing a leading role in the material logic of this house, and at the same time a search engine for new constructive alternatives, based on systems and materials that are simpler to manufacture and handle, exist throughout the territory our countries and adapted to different geographical and climatic conditions. This house offers not only a response to the timely and specific problem of your design and construction, but also to the study of the verification of a series of investigations that have been carried out for several years on the implementation of a prefabricated system of low-cost, quicker implementation [5].

Figure 1. Casa de Madera prefabricated wood house

Figure 2. The wood construction of the house

The second case study is the project of Abarca and Palma studio. The house is constructed in pine wood—using composite beams and pillars—with prefabricated SIP panels and developed as a modular house proposal made up of 10 different types of module, capable of forming 5 different house layouts. This is a system of prefabricated modular units of space within a modular structure constructed on site. The wooden structure is built in situ by carpenters prior to the arrival of the prefabricated panels that are mounted inside. The structure is designed to be built in pine wood using composite

beams and pillars. The prefabricated SIP panels will be of variable thickness, depending on the climatic conditions of the country the project is built in. The 10 spatial modules correspond to living spaces with a specific use which can be combined according to the requirements of each inhabitant. These modules include bedrooms, living rooms, terraces, bathrooms, and kitchens, among others. The modules also vary in their finishes using natural wood, wood painted in carboline oil, corrugated zinc, smooth zinc, and other materials. This allows for a greater range of alternatives to satisfy the diverse requirements of the users. In terms of climate, the house is characterized by a large roof that protects the entire constructed area with eaves over 1 meter in length. This ensures protection from the rain and the sun, giving greater durability to the exterior of the dwelling and considerably decreasing its maintenance. This cover is separated from the modules to reduce the transfer of heat from the sun into the modules, and also to improve air circulation. In addition, the width of the house and the sequence of windows allow an effective cross ventilation of all the enclosures [6].

Figure 3. Facade appearance

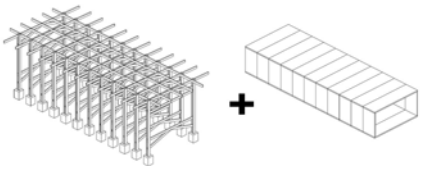

Figure 4. Modules and construction

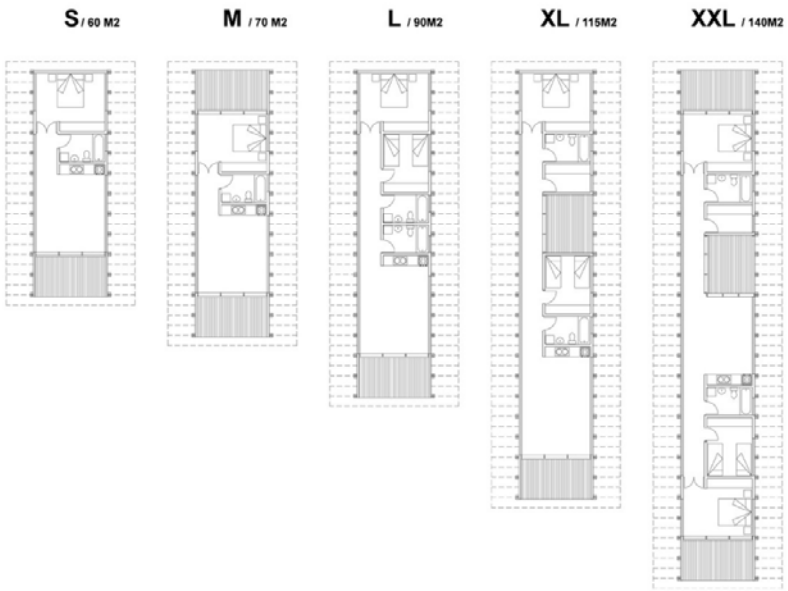

Figure 5. Function developed through modules

The third case study is The Backcountry Hut House as an example of an excellent prefabricated building, seen through the construction, design, and sustainability of the building. The design is reflected in the fact that the components are made into the factory and then each component is flat-packed on pallets for shipping to a location close to the site, then transported via air or off-road vehicles. The site preparation does not require heavy machinery for minimal site disruption. Piling holes are hand-dug and concrete is poured into sonotubes to form piles for the foundation. A prefabricated core minimizes the carbon footprint and site imprint of the structural assembly. Prefabrication allows for an economy and conservation of material and energy usage in the production and assembly of the building components. The hut can serve different purposes: the client can set it up as a backcountry hut for outdoor groups or can use it as a front-country hut for personal usage. The basic shell consists of 4 posts, 4 beams and a roof. The hut fits a community kitchen at the bottom and a bunk-bed sleeping area at the top floor. Environmentally sensitive products are used for all materials such as: engineered wood products, FSC certified lumber, 100% recyclable components [7].

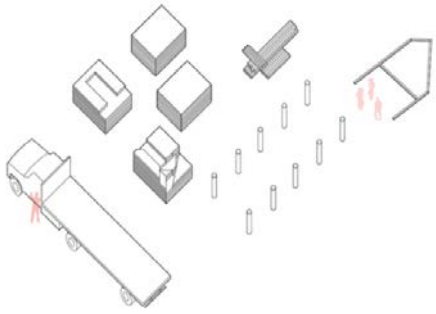

Figure 6. Flat-packed on pallets for shipping

Figure 7. The site preparation

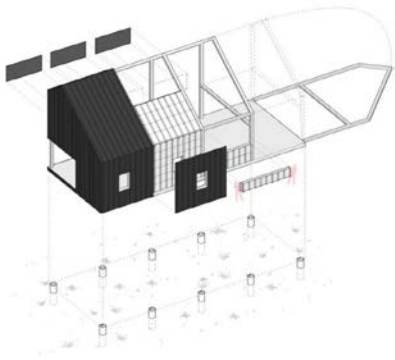

Figure 8. Laying the layers of the object

Figure 9. The final look of the object

5. CONCLUSION

Considering the modern approach to house construction, which as a mandatory requirement has as quick, cheaper and environmentally safe construction with energy savings as the main criterion.
The technological advancement of prefabricated buildings has the potential to solve many environmental aspects of the construction industry. Wood with high potential as construction material in the future will have a major role in sustainable development in the construction sector. Also, the possibility for modern and efficient architecture can be ordered and designed and be very affordable, will represent a great market potential, which can lead to such a design approach and production plants lead to the transformation of the construction industry. Also, the design approach will develop such a system that when purchasing a home, the client chooses an object according to all characteristics of other products such as color selection, size, functionality along the default aspect of energy saving and environmental protection.

REFERENCES

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast) Off J Eur Commun (2010)
[2] https://www.archdaily.com/773621/prefabrications-second-coming-why-now,
[3] http://www.expeditio.org/benefit - living/ index.php?option=com_ content&view=article&id=96%3 Aprefabrikovana-kua-ekoloki-aspekti-ii-&catid=7%3Aexpeditio&Itemid=13&lang=en (preuzeto 1. oktobra 2012)
[4] Madigan D.: Prefabricated housing and the implications for personal connection, The university of South Australia 18th annual pacific-rim real estate society conference adelaide, Australia, 15-18 January 2012
[5] https://www.archdaily.com/796659/casa-de-madera-estudio-borrachia, download 07.03.2018.
[6] https://www.archdaily.com/876644/design-for-a-modular-house-proposes-a-synergy-between-prefabrication-and-carpentry, download 07.03.2018.
[7] http://www.thebackcountryhutcompany.com/the-product download 11.03.2018.

САВРЕМЕН АРХИТЕКТОНСКИ ПРИСТУП ПРЕФАБРИКОВАНОЈ ГРАДЊИ ДРВЕНИХ КУЋА

Резиме: *Архитектонска естетика данашњице условљена је обновљивим, еколошким материјалима и окренута савременој, одрживој архитектури. Један од најкомплекснијих проблема данашњице, представља уклапање савремене архитектуре са природом, где је објекат дефинисан као својствени енергетски систем који користи локалне природне ресурсе и енергију из обновљивих извора. Одговор на савремене архитектонске и грађевинске захтеве даје одржива,*

еколошка, монтажна градња која као главни конструктивни елемент користи дрво, које је обновљиво, могуће је његово рециклирање и пружа високе топлотне перформансе објекта. Префрабикација представља савремен, јефтин и брз начин градње у коме се скраћује време изградње, користе се материјали у складу са принципима одрживог развоја и смањује емисија CO_2, што као коначни продукт има савремене монтажне куће.

Кључне речи: *Префабрикација, одржива архитектура, савремена архитектура, одржива архитектура, еколошки материјали, обновљива енергија*