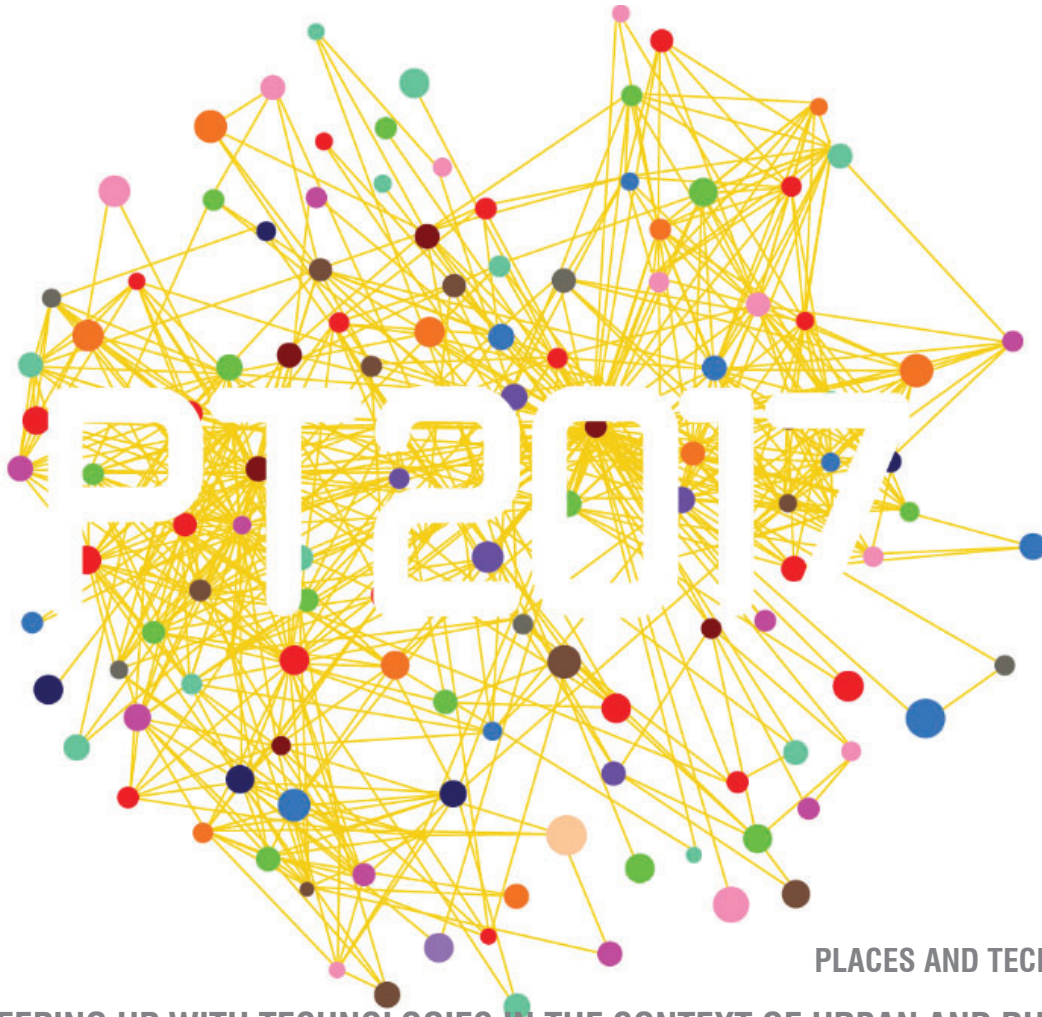


4th International Academic Conference



**PLACES AND TECHNOLOGIES 2017**  
**KEEPING UP WITH TECHNOLOGIES IN THE CONTEXT OF URBAN AND RURAL SYNERGY**  
**Book of Conference Proceedings**

Sarajevo, Bosnia and Herzegovina, June, 08<sup>th</sup> - 09<sup>th</sup>, 2017

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**KEEPING UP WITH TECHNOLOGIES IN THE CONTEXT OF URBAN AND RURAL SYNERGY**

08 & 09 JUNE

SARAJEVO

BOSNIA AND HERZEGOVINA

**BOOK OF PROCEEDINGS**

**PLACES AND TECHNOLOGIES 2017**  
**KEEPING UP WITH TECHNOLOGIES IN THE CONTEXT OF URBAN AND RURAL**  
**SYNERGY**

**BOOK OF CONFERENCE PROCEEDINGS**

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**Dženana Bijedić, Aleksandra Krstić-Furundžić, Mevludin Zečević**



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## PLACES AND TECHNOLOGIES 2017

4th International Academic Conference

## KEEPING UP WITH TECHNOLOGIES IN THE CONTEXT OF URBAN AND RURAL SYNERGY

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TOPIC IV:  
**ARCHITECTURE AND BUILDING TECHNOLOGIES**



## **EVALUATION OF WALL THERMAL PERFORMANCE FOR VEGETATION WALL**

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### **ABSTRACT**

Application of vegetation walls is not a new concept in the realization of facade layer. The integration of vegetation in architectural objects can be a viable approach for the implementation of the facade of new and existing facilities. The vegetation walls are one of the more innovative and developed concepts of green building technology. This fact is based on the original scale buildings with vegetation walls that contribute in improving the overall design performance of buildings and become a significant factor in the process of improving the thermal characteristics of the buildings. This paper explored the potential of new technologies in the realization of vegetation walls in architectural buildings, their thermal characteristics and design potential of the building envelope in the climatic conditions of Belgrade. Research has shown that the application of the proposed design principles vegetation walls may be successful project solutions applied to the building envelope in the climatic conditions of Belgrade. The thesis provides an overview of technical innovations that can be applied in the design process to minimize thermal effects on objects. The study confirmed the possibility of improving the thermal facility by using vegetation wall as the building envelope.

**Keywords:** Vegetation wall, technology, design, energy performance

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<sup>86</sup> Corresponding author

## **MONOCULTURE FACTORY BUILDING PROJECT - Facility relaying on energy efficient technologies in order to prevent abandonment and decay of rural communities in Vojvodina**

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### **ABSTRACT**

For more than two decades, villages in Vojvodina are exposed to decay, as more of young people are turning to the city and urban lifestyle, looking for more comfortable working conditions in non-agricultural activities. Therefore, there is a potential risk of complete disappearance of rural areas in Vojvodina.

These villages, along with its unique rural architecture, represent the identity of the area, therefore with their disappearance Vojvodina would lose its identity. Since the agriculture is the main source of income in rural areas, but also in the whole country, leaving villages greatly negatively affects the further development of economy in Serbia.

Aim of this project is to stop degradation of villages in Vojvodina and prevent further departure of young people by giving them new opportunities to live and work here. This will only be possible in rural areas where will come to reconciliation between rural and urban, or where it will be established an urban-rural synergy.

The MONOCULTURE FACTORY BUILDING project is a project of a new type of facility in villages which would serve for work using modern technologies of energy-efficient construction. Simultaneously placing the production, processing and consumption of one certain agricultural product in such facility, work in agriculture would be greatly simplified. With the construction of more such facilities, the village would be "urbanized" in a certain way and approached to the urban lifestyle. Also, it would provide the new possibilities of employment for the young rural population.

The project MONOCULTURE FACTORY BUILDING represents an attempt to improve economic and social situation in villages of Vojvodina. Within this paper the project of MONOCULTURE FACTORY BUILDING was presented with an explanation of its construction, operation, implementation of energy efficient principles and system functioning of several such facilities within a single rural community.

**Keywords:** Rural areas, Vojvodina, Energy efficiency, Monoculture factory building

### **INTRODUCTION**



TOPIC IV:  
**ARCHITECTURE AND BUILDING TECHNOLOGIES**

More than a half of the total population of Vojvodina lives in cities today, although almost 90% of its territory are villages. Population censuses which have been conducted within last few years reveal a constant decrease of rural population in the region. The results from two last censuses only show how fast the situation in rural areas has been changing, indicating a possibility of their complete abandonment. In 2002, the rural population of Vojvodina comprised 43.27% of the total population, and in 2011 this number was already reduced to 40.64%.

The abandonment of agriculture, as well as increasing urbanization and industrialization of cities, inevitably entails depopulation of rural areas. Although agriculture has always been one of the main economic activities and sources of income in Vojvodina, the population engaged in this activity today is minimal, only 8,08%, as opposed to 51.7%, which was the agricultural population of Vojvodina in 1961. These facts suggest the need to take urgent steps for saving villages. Despite numerous studies that have been dealing with this subject, a unique strategy that would solve this problem and which would make rural areas better and more desirable places to live, has not been established yet. The need to incorporate environmental protection and application of sustainable development principles in new directions of agricultural and rural policy is growing. Agriculture is an activity that requires consumption of large amounts of energy, so the rationality of its production and consumption has a major influence on economic development and improvement of rural areas. Without agriculture and economic stability, rural communities decline.

*"A village is a socio-spatial community, a human settlement, with a specific sociological (rural) structure and the corresponding (rural) development where inhabitants lead a specific way of life."*

*Mitrovic M.: Rural Sociology, Sociological Association of Serbia, 1998*

Certain sociological characteristics and behavioural patterns that are typical for traditional rural society in Vojvodina, like the stability of relations, unity and equality, represent one of the greatest values of this area, raising its significance to a higher level. By moving to cities people have lost their social relations which represented an important support for them while they lived in villages. The identity of Vojvodina is defined by its rural communities and the unique rural architecture. If these local communities disappear, Vojvodina will lose its identity.

It is necessary to find a way to reconcile the traditional and the modern (urban) in rural areas, examine the old problem of relations between villages and towns in a new light of modern society.

This paper presents a Monoculture factory project that will establish a rural-urban synergy by making the rural communities sustainable and more advanced places to live. In order to obtain a good quality of life, organization of these facilities is in accordance with the needs of the local rural population.

**"MONOCULTURE FACTORY BUILDING" PROJECT**

The project presented here focuses on the construction of a building as a new type of facility in rural areas of Vojvodina. By "urbanizing" villages, these buildings stimulate their growth, improve the economic situation, but at the same time preserve their tradition and maintain social communities. The facility, called "Monoculture factory building", involves the production, processing and selling of one specific agricultural product at the same time. All three phases of the agricultural goods life cycle are carried out within the building and the order of these phases is organized according to the levels of the facility, so that the life cycle of the culture and the building make an inseparable union. That's why the priority is given to the production of agricultural goods within the boundaries of monoculture factories, instead of using the land. There would be several facilities of that kind built in one village and each of them would enable the production of a certain type of agricultural product. Each of these buildings functions as a small factory in rural areas. Monoculture factories are designed with a possibility to apply the principles of energy-efficient construction.

## **ARCHITECTURAL FEATURES OF THE BUILDING**

### **Functional Organization of the Facility**

The Monoculture factory building is designed and functionally organized in such a way that it fully meets the needs of production, processing and selling of goods. The ground floor of the building is divided into three sectors. The processing of products is carried out in the factory lab in the last part of the ground floor, while the part of the ground floor which is oriented toward the street is reserved for the restaurant-exhibition space and mobile containers that serve as stands for the sale of products. Facades of this part of the building are fully made of glass in order to promote products in the hours when the market is closed. Passers-by can see exhibited products on the shelves of the stands and the restaurant through the glass. At the time when the market is open, cubes are taken out of the facility, unfolded and placed on the inner part of the plot (Figure 1). The indoor part of the first floor is a space for the processing of products, factory lab, while the open terrace is a garden for the production of a specific plant (Figure 2). The last (second) floor of the facility is also divided into two parts: the factory lab and terrace garden for production. Solar collectors and panels are installed on the roof of the second floor (Figure 4). The simple shape and design of the facility allow for its expansion or increasing the square footage of its surfaces to the depth of the plot and in the height, with an aim of getting larger production areas in case it needs to produce more plants. The building is designed according to the principle of modules that can, if necessary, easily be "reproduced" without violations of its construction and function.

TOPIC IV:  
**ARCHITECTURE AND BUILDING TECHNOLOGIES**



Figure 1: Ground floor function



Figure 2: First floor function

Figure 3: Legend

Figure 4: Second floor function

System functioning

The most difficult thing for young people in Serbia today is to find a job. Employment of young rural population in these new facilities in a village gives them an opportunity to get a job, to learn activities related to production, processing and sale of agricultural products and later on to become independent and start manufacturing within their own households. New young people would come to take their place afterwards and so the whole process of "a social program" would be rounded: employment, training and independence. In order to ensure that the project is successful, different key players should be engaged: experts in production and processing of planned cultures. Young people are the ones who are currently employed and trained, but later on, when they start an independent manufacture, other family members would also be hired. This way the problem of unemployment of rural population in general is solved, regardless of the age of participants. In order to simplify the whole process of production and processing, the plan is to have a number of such facilities in one village, with only one crop (e.g.: peppers, tomatoes, cucumbers, various spices...) produced within each of them. The monoculture system makes it easier for employees to master one particular job and to specialize and really learn about the production process of one product. This system allows for easier equipping of the space for processing cultures because the purchase is done for the equipment and technology for the processing of only one product, as each plant is not processed in the same way. Although it is only one culture that is produced inside the building, the processing would yield a variety of products. For example, the following products can be made from peppers: fresh peppers, chutney, dried peppers, spices, etc. At the end, these manufactured products are being sold on the "markets" that are organized on the ground floor of these buildings. Money that is earned from the sale is again invested in production and processing, and so the whole system becomes sustainable.

## Production, Processing, Promotion and Sale

The production of agricultural crops takes place in the context of green roofs and vertical gardens of a terraced facility. The building is terraced so that the roof area would be as large as possible and in this way we would utilize the maximum of production space. In addition to excellent thermal insulation, the installation of extensive green roofs in these facilities allows the cultivation of various plants and agricultural products of low growth whose processing would be conducted in the building. Green roofs and vertical gardens are organized on terraces of buildings, oriented to the south, and are situated within glasshouses. In order to save electricity for heating and lighting, glasshouses are built with reflective surfaces. Reflective surfaces are the cheapest source of energy, and in addition to thermal radiation, they reflect light as well. For faster growth and maturation of plants, a reflective surface is attached to a glasshouse. The thermal effect is achieved by less dissipation of heat on the north side because of reflective surfaces installed, and in addition to that, insulation is doubled in the cheapest way. Each green terrace has its own heating and led lighting system providing optimal farming during winter months.

The processing part of the building with the necessary equipment for manufacturing and packaging the products is located under the production areas. This part is called Factory Lab and it occupies the enclosed spaces of the building. The processing of products is not a "wholesale" because it is still a small production area.

The promotion of manufactured and processed products is carried out in a restaurant that is organized as a part of the ground floor. The restaurant is intended for potential customers to become familiar with the primary and secondary processed products. This area functions as exhibition space. It is possible to organize festivals, which will draw attention to a specific plant. These festivals would attract many tourists and residents of neighbouring villages.

The sale of raw, finished and processed products is carried out in the context of the last part of the plot where, at a certain part of the day, the so-called market is organized. The stands on which the products are presented on the market are cube-movable containers that are "pulled out" from the building. These movable containers are an integral part of the ground floor of the facility, but not a necessary part of the building because the skeletal system of the construction allows the facility to be maintained without them. Each container is a functionally independent unit for itself. Their mobility allows them to be "pulled out" of the building to the inside of the plot where they unfold and set so they become sale stands at the market (Figure 5). In the hours when the market is closed, cubes are drawn to the ground floor of the building where they fit perfectly so they become a part of it and then the facility is "closed" toward the street which ensures its privacy. When the market is open, the part of the ground floor, which is designed for cubes, becomes an open, fluid area which allows visitors access to the market from the street. Containers are assembled within the last part of the plot so as to allow for the maximum use of the area to display as many products as possible.

TOPIC IV:  
**ARCHITECTURE AND BUILDING TECHNOLOGIES**

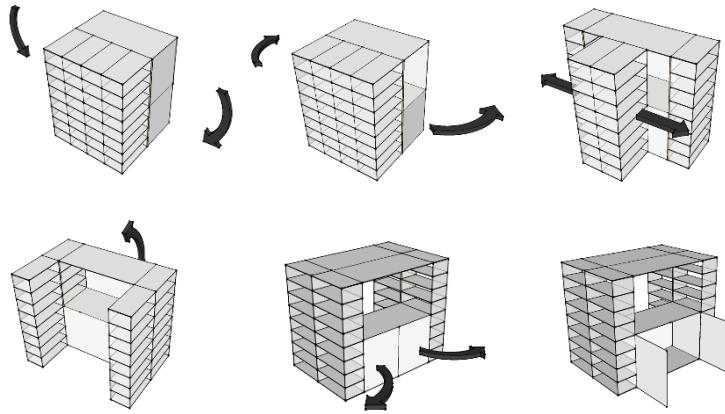


Figure 5: Unfolding system of the cubes

**Applied Principles**

Monoculture factories are designed with a possibility to apply the principles of energy-efficient construction including the installation of a system for producing electricity, solar collectors and panels, rainwater collection systems, vertical gardens, green roofs, etc. Solar panels that produce and provide the whole building with sufficient energy for heating and cooling are set at the top of the building, on the last terrace, and are oriented to the south in order to have the greatest possible gain from solar radiation. The building has the system for collecting rain water and waste water from the factory which provides water for irrigation of green roofs and vertical gardens as well as the water used in toilets (Figure 6).



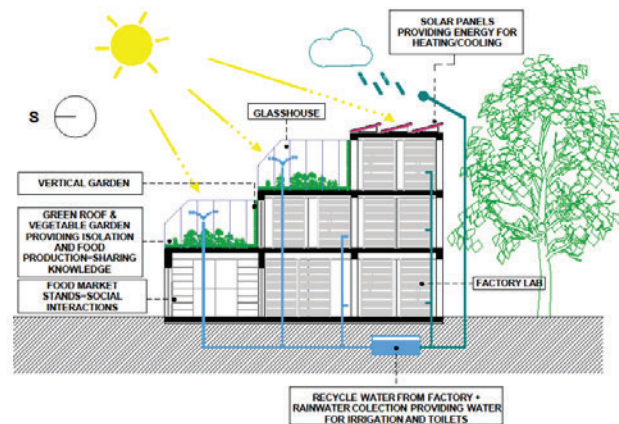


Figure 6: Section with applied principles

## Orientation

The facility has favourable orientation. The roof, vertical gardens and solar panels are oriented towards the south resulting in good day lighting and solar radiation gain is available throughout the whole year. The east side of the building is provided with movable sun breakers on the windows and glass surfaces as prevention of overheating of rooms oriented to this side. The east side has good morning lighting and heat gains during this period which may be a problem in the summer when overheating may occur. The west side also has sun breakers on the windows to prevent overheating in the afternoon during the summer period. The north side of the building will not have enough daylight during the whole year so on this side the ancillary rooms of the factory are oriented and the trees are planted in the front of this area to ensure protection from cold winds in winter.

## Environment of the Building

The form of the building can be rectangular in the plan or in the form of the capital letter L in order to fit the environment of villages in Vojvodina whose plots are conceptualized in a specific way. The first possible version (Figure 7) is that the plan of the facility is rectangular and pulled to one side of the plot, with the front facade facing the street. This is one of the oldest types of housing organization in Vojvodina villages, so the building, in this case, would completely fit the environment. However, with this kind of organization the privacy of the facility would not be preserved. The second version (Figure 8) is that the plan of the building is in the form of the capital letter L, with the shorter side



TOPIC IV:  
**ARCHITECTURE AND BUILDING TECHNOLOGIES**

facing the street, which is also one of the oldest principles of organization of the housing in rural areas of this region. This version would be more favourable for the organization of the planned facility. By closing the plot toward the street, the privacy of the building and the market in the back of the plot is preserved. For these reasons, the plan of the new facility-factory is organized in accordance with the second variant shown. Also, in case larger production and sales areas are needed, it is possible to connect two neighbouring plots which would make the building plan in the form of the capital letter T, multiplying the module of the facility form (Figure 9).

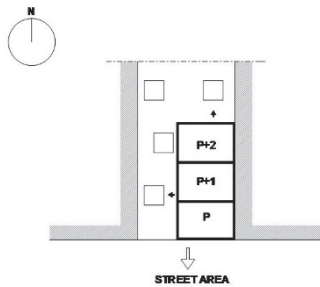


Figure 7: Version 1

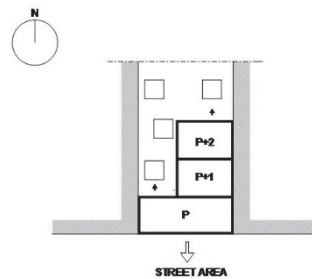


Figure 8: Version 2

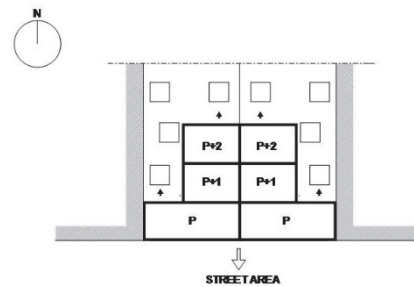


Figure 9: Version 3

**IMPLEMENTATION AND SIGNIFICANCE OF THE PROJECT**

This project represents an opportunity for saving villages in Vojvodina and preventing further departure of people from these areas. It is a strategy that implies modernization of technology and equipment in agricultural production with the rational and efficient use of energy. Construction of several such facilities in one village in Vojvodina facilitates the work of the rural population, creates new job positions and changes the rural tradition and an established rule that land in villages is only for work and not buildings. It gives an opportunity to the rural population to transit from agricultural land to man-made facilities and employment in them, this being one of the reasons for them leaving and moving to cities. It could be said that the village is "urbanized" in a certain way and becomes "closer" to the city and urban lifestyle. In this way, the project offers reconciliation between the traditional and the modern and establishes a synergy of the rural and the urban. The disappearance of previous forms of villages does not necessarily mean the destruction of cultural models that rural areas have created through history. Cherishing rural traditions and customs is also possible in a new form of a rural settlement. With the implementation of this project and establishing the presented system of organization of work in villages, we preserve traditional local rural communities from decline but in a new form that is in accordance with the conditions of modern society, considering the needs of local population. Taking into account conditions of local environment during construction of these facilities and without compromising traditional architecture and urbanity of rural areas, the identity of Vojvodina is preserved.



**Figure 10, 11, 12: 3D model project views**

## **CONCLUSIONS**

Abandonment of rural areas represents a current problem for the entire world. People are increasingly turning to cities and metropolitan lifestyle under the influence of modern urban processes. "Monoculture factory building" is an attempt to improve the economic and social situation, not only in villages of Vojvodina, but also in the entire country, since agricultural production which always takes place within the boundaries of rural settlements is an activity which is one of the primary sources of income in Serbia. The use of renewable resources as an energy source has a significant meaning for the organization of work and improvement of comfort and quality of life in rural areas, and it can also be an important element of their development, which would encourage migrated population to return. Although the cost of construction of low energy buildings is higher by about 10% compared to the conventional construction, long-term and permanent savings in energy consumption make it a better and a less expensive option.

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