PROSTOR

24 [2016] 1 [51]

ZNANSTVENI ČASOPIS ZA ARHITEKTURU I URBANIZAM
A SCHOLARLY JOURNAL OF ARCHITECTURE AND URBAN PLANNING

POSEBNI OTISAK / SEPARAT OFFPRINT

SVEUČILIŠTE
U ZAGREBU,
ARHITEKTONSKI
FAKULTET
UNIVERSITY
OF ZAGREB,
FACULTY
OF ARCHITECTURE

ISSN 1330-0652
CODEN PORREV
UDK | UDC 71/72
24 [2016] 1 [51]
1-130
1-6 [2016]

Znanstveni prilozi | Scientific Papers

102-113 Ljiljana Aleksić
Vesna Kosorić

Building Revitalization and Integration of Solar Systems in Sustainable Rural Tourism
UDC 725.025.4:728.6:379.8:910.4 (4)"19/20"

Obnova zgrada i ugradnja solarnih sustava u održivom razvoju ruralnog turizma
UDK 725.025.4:728.6:379.8:910.4 (4)"19/20"

Af

Criteria	Actions and characteristics	Elements
1. Bio-climatic factors (altitude)	1.1 Architectural expression	1.1.1 Façade
		1.1.2 Roof
		1.1.3 Materials used
		1.1.4 Façade openings
2. Location use planning	2.1 Equipment and renewal of location infrastructural capacities	2.1.1 Water supply
		2.1.2 Sewage
		2.1.3 Road infrastructure
3. Rural settlement arrangement design	a. Arrangement of rural settlements	
	b. Arrangement of rural settlement centers	
	c. Planned revitalization of residential buildings	
	d. Planned revitalization of commercial buildings	
4. Architectural-aesthetic aspects	Preserved architectural heritage 4.1 Revitalized	
	4.2 Reconstructed	
5. Technical aspects	5.1. Construction-static characteristics (depending of construction and material)	5.1.1 Log cabin (wooden house)
		5.1.2 Wood cabin (wooden construction elements with soil filling)
		5.1.3 Stone house
	5.2. Construction material	5.2.1 Stone
		5.2.2 Brick
		5.2.3 Wood
	5.3. Fire protection	
6. Functional aspects	6.1. Living area – residential standard	
	6.2. Functional characteristics	
	6.3. Residential area use	
7. Position of building in yard complex – urban setup	7.1. Relation of residential building and commercial buildings in the yard	
	7.2. Preserve architectural heritage or rebuild the identical houses	
8. Interior equipment	8.1. Preserve inherited interior elements	8.1.1 Fireplaces
		8.1.2 Mantles
		8.1.3 Tile stoves
		8.1.4 Old furniture restoring
		8.1.5 New furniture according to the old elements
	8.2. Old crafts	
9. Renewable energy sources	9.1. Passive energy use	9.1.1 Natural lee
		9.1.2 Window size
		9.1.3 House position against ordinal directions
		9.1.4 Burying and basement
	9.2. Active systems	9.2.1 Solar thermal systems (STS)
		9.2.2 Photovoltaic (PV) systems
		9.2.3 Windmills
		9.2.4 Heat pumps
10. Environmental aspect of location	10.1. Protection and improvement of environment quality	10.1.1 Water
		10.1.2 Soil
		10.1.3 Air
	10.2. Careful waste management	
11. Planned reconstruction	11.1. Residential buildings	
	11.2. Buildings for commercial activities	
	11.3. Auxiliary economic buildings	
12. Sociological aspects	12.1. Rural autochthonous population	
	12.2. Guest activities	
13. Agro-economic aspects	13.1. Preservation of autochthonous vegetables and fruits	13.1.1 Traditional food and drinks
	13.2 Preservation of autochthonous domestic animals	
14. Economic aspects	Renewal of the existing houses provides for savings in energy, construction material, land and infrastructure. Application of the new systems should be planned in the manner that the investments provide return.	

Table I Criteria for evaluation of living conditions in revitalized sustainable rural tourism buildings

Tabl. I. Kriteriji vrednovanja životnih uvjeta u obnovljenim zgradama u kontekstu održivog ruralnog turizma

Ljiljana Aleksić, Vesna Kosorić

University of Novi Sad
Faculty of Civil Engineering Subotica
Serbia – 24000 Subotica, Kozaračka 2
BauLab GmbH
Switzerland – 4656 Starrkirch-Wil, Bumelochstrasse 1
ljiljana.d.aleksic@gmail.com
info@bau-lab.ch

Sveučilište u Novom Sadu
Građevinski fakultet, Subotica
Srbija – 24000 Subotica, Kozaračka 2
BauLab GmbH
Switzerland – 4656 Starrkirch-Wil, Bumelochstrasse 1
ljiljana.d.aleksic@gmail.com
info@bau-lab.ch

Subject Review
UDC 725.025.4:728.6:379.8:910.4 (4)"19/20"
Technical Sciences / Architecture and Urban Planning
2.01.03. – Architectural Structures, Building Physics, Materials and Building Technology
Article Received / Accepted: 14. 2. 2016. / 7. 6. 2016.

Pregledni znanstveni članak
UDK 725.025.4:728.6:379.8:910.4 (4)"19/20"
Tehničke znanosti / Arhitektura i urbanizam
2.01.03. – Arhitektonske konstrukcije, fizika zgrade, materijali i tehnologija građenja
Članak primljen / prihvaćen: 14. 2. 2016. / 7. 6. 2016.

Building Revitalization and Integration of Solar Systems in Sustainable Rural Tourism

Obnova zgrada i ugradnja solarnih sustava u održivom razvoju ruralnog turizma

BUILDING REVITALIZATION
INTEGRATION OF SOLAR SYSTEMS
REVITALIZATION OF RURAL SETTLEMENTS
RURAL TOURISM
SUSTAINABLE DEVELOPMENT

OBNOVA ZGRADA
UGRADNJA SOLARNIH SUSTAVA
REVITALIZACIJA RURALNIH NASELJA
RURALNI TURIZAM
ODRŽIVI RAZVOJ

This paper deals with problematic of sustainable development of rural tourism with particular focus on building revitalization and integration of solar systems. The relevant principles and criteria are established and functional and aesthetic, energetic, economic, social and ecological aspects are considered. The possibilities and effects are presented. Several examples of sustainable building revitalization in Europe in rural tourism are presented.

Ovaj se rad bavi problematikom održivoga razvoja u ruralnome turizmu s osobitim osvrtom na obnovu zgrada i ugradnju solarnih sustava. U njemu se definiraju relevantni principi i kriteriji, razmatraju estetski, energetski, ekonomski, društveni i ekološki aspekti te analiziraju mogućnosti i rezultati. Rad prezentira i neke europske primjere održive obnove zgrada u održivom razvoju ruralnog turizma.

Introduction

Uvod

Rural environment as a possible tourist destination represents significant untapped potential that may, upon certain investments, compete with the other tourist destinations. This paper covers the issues of sustainable development principles application, at the level of accountability held by all participants in the process of revitalizing and creating the tourism-appropriate architecture in the rural communities, and integration of solar systems within the framework in particular.

There is a close connection between the rural tourism development and revitalizing the existing buildings, in line with the environment presentation along with the sustainable development of the entire local community. Criteria for living conditions in the revitalized sustainable rural tourism buildings had been defined, and meeting those criteria would provide users with comfortable living, with rational energy consumption. Great attention is paid to the environment protection and improvement, through environmentally responsible behavior, since the economic-environmental sustainability is an exceptionally important prerequisite of rural areas renewal and development.[1] Rural tourism has threefold growth rate against the classical tourism, with the expected annual growth of 20%.[2] Rural tourism relies on the needs of urban inhabitants for tranquility and areas for sporting leisure in the open. Sustainable development of rural tourism has the task to preserve autochthonous masonry and existing building fund that is being revitalized and extended or rebuilt as needed, however always in line with the characteristics of autochthonous traditional architecture, using local construction material, and employing local inhabitants. Revitalizing rural environments greatly depends on availability of transportation networks, to facilitate efficient travel from urban centers to the remote rural settlements.

If buildings in rural settlements have good sun exposure, not being shaded by the elements from the environment, they are major consumers of thermal energy, i.e. electricity, which is true for numerous residential and hospitality buildings, they are particularly favorable to installing solar thermal systems [STS], i.e. photovoltaic [PV] systems under the revitalization process. The paper lists the fundamental principles of integrating solar systems during reconstruction of a building. Utilization of solar systems may yield multiple benefits: environmental, energetic, functional and aesthetic. Since the older buildings in rural environment are built in traditional style, special attention should be given to the aesthetic aspect of integration. The position, form, type of solar panels must be carefully chosen and in accordance with the whole surrounding, building design and building envelope. Appropriate designed solar systems may improve energy efficiency of a building, potentially up to the level of self-sustainability, and with the quality aesthetic solution, they may become a new, recognizable architectural designations. Educational aspect would also be important, since visually recognizable solar systems directly promote building awareness about the importance of energy preservation, renewable energy sources and sustainable development. The residential building, 110 years old, in a Swiss village, was selected as the example, with its reconstruction being covered by the authors of this paper, demonstrating potential problems and principles of integrating PV systems in rural environment. The possibilities for integration of solar systems in building revitalization in rural tourism are presented through several other examples in Europe.

Sustainable Development of Rural Tourism

Održivi razvoj u ruralnom turizmu

Rural tourism development – Rural tourism spontaneously occurs in Western and Central Europe in the early 20th century. Agro-tourism develops with the agriculture development in 1960's and 1970's. It becomes an international touristic product after 2000, especially in the countries with developed touristic offer,

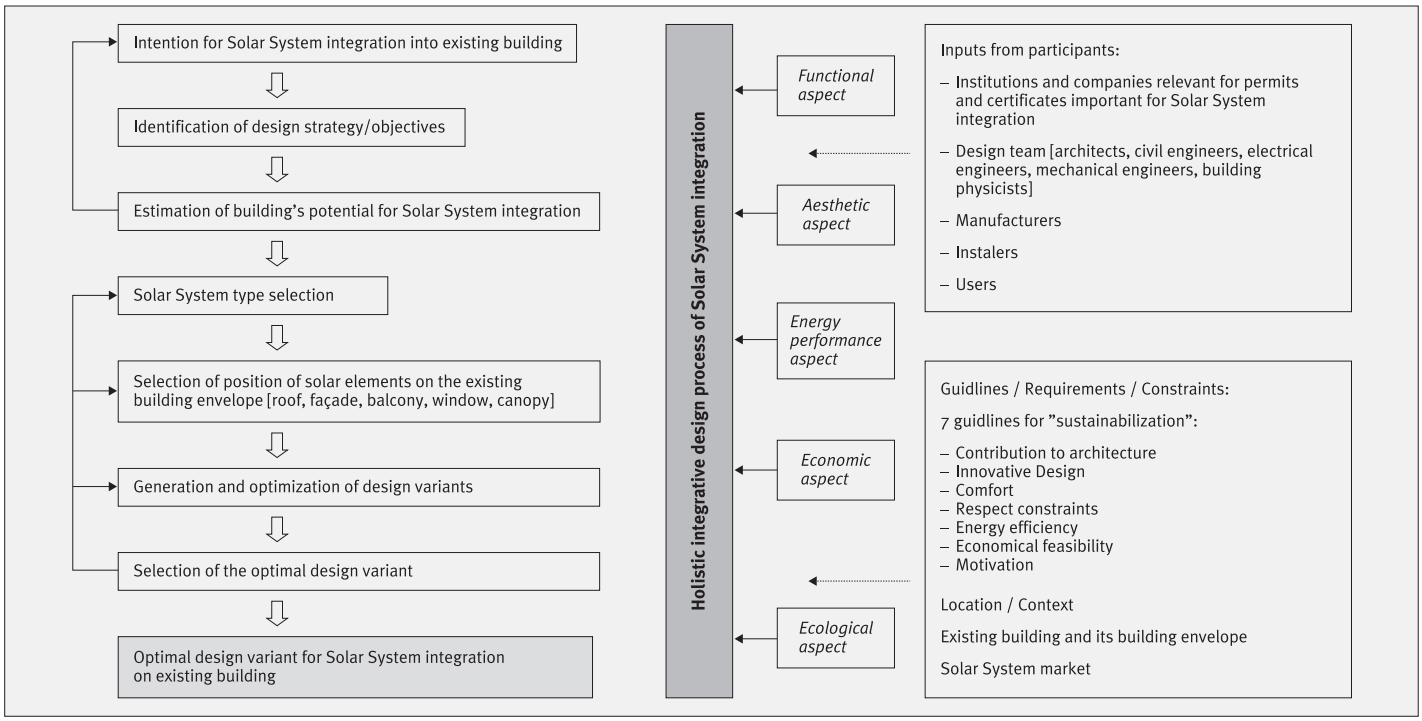


Fig. 1 General model for integration of solar systems into existing building
Sl. 1. Opći model ugradnje solarnih sustava u postojećim zgradama

considering it an important component of an integrated, sustainable rural settlements' development. There are between 600,000 and 1,000,000 households in Europe registered for providing rural tourism services, with 12 million beds and providing 1.5-3 million jobs.[3]

General terms and definitions – The simplest definition of the rural tourism is that this is the tourism that happens in rural environment. Definition by Swiss professors W. Hunziker and K. Krapf from 1942 was extended by the AIST [Academy for the International Study of Tourism] in 1957, focusing on the economic influences of tourism phenomenon, noting that "tourism: a set of social and economic relations, visitor travelling to a destination, temporary stay of visitor unrelated to visitor's economic benefit (a tourist spends funds earned elsewhere, usually at the place of permanent residence)".[4] Broader concept states that "the rural tourism entails not only the agro-tourism; it also includes leisure in the nature, excursions to rural areas, with touristic stay and service including events, festivals, recreation, production and sale of personal crafts, crafting and agricultural products, along with the lodging". Encyclopedia of Tourism (2000) states that the rural area is the fundamental resource for development of rural tourism, and Rural Tourism in Europe – Experiences, Development and Perspectives (2004) publication states that the term of "rural tourism" is used when the rural culture is the key component of touristic product offered".[5]

Concept of sustainable development is laid out in six definitions.

1) Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[6]

2) Sustainable development is development that satisfies the multiple criteria of sustainable growth, poverty alleviation, and environmental management.[7]

3) Sustainable development is development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life.[8]

4) Sustainable development is a process in which the natural resource base is not allowed to deteriorate.[9]

5) Sustainability is the optimal balance of natural, economic, and social systems over time.[10]

1 Lane, 1993
2 Cox Rachel, 2006: 865-888
3 Jović, 2015
4 Štahan, 2014
5 Štahan, 2014
6 Commission on World Environment and Development, 1987
7 World Bank: Environment, growth and development, 1987
8 Allen, 1980
9 Pearce, Warford, 1993
10 The Florida Center for Community Design&Research

Table II SWOT analysis of solar systems
Tabl. II. SWOT analiza solarnih sustava

Strengths: – Green energy generation – Strong brand – Standardized and accessible technology – Integrability into built environment – Architectural values	**Weaknesses:** – Cannot compete with conventional energy sources – High energy payback for PV (2-4 years) – Life cycle of =25 years – High initial costs
Opportunities: – Fast developing market (=40% increase per year) – Constant technological advancements – Increase of fossil fuels price – Limited sources of fossil fuels	**Threats:** – High dependence on subsidies – Reaching technological advancements limit – Limitation of rare minerals needed for present PV technologies

6) An ideal sustainable society would be one in which all energy would be derived from current solar income and all non-renewable resources would be recycled.[11] According to them, sustainability should balance the needs of present and the needs of future, without reducing quality of life and natural resources and additionally provide favorable economic performance. Sustainably designed buildings aim at reducing negative effects on the environment, through energy efficiency and efficient use of natural resources.[12]

According to the above definitions of tourism and sustainability, "sustainable tourism" is the tourism with minimal impact to the environment, while preserving local cultural heritage. This provides for development of the entire rural area, providing new jobs thus decreasing population migration, influencing in general the increase of economic wellbeing and quality of living, while decreasing the use of non-renewable natural resources. Sustainable rural tourism is the responsible tourism, to provide wellbeing to future generations as well.[13]

Criteria for Building Revitalization in Sustainable Rural Tourism

Kriteriji obnove zgrada u održivom ruralnom turizmu

The development of rural area houses reaches the apex in autochthonous construction in early decades of 20th century. Since then, the needs arise regarding new capacities in the houses, such as various sheds, kitchens, bathrooms, indoor closed stairways, better installations. Good solutions for yards and relation of living and other quarters in the household are specific for scattered rural settlements, with yards being divided into functional zones: living area, economic part, and yard, with separate entrance to living and economic parts. Where this is not the case, revitalization of yard entails separation of housing and economic part, thus improving the quality of living.[14] For the reconstruction and rehabilitation of houses in rural areas architectural and aesthetic aspects are emphasized through the respect of the principles of indigenous folk architecture. The elements which are especially considered are form and storey height of houses, materialization and purpose of the attic and the basement space, openings size, used materials, materialization of the façade and form of the roof. Interior equipment mostly utilizes authentic furniture, made of natural material, with authentic interior elements: fireplaces, tile stoves, etc; being refurbished or rebuilt.

Bio-climatic construction is already spontaneously inherent to the traditional rural environment masonry. The houses were built in lee. Position of residential building is such that the construction takes care about the ordinal directions, appropriately sized windows are being placed, terrain slope is used for burying houses, and functional concept of the building is such that the basement is commonly used. Using the traditional construction characteristic, sustainable construction criteria are defined: minimum use of non-renewable energy sources, use of materials from the environment, minimum use of toxic material and environment improving. Ecological aspects of the site are reflected through the protection of water, soil and air with careful management of waste which should lead to environmental sustainability. For the sociological aspect in rural areas the motivation of the local population and local government for responsive waste management is very important. The planned disposal and recycling would result in minimized emission of CO_2, the better quality of drinking water and air. Revitalization of architectural fund and rural environment sustainability may be under a set of urbanism and designing criteria, with their multidisciplinary approach providing architectural solutions that do not violate the environment (Table I).

Integration of Solar Systems in Sustainable Rural Environment

Ugradnja solarnih sustava u održivom ruralnom okolišu

Potential of solar systems integration in sustainable rural tourism – Because of weaknesses mainly related to economic performance of solar systems, under an exclusive condition of careful design and responsible decision-making in every phase of designing process, integrating solar systems can be a quality solution from the aspect of sustainable development principle in general, as well as in particular case of revitalizing a building within the rural tourism setup. Proper understanding of the solar system application in a given project requires realistic comprehending of solar systems' strengths, weaknesses,

Fig. 2 House in Starrkirch-Wil:
Before reconstruction, after reconstruction,
south balcony with PV panels fence
Sl. 2. Kuća u Starrkirch-Wilu:
Prije rekonstrukcije, nakon rekonstrukcije,
južni balkon s ogradom od FN (fotonaponskih) panela

opportunities, and threats (Table II). Solar technologies have very strong brand of green energy and additionally can contribute to architecture, but they are usually expensive. These issues can question application of active solar systems in architecture as sustainable technology.

Taking into account all the issues related to integration of solar systems, it is possible to define seven guidelines that contribute „sustainabilization" of solar technologies:

1. Contribution to architecture: The solar elements should contribute to architecture through their multifunctionality.

2. Innovative design: The solar technologies should be presented in good light through innovative designs.

3. Comfort: The use of solar technologies should increase comfort in the building.

4. Respect constraints (shadows of buildings, trees, vegetation, unfavorable orientation, angles): In rural environment the building density is lower and regarding constraints of shadows, the potential for solar integration is higher.

5. Energy efficiency (optimal tilted angles, improvement of envelope insulation): Simultaneously with designing, simulation software should be used for analyzing energy efficiency of different design variants.

6. Economic feasibility: STSs are generally economically feasible, especially when applied on building with high hot water consumption, which is true for many touristic objects. With increase of fuel and electricity prices, STSs become even more competitive to conventional energy sources and become less expensive with market growth.

7. Motivation: Motivation implies positive mass spreading effect of design for people to support energy savings and sustainable development, and can be exceptionally important as a tool to "sustainabilize" solar technologies in architecture.[15]

It is clear that saving fossil fuels, reduction of CO_2 emissions and decrease of solar systems' prices make integration of solar systems an appropriate solution to be applied in the building revitalization process in the rural environment. Apart from contributing to the environment protection, integration of solar systems in the existing building envelopes would directly improve envelope insulation properties and would demonstrate a concept of active building envelope. Creative and careful design would improve aesthetic aspect of the entire building.

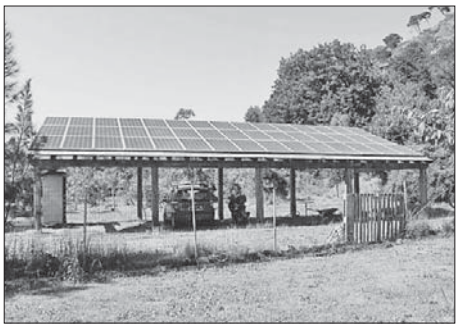
Design principles of integration of solar systems in revitalization of rural buildings – According to given seven guidelines, it can be concluded that the success of "sustainabilization" of solar technologies fully depends on design. Some general guidelines for design principles of both STS[16] and PV systems[17] can be proposed.

Figure 1 systematically presents simplified general model with several basic phases. The integration requires a comprehensive approach with consideration of many aspects. The entire process starts with intention to integrate solar system into design and the complex integrative design process ends with finding the optimal design taking into account inputs from the project participants, and relevant requirements and constraints. Evaluation and selection of optimal design are very subjective; however, this can also be done with the assistance of mathematical methods.[18]

PV integration in 110 year old residential building in the village "Starrkirch-Wil" in Switzerland – 110 years old residential building with 250 m² of living area, in the very center of Starrkirch-Wil at the northwest of Switzerland was completely refurbished in 2014 (Fig. 2).

11 Pirages, 1977
12 Stevovic, Vasilski, 2010
13 George, Mair, Reid, 2009: 177-198
14 Ribar, 1994
15 Aleksić, Kosorić, 2015
16 Golic, Kosorić, Krstić, 2011
17 Kosorić, Wittkopf, Huang, 2011
18 Krstić, Kosoric, Golic, 2012

Fig. 3 The farmhouse "Casa Rosa";
PV panels on the roof of the parking plot
Sl. 3. Seoska kuća „Casa Rosa";
FN paneli na krovu parkirališta



In order to increase comfort, and extend the living area, the winter garden was built on the southern side, covered by the balcony with PV modules integrated in the fence. In line with the requirement of Construction Committee and the opinion of the Chamber for Settlement Cultural Values Protection, the PV modules had to be designed as glass, transparent modules without a frame, that do not excessively cover the façade specific for this area, taking care of the solar cells size, spacing and matching them with the rest of façade materials. It was permitted to install 7 custom-made PV panels, with total installed capacity 0.8746 kWp, dimensions 1200×1110× ×17.52 mm, each with 42 dark mono-crystal solar cells. Apart from benefits regarding electricity production, this PV module fence exquisitely fits the entire project and the façade; solar cells give aesthetic freshness and nice contrast to the façade woodwork, providing partial privacy to the persons sitting on the balcony, hiding them from the street sights. This is the first solar façade integration in this village, which was nicely received, being a motivator and a caveat to the persons passing by and promoting the use of energy from renewable energy sources.

Fig. 4 Cinque Terre settlements
Sl. 4. Naselja Cinque Terre

Fig. 5 "Braeuer" guesthouse hotel;
STCs on the roof of the hotel
Sl. 5. Hotel „Braeuer";
STS (solarni toplinski sustavi) na krovu hotela

Sustainable Design in Sustainable Rural Tourism – European Experiences

Održivo projektiranje u održivom ruralnom turizmu – europska iskustva

According to the evaluation by the Organization for European Cooperation and Development [OECD], rural areas cover some 90% of the EU territory. More than half of the EU citizens live in these areas, and over 40% of domestic products are manufactured there. The trend in 1970's was to renew rural areas; in 1980's, the institutions were passing the programs to protect nature, eco-systems and develop leisure facilities in rural areas. By the end of 20th century and in 1990's, funds were allocated for rural development, particularly focusing on integral rural development.

Cinque Terre, "The five lands", Italia – Cinque Terre area consists of 5 littoral villages in Liguria coastline. Shoreline with five villages and surrounding hills are a part of Cinque Terre national park, being the UNESCO world heritage since 1997, for "harmonious interaction between human and nature, creating an exquisite site".[19]

This area is special because of the villages' position on the steep terrain, with sea view, picturesque houses in pastel colors, littoral charm, a network of walking paths and climbing cliffs, linking small villages with meandering roads, intersecting by hilly terraces of vineyards and olive groves. Paths, trains, and ships link the villages that are not accessible by cars, from the outside, and on that way is the CO_2 emission reduced to a minimum. In 1998, the Italian Ministry of Environment had announced protection of littoral area Cinque Terre.[20] Architecture fits the terrain, becoming a part of sloped cliffs. Architectural aspects were adhered to in reconstruction of buildings to adjust them to the new functions. Houses are built on the hillside, protected from the wind. Local inhabitants take strong participation in tourist activities to develop the entire region, through agriculture, gastronomy, and nourishing the old crafts. (Fig. 4).

The "Casa Rosa" in Marche region, Italy – The "Casa Rosa" is an ancient farmhouse sitting in the hills of Marche Region (Fig. 3). Using only natural materials, the farm was renewed with techniques of sustainable architecture. The renewable resources were used in order to save on energy costs and to remain respectful to the earth and atmosphere. The renovations have maintained historical and geographic characteristics of the farmhouse. The PV system has been installed

made up of 56 single-crystal silicon panels of 175 W each. The PV panels cover the roof of a 70 m² parking lot (Fig. 3). The STS made up of two modules were installed in 2008, one for the production of sanitary hot water and the other for the swimming pool heating. The geothermal drill has been placed on the property and the plant will recover the heat stored by the swimming pool in the summer season and utilize it during colder seasons. The PV panels, the solar heating and the geothermal drills make the whole building self-sufficient.[21]

"Braeuer" guesthouse in Weisskirchen, Austria – The "Braeuer" guesthouse hotel is situated in Weisskirchen. This traditional house was refurbished with the aim of energy efficiency improvement (Fig. 5). As the building is mostly furnished with wooden furniture in rural style, the refurbishment was done with natural materials, such as wood, stone, bricks and cellulose fiber materials for insulation. The STS with the total area of 39 m² of solar thermal collectors was installed providing hot water to 16 hotel rooms. The existing windows were renewed with new old-style windows; the additional insulation of rooftop and external walls was performed, keeping the traditional appearance of the whole building. These refurbishment measures have resulted in annual energy saving of 65,48 MWh and 65,4 tCO_2 is avoided per year.[22]

The Lutheran Conference and Mission Home in Balatonszarszo, Hungary – The Lutheran Conference and Mission Home constructed in 1930 is situated in Balatonszarszo and today is able to host 84 guests at one time. Major expansions were made in 2004 resulting in the creation of a modern hotel.

A complex set of actions were implemented during 2010 and 2011. The solar thermal water heating system with total area of 40 m² of solar thermal collectors is installed which covers 80% of the hot water demand of this building. The PV panels and pellet boilers are installed (Fig. 6). The wall-cooling system is applied with the circulating liquid which is cooled naturally by the local well. The relevant measures in water and waste management were taken and elective waste collection and recycling are organized. Water-saving equipment is installed and the rain water is collected and used for toilets and garden watering. These refurbishment measures have resulted in annual energy saving of 43,38 MWh and 18,34 tCO_2 is avoided per year.[23]

Fig. 6 STCs on the roofs of the Lutheran Conference and Mission Home in Balatonszarszo; PV on the roof
Sl. 6. STS na krovovima Luteranskog konferencijskog i misionarskog doma u Balatonszarszu; FN na krovu

Šumećani village, Zagreb county, Croatia – Šumećani village is situated on the hilly terrain of Moslavina, 40 km from Zagreb. The example used is Kezele family household, wine and brandy producers, rearing domestic animals with the horse stables, preserving autochthonous values through revitalizing architectural buildings and "farmer type" of rural household organization. Their household had covered several traditional houses, and the other buildings were transported from other locations, revitalized with the new functional organization.

Residential and operational buildings are log cabins, characterized by traditional architecture that fits and joins the ambiance (Fig. 7).

The household location is fully utilized, so the cars are being parked outside the family household, so that CO_2 emission is zero; areas used by the restaurant are separated from peaceful business area with a meeting room at the ground floor and apartments upstairs, followed by the areas with playground for children and stable with horses.

During the reconstruction and revitalization, the buildings were adjusted to the new functions, namely: service, rest, leisure and business part; using authentic buildings that already existed at the subject location, or that were transported from other locations. Certain principles of bio-climatic construction are recognizable, which mind ordinal directions, size of openings and construction materials. Having that this is Kezele family property, the entire family is invested in touristic activities, agriculture and wine production, gastronomy and developing old crafts for souvenir production, thus socio-economic aspect is adhered to, having that the entire family is engaged in business.

Chalets in Switzerland – The numerous chalets in Switzerland are good examples of both energetically and aesthetically successful integration of solar technology into these traditional wooden style buildings. The Kiwi

Fig. 7 Building with traditional architecture elements in Šumecani village
Sl. 7. Zgrada s tradicijskim arhitektonskim elementima u selu Šumećani

19 https://www.google.rs/?gws_rd=cr,ssl&ei=hFJeVe7OCYKksAGCioGoBQ#q=cinque+terre [10.8.2015.]

20 https://www.google.rs/?gws_rd=cr,ssl&ei=hFJeVe7OCYKksAGCioGoBQ#q=cinque+terre [10.8.2015.]

21 Liebert, 2011

22 Agenzia per l'Energia..., 2013

23 Agenzia per l'Energia..., 2013

Fig. 8 KIWI Chalet in Switzerland
Sl. 8. KIWI *chalet* u Švicarskoj

Fig. 9 Chalet in Vaumarcus in Switzerland
Sl. 9. *Chalet* u Vaumarcusu u Švicarskoj

chalet (Fig. 8) in the Bernese Oberland built in 1940s has been renovated in 2013 with the goal of eliminating greenhouse effects and it has achieved Zero CO_2 emissions. Through the building revitalization solar panels are installed on the roof; new high performance thin insulation is performed inside the building envelope and the heat pump is installed. The Swiss solar panels carefully integrated on the roof and geothermal heating now produce all the energy needed for heating the chalet on-site, as well as the hot water and all other domestic electricity. The building now produces more energy than it needs, and the surplus is sold to local electricity company.

On the beautiful chalet in Vaumarcus (Fig. 9) above the Lake of Neuchâtel 40 PV panels with the annual production of 11770 kWh are installed on the south oriented part of the roof in order to produce maximum energy.

Sirogojno ethno villages, *Staro selo,* Serbia – Sirogojno village is situated 34 km from Užice. Significant cultural center of the village is outdoor museum *Staro selo*, with some 40 buildings made of woodworks. Residential wooden type buildings consist of two parts, built on stone basement, with high, four-sided roof, covered with shingle. Next to the house, there are cabins for young couples and other auxiliary buildings: milk shed, bread furnace, beehive, and plum dehydrator. Stables for cattle are separated, built outside the yard. Under *Staro selo* revival, some of the buildings were repurposed, thus extending the functions to: workshops for production of folk craft items and souvenirs, souvenir shops and lodging buildings.

The architecture fits the environment and sloped terrain, using mountain architecture elements. Parking for cars is provided at the village entrance, so that CO_2 emission is zero. Reconstruction and revitalization had adjusted the buildings to the new functions, however retaining architectural expression using local construction materials, with characteristic façade elements. The buildings are placed on the hillside, simultaneously protecting them from the wind and utilizing sun radiation to the maximum, with small windows that prevent unnecessary loss of heat. Local inhabitants take maximum participation in *Staro selo* development activities through agriculture, hospitality, gastronomy and nourishing old crafts (Fig. 10).

Fig. 10 Residential building in Staro selo
Sl. 10. Stambena zgrada u Starom selu

Conclusion

Zaključak

Sustainable rural development is among economic, social, and environmental priorities in the modern society. Process of planning and managing sustainable development of rural settlements, with particular focus on reconstructing the existing architectural buildings and active involvement of local population in this process is of exceptional importance for development of the entire rural environment. The integral policy involves holistic approach to managing sustainable tourism, fully engaging local government and educating local population, with the necessity of responsible behavior of all participants.

Tourism economy should take protection, improvement, and rational use of rural space as the priority task, along with the role of the state, which would take a leading role by developing infrastructure to improve all levels of communication. Sustainable tourism is a good foundation for improving inter-sectoral cooperation throughout all domains and levels, while focusing attention to protected areas, cultural heritage, etc. Participation of local population, with reconstruction and revitalization of both residential and hospitality buildings and buildings for the nurturing of old crafts, creates the ambiance of social and economic sustainability, proving that such strategy may provide positive economic balance and sustainability of the entire ambiance in the future.

Rural tourism buildings and other types of buildings in the rural environment have great potential for integration of solar systems, especially STSs because of high hot water consumption of these buildings, and this requires comprehensive approach and complex integrative design process. Final solution must be balanced, and maximize creativity and technical performance of the design. The heritage-protected buildings in the rural environment are very specific. The visibility and aesthetics of solar elements and the technique of integration are the key aspects for integration of solar system. The architects must find ways to "sustainablize" solar technologies, with careful application, using all tools to prove application sustainable, and avoiding mistakes that can shed harmful reputation on efforts of architects to contribute to sustainable future.

Bibliography
Literatura

1. Agenzia per l'Energia e lo Sviluppo Sostenibile di Modena (2013), *RELACS Final Publishable Report: REnewabLe energy for tourist ACcommodation buildingS,* Contract Nº: IEE/09/894/SI2.558309
2. Aleksić, Lj. (2015a), *Unapređenje održivog razvoja ljudskih naselja u ruralnim sredinama*, Medunarodna konferencija savremena dostignuca u građevinarstvu, Građevinski fakultet, Subotica
3. Aleksić, Lj. (2015b), *Projekat Edukativno etno centra Ilina prema 'Agendi 21'*, „Izgradnja", 7-8, Beograd
4. Aleksić, Lj.; Kosorić, V. (2011), *Sunčeva energija za decu: Projekat dogradnje „OŠ Dragojlo Dudić" u Beogradu*, „Izgradnja", 11-12: 671-680, Beograd
5. Aleksić, Lj.; Kosorić, V. (2015), *Energetski efikasna arhitektura kao simbol održivog razvoja u ruralnoj sredini*, iNDIS 2015, Planning, design, construction and building renewal, Novi Sad, Serbia
6. Allen, R. (1980), *How to Save the World, Strategy for world conservation*, Prentice-Hall, Toronto
7. Bolfek, B.; Jakičic, D.; Lončarić, B. (2013), *Mogućnosti razvoja turizma na ruralnom području Brodsko-posavske županije*, „Oeconomica Jadertina", 1: 73-87, Slavonski Brod
8. Bramwell, B.; Lane, B. (1993), *Sustainable tourism: An evolving global approach*, "Journal of Sustainable Tourism", 1 (1): 1-5
9. Cawley, M.; Gillmor, D.A. (2008), *Integrated rural tourism: Concepts and practices,* "Annals of Tourism Research", 35 (2): 316-337
10. Commission on World Environment and Development (1987), *Our Common Future*, Oxford University Press, Oxford
11. Cox, Rachel S. (2006), *Ecotourism,* "CQ Researcher", 16 (37): 865-888
12. Fons, M.V.S.; Fierro, J.A.M.; Gomez y Patino, M. (2011), *Rural tourism: A sustainable alternative*, "Applied Energy", 88: 551-557
13. George, E. Wanda; Mair Heather; Reid Donald G. (2009), *Rural Tourism Development – Localism and Cultural Change*, Channel view publications, Bristol / Buffalo / Toronto
14. Golić, K.; Kosorić, V.; Krstić, A. (2011), *General model of solar water heating system integration in residential building refurbishment – Potential energy savings and environmental impact*, "Elsevier – Renewable&Sustainable energy reviews", 15 (3): 1533-1544
15. Hunziker, W.; Krapf, K. (1942), *Grundriss der Allgemeinen Fremdenverkehrslehre, Schriftenreihe des Seminars für Fremdenverkehr und Verkehrspolitik an der Handels-Hochschule St. Gallen 1, Zürich*

[Editor and translator:
Darinka Popović, BA in Philology,
English language and literature]

Sources

Izvori

16. Jović, M. (2015), *Rural Tourism can Revitalise the Countryside*, http://blog.bearing-consulting.com/2015/05/25/rural-tourism/
17. Kosorić, V.; Wittkopf, S.; Huang Y. (2011), *Testing a design methodology for building integration of photovoltaics (PV) using a PV demonstration site in Singapore*, "Architectural Science Review", 54 (3): 192-205
18. Krstić, A.; Kosoric, V.; Golić, K. (2012), *Potential for reduction of CO_2 emissions by integration of solar water heating systems on student dormitories through building refurbishment,* "Elsevier – Sustainable cities and society", 2: 50-62
19. Lane, B. (2005), *Sustainable rural tourism strategies: a tool for development and conservation*, "Interamerican Journal of Environment and Tourism", 1: 12-18, San Pedro, Costa Rica
20. Liebert, O. (2011), *Tourism companies go green*, The European SETCOM Project – Leading the way in Energy saving
21. Pearce, D.W.; Warford, J.J. (1993), *World Without End,* Oxford University Press
22. Pirages, D.C. (1977), *The Sustainable Society. Implications for Limited Growth,* Praeger Publishers, New York, London
23. REVITAS – Revitalizacija istarskog zaleđa i turizma u istarskom zaleđu, Smernice razvoja kulturnog turizma ruralnog prostora Istre, Sveučilište Jurija Dobrile u Puli, Odjel ekonomije i turizma „dr Mijo Mirković" Preradovićeva 1, Pula
24. Ribar, B.M. (1994), *Vrednovanje uslova stanovanja na selu*, Zbornik radova sa naučnog skupa „Unapređenje stanovanja '94", Arhitektonski fakultet Univerziteta u Beogradu
25. Spenceley, A.; Meyer, D. (2012), *Tourism and poverty reduction: Theory and practice in less economically developped countries*, "Journal of Sustainable Tourism", 20 (3): 297-317
26. Stevović S.; Vasilski D. (2010), *Nove strategije projektovanja gradova putem filozofije održivog razvoja*, „Izgradnja", 7-8, Beograd
27. Štahan, K. (2014), *Energetski učinkovita arhitektura u urbanom održivom turizmu*, „Prostor", 22 (2 /48/): 278-289, Zagreb
28. Videnović, A. (1994), *Geneza, razvoj i nove tendencije u formiranju kuće i okućnice u razbijenim srpskim selima ibarskog tipa na primeru Vlasine*, Zbornik radova sa naučnog skupa „Unapređenje stanovanja '94", Arhitektonski fakultet Univerziteta u Beogradu
29. Wiggins, S.; Proctor, S. (2001), *How special are rural areas? The economic implications of location for rural development,* "Development Policy Review", 19 (4), Blackwell Publishing, London, Great Britain
30. Wilson, S.; Fesenmaier, D.R.; Fesenmaier, J.; van Es, J.C. (2001), *Factors for success in rural tourism,* "Journal of Travel Research", 20: 132-138
31. World Bank (1987), *Environment, growth and development,* Washington, DC

Internet Sources

Internetski izvori

1. http://www.agriturismocasarosa.it/en/galleria/nggallery/casa-rosa/casa-rosa/ [14.4.2016.]
2. http://www.fccdr.usf.edu/ [10.11.2015.]
3. http://www.gasthof-braeuer.at/en_US/home/gallery-video.html [14.4.2016.]
4. https://www.google.rs/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=definicija%20turizma%20prema%20aiestu [15.11.2015.]
5. https://www.google.rs/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=definicija+ruralni+turizam [15.11.2015.]
6. https://www.google.rs/?gws_rd=cr,ssl&ei=hFJeVe7OCYKksAGCioGoBQ#q=cinque+terre [10.8.2015.]
7. http://www.b92.net/putovanja/destinacije/evropa.php?&nav_id=482231 [12.8.2015.]
8. https://www.google.rs/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=nacionalni+park+kiskunsagi++madjars [12.8.2015.]
9. https://www.google.rs/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=selo+les+baux+de+provence [14.8.2015.]
10. https://www.google.rs/?gws_rd=cr,ssl&ei=gl3DVfH_A4m9sQGuyKfABg#q=ruralni+turizam+kezele [14.8.2015.]
11. https://www.google.ch/search?q=chalet+solar+energie+ch&biw=1219&bih=460&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjHkbKBkZnMAhWGaRQKHamjCosQ_AUIBigB#tbm=isch&q=chalet+solar+energy+ch&imgrc=IOQAoY50XBTzJM%3A [14.4.2016.]
12. http://www.immobiliaremartini.eu/proposte/proposte_gb_17.html [11.4.2016.]
13. https://mcr-e.ch/panneaux-solaires/chalet-a-vaumarcus/ [11.4.2016.]
14. http://www.rieder-architektur.ch/ [11.4.2016.]
15. http://www.sirogojno.rs/ii-domacinstvo#sthash.ieZBpnnr.dpuf [14.8.2015.]
16. http://www.steiermark.com/de/unterkunft-gasthof-braeuer-_30477 [5.4.2016.]
17. http://szarszo.lutheran.hu/regi/index.php?tema=otthonunkrol [5.4.2016.]

Illustration Sources

Izvori ilustracija

Fig. 1, 2 Authors

Fig. 3 http://www.agriturismocasarosa.it/en/galleria/nggallery/casa-rosa/casa-rosa/ [14.4.2016.]; http://www.immobiliaremartini.eu/proposte/proposte_gb_17.html [11.4.2016.]

Fig. 4 https://www.google.rs/?gws_rd=cr,ssl&ei=hFJeVe7OCYKksAGCioGoBQ#q=cinque+terre [10.08.2015.]

Fig. 5 http://www.steiermark.com/de/unterkunft-gasthof-braeuer-_30477 [5.4.2016.]; http://www.gasthof-braeuer.at/en_US/home/gallery-video.html [14.4.2016.]

Fig. 6 http://szarszo.lutheran.hu/regi/index.php?tema=otthonunkrol [5.4.2016.]

Fig. 7 https://www.google.rs/?gws_rd=cr,ssl&ei=gl3DVfH_A4m9sQGuyKfABg#q=ruralni+turizam+kezele [14.8.2015.]

Fig. 8 https://www.google.ch/search?q=chalet+solar+energie+ch&biw=1219&bih=460&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjHkbKBkZnMAhWGaRQKHamjCosQ_AUIBigB#tbm=isch&q=chalet+solar+energy+ch&imgrc=IOQAoY50XBTzJM%3A [14.4.2016.]

Fig. 9 https://mcr-e.ch/panneaux-solaires/chalet-a-vaumarcus/ [11.4.2016.]

Fig. 10 http://www.sirogojno.rs/ii-domacinstvo#sthash.ieZBpnnr.dpuf [14.8.2015.]

Tabl. I, II Authors

Summary

Sažetak

Obnova zgrada i ugradnja solarnih sustava u održivom razvoju ruralnog turizma

Ruralni je okoliš kao moguća turistička destinacija značajan, ali još nedovoljno iskorišten potencijal koji bi mogao, uz odgovarajuće investicije, konkurirati mnogim drugim turističkim destinacijama. Ljudi žele pobjeci iz zagađenoga urbanog okoliša i provoditi odmor u ekološki čistim područjima te se upoznati s tradicijom i kulturom ruralnih područja. Ovaj rad analizira mogućnosti primjene principa održivoga razvoja u ruralnom turizmu, s posebnim naglaskom na analizi obnove zgrada i ugradnji solarnih sustava, tj. solarnih toplinskih sustava [STS] i fotonaponskih sustava [FN]. S obzirom na složenost i multidisciplinarne aspekte ove problematike, u radu se razmatraju funkcionalni, estetski, energetski, ekonomski, socijalni i ekološki aspekti.

Održivi turizam je turizam s minimalnim utjecajem na okoliš, dok se istodobno nastoji očuvati lokalno kulturno nasljeđe. Održivi ruralni turizam omogućava razvoj čitavih ruralnih područja, potiče otvaranje novih radnih mjesta – smanjujuci tako potrebu za migracijama, te opcenito utječe na povecanje ekonomskog blagostanja i kvalitete života, a istodobno smanjuje korištenje neobnovljivih prirodnih izvora.

Postoji snažna povezanost između razvoja ruralnog turizma i obnove postojecih zgrada u kontekstu održivosti gospodarstva i okoliša cijele lokalne zajednice. Održivi razvoj u ruralnomu turizmu ima za cilj očuvati autohtoni građevinski fundus, koji treba obnoviti i proširiti ili adaptirati prema potrebi, no uvijek u skladu s karakteristikama autohtone tradicijske arhitekture – korištenjem lokalnih građevinskih materijala i zapošljavanjem lokalnoga stanovništva.

Bioklimatska gradnja inherentna je tradicijskoj gradnji u ruralnim krajevima. Kuće su građene u zavjetrini. Stambene se zgrade već prilikom gradnje pozicioniraju u odnosu na sporedne strane svijeta, ugrađuju se prozori odgovarajuće veličine, nagib terena korišten je za ukop, a funkcionalna je koncepcija kuća takva da se podrum uobičajeno koristi. Na temelju tradicijskih građevinskih karakteristika u ovome se radu definiraju kriteriji koji se odnose na minimalno iskorištavanje neobnovljivih energetskih izvora, korištenje lokalnih materijala, minimalno korištenje toksičnih materijala i poboljšanje okoliša. Obnova građevinskoga fundusa i održivost ruralnog okoliša trebala bi biti u skladu s urbanističkim i projektantskim kriterijima u sklopu interdisciplinarnog pristupa što pruža arhitektonska rješenja koja ne degradiraju okoliš.

Mnoge postojeće zgrade u ruralnom okolišu zahtijevaju obnovu. Ako su k tome u velikoj mjeri izložene suncu, tj. nisu zaklonjene nekim elementima u okolišu, tada mogu biti dobri korisnici toplinske i posredno električne energije, što vrijedi za brojne stambene i turističke zgrade koje su osobito pogodne za instaliranje STS, tj. FN sustava u procesu njihove revitalizacije. U radu se naglašava da su solarne tehnologije snažan primjer ekološke energije, no problemi povezani s njihovim gospodarskim učinkom dovode u pitanje njihovu primjenu kao održive tehnologije. U radu se daje sedam smjernica koje pridonose održivosti solarnih tehnologija, a povezane su s njihovim doprinosom arhitekturi, inovativnom projektiranju, udobnosti, poštivanju ograničenja, energetskoj učinkovitosti, ekonomskoj izvedivosti i isplativosti te motivaciji kao značajnom čimbeniku koji utječe na to da stanovništvo aktivno podrži koncepciju održivoga razvoja.

STS sustavi općenito su ekonomski provedivi i isplativi, osobito kad ih se koristi na zgradama s velikom potrošnjom tople vode, što je slučaj u mnogim turističkim objektima. S povecanjem cijena goriva i električne energije ovi sustavi postaju sve konkurentniji konvencionalnim energetskim izvorima i pojeftinjuju s rastom tržišta. Osnovni principi ugradnje solarnih sustava tijekom rekonstrukcije građevine također su opisani. Korištenje solarnih sustava može donijeti brojne pogodnosti u kontekstu okoliša, energetike, funkcionalnosti i estetike. Pomnjivo i odgovarajuće projektiranje solarnih sustava može poboljšati energetsku učinkovitost zgrade i izolacijska svojstva njezine ovojnice, tako da, u kombinaciji s kvalitetnim estetskim rješenjem, one mogu postati nove, prepoznatljive arhitektonske destinacije u ruralnom okolišu.

Obrazovni i motivacijski aspekti također su vrlo značajni. Kao ilustrativni primjer u radu je prikazana stambena zgrada u švicarskom selu, koje su rekonstrukciju izveli autori ovoga rada ukazujuci na potencijalne probleme, principe i korisnost ugradnje fotonaponskih sustava u ruralnom okolišu. S obzirom na to da je to bio prvi slučaj ugradnje solarnog pročelja u tome selu, takva je intervencija bila dobro primljena i može poslužiti kao primjer korištenja energije iz obnovljivih izvora.

Naselja Cinque Terre u Italiji, sela Šumećani u Hrvatskoj i Sirogojno u Srbiji analizirani su u ovome radu kao primjeri revitalizacije građevina u održivomu ruralnom turizmu. U naseljima nema automobilskog prometa, tako da nema emisije CO_2. Komunikacijski su pravci pješačke, biciklističke ili jahaće staze. Arhitektura je prilagođena konfiguraciji terena, vidljiva je primjena bioklimatske gradnje, koja vodi računa o sporednim stranama svijeta, veličinama otvora i građevinskim materijalima.

Tijekom rekonstrukcije i revitalizacije građevine su prilagođene novim funkcijama, no ipak su zadržale karakterističan arhitektonski stil korištenjem lokalnih građevinskih materijala i karakterističnim fasadnim elementima. U svim tim selima lokalno stanovništvo u potpunosti aktivno sudjeluje u razvoju agronomije, turizma, gastronomije i starih zanata. Sudjelovanje lokalnoga stanovništva, uz rekonstrukciju i revitalizaciju stambenih i turističkih objekata, stvara klimu društvene i ekonomske održivosti, dokazujuci tako da ta strategija može osigurati gospodarsku ravnotežu i održivost cijeloga područja u budućnosti. Primjeri starih seoskih kuća, kao što su „Casa Rosa" u talijanskoj regiji Marche, „Braeuer" hotel u Weisskirchenu u Austriji, Luteranski konferencijski i misionarski dom u Balatonszarszu u Mađarskoj i dvije kuće u Švicarskoj, ilustriraju potencijale, kao i estetske, ekološke i energetske učinke ugradnje solarnih sustava u procesu revitalizacije zgrada u održivomu ruralnom turizmu.

Ljiljana Aleksić
Vesna Kosorić

Biographies

Biografije

Ljiljana Aleksić, PhD, Dipl.Ing.Arch. is an architect and Assistant Professor at Faculty of Civil Engineering Subotica. Her research interests include expert systems in architecture, management of production technical documentation, rural development.

Vesna Kosorić, PhD, Dipl.Ing.Arch. is the architect and founder of Swiss company BauLab GmbH. In the core of her work is interconnectivity between design, space, sustainability, technology and quality of life.

Dr.sc. **Ljiljana Aleksić**, dipl.ing.arh., zaposlena je kao docentica na Građevinskom fakultetu u Subotici. Bavi se znanstvenim istraživanjima u arhitekturi, organizacijom izrade tehničke dokumentacije i ruralnim razvojem.

Dr.sc. **Vesna Kosorić**, dipl.ing.arh., osnivaćica je švicarske tvrtke BauLab GmbH. Bavi se interdisciplinarnim aspektima povezanosti projektiranja, prostora, održivosti, tehnologije i kvalitete života.