Sustainability by improving energy efficiency in traditional housing in Kosovo

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Abstract

The objective of this paper is to identify and evaluate aspects of sustainability by improving the energy efficiency of traditional housing in Kosovo. The refurbishment of traditional houses is looked from different sustainable perspectives, like sustainable occupancy, sustainable environmental protection, sustainable tourism, and as learning case for urban planners, architects and real estate experts l.

It is acknowledged that master artisans of traditional architecture in Kosovo were conscious of the sustainability parameters in designing and constructing traditional houses in villages and rural areas. Efficiency in the use of space, building location and orientation, design of the buildings, functionality of inner spaces, the layout of windows and use of materials have been important from the traditional old buildings. Traditional housing today, does not fulfil the needs and requirements regarding energy efficiency and comfort, as there is not sufficient insulation and heating. Rational use of space in neighbourhood creation, density within a city, connectivity with other neighbourhoods and the rest of the city, accessibility, a careful approach to environment, proper orientation of buildings to enable wind flow through the city, should also be identified as part of the sustainable urban development.

Keywords: sustainability**,** energy efficiency, traditional housing refurbishment, passive design, inner city rehabilitation,

1. Introduction

This paper is prepared within in the framework of joint cooperation project "SEEB – Sustainable Energy Efficient Buildings" between Kosovo and Norway, where have looked at case studies of existing traditional houses to find relevant and suitable measures to improve the energy efficiency and indoor comfort in the traditional houses. Through the energy analysis of refurbishment, we have found recommendations for solutions for energy improvements through passive design. The needs for refurbishment have to take into account the historic values and sustainable qualities of the buildings and historic urban areas. The majority of energy in Kosovo is used for residential needs. The absolute majority of houses in Kosovo, including old and new buildings, are not energy efficient. Furthermore, a large part of the houses and apartments in Kosovo use electrical energy for heating, causing energy efficiency to be at an alarmingly low level. Kosovo authorities have begun planning and drafting public policies related to efficiency based more on the requests made by the European Union rather than on the basic need for efficiency.

Prizren city in Kosovo, is an ancient city and have in its core or central district, the historic nutshell (downtown of the city),compoof cultural heritage buildings, mainly of traditional houses as well as public buildings. Houses are poorly inhabited (mainly empty), with the tendency to either be demolished and newly reconstructed or being left uninhabited, because of poor living conditions, poor living conditions.

The main objective of this study is to analyze possible measures in traditional houses in Prizren /Kosovo and compare them vs sustainability indicators, socio-economic and physical/environmental indicators. Improvements in energy efficiency in traditional houses in Prizren , are seen as appropriate measures, towards reaching other different sustainable goals than of only comfort. This is seen as an initial step, important and useful with big outcome results for the city, region, culture, economy etc.

From most recent data from the Conservation Plan of the City of Prizren, 2007 it is found that many of traditional houses in the city district core were have been demolished or left un-inhabited, from the main reason – to be newly rebuilt. The main driver of these actions are due to higher economic income benefits to the owners of the houses, when renting a new house. New designed houses in downtown of the city, (previosly with traditional design), do not obey on the traditional design and architecture, what is a threat as perceived by the owner-interviewe of this study: "there is a loss of the cultural heritage, loss of the city spirit" (Int. #7, 2015). The refurbishment of existing buildings is a neglected subject within sustainable architecture, where attention is usually focused on new buildings. Demolition is an option but the alternative of refurbishment is starting to be seen as more sustainable in terms of architectural value, materials use, neighbourhood disruption and waste disposal. Building new is more carbon intensive and carries many wider environmental impacts. In addition, the potential impact of low energy refurbishment is much greener than that of new build, since there are many more existing buildings that will be built in the next 10-20 years, the period over which many CO2 emission targets apply (Baker, 2009).

2. Theoretical background

2.1. Literature review

Thee urban development of historic cities is very challenging, especially when it comes to inner city rehabilitation, which is composed of historic area-downtown of the Prizren city. This is due to the need for a more rational/efficient use of space on behalf of redevelopment, but in the other aspect of traditional buildings that need refurbishment as to keep them in use, whereas rebuilt of them seems as more costly and inefficient solution. Sustainable development is seen according to Häkkinen (2012) that nothing can go ahead without radical changes in architecture, construction and spatial planning, a huge drive to conserve energy, increase efficiency and create zero-carbon buildings, all of which are vital in reducing the environmental impacts of buildings. As stated by Bokalders and Block (2010), planning a sustainable society requires a holistic approach in which we learn from and cooperate with nature. Urban development as cautious exploitation of resources can be understood from the fundamental principles for environmental sustainability. Sustainable society as cautious lifestyle should take into consideration that the transition to sustainable technology and renewable energy sources is not enough to achieve sustainable development. It should include a change of lifestyle (Bokalders and Block, 2010).

Environmental cities are cities with the focal point of the energy use and at the same time, the solution to energy efficiency and reduction of pollution. Conventional wisdom about the environmental impact of cities holds urbanization and environmental quality at odds, “the building sector of today has an oversized ecological footprint, being the single largest contributor to global greenhouse gas emissions and is responsible for more than a third of global resource consumption” (Meyer, 2013).

Baeli (2013) states that the housing stock represents some of the oldest in Europe with 55%. Therefore, the green buildings and residential retrofits are necessary to decrease rising levels of greenhouses gases. Residential buildings are seen as a part of the solution too, where retrofit is participating in the reduction of emissions, avoiding the dilapidation of buildings that have become uninhabitable, helping to future-proof houses against the risks of fuel poverty, and providing comfort for occupants. As a solution, Baeli (2013) sees ensuring the use of old houses in continuation, including financial investment to avoid dilapidation, ensuring their representativeness, cultural identity, and at the same time delivering the levels of reduction in energy use. Retrofit options are more preferable than demolition and a complete rebuild can be recommended from different reasons. A more societal point of view shows the retrofit can be more acceptable than a complete rebuild, as it could potentially create long-term employment. From a psychological perspective the replacement of components and tailoring space organization to new uses can improve environmental quality and satisfaction. Implications for change of use is an important factor as refurbishment is often accompanied by change of use (Baker, 2009). Change of use may bring about changes in purely technical parameters. Change of use may bring about an increase in the energy consumption. This does not necessarily mean that the low energy refurbishment has failed, since the measures adopted have undoubtedly led to lower energy consumption than if absent.

2.2. Legislation and strategies on energy efficiency in Kosovo

From the perspective of enabling energy efficiency in Kosovo, the following legislation and strategy documentation are important:

- *The Kosovo Law on Energy Efficiency* is compatible with EU legislation, specifically with reference to the Directives on energy efficiency for provision of necessary incentives and improvement of the energy efficiency in all consuming sectors (Directive 2004/8/EC, amending Directive 92/42/EEC, Directive 2002/91/EC)
- *Kosovo program for energy efficiency and renewable energy resources 2007-2009* provides the framework for the implementation of energy efficiency and renewable energy in Kosovo.
- *National Energy Efficiency Plan of Kosovo*, represents the first long-term energy efficiency plan which covers the period from 2008 till 2016, sets indicative target for energy saving for the period 2008-2016 (based on the article 4(1) of Directive 2006/32/EC).
- *Draft Law on energy performance of buildings* is oriented towards the promotion of improvements to the energy performance of buildings, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness, in Kosovo.
- *Policies for increasing energy efficiency* are developed to increase the efficiency related to the entry into force of the Administrative Instruction on the Labelling of Energy Products, the introduction of excise tax for inefficient light bulbs, mandatory application of energy efficiency measures related to the issuance of the utilisation permit for buildings, the increase in the price of electricity higher than 8.0% and application of block tariffs.

Based on the knowledge from the review of literature and legislation, a list of challenges regarding energy efficiency in Kosovo are given below:

- Implementation of Energy Efficiency (EE) measures is not seen as a priority for the government, but EE is seen as only a legislative “must” to fulfil the gap, aiming EU membership.
- The EE is mainly seen, planned as concept to production of renewable energy perspective.
- The energy production relies on two coal power-plants that produces 97% of overall energy, in paradox that Kosovo is looking for new economic growth, increase opportunities, and enhance quality of life, arising from the development of the energy sector.
- Incomplete legal framework for energy efficiency in residential buildings.
- Incomplete technical regulation regarding energy efficiency and changes on existing regulation on thermal energy saving.
- Lack of human capacities and coordination between organizations at central and local level.
- Lack of environmental awareness campaigns, to change the approach and understanding of the importance of the necessary thermal energy savings in building sector.
- Lack of innovative financing models for energy efficiency investments in the building sector.

3. Methodology

The research is a qualitative and exploratory study. The analysis of the city of Prizren's current historic core district profile is given, together with the strategic documents on conservation/refurbishment, national legislation and strategy documentation on energy efficiency. The simulation analysis of the energy efficiency of the traditional case house is made, based on modelling in DesignBuilder Software, 2015. For obtaining a social impression of the project, a qualitative study was conducted with open-ended questions and 30 interviews with people of Prizren regarding traditional housing in core historic centre of Prizren, presenting the main stakeholder groups: i) inhabitants; ii) municipal officials, and iii) civil society representatives.

The main research questions are:

- Will improved energy efficiency in traditional housing contribute to a more be sustainable solution in economic, social and physical/environmental aspect?
- Does the legislation in Kosovo supports improvement of energy efficiency in traditional housing a development strategy?
- What do the key people of Prizren, think about energy improvement of traditional housing in Prizren/Kosovo as potential towards sustainable urban development of Kosovo cities?

The first hypothesis, based on the climate and envelope data, is "*A traditional Albanian house (such as house Mashkulli), is nowadays not energy efficient due to poor thermal properties, but the use of both passive and active strategies can improve the environmental and energy performance of the building."*

The second hypothesis is: "B*y improving energy efficiency in traditional housing in Kosovo/Prizren, a more sustainable solution would be reached in economic, social and physical/environmental aspect of development"*.

The research methodology is segmented in different phases. In the first phase, the literature review, based theories and best practices on economic, social and environmental impacts of refurbishment vs rebuild, improvement of energy efficiency in traditional housing, building performance, passive design, sustainable urban development and inner city rehabilitation are studied. During the second phase, legislation and strategy documents are reviewed on Energy Efficiency in Kosovo. In the empirical section, the research was divided in two phases BI and BII. B.I. phase is a simulation analyses of a traditional house on building performance in historical core district centre of Prizren (Mashkulli house). U-values of the elements were calculated assuming the thermal properties of the existing building. In B.II phase, a qualitative analysis was conducted, based on 30 in depth interviews. The main driver of these interviews was finding their opinion on the potentials towards sustainable urban development of Prizren by improving energy efficiency in traditional housing in core historic central district of Prizren.

The types of data being used as for this research are divided into two groups, theoretical and empirical sections. Data for theoretical section of the study is based on: Sustainable refurbishment, Strategies

for low emission refurbishment, energy use in traditional housing, environmental comfort standards, and passive environmental strategies. Data for the empirical section of the study is based on the conservation plan of the historic core Prizren city district; building detail design plan of the traditional case-Mashkulli house, and interviews.

4. Case study and results

4.1. Analysis on urban planning and architectural design of the neighbourhood/ traditional house-Mashkulli

Figure 1: Before and after – neighbourhood of Mashkulli house (Source, EC ma NDRYSHE, 2012)

Prizren is famous city for its old, traditional dwellings. Starting from the Castle called Kalaja that dominates the city, the urban landscape is enriched with numerous historic buildings. Prizren has several urban residences. The diversity of the town's inhabitants, influencing each other in social and cultural terms, has had an impact on building and construction and the legacy of Byzantine and Ottoman culture during the 18th and 19th centuries is visible. Houses with a gallery are representative of the typical Albanian house, in comparison to other places in Balkans. It is surrounded by the National Park-Sharri Mountains, what influence on the climate, which is predominantly continental. Mediterranean climate also reaches Prizren due to Adriatic draught that comes through the river canyon.

Pilot project is a home of the Mashkulli family (Fig.1), an old building of the end of 18th century, in the centre of Prizren, near the Bajrakli Mosques and Medrese, nowadays known as the League of Prizren. By typology, the Mashkulli house belongs to the Urban House typology, accessed via main road parallel with the river Lumbardhi, entrance from the public square of "Prizren League", and then continue with private house garden, green zoning of the neighbourhood. The house is next to the landmark of the city, important node that defines character of a neighbourhood/city, under the conservation plan of the Prizren city (2005).

4.2. Energy Efficiency by simulation analysis – a case study

House Mashkulli is located in Prizren, in the southern part of Kosovo. It is a traditional Albanian house, mainly built from bricks (straw and soil mixture), where south/internal walls are made from stone. The floors and roof are insulated with soil between wooden boards, windows are single glazed with wooden frames. The U-values corresponding to the different envelope elements are calculated and summarised in table 2. This table also displays the required U-values according to passive house standards[1] for existing buildings and the amount of insulation needed to fulfil the requirements assuming the use of Rockwool 201 VARIO (λ=0,034 W/mK). The windows need to be replaced.

Element	Layers	thickness d [m]	thermal conductivity λ [W/mK]	U-value [W/m2K]	PHS U-value [W/m2K]	Insulation needed [m]
Wall - brick	Int. surf. Resistance					
	Lime mortar	0,01	0,7			
	Soil and straw bricks	0,16	0,2	0,98	0,15	0,19
	Lime mortar	0,01	0,8			
	Wooden beams	0,16	0,17			
	Ext. surf. Resistance					
Wall - brick, load bearing	Int. surf. Resistance					
	Lime mortar	0,01	0,7			
	Soil and straw bricks	0,7	0,2	0,26	0,15	0,10
	Lime mortar	0,01	0,8			
	Wooden beams	0,7	0,17			
	Ext. surf. Resistance					
Wall - stone, load bearing	Int. surf. Resistance					
	Lime mortar	0,01	0,7			
	Stone	0,7	3,5	2,52	0,15	0,21
	Lime mortar	0,01	0,8			
	Ext. surf. Resistance					
Ground floor	Int. surf. Resistance					
	Concrete	0,1	1,7	2,51	0,15	0,21
	Ext. surf. Resistance					
Floor	Int. surf. Resistance					
	Wooden board	0,03	0,17			
	Soil filling	0,19	0,52	1,09	0,35	0,07
	Wooden board	0,02	0,17			
	Wooden beams					
	Ext. surf. Resistance					
Roof	Int. surf. Resistance					
	Wooden construction	0,14	0,17			
	Soil and straw filling	0,16	0,18	0,53	0,15	0,16
	Clay tiles	0,02	1			
	Ext. surf. Resistance					
Window	Single pane, wood			4,80	0,85	

Table 1: overview of U-values of the existing elements, the required U-values according to passive house standards, and the thickness of insulation that is needed to reach these standards.

Prizren has a maritime temperate climate classified as Cfb according to the Köppen-Geiger classification. The main challenge in a temperate climate is the seasonal variation between under-heated and over-heated periods (Figure 2.). This graph represents the monthly diurnal averages for Prizren with the comfortable temperature zones. Figure 3. shows the effect of passive strategies on the indoor comfort in Prizren for the whole year, the summer and the winter. The effective strategies vary with the season. The indoor temperatures are comfortable during 13% of the year. Over the whole year the effective strategies are solar shading, internal heat gains and passive solar gain. This results in 91,4% comfortable hours during the year and reduces the need for active heating systems to 45%. The hours that are not comfortable occur during the summer (8,6%), when the indoor temperature is higher. There are other passive strategies to make these overheated periods comfortable as well, but they will have only a small effect on the total (<5%) and are therefore not considered in this simulation.

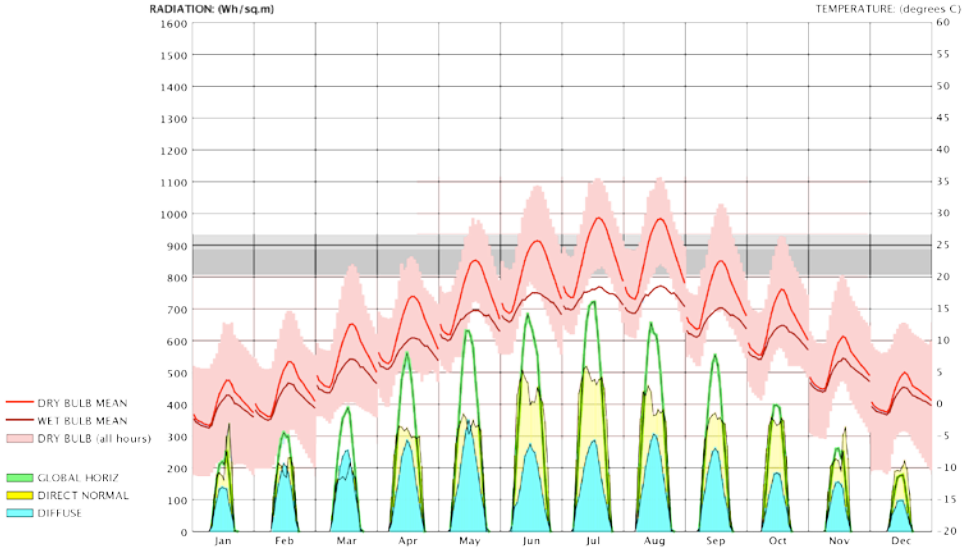

Figure 2.Monthly diurnal averages for Prizren, extracted from Climate Consultant[3]

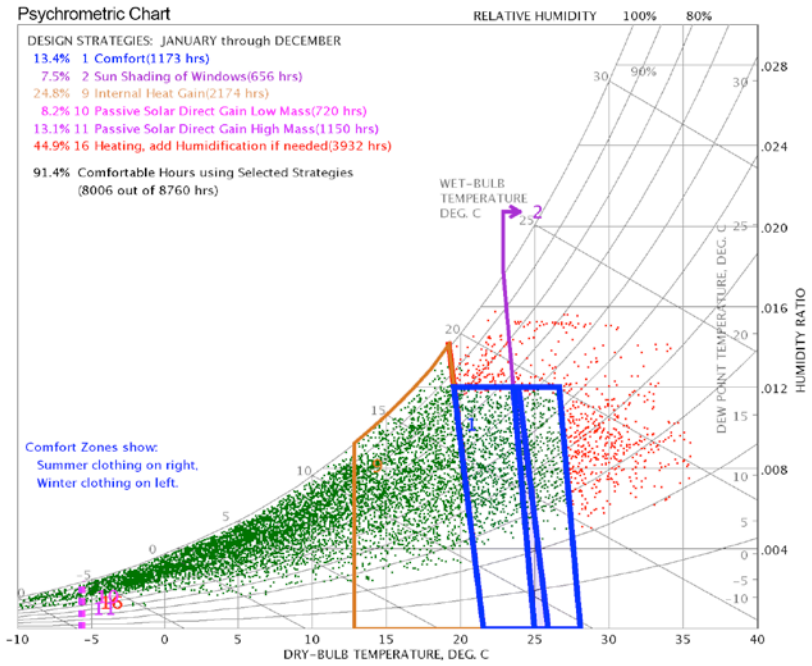

Figure 3: Psychrometric chart with the effect of passive strategies on the indoor comfort (comfortable hours of the total in percent), extracted from Climate Consultant[3]

In addition to these strategies, the shape and form of the building will also affect the energy consumption. A compact shape and no openings towards the north will result in less heat losses through the envelope. Openings towards the south can result in passive gain, but need to be shaded during the summertime to avoid overheating. Some of these strategies are already implemented in the Mashkulli house. The house has a compact design, is closed towards the north, uses thermal mass for solar storage, and has a light coloured building surface to avoid overheating in the summer. The building has a natural ventilation system, but the rooms mostly have openings in one facade, which makes cross ventilation possible only when doors between rooms are opened.

4.3. Research model and results

The building was modelled in Design Builder. U-values of the elements were calculated assuming the thermal properties of the existing building. The climate file used for the simulation was a weather file for Prizren. The building was divided into several zones (living room, hall, kitchen, bedroom), and both occupied and unoccupied zones were used in the simulation to be evaluated as one unit. The HVAC systems in the simulation were a cooling system powered by electricity and a heating system with biomass (wood). The house has no mechanical ventilation, but infiltration is high due to poor air tightness (1,5 ACH). The simulation time was one year, but only typical summer and winter week are shown in the graphs. In order to evaluate the environmental performance and energy efficiency of the house itself, simulations were made both with and without the active heating/cooling systems, for the existing and refurbished house with passive house standards. The HVAC systems were the same, but for the refurbished house, the mechanical ventilation was a fan coil system with 75% heat recovery.

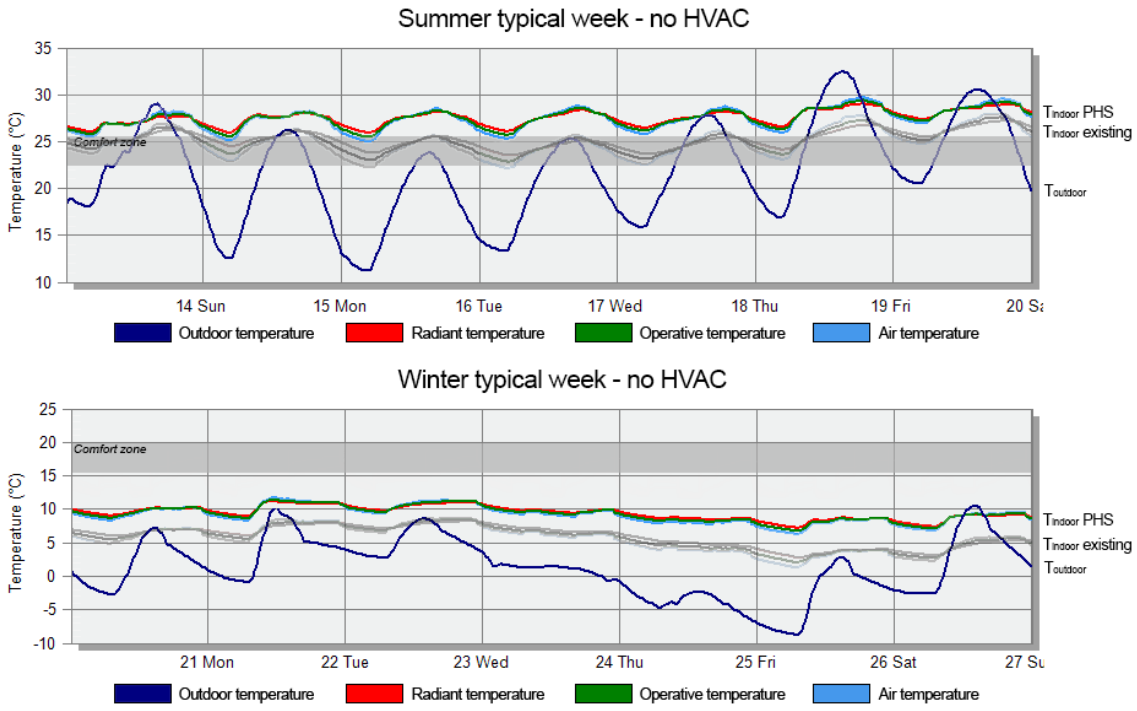

Figure 4: Indoor temperatures (no heating/cooling systems) for a summer and winter typical week

As seen (Fig. 4) that the temperature in the winter is much lower than the comfortable temperature in both cases when indoor temperature is simulated without any heating or cooling system. When passive house standards are applied, the indoor temperature rises throughout the whole year. In the summer it is visible that the indoor temperature can be higher than the comfort temperature, but on average the indoor temperature is within the comfortable temperature range in the existing situation. If the house is refurbished with passive house standards, the indoor temperature in the summer becomes too high and cooling is needed to retain a comfortable indoor climate. This shows that upgrading the house to passive standards is effective in the winter, but results in overheating during the summer.

When the indoor temperature of the house is simulated with active heating and cooling systems, it shows that indoor temperatures in the existing situation are still lower than the comfortable temperatures in the winter. The capacity of the heating system is not high enough to ensure a comfortable climate during the winter. The reason is in the high heat losses due to poor thermal properties of the envelope. When passive house standards are applied, the indoor temperatures are in the comfortable zone. During the summer in both cases the temperatures are lower with HVAC systems than compared to no systems, meaning that there are cooling systems active to lower the temperature in the house.

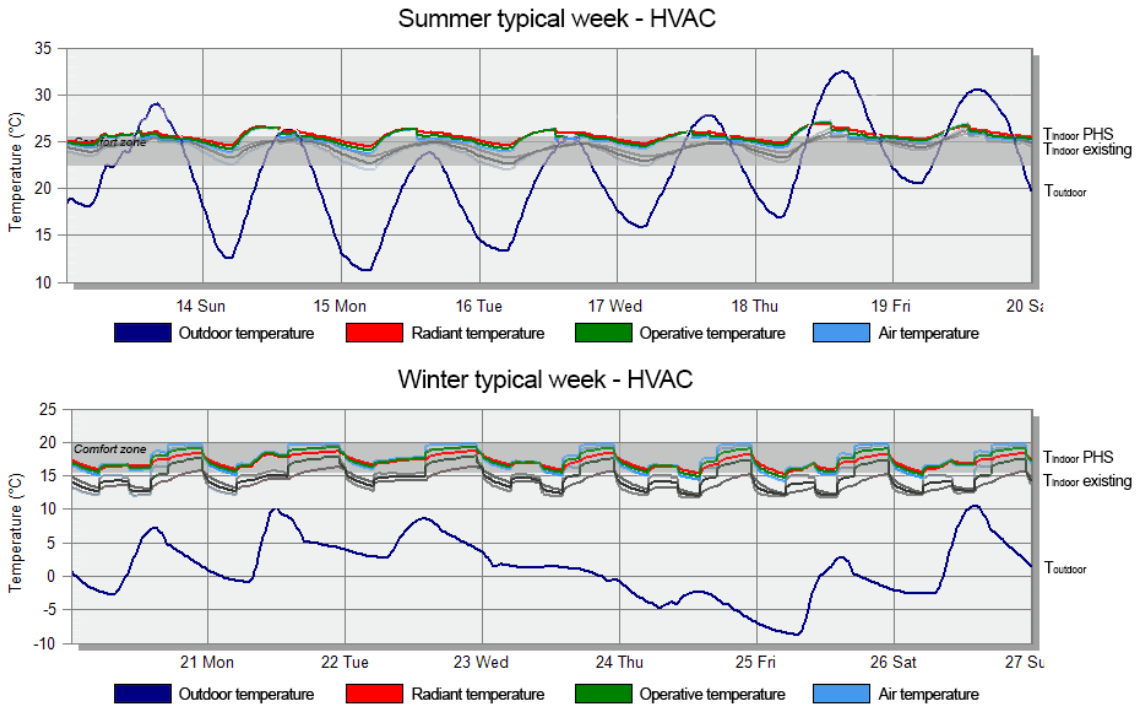

Figure 5: Indoor temperatures when heating and cooling systems are used in house Mashkulli for a summer and winter typical week

The total energy consumption of the house is 180 kWh/m^{2,} and the heating demand 140 kWh/m^2. After refurbishment, the total energy consumption is 105 kWh/m^2 and the heating demand 62 kWh/m^2. An improvement is 42% on the total energy consumption, and 55% on the heating demand.

4.4. Interview analysis

In total 30 interviews were conducted with key people of Prizren regarding traditional housing in the core historic centre of Prizren and their needs, and the potential for sustainable refurbishment. The respondents were chosen from three focus groups: i) Inhabitants; ii) Municipal officials and iii) Civil society representatives (neighbours, owners of the craftsman shops, students and professors of architecture, ethnology researchers, NGO representatives, academic staff). In total, 27 open-ended questions are prepared. The perceived level of awareness/potential about three aspects of sustainable refurbishment: economic and social/cultural aspect, whereas environmental aspect seen as less important. The opinion of each target group regarding three sustainability aspects of refurbishment.

The most expressing warning and enthusiasm is civil society, meaning researchers, professionals, knowers of architectural values, whereas the most un not expressing the challenge were public officials.

5. Conclusions

From the A.I-Literature review, it can be concluded that refurbishment of traditional houses is more sustainable than rebuild or new built areas of housing, in many aspects such as cultural, societal, economic and therefore environmental. From A.II -Kosovo legislation and a strategic review of documents regarding Energy Efficiency in Kosovo, even though housing is considered to be as the biggest exploiter/user of energy, the policies for refurbishment/upgrading of housing are not seen as a priority for the state. Norms and standards aren't set as benchmarking for housing, although ways nor alternatives aren't set in practice (institutional, financial etc). From B.I phase, the simulation and the results show a potentially large decrease in total energy consumption (42%) and a decrease in the heating demand (55%) when the house is refurbished and more passive strategies are implemented. From B.II phase, the interview analyses, the results show that there is a room for improvement in the decision making institutions, taking refurbishment as one of the driving forces for energy efficiency.

From the research questions, it could be seen that those are approved: i)'*By improving energy efficiency in traditional housing would be reached sustainable solution in economic, social and physical/environmental aspect': ii) 'The key people of Prizren, think positively and do see energy improvement of traditional housing in Prizren/Kosovo as potential towards sustainable urban development of their city and of any city of traditional buildings'; iii) 'Legislation in Kosovo does NOT support improvement of energy efficiency in traditional housing as solution and development strategy'.*

The first hypothesis "A traditional Albanian house (such as house Mashkulli), is nowadays not energy efficient due to poor thermal properties, but the use of both passive and active strategies can improve the environmental and energy performance of the building." has been approved. When the envelope of the house is refurbished to reach passive house standards and extra passive strategies are implemented, the total energy consumption of the house improves by 42% and the heating demand is reduced by almost 55% compared to the existing situation. However, the heating demand is still larger in comparison with passive house standards, so this house is not a passive one. *The second hypothesis* has been approved "B*y improving energy efficiency in traditional housing in Kosovo/Prizren city, would be reached sustainable solution in economic, social and physical/environmental aspect of development".* By improving the house, the environmental performance and energy efficiency of the house improves by implementing passive house strategies. In addition, these improvements will have an effect on multiple levels of sustainability, like the quality of life, because of better and more comfortable indoor climate (social), or on better impact of the environment, because it is more energy efficient (environmental), and on energy costs (economic).

International networking from research and development and using experiences to design traditional housing protection via energy efficient refurbishment measures could be beneficiary. The legal

framework for EE in residential/traditional buildings, by settling of correlations in legislative framework within the area of energy, housing, spatial planning and building construction is needed. New strategies for improvement and management in residential/traditional houses regarding energy efficiency followed by the appropriate raising awareness campaigns on thermal energy savings in building sector in general are necessary. Innovative financing in residential buildings through introduction of fiscal policy are needed for the application of customs relief connected with efficient technologies, subsidies on energy auditing costs, energy conservation investment costs and promotional activity costing.

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