

## **ROOF TOP EXTENSION OF EXISTING RESIDENTIAL BUILDINGS IN THE CONTEXT OF SUSTAINABILITY - QUALITY OR QUANTITY? ARGUMENTATIVE ESSAY**

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**Abstract.** *Roof top extension of existing residential buildings is a topic around which have been driven controversies in recent decades, particularly in view of its architectural and design treatment of the existing architecture. The paper aims to show aspects of the roof top extensions other than this, especially the aspect of sustainability, then the aspect of social, economic and urban development, and within them to prove that the vertical extension of the existing residential buildings is a positive process, both in terms of creating new and in terms of preserving the existing housing.*

**Key words:** *roof top extension, density, sloping roof, financial model, sustainability*

### 1. INTRODUCTION

Building extension, as the process of increasing usable area and cubic volume of the existing facilities, often by changing their number of floors and using by that point unusable attic and roof terrace, is not unknown to the history of architecture. On the contrary, it is one of the most common forms of increasing the usable space which is present in all environments and architectural epochs. Earlier, building extensions were considered as creative solutions of authors who conceptually adjunct to the idea and style of the original author, while respecting the relations that prevailed between the author and his work, and the relation between the architectural work and the society it serves. Today there are many important examples of architectural heritage on which the upgraded parts are not even noticeable because the differences in the expressive language of the original and upgraded part are minor (Kurtović-Folić, 2001).

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There is a certain massive scale of roof top extensions in Serbia, with its culmination in the period from 1990 to 2010, especially when it comes to extensions of multi-family residential buildings. The explanation of this phenomenon, above all, lies in the necessity of reconstruction of the flat roofs, housing deficit and the high prices of apartments in new buildings in cities in developing countries (Kuzmanov, 2009). Therefore, the goal of these extensions was to obtain new, in the new market conditions very cheap housing.

Bearing in mind the massive scale of these extensions, different approaches of the authors, and not at all negligible financial resources, as a result there are building extensions that appear with different solutions that can be attributed to a specific typology. When it comes to architectural and aesthetic aspect, upgrades in Serbia can be classified into three types (Kuzmanov, 2009):

- quality roof top extension where the authors were able to seamlessly increase the number of floors, respecting the idea of the original author;
- roof top extension of the facilities that has a completely new expression, and the extended portion cancels the existing architecture;
- interventions, which could be assessed as dangerous from the static point of view.

On the other hand, sources linked to international research project funded by the European Union, SuRe-FIT (Sustainable Roof Extension Retrofit for High Rise Social Housing in Europe), that lasted during 2007 and 2008, have a somewhat different typology:

- Contrast – the extended part is fully expressive contrast to the original architectural design;
- Expansion – an extension of a new part fully respecting the original architectural expression;
- Integration – an extension that involves complete or partial transformation of the architecture building, treating the same way both the existing and the new part.

In contrast to the typology of the first author, authors of the SuRe-FIT project equally treat all three types of upgrades and all three are used as recommendations for potentially good architectural design. This can be interpreted as an indication that the architectural and aesthetic expression of upgrades does not decide whether it is good or bad, but it could be spoken about its quality only after taking into account other aspects, such as urban, social, economic, legal, aspect of increasing density, aspect of utilization of the existing infrastructure, and other aspects of sustainability.

## 2. ROOF TOP EXTENSION OF MULTI-FAMILY RESIDENTIAL BUILDINGS AS A TOPIC OF MANY DEBATES

Although many authors believe that the massive scale of roof top extensions produced numerous low quality formal and technical solutions, according to other authors, the roof top extension is a phenomenon that contributes to the revitalization of entire neighbourhoods, improving the quality of housing, renovation of existing technical damage of buildings, and lately, contributes to the improvement of energy efficiency and sustainability of the whole building. Debate on the issue of "roof top extension of residential buildings - yes or no?" exists in the professional field and in general public for many years, and the arguments are mostly based on the architectural, aesthetic or technical facts. In the European Union

countries, thanks to a number of projects, in accordance with the development of modern technologies, today the issues of the debate is a little differently formulated - "roof top extension, yes, but whether it can be sustainable?" (SuREe-FIT, 2007/2008).

In the EU countries (excluding Malta), there are approximately 100.1 million apartments within multi-family housing. That housing stock represents 47.5% of the total housing stock in the European Union, and most of them are multi-family buildings built after the Second World War (SuRe-FIT, 2007/2008). Bearing in mind that the economies of some EU member states and candidates, especially in Central and Eastern Europe are not able to replace the existing housing stock, they focus on their restoration. Roof top extension, as some kind of sustainable financial model, has been imposed as a potential solution.

Therefore, the author of this paper has the basic attitude that the roof top extension of the existing multi-family residential buildings is a positive process in the context of sustainable development and growth of cities, as well as in the context of the preservation of inherited urban fabric.

Three main assumptions or reasons for accepting the previous attitude are:

1. Upgrading existing facilities creates a new housing space in already urbanized areas of the city with existing infrastructure, which is the cause of increasing population density, meaning that already existing trend of growth of cities is enabled, but with preserving the free land and with no need for costly greenfield construction.
2. Well-built roof top extension creates the possibility of replacing the expensive reconstruction of flat roofs of existing buildings, as well as the improvement of housing conditions, especially on the last floor. From the architectural aesthetic and technical point of view there also comes to change – the flat roof is replaced with sloping roof which is the traditional form and is functionally more suitable for the climatic conditions in our environment.
3. Having in mind that most of the buildings suitable for roof top extension have been built in the second half of the twentieth century, their deterioration is inevitable, and the financing of the reconstruction is often a problem. Roof top extension, as a process of creating a new living space attractive on the market, becomes financially sustainable model that can provide economic resources. Also, by using modern technology, the original buildings could be more energy-efficient.

### 3. ROOF TOP EXTENSION OF MULTI-FAMILY DWELLINGS AS THE PROCESS OF INCREASING POPULATION DENSITY WHILE PRESERVING THE GREENFIELD

According to some authors, roof top extension of residential buildings has a direct impact on increasing the density, leading to insufficient capacity of existing infrastructure and contributing to overloading the urban fabric. However, this may not always be true. The fact is that the constant growth of the human population requires development of urban areas and the preservation of existing and construction of new housing units. Population growth is different in the world. Although the annual population growth in Europe for the last ten years is less than 1%, more specifically about 0.4% (EUROSTAT Statistics, 2013), the surface of Europe is relatively small compared to the number of inhabitants. This means a relatively high population density and the constant pressure for efficient land use. Using multi-family residence, or extending the same, is one possible solution to save the land. This way of

organizing housing was both desirable and widely recommended in the countries of Central and Eastern Europe in the second half of the 20th century and the beginning of the 21<sup>st</sup> (Szekeres, 2010).

In addition to that, one of the most important issues of sustainable planning is to preserve the free land, or its less load with buildings (United States Green Building Council, LEED, 2006). Facilities of all kinds, infrastructure and parking structures with impermeable asphalt layer are affecting the disappearance or disorder of numerous flora and fauna, and most of all, are affecting the natural flow and drainage of water. Due to the lack of awareness about it, Serbia has witnessed the lumbering urbanization especially in several major cities whose population is growing (Niš, Novi Sad, Belgrade, etc.), where every available square meter of land has been used for construction, especially for housing constructions. In doing so, there are cases where investors in pursuit for profit do not take into account the permitted number of floors, the distance between adjacent buildings, insolation, orientation, and least of all about allowing the soil to "breathe". The fact is that the need for this new space exists, but whether greenfield building is the best solution in such circumstances? Of course, here it has been discussed about the new buildings to whose investors the solution with a green roof that would indirectly returned the seized land surface is not the cost effective one, but in almost all cases there is a noticeable attempt to exploit the most remote corner of pitched or mansard roof.

On the other hand, the roof top extensions of the existing facilities have been imposed as a certain solution to the problem of lack of sufficient space, while protecting valuable free land of urbanized areas, which may be filled with other facilities essential for achieving quality of life. Also, in extreme cases, where the need arises, with meticulous planning, infrastructure capacity expansion is enabled. In addition, when it comes to the area of Belgrade, especially the central zone, according to the authors Božović-Stamenović and Stamenović (1998), roof top extension has been prevalent as almost the only possible type of construction of new housing. The first reason for this is certainly the current density of development and constraints in the building height regulation that does not allow rational and economical construction of new buildings, regardless of whether it is a greenfield or a brownfield site. The reasons in favor of massive appearing of roof top extensions include the need for maximal use of the capacity of existing infrastructure systems and so creating new housing with acceptably lower price per square meter (Božović-Stamenović & Stamenović, 1998).

Finally, in the context of sustainability, and as a counter-thesis to the thesis that roof top extensions create overload of the urban fabric, it should be noted that, in a certain sense the roof top extension of existing buildings can be understood as utilization of existing resources and the recycling process. The application of roof top extensions is significantly saving in building materials. The construction industry is a major consumer of material and also a large producer of waste. The roof top extension, as a process of reusing the material, in this case buildings, not only does not burden the urban fabric, but also prevents the formation of waste with eventual demolition of dilapidated buildings (SuRe-FIT, 2007/2008).

#### 4. ROOF TOP EXTENSION AS A PROCESS OF CHANGING THE ARCHITECTURAL LANDSCAPE

Some authors believe that the extended parts of the buildings in architectural terms violate the existing architecture (Kuzmanov, 2009; Popović, 2001), because the extensions are expressionless, and there have been used roof elements which are not appropriate for our climate (such as an attic or roof dormers). Very often roof top extensions give the opposite effect in terms of architectural design from the one intended by the original author himself. However, architects often see pitched roofs as the largest area of freedom and creativity in architecture, which can result in a complex roof form that is not appropriate for residential buildings and does not fit into the existing environment; it could act aggressively, even uncomfortable. Despite that fact, sloped roofs in our country are a traditional form, functionally logical and reasonable for our climatic conditions (Krstić, 1998).

Also, the fact is that, especially in the cities of Serbia, roof top extension of residential buildings caused the disappearance of the significant features of the modern period - a flat roof. However, flat roofs have proven to be functionally unsuitable for the local climatic conditions, and the construction of flat roofs in terms of sustainability (roof terrace with greenery - compensation of expropriated land parcels), still have not gained with us, it is unprofitable and non-functional in residential areas. Because of the inappropriate technical solutions and ways of implementation, flat roofs caused poor living conditions in apartments on the top floors (Krstić, 2001).

Architects accepted with no doubt the return of pitched roof as an architectural expression of great freedom and as a successful recognition motif. There is a large variety in design, principles of materialization and processing. Diversity should exist, but, of course, it should be systematic, based on certain principles which will help avoiding chaos and achieving urban and architectural integrity. Some of the facts that support the resolution of construction of pitched roofs are: (1) pitched roof promotes a simple and rational floor plan, (2) it allows better spatial representation of the structure compared to the flat roof, (3) it offers the ability to navigate and creates sense of direction, (4) it allows contrast, (5) pitched roof fits into the existing urban ensemble as a traditional form, which not only provides the best solution, but could also be a cultural obligation, (6) on sloping terrains offers a variety of opportunities to integrate buildings and settlements in the landscape, etc. (Krstić, 2001).

Moreover, seen in the context of contemporary period and lifestyle, new technologies, and new expressive styles in architecture, already defined forms of roof top extensions of multi-family housing facilities can be expanded, for example, with the themes of contrast, counterpoint, of narrative, symbolism and others. Expanding the range of possibilities opens up new variations for creative expression in roof top extensions field, unexpected positive results and perhaps achieving avant-garde range. Consequently, the quality criteria will change over time. Quality roof top extensions, as complex functional, social, formal, and aesthetic activity, are in the process which is open to all the changes and needs arising from the circumstances, context and time (Božović-Stamenović & Stamenović, 1998).

##### 5. ROOF TOP EXTENSION AS A SUSTAINABLE FINANCIAL MODEL OF CREATING FUNDS

The problem of maintaining flat roofs due to frequent repairs and high costs, is present in our practical construction even from the first buildings with flat roofs. Rehabilitation of flat roofs can be solved with their replacement with pitched roofs in accordance with pre-defined urban-technical conditions. Often owners are not able to secure financing for costly interventions, such as the construction of the sloping roof. From this it follows that one of the main reasons for the appearance of the need for roof top extensions is that they could be a solution to establish economic interest for such construction. From the standpoint of potential investors, basic economic reasons that could affect their determination to invest in extending existing facilities or to build a new residential area are as follows:

- lower cost of construction than building on a greenfield space, and
- the high value of the location where the roof top extension is implemented (Kuzmanov, 2009).

In short, we can say that the interest of investors is to build a residential area on an attractive location with the lowest price, that would ensure a maximum return on equity.

Kuzmanov (2009) considers that the consequences of such policy is mismatch between the upgraded residential buildings and the environment, the existing architecture and building design. According to him it is an inappropriate manner of realization of roof top extensions with low technical quality of construction, which leads to distortion of the existing housing stock. The result of the whole chaotic process of roof top extension is the production of cheap, poor quality and, in the technical sense, a potentially dangerous area, which produces a lot of displeased users, both the occupants of the existing building and the users of the newly created space on top of the building.

However, there is another side of the story, which is necessary to observe. Built heritage, as a product of human activity throughout history in different periods, is corresponding to their architectural, technical and functional solutions determined by the requirements set by the institutional system in a given period of time. Due to the fact that we can track the long-term growth in living standards and quality of life, and also increasingly accelerated development of scientific and technological achievements in the past period, structures that were built about half a century ago cannot fully meet the current needs of the residents. The old buildings in some sense become low-quality ones and, in technical terms, potentially dangerous areas of life. That is why their gradual reconstruction, conversion or replacement with new buildings is required. Given the fact that the economies of developing countries are often unable to replace existing housing, which in most cases consists of buildings constructed after World War II, it is necessary to pay more attention to the renovation of the housing stock. In order to renovate the existing housing facilities, various grants from national or European sources could be provided (although the issue of the use of European funds is complicated bearing in mind the state of the real estate ownership), followed by credit sources approved by financial institutions and others. However, in this case, the sustainability of the solution is questionable (Szekeres, 2010).

One of the options to create sufficient funds for the renovation of residential buildings is to perceive the roof of the building as the location for the construction and upgrade, creating a new space attractive on the market. Proceeds of its sale may be used for the renovation of the entire building (Szekeres, 2010). The aforementioned author believes that this is a process that depends primarily on the location and constructive technical solution for building and

examines all the factors and proposes a model of financing in the implementation process of reconstruction of existing residential buildings through its upgrade, relying primarily on the use of sustainable materials and technologies, which as a result could give a modern energy efficient building.

Finally, the attitudes of some of the above mentioned authors that roof top extension reduces the quality of housing, may not always be accurate. On the contrary, roof top extension, viewed in the context of sustainability, certainly contributes to improving not only the housing profile of the particular facility, but also improves its wider environment. The fact is that the cost of construction of energy efficient buildings is higher than of conventional buildings. However, major investment is more than compensated by lower maintenance and lower energy consumption. Energy-neutral and flexible roof top extension of existing facilities has proven to be a viable solution for achieving energy efficiency in residential buildings from the second half of the twentieth century, both in technological and in financial terms. This kind of roof top extension combines energy efficiency measures with social, environmental and economic benefits (SuRe-FIT, 2007/2008).

## 6. CONCLUSION

Based on the previously stated, it can be concluded that the implementation of the roof top extension of existing residential buildings today may be a positive process, both in terms of creating new and of preserving the existing housing. After reviewing the roof top extension process in a broader context - urban, architectural, sustainable, economic, social – a fundamental factor emerges that should be guiding each activity - the needs of contemporary urban life. If this principle could be the leading one in the ethics and architectural codes of both investors and designers, a positive result is almost guaranteed.

Despite the sharp reactions and the comments of experts, accompanied with the lack of control and the unwillingness of city services to be at the level with the new situation in building, many mistakes have been made which by virtue of their large number acquire affirmation and gain legitimacy. At the same time, the great potential that new roof top extensions provide does not get used to improve the quality of housing, conditions of economic viability and the overall quality of the residential environment.

The paper presents a number of advantages and opportunities that a roof top extension of existing residential buildings could be a sustainable process of creating new and preserving the existing housing. In this sense, just as any process or activity that occurs in human society, roof top extension requires some control. In addition to the systematic implementation of the whole process, starting from the wider planning and design, to feasibility studies and financing, with adequate control by the competent services, roof top extension of the existing housing stock has many positive sides. As one of the activities of modern man as a builder, roof top extension offers a wide range of options to meet the demand for quality housing in the context of modern life.

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## **NADOGRADNJA KROVOVA POSTOJEĆIH STAMBENIH OBJEKATA U KONTEKSTU ODRŽIVOSTI – KVALITET ILI KVANTITET? ARGUMENTATIVNI ESEJ**

*Nadogradnja postojećih stambenih objekata je tema oko koje je vođeno dosta polemike proteklih decenija, i to naročito s aspekta njenog arhitektonskog i oblikovonog tretiranja postojeće arhitekture. Rad ima za cilj da pokaže i druge aspekte nadogradnje osim ovog, pre svega aspekti održivosti, zatim socijalni, ekonomski i urbanistički, te da u okviru njih dokaže da je nadogradnja postojećih stambenih zgrada pozitivan proces, kako u smislu stvaranja novog, tako i u pogledu očuvanja postojećeg stambenog prostora.*

Ključne reči: *nadogradnja, gustina naseljenosti, kosi krov, finansijski model, održivost*