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Renovation – new life for old buildings

Renowacja – nowe życie dla starych budynków

Abstract

Renovation is performed on old buildings and urban areas which fail to meet modern aesthetic, social, economic, energy and environmental requirements in order to bring them to new high-quality level. The result of such works is a new high-quality, multi-functional urban environment, for both permanent residents and visitors, which has economically profitable energy-efficient buildings. This article presents different approaches to the renovation of urban buildings. An example of the renovation of a residential quarter without the demolition of buildings and without resettlement of the inhabitants is discussed in detail. The sequence of the stages of such a renovation is defined, an analysis of each stage is performed and the project payback is presented.

Keywords: renovation, residential buildings, energy efficiency, renewable energy

Streszczenie

Renowacja odbywa się w celu podniesienia na zupełnie nowy poziom jakościowy przestarzałych budynków i obszarów miejskich, które nie odpowiadają współczesnym wymaganiom estetycznym, społecznym, ekonomicznym, energetycznym i środowiskowym. Rezultatem renowacji jest nowe, wysokiej jakości środowisko miejskie do stałego zamieszkania i tymczasowego komfortowego pobytu ludzi; wielofunkcyjne; z opłacalnymi, energooszczędnymi budynkami. W artykule przedstawiono różne podejścia do renowacji zabudowy miejskiej. Pokazano szczegółowy przykład renowacji dzielnicy mieszkalnej bez wyburzeń budynków i bez przesiedleń mieszkańców. Określono kolejność etapów takiej renowacji; prowadzono analizę każdego etapu i opłacalność ekonomiczną inwestycji.

Słowa kluczowe: renowacja, budynki mieszkalne, efektywność energetyczna, energia odnawialna

1. INTRODUCTION

Population growth and the consolidation of cities has led to an increase in both their energy consumption and their emissions of CO_2 into the atmosphere. The construction sector accounts for approximately 40% of the total energy consumption and CO_2 emissions[1]. Most of the houses in Ukraine and Europe are older than 30–40 years; they were constructed when other energy building codes and rules were in operation. Today, these buildings, even if they are in a state of good physical preservation, are outdated and require significant energy and financial investment for their maintenance. Moreover, they are uncontrolled sources of heat release into the atmosphere. There is one of the causes of the emergence of thermal islands, which are characteristic of many cities. This is a problem, the solution to which requires the design of new and the renovation of old buildings on the basis of new rules, where comfort, ecology and energy efficiency are the main priorities.

Renovation is the reconstructive transformation of the urban environment which involves the replacement of its outdated parts and structures with replacements that meet modern requirements[2]. Its purpose is to update and create sustainable architectural solutions that are harmoniously integrated into the urban environment, taking into account regional, climatic and socio-economic characteristics. This reconstructive transformation is primarily associated with abandoned industrial and warehouse buildings and entire areas of the city which are currently outdated, empty, inefficiently used or not in demand. They require revision and new or additional functions as part of their development. Renovation is also appropriate when it comes to the transformation of outdated housing in order to bring it to a completely new level of quality. This applies to residential buildings that were built in the 1960s and 1980s. This poses the question of what should be done with such houses? As a rule, they are of a fairly good physical condition; however, they fail to meet modern aesthetic, economic, energy and ecology standards – they are completely out of date.

There are several approaches to solving the fact that the residential buildings fail to reach the abovementioned standards. The easiest solution is the demolition of old, outdated buildings and the construction of the new buildings that meet modern aesthetic, ecological, economic and social requirements in their place. Residents of obsolete, demolished houses at the same time either receive compensation, or agree to move to the new buildings.

It is much more interesting to solve the questions of the renovation of residential areas without demolishing buildings. In this case, existing buildings change with regard to both planning decisions and facades. They are replaced or supplemented with new constructive solutions, building up floors and adding new communications, and improving their engineering and technical characteristics. The functions of such buildings can remain unchanged, they can be expanded, or they can be entirely changed. Conducting such reconstructive changes in both buildings and entire residential areas is possible only after all coordination and survey works have been completed.

As a rule, the renovation of residential buildings requires the resettlement of its residents. How can residential buildings be renovated without needing to resettle their residents? This question is very sensitive and requires detailed consideration.

2. BASIC MATERIAL

PURPOSE OF WORK

The purpose of this article is to show how it is possible to solve the problem of renovating residential areas without demolishing buildings. Furthermore, using a concrete example, this article shows how it is possible to renovate an apartment house without the resettlement of its residents. It demonstrates how the stages of renovation of an apartment house can be divided without resettlement of its tenants and what is included in each stage. This paper also shows which indicators of energy efficiency can be achieved after renovation, and what is the payback of the proposed project.

MATERIALS AND METHODS

The renovation project of a residential quarter in Madrid proposed in this article was performed after full-scale surveys and pre-project studies using comparative analyses, generalisation, and theoretical modeling. A comparative analytical calculation was used to select the optimal thickness of the buildings' thermal insulation.

An analysis of existing theoretical and practical works on similar objects was also conducted at the pre-project stage. The work of German[3], French[4] and Dutch[5] architects in solving the problems of urban renovation and the use of architectural and technical methods to improve the energy efficiency of buildings after renovation was also considered.

RESULTS AND DISCUSSION

Let us consider both approaches to the renovation of the residential areas stated at the beginning of the article. Without demolition of existing buildings and in the case of the forced demolition of obsolete, disharmonious buildings and structures, the liberation of the territory from industrial and warehouse buildings, underground spaces from engineering communications and networks to ensure the effective conduct of new construction regardless of the extent of physical preservation of the disharmonious buildings located on it. Newly constructed buildings that replace existing structures are regulated by the number of floors, by volume and by composition[6].

Regardless of the approaches used, both renovated and new buildings should form a new qualitative urban architectural environment for permanent residents and visitors which is comfortable, multifunctional, with a developed social infrastructure and public spaces[7]. After renovation, buildings should be energy efficient and should be energy-independent from non-renewable energy sources. Energy efficiency and independence from fossil energy sources is one of the main issues with regard to sustainable development strategies for urban regions.

Similarly, the renovation of the outdated residential areas in the French town of Le Plessis-Robinson was decided (Il. 1). In the author's opinion, this is a very good example, hence its mention in this article. It is a small town not far from Paris. It was built up by typical five-story buildings until 1989[8]. In the renovation project, it was decided that there would be a partial demolition of obsolete, faceless, typical panel buildings of linear construction and that they would be replaced with small, cozy quarters with recognisable buildings of medium height, using regional features in their formation (traditional roof forms and facade details). After renovation, the standard of living increased for local residents; they received quality housing and a quality urban environment (Il. 2).

In this project, residents of the demolished buildings had the right either to receive monetary compensation, or to move to new homes. The overwhelming majority chose the second option. This project is recognised as the most successful from among city renovation projects[9]. This is an excellent example of renovation with a partial demolition of obsolete, outdated buildings, and the resettlement of residents to the newly built quality replacement residential buildings that meet new aesthetic, social, environmental and economic requirements.

We now turn our attention to a renovation project of the residential quarter of the Rejas neighborhood of Gran San Blas Area in Madrid, Spain. This is an example of the renovation project of obsolete residential buildings, which must be accomplished without resettlement of their residents. This project was carried out in the framework of the 13th SAINT-GOBAIN 'Multi-Comfort House Desing' international student competition and was awarded first place at the national and the second place at the international level.

The residential quarter is located in the west part of the Rejas neighborhood of the Gran San Blas area of Madrid. This is a typical sleeping area on the outskirts of Madrid. Its houses are of a typical residential building style of the 1960s (Il. 3).

These are the 4-storey sectional brick buildings. They were built for the workers of the Pegaso truck and tractor factory. This is an example of social housing, most of the residents of which are elderly people. Today, the buildings are well preserved, but they have a number of shortcomings that make them expensive to use, uncomfortable to live in, and unattractive to the younger generation.

The renovation project was aimed at creating a sustainable architectural solution for renovating residential buildings, taking into account the existing environmental context, specifically, climatic, regional construction and architectural features, social and economic factors, with the injection of new life into the existing urban environment. It has been suggested that the solution could be applied to similar situations of housing renovation in many European cities, giving a reference to the local context.

A detailed pre-project analysis was carried out; this enabled the formation of a detailed database of initial data for design.

After analysing the current situation, the following problems that needed to be resolved were identified:

- low quality of living due to the functional poverty of the district,
- the unattractiveness of the area for young families due to the undeveloped social infrastructure,
- discomfort of living for the residents of the ground floor due to the use of the courtyard for storage facilities (Il. 4),
- low level of comfort in the buildings due to poor insolation, noise isolation, excessive heat of living spaces in summer,
- inconvenience with regard to vertical movement due to the lack of elevators in the houses; this is especially true on the basis that the tenants of the houses are mostly elderly people,
- houses are economically inefficient due to the high energy costs for heating in the winter and the costs for air conditioning in the summer, as a result of which, there are very high prices for their maintenance.

The main task of the renovation project of this residential quarter is to create new comfortable living conditions for all generations, both old and young (Il. 5).

The situation with the renovation of these houses is complicated by the fact that their residents are mostly elderly people and they will have to stay in these houses for the entire period of their renovation. Therefore, the entire process had to be organised as currently as possible in order to minimise the discomfort caused by the current construction works.

The whole process has been proposed to be divided into seven stages and gradually move on to each subsequent stage after the full completion of work on the previous stage (Il. 6).

The recommended sequence of steps is as follows:

1) the construction of the fourth floor with an exploited roof,
2) the expansion of the staircases towards the courtyard with an extension of the elevator shafts,
3) to increase the windows on the southern facades in order to improve insolation of the apartments; replacement of all window fillings with the energy-saving versions,
4) thermal insulation of building facades,
5) the construction of a stylobate floor in the courtyard with the organisation in it of individual storage facilities for residents of all apartments and technical rooms for the equipment of engineering support for the houses; on the roof of the stylobate floor a 'green' landscaped community zone will be included – a courtyard for all residents of these houses,
6) installation of the metal galleries-terraces on the facades from the side of the courtyard with the inclusion of sunscreens; each apartment will receive an additional terrace,

orientated to the renovated courtyard to provide the apartments with protection against overheating interiors; perforated metal sunscreens will also be installed on all windows of the southern facades,

7) relocation of the ground floor residents to the new apartments on the fourth floor; the adaptation of the ground floor apartments to various public functions with the inclusion of independent entrances from the street; improvement of the inner courtyard and maintained roofs with recreation and communication zones.

The stages during which the most 'dirty' and labour-consuming works will be performed (with the exception of the third stage) are conducted without the slightest interference in the normal functioning of the house. The laying of communications for the engineering equipment of the house and for the possibility of using energy from renewable sources for heating, cooling, lighting and hot water supply is provided for each of the stages of renovation. As a result, residents will receive renovated houses with new comfortable living conditions, a quality community zone semi-private courtyard area, with a quality urban environment and which are multifunctional, comfortable, active, popular and safe[10].

One of the main components of any renovation project is the use of energy-efficient technologies, the use of renewable energy sources and the reduction of harmful emissions into the atmosphere. Such an approach contributes to the sustainable development of the urban environment[11]. The renovation project of the residential quarter of the Rejas neighbourhood of the Gran San Blas area in Madrid is a good example (Il. 7).

Energy from renewable sources was proposed for the hot water supply, heating and cooling, ventilation, lighting facades, roof patios and courtyard. Furthermore, for watering the flower beds in the courtyard, it was recommended to use rainwater collected from the roofs of the houses. The roof area of one house enables the collection of 207 m3 of rain water per year based on the average annual rainfall in Madrid.

After the proposed insulation of the facades and roof, the replacement of window fillings and the installation of sun screens, the average annual energy consumption of the house was calculated for heating, cooling and possible overheating of internal areas. The following calculated indicators were obtained:

- the average annual energy consumption for heating the house – 8.80 kWh/m^2 a
- the average annual energy consumption for cooling the house – 13.47 kWh/m^2 a
- overheating frequency – 0%

This corresponds to the A+-class of energy efficiency.

In addition to the above, calculations on the payback of the proposed renovation measures were made. The costs of the project will be fully recouped after the sale of the ground floor for commercial real estate.

3. CONCLUSIONS

Renovation is a reconstructive transformation that gives new life to outdated buildings and run-down urban areas. However, to renovate the urban environment, it is not necessary to demolish old buildings and to construct new ones in their place.

The abovementioned project for the renovation of the residential quarter of the Rejas neighborhood of the Gran San Blas area in Madrid is an example of how to give new life to obsolete residential buildings, and to increase the value of low-demand urban areas. It shows how to renovate a residential building without resettlement of its residents, how to improve its comfort of living, and how to achieve very high energy efficiency.

The issue of increasing the comfort of living in such buildings can be solved by:

- the improvement of insolation conditions for all apartments
- supplementing vertical communications with elevators for easy and comfort movement
- relocation of the residents from the ground floor to a new built-up fourth floor
- adaptation of the vacated premises of the ground floor to various public functions, for example: a coffee shop-bakery, a yoga club, a library and computer literacy centre for the elderly people, hairdressers, cooking, varied small shops, early childhood development centre, pharmacy
- organisation of an exploited 'green roof' with a leisure function for all residents; places for solar batteries and collectors should also be allocated on it
- creation of a new community function for the courtyard
- equipping all apartments with galleries – terraces from the side of the courtyard and thus opening them to the renovated courtyard
- thermo-modernisation of facades to increase the energy efficiency of buildings
- using renewable energy sources for hot water supply, cooling, heating and outdoor lighting
- involvement of residents of different ages in public life and as a result, the activation of public space, creating attractions for people with different interests, different kinds of recreation and free time activities

The calculations (Il. 8) show the possibility to achieve energy consumption indicators for the building corresponding to the A+-class of energy efficiency instead of the existing D-class due only to measures such as:

- thermo-modernisation and creation of a continuous thermal building envelope
- protection of the interior from overheating with the help of sun screens and external galleries
- using forced ventilation with the supply of fresh air through the ground air heat exchanger and with the recovery of heat from the outgoing air in winter
- using the ground-water heat pump for the winter heating system and for the cooling of the premises in summer

The presented strategy can be applied to many obsolete residential buildings that were built in the second half of the last century and which occupy 30–40% of the total housing in any European city.

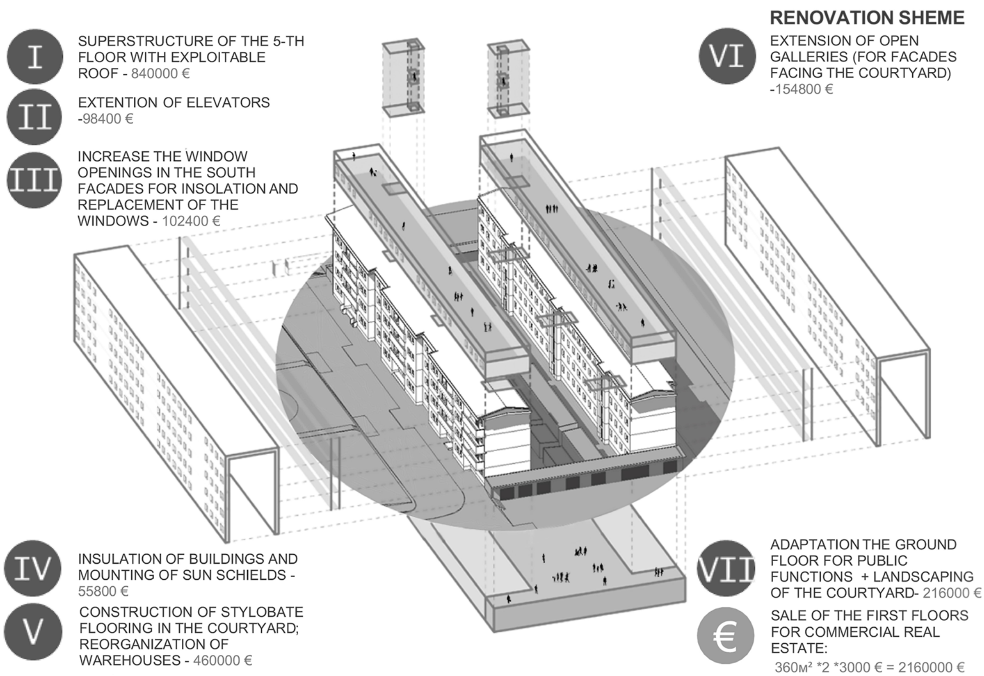
Il. 1. The combination of old typical panel buildings and new quarter buildings (source: http://eveningkiev.com)

Il. 2. New high-quality urban environment, (source: http://eveningkiev.com)

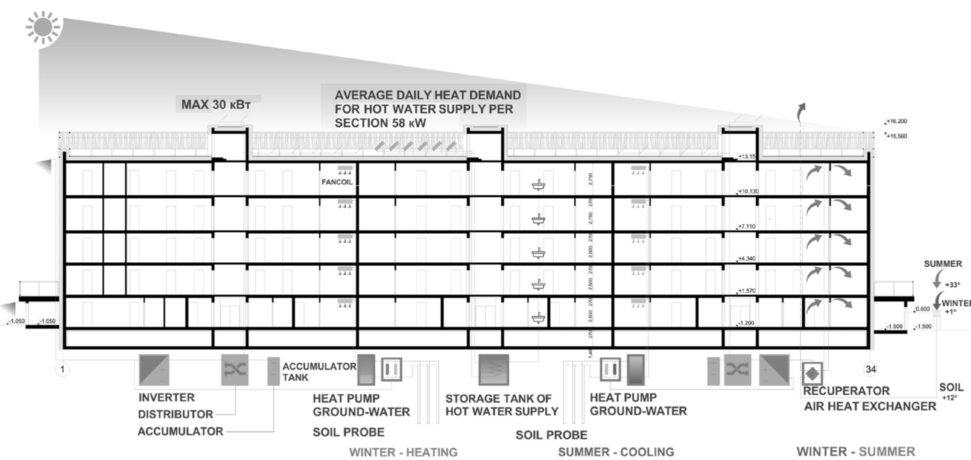
Il. 3. The current view of the residential quarter of the Rejas neighborhood of Gran San Blas area in Madrid, Spain, Author's photo

Il. 4. Current view of the courtyard of the quarter with warehouses (source: Documents for contest task 2017, http:// www.isover-students.com)

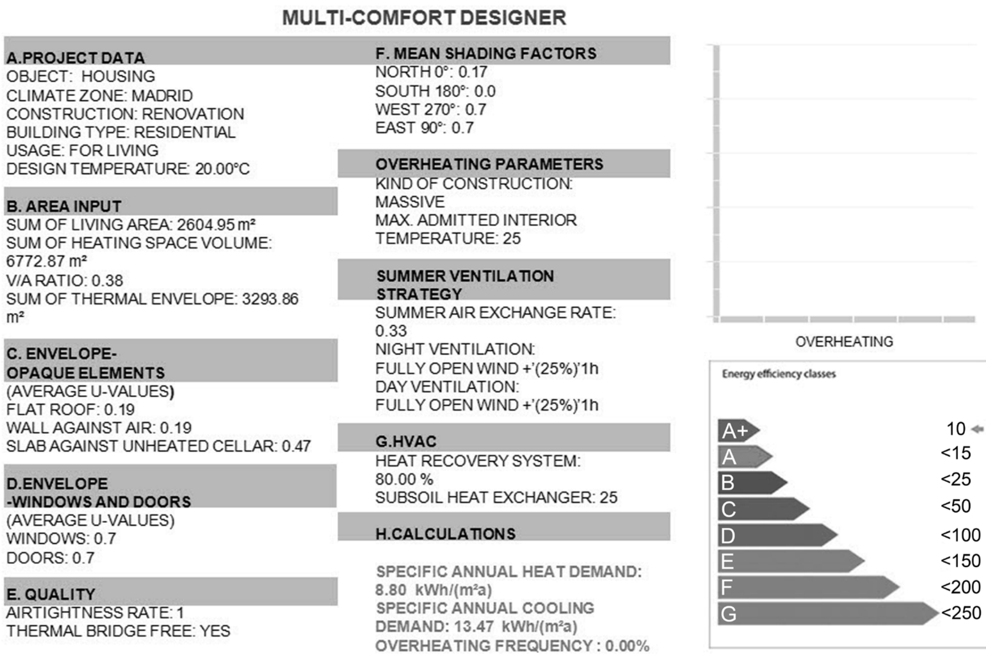
Il. 5. Project proposal for the renovation of the residential quarter of the Rejas neighborhood of the Gran San Blas area in Madrid, Spain; created by the student ABS-67 KNUCA Holovatiuk Alina; tutor – Leshchenko N., PhD Arch., associate professor KNUCA



Il. 6. Renovation scheme; created by the student ABS-67 KNUCA Holovatiuk Alina; tutor – Leshchenko N., PhD Arch., associate professor KNUCA



Il. 7. Scheme of use the renewable energy sources for heating, cooling, ventilation, hot water supply of the house after it renovation; created by the student ABS-67 KNUCA Holovatiuk Alina; tutor – Leshchenko N., PhD Arch., associate professor KNUCA



Il. 8. Results of calculations; created by the student ABS-67 KNUCA Holovatiuk Alina; tutor – Leshchenko N., PhD Arch., associate professor KNUCA

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