INTERNATIONAL JOURNAL OF STRATEGIC PROPERTY MANAGEMENT
ISSN 1648-715X print / ISSN 1648-9179 online

2011 Volume 15(2): 152–172
doi: 10.3846/1648715X.2011.586531

RESIDENTIAL AREAS WITH APARTMENT HOUSES: ANALYSIS OF THE CONDITION OF BUILDINGS, PLANNING ISSUES, RETROFIT STRATEGIES AND SCENARIOS

Saulius RASLANAS [1] ✉, Jurgita ALCHIMOVIENĖ [2] and Nerija BANAITIENĖ [3]

[1] *Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*
E-mail: saulius.raslanas@vgtu.lt
[2] *Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*
E-mail: jurgita.alchimoviene@vgtu.lt
[3] *Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*

Received 26 September 2010; accepted 15 November 2010

ABSTRACT. Modernisation of apartment houses is a particularly relevant issue both in Lithuania and many other countries. To make it more efficient, the modernisation of apartment houses must be integrated–an entire block or residential area must be renovated and the principles of sustainable development must be followed. This article dwells on the issues related to retrofit planning in residential blocks/areas and analyses the condition of apartment houses and their environment. The article also proposes strategies for retrofit of residential areas with apartment houses. The strategies aim to improve the living standards and the quality of environment, to cut energy consumption and CO_2 emissions, to maintain mixed social structure, to integrate new buildings into the existing environment in a sustainable manner, to develop an urban centre of a residential area as a functioning part of the city, to develop democratic planning and to seek close cooperation of modernisation partners. The scenarios based on relevant strategies must define the measures of retrofit, their priority and their potential effect.

KEYWORDS: Condition of apartment houses; Modernisation of areas/blocks; Strategies and scenarios; Sustainable retrofit; Planning issues

1. INTRODUCTION

Modernisation and retrofit of buildings is one of the forms of urban development. Both in Lithuania and in other countries, it should help to solve energy and environmental issues and to improve the quality of life (Mitkus and Šostak, 2009; Kaklauskas et al., 2009; Ginevičius and Podvezko, 2008). Therefore, modernisation should comply with the sustainable development requirements based on three components with equal importance: environmentalism, economic development and social development (Šeduikytė and Jurelionis, 2009). Sustainable development aims to reconcile economic growth, social progress and frugal use of natural resources, to maintain ecological balance and to ensure favourable living conditions for current and future generations (Burinskienė and Rudzkienė, 2009;

Medineckienė et al., 2010). The concept of sustainable development is interpreted as a process for development of healthy environment, viable economics, social welfare and active community (Juškevičius, 2005). The UK Government introduced the Sustainable Community Plan in 2003, describing a vision of how our communities are to be developed over the next 20 years economically, socially and environmentally, while respecting the needs of future generations (McDonald et al., 2009). Sustainable development in construction is interpreted as construction of buildings that better satisfy the needs of people and environment. Fundamental retrofit of buildings constructed in earlier decades and their environment is an increasingly important objective for private, public and non-profit owners or investors. Of course, technical requirements applicable to the building must be considered, but economic and ecological expedience of thorough wide scale modernisation must also be compared with an alternative to demolish the building and to construct a new one or to change the building's purpose.

Retrofit of apartment houses and their environment aims:

- to cut energy consumption;
- to cut building maintenance costs;
- to reduce the effect of polluting factors thus boosting the value of the environment;
- to improve the condition of buildings and to extend their service (30–40 years);
- to improve the indoor comfort;
- to improve the quality of buildings and to make urban areas more attractive;
- to increase the market value of buildings;
- to attract and retain middle classes.

One of the goals set in the Strategic Plan of the City Vilnius for 2002–2011 is to promote residential construction, retrofit and development of urban residential areas and apartment houses with dwindling attractiveness, investment and new construction in such areas, preparation of template retrofit projects for apartment buildings and setting up of programmes for energy saving measures (Vilniaus miesto ... , 2002). Strategic plans of Vilnius and the condition of houses and their environment in the neighbourhoods in question determine the priority order for retrofit of apartment houses in Vilnius neighbourhoods. Separate neighbourhoods of Vilnius have different priority because the condition of their houses and environments differs. Retrofit of houses should not be separated from landscaping. Zoning of the environment is important and the retrofit must be based on territorial considerations, which means that the priority order for retrofit of Vilnius neighbourhoods must be set and the retrofit must be integrated to encompass retrofit of buildings plus arrangement and modernisation of their environment. Thus attractiveness of the territories would improve and the market value of the land would increase along with increasing private investment in the territories to be renovated (Zavadskas et al., 2008d).

Retrofit of residential houses usually covers diverse measures aimed at cutting energy and maintenance bills, improving safety, comfort and aesthetic properties, as well as boosting market value (Martinaitis et al., 2007; Užšilaitytė and Martinaitis, 2010). Energy saving measures in buildings considerably reduce energy consumption and thus the GHG emissions. Plenty of scientists, Galvin (2010), Sartori et al. (2009), Jurelionis and Isevičius (2008), Zavadskas et al. (2008 a, b), Naimavičienė and Mickaitytė (2007), Mickaitytė et al. (2008), Swan and Ugursal (2009), Filippin and Larsen (2009), Lloyd et al. (2008), Johansson et al. (2007), Balaras et al. (2005, 2007), Saidur et al. (2007), Kazakevičius et al. (2002), Bell and Lowe (2000) among them, analyse and suggest solutions how to cut high energy consumption through retrofit in the residential sector. The Copenhagen

Climate Change Conference, which took place between 7 and 18 of December 2009 and attracted representatives from 194 countries, shows international understanding and huge economic potential to cut global GHG emissions in the nearest decades. Countries wanted to sign a joint agreement covering three main issues: financial aid of rich to poor countries, reduction of pollution emissions in developing and developed countries, and setting the upper limit for average global temperature. Active retrofit of residential blocks/areas would have a considerable impact on reduction of energy consumption and CO_2 emissions (Kuronen et al., 2010). However, modernisation must follow the urban structure which reflects the principles of sustainable development and corresponds to the quality of life: compactness, multifunctional use of territories, sustainable transport, ensured public interests and visually attractive (unpolluted) environment. Decisions on retrofit of residential spaces must avoid being too narrow, when retrofit projects for separate houses are considered (Tupenaite et al., 2010).

The key imperatives for efficient modernisation are listed below.

- To sort the legal basis for territorial planning, which (LR Aplinkos Ministerija, 2008):
  - would ensure uncompetitive integration of various laws and would help to set up a single system for sustainable development;
  - would set the underlying quantitative and qualitative requirements for territorial development and use;
  - would establish universal and informative concepts intelligible to anyone;
  - would establish clear criteria for the quality of life in line with the principles of sustainable development.
- To ensure transition from individual plot planning to block planning; to regulate accessibility of social infrastructure and to handle the issues related to transport and monofunctional areas.
- To foresee integrated development of business and social infrastructure.
- To promote public and engine free transport; to actively integrate such transport into the urban transport structure and to enhance the network of walkways; to enhance and reconstruct the street network and to improve traffic planning.
- To ensure sufficient quantity and quality in the development of social and engineering infrastructure.
- To renovate old houses, thus contributing to energy efficiency policies.
- To reclaim abandoned territories.

2. ISSUES WITH RETROFIT PLANNING IN URBAN RESIDENTIAL AREAS/ BLOCKS

The future of Lithuanian cities and towns depends on the territorial planning system, which is improving due to ever-freer market and ever more democratic society (Bardauskienė et al., 2007). Implementation of the sustainable development policies is one of the most complicated tasks and challenges facing a community (Burinskienė and Rudzkienė, 2009). Territorial-spatial planning of residential areas/blocks is important in development of sustainable and attractive cities and areas. Therefore, any part of the city must also comply with the sustainable development requirements, which include environmental, social, construction and transport aspects (Viteikienė and Zavadskas, 2007). Modernisation of apartment houses is a particularly relevant problem in terms of planning. To make it more efficient, modernisation of apartment houses should be integrated and encompass an entire block instead of a single house (Zavadskas et al., 2008d). Such move calls for the development of clear territorial planning regulations for residential areas/blocks.

Currently Lithuania lacks a single normative basis for territorial-spatial planning of residential areas/blocks. Concepts and their definitions are regulated by different legal acts and are often interpreted differently. Ongoing amendment of normative acts is another problem. It is particularly important in development of sustainable and attractive environment in cities and their areas. "Norms for Separate Recreational Green Spaces" of the Republic of Lithuania set the following concepts of a residential area and block: urban residential areas are territories delimited by arterial or intensive traffic streets, while a group of blocks is delimited by supporting streets (LR Aplinkos Ministerija, 2007). The "Regulations on State Support for Modernisation of Apartment Buildings and Determination of Energy Efficiency in Investment Projects" approved by the Government state that "a residential area/block is an urbanised territory of Lithuania dominated by residential buildings and surrounded by transport roads and engineering networks or natural elements" (LR Vyriausybė, 2008a). The project of the Ministry of Environment "Norms for Planning of Cities, Towns and Villages (settlements)" defines a residential area as "a residential space delimited by physical phenomena (streets, green spaces, natural barriers) together with transport and engineering infrastructure corridors and green spaces inside such area" (LR Aplinkos Ministerija, 2009).

On 1 January 2010, a new version of the Law on Territorial Planning (LRS, 2010) came into force, however the law still lacks the definitions of both "block" and "area", although the concepts are used throughout the law. The current legal basis of Lithuania lacks a universal definition to interpret the concept of "residential area/block": current norms do not define the size of residential areas or subdivisions/blocks; also the distances to the most important companies and agencies are not regulated. No mechanism is in place to balance the solutions set in residential planning documents. Plans of territories do not foresee green spaces and areas for social infrastructure; detailed plans often fail to reflect the principles of territorial management and use. Thus the planning environment becomes complicated (inefficient and non-transparent).

In the times of planned economy, a residential area and a block had specific descriptions and their parameters were expressed in numerical values. Therefore, planners of those times hardly encountered any problems to mark functional zones in a single parcel or in the entire territory set for construction. Undefined concept of a residential area/block means that there are no clear measures to determine the density and intensity of buildings, as well as the demand for public spaces and public territories (transport and engineering infrastructure objects).

The current legal basis of Lithuania leads to expansion of monofunctional residential areas/blocks and to ongoing disintegration of social and functional purposes (LR Vyriausybė, 2008b). Such trends contradict sustainable development of cities and urban areas.

The current normative documents of Lithuania regulate the minimum size of the plot for a residential building, as well as the maximum space occupied by buildings and the maximum density of buildings in such plot; however, they fail to regulate the density of population in a residential area/block. Legal acts, which regulate territorial development, even fail to set the recommended values. The current norms of Lithuania stipulate the allowed height of buildings (in meters) in the plot; however, there are no norms or techniques for height calculation. The said issues hinder the planning procedures and leave ample space for interpretations.

Construction regulations set the requirement for green spaces in the plot to take up at least 25% of the unbilt area; such areas intended for green spaces can host playgrounds, simple sports fields for teenagers or recreational zones for elderly residents (STR 2.02.09:2005; STR 2.02.01:2004). Before the order (LR Aplinkos Ministerija, 2007) passed on 21 December 2007, not a single document regulated the interdependence between green spaces and the number of residents, the maximum heights in the spaces and the catchment area of such green spaces. The rules regulating preparation of detailed plans do not make green spaces a mandatory requirement in landscaping and land use. Territorial planning documents (here, detailed plans) often fail to consider non-mandatory regulations for territorial planning and land use. Territories are usually planned without any space left for green areas and social infrastructure. The definition of social infrastructure appeared in the Law on Territorial Planning only in 2010 (LRS, 2010). Yet sustainable social environment is a very important aspect in the quality of life, which is essential to attract and retain people. It helps to satisfy educational, training, cultural, healthcare, social care and other essential needs of people, but it is possible only if we handle the following issues: depopulation and aging populations in some residential areas; increasing disparities between the quality of environment in certain residential areas; uneven distribution of social infrastructure and social objects; and lack of services (LR Aplinkos Ministerija, 2008). The current legal acts of Lithuania scarcely regulate social infrastructure issues – they consider development of only a small portion of social infrastructure objects. Thus distribution of social infrastructure objects becomes a problem; the catchment area for such services remains undefined. A subdivision of a residential area must have the essential social services such as kindergartens, schools and shops, while the entire residential area must have such social services as a special school, a supermarket, a library, a cinema, a sports club and an outpatient clinic. Lithuanian legal and normative acts do not regulate reservation of spaces for social infrastructure (educational, cultural, healthcare and other) in residential areas, the catchment area of such infrastructure, etc.

Newly designed residential areas suffer from land related problems. Urban land increasingly becomes private property, and this fact brings about a conflict of interests between the municipality and the private landowner. Moreover, the municipality sometimes lacks the capacity to control and to regulate land use properly. Thus no space is left for streets and engineering networks, for green spaces and social infrastructure. The definition of public interest is unclear in territorial planning. Representatives from public organisations believe that public interest must be clearly defined in the Law on Territorial Planning and in normative acts, and must be clearly marked in territorial planning documents (Darni urbanistinė plėtra Lietuvoje, 2008). The priority of public interest (common streets, corridors of engineering networks, social infrastructure, parks, etc.) must be legitimised, because the quality of life is impossible without development of public infrastructure.

3. CONDITION OF APARTMENT HOUSES IN RESIDENTIAL AREAS/ BLOCKS, QUALITY ISSUES WITH RESIDENTIAL SPACES

Power (2008) claims that modernisation of buildings presents more benefits than demolition. However, in order to renovate an old building efficiently, a thorough analysis is needed (Kaklauskas et al., 2005). About 70% of residential buildings in Europe are over 30 years old, and about 35% among them are over 50 years old (Balaras et al., 2005). It leads to huge consumption of thermal energy. The European building sector is responsible for about 40% of the total primary energy consumption (Tommerup and Svendsen, 2006; Uihlein and Eder, 2010; Balaras et al., 2007; Kaklauskas et al. 2011), which means for more than industrial and transport sectors in the EU and the USA (Pérez-Lombard et al., 2008; Juan et al., 2010). Meanwhile, the sector of residential buildings in the EU accounts for some 22% of all energy consumption (Kavgic et al., 2010; International Energy Agency, 2008). To determine the wear of building elements, Denmark, France, Germany, Greece, Italy, Poland and Switzerland audited about 50 buildings in each of these countries. The research helped to determine the main reasons of wear: type of ownership, quality of structures (elements), age, type of finishing, type of materials, repair/maintenance, location, etc. The dominating type of housing in Czech Republic, Slovenia, Slovakia, Hungary, Latvia and Bulgaria is flats. Flats make up 75% of the entire housing stock in Estonia; some 10m Polish citizens, about 25% of the population, live in standard flats; while forecasts show that in 20 years 80% of flats in Romania will be uninhabitable. In most of these countries, the flats are located in large-panel houses (Raslanas et al., 2003). Šeduikytė and Jurelionis (2009) state that European apartment buildings have similar technical, functional and architectural problems, thus a single information system for modernisation of typical apartment houses would save considerable time and funds. Improvement of condition would also cut energy consumption in such buildings. About half of construction expenses in Europe are related to building repair and maintenance; however, early deterioration of concrete structures is becoming a serious problem in many countries (Balaras et al., 2005). In the Swiss residential building stock, accounting for about half of the energy demand of all the buildings, i.e. roughly a quarter of the total national energy demand, there is an enormous energy saving potential which can be best exploited by combining energy efficient measures with the normal retrofit cycle of buildings (Amstalden et al., 2007). Siller et al. (2007) believe that by 2050 the Swiss residential building stock can cut thermal energy consumption (heating and preparation of hot water) by a third and CO_2 emissions by a fifth; however, considerable efforts are needed. In eastern and central Europe, thermal energy consumption in residential buildings is often averaging two to three times higher than that of similar buildings in Western Europe (Balaras et al., 2000). Loss of energy in apartment buildings constructed in Moscow between 1953 and 1964 makes up 30–40%; internal engineering equipment sometimes is far from suitable for use. Part of such apartment buildings was demolished. However, in view of the problem related to settlement of people from demolished houses, a research was performed and revealed that the foundation of such five-storey buildings would be able to support another 5 storeys, while the general deterioration of a house was about 30–50%, meaning that the deterioration of the supporting structures was 10–15%. Thus demolition of such buildings was suspended and modernisation started instead (Martinovič, 2007). Estonia inspected about 200 buildings in various locations and determined that the average annual thermal energy consumption in apartment houses connected to local district heating systems is 256–315 kWh per one square meter. Studies show that thermal energy loss in residential buildings is 20–40% higher than planned (Sasi and Hääl 2002). Sitar et al. (2006) point out that the condition of blocks of apartment buildings in Slovenia is also problematic, and in some cases worrying. Apartment buildings constructed in 1940s, 1950s and 1960s are in the most critical condition. About 20% of Hungarian families live in apartment houses constructed using industrialised technologies–mostly prefab reinforced concrete structures. Many were built in 1960s. They HVAC systems are outdated, and damage to buildings increases and becomes more serious (Zöld and Csoknyai, 2005). In Denmark, external walls in residential buildings constructed before 1960 account for most thermal energy losses (Tommerup and Svendsen, 2006). In the Netherlands, most residential buildings were constructed between 1945 and 1965: they lack quality and comfort. The technical condition of such buildings witnesses limited possibilities of those times, as the houses have single glazed windows, no thermal insulation at all, just a wall of perforated bricks, thermal bridges, tile roofs without insulation and outdated layouts (Ham and Wouters, 2006). Bluyssen (2000) states that the main indoor comfort issues in European residential houses are noise, insufficient thermal comfort, humidity, air quality (inadequate ventilation), etc. The research results of Jo and Sohn (2009) show that temperature and humidity make a significant impact on indoor microclimate. Replacement of old windows often means reduced quality of air due to inadequate ventilation (Roberts, 2008), but the thermal transmittance of new windows may be lower three times.

Most people in Lithuania (as many as 66%) live in various types of apartment houses built between 1961 and 1990 (Girčys et al., 2005). The houses were constructed following the Soviet norms, which stipulated particularly low energy efficiency requirements (Burinskienė, 2003). There are currently about 30000 apartment houses in our country, and their modernisation is necessary. There are a handful of types: about 7 types of large-panel houses dominate (see Table 1), followed by 6 types of brick houses and 4 types of monolith houses. About 59% of flats in Vilnius are in large-panel apartment houses.

The key problems, defects and flaws of the condition of large-panel houses are common across all types, and also similar in case of brick houses and monolith houses. The oldest large-panel houses in Lithuania are about 50 years old, but they still have not had major repairs. Privatisation of flats in Lithuania came without the experience and traditions in facilities management (Martinaitis et al., 2007). Lack of proper maintenance caused significant wear of apartment houses. Their quality is very poor and demands for urgent modernisation. Although the Civil Code of the Republic of Lithuania (LRS, 2000) sets a legal basis for a flat owner "to take the necessary measures without prior consent of other owners (users) in order to prevent damage or eliminate threats to parts of common use, and demand from the other owners of flats and premises reimbursement of expenses in proportion to the share of these owners in the common partial property", separate owners are not keen to apply these rules. They fail to ensure proper maintenance of such common partial property and timely repair needed by parts of common use. Moreover, separate owners of flats cannot handle issues related to inefficient energy use in their apartment houses either. Housing retrofit and maintenance projects were almost absent until 1996. The data of the Ministry of Environment of the Republic of Lithuania

Table 1. Features of apartment houses

Series No.	Total heated area, m^2	Number of floors	Number of flats	Number of stairways
1-464LI-18/1	1725	5	30	2
120V-06/1	1069	5	20	1
1605A	2876	5	60	3
1-464A-14LT	5803	5	120	8
120V-027/1	2212	9	36	1
1-464LI-53/1	3783	9	72	2
1/3905	2890	12	60	1

shows that after initiation of the experimental project for energy saving/housing some 700 apartment houses have been partially renovated in Lithuania; however, there are many more to be modernised.

The layout of flats in the oldest apartment houses, particularly early large-panel houses, is outdated and fails to meet modern requirements. They lack auxiliary premises, all sanitary fittings are in the same room, kitchens and entryways are small, and there are some communicating rooms (Karvelis et al., 1998). Apartment houses are far from economical, their windows, walls and internal partitions have poor thermal and noise insulation properties, the heating systems are outdated, they lack ventilation and are known for bad indoor microclimate. Apartment houses with the usable area smaller than 500 m^2 use most thermal energy, which makes up 243 kWh/m^2; while those with usable area over 1500 m^2 use the smallest amount of thermal energy, which makes up 147 kWh/m^2. However, modernisation efforts help to cut these numbers by half (see Figure 1).

Thermal properties of envelopes in large-panel houses, and in most other apartment houses built before 1993–1996, fail to meet the requirements set by construction normative documents (Raslanas et al., 2004). Juozaitienė (2007) states that thermal energy consumption in such houses is twice as large as in Scandinavian countries and 1.75 times as large as in new apartment houses constructed in Lithuania.

A large portion of large-panel houses (older in particular) is a source of troubles for their inhabitants because of the leaks between panel joints. Lack of tightness at panel joints often causes the walls to become damp, while in winter they may even freeze in. Such events damage finish and decoration in rooms, boost thermal transmittance of walls thus causing ever-increasing loss of heat. Indoor microclimate also deteriorates. The loss of heat through the envelope in most apartment houses exceeds the norms twice, while the properties of separate envelope elements may be as many as 4–4.5 times worse than the established norms (Table 2; STR 2.05.01:2005). Analysis of roofs shows that their main defects are related to water leaks through joints of roll roofing with parapets and vertical structures, and through the roofing itself. Leaks at parapets often cause the wall structures to become damp, which is particularly obvious in brick buildings. Water penetrates the roofing, makes the thermal insulation damp thus boosting heat loss, damaging finishing in rooms and causing unacceptable sanitary conditions.

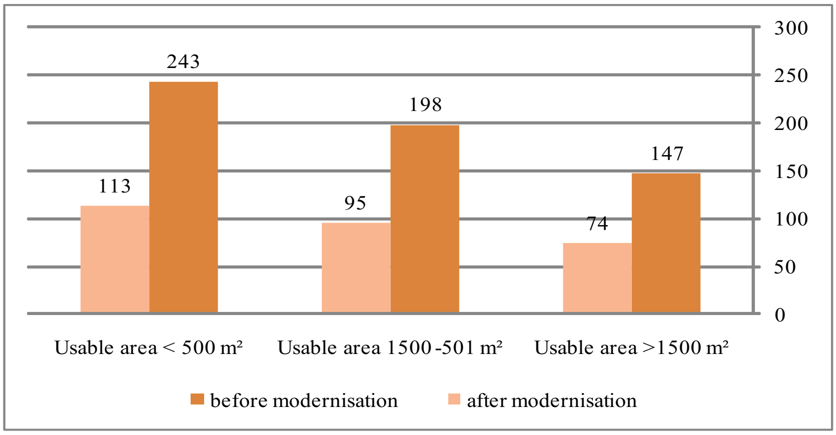

Figure 1. Annual thermal energy consumption per 1 m^2 (kWh) of usable area (Būsto ir urbanistinės plėtros agentūra, 2009)

Table 2. Standard values for thermal transmittance of building's envelopes U_N, W/($m^2 \cdot$K) and for thermal transmittance Ψ_N, W/(m$\cdot$K) of linear thermal bridges

Envelope	Mark	Residential buildings	Non-residential buildings	
			Public	Industrial
Roof	r	$U_N = 0.16 \cdot \kappa$	$U_N = 0.20 \cdot \kappa$	$U_N = 0.25 \cdot \kappa$
Floors, bounded with outside	ce			
Envelops of heating rooms, bounded with ground	fg	$U_N = 0.25 \cdot \kappa$	$U_N = 0.30 \cdot \kappa$	$U_N = 0.40 \cdot \kappa$
Floors above cool cellars	cc			
Walls	w	$U_N = 0.20 \cdot \kappa$	$U_N = 0.25 \cdot \kappa$	$U_N = 0.30 \cdot \kappa$
Windows	wd	$U_N = 1.6 \cdot \kappa$	$U_N = 1.6 \cdot \kappa$	$U_N = 1.9 \cdot \kappa$
Doors	d	$U_N = 1.6 \cdot \kappa$	$U_N = 1.6 \cdot \kappa$	$U_N = 1.9 \cdot \kappa$
Linear thermal bridges	t	$\Psi_N = 0.18 \cdot \kappa$	$\Psi_N = 0.20 \cdot \kappa$	$\Psi_N = 0.25 \cdot \kappa$

According to benchmarking with thermal insulation of public buildings, the thermal transmittance of roof U_r is equal (STR 2.05.01:2005):

$$U_N = 0.20 \cdot \kappa, \quad (1)$$

where: $\kappa = 20/(\theta_i - \theta_e)$ – correction of temperature; θ_i – indoor temperature; °C; θ_e – mean outdoor temperature for heating season.

Studies of large-panel houses in Vilnius by Ignatavičius (2009) revealed the worst situation to be with vertical joints between external panels of basement walls, which are usually cracked in multiple places. The protective plaster is gone in some places; and they are not covered with mastic. Such joints easily accumulate atmospheric humidity and a number of pollutants, which cause damage to external basement walls. We do not have any data sowing any major repair or retrofit of such joints within the lifecycle of such buildings. Heat loss through floors in ground floors needs a particular attention, because the majority of apartment houses have basements, and the basement temperatures are very important for indoor comfort in ground floors and heat loss through the floor (Šimkus et al., 2002).

Panel surfaces of external walls in façades of most large-panel houses are cracked; the cracks accumulate humidity and pollution, which, in turn, negatively affect the aesthetic properties of walls, their physical condition and thermal insulation (Ignatavičius, 2004; Ignatavičius et al., 2008; Zavadskas et al., 2008; Kulakauskas et al., 2004). Internal walls in apartment houses are in good repair. Although sometimes they are cracked, such cracks are mostly due to natural settlement right after construction and do not change. General wear of internal walls is up to 10%, general wear of external walls between 10% and 30%, while general wear of roof brackets and parapets in large-panel buildings is between 10% and 45%. The condition of balconies in apartment houses is probably the worst, sometimes even critical. They are the most worn elements–up to 50%. Due to poor water proofing, poor condition of flooring and corroded metal parts, water penetrates through to the balcony's panel, erodes concrete and causes corrosion in reinforcements. The outlines of reinforced concrete slabs are, however, in better condition when balconies are glazed, because such balconies prevent accumulation of precipitation and pollution, which, in turn, means less precipitation and pollution on reinforced concrete slabs and less damage.

Metal parts and water proofing of entrance roofs are also worn, water penetrates through to the slab, erodes concrete and corrodes reinforcement. The stairs, platforms and roofs of entrances are often in critical condition, while the wear of flights of stairs and their platforms is 10–25%. Although faults of these elements do not affect the overall strength of a building, they pose danger to people and damage the appearance.

Windows and external doors of most apartment houses are worn and are aesthetically hardly pleasing; such windows and doors cause up to 45–50% heat loss. People seal old windows or replace them themselves. Thus windows in one house are often of various types and colours, different materials, with different thermal insulation parameters, questionable ventilation, etc. Such practice disfigures façades and the general image of an area and a city. Examples of such apartment houses are ample across Lithuania.

Structures of apartment houses in newer residential areas of Vilnius are in sufficiently good repair, the flats have average or good layouts and their engineering systems are of satisfactory condition. From an architectural perspective, however, residential areas with typical apartment houses look monotonous, lack vitality and are less aesthetically pleasing.

The main problems with residential spaces are as follows: lack of parking lots, playgrounds, pedestrian walkways and bikeways; also insufficient attention to the needs of disabled people. Newer residential areas of Vilnius, such as Pilaitė, Pašilaičiai and Fabijoniškės, lack green spaces. People who chose to live in apartment houses care about their environment, noise levels, air quality, safety, neighbours (Raslanas et al., 2006) and other aspects; however, most of these features in Vilnius lately deteriorated due to insufficient maintenance of apartment houses (Zavadskas et al., 2008d).

General harmony in the appearance of cities and suburbs is missing, as well as public infrastructure and public spaces necessary for the best quality of life. Up to now, the focus has been on particular detailed plans for private parcels (Narvydaitė, 2008), while such focused planning and development of a parcel rather than a block or an area cause extensive damage to urban and national landscapes (Šulcienė, 2008). One of the main reasons behind such situation is lack of territorial planning norms to ensure the quality of life. It causes urban sprawl, which means access problems and more difficulties to ensure engineering infrastructure in line with contemporary principles of sustainable development. Sector approach affects the environment and utility services, also further depletes energy resources and heritage resources, and boosts social exclusion (Darni urbanistinė plėtra Lietuvoje, 2008).

The data of Statistics Lithuania shows that, at the end of 2007, Lithuania's housing stock included 82.1m square meters of usable area. Since 1995, our national housing stock increased by almost 10%. Soviet residential areas fail to meet the today's requirements. Also, social mix of residents in such areas has changed, and some new residential buildings and social infrastructure objects have been built in free spaces. As said, population densities in areas set for planning are not regulated, thus systematic errors occur, because areas become overpopulated or underpopulated. Municipalities find it difficult to change engineering infrastructure, street networks and public transport.

Insufficient maintenance and management leads to deterioration of residential houses and areas; they become uninhabitable. The importance of ongoing maintenance if often underestimated (Reichelt, 2006; Reichelt et al., 2008; Zavadskas et al., 2009; Otto, 2008; Maliene et al., 2008). The data of Statistics Lithuania suggests that residential houses in Lithuanian cities and towns are worn in physical, economic and functional terms. With increasing energy prices, many households are struggling with their bills. Dormitory-type apartment houses are considered especially problematic. The data of Statistics Lithuania shows that about 3% of Lithuanian housing stock show signs of critical condition as stipulated in the Construction Regulation STR 1.12.01:2004. Data of 2008 shows that, among Lithuanian urban municipalities, Kaunas (9.8%) and Šiauliai (5.4%) had the largest portions of such dwellings (Statistics Lithuania, 2010).

Problems with physical and social infrastructure in residential areas, as well as issues of social housing, eco-friendliness, building modernisation, transport and engineering infrastructure are currently of particular importance.

The cities of Lithuania try to handle the following key issues (LR Aplinkos Ministerija, 2008):

– uncoordinated development of city centres and suburbs;
– the current urban structure in towns and cities has considerable functional zoning, is insufficiently compact, lacks multifunctional and polycentric properties;
– uncoordinated development of cities and outskirts: underdeveloped external streets and roads, underdeveloped suburban centres, shrinking industrial territories in urban periphery and outskirts, still unbalanced numbers of jobs and places for residence;
– insufficient quality and image of physical environment in cities and residential territories (extensiveness of building density, lack of infrastructure, lack of green spaces);
– high mobility of people (more and longer trips due to the features of functional and physical structure);
– insufficient density of street networks;
– worse urban environments: deterioration of buildings, expanding wastelands (uninhabited areas);
– increasing unemployment, unbalanced social structure;
– emerging differences of the quality of life in central and peripheral areas: central parts with the best physical quality of residential environment have the highest concentrations of traffic and jobs, suffer from pollution issues, pedestrian and traffic conflicts, and issues of social environment; while peripheral areas with underdeveloped physical and functional structures mostly suffer from issues related to engineering and social infrastructure and lack of public transport.

These differences bring about negative processes: emigration or forced mobility of people, degradation of separate areas, social segregation and hindrance to sustainable development. All these problems affect urban economy, social and eco environment, the quality of life.

4. STRATEGIES FOR MODERNISATION OF AREAS WITH APARTMENT HOUSES AND THE RELATED SCENARIOS

Strategy is interpreted as use of available resources, skills or competencies to achieve goals in view of environment limitations or risks. A strategy can implement one or several goals. Certain scenarios must be developed for relevant strategies, because strategies stand on scenarios. Scenarios help to show possible outcomes achieved using certain measures.

Strategies for modernisation of areas with apartment houses must have the following key goals:

– to improve living standards and the quality of environment;
– to cut energy consumption and CO_2 emissions;
– to maintain mixed social structure;
– to integrate new buildings in the existing environment in a sustainable manner;

- to develop an urban centre of a residential area as a functioning part of the city;
- democratic planning;
- close cooperation of partners involved in modernisation;
- lasting retrofit and facilities management.

Gorgolewski (1995) and Balaras et al. (2000) state that to achieve optimum energy saving, the most efficient groups of energy saving measures must be set for modernisation of buildings, the best scenario must be selected and the main investment geared towards such scenario. Economic efficiency of building retrofit depends on implementation of energy saving measures (Ginevičius et al., 2008; Zavadskas et al., 2008a,b,c; Kaklauskas et al., 2004). Johansson et al. (2007) state that a politically reasonable way to do this in Sweden would be to suggest municipalities preparation of "the best strategies" for various types of buildings, and then such strategies could be recommended for certification of energy performance in buildings. Alanne (2004) suggested a method that would facilitate finding a project for lasting retrofit actions geared towards retrofit of residential buildings. However, for retrofit to be lasting and efficient, modernisation of an entire residential area must follow an action plan and strategies.

In view of climate change and big energy consumption, it is important in residential sector to understand and promote new technology and efficient use of energy and renewable energy resources. Buildings must be renovated taking every opportunity to use progressive building materials and processes as eco-friendly as possible, which means using "eco-packages" such as:

- rainwater for gardening and special tanks for toilet flushes;
- solar energy for hot water;
- photovoltaic installations for additional electricity;
- choice of building materials following strict environmental criteria;
- possibilities to reduce waste.

Both physical and economic retrofit of an area is essential to ensure return on investment into energy saving, because, in addition to its quality, a building's value is also determined by surrounding buildings, infrastructure and quality indicators of the area in question (Sunikka, 2006). Redesign of residential environment should attempt to include all buildings, to ensure both practical value and the feel of cosiness and modernity. New designs of building façades can be highlighted by colour shading and by bringing out polished pigmentation with bright shades of foundations, parapets and colours of canopies. Blocks of an area can have their individual image: artistic, garden, park or other themes.

The rainwater collected from roofs and directed through rainwater pipes to underground tanks could be used to irrigate yards and flower beds or for ponds with surrounding green spaces, recreational areas or any other such spaces.

Modernisation of residential blocks is related to improved quality of life and new architectural solutions, which give residents a chance to "live outdoors" (spacious balconies, terraces, etc.). Glazed towers with elevators attached to five-storey buildings would boost the quality of life, the architectural appearance and the value of apartments.

Larger income persons try to move out of outdated city blocks that need retrofit, because such blocks lack suitable apartments. Such areas face the threat of lost social balance. Since many people want high quality dwellings and part of them move to areas of single-family houses, we must construct various dwellings and to create the city atmosphere.

Since the requirements and needs of people towards housing increased and changed, this strategy aims to stabilise mixed social structure and to provide a set of diverse and attractive offers:

- construction of new apartments;
- layout redesign in buildings;
- diversity of the forms of ownership;
- improved equipment and installations;
- social housing;
- foster homes for elderly people and children.

Residential houses should form blocks: the free spaces must be populated with buildings and the perimeter of blocks must be closed from the outside but have open areas inside. Retrofit of an area also demands for other solutions, such as gardens and sculptures on some roofs and construction of additional floors on existing houses. The old large-panel construction usually restricts architectural solutions, as it is difficult to change the layouts of flats due to the internal load-bearing walls. But the opportunities to improve architectural aspects, however scarce, are available: entrances could be replaced by glazed porches, floor area could be increased by connecting the glazed balcony to a room, the kitchen could be joined to the sitting-room by cutting an opening in an internal wall, floor areas of bathrooms could also be increased.

Retrofit of residential blocks must also consider social housing for low-income young and large families, for orphans or disabled people. Possibilities to set up a medical facility, a foster home, a home for overnight accommodation or any other similar facility must also be considered.

Before their modernisation, residential areas usually have inadequate infrastructure: lack of shops and lack of any signs of cultural life. The trends of extensive construction, with large internal unbuilt areas, dominated in Lithuania for quite some time (Turskis et al., 2006); thus cities are sprawled and far from compact, while central parts of residential areas also lack concentration. Without viable centres of attraction, such areas cannot be developed as functioning areas. The most important aspect of this strategy is to create an area's central part by determining its best location for each area and then attracting residents with a range of services and leisure activities: for instance, one area has a park, another an old cinema or some abandoned buildings, which after retrofit and population with service companies, playgrounds and other facilities can become an attractive spot not only for recreation and the key needs but also for leisure activities. Parks can be renovated by digging ponds, planting bushes and trees, also by building playgrounds, sites for skaters and artificial rock walls for climbing.

Residential areas with apartment houses lack green spaces, their social infrastructure is inadequate and there are no facilities for recreation. Part of unused spaces in such areas should be planned for recreation, including walkways and play-fields close to homes. The environment could become cosier, should teachers, schoolchildren and their parents plant some flowers, trees and bushes in school and kindergarten territories. Benches, railings and wastebaskets could also be constructed upon request. Involvement of people in the process of modernisation would see them more caring and respecting their renovated environment. The solutions related to retrofit of residential areas make direct impact on residents. Therefore, it is very important to involve society in planning processes. From experience, expenses for public awareness and explanations pay dividends by clearly improved consent to planning solutions, which, in turn, speeds up the planning procedures (Projekt Großsiedlungen, 1996). Since most people live in apartments which they own, cooperation between the planners and society is a must. The concept of planning processes involving residents is part of further development of residential blocks. Meetings of architects and planners with people, entrepreneurs and politicians speed up implementation of offered solutions:

- arrangement of yards;
- optimisation of walkway networks;

– moving of waste containers;
– improved situation with parking.

Improvement of the legal basis, which governs setting up of tenants' associations and maintenance of residential buildings, implementation of the Modernisation Programme for Residential Houses, retrofit and modernisation of dwellings and improvement of their energy performance would cut thermal energy consumption and would improve management and maintenance of dwellings (LR Vyriausybė, 2009). Retrofit of all buildings would be an important step towards modernisation of a neighbourhood, while project implementation would have strict deadlines. Residents involved in preparation for modernisation and in each step of construction would have more interest and would actively supervise the work.

One of the goals set in strategies is to improve the quality of life with involvement of residents. Buildings can be renovated without the need for residents to move out temporary, one stairway after another, following a certain schedule. Those unwilling to wait for their turn specified in the schedule would be allowed to renovate their apartments themselves. Professionals have been invited to form the counselling service "Do It Yourself".

One of the advantages in residential areas with apartment houses is a neighbouring recreational zone. Harmony between housing and nature is a strategic task for further development of multi-storey housing (EXPO 2000 Hannover, 2000). Retrofit should attempt to maintain the pervious natural environment, while new yards, planted bushes, trees and flower beds should create the "green" quality of life as an inseparable distinction of a residential area.

Cooperation of partners is highly important in any modernisation process, modernisation of residential areas among them. Municipalities, authorities, construction companies, designers, architects and residents must cooperate closely, organise discussions and make joint, possibly halfway, decisions. To achieve good results, all these different people must cooperate (Naaranoja and Uden, 2007).

Scenarios based on relevant strategies must define the retrofit measures, their priority and their potential effect.

Four portfolios of retrofit measures–portfolios for small, average and large investment and a portfolio of "basic" measures–can be prepared to determine the preliminary investment and its economic efficiency. The small investment portfolio would foresee replacement, reconstruction or retrofit of building elements and systems in critical and worst condition. It is attractive due to rather smaller investment, but means only slight improvement in the thermal properties of the envelope (only windows and doors) and architectural-aesthetical appearance (only due to replaced windows). Another drawback is that, in such case, deficient measuring of heat consumption (by floor area) will be retained and the possibility to control heating in each flat will not be installed.

The average investment portfolio ensures better energy saving and rather high economic efficiency. Individual heating meters and regulation of heating intensity encourage people to save more energy and, depending on their consumption habits, the savings of thermal energy could be higher. Such portfolios also foresee minimal measures for landscaping. Nevertheless, the architectural-aesthetical appearance after implementation will hardly change and walls (except for back façades) will still fail to meet modern norms.

The large investment portfolio helps to achieve the highest quality: the envelopes will meet the requirements of heat preservation and the heating systems will be technologically most advanced (precise heating meters, possibilities to heat premises or to turn off heating irrespective of the heating season, also repairs or emergency in one flat will not demand turning off of the entire system of the house). The house will be as economical as new houses. However, the investment is large and people rarely can afford it. This portfolio is more suited for prestigious areas, because a slanting roof and some additional apartments can be constructed, which means new housing for sale, which, in turn, means a possibility to reduce the sum of investment.

The “basic” portfolio ensures that envelopes will meet the requirements of heat preservation, structures will have sufficient mechanical resistance and durability, and a more advanced heating system and individual heating meters will be installed. This portfolio also foresees minor landscaping.

The paramount measures for retrofit of apartment buildings and landscaping must coincide with the strategic goals which define the city’s image and the improvement of housing and residential environment. Various areas set different priorities for measures, because the condition of buildings and their environment differs. Therefore, retrofit of buildings must consider the zoning and must be based on territories; it means that blocks/areas must be renovated following a priority order and the retrofit must be integrated–buildings must be renovated and the environment arranged and modernised.

5. CONCLUSIONS

Retrofit of buildings and their environment is one of the forms of urban development. Both in Lithuania and in other countries, it should help to solve energy and environmental issues and to improve the quality of life. Therefore, retrofit should comply with the sustainable development requirements. Retrofit of apartment buildings constructed in earlier decades and their environment is an increasingly important objective. In view of climate change, aging housing stocks and big energy consumption, it is important to promote integrated retrofit of residential areas in residential sectors of a number of countries, and to understand the importance of efficient modernisation, new technology and use of renewable energy resources.

In Lithuania, most residential areas were built in the Soviet times; the areas lacked proper maintenance and currently most fail to comply with the technical requirements. Some apartment houses are in critical condition. The need to renovate dwellings and their environment grows, but the retrofit is encumbered by lack of clear and unified requirements. Absence of territorial planning norms that ensure the quality of life makes a serious negative impact on territorial planning and sustainable development, there is ample space to manipulate laws.

General harmony in the appearance of cities is missing, as well as public infrastructure and public spaces necessary for the best quality of life. Residential areas with apartment houses lack green spaces and recreational areas, their social infrastructure is poor. The main issues facing the residential environment are lack of parking spaces, playgrounds, walkways and bikeways, also insufficient attention to the needs of disabled people.

The retrofit efficiency of apartment houses depends on numerous factors. However, presence of an action plan–a strategy–for retrofit and sticking to the plan is one of the keys to success. The strategy’s goals are to improve the quality of residential environment, to reduce pollution and energy consumption, to maintain mixed social structure, to integrate new buildings in the existing environment in a sustainable manner, to develop vital centres of residential areas, to plan democratically, and to cooperate closely involving residents in retrofit processes. Implementation of these goals should warrant the best result.

Retrofit scenarios based on relevant strategies must define the retrofit measures, their priority and their potential effect. The scenarios, therefore, must be selected considering the priority of areas/blocks to be renovated and the relevant measures, and the retrofit must be integrated–buildings must be retrofitted and the residential environment arranged and modernised.

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SANTRAUKA

DAUGIABUČIŲ NAMŲ GYVENAMUOSIUOSE RAJONUOSE BŪKLĖS, PLANAVIMO PROBLEMŲ IR ATNAUJINIMO STRATEGIJŲ BEI SCENARIJŲ ANALIZĖ

Saulius RASLANAS, Jurgita ALCHIMOVIENĖ, Nerija BANAITIENĖ

Daugiabučių gyvenamųjų namų modernizavimas šiuo metu yra ypač aktuali problema ne tik Lietuvoje, bet ir daugelyje kitų šalių. Kad modernizavimas būtų efektyvesnis, daugiabučius reikia atnaujinti kompleksiškai, modernizuojant visą kvartalą, rajoną, vadovaujantis darniosios plėtros principais. Šiame straipsnyje aptariamos gyvenamųjų kvartalų, rajonų atnaujinimo planavimo problemos, analizuojama daugiabučių ir jų aplinkos būklė. Siūlomos daugiabučių rajonų atnaujinimo strategijos, kuriomis siekiama: gerinti gyvenimo standartus ir aplinkos kokybę, mažinti energijos suvartojimą ir CO_2 emisiją, išlaikyti mišrią socialinę struktūrą, darnų naujų pastatų integravimą į jau egzistuojančią aplinką, plėtoti miesto centro kaip funkcionalios miesto dalies daugiabučių namų rajone sukūrimą, demokratinį planavimą bei prie modernizavimo prisidedančių partnerių glaudų bendradarbiavimą. Scenarijai, grindžiami atitinkamomis strategijomis, privalo apibrėžti renovacijos darbų priemones, jų įgyvendinimo prioretiškumą ir būsimus poveikius.