Sustainable retrofitting of blocks of flats: environmental, economic and social aspects

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Abstract: - One of the most debated issues today is to find innovative and cost-optimal solutions for retrofitting the existing building stock adapted to the local market in order to assure the commitment for the 20-20-20 EU policy. As the dwellings are responsible for around 70% of the total final energy use in buildings, retrofitting these types of buildings represent a challenge for the next decades and also an opportunity for implementing sustainable building solutions. The strategy of rehabilitation of the neighbourhoods made of collective dwellings should be based on a holistic approach, which takes into account all aspects of sustainability: environmental, social and economic, along technical and functional issues. This research paper presents the initial findings and proposals of an extensive interdisciplinary approach that takes into account all the pillars of sustainable development. The case study is a neighbourhood in Timisoara made of collective dwellings from prefabricated blocks of flats built in the '80s with one of the models having the poorest living conditions in terms of space and energy efficiency, 770 Model, widespread in Romania.

Key-Words: - Blocks of flats, retrofitting, sustainability, collective dwellings, interdisciplinary research, building sustainability assessment

1 Introduction

According to EU statistics, in 2009 European households were responsible for around 70% of the total final energy use in buildings, space heating being the most energy intense end-use in EU houses. It is obvious that the policies addressed to the retrofitting of this part of the building stock are crucial.

One of the most debated issues today is to find locally adapted measures that can be taken in order to assure the commitment for the 20-20-20 EU policy (the reduction of CO2 and GHG emissions, increasing energy efficiency and using renewable energy) and to find innovative and cost-optimal retrofitting solutions adapted to the local market [1].

Around 60% of the urban population in Romania live in an apartment situated in blocks of flats made of prefabricated panels, built mostly between 1960 and 1990.

The overall quality of the blocks of flats and these neighbourhoods has been degraded continuously and the tenants usually do not have the financial possibility to invest in refurbishment. On a long run, this may cause considerable social and economic problems.

In order to prevent this, several measures have been taken, such as rehabilitation programs, but besides the fact that they are very few and they lack financing, they bring partial and uncoordinated solutions.

It is important to realize that the rehabilitation of these neighbourhoods cannot rely only on solving some technical issues. Most of the examples of good practice regarding collective dwellings retrofitting take into account mainly the ecological pillar. Instead, the strategy should be based on a holistic approach [2], which takes into account all aspects of sustainability: environmental, social and economic, along technical and functional issues. This research paper presents a part of work from three doctoral researches in progress related to all the aspects of sustainable retrofitting and the current general results of an extensive interdisciplinary research performed by team up-Tim for the competition Solar Decathlon Europe 2014 *(*www.solardecathlon2014.fr/en*)* that takes into account three levels: the neighbourhood, the block of flats and the apartment.

2 Retrofitting the blocks of flats – from weaknesses to opportunities

The goal of such an intervention is to meet specific needs of the Romanian context and the local requirements and possibilities by identifying the opportunities and proposing the most viable and affordable solutions adapted to local context.

2.1 Specificities of the building stock made of blocks of flats in Romania – from weaknesses to opportunities

The study carried out in 2011 by the Building Performance Institute Europe reveals some specificities of the Romania's building stock comparing with the other European countries [3]. There are some other sociological studies [4] and also the results of population census [5], which complete this information with accurate data or information about the perception of population regarding their dwellings.

The Building Performance Institute of Europe studies reveal Europe's general situation regarding the apartment blocks. Compared to the percentage of residential constructions built between 1961 and 1990 in EU, Romania's percentage is rather high (60%). The main problem is that Romania is at the bottom of the list regarding the apartment's area allocated to each person, with 20 m²/person / apartment, while South Europe provides 31 m²/ person and North-West Europe leads with 36 m²/ person. The sociological studies performed in our country reveal that dwelling satisfaction increases steadily with each additional square meter, up to a point. A logical conclusion is that inhabitants will desire more space in the future, a trend that is already visible looking at residential constructions in Romania after 1990.

Another important issue is that Romania has 95% owner-occupied residential buildings, by far the highest percentage among all the European countries. Romania is in the third place in Europe with dwellings in property by private owners. This is a sign of a well-developed sense of ownership and a fact that housing is perceived as a good long-term investment.

As a conclusion of this big picture that can help to establish innovative market schemes, one can say that private property is regarded as an important issue and, as presented in another research [6], there are examples of bottom-up approaches developed in the past decade and the owners are willing to pay for improving the living conditions.

2.2 Criteria and parameters used for building sustainability assessment systems and related standards

The indicators common to the most widely used building sustainability assessment systems (LEED, BREEAM, SB Tool, DGNB) have a number of characteristics that have already been accepted. Even if these criteria can be found under slightly different names in various systems, they are the same. In some comparative studies performed under a doctoral research [7], they were grouped under the three pillars of sustainable development. The parameters used in ISO and CEN / TC 350 will complete the picture of a sustainable building.

The environmental pillar contains the following common criteria:
-climate change and environment – with the following parameters: global warming potential GWP and CO2 and other emissions;
-water efficiency – with the following parameters: potable water use and rain water use, reduce water use, water drainage;
-land use and ecology – with the following parameters: land use and site development, adequate planting;
-materials and resources – with the following parameters: materials with a low degree of toxicity, reused and recycled materials, local materials and waste management;
-energy – with the following parameters: energy efficiency and use of renewable energy.

The economic pillar contains the following common criteria:
-life-cycle costs – with the following parameters: life-cycle costs and minimizing the construction and operational costs;
-stability value – with the following parameters: flexibility and adaptability, a result adapted to the local market conditions, viability.

The socio-cultural pillar contains the following common criteria:
-the quality of indoor air and health – with the following parameters: thermal comfort, acoustic

comfort, visual comfort, indoor hygiene, natural lighting, the quality of indoor air;
-culture and architecture: aesthetic quality and regional architecture;
-innovation and process quality: innovation for sustainability and integrated planning;
-awareness and education: involvement of all stakeholders in the project and society education.

The technical and functional quality assessed separately or under the social pillar contains the following parameters: accessibility on site and in the building, efficient use of the interior surfaces, functionality, the feasibility of functional conversion, operating safety and fire safety.

Furthermore, the overall concept of buildings in terms of sustainability assessment according with standard series CEN-TC 350, namely EN 15643 [8], and EN 15978:2011 define five chapters, three on the pillars of sustainable development: environmental, economic and social performance, and that two related with construction: technical and functional performance. From the ISO series, the most important standard related to this issue is ISO 21929-1:2011 (Sustainability in building construction - Sustainability indicators - Part 1: Framework for the development of indicators and a core set of indicators for buildings) [9].

As mentioned before, even if the environmental parameters seem to have gained a wide acceptance, there are inconsistencies about the social sustainability assessment parameters, but there are some common indicators: accessibility, health and comfort (indoor conditions and air quality), adaptability of the building, safety and security.

As a conclusion, all these parameters should be taken into account when trying to find the most appropriate sustainable solution.

3 Sustainable retrofitting of blocks of flats made from prefabricated panels – case study: Timisoara, “Soarelui” neighborhood, the 770 model

Timisoara is the main social, economic and cultural center in the western part of Romania, with more than 300000 inhabitants in the city area and around 380000 inhabitants in the metropolitan area.

Around 40% of the inhabitants of Timisoara live in an apartment situated in blocks of flats made of prefabricated panels. These neighbourhoods occupy nowadays important surfaces in the city. From this building stock, in the studied neighbourhoods (Soarelui, Girocului, Torontalului, Lipovei, Aradului) 1102 blocks were identified as the 770 model, out of which 473 are Pa (43%), 390 Pb and 239 Pc.

Only 27% of these blocks are in their original condition and just 4% of the buildings are thermally rehabilitated. Furthermore, the blocks on which the inhabitants built a two-slope roof on the initial terrace represent 69% of the total number. In Timisoara, these types of interventions are most common, especially in the “Soarelui” neighbourhood, where 80% have this kind of intervention (Fig.1).

Fig.1 Timisoara map and “Soarelui” Neighbourhood

3.1 Case study: Timisoara, “Soarelui” Neighbouhood – Model 770 and general strategy for intervention

The focus of the extensive research regarding retrofitting the blocks of flats made from prefabricated panels is “Soarelui” neighborhood in Timisoara. There are two main reasons from sustainability perspective for choosing this district as a case study: from the ecological perspective, this was the neighborhood which was initially designed to implement renewable energy, namely solar energy (hence the name, meaning “Sun District” in English) and from the social perspective this is the district that has the most active neighborhood council formed by the tenants associations, which implies that implementation of new ideas with the community support is possible.

After analyzing a 770 Model, one can say that only an integrated intervention can solve the problems of such a building. But it can be done step by step, by using low-tech means and passive systems best suited to the local context (a developing country with low average income per capita and no high-tech knowledge).

The solution is adapted to local conditions and it is based on an integrated strategy involving the use of construction materials effectively throughout the lifespan of the building. The project improves the energy efficiency of the building envelope using innovative interventions by creating a coating, a new external layer that provides an effective relationship with the environment as well as a local source of energy by integrating solar and photovoltaic panels. The project also aims to improve existing methods of construction in Romania by creating and integrating an energy self-sufficient module that horizontally extends the apartment.

The proposed strategy consists of two different sets of consecutive measures as follows:

-the first step is to limit the energy demands (by improving the thermal insulation of the façade, by changing the windows and ensuring air tightness, by using class A appliances) and to improve the comfort of the interior space of the apartments and common areas with small scale interventions (redecorating, small interior changes that do not affect the structural system, etc.);

-the second step is to respond to 20-20-20 targets and the UE long-term goals, and, at the same time, to provide solutions for the local problems identified by a survey (to extend the living space, to offer common areas, to improve accessibility, to accommodate passive systems and mechanical ventilation with heat recovery systems, to use renewable energy and district heating, to use the space above the last floor in the best possible way).

3.1.1 The 770 type of blocks made from prefabricated panels

Some of the most common typology of blocks of flats in Romania are the 5-storey 770 and 1340 types, built between 1970-1985 and 1980-1990 respectively, the first offering the lowest living standards. All of these apartment blocks were created to be combined in different ways in order obtain a variety in the neighbourhood's pattern. However, the repetition produces a sense of confusion, as these districts do not have a visual identity.

The 770 type has been built extensively throughout the entire country. The spreading of these buildings made from prefabricated concrete panels demonstrate an efficient strategy oriented towards industrialization, affordability, transport and speed in execution. Every project type was developed starting from precise and rationally dimensioned prefabricated building components. In the case of the 770 type, 68 different prefabricated building components were used, ranging from vertical exterior and interior walls, ceilings, to staircases and even bathrooms, resulting in 88 different blocks of flats, grouped in 3 major types and 12 subtypes. The particularity of this model is represented by the 5 possible bay dimensions, measuring 2,40 m, 3,00 m, 3,30 m, 3,60 m and 5,40 m.

Based on the prefabrication strategy, three types of the 770 model were identified: Pa, Pb and Pc. Pa typology has 5 bay openings, double orientated apartments, and a staircase with two ramps of stairs. This typology has 4 subtypes: Pa1, Pa2, Pa3, Pa4. The first subtype, the Pa1, has two bay dimensions (3,60 and 3,00 meters). This type has three apartments on each floor, each with just two small rooms. Two of the apartments are double orientated, and only the middle apartment has two balconies only on one side. The Pb typology has 6 or 8 bay openings, and five types of bay dimensions, as mentioned before. This type of block has 4 apartments on the floor, all of them being single orientated. The staircase is made of a single flight of stairs, with no natural lighting in this common space. The Pc typology has only 4 bay openings with the same dimensions as the other types of blocks (five bay dimensions) and are used for the corners.

Analyzing the three types (Pa, Pb and Pc), several problems have been identified, such as the common space, the lack of elevators, the apartments dimension and the low level of comfort, sometimes insufficient natural lighting.

The apartment partitioning is also deficient for the present living standards, because they were conceived for a "standard family" with a "standard way o life". The contemporary living has shifted towards a more dynamic lifestyle, each family member having different jobs, different hobbies and thus, different way of living and using the interior space of a dwelling.

The retrofitting and refurbishment of these blocks of flats can be seen as an opportunity to develop an identity to the neighbourhood while finding solutions for improving the quality of life for all the inhabitants.

3.1.2 Overall and structural description of the Model 770, Pa1 type

The intervention focuses on Pa1 type of Model 770, the most common, having two room apartments. The current floor plan for the model with 3.00 meter bay is presented in Fig.2. The 770 Model has five levels: ground floor and four stories and is covered with a terrace roof.

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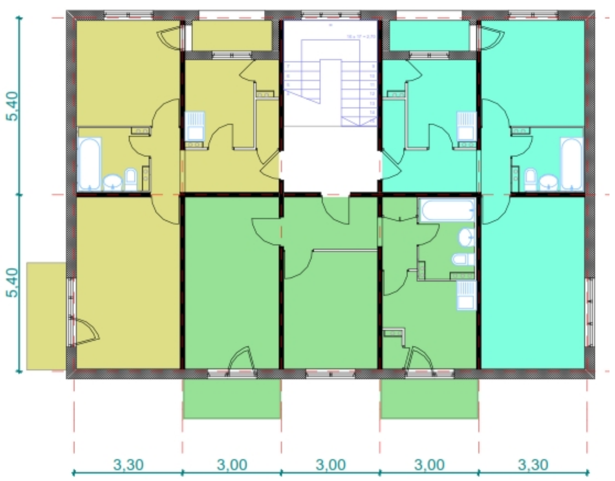

Fig.2 Current floor plan of the Model 770, Pa1 type

The structural system of Model 770, Pa1type is made out of prefabricated reinforced concrete panels on two directions and it has three bay dimensions: 3,00 m, 3,60 m and 5,40 m.

The foundation is continuous under the structural reinforced concrete walls and made out of concrete B75 (C4/5). The width of the foundation varies depending on the block typology, because the conventional pressure is different in all zones, but it is known that in time the load capacity of the ground rises by about 10-20 %, so stacking partial zones above the building, the extension of the existing rooms with a steel structure doubling façade and steel consoles could be possible without retrofitting the foundation of the buildings. Further calculations will show if retrofitting the foundation is needed. The structural walls of the technical basement are made of reinforce concrete B150 (C8/10) with a width of 20 centimeters.

The structural walls and floors of the ground floor and four stories are made of prefabricated reinforced concrete panels. The maximum weight of a panel is 5.1 tones because of the lifting capacity of the crane model MT110. The exterior walls are made of 3 layers and a width of 30 centimeters (12.5+2.5 cm of reinforce concrete B250 (C16/20) and 15 cm of CBA. The interior structural walls are made of reinforced concrete B200 (C12/15) and have a width of 14 centimeters, while reinforce concrete floor slabs have a width of 13 cm. The reinforcement is made out of steel, quality: STNB (fyk=400Mpa), PC60 (S420 or S405 or S395) and OB37 (S255 or S235). The joints are made by welding the steel from reinforced concrete and concreting with B300 (C18/22.5). The vertical walls joints are made as concrete columns and the horizontal joints are designed as belts under concrete. The thermal insulation is made of polystyrene with a width of 2.4 cm.

The stairs and landings are prefabricated. The bathrooms are made as prefabricate blocks and have all the equipments needed installed.

The structure studied has no cracks or rifts, the concrete isn't damaged and the reinforcement steel is not corroded. The concrete used follows all the concrete standards of that period (1975-1985), but it does not respect the actual concrete standards. The joints show a high degree of uncertainty because of the low standard on welding and the uncontrolled zones of the concreting on site. This problem implies a construction expertise that requires testing the existing panels and joints before applying the proposed solution.

3.1.3 Overall description of HVAC systems for Model 770 Pa1

The heating systems mainly used since then for these buildings are the centralized type. These systems produce thermal energy, which provides both heating and domestic hot water. Coal is used as primary fuel. Some energy plants were designed as cogeneration plants. The efficiency of this thermal energy use is around 43%.

Around the year 2000 apartments started to disconnect from the centralized heating systems and adopted individual heating systems using natural gas. In addition, these centralized systems also lack control systems which evidently result in energy losses (energy waste) not to mention thermal discomfort.

After 2008 the subsidies for thermal energy have been constantly reduced. This fact encourages more and more consumers to orient themselves to apartment gas fired boilers for lower exploitation costs, higher energy efficiency and better control thus adequate thermal comfort.

Natural ventilation was the designed option as a ventilation system. The windows were not airtight so infiltrations occurred. Along with energy inefficiency, the lack of control was the main problems. After double glazed vacuum windows entered the market, the infiltrations were not a problem anymore but practically the ventilation was reduced to the manual opening of the windows. As a result the wellbeing of inhabitants was negatively affected.

No air conditioning systems were thought of during the design phase. Only passive architectural solutions were adopted, e.g. balconies. As the technology evolved, in the residential sector split units became popular. This popularity has now

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reached the point in which the façades of apartment buildings have an “exterior split unit” look. The dripping of condensate on street sidewalks and generally on the building’s perimeter has become a normal consequence of better summertime internal thermal comfort.

3.1.4 Different scales of the approach

The approach has three levels: the neighbourhood, the block and the apartment. These were taken into account when proposing the strategy, both in terms of environmental and social sustainability issues. For example, even the common space follows this thinking pattern, as seen below (Fig. 3-5). There are a series of common spaces at different scales that can be remodeled in order to increase the sense of belonging to the community.

Fig.3 Common spaces in the neighbourhood

Fig.4 Common spaces in the blocks

3.1.5 The three scenarios of intervention of the building

The intervention can have three different approaches (scenarios of intervention) that affect the overall design.

The first scenario is that the intervention will be realized in a single stage by an investor or by a public-private partnership. In theory this is the most effective approach, but it requires a big amount of money and the common will of all the tenants, making it the solution less likely to be implemented in the Romanian context (due to the fact that 95% of the apartments are owner-occupied).

Another approach is to realize the usual simple type of thermal system and to provide the façade kit, letting each family to choose their own way to expand the living space. In order to avoid excessive shading and chaotic results, a regulation system will be established, that will take into consideration the building type and orientation. In this case, the main actor / investor will be the tenants association, with the support of public funds.

The third way of implementing the proposal is gradually, in order to be easier accepted by the dwellers. The first step consists in applying a steel structure on the façade that will support the structural loads of spatial extensions and at the same time will solve the problems of thermal insulation and also façade and space ventilation. Gradually, the residents will choose a type of extension kit, customizing it according to their needs. The final result will be a unitary gesture through a dynamic façade.

3.1.6 The upgrading kit

The research team considers the above mentioned sets of measures in the shape of an upgrade kit (Fig.5), rather than a project in itself. The kit is intended to offer a rehabilitation alternative to the collective dwellings by focusing on their specific drawbacks. The expected outcome of the proposed intervention is to upgrade the resident’s living standard and the improve the overall energy impact of such a building.

The upgrade kit consists of two main elements:

-the prefabricated cubicles representing the horizontal extensions of the apartments and the space above the building, used as common space and penthouse apartments; this part represents also an instrument for handling the financial scheme;

-the system use to improve the energy efficiency, reduce the CO_2 and GHG emissions and increase the amount of energy from renewable sources (the façade thermal system, the systems for heating, cooling and ventilation, solar panels, PV panels on the roof).

The prefabricated cubicles represent a local intervention, with spatial implications at apartment scale. Therefore, their dimensions are given by the height of the storey, the bay openings and on the functionality of the space it comprises. The dimensions of this kit component are determined by the bay standard dimensions and by some specifications about the extension's depth. The minimum extension is 1,20 m, beyond which the extensions are increasing, adding modules of 30 cm.

New functionalities can be added to ensure satisfying contemporary needs such as working space modules, reading alcoves, children's play space, yoga or meditation corners, greenhouse or even space for placing temporary items and storage.

Moreover, extending common areas such as intermediate stair landings can significantly improve the overall quality of life in the block. The creation of spaces that attract the common interest of the people such as multimedia rooms, common kitchens, party spaces, playgrounds for children will lead to the strengthening of the sense of community.

Fig.5 The upgrading kit for a block of flats

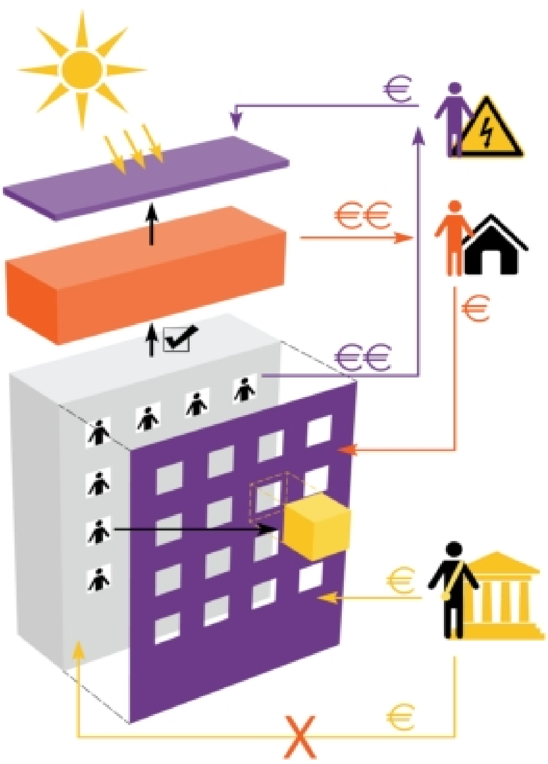

Fig.6 The scheme for the financial strategy

In parallel a financial strategy was developed, based on market models already present in Timisoara [6]: using the space of the terrace and the revenues that will come from the extensive use of PV above in order to finance the investment (Fig.6).

3.2 Environmental aspects of the sustainable retrofitting

The main environmental aspects related to the neighbourhood and the blocks of flats are related to the building services. At all levels (neighbourhood, square, block of flats), an integrated approach is proposed, in order to reduce energy consumption and to use renewable energy systems (solar panels, PV, hybrid ventilation systems with heat recovery), as shown in Fig. 7-9. The main problems of 770 model regarding building services were presented in chapter 3.1.3. The heating energy consumption in the buildings made of prefabricated panels is estimated between 180 and 240 kWh/m^2. As the energy price is constantly increasing and the population income is decreasing, many households are exposed to the risk of fuel poverty.

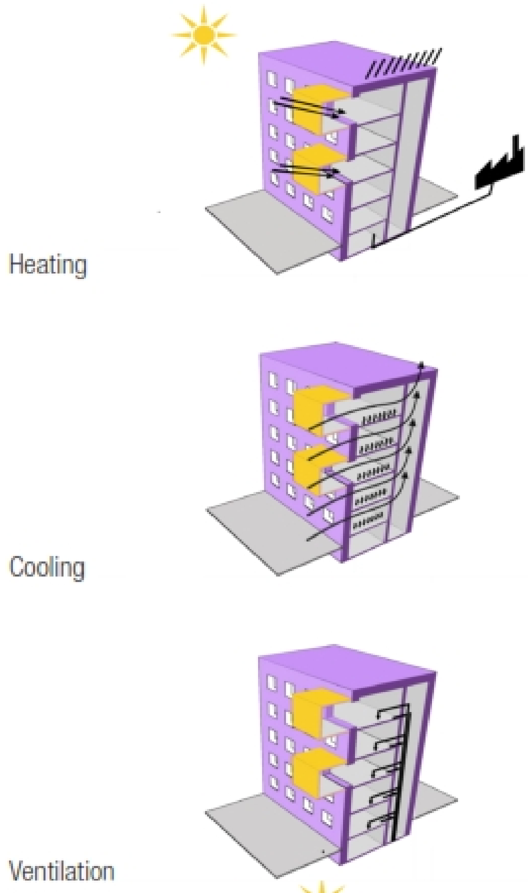

Fig.7 The scheme for heating, cooling and ventilation systems

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Fig.8 Solar thermal and PV systems

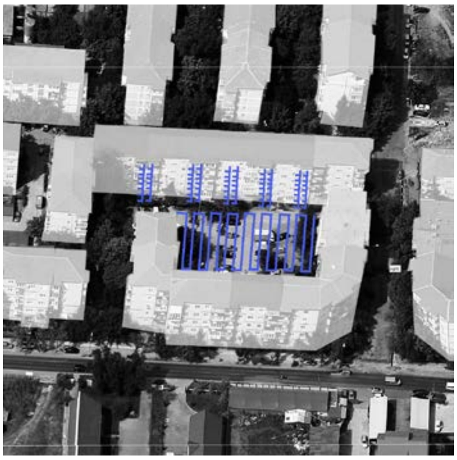

Fig.9 Hybrid ventilation with heat recovery

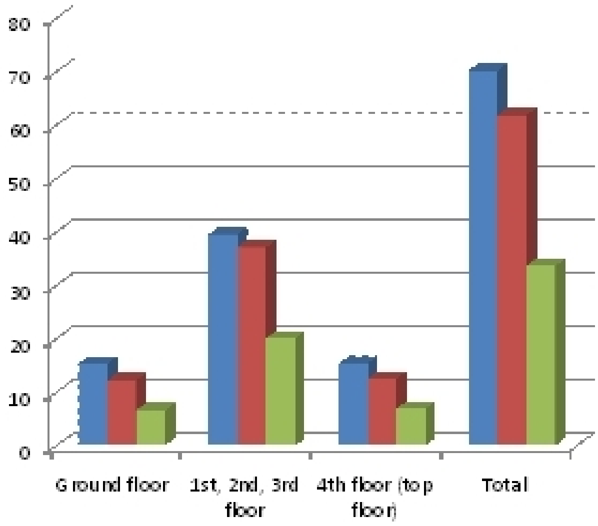

Fig.10 Heat energy demand

Fig.11 Monthly average water consumption

The annual energy consumption for heating is calculated using the outside average monthly temperatures according to SR 4839 standard for the heating period October 19th to April 9th (days with 10ºC daily average temperature - SR 4839). The calculation is made by staircase apartment building and includes 3 situations: the existent situation, the building envelope thermal rehabilitation and extract and supply mechanical ventilation system with energy recovery system (ground coupled air intake and energy recovery unit) situation.

After the rehabilitation the annual heating energy consumption is expected to decrease to up to 52%.

The design heat demands are calculated form Pa1 subtype of 770 Model according to the Romanian standard SR 1907 (Design heat requirements computation for buildings) for 3 situations (Fig.10 – blue – situation 1, red – situation 2, green – situation 3):

1.The existing situation / staircase – total 70,18 kW;

2.The building envelope thermal rehabilitation situation / staircase – total 61,84 kW;

3.The building envelope thermal rehabilitation and extract and supply mechanical ventilation system with energy recovery system (ground coupled air intake and energy recovery unit) situation / staircase - total - 33,62 kW.

As a conclusion, the calculations show that the installation of the mechanical ventilation system has a higher impact on the heat demand than the rehabilitation of the building's envelope.

For the calculations for the energy need for domestic hot water preparation, the monthly average water consumption was established according to the statistic data collected from apartment buildings administrators from Timisoara (Fig.11 – blue – cold water average consumption, red – hot water average consumption).

Three types of occupants are considered: 2 adults retirees (5 apartments), young couples - 2 adults (5 apartments) and couple with child - 2 adults & 1 child (5 apartments).

The daily average domestic hot water consumption is estimated at around 1.830 litres. The

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water is considered to be heated from 10°C to 45°C (legionella bacterium protection is foreseen - once a day the water is heated to more than 50°C).

According to the above hypotheses the energy consumption for preparation the domestic hot water for the tenants of a staircase with 15 apartments is 73,54 kWh / day, meaning 26841,15 kWh / year.

3.3 Economic sustainability of retrofitting

The proposal takes into account the affordability, on one hand, and the life-cycle costs on the other hand, hence the different scenarios presented in chapter 3.1.5. The upgrading kit described in chapter 3.1.6 follows the computer industry model in order to be more dynamic and adaptable and the financial strategy proposed (Fig.6) follows a model that already exist on the local market.

3.4 Social sustainability of retrofitting: the scale of neighborhood, block and apartment

The main parameters defined in the standards related to social sustainability and sustainability assessment systems were included in a survey that focused on the inhabitant's evaluation of their apartments, blocks and neighbourhoods and also the changes desired on these three different scales.

Though the social inquiry determines a subjective evaluation of some features, it was considered useful to relate the perception of quality of life in these types of buildings with the criteria that define social sustainability.

In order to determine the satisfaction with the apartment, eight features were proposed to be assessed by giving grades from 1 to 5 (1 - very dissatisfied, 5 - very satisfied): C1 - general degree of satisfaction with the apartment; C2 - thermal comfort - temperature and humidity; C3 - indoor air quality - quality natural ventilation, odours, moisture etc.; C4 - acoustic comfort (noise, acoustic insulation); C5 - daylight; C6 - apartment's size (overall view, rooms, kitchen, bathroom); C7 - functionality and partitioning; C8 - quality of the interior installations.

The results show that satisfaction with all these features related to the quality of life and social sustainability has a value between 3 and 4 points, without significant differences (Fig.12).

When it comes to improving the apartment, the vast majority of the inhabitants take into account the least intrusive actions and current solutions such as redecoration of the interior space, thermal and acoustic insulation and improving the plumbing fixtures for reducing the energy consumption. Some people considered the horizontal extension of the apartment, the widening of the facade and interior openings as useful measures.

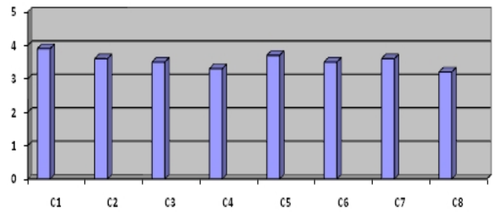

Fig.12 Scores - the ratings for the apartments

The general satisfaction regarding the block of flats is influenced by level of awareness concerning the proposed characteristics that usually define the quality of housing. The results indicate an appreciation below average in most aspects, with emphasis on the difficult accessibility, the unused common facilities (laundry rooms, basement storage rooms), the neglected common green spaces and the poorly illuminated staircases (Fig.13).

In order to determine the satisfaction with the block of flats, along with the general satisfaction (B), six features were proposed to be assessed: B1- lighting and ventilation of the stairwell and the common space; B2 - access for the elderly, children, strollers, people with disabilities; B3 - common spaces (storage boxes, laundry, drying and other spaces); B4 - the access into the building and the external part related to the access (safety and appearance); B5 - the green spaces related to the block of flats (maintaining, planting, layout); B6 - the common plants of the block (water, sewage, heating).

Most of the desired interventions refer to the refurbishing of the common areas, the increase of the thermal and acoustic insulation and the rehabilitation of the building services.

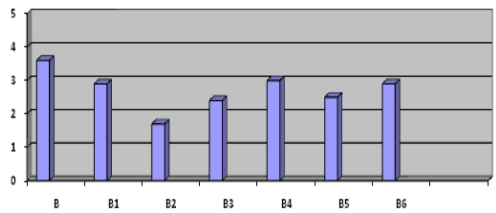

Fig.13 Scores - the ratings for the blocks of flats

In order to determine the satisfaction with the neighbourhoods, along with the general satisfaction (N), six features were proposed to be assessed:

N1 - safe playgrounds for children in the vicinity (<500 m); N2 - spaces of leisure and sport in the neighbourhood (500-1000 m); N3 - green spaces and parks in the vicinity (<500 m); N4 - parking in the area; N5 - facilities nearby (small shops, cafes, services, pharmacy, etc.); N6 - connection with the town, for pedestrians, cyclists, public transport.
The results are presented in Fig. 14.

Concerning the neighbourhood, several directions for improving the overall quality of life referred to the allocation of parking space, the design of green areas in the neighbourhood, children playgrounds, the improvement of accessibility and the increase of the diversity of public facilities.

There were differences between the results from different neighbourhoods. In "Soarelui" district is higher demand for social spaces and playgrounds for children (this area is the one with the highest sense of belonging to the community from all the districts studied in Timisoara).

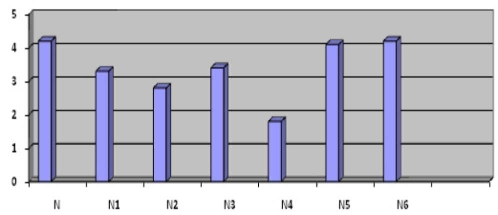

Fig.14 Scores - the ratings for neighbourhood

4 Conclusion

Interventions on these buildings should develop an identity to the neighbourhood [10], as a response to the sense of confusion produced by the repetitive typology of apartment blocks.

The aim of this alternative project is to respond to all the pillars of sustainability through an interdisciplinary approach:
-ecological (regarding improving energy efficiency and comfort using passive and active systems, creating better environmental conditions for the neighbourhood, including issues related to density and transportation),
-economic (affordability from the local market perspective and the positive result of the LCC) and
-socio-cultural (finding a solution that is well adapted to the local context and that increases the social awareness of the population).

A solution adapted to local market conditions must have the following qualities: to be affordable, to address properly the density level of the neighbourhood, to improve the urban quality, as the external „skin" of these buildings form the „walls" for the public space of the neighbourhood, to improve the living conditions and comfort of the existing apartments and to enhance the sense of belonging to a community for the inhabitants.

References

[1] C. Neme, M. Gottstein & B. Hamilton, *Residential efficiency retrofits: a roadmap for the future*, EU, 2011

[2] C.J. Kibert, Policy instruments for sustainable built environment, *Journal of Land Use and Environmental Law*, Vol. 17, Issue 2, 2002, pp. 379-394

[3] M. Economidou & all., *Europe's buildings under the microscope – A country-by-country review of the energy performance of buildings*, BPIE, 2011

[4] D. Sandu & all., , *Viata sociala in Romania urbana (Urban social life in Romania*), Polirom, 2006

[5] INSSE – Institutul National de Statistica. *Recensamantul populatiei si al locuintelor (Population and Housing Census)* – 18 martie 2002, vol.3, table 6, www.insse.ro, 2003

[6] M. Szitar, D. Grecea, O. Veronescu, Policies and strategies to improve the environmental performance of residential buildings made of prefabricated panels in Romania, *SGEM Conference Proceedings, Section Ecology and Environmental Protection*, Vol. V, pp.1143-1150

[7] D.Grecea, M.Szitar, A.Ciutina, Criterii şi sisteme de evaluare ale mediului construit în contextul dezvoltării durabile (Criteria and evaluation systems of the built environment in the context of sustainable development), *Buletinul AGIR*, year XVI, No. 2, 2011, pp.28-38

[8] EN 15643–1:2010 Standard, Sustainability Assessment of Buildings - General Framework

[9] ISO 21929-1:2011 Standard, Sustainability in building construction - Sustainability indicators - Part 1: Framework for the development of indicators and a core set of indicators for buildings

[10] E. Cosoroaba-Stanciu, R.Radoslav, The Enforcement of Local Identity through the Renewable of Public Spaces in Timisoara and its role in the Facilitation of Urban Governance, *International Journal of Energy and Environment*, Issue 1, Volume 5, 2011, pp. 75-82

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