Techniques and Methods for Urban Regeneration and Quality Improvement for Suburbia

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Abstract: The paper is based on the results of two research experiences: an European research titled “Improving the Quality of Suburban Building Stock” (COST Action TU0701) and an Italian National Research project called “Renovation, Regeneration and Valorization of Social Housing Settlements Built in the Suburban Areas in the Second Half of Last Century” (PRIN 2010-2012). The paper summarizes the researches outputs whose main aim was to illustrate the potentialities of different strategies for the improvement of suburbs. In order to implement different strategies for the refurbishment of suburban areas, researches were aimed firstly at the identification of several case studies that are representatives of the European panorama because of their typology, construction and state of physical and social deterioration. The final result was a collection of examples for the urban regeneration, gathered from case studies but offering a wide-scale of applications on public housing complexes. The paper highlights different approaches and strategies taken by different countries towards the methodologies of assessing, refurbishing and adding new value to the suburban areas, in view of increasing not only the quality of buildings but also the quality of public spaces and services, for a better quality of life of the citizens.

Key words: Social housing, renewable energies, sustainable technologies, energy retrofit.

1. Introduction

During the second post-war period, the strong industrialization led to the migration of the rural population to the cities: this phenomenon took place all over the world and the direct result was the need for living space. These urbanization programs stopped at the beginning of the 1990s, after covering up significant parts of European cities, characterized by a multitude of problems, such as the repetitiveness and anonymity of the buildings, the minimum living spaces, the low social and urban quality, the lack of infrastructures and services (e.g., parking and green areas) [1, 2].

Although the new energy-saving measures all over Europe and the necessity of energy efficiency improvement are a crucial issue by considering that suburban areas were built without any attention to the environmental architecture principles, quality of the

building elements and primary energy consumption saving.

In the last years, the Department of Architecture of Ferrara was the coordinator of two research projects focused on the rehabilitation of suburban areas of the European countries.

The COST Action TU0701 (2008-2012) was focused on European strategies for the regeneration and increasing of value of suburban areas, by means of the investigation and comparison of common experiences concerning regulations, tools, policies and plans for renovation and revitalization of suburban housing settlements. The crucial issue of the action was how to improve the quality of the cities and to get more value from regenerating suburban building stock, regarding both the European economic/social needs and also scientific/technological advancement, via the implementation of a new and integrated approach to the improvement and upgrading of suburban building stock. Twenty-one nations were participating for an overall number of 61 members: the primary objective

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was to elaborate a multidisciplinary analysis of strategies that include different and complementary aspects of the construction attributes (social, functional, technical and environmental), considering a global approach capable of implementing performance standards required by current laws and to meet the needs of users [1, 2].

The PRIN (Research Projects of National Interest) research project (2010-2012) followed the same methodologies analyzing Italian case studies. Both the research groups worked on the collection of representative case studies and investigated methods for the improvement of architectural, functional and technological solutions in order to monitor European trends of existing strategies of suburban regeneration [3].

An overview of the most important strategies was done by means of collection of data, critical analysis of the refurbishment projects, and in some cases, working visits on site, in order to analyze the most representative examples in the participating countries.

The analyzed strategies regarded:

- methods for planning and managing urban-scale building redesign;
- improvement of sustainability and energy efficiency (e.g., environmental impact and primary energy consumption);
- sharing the best practices in the field of building redesign and sustainable building methods for the refurbishment of systems and components for multi-family dwellings.

The result of this analysis has been summarized in a series of key words that are related to the European trends, policies and suggestions for improving the suburban areas. Three representative case studies are presented below. Different strategies of intervention with a common intent: not only the improvement of the technical requirements of the buildings but also the quality of life of inhabitants [4].

2. Soarelui Neighborhood Rehabilitation in Timisoara, Romania

GNR (Grey Neighborhood Rehabilitation) is a project that started from the collaboration with the inhabitants of the neighborhood of Soarelui, a very problematic area located in Timisoara, Romania [2, 4].

It presents a pilot-strategy that responds with context-conscious solutions to basic needs: a rehabilitation project for an urban structure in decay, a social project for the revival of community spirit, a sustainable project for the energy system and an economic strategy that gives value to all the above. The approach was carried out from the perspective of the environmental psychology by asking occupants to describe the identity of the place and to highlight the main aspects of disease.

According to a survey, the most important problems were identified. The most regarded the site level: parking places, green areas and the common services are not enough, which is demonstrated by the spaces that have changed their function and also by the lack of spaces for social activities. At the dwelling level, most of the subjects would like to have more space in their flat or to move into a larger one, with a garden.

The building typology is the courtyard block. In the most cases, courtyards are not properly used: parking is taking over green areas and common activities like children's play are impossible (Fig. 1)

Courtyards become the focus point of the project, instead of the private flat. Each courtyard and the buildings around it will receive characteristic aesthetics, atmosphere, mix of function and development tools. This leads to the community forming around them: the neighborhood will become a network of the small communities that start to integrate into the neighborhood grid. Refurbishing the public spaces and giving specific functions to each courtyard means to stimulate small communities to meet each other and to share life space. At the same time, mixing the functions creates a network between inhabitants, giving them a channel to communicate and

Fig. 1 The Solarelui district is characterized by typical post-war buildings, with low quality and poor public spaces [2].

Fig. 2 Regeneration plan of the area and programmatic map with mixed-functionality [2].

helping them to develop as a neighborhood-community (Fig. 2)

This neighborhood is composed of four cells interconnected by a central area, where each cell contains a number of courtyards with different functions: community centre, sports field, park, playground, launderette, barbecue area, terrace and garden. Function and atmosphere make people move

around and start dialogue.

The central area is very important for the image of neighborhood: it closes up the educational, energetic, cultural, commercial and functional cycles. Moreover, redesigning the streets enhances the parking area of 32%, by proposing a sponge-like parking system in the courtyards: reversible metal buildings that generate some topography in the landscape, which

helps sweeten the big scale, also used to absorb water for maintaining the courtyards and farms.

The main goal of the project is to optimize the energetic behavior of the neighborhood area (Fig. 3). Five key points are crucial to this strategy: efficient use of the space (public/private), improving energy efficiency of the old buildings (sanitation, insulation, ventilation and heating/cooling systems), creating closed food chains and better garbage collection and recycling, using sustainable/reversible materials and optimizing all traffic and parking. Building envelope is refurbished not only by considering new thermal transmittance standards, but also receiving a new recognizable face, making a big shift from the general grey. A new skin wraps around each block, fulfilling spatial needs and becoming a new recognizable element that can be representative for people. Roof is used as a productive element both in terms of energy (photovoltaic and panels) and in terms of economy (green roof with vegetable gardens).

The materials strategy for this project has two goals: to reuse materials from demolition and to use only reversible and sustainable materials for the new interventions. Main strategies are: reusing the concrete debris from the demolition of the old garages to create

floors for the new garages; all new structure made of steel, which is reversible and reusable; use organic soil and planting for roof insulation and water filtration.

A heat pump will procure most of the heating and cooling, being helped occasionally by the former district heating system. Social laundries are also introduced in these spaces, and will recycle waste energy from the heating/cooling system for energy heating. Solar panels can provide electricity for the heat pump and for lighting in all the common facilities.

Finally, the courtyard parking is used to store and clean rainwater that will be later used for toilet flushing and farm irrigation.

3. Sustainable Renovation of Multi-storey Housing in Porvoo, Finland

Porvoonportti is a quarter built in 1967-1975 in the suburban area of Porvoo City. The district consists of five large blocks with a service centre between them. The service centre contains a shopping area and a large parking space, an old heating plant that is no longer in use and recreation areas for children: a large ball field and a playground [2, 4].

Fig. 3 Energy strategies for Solarelui neighborhood rehabilitation [2].

Fig. 4 Current buildings in Porvoo, a typical 1970s housing production [4].

Each of the five large blocks is comprised of three oblong prefabricated concrete element buildings and the entire area contains 15 multi-storey apartment buildings (Fig. 4)

The large courtyards of the blocks open towards the south and the buildings are situated around the square courtyard. The problems of the planed area are mainly related to its dimension and to public space use. The tall buildings contain an abundance of dwellings but there are not enough parking places for the inhabitants. In fact, most of the public space is asphalt areas and cars parked everywhere. The residential apartment buildings are characterized by very poor insulation, low energy efficiency and the size of apartments is not appropriate. Parking cars on the ground floor make the courtyards very poor and useless.

The basic principle of the plan is to improve the attractiveness of the block and of the common courtyards by means of infill construction.

The good orientation and size of the courtyards are preserved, as the infill construction will be situated along the edges of the block to demarcate the courtyards. The size of the courtyard is maintained in the plan, but it will become private by nature because the low infill construction will close the block on the

south side. The new courtyard will form a semi-public zone between the public street space and the private yards of the apartments (Fig. 5).

The balcony zone and apartment yards will function as a semi-private buffer zone in front of the building facade. This hierarchy of space will increase the residents' privacy, and on the other hand, the communality of the block.

The green areas will be given clear-cut functions and different possibilities to use them. The share of oversized lawns will be decreased and alternative green surfaces will be introduced: meadows, plants, bushes and trees. The mobility of elderly people will be made easier by means of unobstructed, well-lit paths. Benches and functions added to the green areas will entice residents to spend time in the refurbished park areas.

The old prefab concrete balconies are replaced with a new wooden balcony belt the width of the entire facade. The balconies can be glassed in entirely or partly, which will increase their use (Fig. 6). The large balcony can be used for lounging, as a green room or as a semi-warm winter garden. Small apartments will be constructed on the ground floor (old garage space).

New wooden addition in the old building is the

Fig. 5 Regeneration plan in Porvoo. The courtyard will become private by nature because the low infill construction will close the block on the south side [2].

Fig. 6 Adding new wooden structure for a new building image in Porvoo [4].

core of the refurbishment project. The new balcony belt will give the apartments considerably more usable space. The roof currently consists of a lot of unused

flat roof surface; the utilization of this space—for apartments, yards, green areas—will bring greenness and life to the entire block. The roof offers the

possibility for detached-house-type living in the centre of town. Wood is a local, renewable and ecological construction material that is strongly connected to Porvoo's identity and building tradition.

Improving energy efficiency of envelopes and plants was a crucial issue. Lightweight timber construction is suitable for renovations, particularly for supplementary roof construction. The structures of typical prefabricated concrete element apartment buildings can easily carry the load of a timber-framed additional storey. The new elements will be fastened to the concrete shell and supported at their edges by the load-bearing partition walls. The new top floors of the buildings undergoing renovation will be built from timber-framed modular elements.

The buildings are connected to the district heating network and they have a hot water heating system.

With the proposed refurbishment actions, the pleasantness of the residential area reduces the need to travel. The renewal of the courtyards to make them more attractive is an important factor in ecologically sustainable renovation, as it affects the microclimate of a building lot, for example, wind conditions, and thereby also affects energy consumption.

4. Italian Case Study: Le Piagge District

The Italian case study regards Le Piagge district, a large area with about 10,000 inhabitants placed in the west suburbs of Florence.

The historical urban plan was ambitious from the point of view of the infrastructures, services and residential buildings. However, a series of problems did not allow the completion of the original plan [3].

Today, the district is characterized by a large set of high-density housing dwellings (the most part built in the 1980s) surrounded by many public green areas (particular the Arno river park).

In the last decade, the municipality has promoted several actions, so-called "Piagge emergency", in order to improve the lower social, urban and architectural quality of the district in comparison to

the Italian standards.

The most important intervention regarded the refurbishment of two collective housing, called "Le Navi" built between the 1982-1986. The refurbishment design was developed by IAA (Ipostudio Associated Architects Srl). Meanwhile, the construction site started in the 2002 and it is finished in the summer of 2008.

The renovation project has changed the number, size and typologies of the dwellings, in order to meet the user needs. Moreover, the energy efficiency of the building was improved with building facade renovation and through active systems, such as photovoltaic panels and solar collectors, installed on the roof. The renovation strategies adopted did not promote the changes of the building shape: no addition on the roof or in the facade (Fig. 7).

During the refurbishment (2004) of "Le Navi", the municipality of Florence involved Giancarlo De Carlo Architect to draw up a project plan. The aim of De Carlo's studies was to outline a series of structural and morphological modifications able to make "Le Piagge" neighborhood more balanced in ecological, urban, architectural and social terms (Fig. 8).

Based on a structured and complete survey of the current situation, the plan therefore formulated a series of strategies for the reorganization of the urban landscape of the area. The purpose of this plan was to provide an organic reference framework for future strategies and interventions.

To summarize, the plan concepts regard:

- the environmental protection;
- the creation of a new linear urban park;
- the improvement of the mobility;
- the recovery of navigability on the Arno river;
- the design of new innovative homes.

Recently, the municipality of Florence and Ipostudio has promoted, through an international research called SuRE-Fit, the refurbishment of another building realized in 1983 and located in the south part of "Le Piagge" district.

Fig. 7 The building “Le Navi” before and after renovation (courtesy of Ipostudio Associated Architects Srl).

Fig. 8 Landing design by Giancarlo de Carlo for Le Piagge district (courtesy of Studio De Carlo-Roberto Melosi).

The building is a four-storey terrace house with a basement of cellars and serves 33 dwellings according to three types:

- small dwelling with surface area of 46 m²;
- medium dwelling with surface area of 65 m²;
- large dwelling with surface area of 86 m².

The accessibility to the dwellings is allowable by staircase blocks with elevators.

The building is made of modular concrete slabs (20 cm), with internal prefab walls of gypsum (8 cm), aluminium frames (single glazed) and a rooftop covering made of asbestos corrugated panels.

The foundations are made of piles because of the poor load bearing soil (built on embankment), mostly made of sand, river rubbles and made ground.

The existing building has no signs of structural decay but the dwelling is not in keeping with the existing regulation about seismic resistance, in particular

because of the poor connections between crossing bearing slabs (just superposed to the horizontal ones).

All finishing is in suitable maintenance order but it needs a new external painting.

The building comfort is really poor, with scarce energy saving and many thermal bridges due to the short insulation of external walls, frames and terraces.

By way of a summary, the main building issues include:

- clear lack of roof performance (leakages, presence of asbestos and heat loss);
- necessary adaptation of installations;
- low thermal insulation for the envelope;
- presence of thermal issues;
- access problems.

The refurbishment plan proposes several architectonic and technical interventions on the building. Following the result obtained in “Le Navi”

building, the size and typologies of the dwellings will change for responding to the family's requests.

The refurbishment proposes two new lightweight levels on top of the existing building. Due to the existing seismic condition, the roof retrofit will be based on a self-bearing superstructure of metal "bridges", sustaining a structural metal grid (the "platform" on top). New volumes will stand upon the

platform, according to the client needs of housing and facilities (Fig. 9).

The technical approach to rooftop additions will include semi-prefab component (as wood panels, metal and wood beams, glazed frames, etc.), prefab system or be created directly via the integration of prefabricated units, such as the Soltag system designed by Velux (Fig. 10).

Fig. 9 The building before (above) and after (below) renovation project (courtesy of Ipostudio Associated Architects Srl).

Fig. 10 The new structural grid for building improvement (courtesy of Ipostudio Associated Architects Srl).

The new structural grid will be used, also, to sustain new private spaces to enlarge the existing apartment to improve their serviceability with balconies, rooms, etc..

Moreover, the steel frames of the new structure will possess on both fronts, a range of facade components dedicated to the improvement of building energy-saving (sun-slats, screens, solar and photovoltaic panels).

The design strategies provide many feasible changes for facades (including insulations and new frames) and give the opportunity for double skins, elevators (for wheelchair users) and fire escape staircases.

5. Conclusions

The analysis of several best-practice case studies during the researches (wider than the examples introduced) allows creating a map of the most important building renovation strategies.

Despite the differences from each urban system that generates its own “model of periphery”, different dynamics and growing factors, the common denominator is the low quality that depends on a variety of factors that include both the conditions of degradation and discomfort.

Different problems belong to the different scales of intervention, such as: the social marginalization in the economic relationship between the center and the periphery (urban scale), the problems related to the quality and quantity of services and the public infrastructure (at the scale of the neighborhood), the level of the technical, functional and architectural quality of the buildings (at the scale of the block or the individual body building).

Furthermore, another important aspect related to suburban building concerns the energy efficiency. In fact, these areas are characterized by high consumes and are responsible for high CO₂ emissions [5].

In order to contrast these problems, the EU (United Nations) Commission has recently stated that one of

its highest priority tasks is to address global warming, with special focus on reducing greenhouse gases. The commission states in the directive for energy efficiency in the built environment that the building sector must decrease its use of energy to reduce CO₂ emissions. In addition, the target for energy efficiency within the union states that a 20% increase in energy efficiency shall be met by 2020 [5, 6].

It is very difficult to find a common way of intervention, as each neighborhood has its own peculiarity and context.

By the way, as a conclusion of the study, 12 basic strategies that can be applied to suburban contexts are defined as follows [7, 8]:

(1) subtraction: to reduce the volume of the existing building through removing one or more level as well as singular parts of the building in order to reduce the density or change the shape;

(2) addition: add new volumes on the rooftop or in the facades to an existing building in order to enlarge the dwelling with new spaces and uses;

(3) combining: add up more small dwellings in order to create a bigger for large families;

(4) splitting: to divide a big dwelling into more smaller dwellings for small families;

(5) densification: similar to addition operation but it proposes to realize a new building in the area in order to introduce new function and to complete the urban planning;

(6) mix of functions: introduce new functions that will be different from the residential in order to remove the mono-functional use;

(7) retrofitting: the improving of existing buildings with energy efficiency equipment in order to reduce the energy consumption;

(8) extension: increase the dwelling floor with new balconies or loggias and improve the energy efficiency through greenhouse spaces (winter garden) resulted by glazing loggias and balconies at apartment buildings;

(9) association: similar to combining operation but

it proposes to change the indoor spaces with a new walls partitions;

(10) clustering: to redefine the outside car spaces in order to improve the urban and infrastructures quality (e.g., woonerf and home-zone);

(11) bordering: to redesign the limit of the abandoned courtyard in order to improve the use, the managed and the security of these spaces;

(12) painting: to change the grey or dark color of the suburban building facade in order to contrast the anonymity of the buildings.

The grouping of the different factors in families and, consequently, in keywords that identify possible solutions to the above-mentioned problems, has allowed to simplify the method of approach to such a complex problem by identifying a range of appropriate strategies for redevelopment and urban regeneration all over Europe.

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