TÉCNICO LISBOA

A SUSTAINABLE URBAN REGENERATION AT LOW COST

MYTH OR REALITY?

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Thesis to obtain the Master of Science Degree in

ARCHITECTURE

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Extended Abstract

May 2013

0. Introduction

This dissertation aims to assess sustainability in terms of urban regeneration and the possibility of getting it at low cost. Additionally it aims to warn to the need of urban rehabilitation, focusing on the intrinsic wealth through instruments and solutions that promote sustainable qualification. The awareness of the serious problems in the environment that we all have, the low percentage of rehabilitated park in Portugal and the low level of energy efficiency features, were the major factors that led to this dissertation review, reflection and proposals of a set of actions to be implemented. In fact, it is a double challenge: aims for a sustainable urban regeneration with low cost interventions in its life cycle.

The topic is, therefore, *"A sustainable urban regeneration at low cost. Myth or reality? "*

It required immediately a decision: what scope, what environmental resource to choose for the study?

The decision of the case study was the house where I have always lived with my family as a starting point, extending it later to the neighborhood where it is located. The opportunity to reflect, discuss and write about a concrete case for a dissertation is a very special moment, to explore all possible areas.

This study made it possible to create a dynamic reflection, to find answers and consensus solutions, aimed at rehabilitation of buildings and spaces.

The approach to the work included several aspects:

- A research paper based on credible sources of information;
- Selection of one building type and an urban area for analysis;
- Analysis of the selected house and further enlargement of the scale of the neighborhood;
- Analysis of electricity, water and gas consumption in the last three years, to evaluate costs;
- Calculation of thermal performance through RCCTE, to determine the energy balance resulting from heating and cooling needs, before and after implementing solutions rehabilitation;
- A job analysis through System LiderA by measuring the levels of performance reference before the rehabilitation project, selection of the set of solutions to implement and analysis work after implementing the rehabilitation solutions by measuring the levels of performance achieved;
- Analysis of the economic viability of the most relevant solutions to sustainability, applied to housing and urban scale.
- Evaluation of the solutions in urban regeneration to understand if they are a myth or a reality, when placed in the perspective of cost.

0.1 Working structure

The dissertation is organized into six chapters.

The first three chapters contain a theoretical framework underpinning the Tripod Sustainability, known for 3P's, the Triple Bottom Line PEOPLE-PLANET-PROFIT, which contain the environmental, social and economic features.

The fourth chapter presents the case rehabilitation study, sustainable solutions to implement the verification RCCTE, evaluation of environmental performance under system LiderA and economic feasibility analysis and still specific low-cost rehabilitation solutions.

The fifth chapter presents the discussion of the results and evaluation if the sustainable urban regeneration at low cost is a myth or a reality.

The sixth chapter concludes this thesis with conclusions and recommendations found relevant.

1. PLANET - Interactions: Man and Nature

1.1.Environmental challenges

Resources that exist in nature and that man can use in its natural form or as raw material, no longer are assumed as inexhaustible, due to consumption of an exponential growth population.

The growth of cities demands large amounts of soil that cause deforestation of fertile areas; consumes energy from the burning of fossil fuels, which pollute the atmosphere and consumes natural resources increasingly scarce.

Currently, urban areas account for 75% of global contamination due to intense population concentration. The highest population density is concentrated in urban areas by the constant migration from rural areas. At present, man faces a so serious biological and environmental challenge that urgent measures must be taken, so that no destruction becomes irreversible.

1.2.Biodiversity and ecosystems

On Earth there is a diversity of species calculated between two and four million and the greater the diversity of an ecosystem, the more effective it is. Therefore, the extinction or decrease of species cause total or partial destruction of ecosystems. It was found that the biodiversity on Earth is decreasing due to the enormous impact of human activities. The United Nations Programme for the Environment and the World Wildlife Found, issued the document "World Conservation Strategy", saying that the basis for the conservation of natural resources is essential to sustain life on earth in our generation and future generations.

1.3.Energy and matter

The amount of solar energy that reaches the Earth is 25,000 times the amount consumed by mankind in a year. Of all incident radiation, 15% is absorbed by the atmosphere, 32% is scattered back into space and 53% is direct radiation to Earth, 47% of which 6% is absorbed and reflected.

The final heat balance of the Earth is zero, since all the energy absorbed always ends up being transformed into chemical energy, heat, or mechanical devices, and also through the phenomena of evaporation, radiation, and others. Energy and matter are related through photosynthesis, central point where solar energy is converted into substances that can be assimilated by heterotrophic organisms. Nature in biogeochemical cycles depend on the

activities of living beings as producers, consumers and decomposers that are responsible for the recycling of matter in ecosystems.

2. PEOPLE - Why we must move towards sustainability

2.1.Industrial revolution to sustainability in construction

Since the beginning of the Industrial Revolution there was an increase in economic growth at the expense of increasing consumption of energy and resources of the planet. This behavior led to several climate changes, arising with greater frequency devastating phenomena. In the last two decades there has been a new attitude to reverse this dangerous trend. The concept of sustainable development focus on reducing the use of raw materials, increased recycling and re-use of products and the increasing consumption of renewable energy. The UN tries to align the nations around commitments by a development more harmonious with nature.

2.2.The approach to sustainability in the national context

In Portugal, in 1987 were already referenced environmental, economic and social actions contained in the Law on the Environment 11/87. It was also assumed international commitments in the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The National Strategy for Sustainable Development in 2012 for the 2005-2015 horizon repeated the lines of 2002 and has as its goals to put Portugal on a level of economic development closer to the European average.

2.3.Sustainable urban regeneration reduced costs

The concept of urban regeneration can be considered as the process of reversing the economic, social, environmental and physical decline in our cities. In order to solve the problems of existing cities is necessary to understand that sustainability is an equation between what is saved and what is wasted. As Jaime Lerner advocates and implemented in Curitiba, we must act according to the method of acupuncture using small interventions in the urban fabric to recover and revitalize "sick" areas which effects are felt in a positive way in the city.

2.4.Strategy of urban regeneration: Bottom-up and Top-down

In recent years the strong drop in public investment and an hostile financial environment, did arise several initiatives within the so-called emerging or tactical urbanism. This new paradigm gives citizens and inhabitants the role of producers of a "bottom-up" town, as opposed to the "top-down" view of traditional urban planning. The bottom-up approach is more flexible, allowing to implement specific solutions generating high levels of success on small scale.

2.5.Low life cycle costs

The "low cost" rehabilitation appears as an option by criteria of construction and lower costs of restoration small scale, enabling the recovery of buildings and dwellings degraded, in order to achieve interesting levels of quality. In a world where financial resources are sometimes scarce, we must look not only at the initial investment costs but also for the lifecycle. It will be a good investment when all costs are recovered during the life cycle.

2.6.Environmental assessment system

LiderA: the Portuguese system

LiderA, acronym for "Leading for the Environment" comprises the assessment criteria of sustainability, through which one can recognize or certify plans and projects. It allows to review, at any stage of the life cycle, guiding the best decisions for a sustainable construction.

3. PROFIT - How to assess the sustainability including the economic dimension

3.1.The economic dimension

The environmental assessment of a project is done starting from a base of reference, according to which the impacts are measured. Whenever the effects can not be quantified, should be done its qualitative analysis and this should be included in the environmental assessment.

3.2.Lifecycle building

Life Cycle of a Sustainable Building, attempts to reduce the environmental impact, from the choice of materials and construction techniques to recycling, preferring a process 'cradle to cradle', ie a closed and endless whenever can, than a "cradle to grave". The cost-benefit analysis is an economic methodology that contributes to the most viable solutions in a given period. If the benefits exceed the costs, the economic viability of the project is positive.

4. CASE STUDY - The rehabilitation of housing for urban regeneration

4.1.Study area

The study area is located in the town of Carcavelos, Cascais municipality, in the center, 250 meters from the train station. It is an allotment of houses that sits on the grounds of Quinta da Alagoa, one of the old farms of Carcavelos wine. Currently the vineyard is off and much of the estate was offered by the previous owners to Cascais Municipality, so that it was preserved and open to the enjoyment of the population of the garden, the natural lake, winery and home.

4.2.The villas and the public space

Considered for the study were 39 single-family houses with two floors above ground, built on generous plots of land, most with about 1000 m². This area was subdivided for nearly 60 years and villas were built in the sixties. Avenue D. Vasco da House where is located the house selected for the case study, the axis is constructive for road access to the surrounding areas and is oriented north / south. Composed of a lane of 2-way 5.5 meters wide and a ride on each side with about 1.4 meters wide, lined with plane trees. The circulation in this area is predominantly light vehicles and people attending walk from their homes to the train station to the city center and to the garden. The road design is currently in deficit, due to more recent construction of housing blocks within the Quinta da Alagoa, Fire Station, 3 kindergartens and Tax Office that induces parking on the avenue, hindering the flow. Urban regeneration will be proposed in a bottom-up perspective on housing (case specific to general) and top down in the case of public space and structure that connects the area.

4.3.Reviews considered in the study

4.3.1.Evaluation of thermal performance - through RCCTE

From the technical drawings of the house, it was possible to survey all the elements required under the Building regulations, to discover the unfavorable situations that induced a higher energy consumption and to define the more acceptable thermal comfort indices to be implemented.

4.3.2.Evaluation of sustainability according to the system LiderA

Although the house was already a B ranking, due to its good constructive features and good urban practices, there is still a possible way to improve performance. There was by the owners, both a preoccupation with better rationalization of resources and expenditures, improving also the aesthetics of the property. Also, in fact, after the assessment of a building, the architect must provide workable solutions that promote and motivate good construction practices.

4.3.3.Economic Feasibility Analysis

The financial viability of the improvements that enhance the energy efficiency of buildings is decisive for the choice and application. However, the cost-benefit analysis to adopt solutions are difficult to carry out, as there are several factors that are important for the sustainability concept in construction, which are not readily quantifiable. A financial feasibility study is presented, which calculates the simple payback period for the proposed improvement where this analysis is applicable.

5. Measures with a view to sustainable rehabilitation

- APPLIANCES

  The appliances are becoming more energy efficient but still have a high cost, making payback near the useful life of the equipment. Because the price of energy has risen, it is proposed the replacement of old appliances, as it becomes increasingly attractive and inevitable investment in equipment with better energy performance.

- LIGHT REPLACEMENT INTERIOR LIGHTING

  It is proposed the replacement of incandescent bulbs with CFLs and economic halogen lamp LED. It is one of the most interesting investments of this study as it has a very low payback. The larger lifetime of the lamps is more economical, which makes investment desirable, even with high costs mainly on the LED lamps.

- EQUIPMENT WATER CONSUMPTION

  Cost (€) - 4,455; NPV (€) - 534; Lifetime (years) - 30; Payback (years) – 26

  Class LiderA – D

  For a better rationalization of water, it is proposed to replace the old faucets and lavatory with backpacks, other reducing by 50% the rate of discharge. Although this option has an high payback , it is an investment to be made and a saving of 50% is easy to achieve due to the high efficiency of these devices.

- SOLAR COLLECTORS (AQS)

  Cost (€) - 4,200; NPV (€) - 2,281; Lifetime (years) - 20; Payback (years) – 8

  Class LiderA – A

  The installation of solar DHW is an investment with high income level of the heating of sanitary water. In conjunction with the boiler and water tank, reduces the cost of gas bill. Its installation is simple and presents a very attractive payback.

- CENTRAL HEATING

  Investment 1 (window frames and glass, ceiling and wall insulation exterior)

  Cost (€) - 15,183; NPV (€) - 6,334; Lifetime (years) - 25; Payback (years) – 19

  Class LiderA – D

  This investment ensures a marked improvement in the housing thermal performance as calculated in RCCTE. The replacement of window frames and glazing of the spans is the solution with the highest weight in reducing gross heating needs. Placing a ceiling and insulation of exterior walls allow a more comfortable interior space. The cost of frames and double glazing is high, which lead to the longer payback of this investment.

  Investment 2 (gas boiler, water tank, radiators located)

  Cost (€) - 16,705; NPV (€) - 11,800; Lifetime (years) - 20; Payback (years) – 9

  Class LiderA – A

  This investment assumes that the client has two options to pay the heating bill: either pay for electricity or natural gas. The difference in cost per kW of each of these resources, multiplied by

the annual consumption in kW, give us the value of the annual savings. Opting for natural gas, the solutions allow central heating throughout the house. If we join to this solution DHW solar collectors, the needs of heating water for the house are satisfied. The added gas central heating with new frames and double glazing increases their efficiency by minimizing losses to the outside. Natural gas has a considerably lower cost than electricity and, despite the initial equipment high price, it has an attractive payback. This solution is suitable for homes with large areas because it accurately controls both the temperature through the thermostat or the hours of operation through the embedded clocks.

- MICROGENERATION SOLAR PHOTOVOLTAIC

  Project 1 (placement of 8 photovoltaic panels)

  Cost (€) - 9,922; NPV (€) - 1,911; Lifetime (years) - 25; Payback (years) – 16

  Class LiderA – C

  This project produces enough energy to meet energy requirements consumed annually in housing, 4318 kw, therefore no sale to the public power network. This investment has a high return, exceeding the lifetime of the project.

  Project 2 (placement of 24 photovoltaic panels) – Chosen solution

  Cost (€) - 24,145; NPV (€) - 13,951; Lifetime (years) - 25; Payback (years) – 8

  Class LiderA – A

  This investment aims to supply the energy needs of the house and still produce a maximum of 10Mw/year, maximum sales allowed by law, that the state is obliged to buy the energy given to the power network, by a microgeneration contract. With the proceeds from the sale of this remaining energy, investment has a 7 to years payback. Although the initial cost is high, this investment becomes attractive due to the benefits achieved.

  Project 3 (placement of 50 photovoltaic panels)

  Cost (€) - 76 809; NPV (€) - 9,460; Lifetime (years) - 25; Payback (years) – 17

  Class LiderA – C

  This project includes the installation of 50 photovoltaic panels and the purchase of an electric car. The implementation of this project aims the maximum production that the lot may achieve, with the best conditions of sun exposure, an orientation of the panels to the South / East installed on roofs. This high production of green energy, serves to meet the energy needs of the house (Zero Energy) and also to provide energy for an electric car. It also generates a positive energy balance of about 22 MW / year which can be sold to the power network, taking part thereof of this investment income.

- COLLECTION AND STORAGE OF RAINWATER

  Cost (€) - 3,050; NPV (€) - (- 1.756); Lifetime (years) - 20; Payback (years) -> 30

  Class LiderA – G

  This investment includes a system for collecting rainwater through gutters in PVC, which carry water from the roof of the house to a deposit of 3000 liters which is buried in the soil. This water is used for irrigation in the organic garden, the garden and outdoor spaces and vehicles wash.

Although the cost is low, the payback exceeds the lifetime, which makes it not a viable investment.

- DEPOSITS OF SEPARATION OF WASTE
  Cost (€) - 54; NPV (€) - 12; Lifetime (years) - 12; Payback (years) – 10
  Class LiderA – D
  This investment is proposed to produce the separation of household waste, being aware that we can reduce the amount we produce and also promote the recycling of organic waste which represents between 45-55% of the total, to organic compost in the garden.

- INVESTMENT OF HOUSING REHABILITATION
  Cost (€) - 72,383; NPV (€) - 45,433; Lifetime (years) - 25; Payback (years) – 16
  Class LiderA – C
  This investment brings the solutions described above. The large number of solutions envisaged, some of them with high costs, allow efficiency values well above average and ideal scenarios equate sustainability. The high investment cost combined with a later payback make this an unattractive investment for those who want to see a faster return on invested capital.

6. Measures with a view to sustainable urban regeneration

- HPS LIGHT REPLACEMENT OF LIGHTING FIXTURES IN LED
  Cost (€) - 46,690; NPV (€) - 20,019; Lifetime (years) - 16; Payback (years) – 11
  Class LiderA – C
  The high power consumption of the lamps high pressure sodium, represents a high cost to the Municipality. This investment aims to replace these bulbs and installing efficient LED luminaires of lower power. They have an acceptable payback due to the high life time and its high efficiency.

- GENERATING FIXTURES (Photovoltaic + wind generator)
  Cost (€) - 16,389; NPV (€) - 3,137; Lifetime (years) - 20; Payback (years) – 12
  Class LiderA – B
  This investment is intended to produce electricity in the urban space. It would be possible to produce approximately 8.1 MW of power, which would supply a small building and still sell excess power for high power network. The payback is interesting, but the high cost of investment contributes to the high turnaround time.

- CARSHARING
  Cost (€) - 101 459; NPV (€) - 48,327; Lifetime (years) - 16; Payback (years) – 10
  Class LiderA – B
  This investment is intended to implement a system of carsharing site, which contributes to the reduction in car ownership and encourage the use of electric vehicles. A locality as Carcavelos, outskirts of Lisbon, very often use the train flows to work in the city center. However, it is still common practice to use the transport car for this purpose. With the increasing fuel prices, the high cost of parking meters to park, time spent in traffic jams during peak hour generates

pollution that in fact, coupled with the costs of vehicle maintenance lead to an urgent need to implement a new dynamic to who use public transport. This investment is costly but the benefits promotes an attractive payback.

- URBAN cycleway
  Cost (€) - 17,710; NPV (€) - 16,442; Lifetime (years) - 16; Payback (years) – 12
  Class LiderA – C
  This investment promotes a more functional and safe public space. The creation of an urban cycleway by widening of the rides and the elimination of one of the lanes, allows an increase in the pedestrian area. The solution of a wider shared ride, allows to maintain the old rides and the trees of the avenue. With the creation of a one way, traffic becomes more fluid. This is a good solution to the urban level, because besides being a gain in mobility, it has a low investment for the benefit it produces.

- COMMUNITY GARDENS
  Community Garden of vegetables, fruits and flowers
  Cost (€) - 50,000; NPV (€) - 46,053; Lifetime (years) - 16; Payback (years) – 8
  Class LiderA – A

  Community Garden of small vegetables and herbs
  Cost (€) - 10,000; NPV (€) - 3,607; Lifetime (years) - 16; Payback (years) – 12
  Class LiderA – C
  These two investments are directed to the redevelopment of old gardens and vacant lots. Food production is destined to the consumption of neighborhood residents, at reduced prices and also donations to charitable institutions. These investments are important because they are developed by the community, increasing their awareness to the environmental issues. The investments have interesting paybacks, as they generate a sustainable local economy.

- INVESTMENT LEVEL INCLUDING THE URBAN HOUSING
  Cost (€) - 2,740,730; NPV (€) - 2,050,595; Lifetime (years) - 25; Payback (years) – 13
  Class LiderA – B
  This investment includes the solutions described above, including also those adopted in the rehabilitation of housing. Are contemplated measures that promote urban regeneration to the scale of the neighborhood, either in seeking high standards of energy efficiency, either with numerous projects at a community level that are, all together, a benefit for everybody and everyone.

7. Solutions in a Low Cost View

- LOW COST INVESTMENT OF HOUSING REHABILITATION
  Cost (€) - 30,004; NPV (€) - 35,138; Lifetime (years) - 20; Payback (years) – 9
  Class LiderA – A

- LOW COST INVESTMENT LEVEL URBAN
  Cost (€) - 1.170168; NPV (€) - 1,633,484; Lifetime (years) - 20; Payback (years) – 8
  Class LiderA – A

  There were selected solutions with lower costs, but also those that established synergies among themselves in promoting energy efficiency. The choice of equipment for efficient and sustainable housing and public space, certainly contribute to minimizing costs and to sustainable urban regeneration. Low Cost Investments are on average 50% more economical and with a low payback.

8. Discussion of results

The methodology used was directed to solving the problems related to the urgent need to rehabilitate carefully and the results obtained, led to the decision-making practices. The proposal adopted within the criteria Low Cost does not compromise the sustainability, allowing an investment cost significantly lower, which is essential for its application to be advantageous. On the other hand, it promotes greater savings and benefits, and with lower paybacks, lead to faster investment recovery.

9. Conclusions and Recommendations

Wherever possible, to take up this type of methodology, since the low-cost solutions recommended have high levels of environmental performance and are, economically, also very satisfactory.

Achieve energy efficiency is the pillar of sustainable development that is desired for our and future generations.