Urban Rehabilitation Plans Evaluation
The question of Built Environment Adaptability against the Population Ageing

C.A.I. Mendonça, *Urbanism and Spatial Planning MSc Student, IST*

Abstract— It is often said that "the future is for the young", but in Portugal this is no longer true. Demographic projections indicate that until 2080 only people over 65 will grow inside the country. With a prediction of a generalized population reduction in all other age groups, special attention should be given to the elderly.

This dissertation addresses the adaptability of the built environment in order to equate new solutions to this population spectrum needs.

It is studied "the new type of elderly", citizens who live more years, with more or less health, but above all, citizens typically more active and demanding their rights and preferences.

To achieve the main objective and thus contribute to specific project solutions that effectively improve their daily life, it is necessary to study and understand the requirements of the elderly, as users of living places, public spaces and buildings.

Therefore, by determining what the fundamental requirements are in a space used by the elderly, it is possible to configure an environment built without elements that deprive the autonomy and independence of these people, ensuring an inclusive and sustainable urban design between generations.

In order to assess the adaptability of the coexistence of the elderly in the built environment through the selected requirements, the Model of Adaptability of the Built Environment was elaborated. The model consists of the validation of aspects distributed by the slopes: housing; buildings; and public spaces that are intrinsically linked to performance practices for assessing the adaptability of the built environment.

This model is later validated by Madragoa's Urban Rehabilitation Plan and to support the assertion that the Master Plan is on track in good performance practices that contribute to the sustainability and inclusion of all individuals. A Summary Evaluation was made with recourse to *LiderA*.

***Keywords* — Population Ageing, Elderly, Urban Rehabilitation, Built Environment, Sustainability**

C. Mendonça is with the Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal (e-mail: catarinaimendonca@tecnico.ulisboa.pt).

I. Introduction

ACCORDING to World Health Organization (WHO), "population ageing and urbanization are two global trends that together comprise major forces shaping the 21st century" (OMS, 2008). In 2007, the "Global Age-Friendly Cities: A Guide" project was initiated by WHO to promote policies, services and support structures that allow active ageing.

In addition, the 2015-2080 *Instituto Nacional de Estatística* (INE) projections indicate that the resident population of Portugal will tend to decrease until 2080, from the current 10.3 to 7.5 million residents. Consequently, the population age structure will also suffer changes that will result in a strong increase in the elderly population and a decrease in the young population (INE, 2017).

In this way, the study of the cities trends in terms of their population evolution, characteristics and needs becomes essential, so that plans are developed to respond to the population needs.

The concept of "Sustainable Development" emerged in the second half of the twentieth century, when awareness was raised about the unsustainability of the planet due to the excessive consumption of natural resources and the progressive increase of pollution. These facts are intrinsically associated with world population growth and technological progress. This term is presented by the World Commission on Environment and Development (WCED) as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" (WCED, 1987).

Seeking a "more harmonious and sustainable functioning of cities and guaranteeing decent housing for all", Urban Rehabilitation is thus "an indispensable component of urban and housing policies, insofar as in it converge the objectives of requalification and revitalization of the cities, in particular of their more degraded areas, and qualification of housing stock" (Portugal law nº32/2012).

The Urban Rehabilitation process should ensure a balanced treatment of the principles of sustainability. For its operationalization, sustainability assessment systems have been used, highlighting in Portugal the *LiderA*.

LiderA is a Sustainability Assessment System and had its first version in 2005 for the built environment and surrounding

space. The second version covers beyond the built environment, looking for outdoor spaces and sustainable communities (Pinheiro, 2006). The *LiderA 2.0* system "is based on the concept of repositioning the environment in the construction, from the perspective of sustainability, assuming itself as a system to lead by the environment, being organized in areas that include intervention areas and that are operationalized through criteria that allow guidance and evaluation of the level of demand for sustainability" (*LiderA*, 2011, p.8).

In the current context of population ageing, there is concern about meeting the needs of older citizens as well as the adaptation of equipment and public spaces to these users. Thus, it is now time to adjust these equipment to the new requirements, combining concerns with equity not only to the issues of efficient resources management, but also with regard to quality and safety management of the built environment.

This paper is in Urban Rehabilitation and its main goal is to analyze the parameters related to the "Sustainability Assessment of the Built Environment" considered in the Urban Rehabilitation Plans, considering the population ageing.

This document should also contribute with new criteria for the Urban Rehabilitation sector directed to the ageing population, thus ensuring the existence of a set of urban requirements for the built environments adaptation.

The necessary steps are the following:

1) Study the available literature about the population ageing in the world and most specifically in Portugal;

2) Study the legal documents applicable in Portugal related to this issues;

3) Select the fundamental requirements for an urban rehabilitation intervention analysis against the population ageing;

4) Select a case study where a Urban Rehabilitation Plan is chosen;

II. Population Ageing

Recent demographic trends are marked by the continuous average life expectancy growth, infant mortality reduction, emigration growth, severe fertility reduction and consequently the population growth (INE, 2017).

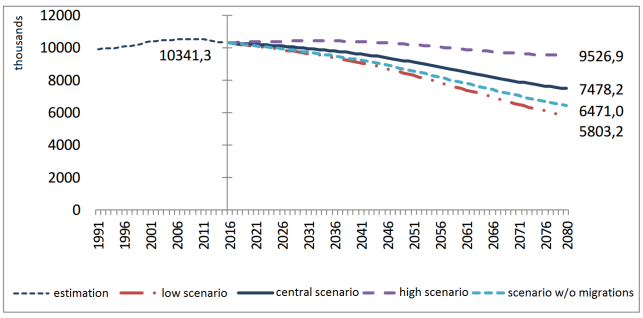


Figure 1 – Resident Population, Portugal, 1991-2080 (INE)

Per the central scenario (Fig. 1), between 2015 and 2080 (INE, 2017):

- The young population will decrease from 1,5 to 0,9 million;
- The number of elderly people will increase from 2,1 to 2,8 million;
- With the numbers mentioned above, the aging index will almost triple, from 147 to 317 elderly people, for each 100 youngsters, in 2080;
- The aging index will only stabilize nearly 2060;
- The showed trends are in general applicable to all Portugal regions, including Madeira and Azores;
- The active population will decrease from 6,7 to 3,8 million;
- The sustainability index (division between the number of people between 15 and 64 years and the number of people above 65 years old) will shortly decrease. Between 2015 and 2080, this index will decrease from 315 to 137 people in active age, for each 100 elderly people.

III. The Urban Rehabilitation Current Concept

The concept of urban rehabilitation emerges from two factors as the patrimony concept extension and the obliteration hazards acknowledgement which face the oldest urban areas. This concept is being constantly improved, both at the level of the objectives as well as in the scope of action and intervention methods to face the different and multidimensional challenges in terms of social, economic and environmental scope.

Nevertheless, this evolution has often been advocated in a bad and incomplete interpretation of the concept, resulting in interventions considered short of urban rehabilitation (Paiva et. al, 2006).

The Council of Europe, an international reference institution for urban rehabilitation, with a coherent, clear and comprehensive approach, publishes in 2004 the Guidance of Urban Rehabilitation, where a current definition of the concept of urban rehabilitation is defined as "a medium or long term urban revitalizing or regenerating process. It is above all a political act aimed at improving components of the urban space and improving the whole population's well-being and quality of life. Its spatial and human challenges require the implementation of local policies (e.g. integrated conservation and heritage policy, spatial cohesion and spatial planning policy, sustainable development and environmental policy). Rehabilitation therefore forms part of an urban project / urban development plan, requiring an integrated approach involving all urban policies"

At the territorial level, the objectives of urban rehabilitation are (Cabral, 2013):

- Ensure integrated cultural heritage conservation;
- Ensure the right to an adequate housing for all;
- Promote territorial cohesion;
- Contribute to the sustainable development of cities through a careful environment management.

These interests presuppose the implementation of policies appropriate to the scope of cultural heritage, housing, land use planning and environment.

Even though they are not as perceptible and measurable as territorial objectives, human commitments are fundamental and inherent in any urban rehabilitation (Cabral, 2013):

- Local development triggered by the economic potential of urban districts;
- Social cohesion;
- Respect for cultural diversity.

Currently, this process is not confined to carrying out conservation work in buildings by integrating strategies to revitalize and modernize urban areas, whether historical or not. Economic and social factors have become inherent in this process and cultural heritage has become essential to ensure quality of life, economic development and social cohesion.

IV. Urban Rehabilitation Sustainability

Looking ahead, the concept of sustainability is intrinsically linked with conservation of resources that undoubtedly represent the natural capital that is bequeathed between generations. Hence, it is crucial do manage this capital in the best possible way, especially when talking about non-renewable resources. At the same time, sustainability also involves direct action on current problems, compensating damages and minimizing impact.

With technological progress, the twentieth century triggered an architecture that manifests an anthropocentric view of human habitat, partly driven by technology itself. The possibility of "building autonomy", as for example, through artificial climate control, generated a sudden abandonment of traditional construction methods.

There is an urgent need to integrate the concept of sustainability into the architectural world, creating with this adaptation the idea of sustainable construction / rehabilitation / architecture. It is by this means that the energy-environmental performance of the built environment will be optimized, starting from a set of innovative strategies in the design of a project with reduced environmental impact and maintaining the balance between development, social quality and planet Earth.

This concept is rapidly associated with sustainable architecture, defined by Gervásio (2010) as the "application of the principles of sustainable development to the global cycle of construction, from the extraction and improvement of raw materials, through the planning, design and construction of buildings and infrastructures, until their final deconstruction and management of the resulting waste.

People are increasingly settling in urban spaces, where they tend to spend most of their lives in buildings, making them one of the most valuable social assets. It is therefore necessary for the construction sector to follow this trend by involving sustainable principles in order to respond to the current way of life.

As with any project, especially when it comes to rehabilitation, there are aspects that must be reconsidered in the design and operation of a sustainable architecture project. The study of all the inherent conditions of the project is imperative to reach the maximum profitability of the intervention. Therefore, nothing is left to think, from the surroundings of the place of intervention to the characteristics of the materials, the exercise should above all pass through the adaptation of the functional requirements of the moment, whenever possible in a sustainable way. From the perspective of what is sustainable, rehabilitation has also boosted the preservation of cultural values – in this case, the heritage that defines the history and identity of a city. The renewal of a city's image presupposes an adaptation of urban buildings and spaces to new trends and functional requirements, contrary to what was once done – new construction over traditional.

The notion of life cycle emerges as a concept applicable to all constructions and comes to view the process as a whole, considering the durability and effects in the future – an instrument of analysis and evaluation of the environmental cost that a building can assume. The lifespan is decisive during the analysis process, based on costs of both the energy consumed and the replacement of the materials.

The recycling of existing materials is implicit, being able to be used in the same function or applied to new needs, never ceasing to be part of the overall functionality of the building. When needed and only with the mission of complementing the life cycle process cost-effectively, new elements are integrated into the built environment. This adaptation of traditional structures to new functions must always be obvious, as well as reversible.

V. The Legal Framework for Urban Rehabilitation

A. *Portugal Law DL Nº. 104/2004, May 7*

Law DL 104/2004 regulates the "Exceptional Legal Regime of Urban Rehabilitation" (RJERU) of historic areas and "Critical Areas of Urban Recovery and Reconversion" (ACCRU).

This law states that municipality must promote the urban rehabilitation procedure. Thus, the municipality is given the opportunity to set up municipal enterprises that must be part of the designation of "SRU – Society for Urban Rehabilitation" and correspond to an intervention zone (ZI) defined to confer authority and police power such as expropriation and licensing. In the consequent constitution of the municipal companies or in the direct intervention of the municipality, it is necessary to grant effective means of intervention and in this way, trigger the rehabilitation process through the constitution of the operation from the delimitation of "Intervention Units" (UI) to the elaboration of "Strategic Documents" (DE).

This whole process seeks the balance between rights and obligations of landowners who should be the first responsible for urban rehabilitation. Nonetheless, in the absence of an

agreement, the SRU will either take forced intervention or expropriation, and once the works have been concluded the right of preferences will be guaranteed to former owners or tenants.

Therefore, the SRU was recognized as a key player in the promotion of urban rehabilitation actions, motivating the involvement of owners and economic agents in the process, to create a rehabilitation market. All the plans of intervention envisaged in the scope of the SCRU obliged the articulation between several actors, with the final objective to find a balance between the interests of each one.

B. Portugal Law DL Nº. 307/2009, October 23

The "New Legal Regime of Urban Rehabilitation" (NRJRU) aims to solve five major challenges to urban rehabilitation: articulating the rehabilitation of private individuals with public responsibility; ensure complementarity and coordination among the various actors; diversify the management models of interventions; streamline procedures for prior control of urban operations; and balance the rights of owners with the need to remove barriers to rehabilitation.

The NRJRU obeys several principles. The first one makes owners responsible for securing and financing the rehabilitation of their proprieties and fractions. The next one is the principle of subsidiarity of public action, which means that public entities directly promote actions of urban rehabilitation of private spaces only when the owners do not. According to the principle of contractualisation, concertation between public and private initiative is carried out through concessions or urban rehabilitation contracts.

It is also worth noting the principle of protection of the existing that admits interventions in the building that do not comply with all the norms in force at the time of its implementation, provided that they do not aggravate pre-existing nonconformities or have as a result the improvement of the safety and health conditions of the building. The NRJRU, in comparison with the previous legal regime, explains the concept of urban rehabilitation more broadly, not only emphasizing the real estate or heritage aspect of rehabilitation but also the integration and coordination of the intervention, in order to reach more coherent solutions between the social, economic, functional, cultural and environmental aspects of the areas to be rehabilitated.

Thus, the NRJRU defines urban rehabilitation as "the form of integrated intervention on the existing urban fabric, in which the urban and real estate heritage ins maintained, in whole or in part, and modernized by carrying out works of remodeling or improvement of the urban infrastructures, equipment and urban or green spaces for collective use and construction, reconstruction, expansion, alteration, conservation or demolition of buildings" (DL Nº 307/2009, Art.2º, j).

C. Portugal Law DL Nº. 32/2012, August 14

Law DL 32/2012 makes the first amendment to law DL 307/2009, as well as to the 54th amendment to the Civil Code (Proposed law XII) with the aim of simplifying administrative procedures for rehabilitation in accordance with the Memorandum of Understanding between Portugal and the European Union, the European Central Bank and the International Monetary Fund. These measures had already been foreseen in the Ministers Council Resolution nº 20/2011, March 23. The purpose of this law is to "eliminate the constraints that have impeded the implementation of an effective urban rehabilitation policy, impelling greater speed to carry out rehabilitation initiatives and promoting private investment" (Proposed law nº 24/XII, Explanatory Statement, p. 2).

Keeping the same areas supported by Proposed Law 24/XII and the same objective of streamlining and revitalizing urban rehabilitation, law DL nº32/2012 supports changes such as:

- Flexibility and simplification of the procedure for creating urban rehabilitation areas;
- Creation of a simplified procedure of prior control of urban operations;
- Establishment of a special regime of isolated urban rehabilitation operations;
- Creation or simplification of measures complementary to urban rehabilitation.

VI. Active Ageing

The problem of active ageing is present in national and international public policies, as a fundamental approach to face the current panorama of population ageing. This emerges in the wake of a healthy ageing advocated until then, seeking an inclusive and multidimensional approach that brings health and focuses on socioeconomic, psychological and environmental aspects that influence ageing (Ribeiro and Paúl, 2011).

In 1998, the concept of active ageing was first mentioned in a publication by the Organization for Co-operation and Development (OECD) (Moulaert and Paris, 2013), which later evolved to advocate for an "active ageing" policy through WHO.

The United Nations (UN), through WHO, the European Commission (EC) and the OECD then promote initiatives to alert societies to the problems of ageing, as well as to the definition of public policies that respond to these challenges (Cabral, 2013). In line with this, it was celebrated in 2012 the European Year of Active Ageing and Solidarity between Generations at EU level, which aimed at combating age-based discrimination and promoting intergenerational sustainability by encouraging active ageing in the field of employment, social participation and autonomy.

The OECD defines active ageing as the ability of people to lead an active and productive life in society as they grow older. Active ageing implies greater flexibility in how individuals and

families manage their time between work, education, leisure and care (OCDE, 1998).

The EC noted that active ageing and its lifecycle approach are key principles in shaping ageing response policies in Europe. Therefore, these orientations go through the promotion of incentives that allow the extension of active life (Silva, 2009).

Thus, it has become necessary to consider a set of practices which encompass "lifelong learning, prolonging the working life, postponing retirement age and introducing a more gradual reform, as well as a continuity of an active life after retirement and the development of activities to optimize individual capacities and maintain a healthy state for each person" (Concelho da Europa, 2002, p. 6). These practices were pointed out as beneficial because they allow to increase the quality of life and at the same time reduce the burden of dependence.

The same phenomenon is happening in Portugal now. With the general social security pension scheme, incentives were created for older people to remain in the labor market through bonus and penalty measures observed in law DL Nº 167-E/2013, December 31.

WHO has proposed a new concept of active ageing that is more inclusive and that integrates the various domains of personal and social life in a multidimensional perspective. In this one, active ageing a process of "optimizing the possibilities of health, participation and safety in order to increase the quality of life during old age" (OMS, 2002: 12). This applies to both individuals and population groups.

In this definition, the concept "active" refers to the participation and continuous involvement in social, economic, cultural, spiritual and civic life and not only to the capacity to be physically active. The scope of this analysis confronts the perspectives that only focus on the labor market.

VII. Ageing and the Built Environment

With more than half the global population living in cities, it is not surprising that the number of megacities (cities with 10 or more million inhabitants) has increased. The number as well as proportion of inhabitants will continue to increase over the coming decades, especially in cities with less than 5 million inhabitants in developing countries (ONU, 2006).

Population ageing and urbanization are the culmination of successful human development over the last century. On the other hand, a successful human development also generates a set of challenges that this century will face. Per the Brasilia Statement on Ageing (1996, p. 21), "healthy older people are a resource for their families, communities and economy".

Dynamic cities bring benefits to the entire population. However, to be sustainable, cities must provide structures and services that enable the well-being and productivity of their inhabitants. In particular, older people need a means to provide them with support and capacity to compensate for the physical and social changes associated with ageing.

Making cities "friendlier" to the elderly is the necessary response that promotes the well-being of elderly citizens as well as maintaining a thriving city.

Adaptability is the ability of the object of evaluations or parts of it to be altered or modified to become suitable for a particular use (Pinheiro, 2006).

The main objective to take into consideration for a city that respects the life of the elderly passes through a set of facilities that allow the operation of their lives in an autonomous and independent way.

Ageing with quality of life is synonymous with maintaining a high physical and mental functioning and maintaining an active involvement with life. Living in community strengthens this rhythm, guaranteeing to the elderly a wide universe of human support.

The ageing of Portuguese (and Lisbon) society has been constant since 1960 (Machado, 2004) and because elderly are different from each other, sociology also reveals different patterns of life in old age. This statistical observation should trigger a new thinking in society, starting with the sectors of construction, rehabilitation and housing - because it is by nature the daily habitat of the elderly.

The retention model (Pastalan, 1999) is associated with the "new type of elderly people" (Hanson, 2001). It corresponds to the permanence of the elderly in their residence, guaranteeing the support services that respond to their new needs, also associating Heideggerian emplacement (Seamon, 2007) - the place and connection of the individual to its surroundings.

At the housing scale, this problem is related to such issues as: how to transform the apartments without excessive individual investments, to allow their residents to be ageing at home, preserving an independent life and with dignity? How to adapt a housing to allow an elderly person to get help and company in the city center? They arise as hypotheses: the adaptation of the interior of the dwellings with small works that comply with rules of accessibility and add security and comfort in its use, as well as, the adoption of the shared housing model with people from other generations, namely university students, this hypothesis makes feasible the aid and human company for aging at home, helping to revitalize the human fabric of neighborhoods - example: Aconchego Program (2017).

At an urban scale, this issue discusses the following questions: how to transform public outdoor spaces, of circulation and permanence, into spaces of universal and age-friendly accessibility, allowing them to grow old in their street and with their usual neighborhood? For this problem are given answers such as: the adaptation and punctual reformulation of certain aspects of public spaces of proximity, providing them with solutions of universal accessibility and urban furniture or equipment for the elderly will allow them to enjoy them, in intergenerational coexistence.

During our life course, we are increasingly acquiring different characteristics and aptitudes that tend to decrease in adulthood. Studies indicate that from the age of 45-50 the abilities are degrading, namely the visual, the motor and the cognitive. This natural and unavoidable reduction leads to difficulties in the handling of objects and living spaces, which can be minimized through the design of products and environments, using "inclusive urban design".

In 1997, a team from the Center for Universal Design at the State University of North Carolina (USA) (Instituto Nacional de Reabilitação, 2010) made up of architects, designers, industrialists, engineers and researchers established a set of seven principles associated with Concept of inclusive design:

1) Fair use – may be used by any group of users;
2) Flexibility of use – encompasses an extensive range of individual preferences and abilities;
3) Simple and intuitive use – easy to understand, regardless of user experience, knowledge, language skills or level of concentration;
4) Noticeable information – effectively provides the user with the necessary information, irrespective of the existing environmental / physical conditions or sensory capabilities of the user;
5) Tolerance to error – minimizes risks and negative consequences arising from accidental or involuntary actions;
6) Minimal physical effort – can be used effectively and comfortably whit minimal fatigue;
7) Size and scope of approach and use – adequate space and size for approach, handling and use irrespective of height, mobility or posture of the user.

VIII. Sustainability Assessment System - *LiderA*

"The *LiderA* system is based on the concept of repositioning the environment in construction, in the perspective of sustainability, assuming itself as a system to lead by the environment, being organized in areas that include intervention areas and that are operationalized through criteria that allow to carry out the guidance and assessment of the level of demand for sustainability" (*LiderA*, 2011).

LiderA presents six strands that seek to encompass the entire spectrum of sustainability in an integrated vision of environmental, social and economic concerns, respectively:

A) Local integration;
B) Resources;
C) Environmental loads;
D) Environmental comfort;
E) Socioeconomic experiences;
F) Sustainable use.

These strands are divided into distinct areas of analysis and then into measurable criteria by assigning credit for good practice in comparison to what is practiced today.

In *LiderA*, the usual practice is level E, which on the numeral scale of 100% (or 0 to 10) is 10%, being the improvements for example of 25% corresponds to class A (twice the usual improvement), with 75% being class A+ (improvement of four times) and values of 90% or higher class A++ (improvement of ten times).

For a better understanding of the system, a description for the aspects presented is given below.

A. Local Integration

In this section, it is sought to evaluate the impact of the project under analysis at the place of implementation regarding the level of its physical presence, considering the value or not of the space what will occupy, in the areas of land use, natural ecosystems, landscape and heritage (Pinheiro, 2006).

B. Resources

In terms of resources, respectively, energy, water, materials and food, there is an attempt to evaluate not only the percentage that can be saved, but also the quantity that can be obtained from renewable and local sources (Pinheiro, 2006).

C. Environmental Loads

Good practices that produce less pollution in their various forms, distributed by the areas of effluents, atmospheric emissions, residues, external noise and pollution are given priority (Pinheiro, 2006).

D. Environmental Comfort

Subdivided in areas such as air quality, thermal comfort and lighting and acoustics, this part seeks to understand the ability of a project to provide quality of life to the user, applying solutions that allow a comfortable use of interior and exterior spaces (Pinheiro, 2006).

E. Socioeconomic experiences

LiderA, as a system that seeks to analyze sustainability, promotes an integrated view of the environment with social and economic factors, and it is in this area that most of these two last corners of the triangle fit. This strand is subdivided into five areas: access to all, costs in the life cycle, local economic diversity, amenities and social interaction, and participation and control. These areas present considerable weight in the final weighting (Pinheiro, 2006).

F. Sustainable Use

Finally, the area defined by sustainable use is divided in the areas of environmental management and innovation that seeks to understand to what extent the project, with all good practices that it is prepared for the future. With this, it is intended to verify if the project presents innovative elements that allow it to keep up-to-date for a good period and provide sufficient information to future users, so that they do not become inconsequential due to misuse (Pinheiro, 2006).

G. *Evaluation and Weighting*

LiderA system (2011) uses the total number of credits per criterion to determine the level of project performance in that same criterion, evaluating it on a scale from G to A ++ (Fig. 2).

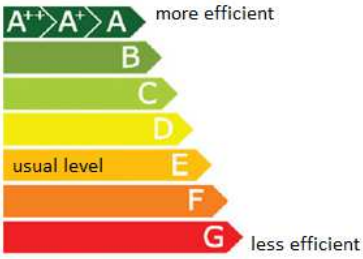


Figure 2 – Efficiency Levels *LiderA* System

The levels on this scale are derived from two key references. The first is based on technological performance, so the existing constructive practice is considered as usual (Class E) and the best performance comes from the best constructive practice feasible at the time "(*LiderA* 2.0).

In *LiderA*, the degree of sustainability can be certified in good performance classes (C, B, A, A + and A ++), which includes an improvement of about 25% (Class C) against usual practice (Class E), going from an improvement of factor 4 (Class A +) to an improvement of factor 10 (Class A ++).

IX. Age-friendly Urban Rehabilitation

Based on Portugal Law DL nº163/2006 – Accessibility Regime to buildings and places that receive public, public roads and housing buildings, a set of requirements was drawn up to conclude an age-friendly urban rehabilitation.

A. *Housing*

The house and its surroundings are fundamental to the safety and well-being of the elderly. The possibility of rehabilitating one's home also influences the ability of the elderly to remain comfortable in their homes. For these people, it is crucial to have enough space and privacy to feel safe.

Considering the following premises: sufficient spaces, adapted spaces, protection against atmospheric conditions and accessibility; some of the parameters to be considered for an urban rehabilitation adapted to the population ageing are described below.

- Enough space to allow the elderly to move freely in housing:
  - Flat surfaces;
  - Passageways wide enough for wheelchairs (Fig.3);
  - Kitchens with appropriate layout to the elderly;
  - Bathrooms adapted for the elderly.

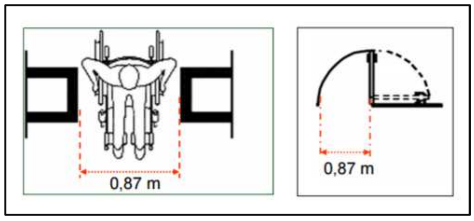


Figure 3 – Minimum recommended door width

- Duly equipped housing against atmospheric conditions:
  - Air conditioning;
  - Central heating;
  - Thermal insulation;
  - Acoustic insulation;

- Housing located near service and infrastructures:
  - Easy accessible (buildings ground floor);

B. *Public Space*

The external environment has a fundamental impact on the mobility, independence and life quality of the elderly, affecting their ability to "grow old at home".

The physical barriers in the cities discourage the elderly from leaving home, which makes it necessary to raise the awareness of architects and urban planners for this concern.

Considering the following premises: adapted and accessible green spaces, public road and public facilities; some of the parameters to be considered for an urban rehabilitation adapted to the population ageing are described below.

- Existence of adapted green spaces:
  - Easily accessible urban furniture (benches, tables, garbage bins, water founts);
  - Rest areas;

- Existence of adapted pedestrian public roads:
  - Non-skid flat surfaces;
  - Sufficiently wide to allow wheelchair circulation (Fig.4);
  - Lowered sidewalks (Fig.5);
  - Obstacle free sidewalks;
  - Adapted staircases: neither too high nor too steep (Fig.6);
  - Ramps;
  - Bridges or underpasses that help people to safely cross busy roads;
  - Adapted and with easy access sanitary facilities.

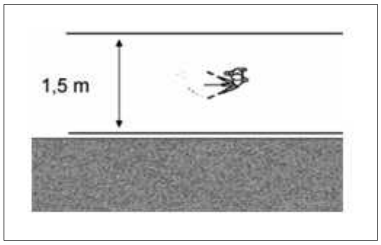


Figure 4 – Minimum recommended pedestrian way width

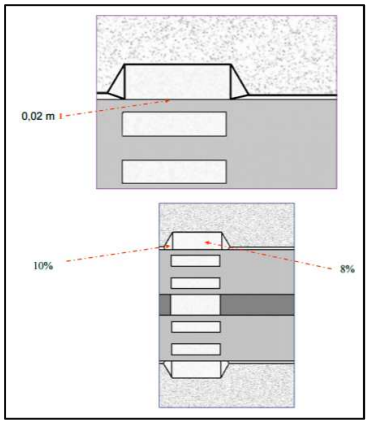


Figure 5 – Relationship between the sidewalk pavement level and the road pavement level

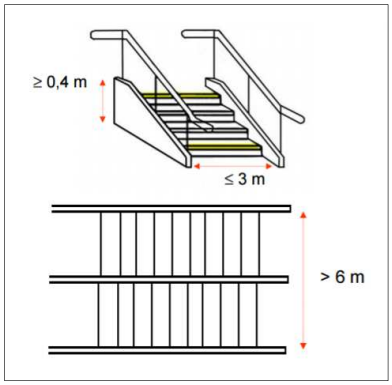


Figure 6 – Minimum recommended width for stairs

C. Buildings

Buildings shall be provided with at least one accessible route providing safe and comfortable access for persons with reduced mobility between the public road, main entrance / exit and all interior and exterior spaces which constitute it.

Considering the following premises: enough space, adapted space, accessibility and adapted public facilities; some of the parameters to be considered for an urban rehabilitation adapted to the population ageing are described below.

- Enough space to allow the elderly to move freely inside the building:
  - Flat surfaces;
  - Passageways wide enough for wheelchairs (Fig.7);

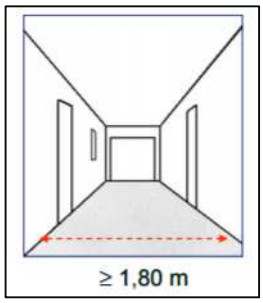
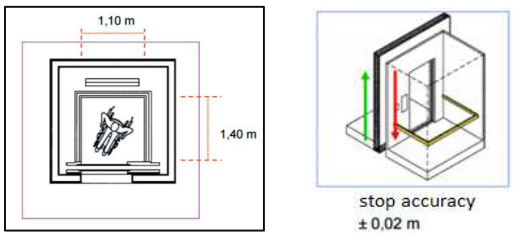


Figure 7 – Recommended corridor width in buildings

- Accessibility in building:
  - Lifts (Fig.8);
  - Escalators;
  - Ramps;
  - Wide doors and passages;
  - Adapted staircases: neither too high nor too steep;
  - Non-skid pavement;
  - Rest zones with benches;



a) **b)**

Figure 8 – a) Recommended interior dimensions for lifts b) Recommended stop accuracy

- Adapted public bathrooms.

X. EVALUATION MODEL FOR THE BUILT ENVIRONMENT ADAPTABILITY

This model is the direct result of an extensive research carried out on the theme. A diagnosis was made that resulted in a set of parameters regarding the elderly needs (comfort, safety, accessibility).

The reflections on the effect of architecture on the perception and well-being of the elderly were later translated into spatial resources used to achieve practical benefits.

Based on the parameters that were considered essential for an ageing without influence on the independence and quality of life of the elderly, an evaluation model was elaborated so that it was possible to measure the adaptability of the coexistence of elderly in the built environment (MAAAC).

The model consists of the validation aspects that are intrinsically linked to performance practices, ranked in a scale of intervals between 0 and 10, respectively:

- Inadequate [0];
- What is usual [1];
- What is good practice [2-4];
- Excelent [5-10].

This model is supported by "principles" laid down in Portugal Law DL nº163/2006 – Accessibility to Buildings and Establishments receiving public, public road and housing buildings, which in this case standardizes the design of structures and spaces prepared for the elderly.

The MAAAC provides a quantitative or qualitative approach to the functional conditions of the built environment, depending on the information available for analysis. It should be noted that the model is merely representative, and can be adapted to different scopes (eg. Citizens with physical disabilities) given the versatility of its general focus – the independence and quality of life of the individual.

XI. Case Study: Madragoa PPRU

A. Framework

The area of the Urban Rehabilitation Detail Plain (PPRU) of Madragoa (Câmara de Lisboa, 2016) corresponds to a morphological and historical unit of the Lisbon urban evolution. Although the urban rehabilitation policy has been a reality in this area since 1992, there is still the maintenance of indices of degradation, old age and insufficiency of buildings, equipment and public spaces that led to the ACCRU declaration, which justifies the delimitation of this urban rehabilitation area, now under the light of RJRU.

The situation that has been characterized since 1997 has shown itself to be facing a patrimony built in a high state of degradation, with many situations of ruin threat, unattractive for the younger layers fixing, proving to be imperative the resolution of the degradation problems. Additionally, there was demographic problems, such as population ageing, for which urban rehabilitation should find answers.

Madragoa's PPRU was approved in 2016, June.

B. Built Environment Assessment

Although quantitative, the model was used qualitatively, given that the low detail of the available information about some requirements makes it not possible to measure them correctly. That requirements were in a range of performance escalation.

Based on the City Council proposal, in terms of housing the main goal is the increase of urban resilience, through the improvement of the structural performance of the building, to raise the standards of habitability and comfort of the dwellings.

The evaluation of the housing component is described below (Fig.9).

Requirements	Performance Scale [0-10]	Good Performance Practice
There is enough space to allow the elderly to move freely in the home		Flat surfaces
		Passages wide enough for wheelchairs
There is space adapted to allow independent use by the elderly		Kitchens with appropriate layout to the elderly
		Bathrooms adapted for the elderly
The house is well equipped to provide comfort.		Air conditioning
		Central heating
		Thermal insulation
		Acustic insulation
The accommodation is close to accessible services and infrastructures.		Can be easily accessed

Scale	Inadequate	What is usual	What is good practice	Excellent
	[0]	[1]	[2-4]	[5-10]

Figure 9 – Housing evaluation

Based on the City Council proposal, in terms of public spaces the main goal is the increase of qualification of the public spaces, where it is proposed an improvement of the conditions of use of the spaces, through continuous pedestrian routes, traversing the neighborhood and establishing a party of the conditions and particularities as the relation with the river and in the details of the architecture that value the experience of the space.

The evaluation of the public space component is described below (Fig.10).

Requirements	Performance Scale [0-10]	Good Performance Practice
Existence of adapted and accessible green spaces		Easily accessible urban furniture
		Rest zones
The public road is adapted to the presence of the elderly		Flat ways
		Wide ways
		Lowered sidewalks
		Obstacle free ways
		Adapted staircases
		Ramps
		Safe passageways
Adequate and easily accessible sanitary facilities		Bathrooms adapted for the elderly

Scale	Inadequate	What is usual	What is good practice	Excellent
	[0]	[1]	[2-4]	[5-10]

Figure 10 – Public space evaluation

The evaluation of the buildings component is described below (Fig.11).

Requirements	Performance Scale [0-10]	Good Performance Practice
There is enough space to allow the elderly to move freely inside the building		Flat surfaces
		Passages wide enough for wheelchairs
Accessibility		Lifts
		Escalators
		Wide doors and passages
		Adapted staircases
		Non-slip floor
		Rest zones with benches
Adequate and easily accessible sanitary facilities		Adapted bathrooms

Scale	Inadequate	What is usual	What is good practice	Excellent
	[0]	[1]	[2-4]	[5-10]

Figure 11 – Buildings evaluation

The overall assessment of Madragoa PPRU was scored on the performance scale as what is considered good practice [2-4].

Despite the positive outcome, given the MAAAC approach, there are constraints to the model that do not go unnoticed.

The approach taken and the development of the criteria allowed, in a way, to identify and measure, in a qualitative way, the points in which the plan contributes to the design of an inclusive neighborhood, adapted to all.

The MAAAC methodology proposal revealed that it ensures the benchmarking of the performance scale, thus contributing to the delimitation of the requirements met and the requirements to be met for better performance. Nonetheless, Madragoa's PPRU for guidance purposes ultimately determines a qualitative and therefore subjective assessment base.

The limitations of the evaluation are the lack of quantitative indicators, which would give the study more precise results.

It would be beneficial to the plan to include indicators that consider good social and economic performance, as well as inclusion of specifications and guidelines for sustainability. Without forgetting that today, the energy certification allows to have more accurate data of the built and that this allows to guide in a more appropriate way the solutions to adapt.

For the housing proposal, it is also suggested to the plan the formulation of a matrix of requirements to be met by private and / or private promoters, to guide and ensure the fulfillment of the objectives of the plan.

These indications are not new to planning. It should be noted that in 2007, LiderA certified the Detail Project Urban Project of Parque Oriente, published in the Diário da República - 2nd Series Nº 214 of May 4, 2008. This plan presented, at the time, a set of specifications, performances, Indicators and guidelines for the search for sustainability.

XII. Conclusions

In order to promote an active ageing, it was analyzed how urban rehabilitation can contribute for a significant optimization in elderly quality of life in terms of health, security and sustainability.

Several requirements were elected to consider an urban rehabilitation as "age-friendly". They seek the adaptability of the built environment and are connoted as conditions for an ageing without influence on the quality of life of the elderly looking for a set of facilities that allow the operation of their lives in an autonomous and independent way.

The case study analyzed the intervention area of the Madragoa's PPRU, where it was verified the maintenance of indices of degradation, old age and insufficiency of buildings, equipment and public spaces.

The result of this evaluation considered Madragoa's PPRU as a plan that leads to a sustainable performance with neighborhood-wide good practices.

To support the claim that Madragoa's PPRU is on track in good performance practices that contribute to sustainability, a Summary Assessment has been conducted with the help of *LiderA*.

The summary assessment of the *LiderA* system allowed to analyze the environmental performance of the proposed solutions, classifying them according to a scale of performance.

The reference class E represents factor 1; the factor 2 corresponds to a class A, this means that the performance in this case is twice as good as the reference class E; factor 4 corresponds to class A + with a performance 4 times better than the reference class E; and factor 10 corresponds to class A ++ with ten times better performance than the reference class E.

It was verified that the implementation of the Madragoa Rehabilitation Proposal promotes an improvement in environmental performance, being included in class A of the performance scale - LiderA.

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