

FUNCTIONAL REHABILITATION OF HERITAGE BUILDINGS BASED ON REINFORCED CONCRETE STRUCTURAL ELEMENTS. CULTURAL/HISTORIC VALUES AND PUBLIC UTILITY TO CONSIDER

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ABSTRACT

For the definition of conservation and rehabilitation actions in buildings of heritage value, it is necessary to take into account the significant evolution processed in several functional aspects of these buildings. The complexity of the issues involved in conservation and repair of their construction elements and functional rehabilitation requires knowledge in several domains, in order to integrate, in an interdisciplinary and multidisciplinary way, the functional requirements that are needed to be considered.

This article focuses attention on the buildings classified as cultural heritage as well as buildings not included in this classification, but which present relevant cultural/historical value or public utility. In both cases targeting the set of buildings that are specifically based on structural concrete elements associated to infill or resistant masonry walls.

Relevant aspects of the overall performance of referred heritage buildings are here presented, in particular of their walls and confining elements, concerning the different basic requirements and the other functional requirements.

Keywords: Heritage buildings/ Masonry walls/ Reinforced concrete/ Rehabilitation

1 INTRODUCTION

Preservation of Portuguese built heritage, namely the 20th century buildings, has been gradually highlighted due to the increasing value assigned to this heritage, by the society, cultural agents and technicians, due to the excellence of the architectural pieces, materials and construction techniques used. However, this share of buildings has been increasingly demanding conservation and rehabilitation interventions, due in large part to the growing degradation of constructive elements, and the need to ensure an appropriate level of functionality and preservation of this type of buildings, given its cultural/historic value or public utility. It is appropriate, therefore, to promote specialized studies of this latest Portuguese built heritage, constructed in the 20th century, due to its importance and complexity of the issues involved in their preservation and rehabilitation.

In this article we intend to approach the buildings classified as cultural heritage as well as buildings not included in this classification (formally belonging to “common

buildings”), but which present relevant cultural/historical value or public utility (fig. 1.1), in both cases targeting the set of buildings that are specifically based on structural concrete elements associated to infill or resistant masonry walls (acronyms of the heritage buildings covered as defined above: “EVPba”).

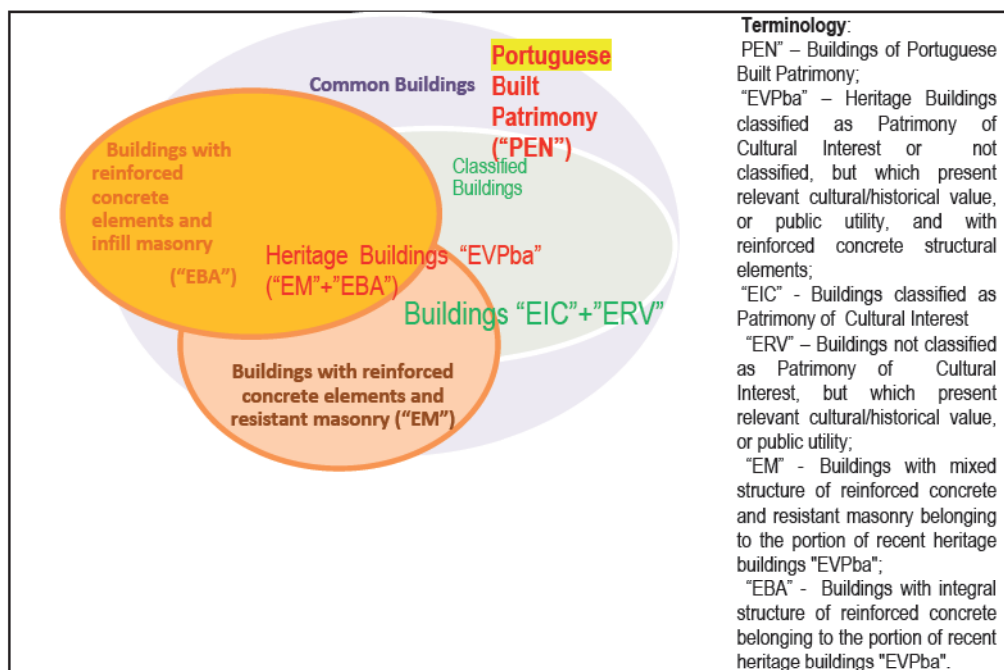


Fig. 0.1: Framework of the heritage buildings with reinforced concrete structure elements (EVPba) within the Portuguese Built Patrimony

In the definition of conservation and rehabilitation actions to be undertaken on existing buildings, it is necessary to take into account the significant evolution, in recent decades, processed in several functional aspects of the buildings, fruit of progress and innovation, both in terms of materials and construction techniques, and of their facilities and technical systems. This development is especially remarkable and challenging in buildings of heritage value, where the complexity of the issues involved in conservation and repair of their construction elements and functional rehabilitation, requires knowledge and technical skills in several domains, in order to integrate, in an interdisciplinary and multidisciplinary way, the preservation principles and requirements that are needed to be considered; in particular those requirements deriving of applicable regulatory changes implemented from the date of construction until the present day as a result of the up-grade of the safety standards, environmental comfort (thermal, acoustic, visual and air quality), energy efficiency and quality of buildings.

Nowadays, there is a trend in buildings, in particular in heritage buildings, which point to the growing importance of their flexibility, such as: the long life cycle of buildings compared to the short life cycle of its functions; the functional obsolescence of buildings because they don't longer meet the present requirements; another trend is the rapid change of user demands compared to the slow changing possibilities of buildings. And, in addition, there is an important trend towards sustainable buildings, which especially addresses environmental and energy management issues. The increasing use of integrated building systems is changing the traditional way of

refurbishing existent heritage buildings, due to the hard task of accommodating and conciliate these complex systems with their rehabilitation constraints. Thus, it is convenient to identify situations where rehabilitation actions of the walls and confining elements, which includes also the modernization of automation and information systems of buildings, as well as of energy resources, have to be compatible in particular, with the need to assure the authenticity of the buildings. Relevant aspects of the overall performance of EVPba buildings are here presented, in particular of their walls and confining structural elements, concerning the different basic requirements and the other functional requirements.

2 PREVIOUS ASPECTS TO CONSIDER ABOUT THE HERITAGE BUILDINGS

EVPba buildings were designed in order to satisfy the programmatic objectives initially defined by its promoters. Over the time, these buildings have been going through a process of change, most of them related to alteration of use, often dictated by the modification of ownership or of its objectives. With the technological development that meanwhile happened, as well as the applicable regulatory changes that have occurred since the date of construction until the present day, as a result, in particular, of the increased security standards, thermal and acoustic comfort, and energy efficiency, it is now possible to respond to new needs. However, the most appropriate solutions to address each of the aspects referred may not be compatible between them, so the overall solution has to result from a compromise between the different approaches.

On the other hand, it can be concluded the need to update the functional performance of buildings, by the results of surveys on the state of conservation of buildings, under the Housing Census 2011 (INE), which points that a considerable portion of the buildings built last century based in reinforced concrete structural elements (universe in which integrates the portion of EVPba buildings addressed to housing) requires conservation and rehabilitation works in view of the predictable degradation of constructive elements, reflecting their age (these are buildings constructed since 1920). To this set of circumstances must be added the desideratum of ensuring, at all times, an adequate level of use, given the cultural/historical value or public utility of this type of buildings.

Accordingly, here it is intended to examine, in general, the current performance of the existing EVPba buildings. As part of this analysis the previous questions about the main conditioning aspects on the overall performance of heritage buildings are presented, in particular the walls and confining elements that integrate these existing buildings, given the different basic requirements applicable to the buildings and the other functional requirements specific to this type of heritage buildings. Essentially, in the case of these buildings, there is a special concern about the functional requirements that oblige the constructive elements to ensure the achievement of relevant functions and activities planned for a building with relevant value, ensuring at the same time, to the respective users, adequate security, health and habitability conditions, in the context of minimizing operating costs of the building.

Through the identification of those conditioning aspects, it can then be more easily addressed aspects relevant to the assessment of the state of conservation of the buildings, both in terms of construction or in functional terms. From the functional point of view, which is here especially focused, on one hand it is important to evaluate the deviation of the current level of performance in relation to the original performance of

the building (this is the performance shortly after the beginning of the use, regardless of whether errors in the execution project were made or not), essentially due to performance loss associated with use during the period of exploration and wear of the materials and the building's original components and equipment; on the other hand, there is an interest in evaluating the degree of deviation of the building's performance in relation to the current regulatory framework, arising from any applicable regulatory changes, or due to alteration of parts of the building or modification of the subjected actions (dead load, variable actions, etc.). To analyze properly the functional performance of buildings EVPba, it is convenient to classify this set of assets in large groups of similar characteristics, taking into account the different functions that are required in each of these groups, as well as their relevance. For this division, it was considered advantageous to use a classification based in the legal Portuguese framework of the fire safety in buildings (SCIE - Decree-Law No. 220/2008 of 12 November), which lays down the characteristics of the buildings through type of use groups (article nº 8), and here it was opted to combine some type of uses to better suit the type of EVPba buildings, as follows:

- a) Houses
- b) Administrative buildings (offices, courts)
- c) School buildings
- d) Hospital Buildings
- e) Entertaining/Show buildings
- f) Sports Buildings
- g) Religious buildings
- h) Hotels buildings
- i) Commercial buildings
- j) Transport Stations
- k) Museums, art galleries, libraries and archives
- l) Industrial buildings, workshops and warehouses
- m) Farm buildings
- n) Multi-functional buildings

It should be noted that European Standardization and the applicable national rules, in some aspects, establish significantly differentiated requirements to each of these groups, with regard to basic requirements: RB1-Mechanical resistance and stability; RB2-Safety in case of fire; RB3-Hygiene, health and environment; RB4-Safety and accessibility in use; RB5-Protection against noise; RB6-Energy economy and heat retention; RB7-Sustainable use of natural resources). It should be referred that the set of buildings EVPba covers both buildings with character of public use or private use. With regard to the share of buildings with character of public use, it can be observed a very significant number of buildings in which the State is its occupant, either as owner or as tenant. This is especially valid (true) for buildings of type b), c), d), f), j) and k). The intervention on an "EVPba" building requires the study of his background: the design of the building, constructive solutions used, and the history of the building for the period of service, in particular the aspects relating to the constructive amendments and with the damage that has occurred in the building. Walls, floors and ceilings surfaces are often elements of particular aesthetic and decorative characteristics, sometimes made of carefully chosen materials by specialized artisans. They are also very exposed to external actions and are in the way for many interventions regarding relevant functions, such as thermal and acoustic behavior, incorporation of technical nets, etc. Thus, it is crucial the identification of the elements to preserve and the definition of techniques for their conservation and repair, with compatible and durable techniques and materials. Then, it is needed to verify the possibility of guaranteeing all the other functions without significant change of those elements. In the cases for which

the option is for non-preservation due to extensive damage and technically inviable repair of the construction elements, solutions shall be defined that enable the accomplishment of the needed functions without promotion of incompatibility or reduction of health, safety and environmental parameters, as well as to assure the authenticity of the buildings.

To the common functional defects, the corresponding needs of repair or rehabilitation must be evaluated, which should be dependent on the respective degree of importance in terms of the functional performance affected and the cultural value of the building. The assessment must be made of the main variables (thermal insulation, acoustic performance, reaction and resistance to fire, etc.), intrinsic to the methodology of repair or rehabilitation, that can be influential in the achievement of goals in terms of the satisfaction of the essential requirements, and to the assurance of adequate level of remaining service life, while simultaneously respecting cultural/historic value and public utility. For that objective it is essential to understand the relative importance of these variables, and possible mutual relation and synergetic effects, aiming an optimization process of choosing proper measures of repair and rehabilitation, and in the search of path for extending building service life and minimizing costs. For example, in a very common case of a EVPba residential building that is to be converted into a Historical Inn (Hotel), the satisfaction of the basic requirements of construction is not as important as the maintenance of the original building outlines, and the ponderation of rehabilitation options should reflect the imperative of primarily respecting the principles of preservation of the essential cultural characteristics of the building. It is an important goal to enhance building global performance in renovation of heritage buildings walls and confining elements, and determine the rate of maintenance actions and the possible need of the rehabilitation actions in order to increase the building service life. To obtain such goal is important to research the crosslink between the different essential requirements, in order to choose the best rehabilitation solutions.

3 BASIC REQUIREMENTS AND KEY FEATURES AND CONSTRAINTS ASPECTS OF HERITAGE BUILDING PERFORMANCE

3.1 GENERAL

Here are presented the main aspects of the overall performance of the heritage buildings, in particular its walls and confining elements, concerning the different basic requirements and the other functional requirement. However it must be stressed that the criterion relating to the basic requirements of construction can be, in a particular building with relevant cultural/historic value, not as important as another criterion related to the maintenance of the original building outlines. On classification of cultural properties, it can be established other criteria, such as the assessment of the added value of types of architectural ensembles associated with modernist architecture and the modern movement, the industrial architecture, military and religious architecture, the resort architecture, etc., which broadens the universe of buildings that may be subject to protection/classification. Such leads to an increase of complexity in the selection of conservation and rehabilitation solutions, in operations of renovation of buildings with heritage value, to ensure the extension of the service life. Under these conditions, due to its relative importance, it is vital to consider this unclassified heritage that complements the cultural heritage for which were laid down ground rules and

objectives through Portuguese Law (Law No. 107/2001) and of Decree-Law No. 140/2009.

Considering the universe of those EVPba buildings that needs to be subjected to conservation and rehabilitation, and the uniqueness of techniques required by different types of constructive solutions, that inevitably imposes different methodologies of intervention. Taking into consideration the arguments previously presented, it is important to define an appropriate methodology to deal with the variety of factors that influence the selection of solutions for conservation and rehabilitation of those buildings walls. The methodology must take into account the diversity of tangible and intangible values of the walls and their architectural and decorative elements, using the various skills that matter to involve and provide integrated solutions considering their multidisciplinary character, but based on the satisfaction of basic requirements. An important aspect is the definition of integrated solutions that solve various functional and aesthetic aspects, without destruction of cultural value, namely, preserving, to the extent possible, the techniques, elements, surfaces and materials which, because of its specificity and characteristics, historical, artistic, or constructive, are part of this cultural value. It searches also set criteria for the decision-making process of choice of durable solutions for the conservation and rehabilitation of walls and also confining structural elements of buildings of heritage value. In construction and rehabilitation of building envelope, when numerous decision criteria must be taken into account in order to give a satisfactory solution, there is a need to rationalize the decision-making process, diminishing the subjective elements that can be in majority in the decision-making process and to promoting the transparency of the prioritization process. In fact, the complexity of decisions involved in the construction and rehabilitation of building facades requires a selection of possible options based on a wider variety of considerations in addition to pure technical considerations. In decision making it is essential to be able to take into account the impacts of basic requirements, and other issues related to economic, technological, functional, ecological, social, and regulatory matters. And, the example above referred of the building rehabilitation into a Historical Inn, can be a challenging case of complex choice between different available options for rehabilitation, when the need of improving global comfort of rooms and well-being of the guests, increasing thermal insulation, solar protection of the external walls, has to be balanced with the need of preserving the decorative elements that exist in the external and internal face of the facades. Moreover, it is difficult to quantify the intangible benefits of advanced construction technologies and the risks involved in implementing such technologies with the use of traditional analysis techniques. So, it may be appropriate to consider these general items in qualitative forms in a multi-criteria analysis. Thus it is crucial the analysis of the interrelation between these basic requirements of walls, in particular concerning mechanical strength and stability, thermal and acoustic insulation, watertightness, fire safety, hygiene and health in the context of complex operations of renovation of heritage buildings, especially of public buildings.

3.2 RB1 - MECHANICAL RESISTANCE AND STABILITY

The evaluation of the structural safety of buildings "EVPba" and their possible structural reinforcement is, in general, of some complexity, largely due to the need of consider the cultural/historical value or public utility, which leads in convenience of adopting specific methodologies, in general other than those that are used in the approach used in construction of new buildings. This need is more critical if it is necessary structural reinforcement of the buildings.

The type of structural intervention to be carried out in a building "EVPba" may vary between simple maintenance to the extensive rehabilitation, in which, alongside the structural reinforcement, it improves the functional performance of the building in relation to the other basic requirements, in particular concerning fire safety, sound and thermal insulation, etc. Concerning the seismic resistance of heritage buildings, one main question related to masonry walls refers to uncertainty of the mechanical properties of the infill masonry and their influence on the structural behavior of the buildings. So, the uncertainty in the evaluation of the existent structures and possible structural intervention, associated to the age and date of construction, to eventual non-visible imperfections, or to the previous ignored effects of earthquakes, is matter that as to be considered in the analysis. But the need to link different construction elements, in particular masonry and structural elements, becomes essential to confer proper seismic behavior of construction. However, that may collide with the demand for minimization of thermal bridges through strengthening masonry panels relatively disconnected to the structure, or even the promoted separation along the interface between the walls and structure. It is important to solve the problem of reconciling the various requirements through choosing solutions that promote the interconnection of the various elements, non-structural and structural. Such passes through an effort of weighting of criteria and evaluation of available alternatives. Other issue of great relevance for EVPba buildings is the assessment of the impact of geotechnical works which affect adjacent buildings with masonry walls, and also to ensure a better performance of masonry walls against the risk of settlements of foundations.

3.3 RB2 - FIRE SAFETY

The fire safety of buildings EVPba was being gradually improved over time as standardization and regulation applicable to build buildings were introduced, which reflected the advancement of knowledge in this area.

Currently checking the safety in case of fire of buildings must take into account the relevant European and national regulatory requirements; with regard to the Portuguese rules, verification of fire safety of the building must be made according to the Portuguese legal system of fire safety in buildings, designated by the acronym of SCIE (Decree-Law No. 220/2008 of 12 November), and with the "Technical Regulation of Fire Safety in Buildings", which sets out the General and specific technical conditions of the SCIE (Ministerial Order nº 1532/2008, 29 December).

As defined in Ministerial Order nº 1532/2008, the fire resistance of the walls refers to the maintenance of the respective characteristics to face the flames and hot gases and the thermal insulation, or another specific function during a given time period, when subjected to heating process resulting from a fire. The limitation of the generation and spread of fire and smoke within a given area bounded by the walls is made by minimizing their ability to contribute to the full development of a fire, and is expressed through the different levels of performance, in terms of reaction to fire of coatings of the walls, in the actual conditions of application. With regard to this basic requirement of fire safety, in the event of an outbreak of fire buildings must be assure that: the load-bearing capacity of the construction can be assumed for a specific period of time; the generation and spread of fire and smoke within the construction works are limited; the spread of fire to neighboring construction works is limited; occupants can leave the construction works or be rescued by other means; the safety of rescue teams is taken into consideration.

3.4 RB3 - HYGIENE, HEALTH AND ENVIRONMENT

In this basic requirement of hygiene, health and environment, the EVPba buildings must be such that they will, throughout their life cycle, not be a threat to the hygiene or health and safety of workers, occupants or neighbors, nor have an exceedingly high impact, over their entire life cycle, on the environmental quality or on the climate, particularly, during their use, as a result, in particular, of: release of toxic gases; hazardous substances, emissions of volatile organic compounds (VOCs), greenhouse gas emissions or hazardous particles into the air inside or outside; emission of dangerous radiation; moisture in parts or construction work surfaces.

Failure of a building facade to control water leaks is one of the most common building facade failures. With traditional masonry walls, water leakage to the interior are minimized because the solid masonry mass will absorb water and gradually expel it as vapor. With cavity wall systems, water that penetrates the facade must be conveyed to internal through-wall flashings and weep holes via wall cavities. The presence of moisture inside the walls of EVPba building's facade can involve a number of risks, in particular the degradation of insulating elements, corrosion of metallic elements that exist in their interior and the consequent cracking of surrounding elements; If this moisture reaches the inner facade wall renders, this can cause the formation of moisture and mold stains in these renders and can be reflected on their progressive degradation, especially in interior finishes.

3.5 RB4 - SAFETY AND ACCESSIBILITY IN USE

On this basic requirement of safety and accessibility in use, the EVPba buildings must have such characteristics that do not involve unacceptable risks of accidents or damage during their use and operation, as, for example, risks of slipping, falling, collision, burns, electrocution and injuries caused by explosion and theft. In particular, should take into account accessibility and use by people with disabilities. The actions relating to permanent and accidental loads on interior and exterior walls, in particular accidental actions of shock resulting from falling or projection of people and objects, or eccentric loads associated with the suspension of equipment or furniture in renderings of walls, can generate significant efforts which oblige these walls to have enough mechanical resistance and adequate stability characteristics in order to not put at risk the security of people, or cause excessive deformations of the elements.

EVPba building facades sometimes includes non-structural building elements, so it is important to study carefully the connections and supporting elements, which must accommodate wind and seismic loads as well as structural deflections, in order to avoid damage to artistic and decorative elements. These features must be provided by setting the maximum size of the walls between locking elements, so as to limit the respective slenderness (i.e. minimizing the relationship between the vertically dimension and their wall thickness).

3.6 RB5 - PROTECTION AGAINST NOISE

With regard to this basic requirement of protection against noise, buildings must assure that the noise perceived by the occupants or people nearby is kept to a level that will not threaten their health and will allow them to sleep, rest and work in satisfactory conditions. Verification of conditions for protection against noise of EVPba buildings must take into account the relevant European and national regulatory requirements. For Portugal, the acoustic requirements related to EVPba buildings are defined in the

Building Acoustics Code (RRAE), approved by Decree-Law No. 96/2008, of June 9.

In the case of Housing buildings (mixed and not mixed), Hotels, Schools, Hospitals and Research Buildings (respectively, articles 5, 7 and 8 of RRAE), the airborne sound insulation of the external walls is characterized by $D_{2m,nT,w}$ index which, from a legal standpoint, must satisfy certain conditions, depending on the classification of urban areas as set by the Portuguese Noise Pollution Act (RGR) approved by Decree-Law No 9/2007, of January 17. In what respects rehabilitation or renovation of Auditoriums or Theaters, herein considered as buildings of cultural value and public utility, the sound insulation provided by facades should be such that the noise level established inside is less than or equal to 30 dB (A). In the case of EVPba buildings subjected to renewal operations, in order to approach the level of current requirements and for the purpose of compliance with the correct environmental integration, it should be, first of all, necessary to quantify the existing sound insulation, using appropriate estimation methodologies, or to carry out acoustic tests. It should be noted that sound insulation of a facade element depends on the opaque and glazed components, the latter being determinant in the estimation of the $D_{2m,nT,w}$ index. The sound insulation of the glazing component is a function of window area, the type of opening, the type and thickness of the glass.

Other aspects that can be considered relevant, according to each existing case, such as those associated with the airborne sound insulation ($D_{nT,w}$) or the impact sound insulation ($L_{nT,w}$) between certain spaces for indoor use, the respective procedure should be identical to that for the facades, based on the verification of the existing situation and subsequent assessment of the correspondent need for the strengthening or improvement of sound insulation between the respective spaces.

Considering that, generally, the EVPba buildings are not addressed for housing, the functional requirements that relate to the acoustic comfort, may not arise from regulatory issues, but just based on programmatic objectives, in accordance with each special case. Finally, for a correct behavior of the spaces of the EVPba interested buildings, it should not be forgotten also all aspects related to the equipment and facilities, which are often considered relevant noise sources, both from the perspective of the resting as well as on the use of building type in cause.

3.7 RB6 - ENERGY ECONOMY AND HEAT RETENTION

On this basic requirement of energy saving and thermal insulation, EVPba buildings and their facilities (heating, cooling, lighting and ventilation) shall provide features to increase energy efficiency and reduce the amount of energy needed to provide comfort, taking into account the kind of occupation of buildings, the users and the climatic conditions of their location. Building materials and buildings construction, maintenance, rehabilitation and dismantling should also be planned to reduce the energy use during construction and dismantling.

The improved thermal insulation of the envelope is essential for the reduction of energy consumption and to the improvement of thermal comfort and to avoid surface condensation and mold growth. So, it is vital the development of solutions which significantly reduce the cost of renovations of buildings; and on the development of innovative and affordable building renovation solutions for heritage buildings that can deliver significant improvements in energy performance while ensuring indoor comfort requirements, reversible solutions, with concern to eco-innovation and sustainability by integrating cost-effective technologies for energy efficiency and renewable energy

solutions. All the research will be developed through increased collaboration and cooperation and fostering of a more interdisciplinary approach. It is essential to study the solutions aimed at ensuring, for the service life, a thermal behavior of surrounding walls (including the windows) to ensure thermal comfort levels considered acceptable and limit consumption of energy in heating or cooling. The challenge is the complex adaptation of building envelope to a dynamic and changeable environment during its service life. And the development of strategies for increasing functional performance must be guided through improved air quality, moisture control, ventilation control and energy recovery; enhanced acoustic properties; and improved fire resistance. The analysis of the conservation status and the potential for rehabilitation should incorporate in decision-making the impact of glazed openings in satisfaction of the requirements of thermal comfort, sound insulation, air quality, visual comfort. This analysis must be identified by the value of the asset, the outer and inner view that can change and the possibility of change for example: the dimensions of the spans, composition, the type of glass, profiles, hardware and sun protection solutions. The interventions in glazed openings must have a comprehensive and integrative perspective of improvement of living conditions, and may enhance the reduction of water infiltrations, meet wind resistance issues, aspects of the spans and improving the architecture of the building.

Portuguese regulation related to thermal performance of buildings (residential and services) are defined in Decree-Law No. 118/2013. This Document defines the requirements for new and / or intervention buildings, as well as the parameters and methodologies for characterizing the energy performance under nominal conditions of buildings and their technical systems, in order to improve of thermal comfort of occupants. Thermal comfort is a subjective sensation that depends on personal factors, the type of clothing and the kind of activity developed. International standards (EN 15251, 2007, ISO 7730, 2005) define operating temperature ranges for different thermal comfort classes, depending on type of building, type of occupants, kind of climate and national differences. EN 15251 also differentiates recommendations for mechanical heated and cooled buildings and for passive buildings (without mechanical cooling systems).

Currently the regulation of energy efficiency of buildings, where applicable, also imposes limits on the thermal insulation of windows and sun protection requirements and integration into the ventilation system of the building. The heritage value of the building and the need to preserve appearance and materials can make the proper rehabilitation of windows. Regarding the visual comfort, two aspects must be addressed: daylighting and electric lighting. The main purpose of daylight in buildings is to provide an adequate indoor visual environment that ensures the most adequate luminous conditions for the performance of visual tasks. These conditions include: i) adequate lighting levels and distribution, ii) the guarantee of visual comfort for the occupants and iii) the more subjective benefits related to the use of natural light instead of artificial light and the contact with the exterior environment through windows. Daylighting can also contribute to energy efficiency provided that its energy impacts are correctly assessed during the design phase of buildings. Buildings should also have energy-efficient and flexible artificial lighting systems in order to provide the most suitable conditions for articulation and complementarity between daylighting and artificial lighting systems so that the use of the latter only takes place when lighting needs cannot be satisfied by daylight only. This articulation should be carried out by means of an adequate zoning of the spaces and a judicious choice of the daylight and electric light control systems. The main requirements for lighting in buildings can be

found in two international standards (EN 12464-1 and EN 15193) and also in (Santos, 2014). These documents include the most relevant parameters and respective target values and methodologies in order to assure that a building has adequate visual comfort conditions for its occupants maintaining good levels of energy efficiency.

R7 - SUSTAINABLE USE OF NATURAL RESOURCES

In this basic requirement, the EVPba buildings shall provide such features that can ensure a sustainable use of natural resources and, in particular, ensure: the re-use or recyclability of the construction, the materials and their parts after demolition; the durability of buildings; and the use in buildings of raw materials and secondary materials compatible with the environment. Recent heritage buildings, based on reinforced concrete frames and infill masonry walls, during service life, are subjected to degradation due to external actions (chemical or biological agents and climate change effect) and internal actions which particularly lead to defects in masonry walls. These defects can affect also other wall confining elements and compromise the expected service life of the building, and in extreme cases can reach such an unacceptable level of inconvenience to the normal use of the building that, to avoid the demolition of the building, a rehabilitation of the walls cannot be further delayed. The deterioration throughout the service life of materials and components (caused by physical agents, biological and chemical) ends up in some cases by significantly affect the performance of construction, particularly with regard to satisfying the basic requirements of EVPba buildings.

4 FINAL CONSIDERATIONS

Under the effort of conservation and protection of EVPba buildings, specific matters that typify the buildings in the context of the respective cultural/historical value or public utility, and of constructive/functional aspects, were discussed. A reflection was made which explore the idea of graduating that efforts taking in account the relative importance of each type of building and, in the light of this, promote the study of preventive and/or curative actions better suited to allow maximizing service life of these buildings. The idea is to extend as far as possible the period of exploration, without significant loss of its intrinsic cultural value and without losing the guarantee of maintaining adequate levels of security and functionality. Relevant performance constraints aspects to consider in EVPba buildings were presented within the framework of complex operations, in particular covering the masonry walls and confining structural elements. Here, in particular, the following aspects were generally examined: basic requirements of EVPba buildings and their interrelation, especially concerning mechanical strength and stability, thermal and acoustic insulation, fire safety, hygiene and health. It is considered essential the definition of a general criteria relating to the process of choice of durable solutions for the conservation and rehabilitation of walls and confining elements of buildings of heritage value. That leads to a definition of a methodology for selection of rehabilitation solutions, based on the discussion of priorities aiming the respect of their cultural/historical value or public utility, and the minimization of constructional defects during the remaining service life as well as global costs, and enhancement of different functional performance and their balanced combination.

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