

Inspection and appraisal of old buildings. Building defect reports for the rehabilitation process

Romeu Vicente

University of Aveiro, Aveiro, Portugal (email: romvic@civil.ua.pt)

J.A.R. Mendes da Silva

University of Coimbra, Coimbra, Portugal (email: raimundo@dec.uc.pt)

Humberto Varum

University of Aveiro, Aveiro, Portugal (email: hvarum@civil.ua.pt)

Abstract

The increasing concern and knowledge on architectural heritage have been, in the recent decades, serious reasons for urban rehabilitation and renovation processes. There are many strategies and methods to systematize various tasks in a city renovation process, which efficiency depends mainly on the type of buildings (structural schemes and techniques, type of construction materials), on the type of global project approach (singular buildings, groups of buildings, urban intervention zones, etc.) and on the exact final purpose (risk assessment and decision making, future rehabilitation projects, definition of a council maintenance policy, etc.).

In what concerns large renovation programs of old city centres, choosing the most adequate approach for inspection, appraisal and diagnosis is a complex task that can determine the success or the total failure of the project purpose. This paper describes the procedure used for the inspection of 700 buildings located in the old city centre of Coimbra (Portugal). A complete identification and inspection survey was carried out for all of the buildings on three different domains: (a) architectural typologies, (b) constructive typology, building defects, conservation state, and (c) socio-demographic characterization. All the data gathered was recorded for each building and connected with a SIG application, as well as with a relational database, in order to have a deeper and interdisciplinary knowledge of the project perimeter and hence to be able to manage the historical building stock.

In this paper will be presented the building check-lists developed for inspection, the building defect reports produced for the rehabilitation and renewal process. It will be presented the overall results from the inspection survey for different construction elements that allowed the characterization of traditional construction solutions and diagnosis of the most common defects for these type of buildings.

Keywords: Historical city centre, building defects, diagnosis, inspection and rehabilitation.

1. Introduction

There is growing evidence that built heritage conservation carries benefits in many areas the urban environment. Responsible decision makers, institutions and authorities involved in urban development programs have recognized the urgent need to preserve their cultural resources and assets, and moreover to relate cultural values to development. In the area of construction, it has been estimated that 50% of all building refurbishments in European cities relate in some way to heritage preservation [1]. The physical refurbishment of historic city centres provides the means for social revitalization of communities and neighbourhoods; economical attraction and improvement of the quality of life (see Figure 1).

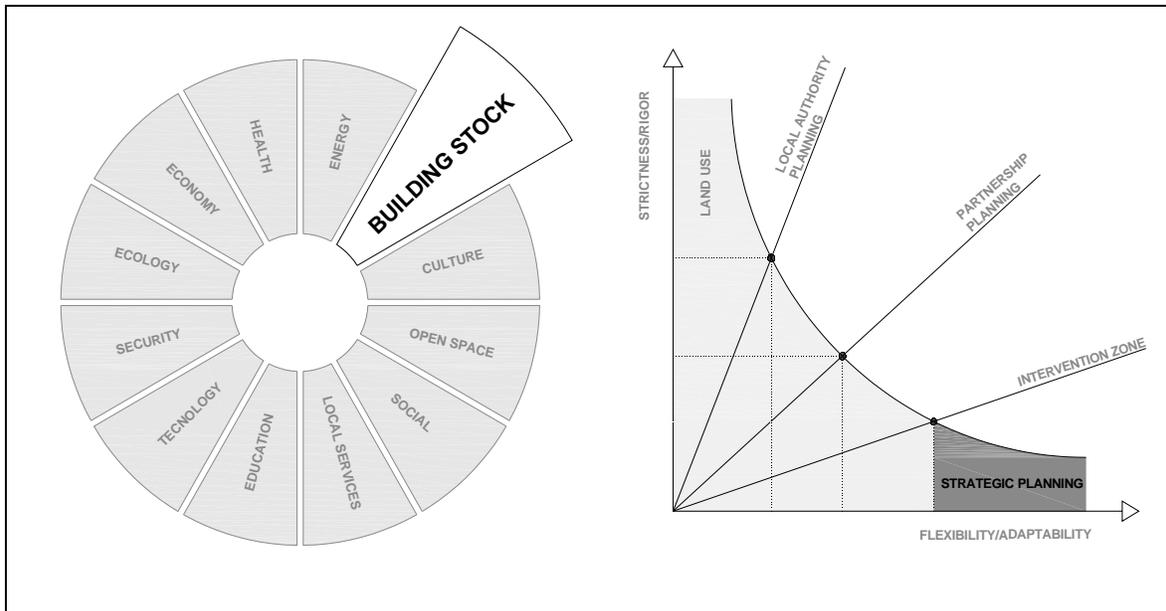


Figure 1. Urban regeneration scope and planning issues

The URBAN Community initiative [2], introduced in 1994, using EU structural funds has carried out the URBAN I and presently the URBAN II, URBACT programs, promoting and funding urban regeneration, tackling multi-faceted urban problems in small areas in an integrated approach, maximizing the impact. The Portuguese city of Oporto was one of the 33 UPP (Urban Pilot Projects) launched and approved in the first phase. In the second phase, Urban II, continues to build on the successful framework of the first phase, with several improvements and new objectives and priorities. Urban II, has contemplated the Portuguese cities of Oporto-Gondomar, Amadora and Lisbon. These projects have very widespread objectives: social inclusion and integration, local partnership and cooperation incentive, physical and environmental regeneration, traffic management, information

technology, culture and at the end line globally exchange experiences of sustainable development in cities over Europe. Basically a SWOT analysis defines the main guidelines and actions, identifying opportunities, threats and on another perspective strengths and weaknesses. Even though the physical building upgrade, renewal and strengthening actions are only one of the objectives of a renewal and regeneration process and has proven to play an important and crucial part in the process, with direct influence on other objectives. The recourse to construction techniques and architectural knowledge is vital when working to maintain a historic city centre core. The history of the old city centre, the urban fabric and the structure of its buildings, skills in appropriate traditional refurbishment and restoration methods are crucial when upgrading an area. Where the private sector is involved, very careful analysis of their commitment is essential before the project is launched. The scientific community and research activities have brought to attention the development of methodologies, technologies and tools to guide, appraise, forecast, monitor and assess old buildings, constituting the basis of our understanding of the sustainable approaches and rehabilitation and renewal needs of the built heritage. The research and case study has been a challenge to demonstrate that development of a urban intervention plan, by applying appropriate means for building inspection and appraisal, decision-making tools, such as building reports, risk assessment, cost/benefits appraisals and valuations, will lead to a balanced solution between the final purpose and resources used. Recently, new legal guidelines have been approved to create the so expectant and awaited SRU's – Urban Rehabilitation Societies for some Portuguese cities (Coimbra, Oporto and Lisbon). These new societies will be implemented as a type of “neighbourhood councils” or “enterprise-city blocks” and they will be responsible, within the rehabilitation process, for defining and planning strategies, promoting and executing renovation actions.

2. Methodological approach: Old city centre of Coimbra

The renovation process of the old city centre of Coimbra is a national singular experience on urban renovation and rehabilitation. Other Portuguese cities have started and still ongoing renewal actions, but have not undertaken the renewal process in such an organized, integrated and methodological manner. In order to survey and study the old city centre area, the project perimeter (see Figure 2) was divided into eight zones (big city blocks). Each zone includes several buildings that share in many cases the same type of architectural, functional and occupational characteristics to be inspected and analysed with the purpose of in a final stage each zone is studied and renewed as a whole.

In the scope of the renovation and rehabilitation process, the city council invited the University of Coimbra to carry out a complete identification and inspection survey of the

buildings on three different domains: (a) architectural typologies, (b) constructive and pathological condition of buildings, and (c) socio-demographic characterisation, of this part of the city. Four teams of inspectors were created, three of them for each aspect mentioned above, and a fourth team to create a computer data-base to manage, inter-cross and analyse information gathered, using SIG platform and a DBMS. The interaction between teams with different interests but with some common final aims is a decisive factor to contribute to a final and balanced solution. It will only discuss the second aspect mentioned above, related to deterioration and defects of buildings under the engineering point of view. This first stage – a complete inspection and identification survey – is the solid basis of the process and it is essential to acknowledge all variables and sensibilities involved, so that further stages, like the definition and proposal of various base-projects, correspond to building features inspected and identified. All this information individualized and recorded for each building in the computer data-base is a tool to promote and justify decision making and help develop in the future rehabilitation projects individually or globally in a larger scale – city block project.

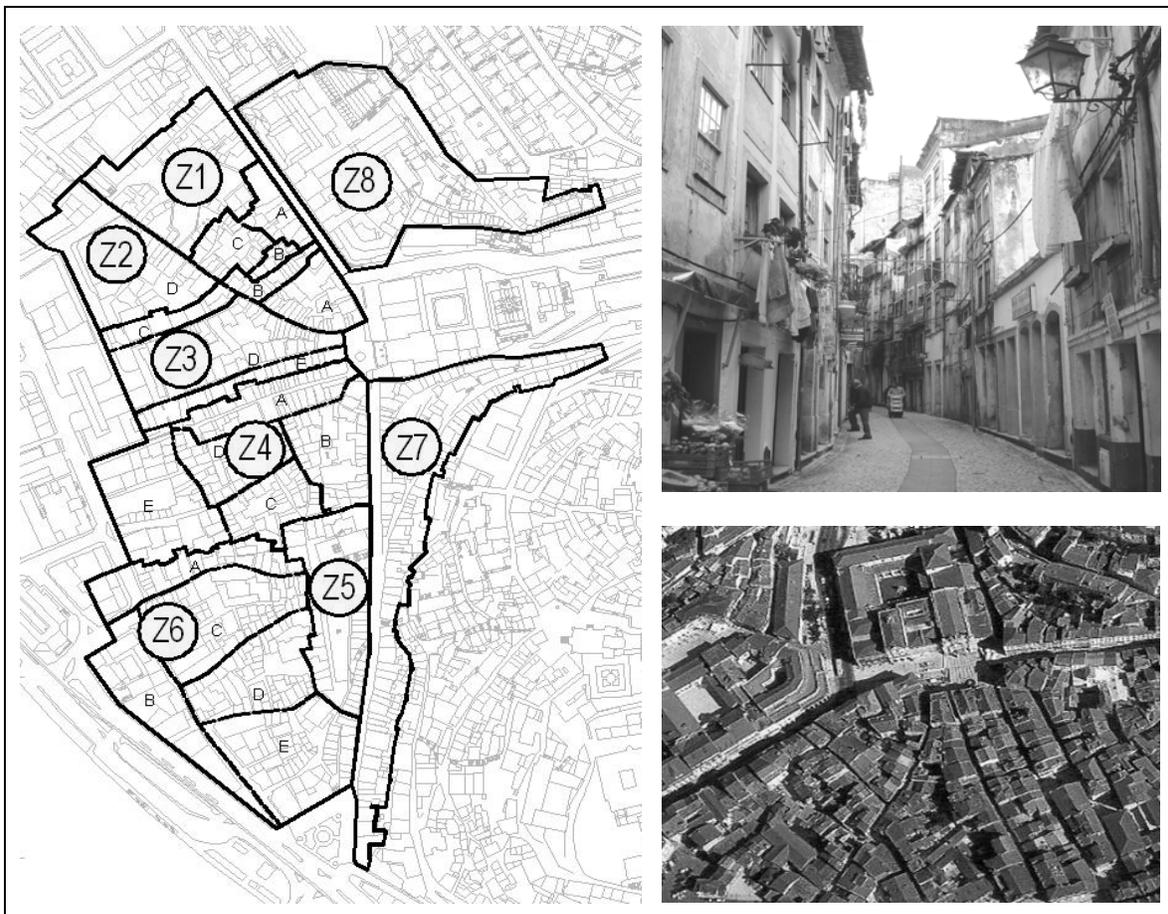


Figure 2. Project perimeter of the rehabilitation process of the old city centre of Coimbra

Urban conservation and rehabilitation initiatives are very costly and rarely public funding is available to meet the demand. Some interesting and successful experiences have been the result of singular efforts or private group projects. However these are small scale interventions (group of buildings, street front), so a more broader and sustainable approaches need to define global strategic model for the case of a city or large urban zone centre. Global strategic and planning models permit to define in such a clear way the means and tools necessary for global and individual approaches to the urban environment and building stock identifying and evaluating of opportunities and objectives in all levels (infrastructures, social, technological, constructive, economical, sustainability, etc).

The presented methodology has as main aim to serve as tool for guiding urban planning and intervention, with particular importance from the building refurbishment and rehabilitation point of view for buildings in urban and historical centres, and also in the definition of maintenance policies and priorities as shown in Figure 3. This methodology has contributed to the organization and decision aiding in a more supportive and clearer manner without compromising the nature of the intervention. There exists no unique model, but general principles and major steps, so this methodology needs to be adapted and modified faced to different urban characteristics and features, as for final end-products.

Many other models developed for rehabilitation and maintenance of constructions and buildings are very complete and objective, but they lack the scale of analysis and the broader sense of the renewal and rehabilitation actions. This model intends to present an important and innovative contribution in the orientation and definition of urban strategies, planning and analysing in the extent of the rehabilitation of the buildings of old historical city centres, with the sense of intervention and planning that values the culture of transforming and rehabilitation of building stock that will stimulate partnership. Figure 3, shows the global layout of the model adopted for this case study.

After defining the project context and definition, the principal part of the strategic model is the data processing and treatment. Through this analysis, a qualitative and quantitative characterization of several elements and aspects of the buildings are recorded. At this stage, one can answer a series of simple questions (number of buildings with roof structure problems, distribution of structural typologies, conservation state of timber floors, etc) through consulting a treated variable (aspect, parameter characteristic registered or diagnosed). The database information could also be explored and enhanced by crossing and relating results with additional data (exterior data) for more complex analysis. This “abstraction level” can be understood as a transformation of results of the direct results into indicators for decision making on different levels and more concise conclusions. For

example, to evaluate seismic vulnerability of the old building stock, the information collected using the inspection check-lists is added to other sources of information which is necessary to carry out risk assessment.

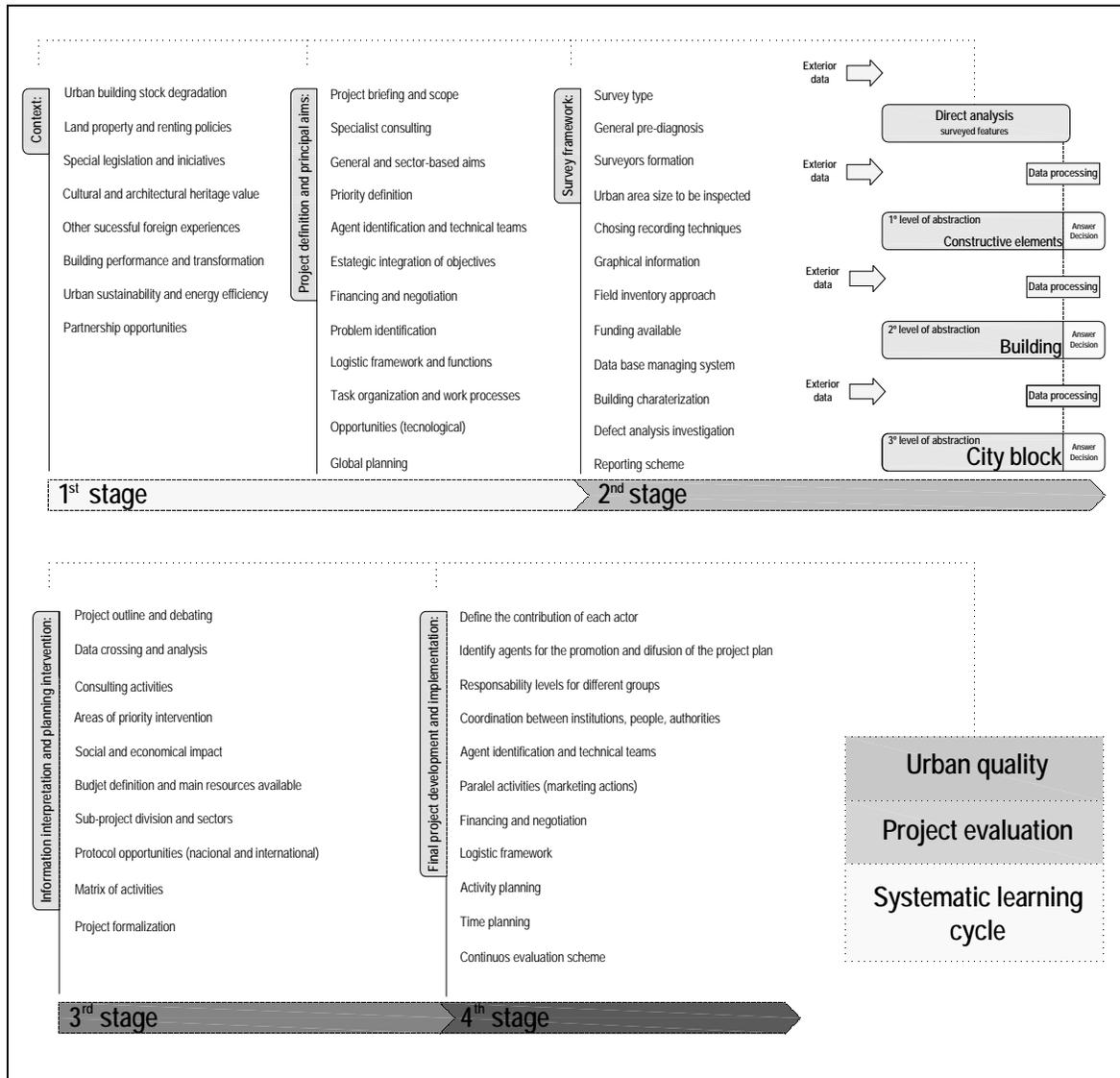


Figure 3. Proposed project process

3. Survey and appraisal of old buildings

The survey is the starting point to assess and identify the condition of the buildings and their defect analysis investigation. Survey actions are often inadequate and unfruitful, because they are not based on a true knowledge of the building stock, from the type of materials used, construction techniques, typical defects, etc. A poor survey can have a

negative effect influence on the way the building is discussed, managed, compromising its future well-being.

Choosing the most adequate approach for inspection, appraisal and diagnosis is a complex task that can determine the success or failure of the project purposes. This problem is particularly important when it is intended to inspect more than 700 buildings in 18 months range, with a good level of accuracy and coherence to achieve reliability set of data. To achieve these objectives, only a very few number a buildings could be revisited, what should happen only in the most dramatic or suspicious situations. There are various levels for carrying out inspection and appraisal of buildings. If the main goal is general planning and strategy issues, the characterization in a general matter of the buildings in a specific zone constitutes an adequate level of inspection. But if a higher level of characterisation of buildings is pursued, then our objective is certainly more sophisticated, for example, an exhaustive and complete inspection and diagnosis, that could involve destructive and non-destructive testing, must precede an individualized rehabilitation project for a valued architectural building. Then, there are various parallel levels of inspection that are specific for only some construction and material features. For example, to evaluate the structural vulnerability of old buildings, specific items must be surveyed, such as wall thickness, building height, plan configuration, type of soil and foundations, floor slab connections to masonry walls, masonry shear strength, etc. The influence of such effort on the level of inspection of buildings must be justified by the degree of action of future rehabilitations carried out. In truth the level of inspection must take direct effect on the quality and depth of rehabilitation and renewal actions, as well as maintenance.

The ICOMOS [3] charter is establishes guidelines on several levels. On the survey and diagnosis level it is very clear, in practice of conservation, the need of complete understanding of the structural behaviour and of the characteristics of the building materials. It recommends as essential to collect information on the structure, techniques and construction methods used, subsequent alterations, present conservation state, etc. It also states that the diagnosis is to based on historical information and on qualitative and quantitative approaches, before any decision on building intervention, it is indispensable to determine the causes of damages and degradations previously and evaluate the level of actual safety of the building structure on the structural point of view.

The rational approach for the survey stage must keep in mind and be aware and guided by 7 principles, listed in table 1:

Table 1. Principles to guide the survey stage

1	Each traditional building has different and singular aspects that make them unique, leading to slightly different survey needs, from case to case. The adopted survey strategy and techniques must be the most adaptable and sensitive to these building features, without losing its broader view of the buildings.
2	The selection of the means of inspection, appraisal and recording must be adaptable to the nature of the building, physical and “in-situ” limitation of survey actions and available resources. The choice of which building features to record, which techniques to use and to what extent or level of the building feature inspections is necessary.
3	The survey actions should be based on the general scope and most important and critical aims of the project. Any repair, maintenance, refurbishment action or intervention strategy should reflect the investment (using the results) made in the survey phase-
4	The approach to define a survey strategy is clearer when what is at stake in the decision-making process and what is to be learned. Therefore, questions such as: construction method, modifications over time, nature of materials, energy efficiency, mutable use of the buildings, heritage building importance classification purposes, long-term conservation actions, among many others are the major guidelines to keep in mind for this stage.
5	The survey is obviously a multidisciplinary task. The contribution of different surveyor teams (engineers, architects, historians, archaeologists, etc.) with expertise opinion is very valuable. The greater challenge is to coordinate these specialists and their objectives.
6	The surveying stage, through inspection, appraisal, diagnosis and recording tasks could attain very high level of complexity. The quality of information, number of people and areas involved, range of tasks, and the natural dynamics of this stage must not generate misleading interpretations or lose the project overview and understanding. Be aware to unexpected data and information that might lead to global strategy discussion of the output and aims forecasted.
7	The use of other sources of information, such as the documentary information is also very valuable and should be considered.

The surveying task is essentially a combination of complementary tasks: recording, diagnosis, inspection and testing. The methodology used in this case study was guided and undergone 3 great phases: survey framework preparation; fieldwork and data processing and treatment (off-site work) as shown in Figure 4. In each of these phases, several processes are carried out: Organizing activities, research, analysis, recording and reporting are some of the major procedures. In figure 3, is shown the progress diagram proposed for these type of projects. The main difficulties that have been encountered in such a process are essentially: time deadlines, limited technical and economic resources, social, cultural and environment reality found in the field, re-housing of tenants and installation of construction work sites, priority decision making in critical cases, lack of knowledge of local and traditional handicraft, construction procedures and materials [4].

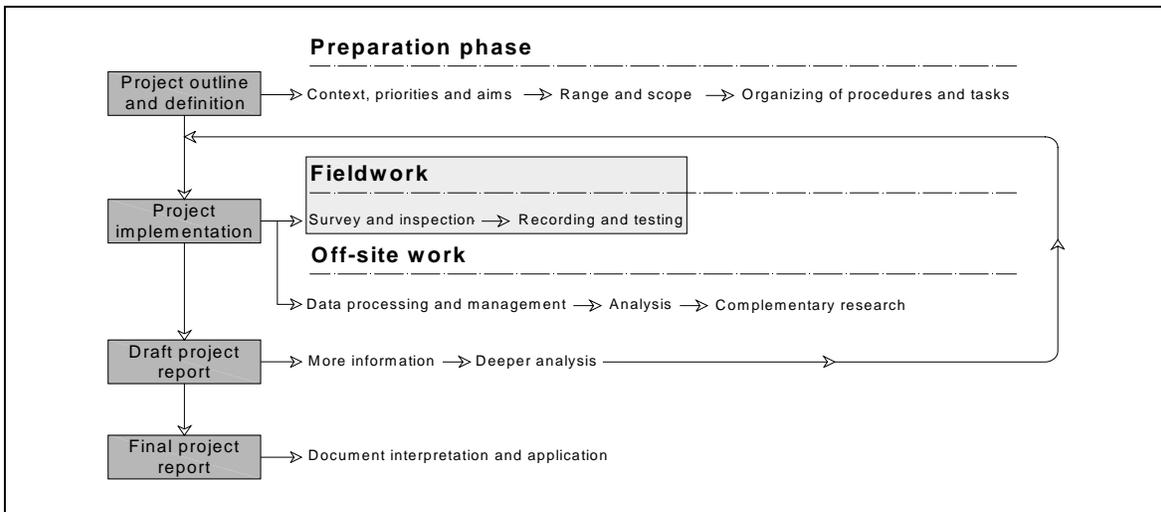


Figure 4. Survey framework

4. Old building stock report sheets

The survey carried out and presented is only upon the building physical inspection, other levels of inspection referred in point 2 are not analyzed in this paper. The inspection and diagnosis check-lists are structured by building elements and components, previously defined and evaluated in a hierarchy manner. Each building element is surveyed by a check-list, recording and characterizing essentially materials, solution, condition state and defect analysis. The adopted method used in this case, was used on 772 buildings within the project perimeter. Figure 5, presents the scope of the main check-lists developed.

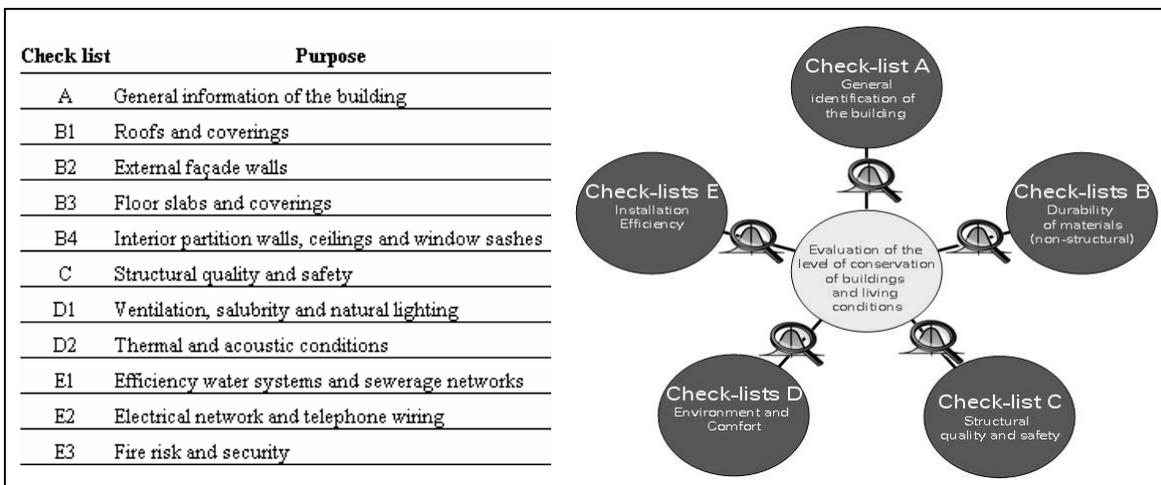


Figure 5. Main check-lists developed for detailed inspection of buildings

The extensive and wide information, resulting from the inspection and survey for each kind of construction element (roof structure, building façade, internal members, and installation efficiency) is introduced in the database system and used for the project development. More specific check-lists were created further on for particular situations: buildings in ruins, abandoned or unoccupied, building renewed and transformed and building used as warehouses or commercial spaces. In Figure 6, is shown an example of one of the checklists and the level of information recorded. Particular importance is given to the structural aspects of the old buildings such as the external masonry walls, roofing systems and floor slabs. Written description, drawings and photographs, noting detailed explanations and comments were made to complete the survey sheets.

Figure 6. Example of a building checklist

5. Inspection results

The information processing of all the 11 check-lists and the final report presentation can be analyzed at two levels: i) or individual building ii) group of buildings (see Figure 7). This

“output” has the most meaningful information that will be used in the eventual decision making and for the rehabilitation and refurbishment of the old buildings, taking into account of the intervention is single building or a broader action as a group of buildings (e.g. city block).

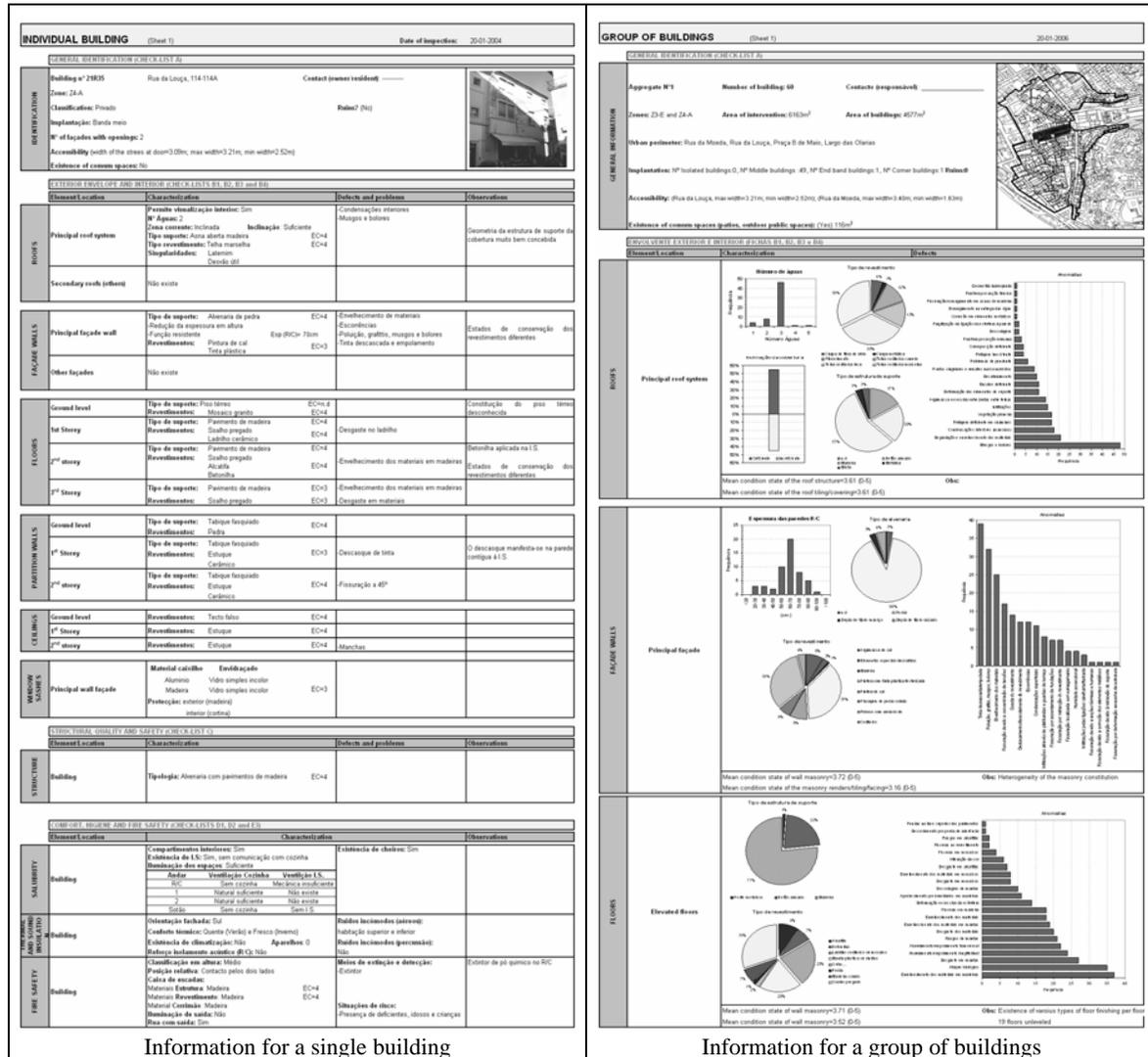


Figure 7. Building reports

It is in this format that presently the information is presented to the technicians and decision makers in the ambit of the “urban rehabilitation partnership” that will rely on the evaluation and analysis made. The information presented is not the same for a single building or a group of buildings. In the group of buildings, relevant information is in the form of distribution histograms, statistics and listing. For small groups of buildings, in the range between 3 and 10, results can be presented in a different format, privileging the

listing form. Obviously, when the group information is made for buildings with similar characteristics, but the criteria used can be substituted by the other: street axis, buffer areas, etc.

6. Conclusions

The importance and influence of the survey must not be underestimated. It is the natural point of interest at which all interested and involved parties will focus and discuss, identifying the needs of the building, understanding the buildings and finally put forward solutions, demands, decisions and practices. The results obtained give an accurate “image” of most of the old building stock in urban areas of our country and allow the analysis of the most relevant problems and defects and essential needs in terms of building refurbishment. The actual state of degradation of old buildings in historical city centres has impact on other levels such as cultural, economical, social and historical values bringing forward the urgent attention on this matter through the implementation of building renewal and rehabilitation strategies. The benefits of interdisciplinary research teams are that it produces synergy: working in teams enables more to be accomplished, far more than working as individuals. It provides added value: It encourages interdependence that strengthens each individual's involvement by recognizing the different yet complementary contribution of each discipline to achieving a balance between cultural heritage preservation and use.

References

- [1] Proceedings of the 4th European Commission Conference (2000) Research for protection, conservation and enhancement of cultural heritage: opportunities for European enterprises, Strasbourg, France, 22nd-24th of November, 2000.
- [2] Urban II (2000) - Community Initiative of the European Regional Development Fund (ERDF) for sustainable development in the troubled urban districts of the European Union.
- [3] International Council on Monuments and Sites (2003) ICOMOS Charter - Principles for the analysis, conservation and structural restoration of architectural heritage, *Ratified by the ICOMOS 14th General Assembly*, in Victoria Falls, Zimbabwe, October 2003.
- [4] Vicente R., Mendes da Silva J.A.R., Varum H. (2005) Strategies for building pathology reports in an urban rehabilitation process. Project of the Old City Centre of Coimbra, *Proceedings of the 10th DBMC International Conference on Building Materials and Components*, Lyon, France, 17th-20th of April, 2005.