Strategies for building pathology reports in a rehabilitation process:
In the old city centre of Coimbra

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Abstract

There are many strategies and methods to systematize tasks in a city renovation process, the efficiency of which depends mainly on the type of buildings, on the type of global project approach and on the exact final main goal. A wide number of activities must take place to assure, in a first stage, the exact description of city buildings, their residents and their way of life.

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.

This paper describes the preparation phase of the inspection of 700 buildings located in the old city centre of Coimbra (Portugal), where a global renovation process is planned for the next few years.

\textit{Keywords: building pathology, rehabilitation and renewal process, sustainability, inspection, appraisal and diagnosis.}

1 Rehabilitation process of the old city centre of Coimbra

The urban and street structure of the old city centre of Coimbra has managed to prevail over the years. To this reality contributes the fact that Portuguese cities were not fustigated by the 2\textsuperscript{nd} World War destruction and consequent reconstruction. The old city centre of downtown Coimbra is delimited on the left by the river and on the opposite side by the higher old centre and the University on the top of the hill (fig. 1).

Nowadays, it is interesting to refer that, most of the ancestral physical and occupational characteristics of the old city centre have not changed through time:
streets and alley lay out, traditional commercial activity (little groceries, shops and taverns, ...), etc.

Since the early 70’s, renovation programs of old city centres became a significant scope of political and research activities, as the consequence of the increasing concern on urban sustainability and its rising public promotion given by international treaties and conferences on this matter.

1.1 Old city centre of Coimbra

The process that is recently starting in Coimbra is not the first national experience of renovation and rehabilitation. Other Portuguese cities have started revitalization actions in the mid 70’s, little after other European cities: Bologna [1], Paris, Barcelona, etc. These examples influenced our few national examples: Historic Centre of Guimarães, Ribeira Barredo (Porto), Bairro Alto (Lisbon) [2,3].

Figure 1: Plan and aerial view of the old city centre of downtown Coimbra.
The city area to be studied was divided in 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 registered and analysed further on. Each zone is supposed to be renewed as a whole.

The old city centre is divided in two areas of population: “São Bartolomeu” and “Santa Cruz”. They are constituted by 721 buildings, in which 481 flats are unoccupied; resident population is of 1979 individuals (445 families); around 40% of the resident population is aged over 65 years; around 65% is unemployed in which 30% are pensioners or retired. The active population (around 57%) works in the area of residence and has very low wages, under 350€ (data obtained from the 2001 national inquiry).

This area has a very important housing function. Concerning the degradation level of buildings, city council statistics (of 1998) indicate that around 48.1% does not present minimal living conditions and only 13.2% are in good condition of preservation. In respect to basic healthy conditions, referring specifically to the existence of toilets and shower-baths, 37.8% of flats, lack one of the mentioned basic needs.

1.2 Type of buildings – general characterisation

Architectural typology and traditional construction techniques are variable in role of the dimension and nobleness of buildings. In respect to housing buildings, very simple structural schemes are observed: load-bearing external stone masonry walls and wooden floor slabs (fig. 2).

In the majority of buildings that have been inspected, we observed the systematic use of wood, in structural elements of floor slabs, roofing structures and floor coverings. Mainly, we registered the abundant use of limestone in external load-bearing walls and other materials less applied, such as solid or perforated clay bricks. The use of river sand in mortars for bed joints and external renderings is also very common. In most cases roofs are covered with clay tiling of various formats. Window sashes are predominantly in wood and simple glazing windows are frequently seen. Interior partition walls are thin and sometimes suffer warping, revealing some kind of structural movement, often as consequence of creep and aging phenomena.

Interior water systems are mainly made of cast and galvanized iron pipes and, in some rare cases, they are still made of lead; sewerage systems are made of grit stone and, more recently, they are made of plastic.

Staircases have, typically, high slopes and use materials with high fire vulnerability, which makes difficult fire emergency evacuation.

The majority of buildings are normally in bands with strait and windy accesses, constituting another negative fire safety factor.

Typically, these building have no basement, since the major area of this part of the historical centre of the town is quite close to the river (downtown), on a flat surface land (in opposition to the high historical centre - not included in this study - that covers the mountain-side, enveloping the old University, erected on the top of the hill).
Narrow streets

External walls-façades (architectural value)

Wooden floor slabs (excessive beam spacing)

Wood flooring (stair-case)

Roof structure (pine or eucalyptus)

Clay roof-tiles

Interior partition walls (lath work with mortar)

Sewerage systems (bad drainage)

Figure 2: Construction details of old housing in the city centre.
1.3 Purposes of the urban and social renewal and renovation process

The visible degradation of buildings and their living, security and healthy conditions have come to such a degree where taking action must be somewhat urgent but prudent. The need to act in a concerted and systemized way to improve the housing conditions of the old city centre in a political, social and coherent manner is our main goal for the next years [4].

The major purposes can be put into questions as: How to adapt the old city centre to new and modern living conditions? How to stop the aging tendency of resident population? How to maintain the diversity of functions and occupations of the old city centre? How to stimulate participation and interest of all groups involved in the renewal process? How to improve economic, social-cultural and commercial development?

The process must take into account, simultaneously, two different approaches: the physical renovation, materialized in the renovation and modernization of housing conditions, commercial spaces, public equipment and urban space; the social, cultural, economical and environmental sustainability, in terms of energy efficiency, gentrification of population and functional services.

2 Methodological approach, procedure and recommendations

There are many strategies and methods to systematize various tasks in a city renovation process, which effectiveness 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.) [5].

Recently, in Portugal, new legal guidelines have been approved to create the so expectant and awaited SRU’s – Urban Rehabilitation Societies. 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. These societies are composed by city council housing department, owners, design engineers and architects, public and private investors and representatives of tenants. This political and administrative tool will sure help out on this complex and long process of urban renovation and renewal.

2.1 Methodology, strategies and difficulties of the intervention plan

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 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 Geographical Information Systems platforms. 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. This paper will only discuss the second aspect mentioned above, related to degradation of buildings under the engineering point of view.

All this information individualized for each building in the computer database 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.

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.

The main difficulties to handle are essentially: time deadlines, limited technical and economic resources, social, cultural and environment reality found in the field, re-housing of tenants, priority decision making in critical cases, lack of knowledge of local and traditional handicraft, construction procedures and building materials and installation of building work yards.

3 Inspection, appraisal and diagnosis of old buildings

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 problem is particularly important when it is intended to inspect more than 700 buildings in 18 months, with a good guarantee of coherence, homogeneity and reliability of data. To achieve these goals, only a very few number a buildings can be revisited, what should happen only in the most dramatic or suspicious situations.

There are various levels of inspection and appraisal of buildings. If the level of approach is to characterize in a general matter the buildings in a specific zone this level of inspection is adequate for a general planning and strategy issues (fig. 3). 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 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 features. For example, the register of urgent and necessary interventions in means of structural, constructive or healthy problems, that would enhance the living conditions in a appreciable way; this kind of situations are permanently reported to the city council housing department during the inspection activities (fig. 4).

The influence of such effort on the level of inspection of buildings must be justified by the degree of future rehabilitation actions carried out. The level of inspection must take direct effect on the quality and depth of rehabilitation work.
Building "A"

**Defects description:**
Eminent ruin. Lateral masonry walls severely cracked and bulging.

**Suggested action:**
Partial or total cautious and studied demolition, imposed by safety requests of neighbouring buildings.

Building "B"

**Defects description:**
Severe insalubrious condition. The upper flat is unoccupied and infested with fleas. There is no sanitary installation.

**Suggestion of Intervention:**
Remove tenants and proceed with disinfections and full rehabilitation and repair for future occupation.
3.1 Difficulties of the inspection and diagnosis tasks

Fieldwork experience is still taking place and it will continue for one year more. Over 128 buildings have been already inspected in spite of several relevant, but expected, difficulties: reluctance of some tenants and home owners to opening their buildings for inspection; absence of design projects of building which would help to understand structural behaviour and to identify cracking phenomena; non-orthogonal building solutions that disturb our interpretation of the construction; physical and financial restraints to carry out more precise and conclusive inspections using destructive and non-destructive testing for the diagnosis of some defects; unknown history of undated building changes, such as the typical example of the suppression of structural elements at ground floor levels or reinforcing of slabs to achieve open-spaces for commercial activity.

3.2 Building inspection check-lists

The adopted method used in this case was tested on 18% of the buildings within the project perimeter. This test shows that the optimal result of the inspection task carried out is quite dependent on the correct number of check-lists created, adapted for each kind of construction element (roof, façade, internal members, installation efficiency) and the availability of their combination in one single building. The inspection and diagnosis check-lists are structured by building criteria that have been previously defined and evaluated in a hierarchy manner. Table 1 presents the purpose of the main check-lists developed within this work (see example in fig. 5). More specific check-lists were created for particular situations: buildings in ruins, abandoned or unoccupied, building renewed and transformed and building used as warehouses or commercial spaces.

<table>
<thead>
<tr>
<th>Check-list</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>A</td>
<td>General information of the building</td>
</tr>
<tr>
<td>B1</td>
<td>Evaluation of roofs and coverings</td>
</tr>
<tr>
<td>B2</td>
<td>Evaluation of external façade walls</td>
</tr>
<tr>
<td>B3</td>
<td>Evaluation of floor slabs and coverings</td>
</tr>
<tr>
<td>B4</td>
<td>Evaluation of interior partition walls, ceilings, windows sashes</td>
</tr>
<tr>
<td>C</td>
<td>Evaluation of structural quality and safety</td>
</tr>
<tr>
<td>D1</td>
<td>Evaluation of ventilation, salubrity and natural lighting</td>
</tr>
<tr>
<td>D2</td>
<td>Evaluation of thermal and acoustic conditions</td>
</tr>
<tr>
<td>E1</td>
<td>Evaluation of the efficiency water systems and sewerage networks</td>
</tr>
<tr>
<td>E2</td>
<td>Evaluation of the electrical network and telephone wires</td>
</tr>
<tr>
<td>E3</td>
<td>Evaluation of fire risk and security</td>
</tr>
</tbody>
</table>

Table 1: Main check-lists developed for detailed inspection of buildings.
Figure 5: Example of Check-list (type A).

3.3 Main inspection results

The use of the check-lists enables the evaluation of the level of degradation and the systematisation of principal and recurrent defects observed in buildings:

- Cracking and disaggregating of stone masonry walls, affecting window openings and external renderings;
- Stains and mould growth, on exterior stone walls, caused by rising damp and rain penetration;
- Deflection of interior partition walls, cracking from excessive compression originated by the deformation and deflection of wooden
structured floor slabs with excessive beam spacing on which they unload;
- Aging of materials, along with bending and arching from retraction, as in wooden window sashes, aggravated by the climatic agents, such as, sloped rain and solar radiation;
- Infiltrations through roofs, resulted from excessive deformation of roof support structures, or essentially, because of the non-treatment of singular roof pointing (roof ridges, corners and edges).

In respect to water distribution systems, sewerage networks, the principal problems are the aging of materials, loss of water tightness, and piping clogs. The electrical installations are obsolete and dangerous, which constitute a higher risk in terms of fire safety.

4 Conclusions

The old city centre of Coimbra has reached a serious level of degradation and urges to be renovated. This problem, faced to the great scale of the process, requires an integrated and global mechanism of inspection and diagnosis. As said before, the kind of approach can determine the success or failure of future stages of the process. Therefore we are developing a specific approach for the old city centre of downtown Coimbra.

In terms of acoustic and thermal conditions, old buildings are in significant inconformity with actual standards of comfort, being necessary the improvement of insulation to achieve a minimal standard of quality.

Further treatment of the inspection and appraisal data will allow us to develop pathology reports for buildings, list repair actions and activities and estimate rehabilitation costs. It will also help to produce defect level diagrams and seismic building risk maps, but, most important, to improve and guide a renewal strategy. A PhD thesis is being developed on this subject, and constitutes one the scientific support to this work.

References