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Social Housing Building Stock Renewal Needs: A Case Study

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ABSTRACT

Providing adequate shelter to low income families was a major focus of public investment in the last quarter of the twentieth century in Portugal. However, most social dwellings have not been built in compliance with essential sustainability principles, therefore compromising their present value. This has been confirmed with a recent field survey conducted by the authors to a set of social dwellings in Aveiro district, in the centre of the country.

According to the survey, both technical and administrative reasons have contributed to the above scenario. On the technical side, inappropriate materials and construction processes have been detected: low durability solutions have contributed to early deterioration of external building façades; deficient installations anticipated problems in water supply and drainage, etc. Some pathologies root in design as deficient or inexistent thermal and acoustic insulation and lack of ventilation induce early problems in the building performance shortly after construction. On the administrative side, restricted budgets and strictly control of construction spaces also played a role.

The aim of this paper is to present the results of the most relevant problems detected in a sample of rental social dwellings. This will be used in the scope of a research project being carried which aims at prioritizing refurbishment interventions in the Portuguese social housing stock.

KEYWORDS: **Social Housing, Pathologies, Performance Level Evaluation.**

1.1 INTRODUCTION

Social housing promotion major aim is to provide houses at lower prices than the current market, to be bought or hired by low incomes families, assuring them habitation with minimum quality conditions (Pedro, 2003). This promotion can be done by public or private initiative.The Portuguese State investment since 1992 to 2001, only to support the construction of public rental housing, was 87 830 millions of Euros. During this interval of time it has been passed from the construction of 1 283 houses in 1992 to 6 343 in 2002, what permitted to give a house to 40 104 families (SEH, 2004). However these State Housing Secretariat studies (SEH, 2004) recognize that the quality and durability of these housings hasn't been the desirable, existing now a days a greater worry with these aspects. In spite of the number and the financial amounts involved in these projects, they weren't accomplished with preventive maintenance plans and with rehabilitation activities (Conceição, 2000).

Buildings have as principal objective full fill its occupants essential needs of weather cover. So its envelope must establish a frontier between the interior and the exterior environment, with safety, habitability and comfort high performance levels. It is also important to establish performance objectives related with economical issues along the service live of the buildings, related with its energetic efficiency, with its durability and sustainability. A short durability implies the precocious appearing of pathologies, the no compliance with the estimated service live of the entire building or of its parts, the need of extraordinary rehabilitation actions, the major waste and consumption of resources and the need of more frequent repair and rehabilitation works.

Analysing the principal pathologies identified in buildings, it can be verified a great incidence in its envelope. This incidence implies a minor performance level of the elements were they appear, and the appearance of interior pathologies in the houses.

The building set considered was recently constructed, between 2001 and 2004, having the same design with 3 housing pavements. The 14 group of buildings are implanted in 14 different local regions of a same council, in the centre of the country. This study initialized with the consult of the respective design (architecture, structure, water and drainage, and thermal comfort). After that it was carried out the building's external and interior visual survey, accomplished with the inhabitants interviews.

1.2 PRINCIPAL BUILDING ANOMALIES DETECTED

The “Agence Qualité Construction” has published the data analyses corresponding to the accidents occurred in buildings that has been registered by the insurance companies in France, relative to the constructed buildings. Through this data it can be verified that the roofs and façades are the most affected elements, corresponding in 66,9% of the cases to a lack of waterproofing, as in Table 1. The registered anomalies occurred mainly in façades (21%), flat roofs (13,8%) and pitched roofs (9,7%), also referring that 5,4% of the anomalies occur in the frameworks.

Table 1 – Detected failed in housing building blocks

Waterproofing	66,9 %
Security against fire	9,9 %
Structural	4,1 %
Moisture, air waterproofing	2,0 %
Thermal and acoustic isolation	1,5 %
Others	15,6 %

Source: AQC, 2006. Period 2002-2004.

Trough the last Censuses it is verified that in Portugal, relatively to the total of constructed buildings, exist 40% of buildings with structural anomalies, 45% with roof anomalies, 47% with anomalies in the external walls and frameworks. So it can be conclude that the buildings envelope present a high rate of anomalies, which frequently implicate internal deterioration in housings (Censos 2001).

During the façades visual survey of the analysed set of buildings, the main pathologies identified were the cracks in the external finishing, with significant areas and thickness, and the development of vegetable organisms in the single-coat render mortar external finishing. The detachment of ceramic tills, discolouration, delamination and efflorescences in the external finishes, affect no more than 5% of the façades area.

During the visual survey carried out in the interior of the apartments, it was observed:

- high occurrence of condensation in walls and ceilings;
- dampness patches in the walls principally near the windows and in its parapets.

The causes of some of these pathologies are incorrect solutions as the no appliance of armed coatings, waterproofing claddings in the windows frame, external protection of the frameworks and poor drainage system in the top of the façades. The poor envelope thermal isolation is also an important cause of these pathologies.

1.3 DURABILITY

The service life of housing buildings is established with a minimum of 50 years. The Portuguese technical recommendations to social housing refer that, “buildings must be designed, to guarantee that its safety and functional characteristics of the materials, elements and construction equipments applied in, don’t be affected during a length of time not inferior of 50 years, admitting they are submitted to normal conservation actions. This period can be reduced in the case of:

- materials, elements, equipments and installations witch substitution is considered as normal conservation cares;
- materials normally submitted of consuming actions;
- some construction components”.

The durability concept – capability of a building or its parts to perform its required function over a specified period of time under the influence of the agents anticipated in design, is intrinsically related with the service life (ISO 15686-1:2000). So, durability defines the period during which the performance keeps a compatible level with the satisfaction of the essential requirements in the normal conditions of use and conservation (MARC, 2003). The absence of maintenance activities in this set of buildings is one of its important degradation factors.

1.4 METHODOLOGY

The interviews applied to the inhabitants where realized with the resource to multi-attribute analyses in which is given an evaluation based on the graduation scale presented in the table 2.

Table 2- Graduation scale

Action	ND
Excellent. No intervention is need only maintenance actions to keep the conservation level.	10
Very good. Satisfy totally. Good without reserves. Normal cleaning and maintenance actions.	9
Good. Satisfy well. Good with some reserves. Normal cleaning and maintenance actions of the elements with deterioration signs.	8
Satisfy. Acceptable with necessity of low rehabilitation actions.	7
Satisfy. Acceptable with necessity of moderate rehabilitation actions.	6
Satisfy less. Acceptable with necessity of deep rehabilitation actions.	5
No satisfy. Priority intervention. Exceptional	4

rehabilitation.	
No satisfy. Not admissible situation, without possible rehabilitation. Demolition.	3

The requirements defined to be measured are the:

- envelope waterproofing (roof, external walls and frameworks);
- interior hydrothermal conditions (winter and summer comfort, humidity and interior moisture);
- interior acoustics conditions (air sound propagation from inside and outside the building, percussion sound propagation);
- external visual aspect (coating cracks, detachment, spread of vegetable and micro organisms, framework, roof and rain water drainage facilities degradation);
- durability and maintainability.

The aim of these interviews is the achievement of a global evaluation to each requirement and to the global building. To achieve this goal the interview's results obtained by the multi-attribute analyses were quantitative and qualitative graduated whit the table 3 scale.

Table 3 – Performance level scale

Excellent	Very good	Good	Satisfy	Satisfy less	No satisfy
10 ≥ ND ≥ 9	9 >ND ≥ 8	8,>ND ≥ 7	7>ND ≥6	6>ND≥ 5	5> ND ≥ 3

1.5 SAMPLE CHARACTERISTICS

In table 4 it can be summarized some of the sample characteristics that are decrypted in the following paragraphs.

- Age of buildings – the age of the buildings, surveyed is less than 5 years old (they have been occupied between 2001 and 2004).
- Number of storeys - 3 housing storeys including the ground level.
- Buildings – each building has 2 or 3 blocs of 6 apartments, with the same design and constructive characteristics.
- Elements number – the sample have 14 buildings groups, 23 buildings, 60 blocs and 347 apartments.
- Constructive characteristics - external brick cavity walls, external finishing in single-coat render mortar and ceramic tiles, metal frameworks with simple glazing, flat roof. It has been putted thermal isolation in the external walls cavity, in the flat roof and in the ground floor pavements, in accordance with the thermal

project. The frameworks have external blinds except in the windows of the laundries and kitchens.

- Localization – the buildings are implanted in 14 different local regions of a same council so, it can be considered that they are exposed to similar climatic factors.
- Seaside - this council is 20 Km far from the seaside, so it was considered no influence of the sea in the building's.
- Main road – all the buildings aren't in the vicinity of main roads (highways and expressways).
- Other residential areas – only one group of housing blocks are in the vicinity of other residential blocks, the others are near individual houses.
- Industrial facility – there are some buildings near by industrial facilities.
- Vegetation – almost all the residential blocs are near vegetation or heavy foliage.

The results of the interviews don't show significant influence of these degradation factors.

Table 4 – Residential areas caracterization

Buildings code	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E13	E14
Date	01	01	01	01	01	01	01	02	03	03	04	04	01
N.º of buildings	1	2	2	2	2	1	2	2	1	2	2	2	2
N.º of blocks	3	7	4	4	5	4	5	4	6	5	4	5	4
N.º of apartments	18	42	24	24	30	24	30	24	36	27	24	30	24
Near industries	0	0	0	0	0	0	0	●	0	0		●	0
Near trees	●	●	0	0	●	●	0	●	●	●	●	●	●
Near houses	0	●	●	0	●	0	●	●	0	●	0	●	●
Near buildings	0	0	0	0	0	0	0	0	0	0	●	0	0

NOTE: 01- 2001; 02- 2002; 03-2003; 04-2004.

1.6 INTERVIEW´S RESULTS

The interviews were been made in 23% of the apartments, which global results were in the table 5. The mean, minimum, maximum and most frequent results are in table 6. Table 5 represent the total of the answers obtained to each performance level, relatively to each of the analysed requirements and to the global building, which percentage distribution is presented in figures 1 to 6.

The building's global medium evaluation satisfies in accordance with the performance level scale in table 3. To this mean value it has positively contributed the envelope waterproof and the external visual aspect evaluation, which mean performance the inhabitants classified as good. Relatively to these requirements it has been obtained the maximum values of 8 and 7,63 respectively. The most frequent classification obtained to the first one was 8 and 7,25 to the second. The hydrothermal conditions in spite of having a maximum classification of 8, the most frequent was 5,36 and the minimum value was 4,57. However its mean is classified as satisfy, 40,7% of the respondents classified the hydrothermal conditions as satisfy less and 4,9% as no satisfy (fig.2).

Table 5 – Global results distribution in order to the performance level of the analysed factors

Performance Level	Waterproofing	Thermal	Acoustic	External visual	Durability	Global evaluation
Excellent 10 ≥ ND ≥9	0,0	0,0	0,0	0,0	0,0	0,0
Very good 9> ND ≥ 8	36,0	1,0	0,0	0,0	0,0	0,0
Good 8 > ND ≥ 7	20,0	13,0	0,0	56,0	2,0	0,0
Satisfy 7> ND ≥6,0	23,0	30,0	3,0	25,0	41,0	63,0
Satisfy less 6> ND ≥ 5	2,0	33,0	21,0	0,0	38,0	18,0
No satisfy 5> ND ≥3	0,0	4,0	57,0	0,0	0,0	0,0

Table 6 – Statistical values

	Waterproofing	Hydro thermal	Acoustic	External Visual	Durability	Global evaluation
Mean	7,38	6,10	4,36	7,11	5,95	6,29
Standard Deviation	0,684	0,762	0,590	0,387	0,433	0,338
Maximum	8,00	8,00	6,00	7,63	7,25	6,91
Minimum	5,71	4,57	4,00	6,29	5,00	5,53
Mode	8,00	5,36	4,00	7,25	5,67	6,58

By other side the global evaluation of the acoustic conditions is in general negative, with 70,4% of no satisfy results (fig. 3). Other requirement that less satisfy the inhabitants is the question related with durability of materials, construction elements and equipments installed, with 40,9% of no satisfy results (fig. 5).

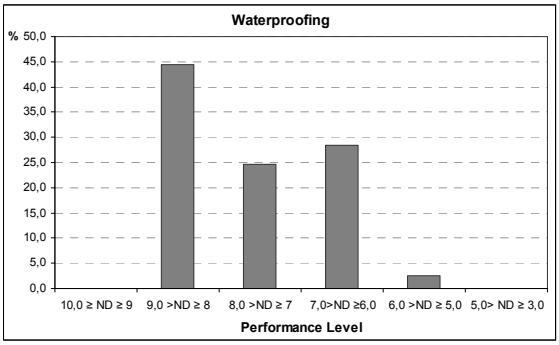

Fig. 1- Waterproofing distribution performance level

The mean value obtained to the envelope waterproofing is due to the general good performance of the flat roofs. The worse results are from some cases of punctual lack of waterproofing of this element and to several cases of bad framework waterproofing. These two situations imply the appearance of dampness in the interior face of the external walls.

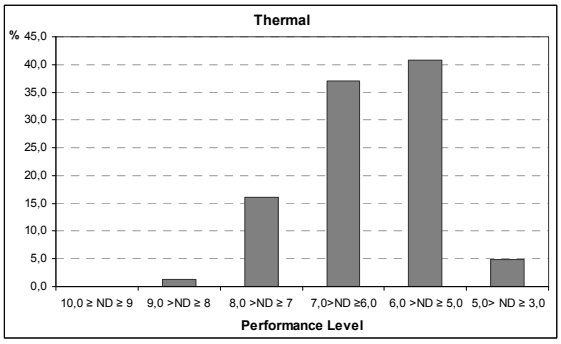

Fig. 2- Hydrothermal distribution performance level

The hydrothermal conditions evaluation was principally conditioned by the general bad thermal performance in winter and with the frequent appearance of condensation in the ceilings and in the interior walls of the apartments.

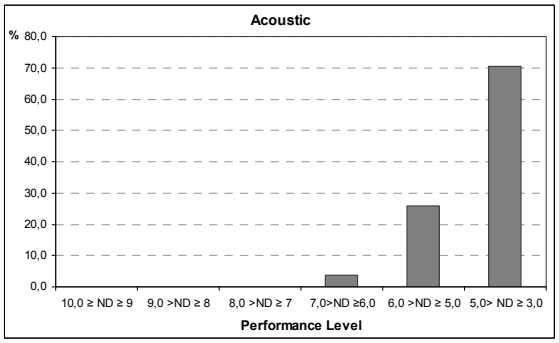

Fig. 3- Acoustic comfort distribution performance level

As referred it was attributed in general the no satisfy evaluation to acoustic conditions, in all the parameters: internal and external sound air transmission and percussion sound transmission. The lack of sound isolation is the reason of these bad conditions.

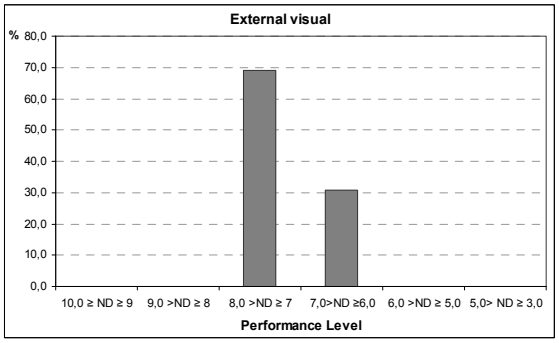

Fig. 4- External visual aspect distribution performance level

In spite of the external façades have significant areas by different kind of cracks and vegetable organisms. The external visual aspect of the housing blocks doesn't seem be among the main requirements of the inhabitants.

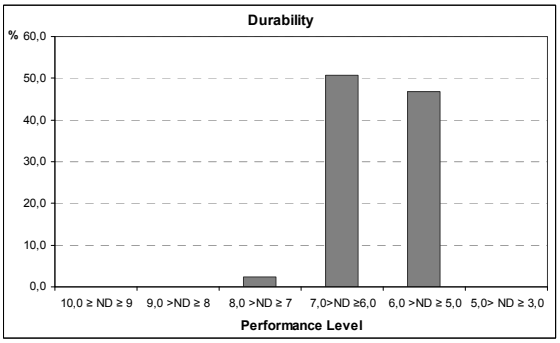

Fig. 5- Durability and maintenance facilities distribution performance level

Relatively to maintenance facilities it is relevant to refer that only one of the buildings, constructed in 2004, have installed a metallic stair to permit de access to the flat roof. In all of the others this access is done with portable stairs. Any external façade has installed systems to permit easier and safer maintenance activities during service life.

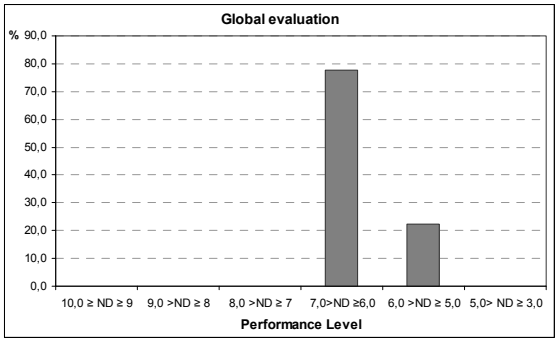

Fig. 6 – Building global distribution performance level

The buildings global evaluation is satisfy in 77,8% of the interview's results and in the others 22,2 % is satisfy less.

1.7 CONCLUSIONS

It can be concluded about the low performance level of this recent set of social rental housing, especially in hydrothermal and acoustic aspects. Its social and economic value implies the necessity of planed rehabilitation activities to get higher levels of habitability and a greater durability. Low rehabilitation solutions with the aim of repair punctual problems in external façades or in roofs aren't enough, because the causes of cracking phenomena's, and the spread of vegetable organisms have to be deeply treated. The thermal rehabilitation of these buildings is urgent, because its

bad performance allied with the inhabitant's low incomes, implies the spread of internal pathologies and the prevalence of bad habitability conditions.

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