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Main Spatial Defects of Illegal Residential Buildings: The Case of Alto da Cova da Moura District

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ABSTRACT

The purpose of the paper is to describe the main spatial defects in illegal residential buildings. Three research questions are addressed: What are the main spatial defects of the dwellings? What are the main spatial defects in the relation between buildings? What is the impact of spatial defects to the minimum habitability conditions of dwellings?

The defects were identified during a survey of the buildings of the Alto da Cova da Moura District (Amadora, Portugal), carried out in 2008. This district is made-up of illegal constructions, covers an area of 16.5 ha and has approximately 5,000 inhabitants. During the survey 833 buildings and 1,884 units were inspected. The main results are: a) 65% of buildings have problems with windows; b) about 20% of buildings have spatial defects in common stairways; and c) more than 50% of dwellings have spatial defects.

The main conclusion is that the lack of urban planning, the confinement of the terrain and the continuous arrival of new residents have led to an overcrowded and disordered urban fabric. Furthermore, buildings are mainly self-built by residents without design and do not comply with recognized technical good practices. As a result, there is a general lack of habitability and a quick decay of buildings' condition.

KEYWORDS

Illegal buildings, Building pathology, Spatial defects, Portugal, Bairro do alto da cova da moura.

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1 INTRODUCTION

In January 2006 the Portuguese Government created a national program for qualification and rehabilitation of problematic urban areas called *Initiative Critical Neighbourhoods*. Within this framework, the Institute for Housing and Urban Rehabilitation (IHRU) requested, in the beginning of 2007, the assistance of the National Laboratory for Civil Engineering (LNEC) in the analysis of the housing conditions of a district called *Bairro do Alto da Cova Moura* (BACM). This district is located within Amadora, a municipality within the metropolitan area of Lisbon. The district has an illegal development that started in the 1960s and had a strong growth from the mid-1970s.

In response to this request a study entitled *Analysis of housing conditions of the existing buildings in the Bairro do Alto da Cova da Moura* was developed, under the coordination of A. Baptista Coelho. This study had three different phases [Coelho 2008, Vilhena & Coelho 2008]:

- in the first phase, a local analysis was conducted to update and detail the existing cartographic support, and an assessment method to determine the buildings rehabilitation needs was developed;
- during the second phase, an experimental application of the assessment method was carried out, training was provided to technicians involved in the survey and the fieldwork was conducted;
- in the third and final phase, the results obtained in the field work were interpreted and the conclusions of the study were drawn.

The assessment method developed in the first phase, *Assessment Method for Building's Rehabilitation Needs* (MANR), is a multi-criteria model and a set of procedures to determine the building's rehabilitation needs [Pedro *et al.* 2008b]. A building requires rehabilitation whenever it does not ensure the satisfaction of functional requirements at a level stated in applicable Portuguese legislation for that type of building or determined by good practices of design and construction. Functional requirements may be compromised by constructive defects or spatial defects. Constructive defects may result from inadequate initial construction solution, poor execution of construction work or degradation of building elements. Spatial defects may result from inadequate conditions of the lot, a deficient initial partitioning solution or modification on the unit partitioning.

This paper describes the main spatial defects found in BACM. Three research questions are addressed: What are the main spatial defects of the dwellings? What are the main spatial defects in the relation between buildings? What is the impact of spatial defects to the minimum habitability conditions of dwellings? The main constructive defects found in BACM are presented in another paper.

In the following sections the research methodology is explained, the assessment method is presented, the main spatial defects are described and, finally, some conclusions are drawn.

2 RESEARCH METHODOLOGY

During the last years LNEC gained extensive experience in building condition assessment methods [Pedro *et al.* 2006a, Pedro *et al.* 2006b, Vilhena *et al.* 2007, Pedro *et al.* 2008a]. However, the specific type of building (*i.e.*, illegal construction) and the type of results required demanded a new method. To establish this new method, the following tasks were carried out: analysis of Portuguese and foreign assessment methods for building condition, definition of assessment criteria, selection of functional elements of dwelling and building, set weighting coefficients for the functional elements, definition of results' calculation formula and development of a computer tool. A first proposal of the method was discussed with several building and planning experts and a pilot test on different building types and units was carried out. The final version incorporated contributions from both experts and the experience acquired during the pilot test [Pedro et al 2008b].

For the survey, the BACM was divided into 61 blocks (Fig. 1), according to the 2003 geographical map provided by the city council. During the survey, 833 buildings and 1884 units were inspected. 1617 units had residential use (*i.e.* dwellings) and the remaining 267 had other uses (*e.g.*, shop, warehouse, industry, indoor parking) [Vilhena & Coelho 2008].

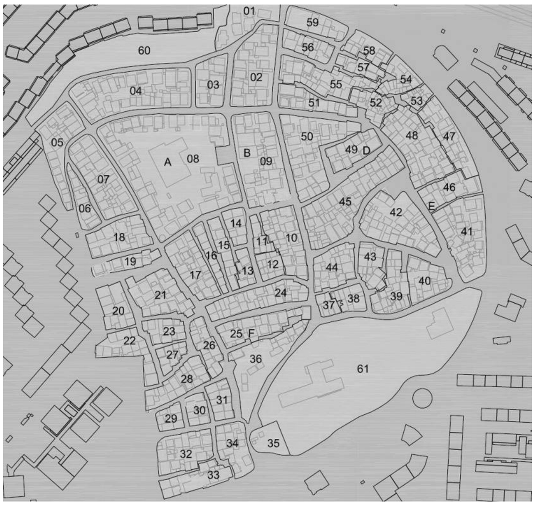

Figure 1. Blocks division of BACM.

The assessment was based on a visual inspection of the buildings, including all units and shared parts (where such exist). The survey lasted six months, from January to July 2008, and it was carried out by IHRU technicians with support of LNEC. Initially 14 technicians were involved in the survey, but during the work it was required to increase this number. All technicians that carried out inspections had specific training on the MANR. Since the method verifies both constructive and spatial defects, inspections were performed by teams of two technicians, a civil engineer and an architect. Some inspections were done by teams of two architects, due to lack of civil engineers.

3 ASSESSMENT METHOD

For each building, constructive defects, spatial defects and defects in the relation to other buildings were assessed.

To assess constructive defects the building was disaggregated into functional elements, such as, structure, roof, walls. Each functional element was assessed relative to three factors: *severity* of the defect, *extent* of the repair work and *complexity* of the repair work. First the *severity* of the construction defect was analysed and classified in a four categories scale: *very slight*, *minor*, *medium* or *severe*. Then, if there are *minor*, *medium* or *severe* constructive defects, the *extent* and the *complexity* of the repair work was determined. The *extent* of the repair work takes into account the amount of the work required and was assessed in a four categories scale: *localised*, *medium*, *extensive* or *total*. The complexity of the repair work takes into account the difficulties of carrying out the work and was assessed in a three categories scale: *simple*, *medium*, *difficult*.

The assessment of spatial defects was divided into two factors: *severity* of the defect and *feasibility* of the intervention. First, the *severity* was assessed on the same four categories scale used for the constructive defects, but according to the rules defined in applicable legislation (Table 1).

For spatial defects classified as *medium* or *severe*, the functional elements that had to be intervened to repair the defect were specified, indicating for each one the *extent* and the *complexity* of the intervention. These interventions are additional to those needed to repair constructive defects. The *feasibility* of the intervention was also assessed, using the following scale: *in the building*, *in the lot*, *in other buildings*, *in contiguous lots* and *in the public space*.

Table 1. Rules for assessing the severity of the spatial defects.

Very slight	*Minor*	*Medium*	*Severe*
Fulfils the general legislation in force	Does not fulfil the general legislation in force	Does not fulfil the requirements of specific regulations for illegal buildings	Does not fulfil an absolute minimum, compromising the health and safety of persons

Defects in the relation to other buildings were assessed by five factors: *parts of contiguous buildings above or under the assessed building*; *distance between windows of the assessed building and windows of other nearby buildings*; *distance between the buildings' roof* (when it does not comply with fire resistance requirements) *and windows of nearby buildings*; *windows of the assessed building on the edge of a bordering lot*; and *obstacle-free distance of habitable room windows*. The assessment of each of these factors was carried out using the four level scale adopted for the *severity* of the defects. These factors aim to assess defects that could not be verified with the existing mapping.

A more detailed presentation of the assessment method was done in a previous paper [Vilhena & Pedro 2010].

4 MAIN SPATIAL DEFECTS

4.1 Relation between buildings

Regarding defects in the relation between buildings, the results were the following:

1) few buildings had parts overlapping other buildings;
2) almost half of the buildings had windows near windows of nearby buildings (*i.e.*, less than 6.0 meters) (Fig. 2);
3) few buildings had windows over roofs of nearby buildings (only roofs that do not comply with fire resistance requirements at a distance less than 3.0 meters);
4) almost one third of the buildings had windows over the edge of a bordering lot;
5) almost half of the buildings had windows near to obstacles that reduced natural light (Fig. 3).

Figure 2. Small distance between windows of neighbouring buildings.

Figure 3. Windows opened to an alley with about 1 meter width.

The prevalence of defects in the relation between buildings is presented in Table 2. If we combine the buildings that have medium or severe defects of number 2), 4) and 5), we find that 65% of the buildings have problems with windows. Furthermore, 12.5% of the buildings have the three types of problems simultaneously.

Table 2. Gravity of defects in the relation between buildings.

Type of defect	*Severity of defect (%)*			
	very light	*minor*	*medium*	*severe*
Parts overlapping other buildings	95.8	–	4.2	–
Windows near to windows of nearby buildings	54.8	1,7	13.3	30.2
Windows over roofs of nearby buildings	91.5	1.4	2.8	4.3
Windows over the edge of a bordering lot	70.8	–	29,2	–
Windows nearby obstacles that reduced natural light	51.2	2.5	10.1	36.2

4.2 Common use spaces

In about 60% of the lots there were no common use spaces (*i.e.* spaces whose use is shared by more than one unit). The evaluation of spatial defects in common use spaces included horizontal circulation (atria, corridors and landings) and vertical circulation (stairs and ramps).

Vertical circulation spaces have more defects than horizontal circulation spaces. In 19% of the lots there was vertical circulation spaces with severe and medium defects, while in only 10% of lots there were horizontal circulation spaces with some type of defect (Table 3).

Table 3. Gravity of defects in common circulation spaces of lots.

	Type of defect (%)				
	not applicable	*very light*	*minor*	*medium*	*severe*
Horizontal circulation	61	27	2	2	8
Vertical circulation	63	16	2	5	14

The most common defect in horizontal circulation spaces was an insufficient width of rest zones in front of the main doors of units or even the total absence of this zone. The most frequent defects in vertical circulation spaces were: low ceiling height, high rise and small tread of steps (Fig. 4) and narrow stairs (Fig. 5).

Figure 4. Stairs with high rise steps.

Figure 5. Narrow stairs with uneven development.

The main problem was the poor accessibility conditions in the buildings to access to units. This, in addition to affecting the safety and comfort in normal use, represents a special risk in emergency situations (*e.g.*, in case of fire).

The correction of spatial defects can be done within the boundaries of the building or on the lot in 84% of horizontal circulation spaces and in 88% of vertical circulation spaces. In the remaining cases, spatial defects can only be solved by using the adjacent lot, the adjacent building or the public space (Table 4). Therefore, it is feasible to solve the majority of spatial defects of the common spaces.

Table 4. Feasibility of the interventions to correct spatial defects.

	In the building (%)	*In the free space of the lot (%)*	*In the free space of adjacent lots (%)*	*In bordering buildings (%)*	*In the public space (%)*
Horizontal circulation	63	21	2	6	8
Vertical circulation	66	22	2	4	6

4.3 Units

The assessment of spatial anomalies in residential units was divided into habitable rooms (*i.e.*, kitchen, living room and bedrooms) and non-habitable rooms (*i.e.*, toilets, bathrooms, corridors, stairs, halls, marquees and pantries). When assessing the non-residential units no distinction was made between types of spaces. Due to the wide diversity of uses that non-residential units have, the specific requirements for the operation of each type of unit were not assessed. These requirements are verified by the municipal authority when the use permit is granted.

50% of the units had spatial defects (Fig. 6). This percentage increases to 54% for residential units. The main space defects in habitable rooms of residential units were: insufficient daylighting and ventilation, low ceiling height and cramped areas.

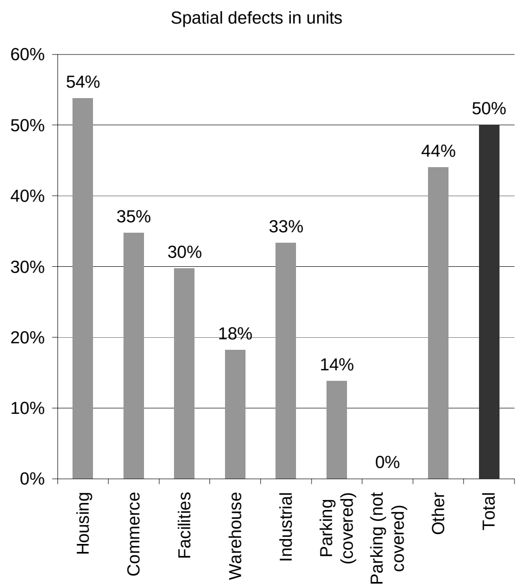

Figure 6. Spatial defects by type of use of units.

The insufficient daylighting and ventilation of rooms was found in about 70% of the units with spatial defects. This defect is due to rooms having small windows or no windows at all. Since many buildings only have one façade, many rooms inside the building only receive daylight through openings to other rooms.

Low ceiling height of rooms was found in about 30% of the units with spatial defects (Fig. 7). This defect is more common in units located in attics. Solving this defect requires extensive and complex interventions on the structure, roof, walls and installations.

Rooms with floor area below the regulatory provisions were found in about 15% of the units with spatial defects. The rooms used as kitchens or bedrooms are particularly undersized (Fig. 8). In some cases, storage spaces were converted into bedrooms, and have an area less than 3 square meters. In most cases, bedrooms with very small floor area had no daylighting or ventilation. Undersized rooms had also more constructive defects.

Figure 7. Bedroom with low ceiling height.

Figure 8. Undersized kitchen.

The main space defects in non-habitable rooms of residential units were: undersized toilets and bathrooms, low ceiling height, narrow corridors, high risers and small treads of steps. There were rooms with non-regulatory path of access, such as toilets with access through a kitchen, a common space or an outdoor space.

In non-residential units, the most frequent spatial defect was the low ceiling height of rooms, particularly in toilets. This defect was identified in 18% of the non-residential units.

5. FINAL REMARKS

The main conclusion is that the lack of urban planning, the confinement of the terrain and the continuous arrival of new residents have led to an overcrowded and disordered urban fabric. Buildings are built on any free space, decreasing public circulation spaces, escape routes and access to daylight and solar exposure. Furthermore, buildings are mainly self-built by residents without design and do not comply with recognized technical good practices. As a result there is a general lack of habitability and a quick decay of buildings' condition.

The overcrowding of the district, the urgent need to provide accommodation, the limited resources of the population, the lack of local authorities building control and the limited institutional support, led to the construction of a district where half the buildings do not meet the requirements set by the Portuguese building regulations. Building regulations set minimum quality requirements to ensure that buildings are safe, healthy, energy-efficient and accessible to everyone who lives and works in and around them. Therefore, failure to comply with the building regulations means that habitability conditions are jeopardized.

The requirements of the building regulations are set in the context of the prevailing cultural, social, climatic, economic and technological conditions in a particular society. The general Portuguese building legislation is geared to construction of new housing. Thus, it can be argued that the performance level defined by these regulations is too demanding for a situation of acute urgency and need of lodging. However, these buildings fail to fulfil even the requirements set in specific regulations for the regularization of illegal buildings. Therefore, units that did not meet these requirements must be either demolished or made fit to live in.

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