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Analysis of the Degradation Condition of Elementary Schools

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1 Introduction

The building condition assessment (BCA) is a systematic inspection, review, and report on the state of a building's structure, construction elements and systems. The BCA provides an identification of elements anomalies and the expected costs to remedy those deficiencies. This is an important step for the management of buildings maintenance and should be applied to the existing elementary public school portfolio of Lisbon. This network of schools includes more than 100 buildings with construction ages ranging from the nineteenth century to the beginning of this century (Raposo, 2011). Despite the existence of schools operating in very old buildings, are the most recent schools, built after 1980, that present major problems of conservation and maintenance (Raposo *et al.*, 2008).

In the present paper, the results obtained through visual inspection of six school establishments, built between 1997 and 2003, are presented. Inspections were carried out in 2007, 2013 and 2018 and it was possible to identify some recurring anomalies and causes for the accelerated and premature degradation that occurs in these buildings.

2 Research Methodology

In 2007 Raposo, Fonseca and Brito (2008) carried out a preliminary research on six elementary school of recent construction in Lisbon. The work was developed in two phases: (i) collection and treatment of information from the design phase and from the use and operation phase, (ii) fieldwork with detailed visual inspection of the buildings. In 2013 an inspection and BCA was performed of the building's structural and envelope components and playgrounds and outdoor spaces (Luís, 2013), and of the building's interior elements, including finishes, walls, ceilings, doors and plumbing (Nogueira, 2013). In 2018, the National Laboratory for Civil Engineering carry out an assessment of the maintenance condition of 55 kindergarten (k) and elementary schools (EB1), for the Municipality of Lisbon (Vilhena *et al.* 2019). Extensive and detailed photographic and written records were made about anomalies detected allowing its comparison over time.

Table 1 shows the building characteristics of Prista Monteiro School (PM), Vale de Alcântara School (VA), Alto da Faia School (AF), Padre Rocha e Melo School (PRM), Alta de Lisboa School (AL) and Vasco da Gama School (VG) integrating the kindergarten and three levels of basic education. Figure 1 shows the result obtained through inspections carried out in 2007, 2013 and 2018, on the supporting wall located in the school's playground. It is possible to observe the existence of settlements and structural movements that remain unsolved.

Table 1. School Buildings Characteristics.

Schools	Year	Pupils	Level	GA (m^2)	Floors	Year of Inspection
PM	1997	110	EB1	2200	2	2007-2018
VG	1999	500	k+EB1/2/3	8800	3	2007-2018
VA	2001	130	k+EB1	1700	2	2007-2018
AF	2001	340	k+EB1	4000	3	2007-2013-2018
PRM	2002	330	k+EB1	3000	2	2007-2018
AL	2003	330	k+EB1	3300	2	2007-2013-2018

Figure 1. Alto da Faia School-outdoor spaces: deformation and settlement of the supporting wall and the recurring appearance of cracks. Anomaly evolution in 2007 (a), 2013 (b) and 2018 (c).

3 Conclusions

This article presents the results of three inspections carried out in 2007, 2013 and 2018, on six school buildings built after 1997. The study revealed the existence of severe and unexpected degradation in these buildings. Anomalies related to the settlement of foundations and movements in the structure, are probable causes for the problems in other construction elements (cracking in interior and exterior walls and water infiltration). Observations made over the years showed that many of the structural problems are not stabilized what may have been caused by execution and/or design errors. Structural problems must be solved before carrying out many of the minor repairs, but they are complex and expensive and so postponed.

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