

# Monitoring and assessment of *azulejo* panels decay: the 20<sup>th</sup> century façade *azulejos* from Manuel Rocha building

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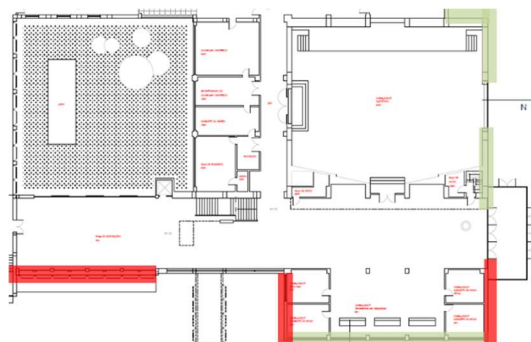
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**Abstract.** This study investigates the deterioration of the 20<sup>th</sup>-century *azulejo* façades of the Manuel Rocha Building in Lisbon. A multi-technique approach, including SEM-EDS, XRD, GPR, thermography, and hyperspectral imaging, was used to characterise materials and assess decay. Photogrammetry and digital image processing enabled mapping of pathologies and reconstruction of the decay chronology. Results indicate rapid degradation, with some panels reaching a critical state of degradation if no intervention is undertaken. The presence of alkali-silica gels suggests that alkali-silica reactions may be a key factor in glaze detachment. Findings highlight the urgency of conservation measures and the value of integrated monitoring strategies for heritage preservation.

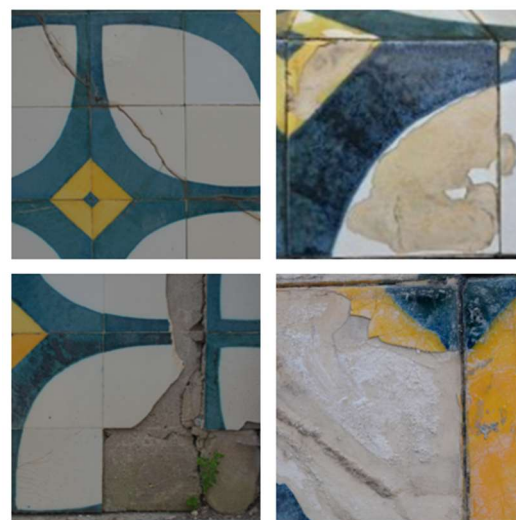
## 1 Introduction

Inaugurated in 1972, the Documentation and Information Building of the National Laboratory for Civil Engineering (LNEC) was named *Manuel Rocha* in tribute to one of the most influential figures in 20<sup>th</sup>-century Portuguese engineering, who also served as LNEC's director from 1954 to 1974 [1].

The building was designed by Manuel Norberto Corrêa [2] and José Gabriel Pinto Coelho, reflecting the architectural sensibilities of the time, which combined functional modernism with artistic components. A distinctive feature of the building is its use of decorative ceramic tiles—*azulejos*—on part of its external façades.



**Fig. 1.** Location of *azulejos* façade from Manuel Rocha Building. Green - tiles in relatively good conservation state; Red – façade with tiles showing considerable decay.



**Fig. 2.** *Azulejos* decay. From left to right and top to bottom: a) fracture; b) glaze delamination; c) lack of elements; and d) efflorescence deposits.

These tiles were specifically designed for the building, hand-painted using the stencilling technique and fired at the Constância Ceramic Factory [3] in Lisbon.

Some of the external tiled façades, but curiously not all of them, are showing alarming signs of decay (Fig. 1) [4]. The most prominent forms of degradation include extensive glaze detachment, fissures, and disaggregation of the ceramic body. In some areas,

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*azulejo* elements are missing, leaving some visible voids in the decorative composition (Fig. 2).

## 2 Objectives

This study aims to investigate the key factors contributing to the degradation of the ceramic tile façades of the Manuel Rocha Building by combining historical, engineering, and material analyses.

Advanced diagnostic and monitoring techniques are used to assess the condition of the tiles. These methods are intended not only to document the current state of decay but also to establish a framework for ongoing monitoring and conservation of similar architectural heritage elements.

## 3 Methodology

To investigate the causes of the tiles' decay, a comprehensive multi-technique approach was employed. The ceramic tiles, setting mortars, and efflorescence deposits were characterised using Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDS) and X-ray Diffraction (XRD). Contextual information was also gathered, including details of the architectural design, building usage, wall structure, and materials used during construction. Non-destructive testing methods: Ground-Penetrating Radar (GPR) and infrared thermography were applied to assess the internal constitution of the façade walls. Additionally, photogrammetry, hyperspectral imaging and digital image processing techniques [5], [6] were used to map the tile panel pathologies. The analysis of historic imagery allowed the reconstruction of the decay chronology, offering a temporal perspective on the progression of deterioration.

## 4 Conclusion

The combination of material characterisation, diagnostic surveys, and digital documentation, alongside information gathered from maintenance and engineering teams, enabled the identification of possible factors contributing to the deterioration of the building façade tiles. The detection of alkali-silica gels at the interface between the glaze and the ceramic body suggests that alkali-silica reactions may play a significant role in the observed deterioration. Monitoring the condition of the tile panels through photogrammetry and digital image processing has revealed a rapid progression of decay, indicating that some panels may soon reach a critical state of degradation if no intervention is undertaken. Understanding the reasons behind this selective deterioration is therefore essential for developing targeted conservation strategies and ensuring the long-term preservation of this important architectural feature.

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