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Presentation · February 2024

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Old azulejos through new lenses: Integration of digital and non-digital methodologies for the assessment and monitoring of azulejo panels decay

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SUMMARY: This work presents a methodology, involving a highly interdisciplinary team, for documenting, assessing, and monitoring the azulejo heritage with a special focus on its degradation. The azulejos of the façade of LNEC Congress Centre are used to exemplify some results of the proposed methodology.

KEY-WORDS: Azulejo; decay; characterization; photogrammetry; digital image processing; Infrared Thermography, GIS.

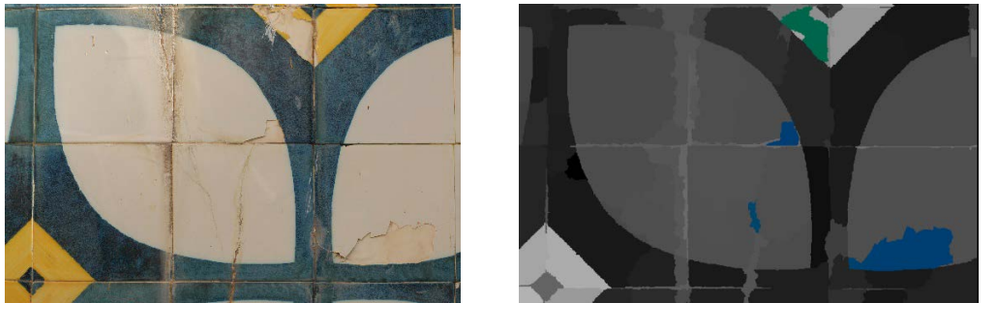
METODOLOGY FOR AZULEJO DECAY CONTROL

Azulejos are one of the most remarkable Portuguese contributions to cultural heritage, their conservation is therefore of utmost importance. This work proposes a methodology for digital documentation, assessment and monitorization of architectural azulejo, with a special focus on their conservation condition. The methodology is intended to be applied to all azulejos, when there is a will to keep them safeguarded but integrated in their current architectural location.

The proposed methodology involves obtaining information regarding the azulejo's history, the building where they are integrated, the materials used (azulejo and mortars materials), their conservation treatments and decay. The azulejos information will be collected *in situ,* researched in archives (e.g. the Gulbenkian Foundation and the National Tile Museum), databases (e.g. AzInfinitum), analysed in the conservation reports (when existing), and extracted from other relevant bibliographic sources with information from the past and present condition of the tiles.

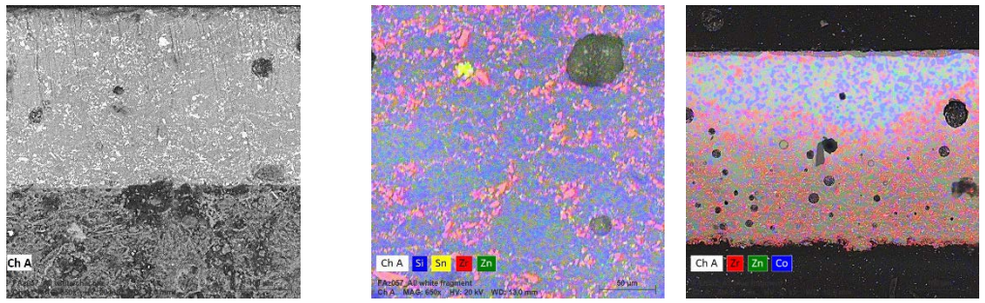
Photographs depicting the conservation state over time are used to obtain an indication of the visible decay rate. Information regarding the probable causes of decay is also collected through

surveys to the owners, persons in charge or other entities that may have knowledge regarding the azulejos and building conditions that may have affected the panels. A 3D digital twin of the actual state of the tiles is obtained through photogrammetry, where the correspondent orthophoto is retrieved. This orthophoto will be assessed through digital image treatment methodologies (using eCognition software) [1]. Neighbour image pixels are organized into objects, through a segmentation procedure. The analysed colour and shape properties of the objects allow the distinction between sound and defect objects, enabling the mapping of the damaged azulejo areas (Figure 1). Additional layers of information to aid in the understanding of possible decay factors can be collected via thermal imaging (infrared thermography), ground penetrating radar (GPR), and hyperspectral photography. For information regarding the micro-morphology, mineralogy, and elemental chemical information of the tiles, non-destructive (XRF) and/or micro - destructive analysis (SEM-EDS XRD) (Figure 2) which imply the removal of small tile samples is performed. All the information obtained will be tentatively correlated with the tiles decay.



a) b)

Figure 1. LNEC's congress centre azulejos. a) detail of an azulejo's area with glaze lacunae, b) image depicting a radiometric index where glaze defects are coloured in blue and green.



a) b) c)

Figure 2. SEM-EDS cross section analysis of LNEC Congress Centre azulejos. Morphology, composition and distribution of glaze and biscuit elements: a) white glaze layer and tile biscuit: b) image detailing the dispersion of the zirconium based opacifier crystals in the glaze matrix: c) cross section of a blue painted glaze tile area showing the distribution of the cobalt-based pigment in the glaze layer.

The information collected is also intended to increment the one existing and be made available in related databases, such as AzInfinitum and DB-Heritage. It is also meant to be integrated into GIS (Geographic Information System) and HBIM (Heritage, Building Information Modelling) methodologies [2]. This strategy will therefore allow gathering and sharing the relevant data on the characterization, history, and conservation state of the azulejos and mortars, which can thereafter be used in the design of conservation treatments and for the monitoring of the panels decay rate in time.

Acknowledgements

Fundação para a Ciência e Tecnologia is acknowledged for financing S. Pereira (DOI 10.54499/2021.01998.CEECIND/CP1703/ CT0001), M. L. Coutinho (CEECIND/00349/ 2017), LAYERS research project **(**PTDC/HAR-HIS/5288/2020**),** R.S. Carvalho within the scope of DL 57/2016/CP1443/CT0003 (DOI 10.54499/DL57/2016/CP1443/CT0003) and UIDP/04189/2020 (DOI10.54499/UIDP/04189/2020). This work is also financed by the HORIZON-RIA (101132163) - ATRIUM "Advancing FronTier Research In the Arts and hUManities" project, and within the scope of the following research projects and programs from LNEC: 1) P2I Ceramic – Study and Conservation of ceramic materials; 2) Research Program Integrated Methods for the Conservation and Rehabilitation of Built Heritage – MICR of the Research and Innovation Strategy (E2I) of LNEC 2021-2027.

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Characterization of 19th-century ceramic objects and paint materials produced by the Portuguese Royal Family

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SUMMARY:
A multianalythical approach was used to investigate the ceramic paint materials and ceramic objects produced by members of the Portuguese Royal Family during the late nineteenth century.

KEY-WORDS: Ceramics, Colorants, HIS

Nineteenth-century ceramic objects decorated with flower bouquets, fables or animals scenes can seem naïve and unsophisticated at first glance. However, the fashion of painting ceramic objects, often referred to as china painting, emerged as a result of the technological advances in the ceramic and glass industry [1] at a time when ceramics were perceived by Western culture as a symbol of industrialiation, scientific knowledge, erudition, and luxury.

The dissemination of this new artistic medium was assisted by the emergent globalization and the organization of numerous world fairs during the last decades of the nineteenth century. Painting on ceramic objects spread rapidly through the European, American, and Australian upper classes, reaching professional and amateur artists [1–3]. This new artistic medium was launched in Portugal amid the Royal Family's inner circle.

Although several studies have focused on the artistic production of the Royal Family, analysing its historical context [4–6], style and iconography, the materials and techniques used for this ceramic production have not been investigated. In this study, we analysed a unique paint box by the maker Lacroix, Paris [2], with 31 tubes of ceramic paints (Figure 1A) detained by Palácio Nacional da Ajuda (PNA). Paint materials were analysed using x-ray diffraction (XRD) for mineralogical characterization, energy dispersive x-ray fluorescence (EDXRF) for elemental