



**Identification of pathological manifestations through the design of
damage maps of facades from a historic building in the city of Recife, PE:
Case study of Block A of the Polytechnic School of Pernambuco**

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ABSTRACT

The city of Recife has numerous historic buildings that have existed for over 100 years and are part of the rich culture of this region. Over the years, these buildings get damaged due to the action of external weather and, in some cases, human action, which ends up generating numerous pathological manifestations that require correction. Therefore, this research's main objective is to study and identify the pathological manifestations present on the facades of block A of the Polytechnic School of the University of Pernambuco, aiming to assist in future, more sustainable restoration works in this building. As a methodological basis, a photographic inspection of the study object was carried out, followed by the identification of the pathological manifestations present on each facade, analysis of the photos and the development of damage maps using AutoCAD software. As a result, several pathological manifestations were found on the four facades of the building and from the preparation of damage maps it was possible to identify the areas that needed the most urgent repairs, due to the high degree of incidence of anomalies. The results demonstrated the importance of conserving historical heritage, since these buildings are living memories of a people's culture, in addition to being important instruments for the economic, social and environmental development of cities.

KEYWORDS: Pathological manifestations. Damage map. Historical heritage.

1 INTRODUCTION

A city's historical heritage encapsulates living memories of its people's history and culture. Historic buildings, in particular, play a crucial role in visually conveying these memories, thereby contributing to the cultivation of a greater sense of community among its inhabitants (BERSCH *et al.*, 2020). Beyond fostering a collective identity, a city's historical heritage also serves as a repository of its population's collective memory, symbolizing their cultural identification (COSTA; TORRES, 2021).

Among historic buildings, facades play a pivotal role as they are often the primary visual elements that capture people's attention. They not only contribute significantly to the architectural aesthetics of the building but also enhance the overall appeal of the surrounding area. Moreover, facades serve a crucial functional purpose by protecting internal environments from external weather conditions and regulating the ingress of external elements (FLORES-COLEN; DE BRITO; FREITAS, 2009).

Due to their exposure to natural elements, facades are often the most vulnerable components of architectural structures, susceptible to various forms of deterioration over time. This vulnerability underscores the significant relationship between the study of these manifestations and the conservation of cities' historical heritage (COSTA; SILVEIRA; TORRES, 2021). Understanding the state of historic buildings' conservation based on the analysis of these manifestations is crucial for making informed decisions regarding their restoration (PRIETO *et al.*, 2017).

Karimi *et al.* (2022) suggest that historic buildings exemplify attributes associated with the three pillars of sustainability, which are social, economic, and environmental. These buildings play a pivotal role in promoting social sustainability, contribute to economic growth through tourism, and hold potential for reducing carbon emissions and energy consumption. However, realizing this potential hinge on the careful selection of intervention techniques that preserve their architectural and historical integrity (GODWIN, 2011).

In Brazil, historical heritage management and administration falls under IPHAN's purview (Institute of National Historical and Artistic Heritage). The definition of historical

heritage, as delineated in Decree-Law No. 25 of November 30, 1937, and subsequently refined in Article 216 of the Federal Constitution of 1988, encompasses assets of both material and immaterial nature that bear reference to the identity, actions, and memories from the diverse and important groups to Brazilian society (Brasil, 1988). Operating in collaboration with states and municipalities, IPHAN coordinates, regulates, and promotes measures aimed at preserving the vast array of material and immaterial heritage found throughout Brazil (IPHAN, 2014c).

In Recife numerous historic buildings are recognized as integral components of the city's cultural heritage. However, through time and inadequate maintenance practices have led to various pathological manifestations emergence, compromising structural integrity and longevity of these architectural treasures (RODRIGUES *et al.*, 2021). Consequently, there is a pressing need to preserve these historic buildings, given their profound significance to society and the city's cultural identity (BARRETO, 2020).

Thus, this study aims to conduct a comprehensive survey about primary pathological manifestations affecting Block A of the Polytechnic School of Pernambuco. This investigation involves meticulous preparation of damage maps detailing this historic building's facades. Ultimately this endeavor seeks to contribute valuable insights that can inform future more sustainable maintenance and restoration efforts for the analyzed building.

2 METHODOLOGY

The research was conducted in two stages. Initially, the object of study was selected, followed by a visual and photographic inspection of the building's four facades. Subsequently, damage maps of the facades were prepared based on the inspections and using the photographs as a reference for creating the designs with AutoCAD software.

2.1 Selecting the research subject and conducting a photographic examination

Block A building in Polytechnic School of Pernambuco was selected as the subject in this study due to the identified need for repairs in this historic building. The block, which was founded more than 111 years ago, has suffered from the effects of nature and human actions over time, leading to pathological manifestations on its facades.

Additional factors contributing to this choice include the building's accessibility, as it is part of the University of Pernambuco's complex, and its central location in the city of Recife.

Therefore, a photographic inspection was conducted to identify the pathological manifestations present on all four facades of the building. The inspections were carried out through visits to the building, focusing on analyzing the primary manifestations that can interfere with and even reduce the structure's durability over the years.

2.2 Facade's damage maps elaboration

After gathering all photographs, damage maps of the facades were created. A damage map can be defined as a graphic representation of all pathological manifestations present in a building (TINOCO, 2009). Employing this approach is crucial as it provides stakeholders with

qualitative insight into the main anomalies present in a building, as well as indicating the urgency level for intervention of the identified anomalies (BERSCH *et al.*, 2020).

To create the damage maps for this research, AutoCAD and Adobe Photoshop were used. These tools helped adjust the perspectives of each facade and accurately position the pathological manifestations in each view. Due to the lack of a standard defining parameters for constructing damage maps in Brazil, a color legend created by the authors was used to identify the pathological manifestations in the building under study.

3 RESULTS AND DISCUSSION

3.1 Characterizing the study object

The selected study object was the Block A of the Polytechnic School of the University of Pernambuco. The school is one of the oldest higher education institutions in the state and it was founded on March 6, 1912, by teachers from the former *Gymnásio Pernambucano*, an old high school unit that is considered the godmother of the engineering school. Poli, as it is commonly known, has a history spanning more than 111 years and has trained numerous professionals in engineering. Currently, the school comprises 11 blocks, which include classrooms, school administration offices, and laboratories. Additionally, Poli offers 8 undergraduate courses, 21 postgraduate courses, 4 master's programs, and 1 doctorate program (POLI, 2023c).

Block A, the first building constructed for the school, is notable for its abundance of references. Its neoclassical architecture, typical of mid-19th-century buildings, is characterized by proportional and symmetrical windows. Both the north and south facades feature triangular pediments. Furthermore, all facades exhibit rectangular, geometric, and symmetrical designs in relation to each other (Figure 1).

Figure 1 – Block A of the Polytechnic School of Pernambuco.



Source: POLI, 2023c.

Added to its architectural features, choosing block A as a study object is also related to its location in ZEPH 03 – Benfica, a Special Zone for Preservation of Cultural Heritage in Recife (Figure 2). Situated in the Madalena neighborhood, one of the oldest and most traditional neighborhoods in the city, this block's location enhances its significance for preservation and study.

Figure 2 – Study object's location in ZEPH 03 – Benfica.



Source: ESIG, 2021.

The neighborhood traces its origins back to the 16th century mills that were once present in the region owned by Pedro Afonso Duro, who was married to Maria Madalena Gonçalves, the namesake of the neighborhood. Additionally, the area where it now stands was once home to the "Passagem da Madalena," a space renowned for being the residence of the Recife aristocracy for several years. This local also hosted visits from prominent figures in the history of the city and Brazil, including the Count of Boa Vista and Her Imperial Majesty Teresa Cristina, wife of Emperor Dom Pedro II (SILVA; BITOUN, 2007).

Figure 3 – Mansions in the Madalena neighborhood in the mid-19th century.



Source: Diniz, 2021.

Considering the significance of this neighborhood in the history of the city of Recife, it is imperative to prioritize the preservation of its historic mansions (Figure 3). Over the years, these architectural treasures have endured considerable deterioration due to pathological manifestations, with the study object of this research serving as a notable example of this issue.

3.2 Photograph analysis and presentation of the damage maps

Through the photographs collected during the inspection carried out on the object of study, it is possible to observe that all four facades of the building present various pathological manifestations. Due to the facades being symmetrical, their analyses will be presented in pairs, as follows: North-South and East-West.

3.2.1 North-South facades

All the pathological manifestations found on the North facade of the building can be observed in Figure 4 below.

Figure 4 – Pathological manifestations on the North Facade.



Source: Authors.

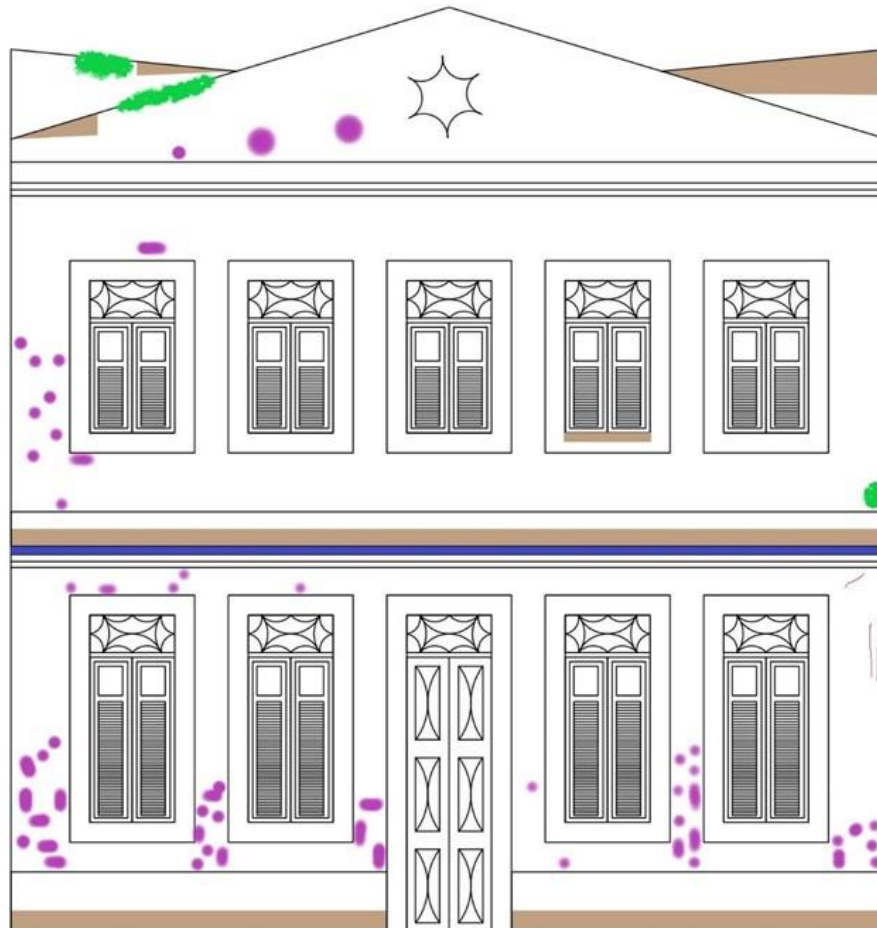
As it is visually noticeable on Figure 4 it is possible to observe a higher prevalence of pathological manifestations at the top and bottom of the facade, confirming the analysis of Bersch *et al.* (2020), who stated that most pathological manifestations generally occur in these areas due to humidity and the increased incidence of rain and wind.

Vegetation growth can also be observed in the upper part of the facade, attributed to humidity and the presence of birds inadvertently transporting seeds to these areas. According to Rodrigues *et al.* (2021), the presence of vegetation is not considered a severe pathological manifestation, however, over time, it can weaken the structure and facilitate the penetration of water and other harmful agents into the concrete.

Another area where a significant presence of pathological manifestations can be observed is the cornice, located between the upper and lower windows of the building. Due to its larger surface area, it is more susceptible to the accumulation of water and debris, which leads to the formation of the black spots seen in the image.

Furthermore, the detachment of the coating in several areas of this facade, especially those closest to the bottom of the building, is likely related to the humidity present in this region. Following this, the damage map of this facade can be consulted, which identifies all pathological manifestations found (Figure 5).

Figure 5 – North Facade’s damage map.



LEGEND:

 Coating Detachment	 Damp Stains	 Structural Degradation
 Dirtiness	 Paint Detachment	 Plaster
 Vegetation	 Wood Degradation	 Cracks

Source: Authors.

We will now analyze the pathological manifestations found on the South facade, which can be observed in Figure 6.

Figure 6 – Pathological manifestations on the South Facade.

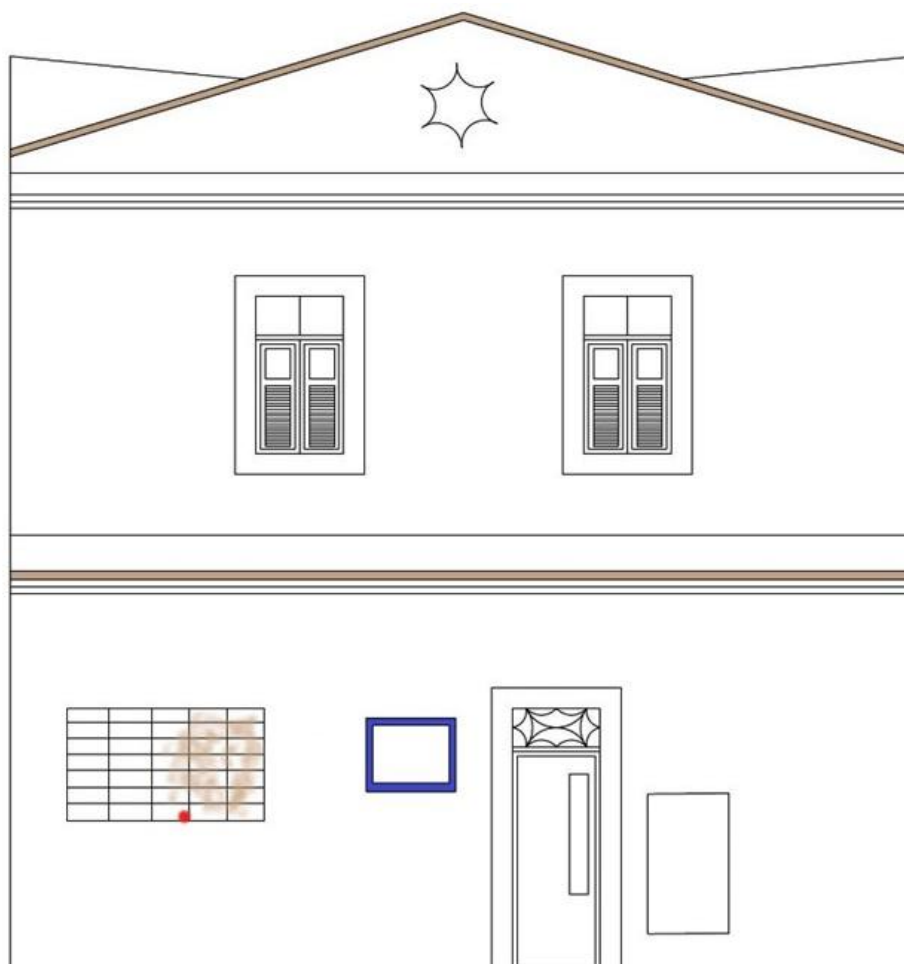


Source: Authors.

Through the image, it can be seen that this facade presents few pathological manifestations, as it recently underwent renovation. Nevertheless, it is still possible to identify some black stains on the building's pediment and on the cornice located in the middle. Similar to the North facade, these stains are caused by the presence of humidity and the influence of wind and rain.

A difference observed on this facade compared to the North is the presence of brises in place of windows in the lower part, in addition to an air conditioning unit between the brises and the access door to the internal environment. It is noteworthy that the brises have dark spots indicating dirt and also show a slight degradation of the wood at the bottom, probably due to humidity. Furthermore, the air conditioning unit is covered in infiltration stains, likely from water running from the condenser. Below is a damage map for this facade, with the identification of all pathological manifestations found (Figure 7).

Figure 7 – South Facade’s damage map.



LEGEND:

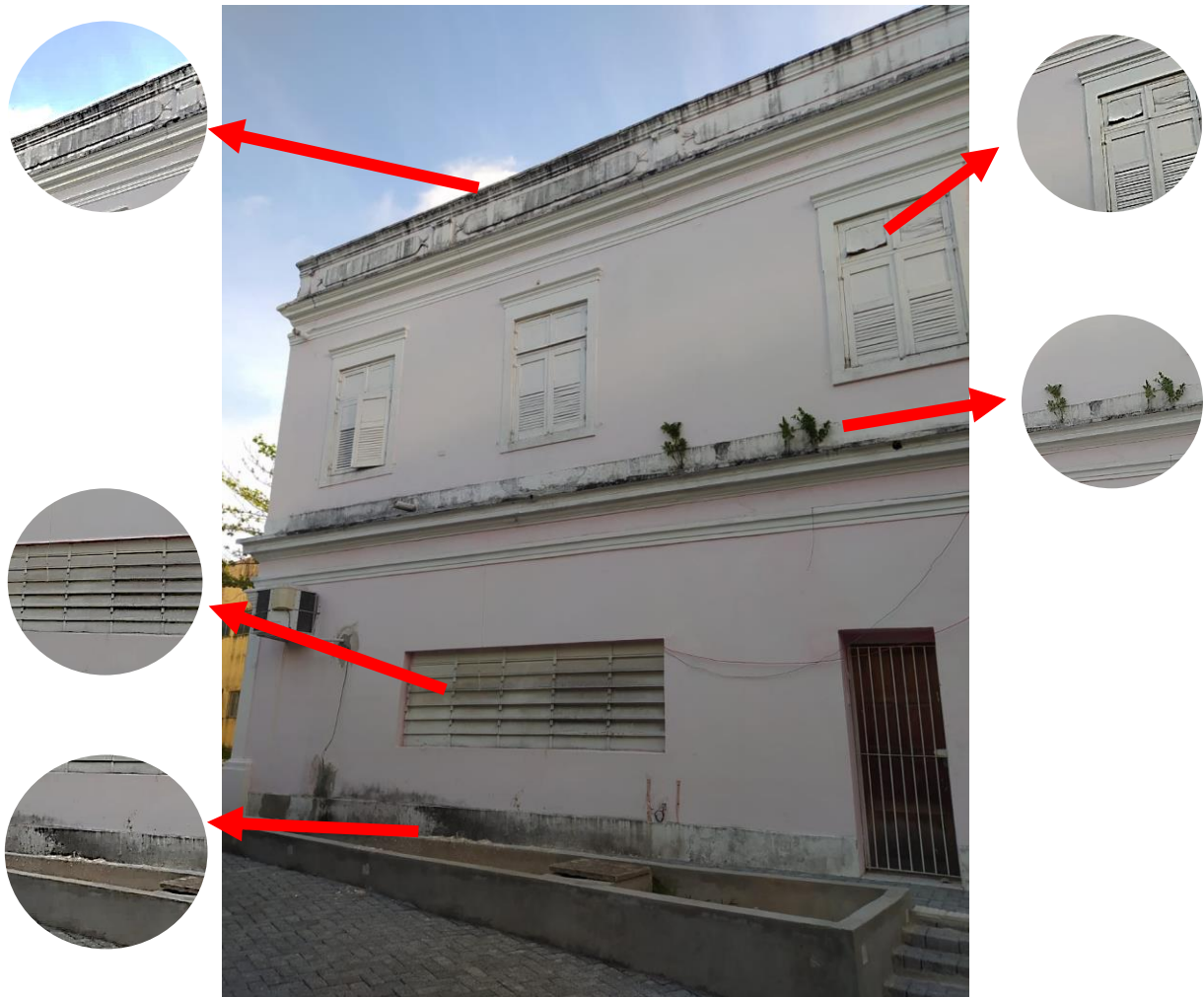
 Coating Detachment	 Damp Stains	 Structural Degradation
 Dirtiness	 Paint Detachment	 Plaster
 Vegetation	 Wood Degradation	 Cracks

Source: Authors.

3.2.2 East-West facades

The pathological manifestations found on the East facade of the building can be observed in Figure 8.

Figure 8 – Pathological manifestations on the East Facade.



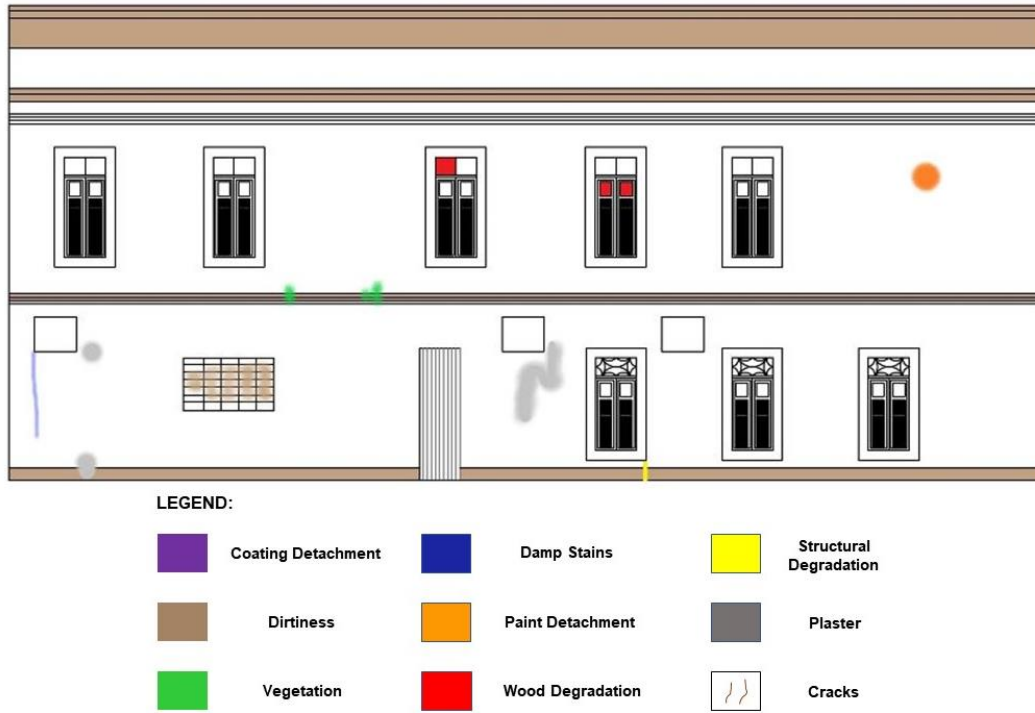
Source: Authors.

It can be seen from the image that this facade is significantly affected, starting with the presence of several dirt spots in the upper and lower areas, due to humidity from rainwater. The presence of moisture can also be observed on the cornice, which is completely covered by black stains. Furthermore, the sunshades are completely dirty, and some windows at the top are broken or have some aesthetic defects, indicating a lack of appropriate maintenance.

Similar to the North facade, vegetation growth can be seen on the cornice, probably due to the transport of seeds by birds that frequent the site. Due to the sun's exposure, the tone of the painting is lighter compared to the paintings on the North and South facades, as this side faces the sunrise.

Finally, some areas with the presence of plaster can be observed, as a consequence of the works carried out to conceal the hoses coming from the air conditioning condensers installed in the building. The damage map of this facade is presented below, with the identification of all pathological manifestations found (Figure 9).

Figure 9 – East Facade’s damage map.



Source: Authors.

10. Finally, we now analyze the West facade of the building, which can be seen in Figure

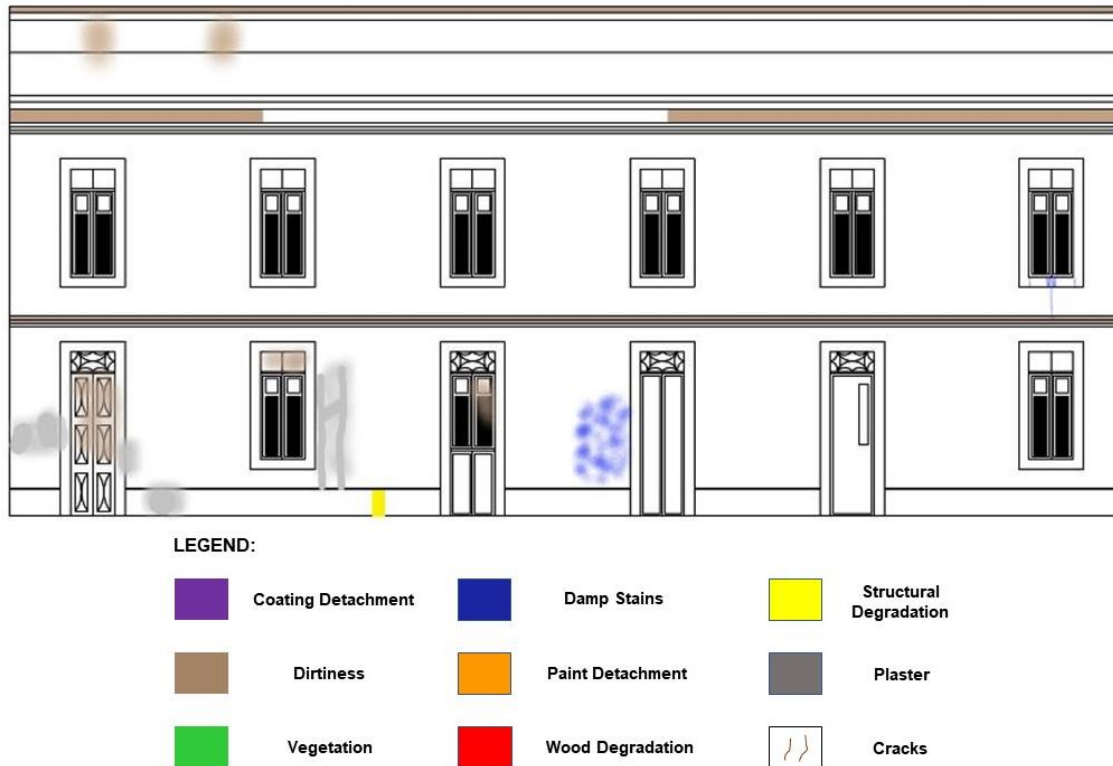
Figure 10 – Pathological manifestations on the West Façade.



Source: Authors.

Similar to the East facade, this side also exhibits dark spots in the upper areas and on the cornice, likely caused by moisture from rainwater. However, the lower part lacks dark spots at the base, instead, infiltration stains can be observed on its walls, along with some patched areas resulting from previous restoration works. Similarly to the East facade, the West side also displays a difference in paint tone, attributable to its exposure to the setting sun. The damage map of this facade, identifying all pathological manifestations found, is shown in Figure 11.

Figure 11 – West Facade’s damage map.



Source: Authors.

4 CONCLUSION

It can be concluded from this study that historic buildings require special attention from public managers, as they often lack regular maintenance due to their age. The object of study in this research is no exception, and as observed, despite some previous restoration work, numerous pathological manifestations remain present on its facades.

Furthermore, the use of the damage map was crucial for accurately identifying the pathological manifestations in the building under study. It enabled the identification of the most affected areas of the facades, highlighting the need for urgent corrective actions.

Finally, the study underscores the importance of conducting periodic maintenance on historic buildings. Preserving these structures is crucial, not only for their historical significance but also from a sustainability standpoint, since those buildings play a significant role in the economic, social and environmental development of cities.

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