Chapter 86

Pathological manifestations in façades of historic buildings – damage map: case study of the church Santuário Nossa Senhora de Fátima

10.56238/tfisdwv1-086

Fabrício Fernando de Souza Lima
University of Pernambuco, Brazil
E-mail: ffsl@poli.br

Eliana Cristina Barreto Monteiro
Catholic University of Pernambuco and University of Pernambuco, Brazil
E-mail: eliana@poli.br

Angelo Just da Costa e Silva
Catholic University of Pernambuco, Brazil
E-mail: angelo@tecomat.com.br

André Gustavo Ferreira de Vasconcelos Filho
Catholic University of Pernambuco, Brazil
E-mail: andre.2017107568@unicap.br

Arthur Rocha Lemos
Catholic University of Pernambuco; Brazil
E-mail: arthurrol@live.com

Ana Flavia Barreto Tenório
Catholic University of Pernambuco, Brazil
E-mail: engcivil.bt@gmail.com

Camila Marques do Rêgo
Catholic University of Pernambuco, Brazil
E-mail: camilamrego@gmail.com

Lucas Feliciano Ferreira Borba
Catholic University of Pernambuco, Brazil
E-mail: eng.lucasborba@gmail.com

Lydia Marques Barreto
University of Pernambuco, Brazil
E-mail: lydia_barreto@hotmail.com

ABSTRACT
In building intervention projects, the elaboration of the damage map, based on the identification of pathological manifestations, is crucial for the understanding of their respective causes, especially in historic buildings. So, the study of pathological manifestations becomes something vital, not only for the survival of historical patrimonies and the evolution of engineering, but also for the understanding of how the action of aggressive agents works and their negative effects on the structure and, thus, make possible the diagnosis. correct maintenance or recovery. Thus, this study aims to collect data on the pathological manifestations present on the facades of the Sanctuary of Our Lady of Fatima church, classified as the main church outside Portugal in honor of this Saint, and to prepare the damage map from that mapping, in order to contribute to the conservation of this building. For this, the methodology consisted of a bibliographic review, selection of historical heritage and visual inspections in loco to map and photographically document the deterioration of the facades of this building. Subsequently, the cloth map was developed in order to contribute to future maintenance and restoration works of the construction under study. Based on visual inspections and on the damage map, it is possible to state that the structure, even with infiltration points caused by the presence of moisture in the balances, as there is no means of drainage for rainwater, and dirt in places of difficult access, it is not in a state of disrepair, showing good state conservation and with periodic maintenance carried out.

Keywords: Damage map, Pathological manifestations, Historic buildings, Maintenance, Facade recovery.

1 INTRODUCTION

The science of the pathology of the buildings is responsible for the study of the symptoms, mechanisms, causes and origins of the defects of civil constructions, that is, locates r and explains the reasons for the existence of each pathological manifestation, measuring the consequences of these in the degradation of the building. In general, pathological manifestations are developed from flaws in the design

stages, planning of buildings and, over time, by natural aging, with the slow degradation of its components, along with lack of maintenance or occurring inadequately (Ferreira & Lobão, 2018).

In this sense, today, there is a growing concern with the quality and performance of the buildings. Thus, the importance of façade conservation increases, since, in addition to presenting cultural and socioeconomic characteristics, it is the first visual contact of an enterprise and has an essential role in the performance of buildings when exercising the role of protection against harmful circumstances and aggressive agents that the environment can offer, such as rain, winds and the sun. Portanto, they must have a minimum service life. In addition, in the case of old and historical constructions, the importance of conservation because they have great relevance to the cultural memorial of the city and inestimable historical value, thus being concerned with preserving these heritages. The cage of Recife - PE, has a large number of old and historical constructions, presenting several pathological manifestations and impacting, consequently, on its useful life, degrading the structure of these heritage (Madureira, et al., 2017; Barreto, 2020).

In the face of this, Rocha et al. (2018) states that after the pathological manifestations are identified, the diagnosis of failures should be correctly based on critical and investigative analyses about the origin of the problem, aiming at the most effectivetreatment z.

In this context, given the scarcity of literature and the problem of conservation and restoration interventions of historical buildings that present various pathological manifestations, damage mapping can contribute to the identification of damage in order to understandthe state of conservation of buildings and demonstrate the need for maintenance and preservation of these. For this, the damage map is used, which is a widely used technique, because it will compile and graphically represent all the damage cataloged in the damage mapping of the building, enabling relatesto agents and their causes. Through the analysis of damage maps it is possible to accurately identify the type of intervention that will be used (Rocha, 2017; Barreto, 2020).

In view of the above, this article aims to identify, investigate and perform the diagnosis of pathological manifestations and determine the conditions of preservation of the igreja Sanctuary Of Our Lady of Fatima, in the city of Recife-PE, together with the photographic records and the elaboration of the mapa of dyears, to contribute to the conservation of its physical structure.

2 THEORETICAL FRAMEWORK

2.1 HISTORICAL HERITAGE

The preservation of a cultural and historical good, material or immaterial, is an objective of common interest of a people, because they represent the memory, history, culture, architecture and the technical, aesthetic and artistic expressions of an era of society, becoming an inheritance for the next generations (Barreto, 2020). In addition, the Federal Constitution, in its article 23, determines to the Public Power that

it must protect and prevent any degradation to goods with historical, artistic or cultural importance (Brasil, 1988).

However, it is emphasized that this concern to ensure the conservation of cultural heritage through legal protection has a recent origin, only in the 1980s when concepts for conservation, maintenance, preservation, restoration, restoration, reconstruction, among others, are defined in the Burra Charter in 1980 (Salcedo, 2019). This is one of the factors that helps explain the neglect and abandonment of structures considered historical heritage. This problem is highlighted by the Court of Auditors of the State of Pernambuco through the booklet Rite of Interventions in Cultural Goods Affected by Legal Protection, which attests to the following:

> The worrying state of preservation of a significant part of the Brazilian material cultural collection is caused, above all, by the absence of appropriate care and procedures for carrying out these interventions, in addition to the insufficient volume of financial resources destined to this area (França & Brandão Filho, 2012. p. 10).

Borges, Carasek and Cascudo (2014) and France and Brandão Filho (2012) add another obstacle in the conservation of historic buildings by highlighting the occurrence of interventions with technical deficiencies due to the use of construction processes and unsuitable materials, causing a lower durability of the structure , in the emergence of new pathological manifestations and the partial or total loss of authenticity and integrity thereof. It is invaluable to maintain aesthetic and historical authenticity, respecting the original design, so it should be avoided to use constructive techniques that are not compatible with the original construction processes (Brasil, 2005).

Therefore, especially in cases of historical heritage, it is vital that an intervention proposal is well anchored and based on a diagnosis obtained through rigorous and detailed investigations so that the pathological manifestations and procedures necessary for intervention can be characterized as much as possible, so that there are no consequences of further deterioration to the building.

2.2 PATHOLOGICAL MANIFESTATIONS

There are several pathological manifestations that can arise in a building and do not occur out of nothing and without a reason that has generated it, as a consequence of the interactions of the materials that compose it a building and the medium, especially in cases of absence of maintenance or these are performed inadequately. In addition, errors in the design or execution of the design stages and use of inadequate materials or deficient interventions in the building may result in the appearance of pathological manifestations (Helene, 2003; Rock, 2017).

Agents of pathological manifestations can be diverse "[...] loads, moisture variation, intrinsic and extrinsic thermal variations to concrete, biological agents, material incompatibility, atmospheric agents and others." (Helene, 2003, p.17). Do Carmo (2003) adds and highlights that it is essential to know the origin of pathological manifestations so that it is possible to solve it, otherwise treating only the symptoms will

not prevent it from happening again. The main pathological manifestations in the old buildings are: cracking, corrosion of armor, biodeterioration, pathological manifestations in stones (mold, vegetation, dirt, erosion, pitting, disaggregation, black crust, etc.) and pathological manifestations in woods, highlighting that pathological manifestations related to moisture deserve greater attention, because moisture can affect every building and accelerate the processes of deterioration from aesthetic to structural components (Rocha,2017; Barreto, 2020).

According to Veiga (2009) and Thomaz (2020), cracking is one of the most recurrent pathological manifestations in buildings and may indicate, in addition to causing psychological embarrassment in users due to aesthetic impact, impairment of building performance or a more serious problem in the structure. Other common problems that can originate from cracks is to cause infiltration of water or aggressive agents, which reduces the durability of the coating and the wall itself and the emergence of new pathological manifestation due to the presence of moisture (Silva, 2007; Rocha, 2017; Piglet Neto, 2022).

In this context, moisture can be the cause or one of the reasons for the appearance of numerous pathological manifestations old buildings, can be cited efflorescences, rust, mold, mold, vegetation, peeling of paints, loss of adhesion of plaster, among others (Souza, 2008; Veiga, 2009). Therefore, pathological manifestations related to moisture deserve greater attention, because humidity can affect every building and accelerate the processes of deterioration from aesthetics to structural components (Rocha, 2017; Barreto, 2020).

Magalhães (2013) and Rocha (2017)point out that for the emergence of efflorescence, in addition to moisture, it is necessary the presence of soluble salts in the components of the plaster or support or in the soil and the presence of hydrostatic pressure to transport the formed substance to the surface. Usually, this pathological manifestation does not cause functional or structural damage, being an aesthetic problem of the building with its whitish color and can accentuate the peeling of the paintings. However, in the case of cryptoflowerings can affect the interior support of the building by causing tensions in the materials in this region of more difficult access, making repair difficult.

The presence of moisture and oxygen, the lack of ventilation and the porosity of the coating are some of the conditions that favor the proliferation of algae, mosses, bacteria, fungi, micro vegetables, among others, which settle on the surface of the coatings, in the existing cracks and pores. Biodeterioration can cause the appearance of stains, formation of black crusts, loss of cohesion, deterioration of the material and cause tensions that cause the detachment of the coating, this is the case of vegetation with developed roots (Tavares, 2009; Magellan, 2013; Carmago, 2017; Rock, 2017).

Finally, it is important to highlight other manifestations normally found in historical buildings, loss of adhesion, loss of cohesion, loss of section, erosion, peeling of paintings, vandalism and decayed wood, especially on facades that are more susceptible to environmental conditions, such as those related to climate, sea air and living beings (Tavares, 2009; Magellan, 2013).

2.3 DAMAGE MAP

The damage map is the graphical representation of the damage of a building from the data obtained during the damage mapping, which consists *of on-site surveys, photographic* records and the historical research of the building under study. In this theme, Tirello and Corrêa (2012) and France and Brandão Filho (2012) highlight the importance of designing the damage map in intervention projects, because, in addition to identifying and representing each point of deterioration of the building, it helps in the diagnosis pathological manifestations and in the identification of the agents causing these damages, thus contributing to the search for solutions in the conservation plan.

However, there is still no rule that regularizes the technical procedures and graphic representations of the damage map by the heritage preservation bodies and, thus, is at the discretion of the creativity of each professional of each project (Tinoco, 2009; Hautequestt Son & Achiamé, 2018). Therefore, it is essential that the damage map is sufficiently clear and easy to read, so that the graphic representations, data and vocabulary used to demonstrate the state of conservation of the building is objectively and, thus, allows the correct interpretation of the situation (Tinoco, 2009; Barreto, 2020). With this being implemented, the damage map can help in the characterization of the pathological manifestations that contain the determination of the origins and causes of these and the level of state of deterioration of the structure and, thus, can delimit which corrective methods will be performed to solve them properly (Soares, et al. , 2022).

3 METHODOLOGY

The research aims to identify the pathological manifestations through the mapping of damage and to carry out the elaboration of the damage map of the selected historical building. For this, the qualitative method was used in this work, which does not need to use statistical tables and methods, with information collection in an exploratory way, that is, performed from visits to the selected building, together with the help of reading books and articles that can complement the study of the theme and that allow the characterization of the case study (Prandov & Freitas, 2013). Thus, it is expected that the identification and diagnosis of the pathological manifestations present encourage the search for solutions or ways to mitigate the processes of deterioration of the structure.

In this context, a narrative bibliographic review was initially carried out with the objective of understanding about pathological manifestations present in old buildings and about procedures for the elaboration of damage map and, thus, facilitate the performance of inspections in the case study. The journals were searched in databases such as SCOPUS, CAPES and Google Scholar using the following search words: Damage Map, Pathological Manifestations, Istoric Heritage, Building Façade and Mortar Coatings. It is notepoint that some criteria were stipulated for the selection of bibliographic materials to be used, such as: should contain case study of historical buildings, describe the methods for mapping damage, recording the pathological manifestations identified and drawing up the damage map of the case study. Table 1 is composed of the chosen works.

Table1 - Identification of selected scientific papers.

AUTHOR	JOB TITLE	YEAR
Barreto	Pathological manifestations in facades of religious buildings: a study in the city of Recife-PE	2020
Borges, Carazek, & Cascudo	Damage Mapping in Art Deco Historical Monument	2014
Camargo	Study of pathology in reinforced concrete and proposal of solutions: analysis of sandbox in the effluent treatment system in a dairy cooperative	2017
Costa & Silva	Pathological manifestations in facades of historical buildings: case study of the Church of Our Lady of Carmo in São Luís - MA	2022
France & Brandão Filho	Rite of Interventions in Cultural Assets Affected by Legal Protection: Roadmap and Technical Guidelines	2012
Hautequestt Son & Achiamé	Guidelines for graphical representation of damage map.	2018
Pigegrandson	Analysis and diagnosis of fissures in a single-family residence in the municipality of Porto - PI	2022
Magellan	Degradation of wall coverings of old buildings: Diagnostic methodology.	2013
Rock	Pathological manifestations in facades of religious buildings of the 16th and 17th century: A study in the region of the historical site of Olinda-PE.	2017
Rocha et al.	Adaptation of damage map for historic buildings with pathological problems: Case Study of the Carmo Church in Olinda PE	2018
Schonardie	Analysis and treatment of pathological manifestations by infiltration in buildings	2009
Soares et al.	Analysis of pathological manifestations in a structural system of precast concrete in a property in the city of Bom Conselho-PE	2022
Tinoco	Damage Map Basic Recommendations	2009
Valentine	Conservation and repair of wall coverings of old buildings: Methods and materials	2009

Source: Authors (2022).

Subsequently, there was the choice of the historical building that met the criteria of accessibility and availability of data, in addition to the significant historical and cultural importance for the city of Recife. Thus, the church Sanctuary of Our Lady of Fatima was selected, a building known for its architectural grandeence and for being one of the historical heritage of the city of Recife, listed by the state heritage.

Subsequently, for the case study, the inspection methodology proposed by Tavares (2011) was partially adopted, consisting of the collection of historical data and the physical structure of the building, seesthe site of the building, mparaamento of the damage and, finally, elaborationof the diagnosis of the pathological manifestations found and recommendations to solve them. These steps are also part of the methodology suggested by Tinoco (2009) for the conception of the damage map, the main objective of this work. Formation of a multidisciplinary team, conducting tests, intervention project and execution of this, are the other steps that make up the inspection methodology produced by Tavares (2011), and not used in the present research.

In viewof this, this characterization occurred through the collection of historical data, which aims to address "[...] style, construction date, original use, physical interventions and changes in use suffered over time, etc. [...]" (France & Brandão Filho, 2012. p. 40). Subsequently, it proceeded with the mapping of damages, which, according to Tinoco (2009), *consists of on-site inspections*, which allowed the identification of pathological manifestations present in the facades, and the elaboration of photographic documentation of the building, recording all information pertinent to the study. Consequently, with the on-site surveys, it allowed the knowledge about the state of conservation of the facades of this building.

With this data collection *in loco* completed, it happened with the next stage of analysis of the information obtained and the diagnosis on the pathological manifestations identified, seeking to determine the causes and possible solutions, as Tinoco (2009) recommends. After that, the damage map was elaborated using the AutoCAD software, which allows a better visualization of pathological manifestations and, thus, detailing the damage and losses of materials, relating them to aggressive agents and the causes of these degradations. Therefore, the preparation of the mapa of dyears can help future projects of interventions aimed at the conservation of the building. It is emphasized that for the production of the mapa de danos of the church Sanctuary Our Lady of Fatima, we used with reference to the legend and graphic representation created by Rocha (2017).

Finally, it was followed with analysis of the results, when detailing the observed pathological manifestations. With this, it was possible to design the scientific article for dissemination of the material produced in this research.

4 RESULTS AND DISCUSSION

4.1 BRIEF HISTORY OF THE BUILDING

The Church Sanctuary Of Our Lady of Fatima, construction under study, is located in the Brazilian school Liceu Nóbrega de Artes e Ofícios, located on Avenida Oliveira Lima, in the soledade neighborhood, central area of Recife. The building is considered the first temple built in the world in honor of Our Lady of Fatima, being the main Sanctuary outside Portugal, and in 2010, received the State Tombamento by the Foundation of Historical and Artistic Heritage of Pernambuco (Fundarpe), classified as Intangible Cultural Heritage and Material of the State (G1, 2012; Mota, 2016; National Eucharistic Congress, 2022).

The church features predominantly semi-Gothic architecture adapted to modern architecture, with reinforced concrete arches and latin cross shape. The project belongs to the French architect Georges Mounier and had its construction begun by the Jesuits, supported by the Portuguese colony in Recife in 1932, with the launch of the cornerstone of the church in 1933 and inauguration on September 8, 1935. Since completion, the construction has not undergone renovations that significantly modified its structure, consisting of a single tower with a height of 50 meters, a dome with 26 meters high and the central nave with 14 meters wide, containing six semi-eclipses. In addition, you can highlight the main piece of the temple, the image of Our Lady of Fatima, created by the artist Portuguese Antônio da Paz, 3 meters high (G1, 2012; Mota, 2016; Diario dand Pernambuco, 2021; National Eucharistic Congress, 2022).

4.2 PATHOLOGICAL MANIFESTATIONS OF BUILDING

Methods for the recovery and prevention of existing pathological manifestations may vary according to the situation in which it is, affected material, climate change, mechanical actions, chemical reactions, among others. As indicated, the possiblerecovery and prevention methods of each pathological manifestation found will be presented.

4.2.1 Efflorescence

To avoid, it is necessary to pay attention to the waterproofing of wet areas to avoid continuous contact of water with free lime, and efflorescence is soluble in water. In the case of recovery, water and steel brush can be used to clean the place. Moreover, it can be appliedalso chemical that does not interfere in the structure. Figure 1 shows the efflorescence on the south façade.

Figure 1 - Efflorescence present in the south façade.

Source: The Authors (2022).

Figure 1 shows the presence of flowering,together with dirt and moisture stains, indicating that water action is a common factor for the emergence of these pathological manifestations.

4.2.2 Moisture stains

It is recommended the identification of infiltrations present in the structure, originated by malmade waterproofing, moisture in wet spaces, such as kitchens and bathrooms, water that comes from rain and affects facades, water coming from the ground, water from various leaks, porous materials used in construction, water coming from the ceiling, in poorly waterproofed slabs, among others. Recommended, after identifying and correcting the source of infiltration, perform a new waterproofing. It is noteworthy that all waterproofing has an estimated time of effectiveness and a guarantee, the estimated time can only be achieved with the proper maintenance being performed (Souza, 2008). Figure 2 shows the record of moisture stain present on the west façade.

Figure 2 - Moisture stain present on the west façade.

Source: The Authors (2022).

Figure 2 shows the infiltrations present in the wall of the western façade, with moisture stains indicating the path followed by water when draining through it.

4.2.3 Peeling of pintura

To make the correctionof the peeling of paint identified in the south façade, with it is possible to observe nto Figura 3, one must follow the following steps: scrape the loose parts with a steel brush, then correct the deep imperfections with plaster dough, wait the time for its cure, apply a background hand preparer to walls, and, after drying, it is possible to reapply the coating (Schonardie, 2009; Alves, 2010; Costa & Silva, 2022).

Figure 3 - Peeling of paint present on the south façade.

Source: The Authors (2022).

Several pathological manifestations are identified in Figure 3, with emphasis on the intense peeling of the paint around the door and the deterioration of the wood.

4.2.4 Etherioran wood

Figure 3 shows a mechanical wear process with greater intensity at the ends of the right door of the south façade, worsening by the vertical flow of rainwater over the surface of the door and the presence of sea air, which occurs because it is located in a coastal region . To reduce moisture damage it is recommended to start applying the waterproofing agent, which can be stain or varnish, with the use of brushes, brushes and rolls for wood, or even conventional paint gun; apply three coats, respecting the drying intervals indicated by the manufacturers and wait for the drying completely.

4.2.5 Corrosion of grades

The presence of corrosion of the edges of the grids belonging to the doors of the south façade was identified, as can be seen in Figure 3, and, dand according to the situation found, it is advisable to clean the material with a steel brush and products to facilitate its removal, after cleaning it is recommended to paint the part with epoxy paint or synthetic enamel for protection of the part, avoiding direct contact with water, which is essential for the oxidation process to occur.

4.2.6 Presence of biodeterioration

For the existence of vegetation growing in the structure, visualized in Figure 4A, there are several possible causes, such as the presence of organic matter in the sand used in the execution of the work and the transport of organic matter by animals or any other means possible, such as the existence of a tree near the building.

Vegetation in buildings, in general, indicate the presence of moisture and organic matter. In the previous topics, thepresence of moisture was confirmed at certain points of the building and, with the presence of vegetation, the presence of organic material can be confirmed. Caso the organic matter has been introduced into the structure in the execution phase, there would be the presence of reactive substances throughout the structure facilitating the contact of concrete with sulfates and alkalis, being harmful to its useful life. In lack of maintenance, the areas accessible to water, eventually will be colonized by the roots, they can settle in fissures and, thus, potentiating them, compromising the structure.

Figure 4 - Biodeterioration present in the south façade. Vegetation growth B. Presence of Mold

Source: The Authors (2022).

Mold is another pathological manifestation classified as biodeterioration, such as vegetation, visualized in the structure studied, as shown in Figure 4B. The emergence of mold is interconnected with the existence of moisture, it is possible to avoid this problem through some measures, such as using hydrofugue materials in the necessary steps while they are building, opting for good solar lighting to the extent that it does not harm the well-being of individuals and also carry out a project that addresses the possibility of cross ventilation. When it comes to the exterior of the building, as there is a greater contact with humidity, it ends up facilitating the deposit of water in several places, so there has to be greater attention to these conditions and avoid them. Figure 4 B shows the appearance, still initial , of the mold in the transverse section of the slab in a balance sheet present in the north façade.

4.2.7 Cracks

In the case in question, it observed the presence of cracks near the pillars on the south façade. The action of water and the retention of thesame in the structure, reducing its resistance and consequently its useful life, the presence of vegetation nearby, in which the growth of roots of shrubs or trees are always in the direction of the largest accumulation of water nearby, entering and increasing existing cracks , and the retraction and dilation of the material exposed to climatic conditions, may be some of the causes of this pathological manifestation. To avoid cracks it is important to have the proper expansion joints where the project asks for, they are a point where tensions are softened giving a safe space for the structure to move without damaging the building. During construction, perform properly and respect the curing process of concrete and mortar (Thomaz, 2020). Moreover, in this situation of completed structure, it is important to monitor this pathological manifestation and, thus, to verify whether they are active or passive fissures (Leitão Neto, 2022). Figures 5 presents the fissures present near the pillars on the south façade.

Figure 5 – Cracks in the south façade.

A. Crack In the stairs.

Source: The Authors (2022).

B. Crack Near the pillar

Source: The Authors (2022).

e,

with the opening filling. Contudo, in case of active fissure, it will be necessary to find out the cause of the origin of this to obtain the complete solution of the problem.

4.2.8 Dirt and crosta negra

It was verified the presence of dirt in the building, possibly due to the large exposure of rainwater that when draining through the façade spread and deposit the pollution particles mainly in points of discontinuities, where these strange fragments support the force of water flow, which is slower due to the bumps and inclinations, causing accumulation in these points. This is confirmed in Figure 6, which is one of the photographic records of dirt in the Church Sanctuary Of Our Lady of Fatima. The methods that are usually taken for cleaning dirt are brushing, pressure water, mechanical cleaning, chemical cleaning and detergent compresses. Cleanliness is the first measure to resolve this pathological manifestation, but when this is not enough, the next step is recovery. That is, the scraping of the site that was cleaned followed by the application of a seamer or primer, to receive the paint (Costa & Silva, 2022).

Figure 6 - Dirt present in the structure.

Source: The Authors (2022).

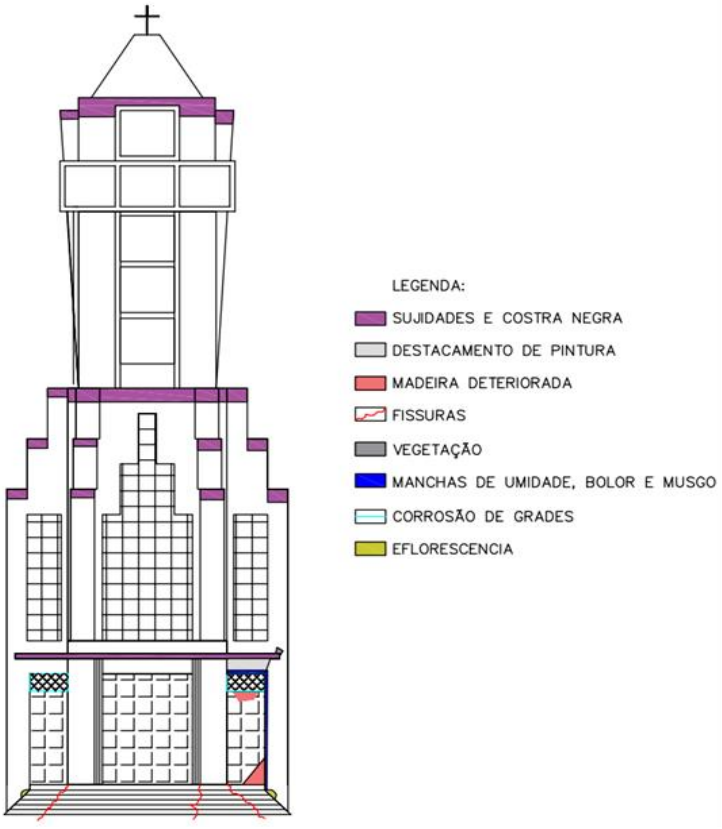
It is shown in Figure 6 thatthe dirt coincides withthe water path when draining through the façade of the building, being deposited in the discontinuities due to the decrease in the speed of water in these points.

4.3 PRESENTATION OF DAMAGE MAPS

The *on-site survey and* photographic record of the building and the pathological manifestations identified, allowed the elaboration of thedamage map of the façade of the church Sanctuary Of Fatima, which is the ultimate objective ofthe research. The elaboration of the damage map of each façade made it possible to indicate the location of each identified pathological manifestation. However, it is important to emphasize that thereis no standardization for graphic representation of pathological manifestations onthe damage map (Tinoco, 2009; Rocha, et al., 2018). Therefore, it was decided to use its own legend, based on those created by Rocha (2017), to perform it.

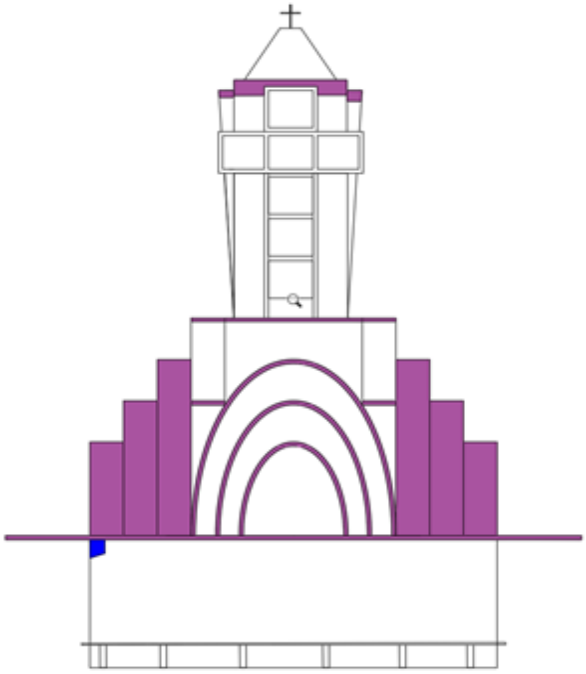
Figures 7 and 8 show the damage maps of the facades norte and sul of the church, respectively. A higher concentration of pathological manifestations is perceived in the areas with cumulative water potential, especially not theright side, nthe south façade of the structure, with the presence of dirt standing out in the points of discontinuities and greater difficulty of cleaning the facadesmentioned . The peeling of the paint around the right door, accentuated by the runoff of rainwater, is another pathological manifestation that should be highlighted, affecting the aesthetics of the building, along with dirt.

Figure 7 - South façade damage map.



Source: The Authors (2022).

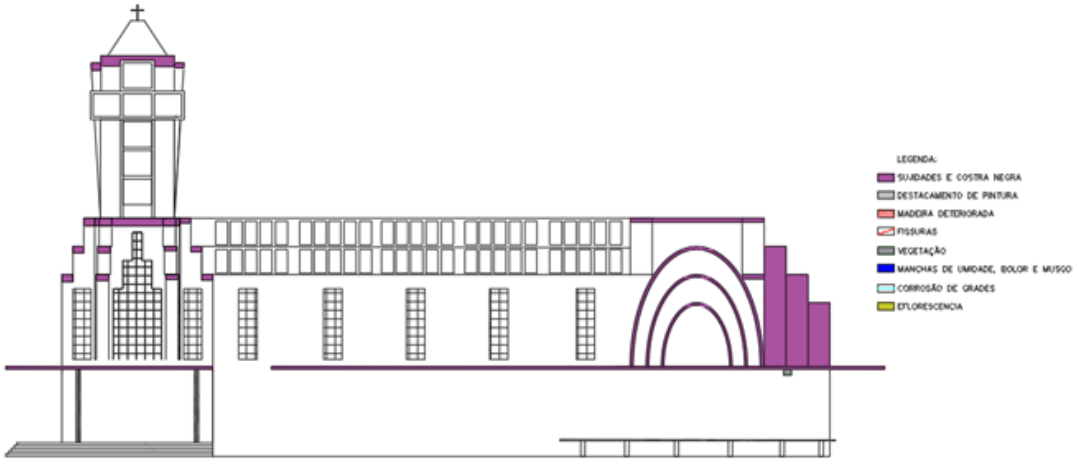
Figure 8 - Damage map of the North façade.



Source: The Authors (2022).

While in Figures 9 and 10A, it contains the damage maps of the east and east facades, respectively. As in the façade sul and norte, dirt is the pathological manifestation with greater concentration in the facades least and east, especially in the points of concentration of water, discontinuities and difficult to access for cleaning. In addition, it observed the presence of vegetation, favored by the moisture present, according to the map of damage of the west façade in Figure 9 and the east façade in Figure 10A. While Figure 10B presents the cross-sectional damage map of the building under study. This was elaborated with the objective of indicating, with greater precision, the presence of pathological manifestations catalogued, but that could not be visualized in the maps of damage ofthe facades due to their locations. Notthe same, it is noticed the presence of moisture and mold stains, due to the accumulation of water in the balances of the structure in rainy season

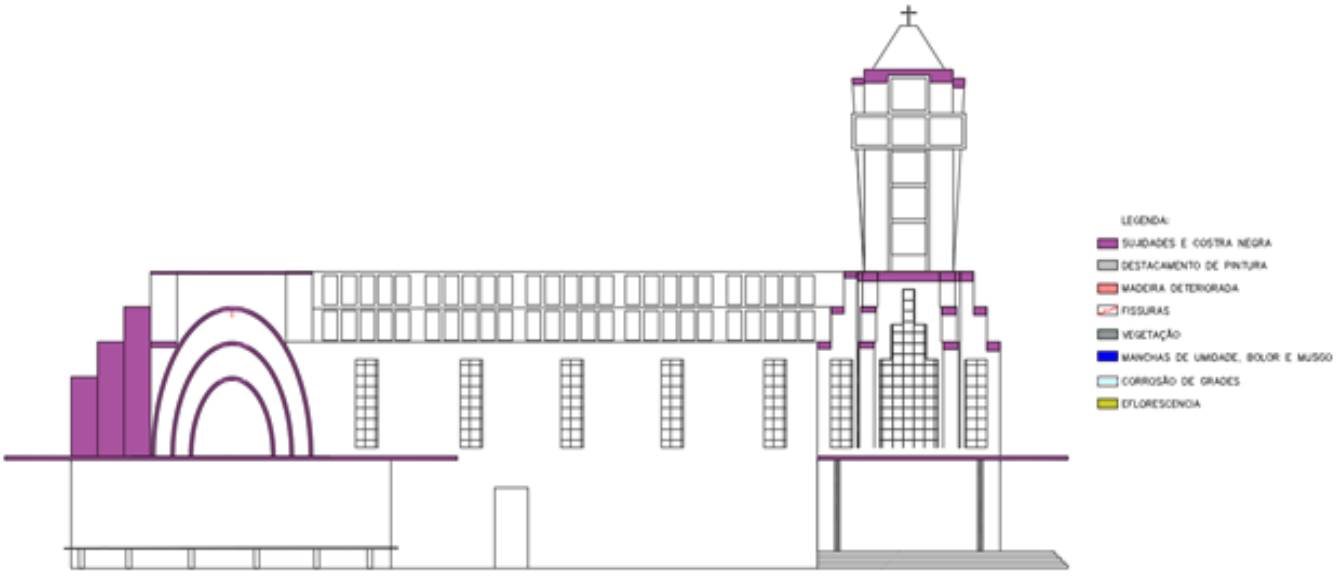
Figure 9 - Damage map of the West façade.



Source: The Authors (2022).

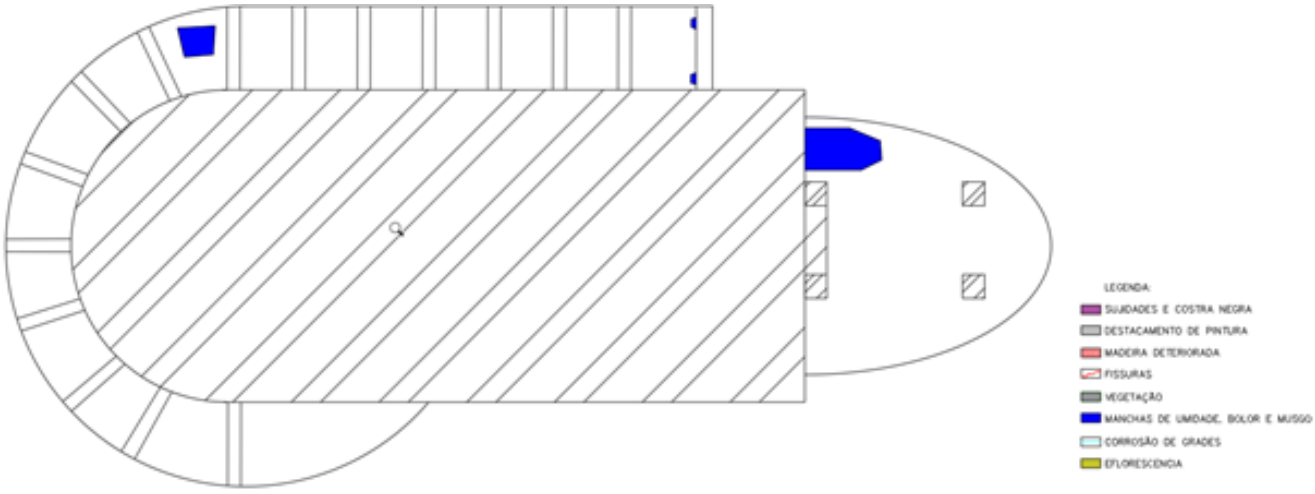
Figure 10 - Damage map of the ffound East.

A. Side view



Source: Autores (2022).

B. View of cross section



Source: The Authors (2022).

On the other hand, there was no presence of pathological manifestations that would compromise the integrity of the structure, such as loss of material section, disaggregation of concrete and cracks, except for some cracks in the south façade.

5 FINAL CONSIDERATIONS

The Church Sanctuary Of Our Lady of Fatima is not in a state of abandonment, still receiving maintenance care, such as painting and cleaning of the facades. This is remarkable, especially compared to the state of conservation of several historical churches in the city of Recife. The pathological manifestations with greater presence are moisture stains, due to the accumulation of water in the balance, and dirt due to the difficulty of access for cleaning, verified *in the on-site* inspection, in the photographic

records and through the analysis of the elaborate d'damage map. The existence of thebulletwithout the slope necessary for the flow is the main cause for the presence of some pathological manifestations present, such as vegetation and peeling of the paint, which are consequences of the constant action of water.

Nevertheless, it is perceived that the pathological manifestations mentioned affect the aesthetics of the building, without compromising the structural integrity. Thus, it presents less costly and viable solutions in the short term with regular maintenance, without the need for a restoration process. It is expected that the damage map created in this case study will contribute to the conservation of the building, by assisting in maintenance programs. Therefore, it compiled all the pathological manifestations identified in the mapping of damage, facilitating future diagnoses.

Thus, future studies are necessary to verify whether the fissures, identified in the south façade, are active. In addition, it is important to emphasize that an analysis in search of corrective measures and solutions for the flow of rainwater in the slab in balance would mitigate the pathological manifestations present and prevent future further deterioration and, consequently, avoiding functional and structural problems of the part in question. In this sense, the non-destructive test of infrared thermography could help in the identification ofthe points with the presence of humidity.

REFERENCES

Alves, G. (2010). *Sistemas de Pinturas em edifícios Públicos de Maringá*: patologias, processos, execução e recomendações. (Dissertação, Especialização de construção de obras públicas). Universidade Federal do Paraná, Maringá.

Barreto, L. M. (2020). *Manifestações patológicas em fachadas de edificações religiosas*: um estudo na cidade de Recife-PE. Dissertação de Mestrado em Engenharia Civil, Universidade de Pernambuco. Recife.

Borges, E. A. M. M., Carazek, H., & Cascudo, O. (2014). Mapeamento de Danos em Monumento Histórico Art Déco. *REEC - Revista Eletrônica de Engenharia Civil*, 8(3), 20 - 37. https://doi.org/10.5216/reec.v8i3.29051.

Brasil. (1988). *Constituição da República Federativa do Brasil de 1988*. Brasília, DF: Presidência da República. http://www.planalto.gov.br/ccivil_03/Constituicao/ Constituiçao.htm.

Brasil. Ministério da Cultura. (2005). *Manual de elaboração de projetos de preservação do patrimônio cultural*. Brasília: Ministério da Cultura, Instituto do Programa Monumenta.

Camargo, R. G. (2017). *Estudo de patologia em concreto armado e proposta de soluções:* análise de caixa de areia no sistema de tratamento de efluentes em uma cooperativa de lacticínios. (Trabalho de Conclusão de Curso, Bacharelado em Engenharia Civil). Universidade Estadual Paulista, Guaratinguetá.

Congresso Eucaristico Nacional. (2020). *Primeira igreja no mundo em honra a Nossa Senhora de Fátima celebra festa com tema eucarístico,* https://cen2020.com.br/2022/05/17/primeira-igreja-no-mundo-em-honra-a-nossa-senhora-de-fatima-celebra-festa-com-tema-eucaristico/

Correa, R. H., & Tirello, R. A. (2012). Sistema normativo para mapa de danos de edifícios históricos aplicado à Lidgerwood manufacturing company de Campinas. In *Anais VI Colóquio Latinoamericano sobre Recuperação e Preservação do Patrimônio Industrial*. São Paulo, Brasil: Centro Universitário Belas Artes de São Paulo.

Costa, L. S., & Silva, W. A. (2022). Manifestações patológicas em fachadas de construções históricas: estudo de caso da Igreja de Nossa Senhora do Carmo em São Luís – MA. *Research, Society and Development*. doi: http://dx.doi.org/10.33448/rsd-v11i2.25819

Diario de Pernambuco. (2021). *Santuário Arquidiocesano Nossa Senhora de Fátima anuncia programação com restrições,* https://www.diariodepernambuco.com.br/noticia/vidaurbana/2021/05/santuario-arquidiocesano-nossa-senhora-de-fatima-anuncia-programacao-c.html

Do Carmo, P. O. (2003). Patologia das construções. Santa Maria, Programa de atualização profissional – CREA – RS.

Ferreira, J. B., & Lobão, V. W. N. (2018). Manifestações patológicas na construção civil. *Caderno de Graduação-Ciências Exatas e Tecnológicas-UNIT-SERGIPE*, 5(1), p. 71.

França, E., & Brandão Filho, J. O. C. (2012). *Rito de Intervenções em Bens Culturais Afetados por Proteção Legal: Roteiro e orientações técnicas*. Tribunal de Contas do Estado de Pernambuco.

G1. (2012). *No Recife, Igreja Nossa Senhora de Fátima vira santuário arquidiocesano,* https://g1.globo.com/pernambuco/noticia/2012/05/no-recife-igreja-nossa-senhora-de-fatima-vira-santuario-arquidiocesano.html.

Hautequestt Filho, G. C., & Achiamé, G. G. (2018). Diretrizes para representação gráfica de mapa de danos. In *Anais 6º Encontro sobre Patologia e Reabilitação de edifícios.* Rio de Janeiro, Brasil: Universidade Federal do Rio de Janeiro.

Helene, P. R. L. (2003). *Manual de reparo, proteção e reforço de estruturas de concreto*. Red Rehabilitar.

Leitão Neto, E. A. (2022). Análise e diagnóstico de fissuras em residência unifamiliar no município de Porto – PI. *Research, Society and Development*. doi: http://dx.doi.org/10.33448/rsd-v11i6.28971

Madureira, S., Flores-Colen, I., Brito, J., & Pereira, C. (2017). *Maintenance planning of facades in current buildings*. Construction and Building Materials.

Magalhães, A. C. A. (2013). *Degradação de revestimentos de paredes de edifícios antigos:* Metodologia de diagnóstico. (Dissertação de Mestrado em Conservação e Restauro). Universidade Federal da Bahia, Salvador.

Mota, A. (2016). *História do Santuário de Nossa Senhora de Fátima,* http://www.impresso.diariodepernambuco.com.br/noticia/cadernos/opiniao/2016/05/historia-do-santuario-de-nossa-senhora-de-fatima.html

Prandov, C. C., & Freitas, E. C. D. (2013). *Metodologia do trabalho científico: Métodos e Técnicas da Pesquisa e do Trabalho Acadêmico*. Universidade
FEEVALE. (2ª ed.), 1-277.

Rocha, E. A. (2017). *Manifestações patológicas em fachadas de edificações religiosas do sec. XVI e XVII:* Um estudo na região do sítio histórico de Olinda-PE. (Dissertação de Mestrado em Engenharia Civil). Universidade de Pernambuco, Recife.

Rocha, E. A., Macedo, J. V. S., Correia, P., & Monteiro, E. C. B. (2018). Adaptação de mapa de danos para edifícios históricos com problemas patológicos: Estudo de Caso da Igreja do Carmo em Olinda PE. *Revista ALCONPAT*, 8 (1), 51 – 63.

Salcedo, R. F. B. (2019). Evolução do pensamento preservacionista através das cartas patrimoniais internacionais. In: Magagnin, R. C. *et al.* (Orgs.), *Cidade, história e patrimônio (*pp. 15-38). Tupã: ANAP.

Silva, A. F. (2007). *Manifestações patológicas em fachadas com revestimentos argamassados:* Estudo de caso em edifícios em Florianópolis. (Dissertação de Mestrado em Arquitetura e Urbanismo). Universidade Federal de Santa Catarina, Florianópolis.

Schonardie, C. E. (2009). *Análise e tratamento das manifestações patológicas por infiltração em edificações*. (Trabalho de Conclusão de Curso, Bacharelado em Engenharia Civil). Universidade Regional do Noroeste do Estado do Rio Grande do Sul, Ijuí.

Soares, R. G. P., Rodrigues, E. P., Texeira, J. R. S., Vieira, J. F., Medeiros, B. F., Jatobá, B. M., Costa, M. L. S., Vieira, A. L. X., Oliveira, R. A., & Pacheco, C. R. X. (2022). Análise das manifestações patológicas em sistema estrutural de concreto pré-moldado em imóvel na cidade de Bom Conselho-PE. *Research, Society and Development*. doi: http://dx.doi.org/10.33448/rsd-v11i8.30912

Souza, M. F. (2008). *Patologias ocasionadas pela umidade nas edificações*. (Monografia, Especialização em Construção Civil: Avaliações e Perícias). Departamento de Engenharia de Materiais de Construção, Escola de Engenharia, Universidade Federal de Minas Gerais, Belo Horizonte.

Tavares, F. M. (2011). *Metodologia de diagnóstico para restauração de edifícios dos Séculos XVIII e XIX nas primeiras zonas de mineração em Minas Gerais. Juiz de Fora*. (Dissertação de Mestrado em Ambiente Construído). Faculdade de Engenharia da Universidade Federal de Juiz de Fora.

Tavares, M. L. (2009). *A conservação e o restauro de revestimentos exteriores de edifícios antigos*. (Tese de Doutorado em Arquitetura). Universidade Técnica de Lisboa/Faculdade de Arquitetura, Lisboa.

Tinoco, J. E. L. (2009). *Mapa de Danos Recomendações Básicas. CECI: Centro de Estudos Avançados da Conservação Integrada*. Olinda, Brasil.

Thomaz, E. (2020). *Trincas em edifícios: causas, prevenção e recuperação.* Oficina de Texto.

Veiga, M. R. (2009). *Conservação e reparação de revestimentos de paredes de edifícios antigos: Métodos e materiais*. LNEC.

Veiga, M. R. (2009). Patologia das argamassas de alvenaria. In *Anais 3º Encontro sobre Patologia e Reabilitação de edifícios. (p. 41). Porto, Portugal:* Universidade do Porto.