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Application of GUT Matrix in the assessment of pathological manifestations in heritage constructions

I. C. Braga[1], F. S. Brandão[2]*, F. R. C. Ribeiro[3], A. G. Diógenes[4]
*Contact author: eng.fsbrandao@gmail.com
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ABSTRACT

The present paper presents the application of GUT (Gravity, Urgency, Tendency) Matrix methodology as a tool in the assessment of pathological manifestations in buildings. Three heritage constructions of the historic center of Sobral, Ceará, Brazil were studied through *in situ* inspections, photographic records and elaboration of the damage map. The GUT Matrix was used as a tool to rank, in each building, priority levels for each damage in order to define their order of treatment. Thus, it was possible to conclude that the applied method can be used as a useful tool to manage the maintenance of buildings through prioritization of the most significant problems and, to contribute directly to the preservation and safety of the built historical heritage.

Keywords: Heritage constructions; Sobral; Damage; GUT Matrix.

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[1] Department of Civil Engineering, UVA, Sobral, Brazil.
[2] Civil Engineering Graduate Program-PPGEC/UFRGS and LAREB/UFC, Porto Alegre, Brazil.
[3] Civil Engineering Graduate Program-PPGEC/UNISINOS and LAREB/UFC, São Leopoldo, Brasil.
[4] GEM/UVA, Department of Civil Engineering, UVA, Sobral, Brazil.

Aplicação da Matriz GUT na análise de manifestações patológicas em construções históricas

RESUMO

O presente trabalho apresenta a aplicação da metodologia da Matriz GUT (Gravidade, Urgência, Tendência) na análise das manifestações patológicas em edificações, tomando como exemplares, três construções históricas do centro histórico de Sobral, Ceará, Brasil. O estudo foi conduzido com inspeções *in situ*, registro fotográfico, elaboração dos mapas de danos e aplicação do método, do qual foram gerados os gráficos de prioridades que representam a ordem para o tratamento de cada dano em cada edificação. Assim, foi possível concluir que o método aqui aplicado, pode ser utilizado como uma importante ferramenta de gestão da manutenção de edificações através da priorização da resolução dos problemas mais graves e também, contribui diretamente para a preservação e segurança do patrimônio histórico edificado.

Palavras-chave: Construções históricas; Sobral; Patologia; Matriz GUT.

Aplicación de la matriz GUT en el análisis de manifestaciones patológicas en construcciones históricas

RESUMEN

Este trabajo presenta la aplicación de la metodología de la Matriz GUT (Gravedad, Urgencia, Tendencia) en el análisis de las manifestaciones patológicas en edificaciones, teniendo como ejemplos tres construcciones históricas del centro histórico de Sobral, Ceará, Brasil. La investigación fue conducida con inspecciones *in situ*, registro fotográfico, elaboración de mapas de daños y aplicación del método. Los resultados generaron los gráficos de prioridades que representan el orden para el tratamiento de cada daño en cada edificación. Así, fue posible concluir que el método aplicado puede ser utilizado como una importante herramienta de gestión del mantenimiento de edificaciones a través de la priorización de resolución de los problemas más graves y contribuye directamente a la preservación y seguridad del patrimonio histórico.

Palabras clave: Construcciones históricas; Sobral; Patología; Matriz GUT.

1. INTRODUCTION

Heritage constructions (HC) are material elements of the historical heritage with high documental, artistic, cultural and social value for a community, because the HC is part of its history. Therefore, these constructions have an immeasurable value for the society in which they are inserted. As highlighted by Roca et al. (2010), such other types of buildings, HC are also subject to several scenarios of degradation due to natural actions (physical and thermal effects, chemical attacks), anthropic actions (including alterations in the original building architecture, intentional destruction and inadequate interventions) and also dynamic actions (such as wind and earthquakes).

Differently contemporary constructions, where structural properties of their components and materials are already well studied and since majority scientific efforts currently are focused on the development of new materials and structural systems for applications in future construction, heritage constructions are still an unexplored field. Thus, to study this type of structure is very important, not only as a contribution to the valorization and preservation of the memory of a given society, but also allows the development of retrofitting techniques for these structures (MESQUITA et al., 2015).

Pathological manifestations in this type of structure can cause a decrease in their performance and

negative effects in the architectural aesthetics. In addition, these problems can also compromise the structural safety of the building. In general, the pathological manifestations tend to intensify over the time and if not correctly treated, they can cause many damages and, in severe cases, the structural collapse.

These problems can be exemplified by fissures, cracks, detachment of coatings, detachment of ceramic coatings, humidity stains, infiltrations, efflorescence, mold mildew, and others. Their origins may be related to lack of maintenance and/or exposure to environmental actions over a long period of time. Therefore, the role of building pathology is very important in order to know the state of degradation of these structures and provides subsidies for making-decisions focused on the repair and maintenance of structures.

In this perspective, it is necessary to have knowledge about the conditions of the structure and the severity of the pathological manifestations found. For this reason, the management tools are used to contribute to a better elaboration of a strategic planning regarding situations that require complex decisions. The GUT Matrix (Gravity, Urgency, Tendency), developed by Kepner and Tregoe in 1980, is a very useful and important tool that can contribute in this process. With the GUT Matrix it is possible to prioritize the problems and pay more attention to those that have more risks. This methodology, according to Brandão (2018), considers Gravity (G), Urgency (U) and Tendency (T) of the problems detected. For this evaluation, the method uses a quantitative classification for each damage inspected in order to define the degrees of criticality in relation to each problem found.

According to Martins et al. (2017), in the GUT method, Gravity (G) represents the importance of the problem to be examined and its potential of damage. Usually its study is carried out focusing on medium and long-time effects. Urgency (U) requires analysis of how significant the problem is, that is, the deadline for the damage to materialize; and the Tendency (T) consists of problem evolution in function of the time, that is, the probability of the problem to evolve negatively over the time.

In this context, the city of Sobral, located in the North region of Ceará State, in Brazil, preserves a large number of heritage constructions in its historic center with more than 1,200 buildings listed by the National Historic and Artistic Heritage Institute (IPHAN) and many of these buildings present several types of pathological manifestations. In this perspective, this study aims to show the application of the methodology of the GUT Matrix as a management tool in the assessment of pathological manifestations in buildings, taking three samples of heritage constructions of the historical center of Sobral as case study in order to obtain the prioritization of the solution for each damage in each construction.

2. METHODOLOGY

Initially, an extensive literature review was carried out about historical context of the historic center of Sobral and its buildings, and also, about the methodology of the GUT Matrix. Posteriorly, through *in situ* inspections, based on the technical recommendations of the scientific literature and Technical Bulletin Nº 11 of ALCONPAT: Characterization, evaluation and structural recovery of historical buildings by Mesquita et al. (2015), the three buildings were selected for the application of the GUT Matrix, taking into account their ages, cultural importance and historical context and degradation scenario. The three buildings selected were: Nossa Senhora do Rosário Church (18th Century), Nossa Senhora das Dores Church (19th Century) and Menino Deus Church (19th Century).

During *in situ* inspections, a photographic record of all pathological manifestations found in each construction was done and posteriorly used to prepare the building damage map. The check list of GUT Matrix, adapted from Verzola , Marchiori and Aragon (2014), was also completed during *in situ* inspections. The development of the GUT method was based on the work of Verzola, Marchiori and Aragon (2014) and according to those authors it is necessary a list of all pathological manifestations that could be found in each building, to do a check list and to fill it with numerical

values (weights) corresponding to the Gravity, Urgency and Tendency of each damage. When classifying Gravity, it is necessary to consider the possible risks and losses to users and the patrimony, where the definition of a problem considered critical was inserted in the degrees "Total" or "High"; the designation of the problem considered regular is inserted in the degree "Average"; and the definition of the problem considered as minimum, is inserted in the degrees "Low" or "None", as shown in Table 1.

Table 1. GUT classification regarding the Gravity.

Degree	Definition of degree	Score
TOTAL	Risk of death, unrecoverable impact with excessive loss of performance, very high financial loss.	10
HIGH	Danger of lesion to users, recoverable damage to the environment and building.	8
AVERAGE	Risk to user's health occasioned by degradation of systems, reversible environmental damage, average financial loss.	6
LOW	No health risk to users, low environmental degradation, necessity to substitute some systems, low financial loss.	3
NONE	No risk of health or physical, minimal deterioration of the environment, no financial damage.	1

Source: Adapted from Verzola, Marchiori e Aragon (2014).

Regarding Urgency, the definition of each degree is based on how significant the manifestation is at the time when the problem must be solved and how soon the adversity must be intervened. Table 2 represents the situation described.

Table 2. GUT classification regarding the Urgency.

Degree	Definition of degree	Score
TOTAL	Immediate event, necessity of interdiction of the property without extra deadlines.	10
HIGH	Event in the imminence of happening, urgent intervention.	8
AVERAGE	Adversity expected soon, necessity to intervene rapidly.	6
LOW	Initiation of an incident, intervention still in planning.	3
NONE	Unexpected adversity, but necessary monitoring for future maintenance.	1

Source: Adapted from Verzola, Marchiori e Aragon (2014).

For the Tendency, the degree is defined as a function of the possibility of the increasing, reduction or extinction of the problem over the time scale, as shown in Table 3.

Table 3. GUT classification regarding the Tendency.

Degree	Definition of degree	Score
TOTAL	Immediate progress of manifestation, could have worsening rapidly.	10
HIGH	Evolution of the situation about to occur.	8
AVERAGE	Medium-term evolution.	6
LOW	Possible long-term evolution. It may occur. Delay situation.	3
NONE	Situation stabilized, without evolution case.	1

Source: Adapted from Verzola, Marchiori e Aragon (2014).

After determined the weights for each topic (Gravity, Urgency and Tendency), the level of each problem in the three functions was classified and the product of their respective values (GxUxT) was calculated. The priorities were determined by descending order of the value calculated for each pathological manifestation of each building. Finally, to better visualize the results, the prioritization graphs of the damages of each church were developed. In these results, for a better elucidation of the GUT method, the classification of each observed damage (Total, High, Average, Low, None) according to its total scores in the prioritization graphs and based on each degree presented in Table 1, Table 2 and Table 3, is also commented.

3. ANALYZED STRUCTURES

3.1. Nossa Senhora do Rosário Church

The Nossa Senhora do Rosário Church, shown in Figure 1, is the oldest church of the historic center of Sobral and therefore it has a very important role in the historical-social context of this city. Its construction, in vernacular masonry, occurred in the first half of 18th Century, approximately in the year of 1740. In the year of 1777, the church originated the "Pretinhos Church" and its architectural structure tending to baroque. This denomination was given by the Nossa Senhora do Rosário dos Homens Pretos de Sobral Brotherhood, founders of the church. In 1914, by request of Dom José, priest and later bishop of Sobral, a lateral expansion of the building was done. Later, in 1926, the floor (done of solid bricks) was changed for hydraulic ceramic floors.

Its floor plan, shown in Figure 1 (a), has two lateral naves and one main nave. In the same axis of the main nave, there is a main and two other secondary altars, and the sacristy can be seen in the middle of the main altar. The main entrance is in the main facade where, few meters from the main entrance, there is a metallic gate characterizing the environment as an anteroom that provides access to the sanctuary. There is also a coro-alto just behind the main facade, from which the altars can be seen, as shown by the Figure 1 (c).

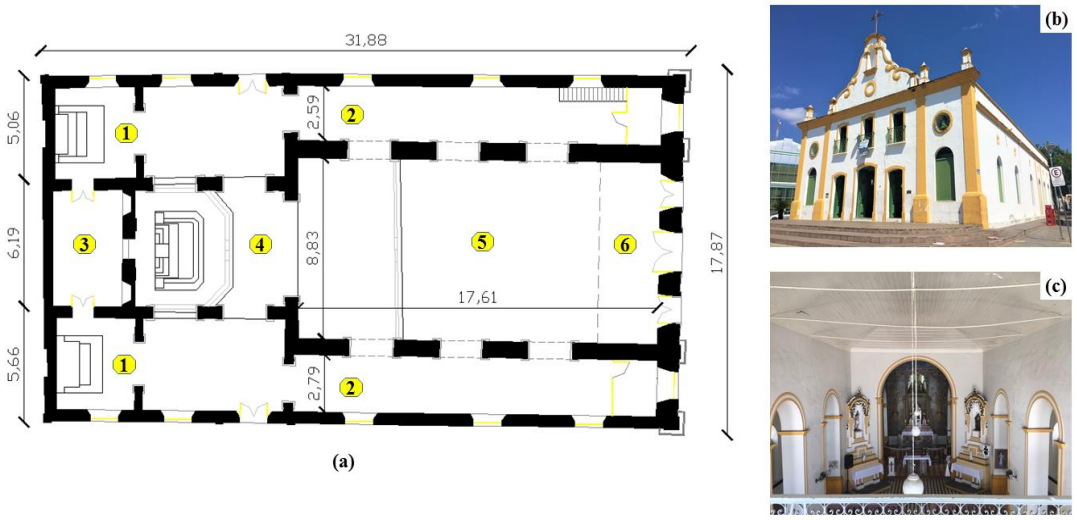

Figure 1. View of the Nossa Senhora do Rosário Church: (a) floor plan where (1) indicates the secondary altar, (2) lateral nave, (3) sacristy, (4) main altar, (5) central nave and (6) coro-alto; (b) main facade and (c) internal view of the central nave.

As highlighted by Santos et al. (2016) in Figure 1 (b), one of its most expressive characteristics is the pediment, which in much resembles baroque features, due to its curvilinear movements, creating an aperture in arc format, centrally arranged and enriched by the insertion of a cross.

3.2. Nossa Senhora das Dores Church

Considered one of the oldest churches in Sobral, the Nossa Senhora das Dores Church (Figure 2) was built near the Acaraú River, one of the few churches in the city which faces partially the river. The church, according to Pinto (2009), was built in 1818, although the date is not accurate. It has a neoclassical architecture, however, it has a single lateral tower, as shown in Figure 1 (b), posteriorly built, according to Mesquita et al. (2017) around 1924, not following the neoclassical rule. To build the church, constructive techniques of the period are used, being totally constructed in solid masonry bricks.

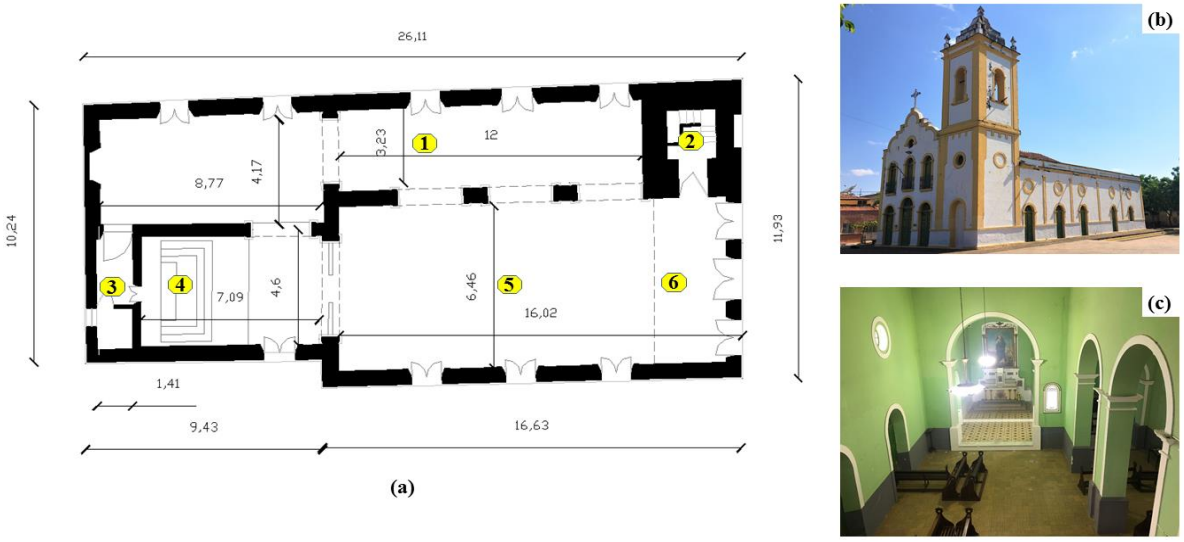

Figure 2. View of the Nossa Senhora das Dores Church: (a) Floor plan where (1) indicates the aisle, (2) lateral tower, (3) sacristy, (4) main altar, (5) central nave and (6) coro-alto; (b) main facade and (c) superior view of the main nave.

Its geometry is shown in Figure 2 (a), where can be observed that the church has a main nave, an aisle, a single lateral tower, a coro-alto, a single altar and, in the back of the main altar, a sacristy. Figure 1 (c) illustrates the interior view of the building, where it is observed that the church is little ornamented with only one picture located at the bottom of altar representing the image of Nossa Senhora das Dores, a wall with a large lateral arches separating the naves and a large arch located in front of altar.

3.3. Menino Deus Church

The Menino Deus Church (Figure 3), had its construction process started around the 1810 through the idea of two Carmelitas sisters arrived in Sobral in this same year with the nuns of the third order of the Carmelitas Emerenciana de Sant'Ana and Teresa de Jesus. According to the Inventário de Bens Arquitetônicos-IBA (IPHAN, 2005), a document that catalogs all the heritage constructions listed in Sobral, it is estimated that in 1820 the central part of the church was built. The towers were only got completed in 1940. The design clearly shows a correlation with the city's Cathedral, adopting the standard of the second half of the 18th century, with a distinctive characteristic of the cornice, which are elements constituents of facades of the period, generally located above the windows or main oculus of the building.

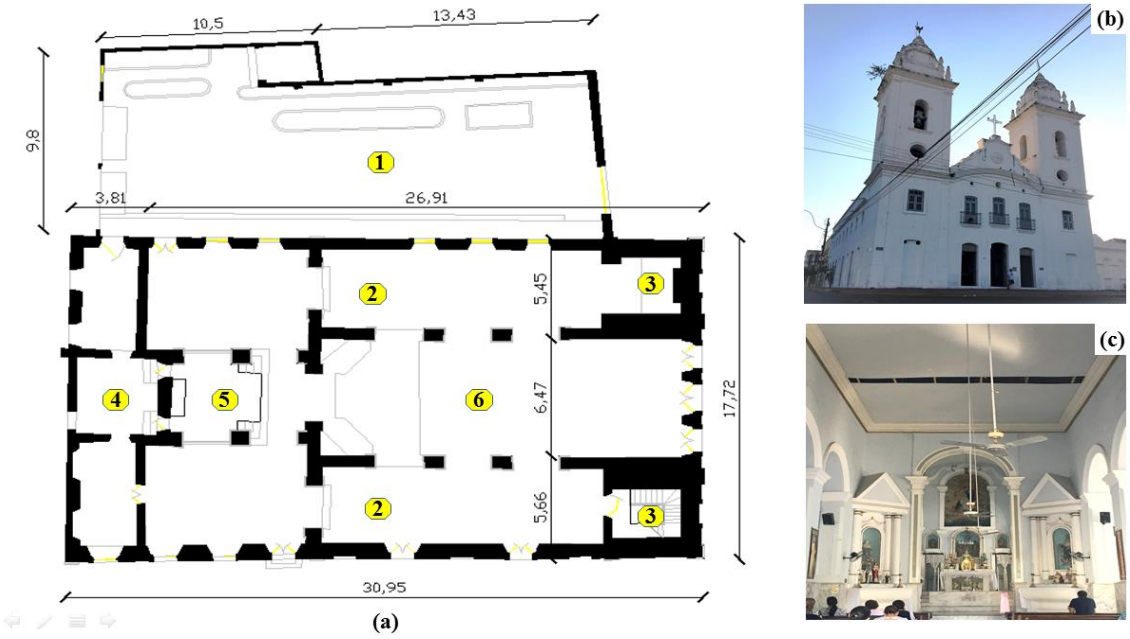

Figure 3. View of the Menino Deus Church: (a) Floor plan where (1) indicates the lateral courtyard, (2) aisles, (3) towers, (4) sacristy, (5) main altar and (6) central nave; (b) main facade and (c) internal view of the main nave.

Figure 3 (a) represents the floor plan of the church and shows that its geometry is divided in many parts, where in the side there is a large courtyard, in the internal part there are two aisles, each one in front of each tower, a large central nave that is located in front of the main altar and just behind this, the sacristy. In Figure 3 (c), it is observed that the degree of ornamentation of the church is also low.

4. RESULTS AND DISCUSSIONS

4.1 Pathological manifestations of the Nossa Senhora do Rosário Church

Visual inspection provides valuable data, being an important tool in the assessment and

identification of the damage of the structures. Moreover, combining the visual inspection with other control tools, as presented in this work through the GUT Matrix, enriches the results and contributes to their reliability. The inspection of this first church was carried out from the outside to the inside, where firstly the four facades and later the interior were inspected. During inspection the following pathological manifestations were identified: fissures and cracks, disintegration of lining elements, detachment of coating, humidity stains, atmospheric stains, mold/mildew. The main facade presented the biggest number of damages and it is represented by the damage map shown in Figure 4, where detachments are observed in the lower parts of the structure, in the openings and in the central door column some cracks are also visualized, and atmospheric stains can be seen on the top of the church.

The main reason for cracking may be associated with the vibrations existing in the place, because it is located in a central region of the Sobral city and there is a large flow of people and vehicles nearby, that can induce vibrations causing changes in the structure dynamic behavior, which often lead to fissures.

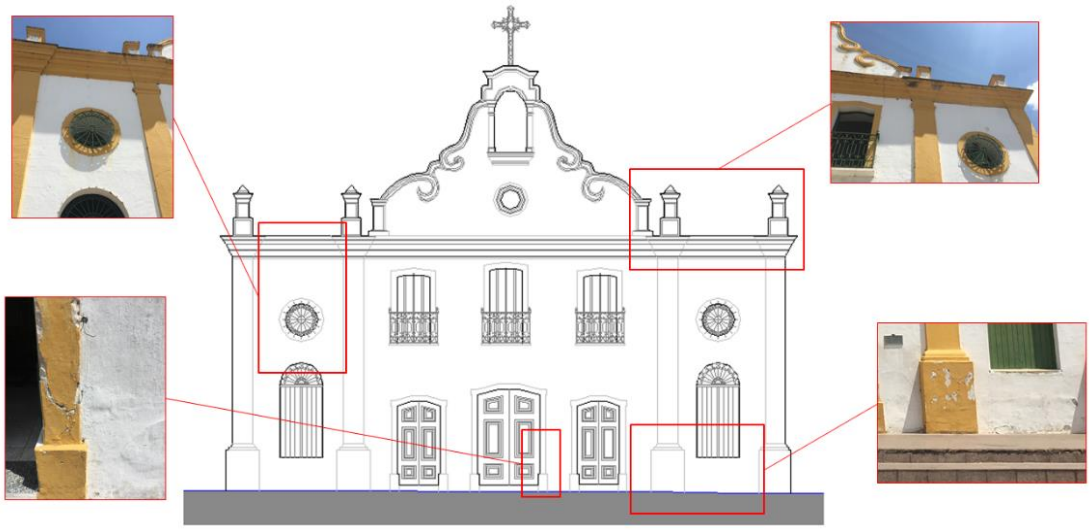

Figure 4. Damage map of the main facade of Nossa Senhora do Rosário Church.

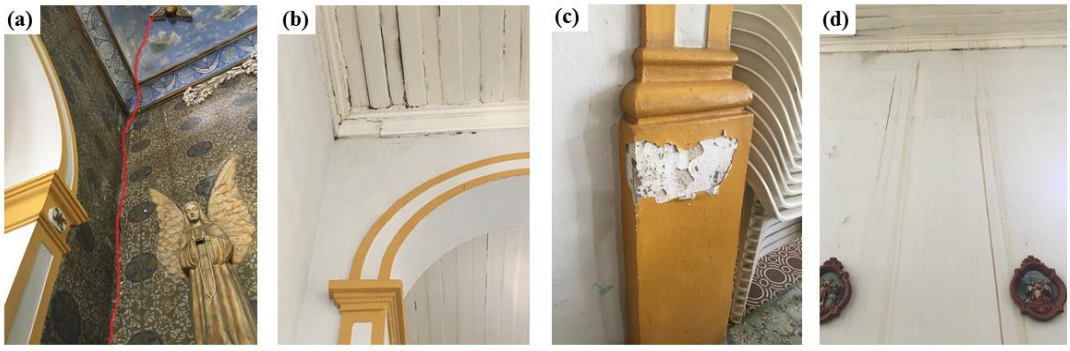

Figure 5. Internal pathological manifestations of the Nossa Senhora do Rosário Church: (a) crack, (b) disintegration of lining elements, (c) detachment and (d) humidity stains.

In the internal part of the church the main, the following pathological manifestations were observed: crack, disintegration of lining elements, detachments and humidity stains, as illustrated by the Figure 5. The most serious situation was the crack located near the altar (Figure 5 (a)), because its presence may be associated with the movements adjacent to the building and new constructions in the vicinity of the sanctuary. These movements occasionally cause sinking of the soil and cracks and fissures in

some parts of the church.
For the Gravity in the application of the GUT methodology a score 8 was attributed to the crack located near the altar due its large opening. For the Urgency, a score 8 was also inserted due large area of commitment of this damage that requires urgent intervention. Regarding Tendency, a score 6 is attributed knowing that the problem is in a situation of average progression.
From the application of the checklist of the GUT Matrix in this building it was possible to elaborate the graph of priorities, which is represented by Figure 6, where it is possible to verify that priority pathological manifestations, that must be treated first, are fissures and cracks, in this case, in the main altar of the church, because it presents the highest scores, 384 scores, and represents a high priority damage, according to the descriptions in Tables 1, 2 and 3 of Section 2.
Second, in the order of priorities, it is the disintegration of lining elements with a total of 216 scores, being framed as an average damage. In the third position are the detachments of coating with 108 scores, being also framed in the degree of average damage. Humidity stains and atmospheric stains, both with 54 scores, are also identified as average damage. The damage with lowest severity, which is in the last position of the order of priorities, is mold /mildew, with 9 scores and low damage.

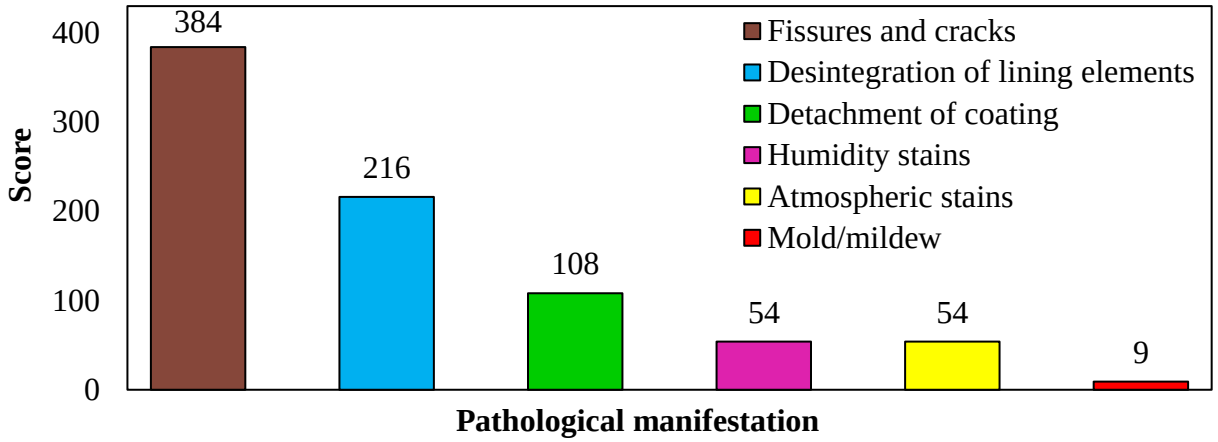

Figure 6. Priority graphic of the Nossa Senhora do Rosário Church.

In this building the number of pathological manifestations found was low, presenting as main and concern the cracks located on the sides of the altar, that can generate impacts that partially compromise the functionality of the structure. This little amount of damage found is related to periodic maintenance that is carried out by the administration of the church, because it is the oldest and most important cultural church for the city and it has a great contribution to the implementation of historical tourism to the city.

4.2 Pathological manifestations of the Nossa Senhora das Dores Church

The pathological manifestations identified in the Nossa Senhora das Dores Church were the most numerous among the three churches analyzed. In many parts of the structure, several types of damages were found such as fissures, detachments and humidity stains and atmospheric stains. The damages observed were fissures and cracks, infiltrations, disintegration of lining elements, electrical system failures, mold/mildew, atmospheric stains, humidity stains, detachment of coating, disaggregation of roof elements, grouting inefficiency, frame failure, efflorescence and oxidation of metallic elements. The damage map of this building is presented through its facade with more incidence of pathological manifestations, the back facade, as illustrated by Figure 7.

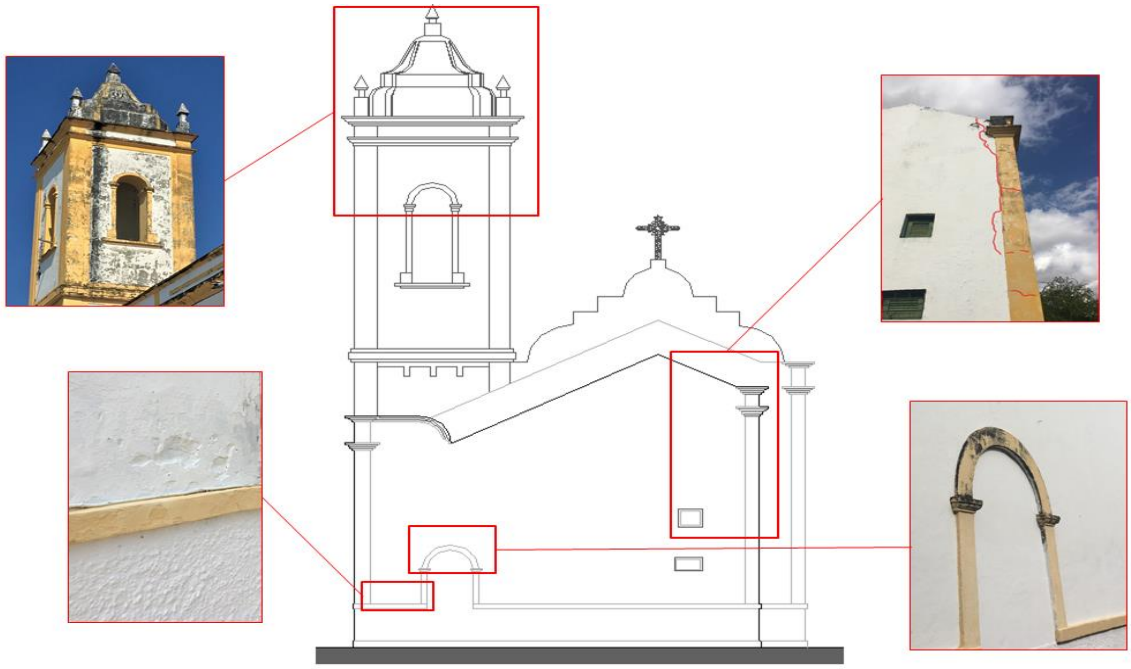

Figure 7. Damage map of the Nossa Senhora das Dores Church.

Figure 7 shows the incidence of a large amount of atmospheric stains in the lateral tower and also in the upper parts of the church. This type of damage was also evident in all other facades. A large crack in the right part of this figure, that starts from the mid height of the wall to the top, was observed. This anomaly is closely linked to a possible sinking of the soil, considering that the structure is located near of the Acaraú River and that over time was impacted by numerous new constructions in the vicinity. Besides this region, in the circular openings of the other facades, this type of damage is also evidenced. There are also detachments of coating in the lower part of this facade, which are also found in the other facades.

The main pathological manifestations observed in the internal part of the structure were: fissures and cracks, detachment of coating, humidity stains and detachment of coating with exposure of parts of the frame, which are illustrated in Figure 8. In Figure 8 (a), there is the most severe pathological manifestation for this building: a crack located in the central arch of the main nave. This anomaly is in a very aggravated situation, being its occurrence related to the incidence of soil movement of the foundation and to a possible overload in the arch, since many interventions with an increase of load were executed over time, as for example, the exchange of a lining that was previously made of PVC by a slab of reinforced concrete. Thus, to Gravity, a score 10 was attributed, that is, the maximum score of the method here used, which causes a high impairment of the performance of the building. Regarding Urgency, a score 10 was also inserted, due to the large area of commitment of this manifestation, requiring urgent intervention. And for Tendency it was also chosen a score 10, corresponding to the large possibility of evolution of the situation.

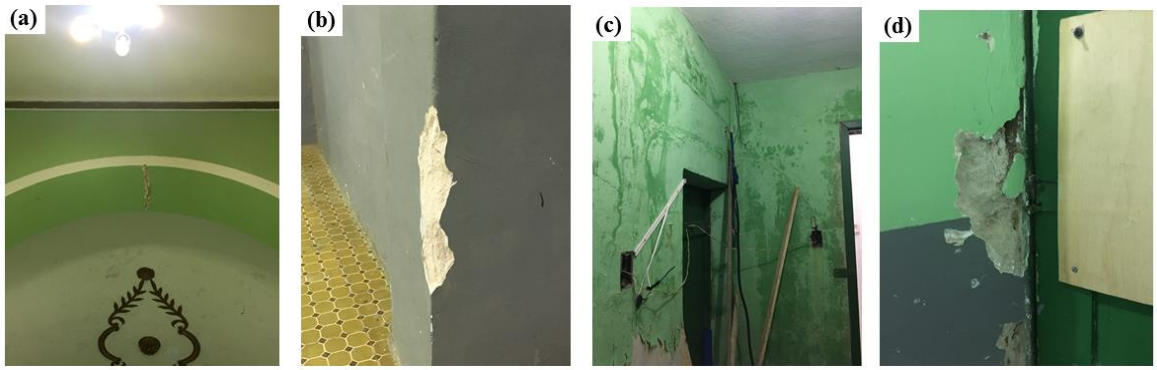

Figure 8. Internal pathological manifestations of the Nossa Senhora das Dores Church: (a) crack in the central arch, (b) detachment of coating, (c) humidity stains and (d) detachment of coating with exposure of the frame parts.

The data obtained from the application of the GUT Matrix in this building were organized in the priority graph shown in Figure 9, where it is verified that the pathological manifestation of highest priority is the crack in the central arch of the main nave, with a total of 1000 scores, which classifies it as a total damage, that is, of extreme gravity, urgency of solution and fast tendency of evolution. In addition, the difference between this damage and the two other (infiltration and disintegration of lining elements, both with 216 scores each) is very high, that corresponds to 784 scores, which show the severity of this crack.

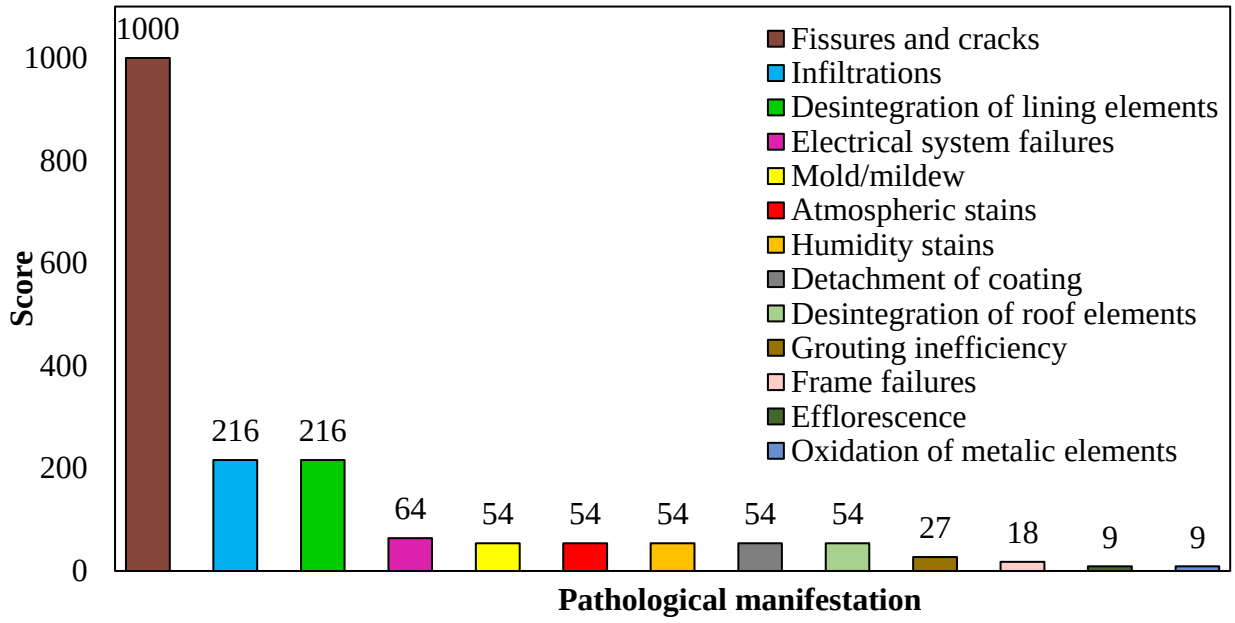

Figure 9. Priority graphic of the Nossa Senhora das Dores Church.

Four pathological manifestations presented the same scores (54 scores): mold/ mildew, atmospheric stains, humidity stains, detachment of coating, which evidences pathological manifestations of average damage. The damages: grouting inefficiency (27 scores), frame failure (18 scores), efflorescence (9 scores) and oxidation of metallic elements (9 scores) correspond to category of low potential damages, the latter two occupying the final position of the order of prioritization.
This building presented the largest number of pathological manifestations and this fact is connected to the lack of maintenance of the structure, moreover this church is now interdicted. The existing

damages, if left untreated, can evolve into more severe problems that can seriously compromise the stability and safety of the structure.

4.3 Pathological Manifestations of the Menino Deus Church

The right lateral facade (connected to the lateral courtyard) and the back facade of the Menino Deus Church were not analyzed because these two facades are linked to the adjacent buildings. However, the other facades as well the internal area were thoroughly inspected, and the main facade presented the most severe damages, which can be observed in Figure 10, where the most evident were: atmospheric stains, located in many regions of the structure mainly on top of the two towers; fissures in the vicinity of circular openings of all doors and windows and in the lower part the columns of a tower, which is accompanied by detachment of coating; and rooting of shrubs, located at the top of the left lateral tower.

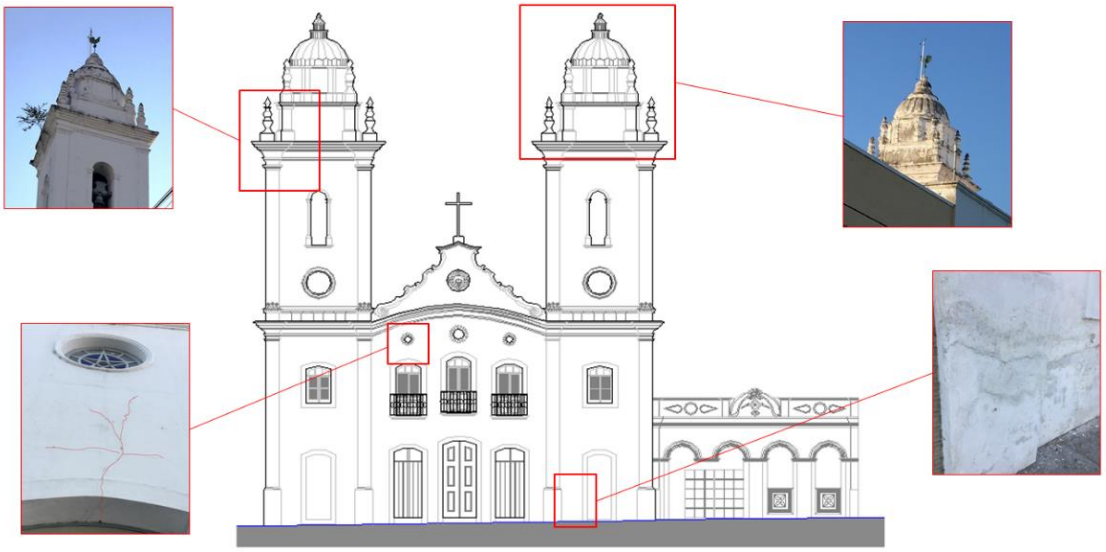

Figure 10. Pathological manifestations of the Menino Deus Church.

In the internal part of the church the main damages observed were fissures and cracks, disintegration of lining elements and disintegration of floor elements, as shown in Figure 11. Disintegration of lining elements was observed in many parts of the roof, as well as fissures.

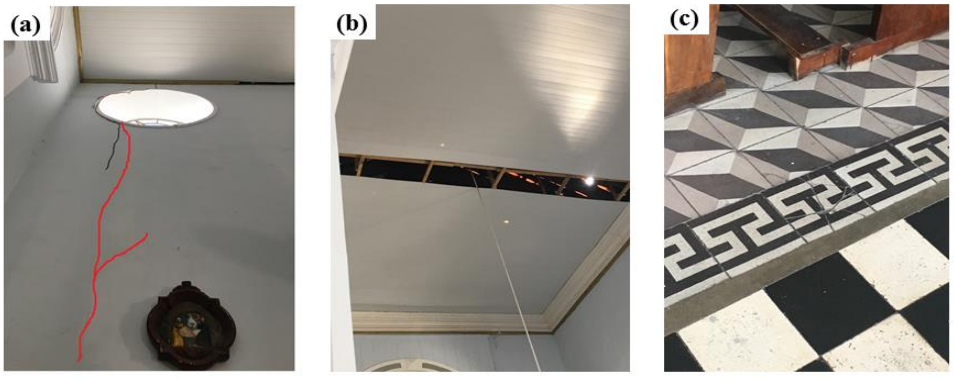

Figure 11. Pathological manifestations in the internal part of the Menino Deus Church: (a) Fissures, (b) disintegration of lining elements and (c) disaggregation of floor elements.

With the results of the checklist of GUT Matrix applied in this building, the graph of priorities was constructed and it is illustrated in Figure 12, where it is verified that the most prioritized pathological manifestation are the fissures, which can be observed in the upper opening of the front facade door (Figure 10) and also in an internal wall of the left lateral facade (Figure 11 (a)). The scores of this anomaly corresponds to 216 and are obtained by applying to the Severity, Urgency and Tendency 6 scores per each one, being therefore an average priority damage. In second position is the detachment of coating that presents a total of 108 scores, being also an average damage. In third and fourth positions are the disaggregation of lining elements and atmospheric stains, with 36 and 27 scores each one, being classified as average and low damage, respectively. In the final positions in the order of priorities, are the rooting of shrubs and the disintegration of floor elements, with 18 scores each, classified as low damage.

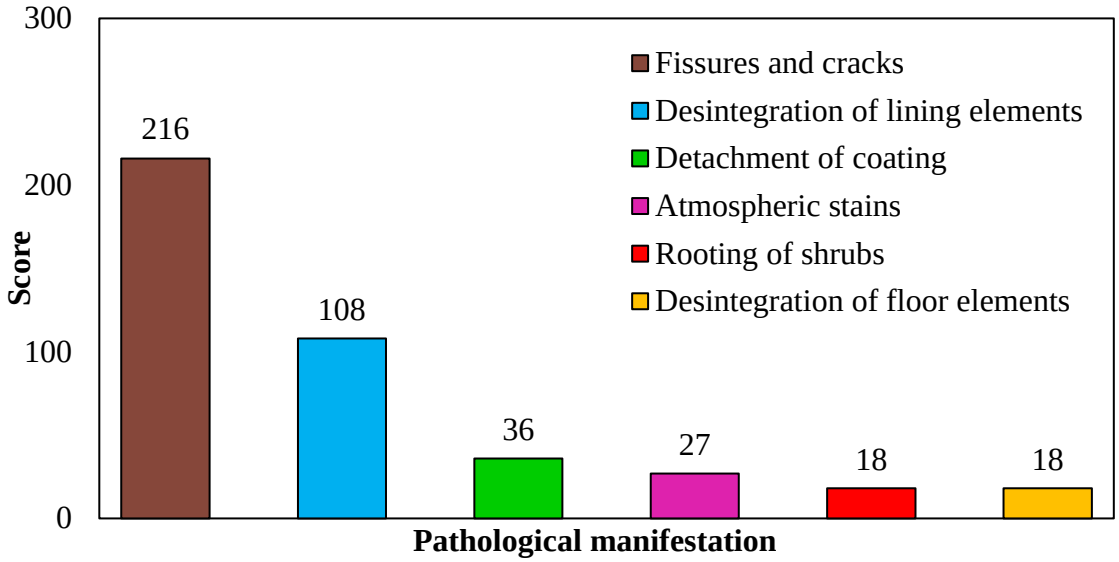

Figure 12. Priority graphic of the Menino Deus Church.

The Menino Deus Church presented few pathological manifestations and among the three inspected, it was the one that also presented the lowest scores in its most severe damage. This may also be related to the good level of maintenance that is performed by its managers.

4.4 Comparison among the obtained results

By the comparative analysis of the pathological manifestations listed in first position for each church and having as parameter its total score, among the three buildings studied, the Nossa Senhora das Dores Church presented the most severe damage with a total of 1000 scores for the crack in the central arch of the main nave. The second most severe was the Nossa Senhora do Rosário Church with a total of 384 scores also for a crack in the main altar. And finally, the third most severe damages were the fissures present in the main facade near the opening of the upper window, in the lower part of one of the columns of a tower and in walls of the internal part of the Menino Deus Church with a total of 216 scores. Figure 13 shows the comparison between the most severe damages of these churches.

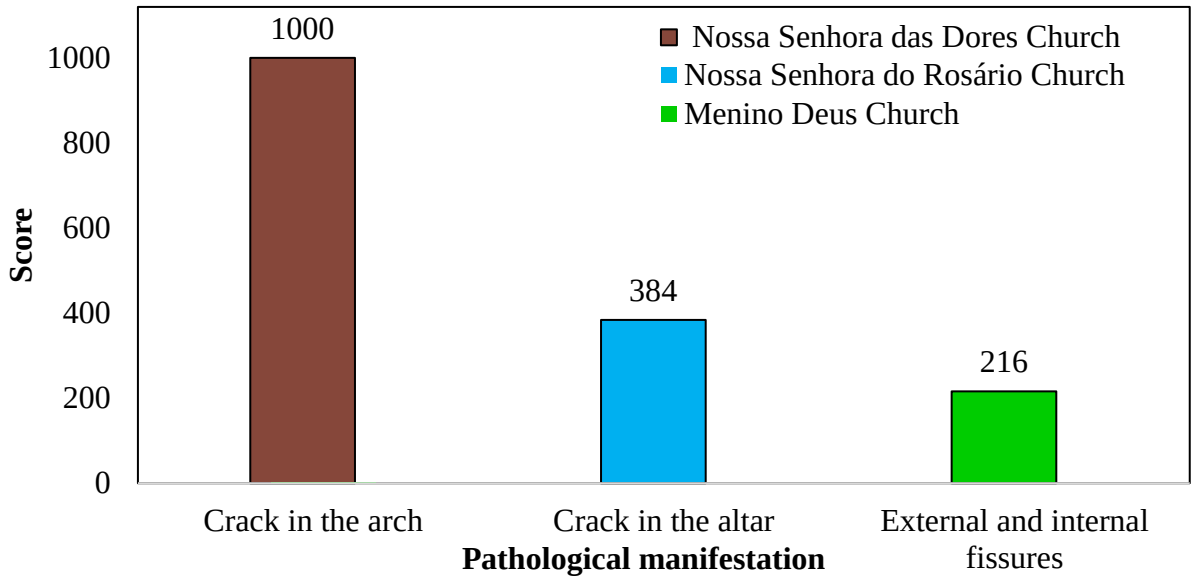

Figure 13. Comparative graphic between the most severe pathological manifestations for each church.

The analysis of the pathological manifestations through GUT Matrix can help the manager in the decision process about interventions that may contribute to the preservation and safety of the building. In this study, it was observed that the newest building among the three analyzed (Nossa Senhora das Dores Church) was the one that presented the largest number and severity of pathological manifestations, thus, it is highlighted that the characteristic factors of the deterioration associated to the lack maintenance, are elements of large influence in the conservation and protection of the historical good.

4.5 Limitations of GUT Matrix

From these results, it can be verified that the GUT Matrix method is a very useful strategic planning tool that, through visual inspections, contributes to the making-decision process on possible interventions that may be implemented in the structures, aiming the repair of the observed damages. However, being a visual inspection, this tool has some restrictions and is very important that the inspectors involved have knowledge and experience about building pathology, which allows the evaluations to be coherent and reflect the reality of the damages observed in the structures.

For the heritage constructions, usually protected by preservation organism, therefore they cannot be damaged, the visual inspection, even providing qualitative data, is an important tool in the process of assessing and diagnosing of the state of structural damage, because it is not an invasive tool and does not cause damage to the good. When combined with non-destructive tests, the information from visual inspection also contributes to the efficiency of the results which collaborate for a better knowledge about the conservation status and severity of damage of these structures.

An example of the application of visual inspection in heritage structures can be found in Santos and Silva (2017) that identified the damages in the facade of the Block A of the Polytechnic School of the University of Pernambuco, a building of the 19th century in Recife, Brazil. The following pathological manifestations were identified: disaggregation, cracking, spurious element, chromatic alterations, superficial spots, partial loss, presence of vegetation, cracks and contamination. The results showed that the state of conservation of the structure, considering that the building is more than 100 years old, is regular. However, the authors emphasize that the identification of these damages was very important for the elaboration of an efficient restoration plan and that the maintenance activities, if executed correctly and at adequate intervals, guarantee a good

performance of the building.
Another important example of the use of the visual inspections can be found in work developed by Rocha et al. (2018) that through this technique combined with Damage Identification Lists (DIL), that registered the pathological problems in the building, it was possible to draw a damages map of the Igreja do Carmo, in Olinda, Pernambuco, Brazil, a very important structure of the 16th century. The results allowed to show the location of the problems found and their dimensions, more accuracy in the correct diagnosis and in the preventive measures for the anomalies. The authors concluded that the use of this technique in the elaboration of damage map provides subsidies that facilitate the analysis of the symptomatology and the correct diagnostic of the pathologies found, guaranteeing a more reliable proposal for the treatment of these problems.
Therefore, visual inspection combined with GUT Matrix, for an initial diagnosis of the problems, is efficient in the identification of damages in heritage constructions, their gravity and possibilities of evolution over time, because it is a not invasive technique. However, it can still be complemented with non-destructive tests.

5. CONCLUSIONS

Identification and assessment of the pathological manifestations of heritage constructions has essential importance to the preservation of these types of structures. Sobral is one of the few Brazilian cities that presents in its urban structure a historic center with many heritage constructions, which denotes the importance of studies directed to the conservation of these structures. This study aimed to demonstrate the application of GUT Matrix for an initial diagnostic of the pathological manifestations in heritage constructions and in the development of a prioritization order, regarding the solution of the damages found in these constructions, showing that it can be a very useful tool for the management of maintenance of buildings.
The Nossa Senhora das Dores Church, among the three buildings studied, presented the largest degree of deterioration, especially as regards to a crack in the arch in front of the altar. In the Nossa Senhora do Rosário Church, the number of damages found was low, presenting as the main and worrisome the cracks located on the sides of the main altar. For Menino Deus Church, the main aggravating factor was the cracks in the main facade and some internal walls.
In this perspective, it was possible to conclude that the GUT Matrix can be an important support tool in the management of the maintenance of buildings, contributing to the preservation and safety of structures, especially when applied to the heritage constructions.

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