DIAGNOSTIC ENGINEERING: PATHOLOGICAL ANALYSIS OF THE FEDERAL GOIANO INSTITUTE – TRINDADE CAMPUS

ENGENHARIA DIAGNÓSTICA: ANÁLISE PATOLÓGICA DO INSTITUTO FEDERAL GOIANO CAMPUS TRINDADE

INGENIERÍA DIAGNÓSTICA: ANÁLISIS PATOLÓGICO DEL INSTITUTO FEDERAL GOIANO – CAMPUS TRINDADE

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ABSTRACT

The study and development of a diagnosis of pathologies in civil construction occurs through the analysis of the construction method and the quality of materials, the maintenance frequency, and whether it is being carried out according to technical guidance, in order to identify the cause of the problem. The issue may result from construction defects, low-quality materials used, lack of maintenance, or improper use. This analysis can also indicate the level of criticality, the priority for intervention, and possible methods for treatment. The present work aims to analyze the main construction pathologies found at the Trindade Campus of the Federal Institute Goiano. The methodology used is based on the Building Inspection Standard of the Brazilian Institute of Engineering Evaluations and Expertise (IBAPE), through the visual analysis of pathologies, classifying them according to their level of criticality and nature, as well as indicating the priority for treatment. Therefore, through the study developed, the Institution will be able to take appropriate actions to address the main pathologies that affect the Campus.

Keywords: Pathology. Construction. Diagnosis. Post-Construction. Maintenance.

RESUMO

O estudo e o desenvolvimento de um diagnóstico de patologias na construção civil ocorrem por meio da análise do método construtivo, da qualidade dos materiais e da periodicidade da manutenção, verificando-se se esta está sendo realizada conforme orientação técnica, a fim de identificar a causa do problema, se é decorrente da obra ou baixa qualidade dos materiais empregados, ausência de manutenção ou uso incorreto, podendo indicar a criticidade, nível de prioridade para intervenção e até formas para tra tamento. O presente

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trabalho visa analisar as principais patologias da construção do Campus Trindade do Instituto Federal Goiano. A metodologia utilizada se baseia na Norma de Inspeção Predial do Instituto Brasileiro de Avaliações e Perícias de Engenharia, através da análise visual das patologias, classificando-as quanto ao grau de criticidade e natureza, além de indicar a prioridade de tratamento. Portanto, por meio do estudo desenvolvido, a Instituição poderá tomar medidas para o tratamento das principais patologias que afetam o Campus.

Palavras-chave: Patologia. Construção. Diagnóstico. Pós-Obra. Manutenção.

RESUMEN

El estudio y desarrollo de un diagnóstico de patologías en la construcción civil se realiza mediante el análisis del método constructivo y de la calidad de los materiales, la periodicidad del mantenimiento y si este se está realizando conforme a las orientaciones técnicas, con el fin de identificar la causa del problema. Este puede derivarse de fallas en la obra, baja calidad de los materiales empleados, ausencia de mantenimiento o uso incorrecto, pudiendo además indicar el nivel de criticidad, la prioridad de intervención e incluso posibles formas de tratamiento. El presente trabajo tiene como objetivo analizar las principales patologías constructivas del Campus Trindade del Instituto Federal Goiano. La metodología utilizada se basa en la Norma de Inspección Predial del Instituto Brasileño de Evaluaciones y Pericias de Ingeniería (IBAPE), mediante el análisis visual de las patologías, clasificándolas según su grado de criticidad y naturaleza, además de indicar la prioridad de tratamiento. Por lo tanto, a través del estudio desarrollado, la Institución podrá tomar medidas para el tratamiento de las principales patologías que afectan al Campus.

Palabras clave: Patología. Construcción. Diagnóstico. Post-Obra. Mantenimiento.

1 INTRODUCTION

Civil Engineering and its technological advances are constantly innovating in the market and in its lines of research. Civil construction has sought agility in the execution of buildings with the use of construction techniques and methods that enable this acceleration, however, such progress needs attention to avoid possible problems during and after the completion of the work, and it is essential to carefully control quality, in addition to knowledge in the execution process and good practice of construction techniques. In turn, the failure to take due care, for example, errors in the compatibility of projects, failures in the execution of the work, use of low-quality materials, as well as the lack of preventive/corrective maintenance after the end of construction, can lead to the emergence of pathologies that are capable of compromising the operation, aesthetic comfort, durability and safety of the building.

In this way, Diagnostic Engineering has been taking a considerable strand in the daily life of Civil Construction, being an analysis tool, both at the time of the work for the care of execution and verification of the projects, and in the post-work, used in the diagnosis of pathologies and indication of the causes, in addition to the presentation of a recovery and maintenance plan, thus, ensuring a method to maintain the durability and effectiveness of buildings.

The Federal Institute of Goiás, Trindade campus, had its first class in 2015 for technical courses integrated with high school and subsequent, housing a considerable flow of teachers, students and administrative staff. Over time, from the first year of collective use, the building is faced with apparent pathologies, in order to impair the functioning of certain areas and facilities, in addition to the aesthetic discomfort caused by these constructive anomalies.

Due to the functionalities and continuous use by hundreds of people, there is a constant concern about the "deterioration" of some points of common use, and it is necessary, initially, a building inspection to prepare an action plan to correct the identified flaws and to ensure the proper maintenance of the building in the long term, extending its usefulness and useful life.

In this context, there are methodologies for expert evaluation and analysis of pathologies in civil construction, as provided by the Brazilian Association of Technical Standards (ABNT) and the Brazilian Institute of Engineering Evaluations and Expertise (IBAPE, 2021). Finally, the objective of this work is to identify, characterize and expose the possible causes of constructive pathologies at the Federal Institute of Goiás – Trindade Campus.

2 THEORETICAL FRAMEWORK

2.1 PATHOLOGY IN CIVIL CONSTRUCTION

The study of pathology can be defined as the study of diseases, their causes, effects, as well as the development of treatments and prevention of diseases. In civil construction, pathology refers to the study of anomalies, defects, damages, or manifestations that occur in buildings, structures, and other constructions, and are associated with some factors such as design or execution errors, actions of time that cause deterioration, or actions of external agents (IBDA, 2017).

These pathological manifestations may be visible or they may be internal problems. In order to reduce costs and speed up construction, the procedures that prevent the appearance of pathological manifestations end up not being practiced. With the emergence of these manifestations, there is a need for studies to understand the causes, extent of the anomalies, as well as the recommendation of solutions to repair them and prevent their recurrence (Fachin, 2016).

The study of pathology can be divided into some parts, such as the existence and investigation of the problem and the feasibility of the proposed solution. A concern of the occurrence of pathological manifestations is the number and frequency they occur, and for greater effectiveness in correcting problems and lower cost, it is necessary to identify and solve them as soon as possible. This resulted in cost reduction over time (Silva et al., 2020).

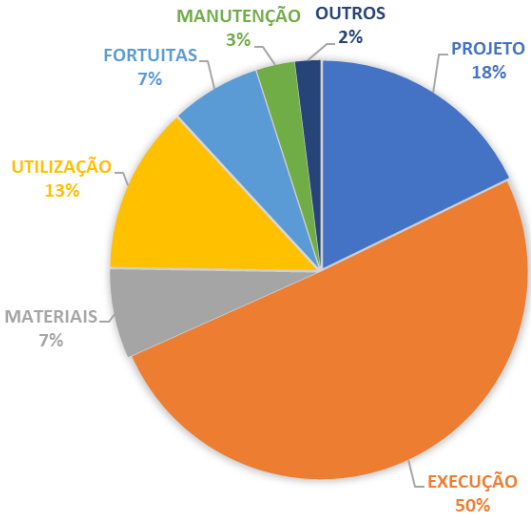
The study of pathologies in civil construction is extremely important, as the lack of attention to the components can affect the safety, functionality and useful life of a building, as well as the well-being of the occupants. And with a quick identification of a pathology, in addition to reducing the costs of corrective actions, it allows the building to have a longer useful life and durability.

2.2 PATHOLOGICAL MANIFESTATIONS

The origin of the pathological manifestations is related to the stage of the structure's life, and is associated with failures that occur during the development of activities throughout the construction processes. According to Piancastelli (2017), the highest rate of pathological occurrences in Brazil is in the construction execution phase (Figure 1).

Figure 1

Incidence and origin of pathological manifestations in Brazil



Source: Piancastelli (2017).

2.3 SERVICE LIFE AND DURABILITY

The useful life of a building is the period in which it can be used for the purpose for which it was built, with satisfactory performance in terms of safety, comfort and functionality. The useful life of a building can vary depending on several factors, such as the type of use, the design, the quality of the materials, and proper maintenance.

The ABNT NBR 15575:2013 (ABNT, 2013) standard establishes the minimum requirements for the performance of residential buildings, including the minimum expected useful life, which is 50 years. However, it is important to note that the useful life of a building can be longer or shorter than the expectation established by the standard, depending on several factors, such as the level of use, the quality of the materials, the climate, and proper maintenance. Proper and preventive maintenance can significantly extend the useful life of a building, while lack of maintenance can accelerate degradation and reduce its useful time.

2.4 MAINTENANCE

Maintenance of pathologies in civil construction is the set of preventive and corrective actions that aim to ensure the integrity, safety, functionality and durability of buildings, based on their identification and correction. According to the NBR 5674 standard (ABNT, 2012) that portrays the maintenance of buildings, it presents the concept of maintenance, which is the set of actions performed with the purpose of conserving or recovering the functionality of a building and its parts, meeting the established criteria as well as the safety of its users.

The maintenance of pathologies can be preventive or corrective. Preventive maintenance is carried out with the objective of avoiding the occurrence of future problems,

through the periodicity of verification and review of the integrity of the construction components. Corrective maintenance, on the other hand, is performed to correct existing problems and defects, such as cracks, infiltrations, corrosion, among others.

The maintenance of pathologies in civil construction is essential to ensure the safety and proper functioning of buildings and with the lack of maintenance, pathologies can worsen, compromising the structure of the building and putting the safety of users at risk. Therefore, it is important to carry out maintenance regularly and rely on qualified and experienced professionals to perform the necessary interventions.

2.5 EVALUATION OF PATHOLOGIES

With the constant updating of standards related to the performance and quality of construction, it was necessary to highlight a front of services aimed at the evaluation of constructive pathologies, which is a demand under the responsibility of the diagnostic engineering methodology in order to study the origin, the degree of risk and propose repair and prevention methods. NBR 13752 (ABNT, 1996) presents the basic guidelines, concepts, criteria and procedures related to engineering expertise in civil construction, providing for the classification of the object as to the nature, basic methodology and criteria to be used.

In addition, IBAPE (2021) presents the definitions contained in the IBAPE/NACIONAL Glossary of Terminology and complements the definitions contained in the related ABNT standards, bringing the most used expert evaluation method for diagnostic engineering in Civil Construction.

It should be noted that the method exposed by IBAPE (2021) is the same as that adopted in this work, giving the definition of the type of building inspection adopted, as well as the level of complexity of the evaluation, definition of the degree of risk of the pathologies found according to the technical concept, definition of priorities, technical recommendations and evaluation of maintenance and use, finally, indication of responsibilities. Thus, with the mixture of the referenced methodology with the research objective, the expected results will be achieved.

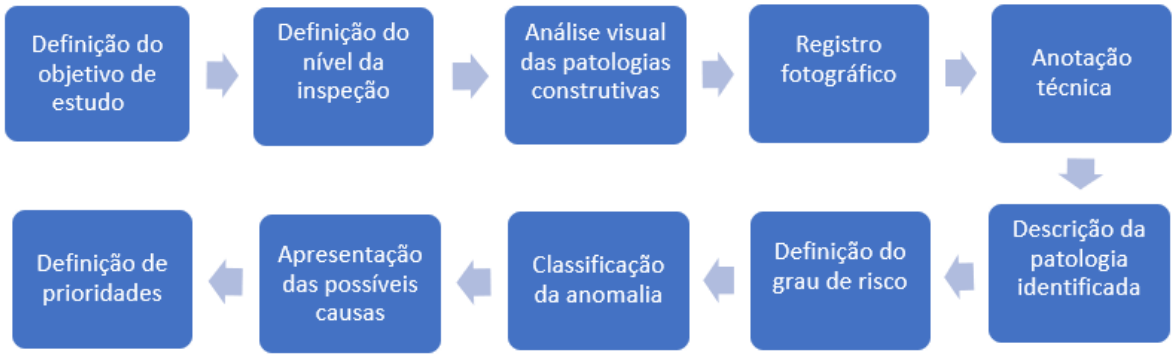
3 METHODOLOGY

3.1 RESEARCH ROADMAP

Figure 2 shows the Research Guide, referring to the steps that were carried out during the study on pathologies in civil construction.

Figure 2

Flowchart of the research script



Source: Prepared by the authors themselves.

3.2 OBJECT OF THE RESEARCH

The building analyzed refers to the second stage of the expansion plan of the Federal Network of Professional and Technological Education. Located in the city of Trindade - Goiás, the Trindade Campus began its activities in the first semester of 2015, and over the years it has expanded its audience and its built area.

The unit currently (2023) has a built area of 43 thousand square meters, located in the urban area of the city. Its structure includes an auditorium with support for 200 people, library, professional and specific laboratories, classrooms, administrative facilities, sports court and living area (Figure 3).

Figure 3

Federal Network of Professional and Technological Education – IF Goiano - Trindade Campus – 2023

Source: Google Earth (2023) Drone photography (IF Goiano – Trindade Campus).

Taking into account the first structures of the Campus, the case study of this work focuses on the environments of the main block of rooms, library, auditorium and laboratory of materials and soils. In each environment mentioned as a case study, a technical inspection

was carried out for data collection, which is essential for the composition of the results. During the analysis of the identified pathologies, visual and photographic records were made, later using authorial theoretical foundations to reference each deterioration.

In order to highlight the methodology adopted for the identification of apparent pathologies at the Federal Institute of Goiano - Trindade Campus, fundamental concepts were used, following the idea proposed by this article through the method of evaluation and characterization of pathologies through direct visual inspection, as provided in the Building Inspection Standard of the Brazilian Institute of Engineering Evaluations and Expertise (IBAPE, 2012).

3.3 APPLICABILITY OF THE BUILDING INSPECTION STANDARD METHOD

3.3.1 Level of Inspection

The IBAPE National building inspection standard presents definitions regarding the isolated or combined analysis of the technical, use and maintenance conditions of the building, bringing the classification of the level of building inspection as to its complexity and preparation of a report. This inspection referring to the levels that are classified as 1, 2 and 3 are carried out by professionals in a specialty, but these professionals also prepare the report (IBAPE, 2021).

Level 1: Building Inspection carried out in buildings with low technical, maintenance and operation complexity of their elements and construction systems. Usually used in buildings with very simple or non-existent maintenance plans.

Level 2: Building Inspection carried out in buildings with medium technical complexity, maintenance and operation of their elements and construction systems, of medium construction standards and with conventional systems. Usually used in buildings with several floors, with or without a maintenance plan, but with outSourced companies hired to perform specific activities such as: maintenance of pumps, gates, water reservoirs, among others.

Level 3: Building Inspection carried out in buildings with high technical complexity, maintenance and operation of their elements and construction systems, of higher construction standards and with more sophisticated systems. Usually used in buildings with several floors or with construction systems with automation. At this level of building inspection, a maintenance based on ABNT NBR 5674 is mandatorily performed in the building. It also has a qualified professional in charge of the technician, a maintenance plan with planned activities and detailed procedures, management software, and other management tools for the existing maintenance system. At this level of inspection, the work may be called Technical Audit.

3.3.2 Degree of risk and classification of anomalies

Regarding the classification of the Degree of Risk, IBAPE (2012) recommends the criterion regarding the existence of anomalies and flaws in the building found by the evaluation, considering the risk offered to users, the environment and property, within the limits of the building inspection, which can be classified as follows:

Critical Risk Level: Risk of causing damage to the health and safety of people and the environment; excessive loss of performance and functionality causing possible downtime; excessive increase in maintenance and recovery costs; significant impairment of useful life.

Medium Risk Degree: Risk of causing partial loss of performance and functionality of the building without prejudice to the direct operation of systems, and early deterioration.

Minimum Degree of Risk: Risk of causing minor damage to aesthetics or programmable and planned activity, without incidence or without the probability of occurrence of critical and regular risks, in addition to low or no impairment of real estate value.

In addition to the degree of risk that must be analyzed, it is also important to understand the classifications of anomalies that can occur when there are pathologies in buildings. Thus, IBAPE (2012) classifies them as: endogenous, exogenous, natural and functional. Endogenous occurs in the building itself, and can be design, materials and execution. Exogenous, on the other hand, originates from factors external to the building, caused by third parties. The definition of natural pathology occurs in relation to the events of natural phenomena. Finally, the constructive anomaly defined as functional originates from the degradation of construction systems by natural aging and, consequently, the end of the useful life.

3.3.3 Classification of failures and definition of priorities

Planning Failure: Resulting from failures in procedures and inadequate specifications of the maintenance plan, without adherence to technical issues, use, environmental exposure and, mainly, reliability and availability of the facilities, according to the maintenance strategy. In addition to the design aspects of the plan, there are flaws in the periodicities of execution.

Execution failure: Associated with maintenance arising from failures caused by the improper execution of maintenance plan procedures and activities, including improper use of materials.

Operational: Relating to inadequate procedures for registrations, controls, patrols and other pertinent activities.

Managerial: Resulting from the lack of quality control of maintenance services, as well as lack of cost monitoring.

The definition of priorities will have the functionality of alerting about the need for repair, aiming to prevent further damage to the structure of the building or to the lives of users, and will be carried out through the degree of risk, where the indicated pathologies should be pointed out with priority of intervention as "High", "Medium" and "Low".

4 RESULTS AND DISCUSSION

After performing the visual inspection of the environments defined for this case study, it was possible to identify 5 (five) predominant pathological occurrences, with the respective definitions:

Infiltration: refers to the process by which a liquid penetrates the voids of a solid (IBDA Forum, 2017). Water infiltration entails a series of pathological consequences such as corrosion of reinforcement, efflorescence, degradation of concrete and mortar, blistering and bubbles in paints, short circuits, among others (GRANATO, 2002).

Oliveira (2012) defines cracks, fissures and cracks as pathological manifestations of buildings observed in masonry, beams, columns, slabs, floors, among other elements, usually caused by material stresses. If the materials are ordered with an effort greater than their resistance, failure occurs, causing an opening, and according to their thickness, it will be classified as fissure, crack, crack, crack or breach (Table 1).

Table 1

Thicknesses and classification of anomalies

ANMALIES	Fissure	Crack	Crack	Crack	Breach
OPENINGS (mm)	Up to 0.5	From 0.5 to 1.5	From 1.5 to 5.0	From 5.0 to 10.0	Over 10.0

Source: Oliveira, 2012.

Menezes (2006) defines efflorescence as saline deposits that form on the surface of construction materials, resulting from the migration and subsequent evaporation of salinized aqueous solutions. The soluble salts that give rise to efflorescence can have various origins, including raw materials, construction materials, water in the subsoil, among others.

Mold and mildew is the common occurrence in tropical climates. It is associated with the existence of a high moisture content in the attacked component and in the environment, which can interfere with the healthiness and habitability of the building (GRANATO, 2002). Classifying the inspection as level 2, according to figures 4, 5, 6, 7 and 8, pathologies with different degrees of risk, definitions of the nature of the pathology, and the environments where they were found were observed.

According to Figure 4A, infiltrations were found in the ceilings of almost all the environments of the campus case study, considering the origin of the pathology as exogenous, that is, due to factors external to the building, caused by third parties, considering it as a critical risk level, and it can also be highlighted in Figure 4C that in the laboratories infiltrations in the ceiling (also considered as exogenous of critical degree) were identified. According to IBAPE (2012) states that this degree is a risk of causing damage to the health and safety of people and the environment; excessive loss of performance and functionality causing potential outages; excessive increase in maintenance and recovery costs; sensitive impairment of service life.

Figure 4

Pathologies of molds and infiltrations – IF Goiano - Trindade Campus – 2023.

Source: Prepared by the authors.

In figure 4B, it showed infiltration in the ceramic coating, located in the courtyard, classified as endogenous and medium grade. Figure 4C showed another infiltration, located in the pillars of the courtyard and on the ramp, classified as endogenous. According to IBAPE (2012), this type of nature originates from the building itself, as in the case of a possible failure of execution, thus defining it as a medium degree. This degree means that the risk of causing partial loss of performance and functionality of the building without prejudice to the direct operation of systems, and early deterioration.

Table 2 – Part 1 presents the classifications, intervention priorities and observations considered according to the main pathologies of mold and infiltrations identified during the visual inspection.

Table 2

Classification of pathologies - level 02 inspection - part 1

Main Pathologies	Classification	Priority of intervention	Notes
Infiltration in the ceiling	Managerial	High	The classification as managerial and exogenous in nature is given by the identification of lack of corrective maintenance in the roofing systems, causing infiltration damaging the physical structure of the affected components.
Infiltration in the ceramic coating	Execution failure	Average	The classification as an execution failure and of an endogenous nature is given by the identification of a possible waterproofing failure causing infiltration of ceramic water, damaging the ceramic pieces.
Wall infiltration	Managerial	Average	The classification as managerial and exogenous in nature is given by the identification of lack of corrective maintenance in the roofing systems, causing infiltration damaging the physical structure of the affected components.
Infiltration in the ceiling	Managerial	High	The classification as managerial and exogenous in nature is given by the identification of lack of corrective maintenance in the roofing systems, causing infiltration damaging the physical structure of the affected components.

Source: Prepared by the authors.

Figure 5 presented the possible cause of the infiltrations of the campus, with the analysis of the drone cracks were observed in the roof slab. The cracks found can allow rainwater or other Sources to enter, causing additional damage to the structure and interior of the building, consequently causing infiltrations.

Figure 5

Pathologies of molds and infiltrations – IF Goiano - Trindade Campus – 2023

Source: Prepared by the authors.

Ceramic detachment, which is the detachment or detachment of ceramic plates, is defined through the loss of adhesion between the substrate and the ceramic coating, or of the adhesive mortar, which occurs when the stresses on the components exceed the competence of adhesion between the materials to remain stable (Fontenelle; Moura, 2004 and Oliveira, 2012). Because this pathological manifestation affects the physical integrity of users and with the high cost of repair, this anomaly is considered the most serious among them. According to figure 6A, the pathology showed the ceramic detachment, located in the pillars of the courtyard and in some rooms, classified as endogenous. According to IBAPE (2012), this type of nature originates from the building itself, as in the case of a possible failure of execution, thus defining it as a medium degree.

Figure 6

Crack, peel and fissure pathologies – IF Goiano - Trindade Campus – 2023

Source: Prepared by the authors.

In Figure 6B, cracks were found in the classroom, considering the origin of the pathology as endogenous, that is, originating from the building itself, as in the case of a possible failure in execution, as a degree of critical risk, which can also be highlighted in the

laboratories, in the auditorium, on the ramp, in the rooms and in the courtyard, cracks were identified in the corners (Figure 6C), also considered as endogenous of medium degree.

Table 3 – Part 2 presents the classifications, intervention priorities and observations considered according to the main pathologies of cracking, fissure and detachment identified during the visual inspection of the citation figures.

Table 3

Classification of pathologies - level 02 inspection - part 2

Main Pathologies	Classification	Priority of intervention	Notes
Crack	Execution failure	High	The classification as execution failure and endogenous nature is given by the identification of possible overload around the opening due to poor sizing of lintel and counter-lintel, causing cracks damaging the physical structure of the affected components.
Fissure	Execution failure	Average	The classification as an execution failure and endogenous nature is given by the identification of a possible execution failure in the masonry fastening, leaving weakened abutments, causing vertical cracks in the corners damaging the physical structure of the affected components.
Ceramic Peeling	Execution failure	Average	The classification as an execution failure and of an endogenous nature is given by the identification of a possible execution failure in the adhesion of the mortar with the ceramic piece, causing the pieces to peel off.

Source: Authors.

Figure 7

Pathologies of efflorescence, mold, mildew and warping of frames – IF Goiano - Campus Trindade – 2023

Source: Prepared by the authors.

According to Figure 7A, efflorescence was found on the façade of the auditorium, considering the origin of the pathology as exogenous, that is, due to factors external to the building, caused by third parties, considering it as a medium risk level, which can also be highlighted in the laboratories, the library, mold and mildew were identified (Figure 7B) also considered as exogenous of medium degree. According to IBAPE (2012) states that this degree is a risk of causing partial loss of performance and functionality of the building without prejudice to the direct operation of systems, and early deterioration.

In Figure 7, C presented another type of pathology, which was the warping of the frames, located in the classroom, classified as functional. According to IBAPE (2012), this type of nature originates from the degradation of construction systems by natural aging and, consequently, the end of useful life, thus defined as a critical degree. This degree means that the risk of causing damage to the health and safety of people and the environment; excessive loss of performance and functionality causing potential outages; excessive increase in maintenance and recovery costs; sensitive impairment of service life.

Table 4 presents the classifications, intervention priorities and observations considered according to the main pathologies identified during the visual inspection related to Figures 7. According to the figures, level 2 pathologies were observed, presenting different degrees of risk, definitions of the nature of the pathology, the environments where they were found, the classifications, intervention priorities and observations considered according to the main pathologies identified during the visual inspection.

Table 4

Classification of pathologies - level 02 inspection - part 3

Main Pathologies	Classification	Priority of intervention	Notes
Efflorescence	Managerial	Average	The classification as managerial and exogenous in nature is given by the identification of a lack of corrective maintenance on the façade to ensure that the surface remains clean, causing the accumulation of salts, forming efflorescence.
Mold and mildew	Managerial	Average	The classification as managerial and exogenous in nature is given by the identification of a lack of corrective maintenance in the frames to ensure that the surface remains clean, causing the accumulation of moisture, forming mold.
Warping of the frames	Managerial	High	The classification as managerial and functional is given by the identification of misuse of the frame, due force used to open and close the window, causing warping and affecting the correct sealing.

Source: Prepared by the authors.

According to figure 8A, infiltration was found on the floor of the auditorium, considering the origin of the pathology with endogenous, defining it as a critical degree, leading to the priority of intervention being high. The pathology was considered as a possible failure to execute the waterproofing of the floor, causing water infiltration by capillary absorption and undermining water in the floor, damaging the physical structure of the affected components. Figure 8B presented another pathology, which was the detachment of the laminate flooring from the auditorium, classified as functional, defined with a degree of critical risk, classified as managerial, identified as a possible lack of corrective maintenance of the laminate floor, causing detachment and significant impairment of useful life, which can lead to the loss of laminate flooring.

Figure 8

Infiltration and detachment pathologies – IF Goiano - Trindade Campus – 2023

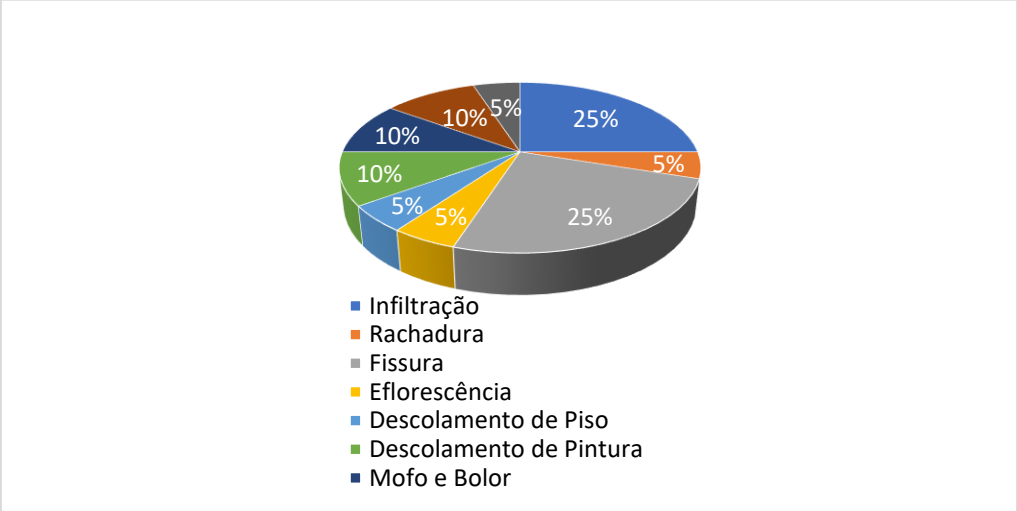
Source: Prepared by the authors.

According to Figure 8C, paint detachment was found in the laboratories, considering the origin of the pathology as exogenous, that is, due to factors external to the building, considering as a degree of critical risk, classified as managerial as a possible lack of corrective maintenance in the frames, causing infiltration and humidity in the masonry, damaging the paint leading to its displacement.

Figure 9 shows the summary of the types of pathologies found on campus. It is possible to see that the pathologies with the highest incidence were infiltrations and fissures with 25% each. These pathologies largely arise from executive failures, such as inadequate waterproofing in the case of infiltration, failure to execute the masonry in the case of cracks, and mainly due to lack of preventive and periodic maintenance. According to BONIFÁCIO; SANTANA; PERIOTT (2020) After the completion of the building, there is a need to carry out preventive and reparative maintenance, since certain anomalies are linked to the way a building is being operated.

Figure 9

Pathologies found at IF Campus Trindade - 2023

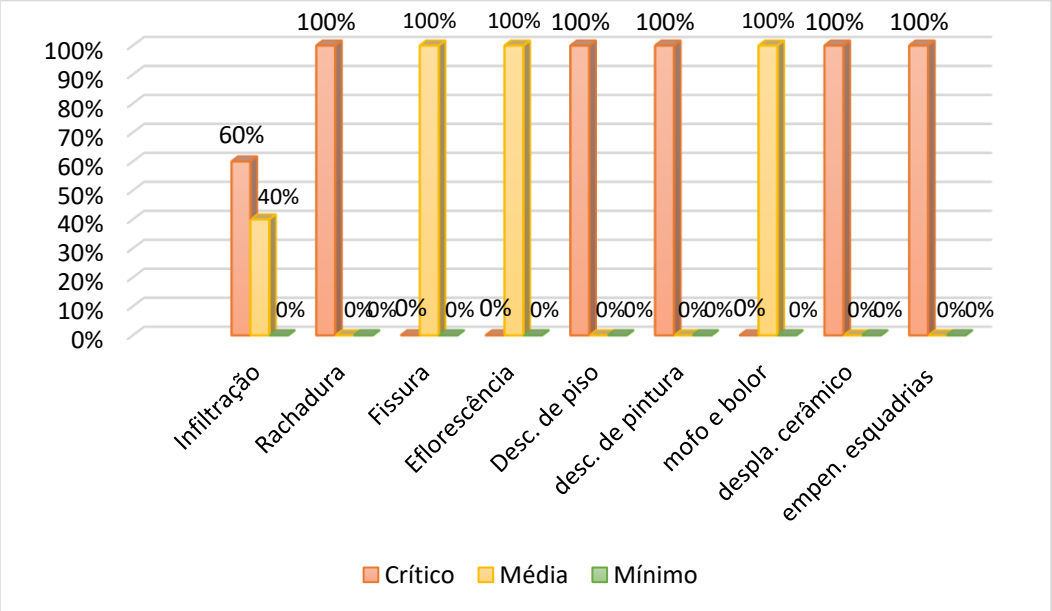


Source: Prepared by the authors.

Figure 10 shows that these pathologies were not classified with the minimum risk level. IBAPE (2012) states that the degree of risk causes small damage to the aesthetics or programmable and planned activity, without incidence or without the probability of occurrence of critical and regular risks, in addition to low or no impairment of real estate value.

Figure 10

Degree of Risk for pathologies found at IF Campus Trindade – 2023.



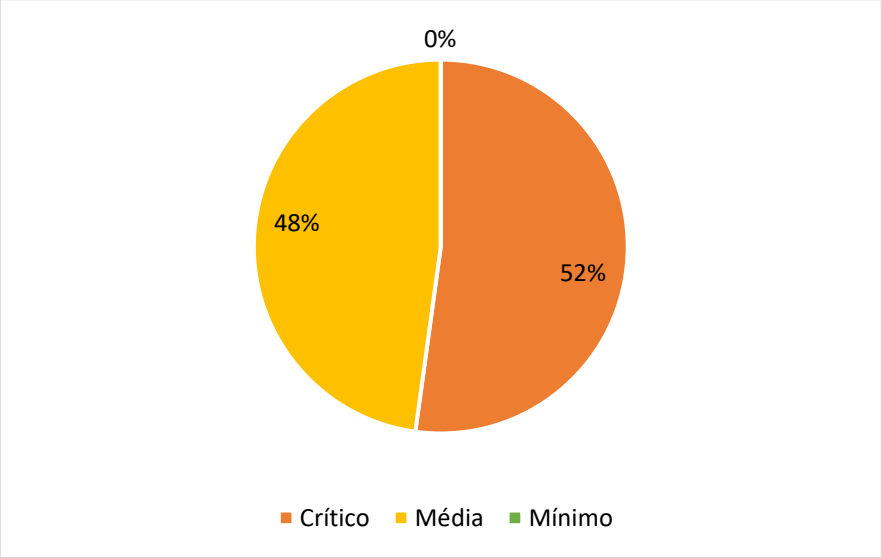
Source: Prepared by the authors.

Figure 11 shows that the pathologies were classified as medium and critical risk, so it is understood that with preventive and periodic maintenance they could reduce the number

of pathologies with the most serious risks, avoiding an excessive increase in maintenance and recovery costs.

Figure 11

Degree of Risk for pathologies found at IF Campus Trindade – 2023



Source: Prepared by the authors.

5 CONCLUSIONS

As exposed in the work, the various problems presented at the Federal Institute of Goiano – Trindade Campus become evident. In view of the above, it became possible to identify the causes according to their degree of risk and criticality. In this case, it is essential to be careful in relation to the preparation of a project that complies with the appropriate specific standards, the monitoring of the engineer/person responsible for the work throughout the executive process, the performance of periodic maintenance, and consequently, the government financial investment for these purposes, since it is a public educational institution.

However, it is possible to affirm that the objectives set at the beginning of the research were achieved, considering the assumption of the characterization of the constructive anomalies, their causes and degree of risk. Furthermore, it is worth noting that the theoretical foundations analyzed, for the most part, are based on the useful life of the building, since its functionality is directly related, that is, the deterioration is proportional to the continuous use of the Campus, as well as any other building. However, when you have a frequent and proper inspection, the useful life tends to increase.

Finally, from a general perspective, with regard to civil construction, the topics based on the writing were necessary to the point of resulting in a possible continuity of the theme

addressed, since it is a Campus that offers opportunities for an audience with different identities, but that value the same objective, education. It is recommended, in the case of future analyses related to this case, that specific preventive and repair methods for each type of pathology identified be investigated and presented, in order to further contribute to this line of research.

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