



Analysis of Pathological Manifestations in the Municipal Public Market of the City of Frecheirinha – CE: Case Study

Ana Jéssica Farias da SILVA¹, Pammela Conceição Pontes FEITOSA², Ana Jéssica Farias da SILVA²,
Juscelino Chaves SALES³

¹ Universidade Estadual Vale do Acaraú, Sobral, Brasil, jessica.farias02@outlook.com

² Universidade Estadual Vale do Acaraú, Sobral, Brasil, pammela03@gmail.com

³ Universidade Estadual Vale do Acaraú, Sobral, Brasil, juscelinochaves@hotmail.com

Abstract: Civil construction is related to the growth of society in adapting to constructive needs. Over time, human society has gained understanding for the development of construction technology. However, technological advancement can cause risks, and these generate deeper development on structures and materials from the mistakes made that result in degradation, failures and/or accidents. Deterioration occurs due to natural factors, constructive failures, design errors, inappropriate materials, lack of maintenance, among others. Degradations compromise the efficiency of the building, so a corrective action plan is necessary. This work aims to analyze and identify the pathological manifestations of the Public Market in the city of Frecheirinha, observing the pathological manifestations, their causes, and propose interventions and improvements for the restoration and recovery of the building. In the results, the main most frequent pathological manifestations were identified, which consist of the presence of stains, displacement of the ceramic coating, deterioration of the concrete, corrosion of reinforcements and inadequate electrical installations. Therefore, the present work shows the importance of identifying, analyzing the pathological manifestations present in the building and proposing recovery techniques for maintenance, providing safety and comfort to users throughout its useful life in addition to contributing to the municipal reform of the public market.

Keywords: Pathological manifestations. Recovery. Edification.

1. Introduction

The history of civil construction is related to the growth of man in adapting to his constructive needs, whether work, housing or infrastructure. Over time, human society obtained the necessary understanding for the development of construction technology, generating enormous scientific and technological growth (Silva, 2022).

Researchers presents a case study aimed to protect a set of reinforced and prestressed concrete structures that were discontinued in 2014, to demonstrate the importance of the measures adopted in view of the benefits obtained, especially in reducing or minimizing pathological manifestations (Possan, 2020).

With the accelerated advance, there was also the generation of risks, and these risks together with the limits determined by them, it was possible the technological development with the acquisition of a deeper understanding about the structures and the materials that compose them from mistakes committed that resulted in early degradation or accidents (Silva, 2022).

The current scenario construction has been characterized by the increasing use of new materials, components, and construction technologies. Simultaneously, the adoption of new techniques rather than the little scientific approach and project failures, execution and project planning have contributed to the occurrence of pathological manifestations (Antunes, 2016).

The deterioration of a building can happens due to several factors, such as natural occurrences, which consists of climate, soil movements, among others; constructive failures arising from disabled professionals, the use of inappropriate materials, incorrect executions, lack of knowledge of technical standards and lack of maintenance in construction (Griebeler; Wosniack, 2017).

Cultural assets are historical buildings that combine formal and technical elements with an immaterial dimension with great significance and value for the population. These buildings may present several pathologies, since they were constructed with outdated systems and techniques and are subject to weathering (Resende, 2022).

The degradation of materials tends to compromise or impair the efficiency of the construction and its structure, therefore, the realization of a corrective action plan, to recover the building in a way that the adequate performance of the use of the construction is met is necessary (Bertolini, 2010). For Nóbrega (2019), carrying out the process of identifying pathological manifestations is necessary for the proper diagnosis, since knowledge of the origins and causes is important to determine the most coherent and correct way of recovery and guarantee the durability of the recovered structure.

There are techniques to detect pathological manifestations. Rocha (2018) says Infrared thermography has recently been used in civil work inspection to detect various types of pathological manifestations due to its speed, easy handling, and capability to cover large areas and detect hidden faults, among other advantages. The specific implementation for humidity detection in buildings still presents some uncertainties, since parameters that influence results are present, for example: mechanisms that generate humidity, specific conditions of premises being studied and constructive characteristics of the building.

The main objective of this work is to analyze and identify the pathological manifestations of the public market in the municipality of Frecheirinha in the state of Ceará in Brazil. Built in the 20th century, the market being an environment of high traffic combined with low or even lack of maintenance, never undergone any total renovation before, pathological manifestations became part of the aging process of the structure. The causes of deterioration were observed, as well as possible corrections of the problems in a simplified way, to contribute to the maintenance, durability and site security.

2. Theoretical Reference

2.1 Pathology in civil construction

The term pathology in civil construction means the science that studies the agent of damage and its causes. The pathological manifestations are the result of pathologies.

Pathologies in civil construction are a set of diseases that cause damage to structures, which can be superficial or deep. In addition, there are occurrences of external damage that are associated with the actions of wind, rain, light, heat, gaseous emissions, vibrations, temperature variations and humidity. The occurrences of internal damage are associated with the effects of ventilation, cold air, hot air, humidity and condensation (Oliveira, 2021).

The pathology encompasses all stages of civil construction, starting with the elaboration of the project, choices of materials and labor, execution of the works and use of the building. Thus, the lack of proper analysis at all stages of construction leads to the appearance of various pathological manifestations throughout the useful life of the construction (Ludovico, 2016).

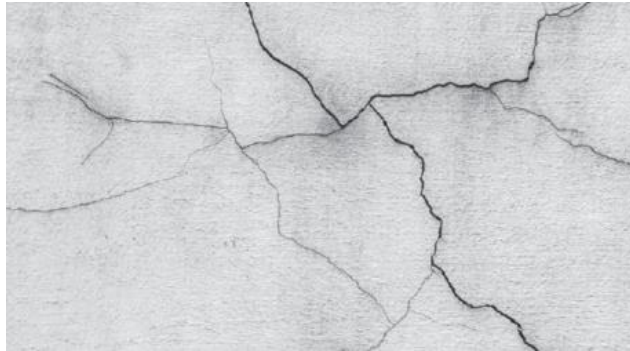
According to Ferreira and Oliveira (2021), greater attention is being paid in civil construction to the identification of pathological manifestations and intervention proposals right at the beginning of the work. Since, considering that pathologies can be avoided, when there is a better detailing of the project, appropriate choices of materials and labor, and consequently, maintenance.

2.2 Main pathological manifestations

The main pathological manifestations present in buildings are presented below.

Cracks are the most found and most common to appear in concrete structures in civil construction, since the crack can be triggered by a pathological manifestation, as it can also be due to the concrete itself in its natural process of resistance gain. They have openings up to 0.5mm. For Oliveira (2021) cracks are the types of pathological manifestations most found in concrete. Its causes may be associated with chemical shrinkage, drying, carbonation and lack of reinforcement coating. Another factor that also influences the formation of cracks are the types of active efforts to which the structures are subjected, such as bending, torsion, traction, cutting, loss of adherence and concentrated loads. Figure 1 illustrates a cracking process in a wall.

Figure 1 - Presence of cracks in a wall.



Source: Mapa da Obra, 2016.

Cracks, on the other hand, are more pronounced and deeper than fissures, causing the parts to separate, so they require a little more attention. They have openings from 0.5mm to 1.5mm.

The cracks indicate that something serious is happening, also with division of the parts, compromising the stability of the building, but this was not the case to be found in the structure analyzed in this study.

Stains (Figure 2) are pathologies caused by humidity, they can be very harmful and difficult to resolve, and can cause functional, aesthetic and structural damage, which represent a risk to the safety and health of users. In addition, they have a higher incidence in residential type constructions and residential buildings (OLIVEIRA; OLIVEIRA, 2021).

Figure 2 - Presence of stains on a wall.



Source: Souza, 2008.

Another type of pathology resulting from humidity is efflorescence. They occur in masonry walls, which have a high concentration of salts, which, when transported from the interior of the material to the surface of the coating, form a whitish crust. They do not present problems to the structure or its stability, however, it should

be noted that there is moisture in the structure, which can generate future problems in this regard (Gonzales; Oliveira; Amarante, 2020). Figure 3 shows a wall with efflorescence.

Figure 3 – Efflorescence on a wall.



Source: Silva, 2022.

Mold is also another type of pathological manifestation that occurs in the presence of moisture. It is formed by filamentous fungi, which do not have a mushroom-like structure. They need a high moisture content to develop, and the main type of moisture required is not that where there is surface runoff, such as infiltration (Fim, 2021).

Displacements of ceramic tiles are characterized by the loss of adherence of the ceramic tiles to the substrate, or of the adhesive mortar, when the stresses exceed the adhesion capacity between the ceramic tiles and the adhesive mortar. The existence of this type of pathological manifestation is due to the production of a hollow sound in the ceramic plates when percussed, or even, there is swelling of the finishing layer (Ferreira; Lobão, 2018).

Another type of common pathological manifestation to be found is the deterioration of concrete occurs due to the potential loss of binding cement, causing pieces of concrete to detach from the whole. Generally, it has physical origins, that is, by impacts, vibrations, among others. Furthermore, when it deteriorates, the structure becomes vulnerable to the action of chemical agents, due to the ease of penetration into the material. Corrosion of steel reinforcement is caused by exposure to environmental elements such as oxygen and moisture present in the atmosphere. These elements react with steel, oxidizing them. Thus, the efficiency and durability of the armor are compromised. To prevent this from happening, the covering of the armor must be thick enough so that it does not come into contact with the atmosphere. This thickness must be in accordance with the aggressiveness of the site where the work will be carried out (Gonzales; Oliveira; Amarante, 2020).

Stains, on the other hand, are pathologies caused by humidity, they can be very harmful and difficult to resolve, and can lead to functional, aesthetic and structural damage, in which they represent a risk to the safety and health of users. In addition, they have a higher incidence in residential buildings and residential buildings (Oliveira; Oliveira, 2021).

3. Methodology

In order to carry out this work, on-site visits were made to the building of the public market, where photographic records of the most apparent and visible pathological manifestations were made, evaluating the current condition of the establishment. The building was built in 1938, which was an abandoned shed located in the center of the city. In the mid-1980s, the shed was demolished, and a new building was built where it would serve the stallholders, which were previously located on the streets of the city, establishing improvements for the local population. The public market is located at Rua Norberto Rodrigues, number

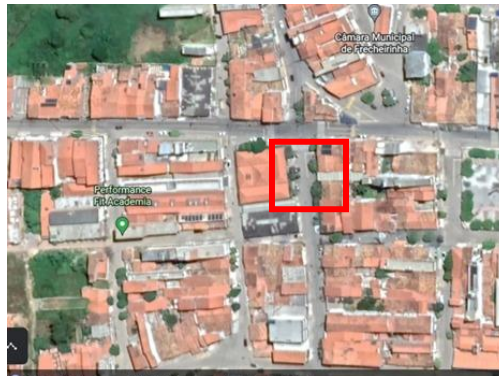
1148, in the municipality of Frecheirinha, located in the northern region of the State of Ceará in Brazil, as shown in Figures 4 and 5.

Figure 4 - Location of the city of Frecheirinha.



Source: Google Earth, 2022.

Figure 5 - Location of the public market in the city of Frecheirinha.



Source: Google Earth, 2022.

Figures 6 (a) and (b) show the main façade of the public market.

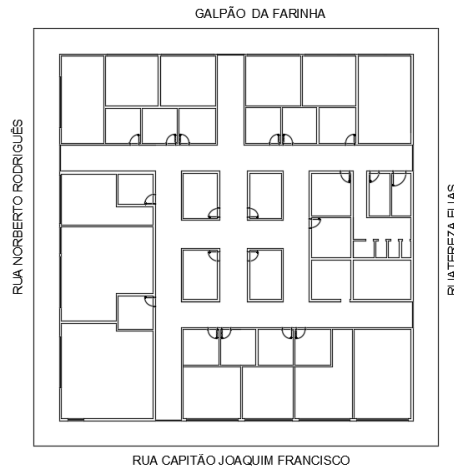
Figure 6 – Main façade of the Frecheirinha public market.



Source: Own, 2022.

The public market in the municipality of Frecheirinha/CE occupies an area of one block, with about 787.93 m². It has 33 boxes with different dimensions, which are used for the most varied types of trades. In addition, it has restrooms and a circulation area covering the entire market, facilitating the movement of users. Figure 7 shows the floor plan of the municipal public market.

Figure 7 – Floor plan of the Frecheirinha public market



Source: Prefeitura Municipal de Frecheirinha, 2022.

For the development of this study, field visits were carried out together with the observation and identification of existing anomalies in the building, and the pathological manifestations were later recorded through photos. In carrying out the research, different means of disseminating information were also used, such as articles and works published in journals and congresses, textbooks and websites with the subjects addressed and properly referenced.

With the data collected, a qualitative approach was made with a photographic survey carried out in loco, in which the state in which the manifestations were found was recorded. Soon after being registered, they were identified based on the literature used in this work, the author's observations and knowledge, suggesting possible mitigating measures for the analyzed problems.

4. Results and discussions

With the photographic records obtained during visits to the public market of Frecheirinha, it was demonstrated that this presents some types of pathological manifestations that occur more frequently in the field of civil construction. In addition, for each type of pathology observed, its possible causes were presented and then, the appropriate recovery techniques according to each pathological manifestation. Each pathology observed and its possible causes are presented below.

4.1 Pathological manifestations found in the municipal market of Frecheirinha

The main pathological manifestations found in the municipal public market of Frecheirinha in the state of Ceará are presented below.

4.1.1 - Infiltration stains

In Figures 8 (a), (b) and (c) stains due to seepage in the ceiling of the building were identified. As it has only one floor, it is assumed that infiltrations in the slab may come from a lack of or poor waterproofing of the roof structures (ruffs, gutters), poor suitability in laying the tiles or even damaged tiles. In Figure 5 (d) there is infiltration in the structure of the market marquee on the rear facade, its causes are due to the absence of a drop left in the upper part of the marquee together with the lack of a waterproofing layer on it.

Due to the location, stains on the ceiling make the appearance of mold more susceptible, since it is conditioned to an environment exposed to low temperature and the presence of abundant humidity, in addition to the fact that the water present is not running.

Figure 8 – Stains on the ceiling of the public market in the municipality of Frecheirinha.



Source: Own, 2022.

According to Santos and Beckhauser (2018), for the recovery of stains, it is necessary to remove the paint film without adherence to the surroundings of the pathological manifestation. Then clean the area using brushes or sandpaper, remove crystalline deposits and traces of contaminants, apply a suitable primer to improve adhesion and wait for correct curing. After carrying out the necessary procedures, the area will be ready to receive a new coating.

4.1.2 Displacement of ceramic coatings

In addition to stains, the detachments of ceramic tiles were the ones with the highest incidence. Figure 9 (a) shows that there was a detachment of complete pieces, in addition to part of the ceramic plates, which indicates that there was cracking of these before the displacement. Figure 9 (b) shows that there was total detachment of the pieces, located in the upper part of the workbench.

The main causes for the occurrence of detachments are the poor execution of the application of the adhesive mortar by not performing the adhesion cords using a notched trowel, the lack of correct preparation of the substrate, or even, carrying out the laying on whitewashed paint, not performing double bonding, when

necessary, the presence of moisture in the place without waterproofing, causing the lack of adhesion between the plates and the substrate.

Figure 9 – Detachment of complete parts, in addition to part of the ceramic plates.



The recovery of the compromised ceramic coating consists of the replacement of faulty ceramic parts. All compromised ceramic pieces and adhesive mortar remains must be removed, checking the state of the non-compromised pieces. Then, the existing deep imperfections must be corrected with mortar coating and wait for the adequate curing time, preparing the substrate. Then, apply a primer for walls, in the case of wet areas it is necessary to waterproof and, after drying, install the new ceramic coating, using double gluing in order to have a better adhesion between the ceramic and the substrate (Santos; Beckhauser, 2018).

Research concerning the facade of a building involves a comprehensive review of the impermeability of building materials, in order to determine their maintenance and repair techniques. Usually, moisture generates different levels of deterioration and decreases the life cycle of buildings, however, quantifying the presence of moisture is an arduous procedure (Barbosa, 2021).

4.1.3 Corrosion of reinforcement and deterioration of concrete

Figures 10 (a), (b), (c) and (d), in addition to showing stains caused by humidity, also show two pathological manifestations that exist together, namely corrosion of the structure's reinforcements and deterioration of the concrete. Concrete disaggregation is related to reinforcement corrosion, in addition to physical impacts. In addition, flaws in the construction process, such as the execution of concrete in the work itself, inadequate proportions of its components, consolidation, can contribute to the disintegration of the concrete.

As for the occurrence of corrosion of the reinforcements, it is mainly due to the execution of inadequate covering, leaving the reinforcements exposed to the air. The presence of moisture also contributes to oxidation. The lack of waterproofing or problems in hydraulic and pluvial installations are crucial factors for the origin of humidity.

Figure 10 – Corrosion of the reinforcement of the structural elements of the public market.



Source: Own, 2022.

For the recovery of deteriorated concrete, recovery works are necessary and, when necessary, structural reinforcement of the reinforced concrete pieces, with the application of the technique of scarification, covering and increasing the section. Scarification consists of enabling better adhesion conditions between the existing part and the repair, where the degraded and disaggregated material is removed by the action of corrosion and then the reinforcements are treated with the application of a rust inhibitor (Gonçalves et al., 2022).

Gonçalves et al. (2022) recommends that adequate covering of concrete structures be carried out, soon after, the increase of the section is carried out, which is the most adopted method for increasing the reinforcement and structural reinforcement and, finally, the application of filling the voids to the self-compacting concrete base.

4.1.4 Exposed electrical installations

In Figure 11, it is possible to identify electrical installations exposed on the market sidewalk, where there is a high traffic of people and materials, generating life risks for the population.

Rodrigues et al. (2021) mentions that it is very common for Brazilian professionals and companies to assign little value to safety rules, especially when the activity is carried out for many years, thus causing exacerbated self-confidence and allowing carelessness that is often incomprehensible. In addition, it is constantly verified that the safety culture is placed as an obstacle because it is considered a reduction in productivity and/or expenses/costs for companies.

Exposed electrical wiring transported from one frame to another without being embedded, the risk of being peeled and exposed to moisture, non-standard frames and without covers, exposed circuit breakers, and even hydraulic pipes at the bottom of the sidewalk. It is recommended that an electrical installation project be carried out by a qualified professional, following safety standards and that the situation be applied to other types of existing installations in the building that are probably outside the standards and safety advice.

Figure 11 - Corrosion of reinforcement of structural elements of the public market



Source: Own, 2022.

5. Conclusions

The development of this work allowed a detailed analysis of the main pathological manifestations present in buildings. In addition, a case study was carried out in the public market of the city of Frecheirinha in the state of Ceará in Brazil, in which the existing pathological manifestations and their possible causes were identified. And then, the appropriate recovery techniques were proposed for each type of pathological manifestation found.

According to the visits made, it was found that the public market has a large number of pathologies, which are easily visualized. The most recurrent pathological manifestations were stains, displacement of ceramic plates, corrosion of reinforcements, deterioration of concrete, inadequate electrical and hydraulic installations and rising damp around the perimeter of the building.

The incidence of stains occurs mainly on the ceiling of buildings with different dimensions. The detachment of ceramic tiles on the wall cladding indicates that there was the appearance of cracks in the tiles that stood out only in one part and, in other places of the cladding, the pieces were completely displaced. And, the

deterioration of concrete and corrosion of reinforcement in structural elements, such as slabs, beams and pillars.

In the case study, it is concluded that the possible causes for the appearance of pathologies in the case of stains are lack of waterproofing, problems in hydraulic and rainwater installations. For the detachment of the ceramic pieces are bad execution of the laying and presence of humidity. And, inadequate covering, impacts and humidity for the deterioration of the concrete and corrosion of the reinforcements. Also, the lack of maintenance in the building during its useful life is considered.

With regard to the recovery of pathological manifestations, it was proposed for stains, removal, cleaning of the site and application of a new coating, as well as for the detachment of ceramic coatings. And, for the deterioration of concrete and corrosion of steel reinforcements, it is necessary to apply the techniques of scarification, cover and increase of the section.

That said, for future work, a deeper understanding of the pathologies found is suggested, as well as a study on recovery techniques for these pathologies. Because it is a building that has a considerable flow of people, it is essential that it has adequate conditions that fulfill the function of providing safety and comfort for users during its useful life.

References

Silva, M. A. (2022). Impermeabilização de fundações rasas como prática preventiva ao surgimento de eflorescências na construção civil: estudo de caso na cidade de Cupira – PE. 27 f. Monografia (Graduação) – Curso de Engenharia Civil, Universidade Federal do Pernambuco, Caruaru.

Possan, E., Berwanger, C.; Rigo, E., Felix, E. F., Brant, C. A. C. Protection of interrupted concrete structure to prevent degradation: a case study. *Journal of Building Pathology and Rehabilitation* (2020) 5:18 <https://doi.org/10.1007/s41024-020-00083-1>

Silva, V. P. A. (2022). *Análise de patologias construtivas nas áreas comuns em um condomínio residencial de médio-baixo padrão*. 78 f. Trabalho de Conclusão de Curso (Bacharelado em Engenharia Civil) – Campus Anápolis, Instituto Federal de Educação, Ciência e Tecnologia de Goiás, Anápolis, 2022.

Antunes, G.R., Masuero, A.B. (2016). Flexural tensile strength in mortar coating reinforced with different types of metal mesh: A statistical comparison. *Construction and Building Materials*. Volume 121, 15,2016, Pages 559-568. <https://doi.org/10.1016/j.job.2022.104916>

Griebeler, J. R.; WOSNIACK, L. M. (2017). *Análise de patologias em estruturas de unidades básicas de saúde da cidade de Curitiba*. 133 f. Trabalho de Conclusão de Curso (Bacharelado em Engenharia Civil) – Departamento Acadêmico de Construção Civil, Universidade Tecnológica Federal do Paraná, Curitiba.

Resende, M. M., Gambare, E. B. *et al.* (2022). Infrared thermal imaging to inspect pathologies on façades of historical buildings: A case study on the Municipal Market of São Paulo, Brazil. *Case Studies in Construction Materials*. Volume 16, 2022, e01122. <https://doi.org/10.1016/j.cscm.2022.e01122>.

Bertolini, L. (2010). *Materiais de construção, patologia, reabilitação, prevenção*. 1. ed. São Paulo, Oficina de Textos, 2010. 414 p. Disponível em: <https://books.google.com.br/books?id=ciaPDAAQBAJ&printsec=frontcover&hl=ptBR&source=gbg_summary_r&cad=0#v=onepage&q&f=false>. Acesso em: 21 jun. 2021.

- Nóbrega, N. P. (2019). Patologias na construção civil – análise das principais manifestações patológicas em residências do município de Paraú-RN. Trabalho de Conclusão de Curso (Bacharelado em Ciência e Tecnologia) – Centro de Ciências Exatas e Naturais, Universidade Federal Rural do Semi-árido, Mossoró.
- Rocha, J.H.A., Santos, C.F., Póvoas, Y.V. (2018). Detection of precipitation infiltration in buildings by infrared thermography: a case study. *Procedia Structural Integrity*. v 11, pg 99-106. <https://doi.org/10.1016/j.prostr.2018.11.014>.
- Oliveira, P. R. (2021). Levantamento das manifestações patológicas – estudo de caso de manifestações patológicas em condomínio de paredes de concreto moldadas *in loco*. *CIPPUS*, Canoas, v. 9, n. 1. Disponível em: <<https://revistas.unilasalle.edu.br/index.php/Cippus/article/view/8110>>. Acesso em: 31 out. 2022.
- Ludovico, T. S. (2016). *Desempenho a estanqueidade à água: interface janela e parede*. 176 f. Dissertação de Mestrado – Pós-Graduação em Engenharia Civil, Universidade Federal de Santa Maria, Santa Maria. Disponível em: <<https://repositorio.ufsm.br/bitstream/handle/1/7928/LUDUVICO%2c%20THESE%20SOUZA.pdf?sequence=1&isAllowed=y>>. Acesso em: 31 out. 2022.
- Ferreira, A. R.; Oliveira, R. F. (2021). Patologias na construção civil: estudo de caso em duas residências na cidade de Iraí de Minas – MG. *GETEC*, v. 10, n. 26, p. 1-16. Disponível em: <<https://revistas.fucamp.edu.br/index.php/getec/article/view/2362>>. Acesso em: 31 out. 2022.
- Oliveira, K. A.; Oliveira, R. F. (2021). Análise de patologias em imóveis residenciais. *GETEC*, v. 10, n. 26. Disponível em: <<https://revistas.fucamp.edu.br/index.php/getec/article/view/2367>>. Acesso em: 02 nov. 2022.
- Mapa da Obra. (2022). Entendendo as trincas e fissuras. Disponível em: <<https://www.mapadaobra.com.br/inovacao/entendendo-as-trincas-e-fissuras/>>. Acesso em: 01 nov. 2022.
- Souza, M. F. (2008). Patologias ocasionadas pela umidade nas edificações. Monografia (Especialização) – Especialização em Construção Civil, Universidade Federal de Minas Gerais, Belo Horizonte.
- Gonzales, F. D.; Oliveira, D. L.; Amarante, M. S. (2020). Patologias na construção civil. *Revista Pesquisa e Ação*, Centro Universitário Brazcubas, v. 6, n. 1, p. 128-139. Disponível em: <<http://revistas.brazcubas.br/index.php/pesquisa/article/view/910/901>>. Acesso em: 02 nov. 2022.
- Fim, V. H. P. (2021). Patologias da construção civil: investigação em marquises na cidade de Uberlândia – MG. 29 f. Monografia (Graduação) – Curso de Engenharia Civil, Universidade Federal de Uberlândia, Uberlândia, 2021.
- Ferreira, J. B.; Lobão, V. W. N. (2018). Manifestações patológicas na construção civil. *Ciências Exatas e Tecnológicas*, Aracaju, v. 5, n. 1, p. 71-80.
- Google Earth, (2022). Disponível em: <<https://earth.google.com/web/@-3.7590611,-40.81652834,122.19616902a,1337.81409449d,35y,-4.28450264h,5.00312299t,0r>>. Acesso em: 03 nov. 2022.

Prefeitura Municipal de Frecheirinha (2022). Secretaria de Infraestrutura e Meio Ambiente de Frecheirinha.

Santos, L. S.; Beckhauser, P. H. (2018). *Investigação dos problemas patológicos construtivos da unidade sanitária de Rio Fortuna*. 2018. 78 f. Monografia (Graduação) – Curso de Engenharia Civil, Universidade do Sul de Santa Catarina, Tubarão, 2018.

Barbosa, M.T.G., Rosse, V.J., Laurindo, N.G. (2021). Thermography evaluation strategy proposal due moisture damage on building facades. *Journal of Building Engineering*. Volume 43, 102555. <https://doi.org/10.1016/j.jobbe.2021.102555>

Gonçalves, J. L et al. (2022). *Avaliação de patologias na Baixada Santista estudo de caso: surgimento de patologias na estrutura do condomínio Residencial Albatroz (Guarujá)*. 30 f. Trabalho de Conclusão de Curso (Bacharelado em Engenharia Civil) – Campus Unimonte, Universidade São Judas Tadeu, Guarujá, 2022.

Rodrigues, Y., Nascimento Neto, A. P. (2021). Segurança em instalações elétricas. *RECIMA21 - Revista Científica Multidisciplinar* 1(1), e11823. <https://doi.org/10.47820/recima21.v1i1.823>.