STUDY OF THE ANCIENTY MORTARS IN THE CHURCH OF NOSSA SENHORA DA CONCEIÇÃO DA COMANDAROBA IN LARANJEIRAS SE/BR

ESTUDO DAS ARGAMASSAS ANTIGAS DA IGREJA DE NOSSA SENHORA DA CONCEIÇÃO DA COMANDAROBA EM LARANJEIRAS SE/BR

ESTUDIO DE MORTEROS ANTIGUOS DE LA IGLESIA DE NOSSA SENHORA DA CONCEIÇÃO DA COMANDAROBA EN LARANJEIRAS SE/BR

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ABSTRACT
In recent years, Conservation and Restoration Technology has faced, as usually happen in Sciences that are constantly changing and transforming, the need for adaptations in the face of new technologies, impositions and difficulties in the use of instruments and laboratory products/reagents for carrying out tests due to costs, health and environmental requirements, administrative policies, execution time, etc., and the natural scrupulous difficulty which has always existed in the non-destructive interventionist care that a heritage asset requires; these premises have imposed a reaffirmation/revaluation of knowledge in the face of rethinking the way in which one should act in studies involving the preservation of material cultural assets, in this case, specifically, in the collection of samples and laboratory tests. This paper follows the traditional methodology of analysis of mortars in historic buildings learned more than 20 years ago in the doctorate carried out in the postgraduate program in Architecture and Urbanism at the Federal University of Bahia and in post-doctorate carried out at the University of Lisbon/ National Laboratory of Civil Engineering (LNEC) in 2014 (financed by CAPES); these two experiences, related with numerous research works carried out at the CTPR (Center for Preservation and Restoration Technology) of the Federal University of Sergipe, led to the development of a technological initiation project (PIF11020-2022), between 2022 and 2023, with a view to the STUDY OF ANCIENT MORTARS FROM THE CHURCH OF NOSSA SENHORA DA CONCEIÇÃO DA COMANDAROBA IN LARANJEIRAS SE/BR, which revisits the traditional routines of historical mortar analysis, however, it proposes learning from the observation that precedes the choice and quantity of collection and a detailed critical reflective observation of these samples that allow the final choices for testing to fall on the qualitative assertion and represent effective scientific technical possibilities for the conservation/restoration of historical heritage buildings.

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Keywords: Architecture. Conservation. Restoration. Technology. Knowledge.

RESUMO

A Tecnologia da Conservação e Restauro tem se deparado nos últimos anos, como é comum as ciências em constante mudança e transformação, na necessidade de adequações frente a novas tecnologias, imposições e dificuldades de uso instrumentais e produtos/reagentes laboratoriais para execução dos ensaios devido a custos, exigências sanitárias, ambientais, políticas administrativas, tempo de execução, etc., e à natural dificuldade que sempre existiu no cuidado escrupuloso intervencionista não destrutivo que um bem patrimonial exige; essas premissas impuseram uma re-afirmação/re-valorização dos saberes frente ao repensar a forma de como se deve agir nos estudos que envolvem a preservação de bens culturais materiais, neste caso, em específico, na recolha de amostras e ensaios laboratoriais. Esta comunicação caminha sobre a metodologia tradicional (história/teoria/tecnologia) de análises das argamassas em edificações históricas apreendidas há mais de 20 anos no doutoramento realizado no programa de pós-graduação em Arquitetura e Urbanismo da Universidade Federal da Bahia e em pós-doutoramento realizado na Universidade de Lisboa e Laboratório Nacional de Engenharia Civil (LNEC) no ano de 2014 (financiado pela CAPES); estas duas experiências agregadas à inúmeros trabalhos de pesquisa realizados no CTPR (Centro de Tecnologia da Preservação e Restauro) da Universidade Federal de Sergipe, levaram ao desenvolvimento de um projeto de iniciação tecnológica (PIF11020-2022), entre setembro de 2022 e agosto de 2023, tendo em vista o ESTUDO DAS ARGAMASSAS ANTIGAS DA IGREJA DE NOSSA SENHORA DA CONCEIÇÃO DA COMANDAROBA EM LARANJEIRAS SE/BR, o qual revisita as rotinas tradicionais das análises de argamassas históricas, no entanto, propõe um aprendizado da observação que antecede a escolha e quantidade de recolha e uma observação reflexiva crítica minuciosa dessas amostras que permitam que as escolhas finais de amostras para ensaios recaiam sobre a assertiva qualitativa e representem possibilidades técnicas científicas efetivas para a conservação/restauro das edificações históricas patrimoniais.

Palavras chaves: Arquitetura. Conservação. Restauro. Tecnologia. Saberes.

RESUMEN

La Tecnología de Conservación y Restauración se ha enfrentado en los últimos años, como es común en las ciencias en constante cambio y transformación, a la necesidad de adaptaciones a las nuevas tecnologías, imposiciones y dificultades en el uso de instrumentos y productos/reactivos de laboratorio para la realización de ensayos debido a costos, exigencias sanitarias y ambientales, políticas administrativas, plazos de ejecución, etc., y la natural dificultad que siempre ha existido en el escrupuloso cuidado intervencionista no destructivo que requiere un bien patrimonial; Estas premisas impusieron una reafirmación/revalorización del conocimiento de cara a repensar la forma en que se debe actuar en estudios que involucran la preservación de bienes culturales materiales, en este caso, específicamente, en la recolección de muestras y pruebas de laboratorio. Esta comunicación sigue la metodología tradicional de análisis de morteros en edificios históricos incautados hace más de 20 años en el doctorado realizado en el programa de posgrado en Arquitectura y Urbanismo de la Universidad Federal de Bahía y en el posdoctorado realizado en la Universidad de Lisboa/Laboratorio Nacional de Ingeniería Civil (LNEC) en 2014 (CAPES); Estas dos experiencias, combinadas con numerosos trabajos de investigación realizados en el CTPR (Centro de Tecnología de Preservación y Restauración) de la Universidad Federal de Sergipe, llevaron al desarrollo de un proyecto de iniciación tecnológica (PIF11020-2022), entre 2022 y 2023, con miras al ESTUDIO DE MORTEROS ANTIGUOS DE LA IGLESIA DE NOSSA SENHORA DA CONCEAÇÃO DA COMANDAROBA EN LARANJEIRAS SE/BR, que revisita las rutinas tradicionales de análisis de morteros históricos, sin embargo, propone aprender de la observación que precede a la elección y recolección de cantidades. y una observación crítica y reflexiva minuciosa de estas muestras para la elección final cualitativa y represente posibilidades técnicas científicas efectivas para la conservación/restauración de los edificios del patrimonio histórico.

Palabras claves: Arquitectura. Conservación. Restauración. Tecnología. Conocimiento.

INTRODUCTION

This paper exposes critical reflections, learnings and results obtained in the technological initiation research project PIF11020-2022, developed between September 2022 and August 2023 at the Federal University of Sergipe, in the area of Conservation and Restoration Technology, analyzing the characteristics of mortars present in historic buildings, in this case, the mortars of the Church of Nossa Senhora da Conceição da Comandaroba in the City of Laranjeiras, interior of the State of Sergipe, with the aim of knowing the production of these mortars and seeking alternatives to "cure" pathologies related to phenomena such as humidity, crystallization, "leprosity" and other agents to which heritage objects are susceptible.

In the Restoration Technology practiced today, which can also be called "modern" restoration, one of the most evidenced practical issues is that, despite all the care with the theory and techniques applied in the process, the restored building, sometimes and in a very short time, already begins to present a series of pathologies that, in most cases, are associated with humidity, due to reactions in the reconstitution mortars. Therefore, it is sought in the ancient, well-known techniques of the production of restorative "sanitation" mortars, to study, improve and know the properties and characteristics of restoration mortars and the compositions of which they (sand, lime, gravel, clays, salts, coal ash, etc.) are made up and whether there has been an association of ceramic dust, steel mill slag, plant or animal waste (blood, fat, seeds, ashes, oils, etc.), finding in the parameter of respect for the past and its knowledge, an action in the present and in the future, without losing sight of the new technological possibilities of the manufacture and use of restoration mortars.

In this communication, the basic/traditional tests that are practiced in mortars are demonstrated to understand the actions that may be necessary for the intervention/conservation/restoration of historic buildings, and the methodology applied in this technological initiation reported here seeks to differentiate itself from the basic premises employed in the studies of this area by provoking reflective arguments about the quantity versus the quality of samples studied, that is, special attention was given to what was called learning from observation; In this topic of communication, the need and importance of understanding the architecture of the building, the old construction techniques, the pathologies incident on the property are exposed, even aiming at the assertive choice of locations and number of sample collection; as well as, subsequently, the execution of detailed visual observations on these qualitatively pre-chosen samples for the definition/scientific choice of which sample offers greater possibilities of representing the "original" mortar or more suitable for reconstitution/complementation of the parietal surfaces of the building under study, avoiding unnecessary expenditure of time and resources.

The case study of the old mortars of the Church of Nossa Senhora da Conceição da Comandaroba, a "rural chapel" built around 1734 by the Jesuits in the city of Laranjeiras, in the interior of Sergipe, allows us to characterize/propose a mortar of restitution in the face of scientific demands that today require contributions of revaluation/revisitation of human knowledge; optimization of the cost-benefit in the collection of samples and execution of laboratory tests; generate reflective discussions about mortars and ancient construction techniques; to produce inventories on the constitution of mortars in the Brazilian colonial period and to contribute to future interventions in the works to be restored from laboratory information, serving as data files valuing the development of knowledge in the area of Conservation and Restoration Technology and knowledge of national heritage.

LARANJEIRAS AND THE "BITTER BEAN" CHURCH IS IN CHARGE OF THE "BITTER BEAN"

About the colonization of the region of the Cotinguiba Valley (Nunes, 1989, p. 29 and 104), especially the origin of the village of Laranjeiras (Freire, 1995, p. 35-37), some stories and stories are reported, the most romantic tells that the city was born from a flower: "Laranjeiras was born from a flower. From the fragrant and beautiful orange blossom, which symbolizes the virginity of brides, was born the heroic Laranjeiras, murmuring and sobbing, wife of Cotinguiba." (Oliveira, 1942, p. 35). The settlement would have been implanted on the left bank of the Cotinguiba River, where there was an orange tree, under which the primitive inhabitants sang to the sound of the viola their loves, and rested from the vigorous sun, waiting for the time of the journeys (Oliveira, op. cit., p. 35). One of the most important elements for the foundation of the village of Laranjeiras were the Sugar Mills, which, of the three known types, predominated those powered by animals and those powered by water and which, in the nineteenth century, figured in the Cotinguiba Valley with more than 300 mills (Nascimento, 1981, p. 34 and 63); this mechanism, classically described by Gilberto Freyre in his book "Casa Grande e Senzala" (1996), was constant throughout the lands of the Brazilian Northeast and influenced the first settlements in this Valley of "Serigipe" (Oliveira, op. cit., p. 38).

The romantic history of the foundation of Laranjeiras has been associated with the fact that it has become the cradle of the culture of the Province and the State and, over time, has been nicknamed "The Sergipe Athens" (CINFORM, 2002, p. 126-128). Another connotation decanted in the poems is the relationship with the Orange Blossom which, since Antiquity, has signified virginity and innocence (Oliveira, op. cit., p. 36). Laranjeiras is located between six hills that would be: Alto do Bonfim, Colina de Bom Jesus dos Navegantes, Cruzeiro do Século, Boa Vista, Oiteiro do Horto and Pedra Furada and the date of its birth cannot be determined due to the slowness of its implementation on the right bank of the river, and some consider that the urban nucleus will appear around 1794 (LARANJEIRAS, 2000, p. 24).

In the history and urban evolution of Brazil, the implantation of religious constructions in the village meant the very result of the emergence of settlements (Reis Filho, 1968, p. 177-181). The case of Laranjeiras would be no exception to this rule and would be related to the construction of the Mother Church of the Sacred Heart of Jesus in 1791. However, it is the Church of Retiro, built in 1701 by the Jesuits, that was the first important reference for the establishment of the village of Laranjeiras (Nascimento, op. cit., p. 42). Another important construction to determine the establishment of the village of Laranjeiras was the Church of Comandaroba from 1731-1734, the second home of the Jesuits in the region and which was approximately one kilometer from the village, having as patron saint the Virgin of the Conception and currently considered one of the most important and beautiful representations of Rural Chapels in Brazil (Tirapeli and Pfeiffer, 1999, p. 198-199).

About the Church of Comandaroba, the most famous parish priest of the city, Philadelpho Jonatas de Oliveira, describes: "(...) on a sweaty collina, unveiling a long and vague horizon, sits at the gates of the city of the Heart of Jesus, as an advanced sentinel of the faith of the people, the Church of Comandaroba." (Oliveira, op. cit., p. 44).

The Church of Nossa Senhora da Conceição da Comandaroba was built in the place where the indigenous people cultivated beans, hence the name Comandaroba which, in the *Old Tupi* and *Guarani* language, means: Comanda – Beans and Róba – bitter ("green"), in this way, "Bitter Beans" would be, according to scholars Viscount de Beaurepaire and Dr. Theodoro Sampaio, the "understanding" of its "meaning" (National Inventory of Integrated Movable Assets – IPHAN, 2001, p. 02). This Jesuit construction, begun around 1731 and completed in 1734 (Figures 1 and 2), according to the date marked on its door, is a national heritage listed in the Book of Fine Arts Sheet 58 - inscription 272-A of March 23, 1943; and in the Historical Book V. I, page 35 - inscription 207, of March 23, 1943 (Movable and Immovable Property Inscribed in the IPHAN Tombo Books, 1994, p. 195).

Figure 1: Church of Nossa Senhora da Conceição da Comandaroba (Feijão-Amargoso).

Source: PIBITI Research Group 2022/2023.

Figure 2: (left) – Limestone doorway. (right) – Detail of the cartouche at the top of the doorway dated 1734 and above the cartouche, pagan representation of the God Zephyr. 2022/2023.

Source: PIBITI Research Group

Located at Fazenda Boa Sorte S/N, it belongs to the Archdiocese of Aracaju; In its architectural ensemble, the horizontal line predominates, the frontispiece is quite expressive and has an oculus in the center, surmounted by a limestone cross. Germain Bazin, one of the most important scholars of the Baroque in Brazil, describes it as follows: "This Church has a rectangular plan, inside which are inscribed the nave and the chancel, surrounded by constructions that in the middle of the surface, are supported by a portico of benches, which goes around the façade (...) the towers were replaced by steeples-arcades." (Bazin, 1956, p. 176). The limestone entrance door is inscribed with the date of 1734, perhaps the style revealed its construction date a little earlier, since it is the second residence of the Jesuits in

Laranjeiras (Nogueira e Silva, 2009, p. 89 to 93); inside, the main altar, the baptismal font and the chest stand out (Figure 3).

Figure 3: (left) – Portico of benches flanking the main nave (called porches). (center left) – High altar. (center right) – Baptismal font in limestone. (right) - Chestnut in rosewood. 2022/2023.

Source: PIBITI Research Group

The portico of the Church in limestone may have been carved in Portugal and sent to the captaincy with a return charge, or in the environment itself, where there is an abundance of this material, in this portico is engraved in monogram (*AD Majorem Dei Gloriam*) that informs the Jesuit origin and its patron saint, the Virgin of the Conception. The Arco Cruzeiro is three meters and fifty wide and from there to the high altar it is six meters, surmounted by a shield with the inscription: "toda Pulchria es Mana" meaning that the Virgin Mana of the Conception is its Patroness. On the façade of the Church, five arcades, three on the body and two on the sides. The rear façade has a stone cross and two spires and, inside the Church, exquisite carved wood work with Solomonic columns and vine leaves, grape bunches, pelicans, etc., a festive multiplication of canonical symbols; the sacristy chest has the same characteristics as the high altar (Nogueira e Silva, op. cit., p. 89 to 93).

The popular imagination reports that at the bottom of its high altar there is a well (currently closed), which enters a connection that leads to the cave of Pedra Furada. The Church is located in the countryside approximately 1 km from the city center and the building is on an elevation, like all Jesuit construction, it takes advantage of geography to impose itself on the landscape. In front of the building is a churchyard with a cross, which is not Jesuit but Franciscan (probably a remnant, placed after the expulsion of the Jesuits); on the frontispiece, there is a main doorway on the ground floor formed by three full arches; in the upper one the three basic windows of the Jesuit construction typology; the ground and upper floors, as well as the pediment, are separated by tears, with the pediment of lacy cornices, surmounted by a Latin cross and the bell towers (bell towers) by spires in the shape of arrowheads (Nogueira e Silva, op. cit., p. 89 to 93).

A striking feature of this rural chapel is the veranda (porch), established both at the front entrance of the building and in its external lateral body, which served to shelter the faithful who were not invited, due to their social hierarchy, to enter the Church, but who saw themselves protected from the weather by this constructive element. The other two elements of importance in this construction are the main shutter and the notched protections of the internal windows of the main façade; The main doorway is preceded by a veranda narthex and has lintels (pilasters) formed by friezes of acanthus foliage in several layers, with allegorical grotesque leaves and grotesque masks in its center and in the main cartouche, dated 1734, and from the mouths of the sculpted characters come foliage and apparently winds (winds – gods of the good winds), The style is Manueline, represented by wooden turns that form protective railings on the internal windows of the main façade, reminiscent of the twisted ropes (knots) of the Portuguese ships.

Godofredo Filho describes the Jesuit buildings in Brazil as works of architectural genius and located in places where silence and "perfect" solitude always reigned, typical of the possibility of catechesis of his pedagogy and that the rude construction unravels in the face of the affectionate care of the details that make up its ornaments (Filho, 1937, p. 101); this Jesuit taste can be seen in the tracery of the pulpit which, in Comandaroba, features a lion carved in limestone; the paintings so present in representations on the parietal surfaces in Jesuit churches with floral and geometric elements, cannot be seen in the Comandaroba, except for the representations carved in wood of its high altar and chest and in the carved carving of the toilet (Figures 4 and 5).

Figure 4: (left) – Pulpit in limestone and rosewood; detail of a lion carved in limestone as if doing the "times" of an Atlantean. (right) – High altar in rosewood with floral representations including vines.

Source: PIBITI Research Group 2022/2023.

Figure 5: (left) – Detail of the chest with floral elements. (center) – Detail of the ornaments of the drawers of the chest. (right) – Detail of the sacristy toilet.

Source: PIBITI Research Group 2022/2023.

The construction techniques and materials used in the Church of Comandaroba present, as is common in Brazil and in the buildings of Sergipe in the eighteenth century, a central reflection of how much our architecture demonstrates originality and how much it innovated due to the difficulties of transposing models (Costa, 1995, p. 451). Opposing the supposedly original lessons to the needs imposed by the lack of materials, technical knowledge, specialized people, financial resources and the local way of know-how, inevitably imposed new solutions and new concepts. Society, religiosity, economy, geography, climate, construction time, in short, cultural elements, undoubtedly, shaped a more characteristic local architecture that is being carried out and that can be easily recognized in this building, such as exuberance, vigorous naturalism, robustness, dynamism of curves and shapes, adding motifs from the sea and terrestrial plant world (Nascimento, op. cit., p. 15).

The materials used in the first constructions in Sergipe, such as the *"TEJUBEBA" property*, from 1601, in Itaporanga D'Ajuda, used by the Jesuits, was *the Taipa de Sebe* (wattle-and-daub/hand-clay); and that, in addition to the Portuguese influence in these buildings of the seventeenth century, the Italian influence is noted, especially in the ornamentation of the altars (Nascimento, op. cit., p. 27). In relation to the masonry used in Sergipe in the seventeenth to nineteenth centuries, in addition to clay (kaolinite), limestone and sandstone were used; However, regarding the use of mortars in this period, many questions are still to be answered. Nascimento argues that, although mortars in Sergipe were based in the sixteenth and seventeenth centuries on the use of rammed earth and sticks and vines in the moorings, masonry began to use limestone in the seventeenth, eighteenth and nineteenth centuries, especially in religious architecture and in richer civil buildings and that mortars were always constituted or characterized as: "... mortar formed by lime, hall (red clay) and molasses (residue from sugar refining), after trampling by slaves, a more expensive technique, but more solid and more indicated..." (Nascimento, op. cit*element.*, p. 47).

In structural systems, the foundations, in the colonial period, are always made of clay or stone masonry, or sometimes, lime mortar is used to fill small voids, and its dimensioning depends on the volumes that the building will demonstrate, and, on average, the depth of the baldrames beams in colonial residences could reach 1 meter (Vasconcellos, 1979, p. 13), we believe that, in the case of the Church of Comandaroba, this depth may have reached 1.5 meters. The walls of the Church of Comandaroba are also structural, that is, in addition to being a fence, they support the loads of the construction throughout their length. Silvio de Vasconcellos states that walls, in the colonial period, could be built in rammed earth and stone, lime and bricks (Vasconcellos, op. cit., p. 19); in the case of the Church of Comandaroba, from the *in situ* observations that will be further explored in the next topic, we find what can be said of a "mixed" system, where the clay, probably sifted, was purposely mixed with larger and smaller boulders, forming a conglomerate in the form of concrete, however, in some stretches there are also ceramic bricks and stones composing the masonry; in Minas Gerais (Diamantina), this type of mortar is called "Piruruca" by popular knowledge and rammed earth "Formigão" (Vasconcellos, op. cit., p. 21); in Sergipe Del Rei, this type of mortar is called "Salon Clay" by the ancients (Nascimento, op. cit., p. 47).

In Comandaroba, construction processes from the colonial period, linked to certain details of the construction, present peculiar technical solutions, such as the side and front balcony. Luis Saia calls some of these spaces "Porches", truly representative of a "popular Brazilian architecture" (Saia, 1978, p. 101). In Comandaroba, these side and front porches of the Church are presented in arcades that receive a great structural effort referring to the overlapping upper part, formed by the weight of galleries and the extension of the roof. For Philadelpho Jonatas de Oliveira, the Fathers of the Society of Jesus did not build a better residence "because they could already hear in the distance the screeching of weapons and the creaking of the bars of the Marquis of Pombal's prisons" (...) kneading the clay, cutting the wood and performing the material work" (Oliveira, op. cit., p. 43). Understanding these construction techniques, the know-how acquired and imposed by the difficulties of the environment from the detailed analysis of the building, the pathologies incident to it and the determination of the most expressive places for sample collection, having as principles the minimum intervention and the methodological proposal of learning from observation is what will be demonstrated below.

THE LEARNING OF OBSERVATION.

Starting from the established idea that any intervention in a monument cannot dispense with a critical judgment and preliminary investigation into the nature of the object in order to detect its pre-existence (Riegl, 2014, p. 20) and that the nature of conservation and restoration end up entailing dangers that threaten its preservation (Dvoràk, 2008, p. 65), where the enjoyer observer, including in this category those who have the role of intervening and acting on heritage assets, must awaken in themselves three indispensable senses: the *sensitive*, which indicates the perception of the value of the object; the spiritual, the *perception* of memory and; the *functional*, the perception of the use, novelty, volable and technical condition of the building (Dvoràk, op. cit., p. 111); So, how and in what way to awaken these senses and apply them?

The study of heritage initially requires an inventory, a questionnaire (Choay, 1999, p. 11). As well as the knowing, knowing and understanding of pathological manifestations, which act on goods (Tinoco, 2009, p. 3). However, even knowing the need to identify these issues that act on heritage objects, what we really need is to observe details, minutiae, small arrangements and, in the words of conservation and restoration theorists, we need to learn to see the minimal interventions, the distinguishability, the harmony and disharmony, the complements (style or analog), the additions, the renewals, the reversibility, ephemerality, patina, ambiance, repristination, arbitrariness, efficiency, removals, releases, reconstructions, accessory alterations, reintegrations, cleaning and sanitation, modifications and conservation in structures (consolidation and stabilization), chromatic alterations, new techniques and procedures of interventions, the use of cement and additives in mortars, non-destructive analyses, prostheses and replacements (Brandi, 2004).

For the characterization of the mortars of the Church of Comandaroba, we applied as an initial methodological action what we call *learning from observation*, that is, *in situ* we identified and evaluated the common degradations in buildings of colonial "typology" implanted in regions with periods of intense and prolonged rains, usually the result of rising and falling humidity, caused by the capillarities and porosities of the materials involved, in addition to the marked presence of saline efflorescence that causes fissures, cracks, detachments, stains, biological degradations, etc. (Oliveira, 2002, p. 37). Along with these observations, we cultivate a critical reflection on the theory of conservation and restoration based on direct contact with the building to achieve some mastery of knowledge about the history, materials, techniques and constructive know-how applied in this building, accepting as legitimate the Vitruvian proposition of the training of architects with more complete knowledge in the attributes of solidity, of utility and beauty (Polião, 1999, p. 57).

On the steep climb up the hill, until you reach the cross in front of the Comandaroba Church, a route of approximately 150 meters, you can see the clay soil that outcrops the surface, suitable for planting sugar cane; this path, in Sergipe's winter seasons (rains), makes the climb painful and extremely difficult (Figure 6). This condition of the soil indicates the anticipated possibility of problems in relation to humidity and resistance of the walls, since this material was probably used in the construction of the Church and it is typical of its condition to present these characteristics, when evaluating tactile this soil we realize its fragility, due to the thinner thickness of the composition, despite its plasticity and resistance to finger pressure and its disaggregation from clods being slower, and its color is extremely reddish, contributing to the name given to it by the ancients of "clay hall" (Santiago, 2001, p. 18-20).

Figure 6: (left) – Chapel (Comandaroba Church) at the top of the hill. (center) – Detail of the soil of the land on which the building was erected (red clay called "hall" by the locals). (right) – View of the path that leads to the Church through the Choir window (inner side).

Source: PIBITI Research Group 2022/2023.

On the main façade, despite having received recent whitewashing, dirt is visible that settles in the limestone of the crucifix topped on the pediment, in the capitals in the shape of arrowheads and, especially, in the tears and cornices. These soils are black in color and in spots that denote an aspect, possibly, caused by the runoff of rainwater on the architectural surfaces, containing, perhaps, carbon dioxide (CO_2) or other chemical agents, coming from and expelled by the large flow of motor vehicles on the highway in front of the building and on the side of the west façade, due to a side road that leads to the farm's headquarters and neighboring villages (requires further studies); regarding the humidity that can also be observed on the external side walls, there are several possible agents that cause this anomaly, such as the humidity of construction, terrain, precipitation, condensation, hygroscopicity and fortuitous causes (Henriques, 2007), from the shapes of the moisture stains observed on the external walls, we believe that this humidity is caused by precipitation (Figure 7).

Figure 7: (left) – Stone cross on top of the pediment. (left center) – Coruchéu in the tower. (center right) – Circulation of vehicles through the side road on the west side of the Church. (right) – The back of the church attacked by high humidity.

Source: PIBITI Research Group 2022/2023.

The attack by humidity on the external side walls also appears below the benches of the veranda (porch), in this case due to the humidity on the ground (Henriques, 2007, p. 09), as visual observation detects stains near the ground (externally) and floor (internally) with eroded areas on the upper part of these stains accompanied by mold and the possibility of attack by salts, although the efflorescence is not present in high concentration, it may be at a given internal level of the mortars; In the internal areas of Camandaroba, the issue of moisture spots with characteristics related to infiltrations caused by precipitation is also widely observed, which may be occurring by direct penetration, we believe that this pathology is also related to the intense winds that reach the top of this hill, causing an increase in the kinetic energy of the droplets, however, another component causes the penetration of rainwater into the interior of the building, that is, the walls of the Church have a marked presence of cracks, which in certain places are more expressive and can easily be classified as cracks; also throughout the internal part of the building, humidity is observed very intensely by surface condensation, especially in the sacristy and behind the altar, probably associated with poor ventilation, these humidity is always associated with the presence of mold, lichens and bacteria (Figures 8 and 9).

Figure 8: (left) – Humidity in the benches of the balcony of the west façade. (center) – Detail of infiltrations, moisture stain, balcony wall, west façade. (right) – Detail of condensation humidity accompanied by cracks in the sacristy on the left side of the high altar (west side).

Source: PIBITI Research Group 2022/2023.

Figure 9: (left) – Internal side wall of the sacristy on the right side of the high altar (condensed humidity). (center) – Wall behind the high altar with high concentration of humidity and condensation. (right) – Detail of the internal wall of the sacristy on the left side of the altar, condensation humidity accompanied by one of the largest cracks found in the building, with great loss of material (west side).

Source: PIBITI Research Group 2022/2023.

In the Church of Comandaroba, the attack by soluble salts (Sodium Chloride - NaCl; Sodium Sulfate - Na2SO4 and Sodium Nitrate - NaNO3) is intrinsically linked to the issue of attack by moisture, especially to episodes of "wetting" and "drying" of surfaces, which cause the crystallization of these salts with the appearance of saline efflorescence (Rodrigues and Gonçalves, 2007, p. 2-3); however, it is necessary, before analyzing and indicating places attacked by this pathology, to understand that this building is 42 meters above sea level, on the top of a hill, which is approximately 18 kilometers east of the Atlantic Ocean at position 10048'25"S37011'01"W and that the predominant wind in this region of Laranjeiras is the East/Southwest, reaching average speeds of 8 km/h (Google Earth, 2023), which are indisputably factors that contribute to the attack of these salts; in addition, of course, to issues associated with them, such as the presence of fertilizers with ammonia that contaminate rivers and their sands (Nitrates); composition of the sulfur-rich soil in the region

(Sulfates and Nitrates), contamination by animal feces, such as bats, pigeons and rats (Nitrates), variables always present in the pathologies incident to historic buildings (Oliveira, 2002, p. 48-49).

The phenomenon of salt attack and the presence of efflorescence and cryptoflorescence, followed by lightness and powderiness, are associated with several issues, among which are infiltrations in the roof and condensation of the parietal surfaces, anomalies that can be easily noticed in most of the walls of the Church of Comandaroba, despite the detection of that famous "whitishing" being amalgamated with the stains of humidity and, In most of these places attacked by humidity, go unnoticed by the less attentive observer.

The wider thickness of the walls of old buildings, such as those of the Church of Comandaroba, more porous and more deformable, cause the penetration of water more easily, as well as its evaporation and retention of salt crystals within their capillarities; These conditions are observed on most of the external and internal wall surfaces of this building, however, the side wall of the west façade (external and internal) is highly attacked by saline efflorescences, even causing the detachment of the plaster; another place with a high incidence of soluble salts is the internal wall of the sacristies lateral to the chancel (Figure 10).

Figure 10: (left) – Attack by salts on the external west side façade. (center) – Attack by salts on the west side wall upper part (galleries above the balcony). (right) – Attack by salts on the inner wall of the Sacristy on the left side of the chancel (west side of the Church).

Source: PIBITI Research Group 2022/2023.

Mechanical stress is, together with humidity and attack by soluble salts, the pathology that is most present in the Church of Comandaroba. Disaggregations, crushing and cracking were observed, especially on the west side of the building, in the region of the arcades of the balcony and the interior part of the sacristy. This anomaly is worrisome, because, in addition to affecting the issue of safety and conservation of heritage property, it makes it unfeasible or at least makes difficult various actions in the possible interventions and restoration methodologies that may be necessary, such as the extraction of samples carried out in a destructive way (Pinho, 2008, p. 193). Two hypotheses can be launched in relation to this problem and that, in a way, are relatable to each other in view of the observations made: 1) Occurrence of movement of the land and respective structural shock (accommodations) due to the flow of cars/trucks in the west side vicinal; 2) Attack of moisture and salts causing mechanical anomalies in the walls.

On the wall of the west side façade (external and internal), the disaggregations are the indication that there is an action of alternation of successive expansions and contractions, along with the effect of the prevailing southwest wind, and the limestone stones in the windows and main doorway suffer greatly from these actions; these disaggregations in the Church of Comandaroba take place at the level of the ground floor due, normally, to the humidity of the land that rises by capillarity. Crushing usually occurs in "localized zones", that is, places of excess concentrated loads, in Comandaroba, the points most attacked by crushing are the arches of the balcony of the west wall, where a "stabilization" was even carried out with a curved metal piece (iron). This occurrence is one of the points that requires further study. Cracking (fissures/cracks/cracks) occurs both in the walls and in the corners of doors and windows, where high stress loads act more intensely, as in the case of the passage door of the internal wall of the sacristy on the west side, in the center of the arches and in many limestone lintels of the windows of the Church, especially in the side windows of the main door (Figure 11).

Figure 11: (above - from left to right) – Disaggregations, crushing and cracking in the benches and arches of the balcony of the west wall. (center - from left to right) – Crushing and cracking at the sacristy door; in one of the arches of the balcony with stabilization, both on the west wall; cracking in the limestone of the window next to the main doorway. (below - from left to right) – cracks with disaggregation and crushing in the center of the arches of the balcony of the west wall; cracking in the limestone main doorway.

Source: PIBITI Research Group 2022/2023.

In the Church of Comandaroba, attacks by aerial vegetation were also observed, specifically in the bell tower next to the east façade and on the roof of the chancel and sacristies; biological attacks associated with humidity were observed in some places, such as in the oculus inside the building and in some walls of the choir passages to the upper galleries, but easy to remove and treat. We must, in general, consider that all these pathologies must be corrected or at least reduced, however, these actions must be based on the assumption that technical action should solve the problem and not increase the causes that are causing them, as well as these interventions, when indicated and carried out, should be guided by scrupulous issues, recovering the best part of the quality of the building (Rodríguez, 2003, p. 1-5). Therefore, visual observation made it possible to understand several technical issues of degradation present in the Church of Comandaroba, including the understanding of which places can offer studies for collection and laboratory tests that prove many of the visual observations carried out, including the assumption of minimal intervention for the collection of samples and the principle of efficiency for carrying out laboratory tests.

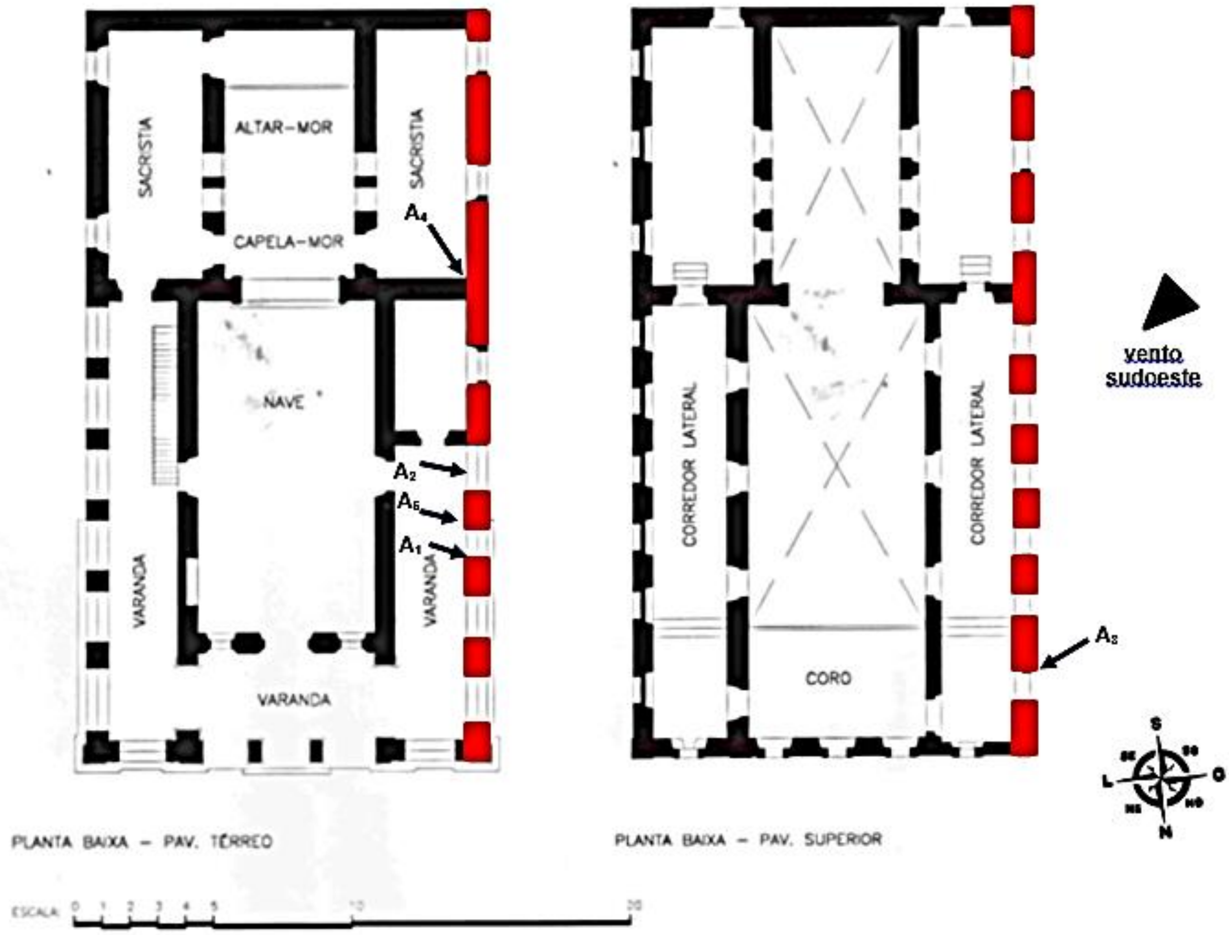
APPLICATION OF LEARNING FROM OBSERVATION – COLLECTION AND REHEARSAL

The documentation, identification and complete record of the state in which the building is located is part of any methodology of actions on heritage buildings in view of their conservation and restoration, but the interpretation of these results, beyond the simple quantitative motivation, must be characterized by the conceptual determination of a sense of efficacy providing a possibility of acting "before" and "after" the intervention, it is also part of the choice of places for collecting and testing samples (Veiga et al., 2004, p. 23-27). The observations and reflections regarding the historical value judgment, aesthetic, economic, volable, risk value judgment, etc. (Riegl, op. cit., p. 49), as well as the identification of the places attacked by pathologies in the Church of Nossa Senhora da Conceição da Comandaroba indicated as a greater possibility of efficacy, in the sense of providing answers to the characterization of its mortars, the walls of the west façade, both on the outside and on the inside.

The selection of the west wall for the collection of samples for the tests was based on the methodological justification of some principles and objectives: a) it was based on the spatial conception of the structure of the building – volumetry and structural constructive folding; b) in the transformations and anomalies that the building is presenting with the determination of points that are more representative of the cases such as humidity, salts, mechanical stress, trace, granulometry and color; c) in the identification of zones that present the same information in relation to constructive aspects (construction materials and techniques) and pathological aspects (identification and mapping of local damage); d) possibilities of cross-referencing historical information (know-how/orality/documentary) with observations of mortars *in situ*; e) selection of the place that presents the possibility of identifying more original or untouched materials, when possible older extracts; f) principle of minimum destruction of the building with minimum necessary collection.

On the wall of the west façade, five (5) samples were collected, called **A1**, **A2**, **A3**, **A4** and **A5**; the locations and quantity, in addition to respect for the principles listed above, are methodologically justified as: a) constructive spatial conception of the Church of Comandaroba within the Palladian contributions (Argan, 1999, p. 399), that is, of its "bone" and its essential parts such as the the balcony, interconnected to the nave and the chapel, structurally "replenish" the east and west sides, producing the same efforts; in the repetition of the arcades, which symmetrically receive the same windows in the upper overlapping part of their galleries, but which demonstrate more intense pathologies on the west side; b) greater attack by humidity and consequently salts, as well as mechanical stress on the west side, that is, accumulation of tensions altering the stability of the building (Rodríguez, op. cit., p. 17); c) predominant incidence of wind coming from the southwest, causing an increase in pathological causes; d) principle of minimum intervention and effectiveness (Figure 12).

Figure 12: Floor plans of the ground and upper floors of the Church of Comandaroba with the determination of the site and collection of samples **A1**, **A2**, **A3**, **A4** and **A5** on the west façade (in red on the floor plans).

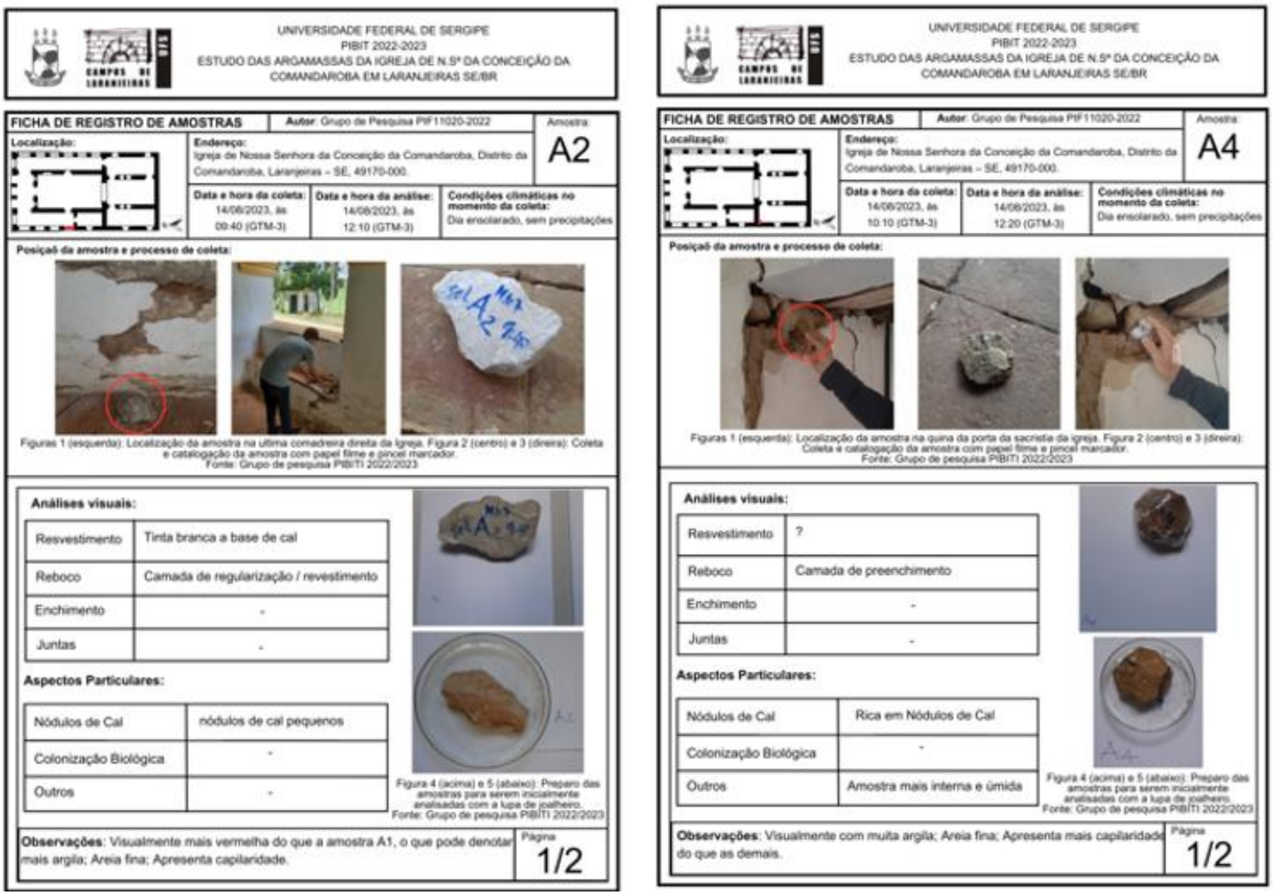


Source: National Inventory of Integrated Movable Assets – IPHAN, 2001, p. 03-04 – changes PIBITI research group 2022/2023.

The choice of the collection site and tests were also structured on the experience and understanding that the most representative mortar of historic buildings in Sergipe in the eighteenth and nineteenth centuries is the one characterized by the trace/granulometry with lime nodules (1 part); red clay between 0.5 and 3 parts (hall); sandy 3 to 6 parts (predominance of medium sand) and possibility of the presence of nodules of charcoal, seeds and sugarcane bagasse, as well as sugarcane molasses; This information can be verified in several studies already carried out at the CTPR (Center for Technology for Preservation and Restoration) of the Federal University of Sergipe, based on projects approved in Scientific and Technological Initiation research and published in annals and journal articles such as: Characterization of the historical mortars of the center of traditions of the municipality of Laranjeiras/SE (Silva et al., 2019); Study of the ancient mortars of the church of Our Lady the Amparo of brown men in São Cristóvão SE/BR (Silva et al. 2019); Ceramic powder as an alternative additive in the restoration of historic mortars: the case of the Church of Nossa Senhora do Amparo de São Cristóvão SE/BR (Silva et al., 2021); Study of the ancient mortars of the church of N. Sa do Rosário dos Homens Pretos in São Cristóvão SE/BR (Silva et al., 2021); Documentation, conservation and restoration, heritage record: The ruin of Nazaré of the Itaperoá SE/Br mill (Goes e Silva, 2021); Characterization of the mortars of the Convent of São Francisco in São Cristóvão, Sergipe, Brazil (Silva et al., 2023).

The collection of samples sought in the exercise of observation to characterize, initially, whether the samples contained or were part of the coating, plaster, plaster, joints, entanglements; of their particular aspects such as lime nodules, biological colonizations, special characteristics such as moisture intensity, clay, sands, mineral elements, vegetables, dirt, size of the samples, color, cement, hardness, consistency, roughness and smoothness; it was sought to understand the possibility of being a more "original" mortar from additives such as charcoal and sugarcane bagasse (vegetable fibers), lime and red clay. In this sense, inventory forms were produced and used *in situ* for all samples collected (**A1**, **A2**, **A3**, **A4** and **A5**) and, later, were complemented (further studies) with analysis of the samples in the part of the tests referring to visual observations (Figure 13). Seeking minimal destruction of the walls, all the samples collected were not extracted, but were already detached from the previously determined surfaces, as well as, when collected, they were packed in plastic film so as not to suffer any type of loss during transport to the laboratory (CTPR).

Figure 13: Visual evaluation sheets of samples **A2** and **A4** of the Church of Comandaroba with the determination of the location, collection and previous characterization.



Source: PIBITI Research Group 2022/2023.

The simplest laboratory tests to determine the behavior of a mortar are related to the presence of soluble salts, resistance to the presence of water, understanding of the trace and granulometry and verification of the visual appearance, including color (Kanan, 2008, p. 73). In fact, in the face of a methodology of learning observation, the most important test becomes the detailed visual analysis of the samples collected, thus, samples **A1**, **A2**, **A3**, **A4** and **A5,** upon arrival at the laboratory, in a time and under conditions that do not alter their constitution, were separated and weighed in petri dishes (wet weighing) and then placed to dry in an oven for 24 hours at 75℃ (Figure 14).

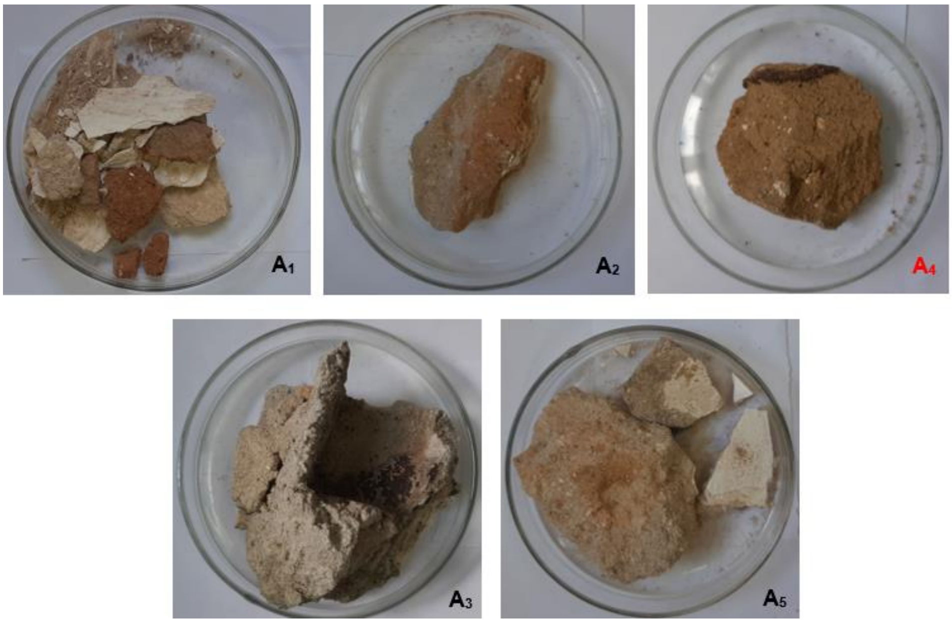
Figure 14: (left) - Sample preparation for visual observation and moisture analysis. (center) – Weighing of the A2 sample. (right) – Samples **A1**, **A2**, **A3**, **A4** and **A5** placed in the oven for drying**.**

Source: PIBITI Research Group 2022/2023.

Sample **A1** collected from the lower part of the west balcony bench (arcade 3), when analyzed visually, demonstrates a constitution formed by lime nodules, red clay in large quantities, fine and medium sand – under-rolled sand (evaluation by jeweler's magnifying glass 10 x 21 mm); it did not present charcoal and vegetable fibers, medium consistency and whole but in pieces, without biological attacks or dirt, little mineralogical material, it is characterized as plaster with a dark reddish color, measured with the digital caliper of 49.78 x 36.39 and thickness of 13.70 mm. Sample **A2** collected from the lower part of the west balcony bench (arcade 4) is characterized by expressive, homogeneous lime nodules, dark red clay in large proportion, has vegetable fibers, has no dirt, is very sandy, fine and medium, its composition is very similar to that of sample **A1**, measurement of 78.69 x 45.85 and thickness of 20.43 mm. Sample **A3** detached from the upper lintel of the gallery window above arch 1 and is characterized by the presence of cement, little or no lime and if it exists it is pulverized, has no clay, rich in medium sub-rolled sand, small grains of minerals, lichens, fungi and bacteria, insects, light grayish color, measurement 83.95 x 78.64 and thickness of 47.70 mm, High consistency, very hard, probable cement-based restitution mortar (new). The **A4 sample** is the one that visually demonstrates that it may be the most "original" of the building, collected from the internal wall of the upper part of the sacristy door on the west side, very humid, it shows a dark reddish color (clay hall) with lime nodules ($CaCO_3$) and little sand, there are no traces of cementitious, it presents a colonization of dark spot termites (biological attack), measurement of size 57.21 x 57.21 with thickness of 28.38 mm. Sample **A5** was collected from the bench of arch 3 as sample **A1** and consists of a complement plaster with few nodules of lime (calcite) with an imbalance in the proportion of the trace, it has no clay, biological attacks, whitish grayish color, no charcoal and no dirt, size measurement by the digital caliper 69.86 x 48.87 with a thickness of 25.22 mm, is similar to the **A3 sample**.

In visual observation, in general, samples **A1**, **A2** and **A4** have similarities in their constitutions, and sample **A4** is the one that has characteristics closest to representing a historical mortar, that is, lime (calcite), clay (kaolinite), sandy and color have a great possibility of being an "original" mortar of the building, as well as the collection region, being a place of difficult access, corroborates this understanding of an "old" mortar. Samples **A3** and **A5** do not present possibilities of representativeness of "old" mortars since they have cement in their composition and little red clay (Figure 15).

Figure 15: (above – from left to right) – Samples **A1**, **A2** and **A4**, the latter despite similarities with the previous ones is the one that has the most possibilities of representing the "old" mortar of the Church of Comandaroba. (below – from left to right) – Samples **A3** and **A5** presence of cement – modern complementation mortar**.**



Source: PIBITI Research Group 2022/2023.

The tests are intrinsically related to visual observations, the measurement of humidity and salts is no different, the choice of the position of sample collection, on the west face of the building, the place of highest incidence of precipitation and winds already indicated the high rate of attack by these agents. The wet weighing (PU) on a semi-analytic scale of sample **A1** was 77.31 grams (discounting the weight of the petri dish of 46.62 grams) placed to dry in an oven at 75$^{\circ}C$ for 24 hours resulted in a dry weight (PS) of 74.81 grams, which applied to the formula %U= ((PU-PS)/PS) x 100, resulted in a moisture content (%U) of 3.341%. Sample **A2** resulted in a moisture content of %U= 7.035% for a PU= 45.79 g and a PS= 42.78 g. Sample **A3** had a moisture content of %U= 1.387% for a PU= 214.12 g and a PS= 219.91g. Sample **A4** recorded a moisture content of %U= 12.037% for a PU= 85.63 g and a PS= 76.43 g. Sample **A5** %U= 0.518% PU= 104.70 g and PS= 104.16 g. These results together with visual observation confirm that the external sample **A3** demonstrates low %U since it is located in the external position, façade that receives the incidence of the afternoon sun (west) and, due to the expansion/retraction caused by the material (cement) caused its detachment from the surface (high stress index); samples **A1**, **A2** and **A5**, despite being in internal positions (benches of the balcony arcades), showed variations that indicate the increase in humidity the closer to the entrance of the sacristy (sample **A2** higher index), therefore, it has been proven that the place of greatest attack by humidity is the internal wall of the west façade of the sacristy, with a high moisture content (sample **A4**).

In the Church of Comandaroba it was proven, from the rehearsals, that the highest incidence of humidity attack is on the internal wall of the sacristy, a point exactly below the junction of the roof of the chancel with the main nave (crossing of the roof of the chancel with the eighth of the main nave), it is in this place that infiltrations from precipitation occur, Therefore, inspection and recovery work and waterproofing of the roof in this position is recommended. In the humidity of the arches and walls of the sacristies, which are due to capillaries in the porous material itself (hygroscopicity), studies of additive of the representative mortar from the **A4** sample with tile dust or brick dust (*concciopesto* and *mantopesto) are recommended,* since the knowledge and application of the old knowledge can help reduce the attack by humidity and not interfere in the dialogue between the new and the old, in addition, of course, to the greater effectiveness between cost-benefit and the environment (Figure 16).

Figure 16: (both on the left) – A2 PU and PS samples + petri dish. (center) • **A4** PS sample + petri dish. (right) – Junction between the roof of the sacristy and chancel with the eighth of the main nave (high rate of infiltrations).

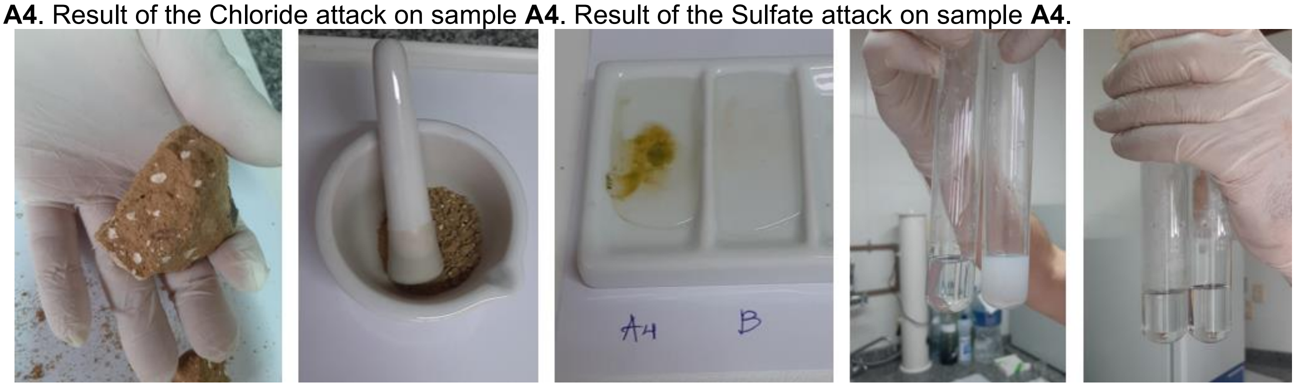
Source: PIBITI Research Group 2022/2023.

In the soluble salts test, there is a methodical interrogation of the phenomena observed so far, that is, the observation of different operations in the measure of different parameters already makes it possible to understand real causes and effects that occur in the Church of Comandaroba, such as the point of greatest occurrence of humidity, tensions and respectively of attack by salts is the wall of the west façade; as well as the greatest representativeness of the possibility of "old" mortar is the represented by the **A4 sample**;

therefore, the efficient action (Rodrigues, 2012, p. 26) that should be applied at this moment is in the determination of the soluble salts in **the A4** sample, because the other samples, due to their characteristics, will not produce scientific knowledge that can add value judgments to future interventions to be carried out in the building.

The sample **A4** under the analysis of the presence of nitrate (NaNO3) was distorted, weighed 10 grams, added 80 ml of deionized water in a 100 ml beaker, filtered in an erlenmayer which resulted in a filtrate poured into a touch plate, in which 2 drops of 1% sulfuric acid and three drops of diphenylamine were added, appearing the bluish reaction in the filtrate, the qualitative result of Nitrate in the sample **A4** Was discharge. To measure the presence of Chloride (NaCl), a little of the same previous filtrate placed in test tubes is used (one with the filtrate and the other blank), five drops of nitric acid (HNO are added$_3$ P.A) and three drops of silver nitrate solution (1% AgNO3), appearing cloudiness is the indication of the presence of Chloride, which, in the case of the sample **A4**, was highly concentrated. For the determination of the presence of sulfate (Na_2SO_4), the same filtrate is placed in test tubes (one with the filtrate and the other blank with deionized water), three to five drops of hydrochloric acid (HCl P.A) and three to five drops of barium chloride (5% BaCl2) are added, the appearance of turbidity indicates the presence of Sulfate, which, in this case, was non-existent of this salt (Figure 17). In view of the results obtained, it is recommended that the moisture that is attacking the sample region be tightened **A4**, as well as studies related to additives used by the ancients in constructive know-how (Lengen, 2009, p. 204) such as charcoal and sugarcane molasses (require more in-depth studies).

Figure 17: (from left to right) – A4 sample after being divided into two pieces showing the characteristics of an old mortar (rich in lime nodules and red clay). A4 sample being distorted. Result of nitrate attack in sample **A4**. Result of the Chloride attack on sample **A4**. Result of the Sulfate attack on sample **A4**.



Source: PIBITI Research Group 2022/2023.

The learning from observation indicates that sample **A4** is the one that has the most characteristics to be called the "original" of the building; this statement is also based on written sources that report "... mortar formed by lime, hall (red clay) and molasses (residue from sugar refining), after trampling by slaves" (Nascimento, op. cit., p. 47); the old mortars in Brazil "based on aerial lime have at least 25 to 35% of $CaCO_3$, which corresponds to a trace, in volume, that varies between 1:4 to 1:3 (lime:aggregate), but depending on the function of the mortar, they can present a much richer trace in lime (1:2 to 1:0.5)." (Kanan, op. cit., p. 38). To consolidate this verification, that the oldest mortar in Comandaroba is the one represented by the **A4 sample,** an analysis of its trace, granulometry and color was carried out.

In the analysis of the trace of the **A4** sample, one of the remaining pieces of the collection was distorted and weighed, approximately 10 grams on a semi-analytic scale in a beaker, also previously weighed, moistened with deionized water, attacked with a solution of hydrochloric acid 50ml of HCl 1:4 in a 100 ml cylinder; the sample will present an effervescence, a natural reaction from the presence of lime (dissolution of the binder), add three more drops of hydrochloric acid (sure that all binder has been dissolved), shake with a glass stick and proceed to filter to separate the fines from the coarse ones, after filtering it is placed in an oven for 24 hours at 75 degrees ºC, the material that is retained in the filter corresponds to the fines and the material that remains in the beaker corresponds to the coarse ones (Figure 18). The weighings obtained in this assay, after application of specific formulas (Table 1) for the fines (clay and/or silt) were: weight of filter paper 1.07 g, weight of paper plus residue 1.86g, weight of fines found 0.79 g, % over total mass 7.9%. For coarse (sand): beaker weight 52.01 g, beaker + sample weight 62.01 g, sample weight 10.00 g, beaker weight plus residue 59.60 g, found sand weight 7.59 g, % of total mass 75.90 %. For binder (insoluble residue) binder % 16.2%, carbonate weight 1.62 g, hydroxide weight 1.20 g. These measurements resulted in a probable trace of lime:clay:sand in the amount in parts of 1.0:0,5:6.0; that is, one (1) part lime to half (0.5) part clay to six (6) parts sand (Table 1), which resulted in the confirmation, in view of the references cited and visual observations made during this communication, that the **A4 sample** has characteristics very similar to the traces used in "old" mortars in Sergipe and in the Brazilian colonial period, being the most suitable for the restitution/complementation of the plaster in the restoration and conservation of the Church of Nossa Senhora da Comandaroba.

Figure 18: (from left to right) – Weighing of the A4 sample after being distorted for trace testing. Attack with hydrochloric attaché to separate the coarse from the fine (digestion). Filtering of the A4 Sample after acid attack. Result of the separation of the coarse from the fine of the **A4** sample. Coarse (beaker) and fine (filter paper) after drying in the oven for 24 hours of the **A4** sample. Result of weighing the coarse of the **A4 sample**.

Source: PIBITI Research Group 2022/2023.

Table 1 – (left) - Formulas applied in the determination of the mortar trace of the **A4** sample. (right) – Data obtained from the weighing and application of formulas to obtain the probable trace of the **A4 sample**.

$$\text{FINOS - \% MASSA TOTAL} = \frac{\text{PESO DOS FINOS}}{\text{PESO DA AMOSTRA}} \times 100$$

$$\text{GROSSOS - \% MASSA TOTAL} = \frac{\text{PESO AREIA ENCONTRADA}}{\text{PESO DA AMOSTRA}} \times 100$$

MASSA DO CARBONATO = PESO DA AMOSTRA – (PESO DOS FINOS + PESO DA AREIA).

$$\text{MASSA DO HIDRÓXIDO} = \frac{\text{MASSA DO CARBONATO} \times 74}{100}$$

PESO MOLECULAR Ca(OH) = 74

PESO MOLECULAR CaCO3 = 100

$$\text{TRAÇO MAIS PROVAVEL} = \frac{\text{MASSA DO HIDRÓXIDO}}{\text{MASSA DO HIDRÓXIDO}} : \frac{\text{MASSA DOS FINOS}}{\text{MASSA DO HIDRÓXIDO}} : \frac{\text{MASSA DA AREIA}}{\text{MASSA DO HIDRÓXIDO}}$$

FINOS (Argila e/ou Silte)	AMOSTRA A4
Peso do papel de filtro	1,05
Peso do papel + resíduo	1,60
Peso dos finos encontrados	0,55
% sobre a massa total	5,467
GROSSOS (AREIA)	
Peso do béquer	51,33
Peso do béquer + amostra	61,39
Peso da amostra	10,06
Peso do béquer + resíduo	59,17
Peso da areia encontrada	7,84
% sobre a massa total	77,932
LIGANTE (Resíduo solúvel)	
%L = 100 – (%F + %G)	16,608
Peso do Carbonato	1,67
Peso do Hidróxido	1,2358
TRAÇO MAIS PROVÁVEL	
Cal : Argila : Areia	1:0,5:6

Source: PIBITI Research Group 2022/2023.

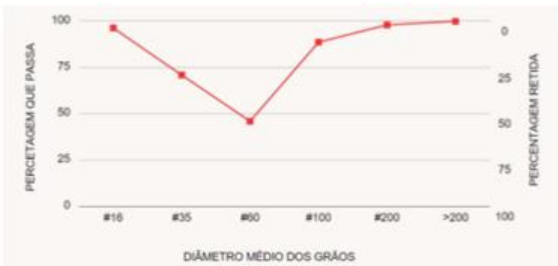
The granulometric analysis complements the characterization of the mortar to be used in a possible reintegration of the plaster of the walls of the Church of Comandaroba, To determine the composition of the coarse (sand) of the **A4** sample, the coarse residues dried in an oven for 24 hours at 75 degrees ºC were used, removed and left to cool in the desiccator for 15 min.; this material is placed in a set of mesh sieves (16, 35, 60, 100, 200 and >200) previously weighed and then manually stirred for 5 minutes, weighing the material that is retained in each mesh of the respective sieve (Figure 19). The sieves + sample measured a weight of **100.34** g for mesh 16; **99.45** g for mesh 35; **102.14** g for the 60 mesh one; **97.25** for the 100 mesh one; **93.87** for the 200 mesh and **77.47** for the >200 screen, i.e. with a retained material, respectively of **0.30** g (16); **2.23** g (35); **4.11** g (60); **0.89** g (100); **0.16** g (200) and **0.01** g (>200) (Table 2) that can be visualized from its particle size curve (Graph 1). The determination of the granulometry of the **A4** sample is rich in medium sand (sandy), this result is similar to most of the results obtained in several research projects carried out by CTPR/UFS (referenced throughout this communication), works that indicate the oldest characteristics of mortars in several buildings of the eighteenth and nineteenth centuries in Sergipe.

Figure 19: (above) – Sieves of meshes 16, 35, 60, 100, 200 and >200. (center from left to right) • Sieve mesh 35. Placing the beaker thickets for manual stirring for 5 minutes. Sieve weighing 60 + retained material. Sieve 60 with retained material (the one with the highest retained weight). (below) – 16 mesh sieves; 35; 60; 100; 200 and >200 after manual stirring with retained material (in yellow the mesh that retained the most material - medium sands).

Source: PIBITI Research Group 2022/2023.

Table 2 – (left) - Data obtained from the weighing of dry sieves, sieves + sample, sample weight, retained % and accumulated % of the particle size of the **A4 sample** with the application of the formula % retained = retained sample weight/total sample weight x 100.

PENEIRA (Nº)	PENEIRA (mm)	PESO DA PENEIRA (g)	PENEIRA+ AMOSTRA (g)	AMOSTRA (g)	% RETIDA	%ACUMULADA
16	1,18	100,04	100,34	0,30	3,74	3,4
35	0,5	97,22	99,45	2,23	29,10	32,24
60	0,25	98,03	102,14	4,11	54,0	86,26
100	0,15	96,27	97,25	0,89	11,40	97,66
200	0,075	93,65	93,81	0,16	2,12	99,78
>200	-	77,46	77,47	0,01	0,13	100



Source: PIBITI Research Group 2022/2023. **Graph 1** - (right) - Particle size curve of sample **A4** indicating predominance of medium sands. Source: PIBITI Research Group 2022/2023.

The sensation of the color produced in the retina depends on the *intensity of the light* that excites the pigments (Pedrosa, 2014, p. 20), therefore, in learning observation and its application, it is of fundamental importance to determine the color of the mortars, however, under this analysis it is necessary to be aware of the optical phenomena that can interfere in the identification, among which *Metamerism*: a situation in which two samples of colors appear the same under one lighting condition, but different under another; there is also geometric Metamerism and the observer's Metamerism; as well as *Color Constancy*: tendency to make the colors of an object remain the same when lighting conditions are changed (as opposed to metamerism); : the tendency of the eye to intensify the difference between colors, when they are placed side by side, especially in the case of complementary colors; Adaptation: adjustment of the visual system to the intensity or quality of the light stimulus, this phenomenon is common when entering a dark room; *Color memory*: the perception of color that a familiar object under normal lighting conditions will evoke in the observer's judgment, an apple, for example, will always appear red to the inattentive observer (Urland, 1999, p. 6).

The "reddish" color for mortars in the eighteenth and nineteenth centuries is a pattern cited by scholars of constructive history in Sergipe, as well as, by local know-how, even called "clay hall" due to the intensity of the red color in its typology (Nascimento, op. cit, p. 47). These mortars were made up of iron oxide, copper and silicon, which resulted in the accentuated red of their constitution; therefore, the **A4 sample** was the one that presented the closest staining to this determination. For the color analysis, the clods of the A4 sample were visually observed and inferred the "dark reddish" color or the color **10R 6/4** - a session of color 10 red hue with luminosity (brightness) 6 and saturation 4 (MUNSELL SYSTEM), later we analyzed the color of the fines (clay and/or silt) by the NCS System (natural Color System), The choice of this system was due to the fact that the use of the RM200 Digital Colorimeter can build a comparative methodology between visual observation and technological measurement. The color identified in the fines by the NCS system was **S4010-Y10R**, that is, 40% luminosity (brightness), 10% saturation and a yellow hue with 10% red, so the color for the fines would be a "reddish yellow", which corroborates the issue of the presence of lime and clay in this mortar.

The "dark reddish" color identified in the **A4** sample establishes, in addition to all the tests performed, the indication that the mortar present in this sample is the closest characterization to the old mortars of the Church of Nossa Senhora da Conceição da Comandaroba (Figure 20). It is important to emphasize that the NCS and MUNSELL systems are different systems for color evaluation, but they can serve to learn observation and its application.

Figure 20: (from left to right) – Lumps of the **A4 sample** analyzed by the MUNSELL process obtaining the color **10R 6/4**. Filter paper with the fines (clay and/or silt) and digital colorimeter RM200 NCS (Natural Color

System). Filter paper with fines residue, A4 sample. Measurement of the color of fines by the NCS process identifying the color of fines as **S4010-Y10R**.

Source: PIBITI Research Group 2022/2023.

FINAL CONSIDERATIONS

The complexity of the science of Conservation and Restoration provides us with a multiplicity of methodological possibilities to achieve the purpose of preserving heritage assets, the human role in this endeavor has always been indisputable, because knowing and valuing the cultural knowledge and way of doing things of the places have always been in the main lessons, principles, axioms and recommendations of theorists; this communication, by revisiting the learning of observation and its applicability, as an example of the old construction techniques amalgamated with solutions imposed by the lack of resources and specialized labor, unveils actions of extreme genius of local knowledge in original solutions, with the use of Argila Salão in the production of mortars for buildings in Sergipe, in the eighteenth and nineteenth centuries.

In the search for this understanding, the exercise of "discovery" permeates through conditioning factors that enter into the dialectic of actions between the tradition of knowledge and of doing the new needs imposed by the social, economic, political, administrative, ethical, etc. changes experienced by the research and by the "actors" who practice it; The solutions presented here in the search to recognize an old mortar, far from being innovations, exercise and revalue the principle of efficiency and "knowing how to look", since they start from the detailed qualitative analysis of the choice of which representation meets the hypotheses of answers to the formulated case.

The exercise is established within the precepts and concepts of a scientific initiation, therefore, despite being conducted in order to seek most of the answers and practices of understanding the Technology of Conservation and Restoration, many questions are still being answered and answered, which is typical of any scientific study, however, critical reflection, The main motivating agent of the science of the preservation of heritage assets is immeasurably attended to by determining, in view of all the basic techniques of recognition of the case, thoroughly studied, that the mortar of greatest "old" representativeness present on the walls of the Church of Nossa Senhora da Conceição da

Comandaroba is the one characterized by the **A4** sample, therefore, reintegrations that may be implemented should start from the study of this sampling.

The technical improvement of skills/methodologies related to the less destructive issue of sample collection, which usually involves the extraction of material that is sometimes not possible due to the historical fragility or resistance of this material, alternative techniques that increase the quality/effectiveness of laboratory investigations, the exercise of a maturity of research experiences that can and should be replicated, These are issues demonstrated in this communication that are expected to contribute to the preservation of the built heritage, causing the natural multiplier effect to the process of knowledge and, specifically, to the search for knowledge.

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