Chapter 39

Product Proposal For Restoring Residential Facades In Historical Sites Using A Lime-Based System

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José Genival Alves Junior
Bacharel em Arquitetura e Urbanismo. Faculdade ESUDA
E-mail: Esudajosejunior2@gmail.com

André Pina Moreira
Arquiteto e Urbanista Mestre em Desenvolvimento Urbano UFPE
E-mail: pinamoreira@gmail.com

André Neves Lemoine
Arquiteto e Urbanista, Doutor em Desenvolvimento Urbano, UFPE
E-mail: lemoineandre@gmail.com

Clodomir Barros Pereira Junior
Arquiteto da Prefeitura de Olinda, Mestre em Desenvolvimento Urbano, UFPE
E-mail: clodomirbarros@uol.com.br

ABSTRACT
Historic Urban Centers are important in the new era of the globalized world and the economic development of sustainable tourism. These centers are laden with symbolism and cultural identity. Key elements in the landscape. In this way, to attract visitors, it is essential to preserve the architectural and urban complex.
Facade coatings have as their main function the protection of masonry elements. In the context of historic buildings, in addition to protection, the external coating is an integral and inseparable element of the material authenticity of the monument. They are ancestral materials and techniques, in addition to chromatic concepts that, over the years, give it value and coherence within a whole.
Based on the aspects described above, the research consists of presenting a lime-based coating system that responds positively to the physical and chemical requirements of old supports, ensuring satisfactory resistance in addition to aesthetic and historical coherence, guaranteeing greater authenticity. , preserving the historical and aesthetic reading of the monument.
From the study of building typologies and ancestral construction techniques, combined with the study of mortars, their main characteristics, constituents, and pathologies, it was possible to adopt an experimental trait for the construction of a coating system inspired by ancient constructive practices for mortar coating on facades.
Finally, this research describes guidelines for further studies considered necessary for the improvement of this intervention process, which aims to reduce the distortions verified in the current practice of restoring old residential facades located in the Historic Site of Olinda.

Keywords: Historical Heritage, Conservation, Restoration, Lime.

1 INTRODUCTION

In the Historic Site of the City of Olinda (SHO), a wide degradation can be observed, as well as a marked de-characterization of several building facades, associated with a total absence of chromatic concepts in the interventions carried out. Likely, such pathologies are largely linked to natural aggressions. "The local climate, predominantly hot and humid, poses major problems for building conservation". (BRUAND, 2005, p.147).

In historic urban centers, one of the greatest difficulties encountered in conservation and maintenance is qualified personnel who know retrospective techniques and the correct use of materials that adapt to the various construction techniques used in past buildings.

In the context of historic buildings, in addition to the functions of protection, aesthetics, and comfort, the external coating is an integral and inseparable element of the material authenticity of the monument. They are ancestral materials and techniques, in addition to chromatic concepts that, over the years, have attributed value and coherence within a whole. The facades bear witness to the building's passage through time. They register on their surface, natural aging, and successive human actions, giving the building a character of originality through the patina2 that was constituted in the course of history. (AGUIAR, 1998). Facade coatings have as one of their main functions the protection of masonry elements, to guarantee greater durability to the building. Throughout their useful life, these coatings tend to suffer chemical, physical, and biological aggressions, which contribute to a slow and continuous degradation process. (SANTIAGO, 2007).

In certain cases, for the preservation of old buildings, it is necessary to partially or replace their external coating, according to the extent of degradation. However, the techniques for such interventions must be based on the characterization of the building's constructive elements, to use methods and materials that are compatible with the particularities of these building typologies.

However, it is possible that this degradation that is revealed on the facades of the buildings in the city's listed polygon, has other associated causes, such as the lack of maintenance and preventive conservation, as well as the inadequate and predatory use of its urban complex. During festive seasons, population density is much higher than the capacity of the city and, consequently, all waste disposal resulting from the most diverse activities that characterize such festivities. With this, to ensure the preservation of its collection, it is necessary to maintain and intervene even more periodically in its built set.

In turn, in the interventions of historic buildings, despite all the efforts of preservation entities, inappropriate constructive practices are generally observed, with the use of incompatible materials and procedures, ignoring the specificities and the very identity of the old constructions With this, both the durability of the buildings and their authenticity and consequent historical value are lost.

The city of Olinda, like other historic cities, has special characteristics in its urban planning that often do not meet the expectations of economic development of contemporary standards. Notably, these cities have in their historical heritage and associated cultural activities, an important source of income for the municipality, and therefore, it is necessary to seek to preserve their physical heritage durably, without harming their aesthetic, functional, and historical characteristics.

It is also observed that a large part of the available workforce is unaware of the ancestral techniques for executing coatings in inorganic lime-based mortar, now replaced by cement-based mortars. Indeed, this replacement, instead of protecting, could accelerate the process of degradation of the ancestral walls, due to the incompatibility between the old supports and the new techniques and cement-based coating materials. (VEIGA, 2007).

In this context, the degradation of many buildings in SHO3 becomes visible and, in a quick look at the listed heritage, examples of external plaster with a high degree of deterioration can be seen. No different, the paintings carried out on the facades also present different pathologies caused in part by the action of the weather, but accentuated by specifications and/or inappropriate use of products incompatible with the peculiar behavior of these buildings.

In general, the rigor in characterization, preservation, and restoration techniques is assigned according to the historical and artistic value of the building. Thus, the correct practice of intervention is limited to certain isolated monuments, such as administrative, religious, and military buildings, or even those that may represent economic interests. In this way, residential facades of a private character are left on a secondary level, but which are equally important in the composition of the image of the preserved urban complex.

According to Moreira (2006), SHO is predominantly residential, with 88% of residential properties and of this 76% owned by the resident population. In this way, interventions in most of the buildings in the listed polygon are under contract by the owner. The low qualification of the workforce to carry out these interventions may explain, in part, the pathologies observed in the vast majority of facades.

It is known that in traditional cities, the building's relationship with the urban space will be processed through the façade. It is the façade that expresses the distributive characteristics and the architectural language of the building, as well as being the identifying element of the city's image. (BARROS, 2006).

It is observed that there is a constant practice of reforms and repairs in the residential façades of the SHO. Such interventions almost always use inappropriate methods and materials for the particularities of these building typologies. Another fact to be considered is related to adequate solutions for these interventions, which require high research costs to characterize the original materials and, therefore, escape the financial reality of most SH residents. In this regard, religious buildings and others taken over by the government for administrative purposes can obtain more satisfactory results in interventions, as they have access to more appropriate resources from a technical and financial point of view.

Recently, at the end of 2017, to mitigate this problem of using inappropriate methods and materials, a project called Paint Your Heritage was created at the Secretariat of Cultural Heritage, using a small team of reeducated prisoners from the prison system, trained by employees of the PMO and the Sarasá institute. This project coordinated by the Executive Secretariat of Heritage has so far painted 10 buildings and has a long waiting list. In this partnership, the resident provides the material and the Project provides the labor.

Thus, this article is justified in the sense of presenting a product for the restoration of residential facades in historic sites using a lime-based system, which can meet the Paint Your Heritage project and the reality of owners who want to restore their facades.

2 OBJECTIVE

Sendo assim, o objetivo geral do presente artigo é apresentar proposta de produto para restauro de fachadas residenciais em sítios históricos utilizando sistema à base de cal, que possa atender a realidade de proprietários, aplicadores, assim como aos requisitos determinados pelos órgãos de competência, tanto na estância federal quanto municipal da cidade de Olinda. Uma solução que possa ser prática e segura, que responda de forma positiva às necessidades físicas e químicas do suporte e que possa assegurar ainda a constância e uniformidade na sua composição, de modo a se obter um resultado com regularidade em toda a extensão de aplicação. Contudo, será fundamental que a resposta das técnicas e produtos utilizados apresentem conformidade e compatibilidade com o tecido urbano e os aspectos históricos do edifício e de sua relação com o entorno, mantendo-se preservada a leitura histórica e estética do monumento.

3 METHODOLOGY

To carry out this article, the methodology used was based on bibliographical research through consultations with books, articles, theses, dissertations, catalogs, and technical standards, as well as any reliable source that deals with the subject, field research was also carried out through from interviews to specialists and applicators, carrying out photographic essays in historical preservation areas, elaboration, and testing of products; Finally, an analysis and comparison will be carried out between the constructive processes applied in the intervention of facades, to present an intervention proposal.

4 GENERAL CONSIDERATIONS

Neste tópico será abordada a origem e evolução da cidade de Olinda. As influências econômicas, políticas e sociais responsáveis pela sua fundação, crescimento, apogeu e declínio. Os séculos de abandono e o reencontro da sociedade com a história edificada da cidade que no período colonial foi uma das mais importantes do Brasil. Como também abordará a influência do pensamento dos principais teóricos da conservação e do restauro, assim como as posturas intervencionistas contemporâneas formatadas a partir destas teorias e apresenta conceitos tais como reabilitação, reconversão e restauro e a estreita relação entre estes, descrevendo também as cartas patrimoniais que conceituam e validam grande parte das intervenções em prática na atualidade.

4.1 URBAN EVOLUTION

The Letter of Donation of March 20, 1534, signed by the King of Portugal D. João III, a document drawn up in the Portuguese city of Évora on September 24, 1534, established the Captaincy of Pernambuco to its donee, Duarte Coelho, and with that the mission of building the extension of the kingdom of Portugal in the Americas. (ARAUJO, 2008).

> The Captaincy of Pernambuco was donated to Duarte Coelho in 1534, by King Dom João
> III. The donee took possession of the land on March 9, 1535, in the place now known as Sítio dos Marcos, where he installed the landmark of possession and the dividing mark between Pernambuco and Itamaracá. After his arrival, he set about founding the Vila
> de Igarassu, which must have happened between March and September 1535. Checking
> that the site where he built Igarassu was not very suitable for the seat of the captaincy, he decided to choose an elevation 20.0 km south of Igarassu and there he began the
> construction of the village of Olinda. (LEMOINE, 2000, p. 8).

Through the royal concessions granted to him, Duarte Coelho founds Vila de Olinda, donating a Charter to it in 1537. According to Oliveira (1996, apud Lemoine, 2000), The first written mention of Vila de Olinda is found in the called Foral de Olinda, which dates from March 12, 1537, whose original was lost during the Dutch invasion. The Charter of Olinda was considered by Duarte Coelho to be a kind of master plan for the city, as in addition to donating land for mercantile production, it also donates land to the City Council so that these could be transferred, in the form of tenure, to those who needed for building in the village, under the established terms. (ARAUJO, 2008).

Pereira Jr (2004) discusses in his dissertation that the Caetés Indians occupied the promontory in Olinda since the 15th century, where the so-called Marim d'Olinda sees is located. at the beginning of the 16th century, Pernambuco sticks with the natives. Thus, the small village appears on top of a hill, following Celtiberian and Muslim traditions, opposing the Renaissance and Roman idea of implanting the city in a regular plain.

Olinda was the most important city in colonial Brazil until the founding of Salvador, which would guard the seat of government against 1536 onwards, although rulers and other authorities preferred to settle in Olinda, as this was a city "head of the Portuguese colony", both to the north and the west of the territory. At this historical stage, Olinda was one of the richest cities in the Americas and the world, therefore of greater influence for Brazil. (ARAUJO, 2008).

The initial layout of the village contemplated a square at the top of the hill where a “tower” was built and where, a few years later, the main church of Salvador do Mundo would be built (today, Igreja Matriz da Sé) as well as the town hall and jail. . This structure was surrounded by lots donated to the relatives and associates of the donee Duarte Coelho. Starting from the square, at the top of the hill, a street stretched to the church and hospital of Misericórdia and from there, you went down to Varadouro, or the place where boats were moored. (LEMOINE, 2000). "This route was configured with the definition of the paths and the occupation of the main religious headlands, still in the 16th century". (MOREIRA, 2006, p. 64).

> Ambrósio Richshoffer (1897), in his diary book of a Soldier of the Company of the West Indies (1629-1632), describes the destruction of the city: On the 17th (November) the demolition of buildings in the city of Olinda de Pernambuco began, transporting them if later for the people the usable material. THE 24 our people who were there withdrew to Povo or Recife village, destroying first of all what was possible and setting fire to the city at several points. This resolution was prompted by the fact that the city was mountainous and unevenly built, being difficult to fortify, and required a strong garrison, which we could better employ here and elsewhere.

Still, according to Pereira Jr (2004), the development after the departure of the Dutch in 1654 was of little significance. The village of Olinda, even elevated to the status of city in 1676, would never again be what it was before 1630. The city gradually lost its importance in the face of Recife, which grew economically and became the capital of the province in 1827, leaving Olinda relegated to abandonment and decay.

According to Moreira (2006), the reconstruction of Olinda after 1654 privileged the lower parts served by fountains and close to the river, leaving the upper part of the city in the background. Once again in decay, the city was abandoned and with some houses in ruins.

In the 18th century, according to Pereira Jr (2004), Olinda lost its status as the capital of the province and fell into decline for almost a century. However, it reappears at the end of the '20s of the last century with the growing interest in healthy sea baths recommended by doctors, bringing back the Recife bourgeoisie to the city of Olinda, and giving rise to new types of buildings and land occupation. European eclecticism appears with the installation of stucco, iron railings, glazed window frames, chalets, and other French stylistic aspects, clearly visible in the houses close to the sea whose facades undergo transformations and adaptations to the new trend.

Olinda, one of the most important cities of the Brazilian colonial period, still retains its charm thanks to the predominance of its Baroque religious architecture combined with its civil architecture that preserves the stylistic and morphological unity that was established between the 16th and 19th centuries. Its colonial houses intertwined with vegetation cover, according to Pereira Jr. (2004) and Moreira (2006), is part of a unique landscape and for this reason, was granted the title of World Heritage.

Thus, on December 14, 1982, UNESCO recognizes and certifies the city of Olinda as a Cultural Heritage of Humanity, the city document, recording the technical and cultural evolution of Brazil, based on its abundant material and immaterial heritage. However, according to Pereira Jr (2004), the gentrification process started in the SHO from the 1960s onwards, combined with the lack of rigor in preservation policies, and the lack of heritage education of a portion of the population, as the image and integrity value are at risk. and the historical value of the city.

To meet the new dynamics and needs of this new population, inappropriate uses and constructive practices used indiscriminately degraded, cleared the vegetation, and mutilated the material heritage with irremediable consequences.

Currently, the lack of surveillance and heritage education by the ZEPC (special cultural preservation zone) paves the way for graffiti on the surfaces of monuments, compromising and causing serious damage to the superficial layers of the plaster on the facades, both from an aesthetic point of view and from a technical point of view, considering that the removal of these materials based on synthetic enamel requires deep scrapings on the surfaces that have low cohesion.

Recapitulating that the practice of changes is not new, it appears in waves, at the beginning of the 18th century, with the law of the platbands, in the 19th century with eclecticism, and the 60s of the 20th century, with gentrification. The first mutilations appear in the name of supposed progress, with the advent of the insertion of glass and iron to replace the wooden elements used on the facades, such as lattices and muxarabis. Then came the parapets and the adoption of decorative elements on the facades influenced by a pseudo-classicism that proliferated, albeit late, in the capitals of the Brazilian northeast.

Then, under the influence of modernist ideas of breaking with the past, simplicity, and rationalist purism, some single-story houses and two-story houses in Olinda have their facades reformulated, so that nothing remains of the original characteristics of the monument. Indeed, such reformulations occur more significantly in the façade, from the 1940s onwards and exacerbate from the 1970s onwards with the process of exchanging the native population for artists, intellectuals and fashion designers. During this period, many of the acquired houses were falling into disrepair and inadequate, often anachronistic, renovations were carried out, creating false historical records in the city.

4.2 PRESERVATION OF HISTORICAL AND ARTISTIC HERITAGE

According to Zancheti (1998), “replacing the cladding of old buildings should be the last alternative, when there is definitive and irrefutable evidence that there are no conditions to guarantee their maintenance and conservation”. Thus, while the external coating is fulfilling its main functions of protecting the building and guaranteeing its healthiness, all the necessary methods for its preservation must be used, in strict observance of the specificities of old buildings. based on these statements and, for a better understanding of the decision to intervene or not to intervene in the cladding of facades of old buildings, it is up to this research to present, in general lines, the thinking of the main theorists of conservation and restoration. With this, it is intended to register the influence of currents that serve as a basis for the construction of premises that lead to contemporary interventionist postures.

According to Houaiss (2001, p. 592), to preserve means “to save, defend, safeguard, keep in good condition and/or with its natural characteristics”. In this way, it can be concluded that preserving an old building guarantees its authenticity, however, on the other hand, it will cover it with limitations regarding its use, thus opposing the dynamics of the evolution of a society that is always in constant change. . The adoption of such a posture of preservation, pure and simple, may not allow the old building to adapt to a new function or program, which may compromise the essence of its materialization, its perennial functionality. Aguiar (1998, p.1) states that “conservation obliges us to ensure the transmission into the future of the artistic and historical values of historic buildings and cities”.

Faced with the conceptualization of what it means to conserve and preserve, the importance of the authenticity of a monument is perceived, as well as its usefulness, as a way of meeting contemporary social demands and still safeguarding the built heritage from the possible condition of doom. According to Larkham (1997), this is the dichotomy between preservation and conservation from the perspective of the discipline.

The roots of this stir can be found at the end of the 19th century; one of the theoretical conflicts that still permeates the discipline of conservation and that began between two important and influential theorists of the late 19th century: John Ruskin (1819-1900) and Violet-Le-Duc (1814-1879). Ruskin defended the value of antiquity and the importance of patina, the marks of time on coatings. He was one of the forerunners of the concept of preserving the urban fabric and domestic architecture and not just isolated monuments, as was the case at the beginning of the movement around the discipline of conservation and restoration.

For Ruskin, "Great nations write their autobiography in three manuscripts: the book of their deeds, the book of their words, and the book of their art." (RUSKIN apud CHOAY 2001, p. 156). Defender of the anti-interventionist current, he defended that the maximum attitude of maintenance in the old buildings, of monumental character, would be the consolidation of their structures. According to Choay (2001, p. 195), “for Ruskin and Morris, to want to restore a building is to attack its authenticity, which constitutes its very essence”. As it seems to both, the destiny of every historical monument is ruin and progressive degradation, without being able to intervene in this process, under the penalty of violating its original character, its marks of time.

The antithesis of Ruskin's conservatism was found in the interventionist posture of the great

French theorist, Eugène Viollet-Le-Duc. For him, “to restore a building is to return it to a complete state that may never have existed at a given moment” (VIOLLLET-LE-DUC apud CHOAY 2001, p. 156). His interventionist stance was arbitrary. One could not neglect the usefulness of the buildings. His theory emphasized in-depth research design and the study of styles and schools, as well as the constructive techniques used. Its restoration, ideal and stylistic, was based on the use of analogy under the imminent risk of fanciful reconstructions, with consequent loss of authenticity of the building. Viollet-Le-Duc was in favor of using the building as a way of guaranteeing its conservation.

The bringing together of such antagonistic elements into a coherent whole about the discipline of conservation and restoration came about through the Italian architect Camillo Boito (1835-1914). Boito was responsible for formulating a set of guidelines for conservation and restoration that were soon incorporated into the Italian law of 1909 (CHOAY, 2001). From Ruskin and Morris came the concept of authenticity. Boito defends Viollet-Le-Duc's restorative intervention, however valuing the marks of time, “not just the patina, but the successive additions due to time – true stratifications comparable to those of the earth's crust”. (CHOAY, 2001, p. 165). He defends the principle of distinguishability in the identification of elements added during the restoration. This distinction between the new and the original clearly shows the lack of concern with the total reading of the work, its unity. Restoration for Boito would be the last resort for the building to “survive”. Therefore, making the building useful would be a necessary condition, as long as incompatible uses could be avoided.

Among the main aspects of his proposition is the value of authenticity, the hierarchy and style of the interventions, the decision of the moment to restore, the question of the legitimacy of the intervention, making clear what is of today and what belongs to the past, distinguishing the which is the restoration of the original. The types of intervention according to Boito would be according to the style and age of the buildings. For monuments of antiquity it would be an archaeological restoration; for Gothic monuments, a picturesque restoration that focuses on the structure of the building and for classical and baroque monuments, an architectural restoration that takes into account the building in its entirety. (CHOAY, 2001).

Alois Riegl (1858-1905), a Viennese jurist, philosopher and historian, developed a work of reflection, according to Choay (2001, p. 166), "more ambitious concerning attitudes and conduct linked to the notion of the historic monument". Riegl classified the monuments, assigning them values for decision-making at the time of restoration, thus building an opinion about the intervention.

Among the different categories of values assigned by Riegl are: remembrance, contemporaneity, the value of the old, the new, and finally the value in terms of the use of the building. Still regarding the use of the building, the ruins can be classified as being for contemplative use only and, in case of use of the building, if possible within its original program. If the building has lost its original function, it must assume another one to avoid its probable degradation due to lack of maintenance and/or natural wear and tear. One of the characteristics that were important for obtaining the title of World Heritage of Olinda in the Historic Urban Center of Olinda was the predominant typology of use in the city and its degree of conservation where more than 80% of the buildings are for residential use.

After the Second World War (1939-1945) there was an immediate need for large-scale reconstruction of European cities destroyed by bombing and land war incursions. In this context Cesare Brandi (1906-1988) will be a figure of great prominence. Brandi was director of the Central Institute of Restoration in Rome for twenty years and in 1963 he published his Theory of Restoration for the first time, in which he developed and presented the boundaries and theoretical precepts that would serve as a basis for restorers. (CUNHA, 2004).

Based on the restoration theories that begin with Ruskin and Viollet-Le_Duc and are consolidated in the ideas of Cesare Brandi, it is possible to extract necessary elements for the construction of procedures regarding the restoration of facades of old buildings, taking into account aspects such as: the principle of authenticity, distinguishability and the concern with reading the whole. Based on the studied theorists, in an intervention proposal, the guarantee of the use of the old building must also be taken into account as a basic condition to be able to preserve it perennially.

Other documents that were used to base this article were the Patrimonial Letters, which are documents that resulted from international and national meetings between architects and other professionals related to conservation and restoration and aim to establish proposals for themes related to the preservation and conservation of the Cultural Heritage of Humanity. In addition to establishing proposals through norms and procedures, the Patrimonial Letters also present concepts and aspects that form postures that guide and validate actions related to the conservation and restoration of built heritage on a regional and global scale.

The Charter of Athens (1933) was the first to address issues of conservation of built heritage. The document is presented from a modernist perspective whose main characteristics are the break with the past, the value of a function over form, the character of monumentality and urban composition treated according to the functional order structured in human activities of work, housing and leisure. Regarding the preservation of the built cultural heritage, the emphasis was given only to the monument, disregarding its surroundings.

The Venice Charter (1964), unlike its predecessor, presents a vision of the interdependence of the building and its surroundings. "The monument is inseparable from the history it bears witness to and the environment in which it is located". In this respect, the Charter of Venice came to deepen and endow the Charter of Athens with greater scope. According to Moreira (2006, p. 24) "it is the most important document prepared on the notions of conservation and restoration and monumental sites, becoming a fundamental basis for everything that followed in this discipline".

The Norms of Quito (1967) arise on the occasion of the meeting on the conservation and use of monuments and places of historical and artistic interest organized by the O.E.A - Organization of American

States. The norms propose the revaluation of heritage assets in line with economic and social development. They also aim to recognize the SH4 as an economic asset to be worked on from the perspective of socioeconomic development and tourism.

The São Domingos Resolution of December 1974 came about during the 1st Inter-American Seminar on Experiences in the Conservation and Restoration of Monumental Heritage from the Colonial and Republican Periods, organized by the O.E.A - Organization of American States and the Government of the Dominican Republic. The resolution deals with the search for solutions in the sphere of housing policy, which provide for the permanence and improvement of the existing social structure in historic centers.

The Congress of Amsterdam, through the declaration of 1975, recognizes that "the unique architecture of Europe is the common heritage of all its peoples and affirms the intention of the Member States to cooperate among themselves and with the other European countries to protect it" . It presents the principle of integrated conservation. Of the importance of preserving not only monuments and surroundings but sets, neighborhoods and villages of historical and cultural interest, without bringing about changes in their social composition, which brought benefits to all social strata. (MOREIRA, 2006).

The International Charter of Historic Cities of Eger, Turkey (1983) addresses the character of identity and integrity of historic towns and districts. It recommends protecting the morphology, the spatial order of buildings, the silhouette of cities. It proposes the integration of the city and landscape, in addition to addressing the development of the urban fabric and its relationship with historic centers. It proposes that new neighborhoods must adapt in scale and characteristics to primitive urban centers. The letter also addresses issues related to the technical quality of SH rehabilitation. (IPHAN, 2009).

The Washington Charter (1986) defines that the conservation of SH implies its permanent maintenance and that the new functions to these spaces must be compatible with the structure, character and vocation of the city. Addresses the issue of habitat improvement as one of the main objectives for intervention in historic preservation areas. (MOREIRA, 2006).

Intending to complete the Venice Charter, ICOMOS draws up the International Charter for the Conservation of Historic Cities (1987), which sets out the objectives and methods of preservation, to reconcile individual and collective interests. It also deals with the coherent development and adaptation of preservation areas to contemporary life and presents the values to be preserved to guarantee the authenticity of the SH.

In the Brazilian context, the Brasilia Commitment (1970) was the main treaty regarding the preservation of the National Historic and Artistic Heritage and provided for the role of States and Municipalities in the protection of cultural assets of national value in conjunction with the Federal Sphere. The Brasília Commitment was followed by the Salvador Commitment (1971), which addresses legal and financial aspects linked to the preservation of cultural assets. It also deals with the participation of students in surveys of cultural assets, as well as the improvement of courses related to conservation and restoration. (MOREIRA, 2006).

The first federal law for the protection of national heritage would appear in 1933, along with the listing of the city of Ouro Preto. With the opening of the National Historical Museum in July 1934, the government organized a protection service for national monuments and works of art. The Inspectorate of National Monuments (IPM), established by Decree No. 24,735, of July 14, 1934, was the first body dedicated to the preservation of heritage in Brazil, created in 1933, as an entity linked to the National Historical Museum.

According to Aguiar (1998, p. 01) “conservation obliges us to guarantee the transmission, for the future, of the artistic and historical values of historic buildings and cities”. In this respect, the restoration must consist of coherent and balanced interventions, aiming at a qualitative transformation of the building, but as long as its historical and artistic values are preserved.

As can be seen, intervention in historic buildings presupposes not only the reconstitution of matter, but the preservation of know-how, applied techniques, and characterization of the materials that constituted the building's original conception and execution process. In this respect, the work must be understood as something beyond stone and lime. It must be understood as a continuity in the evolution of man's technique in the art of building. A consolidated record of its technological and cultural progression, which transforms itself over time, slowly and lastingly, always meeting present programs and needs, thus guaranteeing its usefulness and consequent longevity.

5.0 TECHNICAL REFERENCE

5.1 SHO'S RESIDENTIAL BUILDINGS: MATERIALS AND TECHNIQUES USED

For the construction of the city of Olinda, materials available in the region were initially used. Stone masonry, generally limestone, was the most common constructive method for raising the outer walls of older buildings, which were of great thickness, as they received all the load from the roof and upper floors. The internal walls were made of rammed earth, which was also used in simpler constructions. The external walls were coated with sand and lime mortar, obtained by burning oyster shells, with the final painting being executed with lime-based paint.

Already in the 16th century, manual bricks were used for the execution of the masonry, obtaining, however, walls of great thickness (walls with more than one meter thick are recorded in some churches). Stones were also used, generally equipped with limestone, for the execution of jambs, lintels, sills, parapets, corners, and cornices on the eaves, with the piece protruding from the façade and framing the openings and large wall panels.

In the foundations or foundations of the SHO houses, stone or brick masonry was used. The oldest ones were made with large stones, paved with smaller stones connected by clay mortar, applied in a very fluid consistency, facilitating its penetration through the voids. The use of lime mortar in foundations occurred later, already in foundations executed in masonry of solid bricks. The slump or repression of the foundations, caused mainly by the infiltration of water from leaking pipes, cesspools and rain, are one of the main causes of the formation of cracks in the walls of SH buildings. (SILVA, 1992). It is important to point out that, due to the lack of a capillary cut, the water contained in the soil, from rainfall and underground water tables, is responsible for the appearance of rising humidity by capillarity, which manifests itself in the first rows of the walls of the ground floor of the buildings. from SHO.

According to Silva (1992, p. 25) “most of the external walls of the old houses in Olinda are built in masonry of solid bricks laid with mortar based on sand and lime”. Walls made of stone can also be found, these are rarer, or even mixed masonry of solid bricks and stones. The bricks used were made of baked clay, in the form of rectangular parallelepipeds, generally measuring 40x25x10cm or 30x20x5cm. In the stone masonry, found in the oldest houses, limestone or sandstone was used. In the internal walls and in the simplest constructions, it was common to use rammed earth walls, which consist of a wooden frame whose voids are filled with tight clay and tamped by hand. Silva (1992, p. 27) states that, “since they are lighter, rammed earth walls are more often used as a divider on the upper floors of two-story houses”.

Wall coverings in the colonial period were made up of two layers. The regularization layer, called emboço and the thinner layer called plaster. The coatings were made with sand and lime mortar and eventually other organic binders were used (SILVA, 1992).

“ The urban model of Olinda is based on ancient Portuguese urban traditions, defined by the two-story houses and houses built on the alignment of the public road and the lateral limits of the land". (MOREIRA, 2006, p. 50). This model of implantation of the building in the lot protected the lateral supports, leaving the front façade protected by the eaves made of wood and clay tiles, until the moment of the introduction of the parapets in the buildings. The use of this constructive element was stimulated by the public power that, until the beginning of the 20th century, charged a fee called "impost tax", to prevent the water from the roofs from draining directly onto the sidewalks, causing damage to the pavements, in addition to disturbing pedestrians. . The collection of the tax thus stimulated the construction of gutters covered by platbands which, raised in solid brick masonry, have ornaments in high and low relief, characteristic of the eclectic style (geometric designs, floral garland, cartouches, canopies) and also elements of the classical architecture (cornices, friezes, architraves) that constitute what is called cyma. Such ornaments were executed in sand and lime mortar. (SILVA, 1992).

Recognition of the materials and techniques used in the construction of SHO houses and townhouses will help in the search for solutions in facade cladding that significantly contribute to the compatibility and adequate protection of the built complex.

The facades and their elements Regarding the primitive urban nucleus of Olinda, Lemoine (2007, p.8) observe that "there is no evidence that the village had a previous design, growing according to economic and population needs. The traditional elements of the Portuguese urban space emerge throughout its development". A strong trait, characteristic of the medieval Portuguese city, is the organic layout, adapting to the topography of the place, with the buildings built in a current system (twin buildings) with only their facades - frontal for communication with the urban space, while The rear façade opens onto the patio, which is generally extensive and has a rich vegetation cover. Except for the corner houses or the few that have free space, the vast majority of SHO houses and townhouses are connected to the urban space only through their front facades.

The composition of the facades obeys a defined reading and is composed, according to Silva (1992), of three parts, namely: the body of the building, crowning, and roof.

- The body of the building is the part that contains its openings (windows, doors) and, in the case of the houses, elements such as balconies and balconies can still be seen. The door and window openings are framed by jambs, lintels, and sills, as in the case of windows, which are highlighted by the frame, an element that can be made of stone or sand and lime mortar. The stone borders have a structural function while the mortar ones only have a decorative function. (SILVA, 1992).

- According to Silva (1992, p.63) “the crowning of the facades is formed by the set of decorative elements such as the cornice, friezes, architraves, ornaments, etc”. Most of the houses in Olinda have parapets for reasons already recorded in this research, however, some older facades still preserve the eaves, the first characteristic of the crowning of SHO buildings. As for the typology of the eaves, these can be simple, with cornice, eaves and spouts (double tile) or eaves (triple tiles).

- The types of roofs characteristic of the SHO have a wooden structure covered with baked clay tiles and, in general, have two pitches or slopes. There are still roofs with one and four waters. In general, the trim of the roofs is given to the front and the back of the building. The tiles used are called canal or colonial-type tiles, consisting of a cover and spout. The woodwork or structure of the roofs of the SHO houses is composed of lines, purlins, rafters, ridges, rafters and slats. The woods most used are massaranduba, ipê, freijó and cocão in thicker pieces. Embira "embiriba slats" was used in making the slats. Until the beginning of the 20th century, all

The facades of the townhouses generally have balconies or balconies. According to Ching (2003, p.83) the term balcony defines “the elevated platform projecting from the wall of a building and delimited by a handrail or parapet”. In this aspect, what differs the balcony from the balcony in the SHO is its extension. While the balcony extends to a single span, the balcony projects itself in front of two or more openings in the upper span of the two-story houses. The floor of balconies and balconies can be found in wood, stone masonry or bricks, structured by pieces in stone or wood called consoles or corbels. The parapets can be in iron with a wooden handrail or, as in the case of the Moorish balcony, completely in wood. (SILVA, 1992).

It was considered of paramount importance for this research, the identification of the constructive elements of the old houses of the SHO, especially the façade elements, as well as their relationship with the image of the city, so that it is possible to present viable proposals for recovery, both from the point of view economically, as well as aesthetically, technically and historically. Therefore, the choice of materials for carrying out interventions on the cladding of the external walls must take into account their compatibility with the other original components used on the facades of the old SHO houses.

6.0 MATERIAL AND METHODS

6.1 PROTOTYPES OF MORTARS FOR COATING TRADITIONAL MASONRY

This topic will present the tests carried out with coating mortars prepared and applied based on the bibliographical references used in this research. Two tests called A1 and A2 were performed.

In the first test (A1) an attempt was made to use an industrialized lime-based mortar, of a renowned brand, but whose manufacturer is indicated for application with thicknesses between 3 and 5 mm. Table 02 presents the physical characteristics of the mortar used. The material was applied in a single layer, 20 mm thick, on two types of substrate. The first application was carried out on a plaster of mixed cement, lime and sand mortar with an average thickness of 2 cm. The second application was carried out on perforated ceramic brick masonry, laid with a mixed cement, lime and sand mortar. The objective of this test is to verify the behavior of the product during the first months after its application and, consequently, to evaluate its viability for use in covering traditional masonry facades.

According to Kanan (2008), in practice it is observed that cement, in small quantities, has been recommended for use in the preparation of mortars used in the recovery of facades of historic monuments. According to the practitioners, a percentage of cement, even if reduced, contributes to the setting of the mortar and reduces the tendency for initial cracks due to material contraction. Thus, in test (A1) a percentage of five percent CPB-40 structural white cement was used per 20 kg bag of ready-made (industrialized) lime-based mortar, whose characterization is shown in table 02.

In the second test (A2) a mortar developed based on the researched literature was used, considered within acceptable standards for use as a coating mortar for the facades of historical monuments. In the mortar (A2) hydrated aerial lime was used as the only binder, washed sand with a balanced grain size, kaolinitic clay and synthetic additives to optimize the adhesion of the mortar to the base. The applications were carried out on masonry support of ceramic bricks laid with a mixed cement, lime and sand mortar. The characterizations of the raw materials are described in tables 03 and 04.

TEST A1

6.1.1 Materials used and test method

- Mortar

The industrialized mortar Reboquit Quartzolit was used in this test, whose characteristics provided by the manufacturer are shown in table 01.

Table 02: Physical characterization of the mortar used

Características físicas da argamassa industrializada utilizada Reboquit - Fabricante: Weber Quartzolit - Composição: Cal e agregados						
#20	#28	#48	#100	#200	PRATO	SOMA
0,4	1,5	13,4	25,3	22,4	37,0	100,0
Densidade aparente		1,40 g/cm³				
Densidade Fresca		1,89 g/cm³	NBR 13278:2005			
Retenção de água (%)		74	NBR 13277:2005			

Source Weber Quartzolit, 2008.

- Cement

A percentage of 5% of CPB-40 structural white cement, Weber Quartzolit brand, was used, whose characteristics provided by the manufacturer are shown in table 03.

Table 02: Physical characterization of the CPB-40 cement used

Caracterização do cimento utilizado Cimento Branco Estrutural CPB-40 - Fabricante: Weber Quartzolit			
Determinações		**Resultados**	**Método de Ensaio**
Finura Peneira 0,044 (nº 325 mm) (%)		0	NBR 11579:1991
Tempos de pega	Início (h)	03:30	NBR NM 65:2003
	Final (h)	04:25	
Índice de consistência da pasta normal (mm)		7	NBR NM 43:2003
Água lançada (%)		27,2	
Índice de consistência da argamassa (mm)		238	NBR 7215:1996
Expansibilidade Quente/Frio (mm)		1,5/1,0	NBR 11582:1991
Massa específica (g/cm²)		3,07	NBR NM 23:2000
Determinação da Finura Blaine (cm²/g)		4.520	NBR NM 76:1996
Resistência à Compressão	03 dias (MPa)	42,9	NBR 7215: 1996
	07 dias (MPa)	47,8	
	28 dias (MPa)	55,4	

Source Weber Quartzolit, 2008.

The preparation of the product strictly followed the manufacturer's recommendations for applications in external areas. In an airtight, clean container, protected from the sun, wind and rain, the entire contents of a 20 kg bag were manually mixed (water was added little by little), until a firm, pasty consistency was obtained, without dry lumps. Cement was added to the product, (1 kg) for 20 kg bag of mortar.

Figure 01: CPB-40 Cement Addition
Source: ALVES JÚNIOR, 2009.

The first application was carried out on cement, lime and sand plaster with a curing time of more than 28 days. The application thickness was 20 mm, therefore in disagreement with the manufacturer's recommendations, which indicate thicknesses between 3 and 5 mm. (Figure02).

Figure 02: Base preparation for plaster application
Source: ALVES JÚNIOR, 2009.

Before application, the base was moistened to reduce the absorption of the support when in contact with the coating mortar, as shown in figure 02. The application was carried out using a PVC trowel and a trowel. (Figure 03)

Figure 03: Application of lime mortar on cementitious substrate
Source: ALVES JÚNIOR, 2009.

After the area was filled in and the mortar had acquired adequate consistency, removal of excess mortar and smoothing of the surface through screeding, using an aluminum ruler (figure 04).

Figure 04: Removal of excess and leveling of the coating
Source: ALVES JÚNIOR, 2009.

The depressions were filled in and new screening was carried out, until a flat and homogeneous surface was obtained. The surface finish was obtained by passing the trowel and then a damp sponge (figure 05).

Figure 05: Surface finishing with trowel and sponge
Source: ALVES JÚNIOR, 2009.

The entire coating operation was also carried out on a masonry surface, without base preparation, only cleaning and wetting the substrate as per (figure 06).

Figure 06: Direct coating application on the masonry
Source: ALVES JÚNIOR, 2009.

In the application, there were no significant changes in the product due to the difference in the substrate. After a period of “pulling” the mortar, the surface was evened out using slatting, using an aluminum ruler (figure 07).

Figure 08: Mortar mortar applied directly on the masonry

Source: ALVES JÚNIOR, 2009.

The surface finish was carried out by passing the trowel and in followed by a damp sponge (figure 08 and 09).

Figure 09: Finishing the surface with a PVC trowel
Source: ALVES JÚNIOR, 2009.

The mortar used in A1, with the addition of CPB-40, was characterized and the results presented in table 03 of this research.

Table 03: Physical characterization of the mortar used with the addition of 5% CPB-40

Principais características da argamassa utilizada A -1 Argamassa industrializada à base de cal com adição de 5% de CPB-40						
Granulometria do produto (NBR NM 248:2003)						
#20	#28	#48	#100	#200	PRATO	SOMA
0,5	1,6	11,4	24,7	19,9	41,9	100,0
Densidade fresca		1,99 g/cm³	NBR 13278:2005			
Densidade endurecida		1,66 g/cm³				
Retenção de água (%)		83,1	NBR 13277:2005			
Relação água/Arg (ml/kg)		260				
Coef Capilar. (g/dm³/min)		30,4				
Permeabilidade 22 dias		> 3,5				
Resist à tração na flexão 22 dias (MPa)		0,4				
Resist. à compressão 22 dias (MPa)		0,9				
Módulo deformação dinâmico 22 dias (Gpa)		12,6				
Resist. Aderência sub padrão 22 dias (MPa)		0,1				
Nota: argamassa aplicada em substrato padrão com espessura de 5mm e 20mm , sendo que os mesmos apresentaram fissuras.						

Source: Weber Quartzolit, 2008.

According to the research carried out, the results do not express values that can justify significant changes concerning mortars consisting only of CH-I aerial lime as a binder.

Figure 10: Coating executed with industrialized mortar with addition of CPB-40

Source: ALVES JÚNIOR, 2009.

After 24 hours of application, no surface changes were observed in the coating layer applied on a cementitious substrate. Small cracks were found, possibly due to the thickness of the coating, outside the standards recommended by the manufacturer.

In the coating applied over direct masonry, however, mapped cracks were formed, indicating a direct relationship with the absorption of the base (figure 11). In addition to this aspect, the finish with excessive flatness and the excess of fines, caused by the addition of cement, in addition to the thickness used, outside the manufacturer's recommendations, can explain the pathologies verified in the coating.

Figure 11: Formation of cracks mapped in direct application on masonry
Source: ALVES JÚNIOR, 2009.

After conclusion of the tests for (A1) it was verified basic aspects that must be observed in the preparation and application of lime-based mortars, being of great influence in its performance. Aspects such as - support absorption, thickness of the coating layers, excessive surface finishing, non-observance of the correct time of slaking, excess of fines, among other associated factors, can generate tensions in the coating and the appearance of pathologies such as lack of adhesion to the support, hollow sound and mapped cracks.

6.1.2 Materials used and test method

- **Hydrated lime CH-I**

In this test, hydrated lime type CH-I, manufacturer: Carbomil, was used. Lime classified as CH-I under NBR 7175. Density 0.5 kg/dm³. Chemical characterization according to table 05.

Table 04: Chemical Characterization of Kaolinite Metakaolin

Caracterização da Cal Hidratada CH-I			
Análises químicas			
Composição	**Min %**	**Resultado %**	**Máx %**
Perda ao fogo	23	24,1	25
Resíduo insolúvel em HCl		0,4	0,5
CaO disponível			
$Ca(OH)_2$ disponível	90	90,7	
CaO	70	71,4	
MgO		2,8	3,5
R_2O_3		1,1	1,5
SiO_2		0,2	0,3
Óxidos totais não voláteis	88	97,8	
Pureza	92,5	94,3	

Kaolinite clay Metakaolin

Kaolinite clay, manufactured by Metakaolin, of high reactivity, was used in the test, whose characterization provided by the manufacturer is shown in table 05. According to the manufacturer, the addition of the product, in contact with the calcium hydroxide of the mortar, causes a pozzolanic reaction forming more stable, resistant and insoluble compounds called "gelenite".

Table 05: Chemical characterization of the kaolinitic clay used

Composição Química do Metacaulim	
(porcentagem média, por peso)	
SiO_2	51%
Al_2O_3	41%
Fe_2O_3	< 3%
TiO_2	< 1%
MgO	<0,4%
Na_2O	< 0,1%
K_2O	< 0,5%
SO_3	< 0,1%
CaO	< 0,5%
Finura # 325 (via úmida): < 1,0%	
Massa Específica: 2,60 kg/dm³	
Área Específica > 300.000 cm²/g (BET)	

Source: METACAULIM, 2009.

- **Aggregates**

The fine aggregate used is made of natural quartz sand. The granulometry of the material is shown in table 06. Two predominant granulometric ranges were used for the perfect balance of the inert load, aiming at a better physical arrangement, with consequent optimization of the resistance and workability of the product. The material was extracted from local deposits (Zona da Mata de Pernambuco).

Table 06: Characterization of the aggregate used

Caracterização da area utilizada Granulometria do insumo (NBR NM 248:2003)						
#14	#28	#48	#100	#200	PRATO	SOMA
8,50%	24,50%	20,30%	14,10%	5,70%	26,70%	100%

Source: ALVES JÚNIOR, 2009.

- **Determining the trait**

Initial volumetric trace used for research – 1:1.7.

Additive used (kaolinitic clay) – 13.3% concerning the mass of hydrated lime.

Water/mortar ratio – 175 ml/kg.

- **Product application**

For the application of the product, a masonry wall of ceramic bricks was used, with 8 holes, (9x19x19 cm) settled with industrialized mortar, joints of 20 mm. Before applying the first layer (base preparation), the substrate was cleaned and previously moistened. The product was prepared in an airtight container, mixed by hand until obtaining a homogeneous mass without lumps. The mixture was carried out using a liquid additive mixed with the mixing water (1:4), whose objective is a better performance of the coating in relation to adherence to the substrate. (Figure 12).

Figure 12: Preparing mortar A2
Source: ALVES JÚNIOR, 2009.

The first layer of the coating called base preparation was applied with a steel trowel No. 8, first spreading the mortar with the smooth side of the trowel and then, with the jagged side, the cords and parallel grooves were formed, whose objective is to provide better anchorage of the next layer. Before application, the product was allowed to rest for 1 hour.

After 24 hours of application of the base layer, with a thickness of 5 mm, the application of the plaster body or intermediate layer was started, which had a thickness determined at 10 mm, in order to avoid cracks caused by large thicknesses of the applied coating in a single layer. (Figure 13).

Figure 13: Execution of base preparation
Source: ALVES JÚNIOR, 2009.

The surface of the plaster layer remained only slatted to optimize the anchoring performance of the finishing layer. The mortar "pulling" time for screeding was approximately 20 minutes. Before applying the plaster layer, the surface was pre-moistened.

After 24 hours of execution of the plaster body, a finishing layer or smoothing with a thickness of 5 mm was applied. The finish was carried out by smoothing the surface, using a plastic trowel and then using a slightly damp sponge in circular motions. (Figure 14).

Figure 14: Smoothing with sponge
Source: ALVES JÚNIOR, 2009.

After 24 hours of application, the surface was firm and well adherent, with no hollow sound or the presence of cracks. After 28 days of application, tensile adhesion strength and permeability tests were carried out, in strict compliance with Brazilian technical standards through ABNT.

Laboratory tests were carried out on the product to verify its performance and consequent viability for field tests. The final thickness of the A2 coating was 20 mm, 5 mm for the base preparation and finishing layers and 10 mm for the plaster body.

- **Tensile bond strength test.**

The test was carried out 84 days after applying the first coating layer, in strict compliance with NBR 13528 (ABNT, 1995) which prescribes the method for determining the tensile adhesion strength of inorganic mortar wall and ceiling coatings. (Figure 15)).

Figure 15: Tensile adhesion resistance test
Source: ALVES JÚNIOR, 2009.

According to the results obtained (Table 7) it is observed that mortar A2 presents satisfactory results taking into account its composition, free of cement.

Table 07: Tensile adhesion strength test results

Determinação da Resistência de Aderência à Tração - Ensaio em parede externa (84 dias)

Peças	CP-1	CP-2	CP-3	CP-4	CP-5	CP-6	Tensão média
Forma de ruptura	F	AS	AS	A	A	A	MPa
Tensão de aderência (MPa)	0	0,21	0,24	0,32	0,28	0,36	0,28

Tipos de ruptura : AS - Ruptura na interface argamassa e substrato / A - Ruptura na argamassa / F - Falha na colagem

Source: ALVES JÚNIOR, 2009.

- **Permeability test**

The test was carried out based on NBR 14992:2003, in strict compliance with Annex G of this technical standard for determining the permeability of a hardened specimen when subjected to a water column of 13 cm.

The product did not withstand water pressure, showing an absorption equivalent to 4cm³ for a 13 cm high water column for 8 minutes. Thus, we can say that the product offers good conditions for the coating to develop its characteristic water cycle, making it impossible to retain moisture in the masonry.

Figure 16: NBR 14992:2003 permeability test
Source: ALVES JÚNIOR, 2009.

6.2 PROPOSAL FOR COATING TRADITIONAL MASONRY USING LIME-BASED SYSTEM

6.2.1 Materials

According to the bibliography consulted and still based on the experiments carried out throughout the research, it was possible to confirm that the behavior of lime-based mortars produces greater benefits for traditional masonry, compared to the use of cementitious mortars.

Lime mortar has a low modulus of elasticity, being more deformable, in fact, not causing incompatible stresses to old supports, in general of low cohesion. As previously mentioned, lime mortars have more porous structures, with greater permeability and reasonable thermal inertia. Due to its hygroscopic behavior, it allows the wall to “breathe”, preventing the accumulation and crystallization of soluble salts inside the support, which can cause expansion and accelerated degradation of the components of traditional masonry. In lime mortars, curing is slower (recarbonation) and the increase in mechanical resistance occurs gradually, offering greater compatibility between coating and support.

From an aesthetic point of view, lime-based mortars give a peculiar effect to the surface of old facades, offering a reading that is more consonant with the environment in which the building is inserted, since the restorer must always seek a vision of interdependence of the building and its surroundings, bearing in mind that the monument is an inseparable element of history and the environment in which it is located. In this regard, coatings with lime mortar, finished with skimming or paint, also based on lime and inorganic pigments, contribute to an aesthetic reading that is more coherent with the historical reading of a restored building.

Also according to Kanan (2008) lime is a non-toxic and non-polluting material and uses lower production temperatures compared to cement production. Lime-based mortars also allow for more frequent maintenance and reapplications (sacrificial layer), without causing damage to the support, in effect, offering lower cost and greater durability of the façade.

The satisfactory result, however, will depend on the quality of the materials used to obtain the mortar, on the mix used, as well as on the adequate preparation of the base, besides the correct application of the product, in strict compliance with the aspects described in this work.

After carrying out this research, it was possible to observe that even a small variation in the granulometry of the sand, for example, can produce reasonable differences in performance between the mortars obtained.

In this research, lime classified as CH-I, in accordance with ABNT - NBR 7175, presented satisfactory results for the development of the coating.

Regarding the aggregate, the best option considered in the research is balanced quartz sand, with granulometry according to table 7.

The kaolinitic clay (Metakaolin HP) showed satisfactory performance in accelerating the mechanical resistance of the lime-based coating, provided that it was applied in strictly controlled percentages.

6.2.2 Application techniques

For practical purposes, the best performance obtained occurred when applying the coating in three different layers. The base preparation, then the plaster body (plaster) and finally the smoothing or final finishing layer, although single-layer applications were also carried out, both with a final thickness of 20 mm.

When applied as a single coat, the product showed cracks, generally vertical, right after the surface was finished. Cracks tend to decrease with the reduction of coating thickness.

For the application in three layers, one application per day was considered. On the first day, the base preparation layer was applied, using an additive based on polyvinyl acetate mixed with mixing water, to improve the adhesion of the layer to the substrate. The application of this layer was carried out with a notched trowel so that the surface presents parallel cords and grooves serving as anchorage for the next layer. The final thickness is approximately 0.5 mm.

On the second day, a plaster layer with a thickness of 10 mm was applied, using a wooden trowel, an aluminum ruler and a trowel. The surface must be rough to optimize the anchoring of the final layer.

On the third day, the final render layer was applied, with a thickness of 0.5 mm. The application was carried out with a wooden trowel and the suede surface finish was obtained by passing a damp sponge over the surface of the coating immediately after smoothing with the trowel.

Another important aspect in the application is related to the moistening of the foundation. Ceramic brick masonry in general has high absorption and, if not well moistened, causes mapped cracks on the coating surfaces. In fact, before applying each layer, and especially the first one, the substrate was pre-wetted. Such reactions could be observed in tests carried out both under controlled laboratory conditions and in applications on external walls without humidity and temperature control. Pre-wetting also favors greater control of the temperature of the base to be coated, avoiding the sudden escape of the mixing water, either by suction from the base, or even by evaporation.

In short, the precautions related to controlling the thickness and absorption of the base were key aspects for the best performance of the coating, avoiding the occurrence of cracks, detachments (cavo sound) and pulverulence.

Regarding the final texture of the coating, the suede finish, that is, obtained by passing a sponge over the straightened surface, proved to be more suitable. This is because such a finishing process, associated with the granulometry of the mortar, provoked an effect of contextual continuity, respecting the aesthetic reading of the surroundings, but making the insertion of the new coating clear. Indeed, this form of intervention is in line with the recommendations of the Venice Charter (1964).

As observed in the SHO, several contemporary techniques and materials are used in the cleaning, painting and treatment of the facades, as a way of changing the advanced state of degradation of these elements. With this, what was authentic undergoes a process of standardization with interpretive solutions that have little or nothing to do with the different expressive possibilities of the original surfaces and colors. One sees, therefore, surfaces with a roughened, scraped, travertine or even extremely smooth finish obtained by the use of cement and acrylic masses that have nothing to do with the historical reality of the site, in addition to causing pathological damage that is often irreversible, as already registered. in this search.

6.2.3 Facade painting

According to the theoretical framework that guided this research, the painting to be done in the facades of SHO houses and townhouses must consider some basic assumptions, described below .

In the first place, the specification of paints and their mode of application must consider the specificities of traditional masonry. As previously mentioned, old walls generally have low mechanical resistance and high deformability. They are more permeable and without capillarity cut. Moisture retained in the wall tends to evaporate through the surface, eliminating soluble salts that can damage the masonry structure. Therefore, the choice of product for painting must consider the water cycle of traditional walls.

Furthermore, the chromatic compositions observed in the SHO seem not to observe rules that allow for a harmonic solution, a relationship of interdependence between the building and its surroundings. If each era has its architectural culture, which materializes the technical-artistic development of a society, chromatic concepts are inseparable elements of the style, of an era, and are full of aesthetic and linguistic meanings. Aguiar (2003) states that obtaining the colors, at first, depended on the minerals available locally. However, the availability of industrialized products, from the beginning of the 20th century, made possible the diffusion of the polychromatism adopted for the façades of the buildings.

For the preservation of the urban landscape of the city, however, it would be desirable to promote the physical survey of the surface of the facades, which could identify the superimposed colors and, if desired, define the colors of the first layers of paint. With this, linguistic errors, obliteration of decorative details and other mistakes could be avoided. Therefore, lime-based paints appear to be the most reasonable solution for use on SHO facades. Firstly, because of its compatibility with traditional renders. Secondly, due to its low acquisition and application cost, allowing for more frequent maintenance. Thirdly, it allows the wall to “breathe” while still having great resistance to the formation of fungi due to its high alkalinity.

Figure 17: Execution of lime-based painting
Source: ALVES JÚNIOR, 2009.

Another alternative for obtaining the color on the facades can be in charge of the final plaster layer. This can be composed with inorganic pigments that allow, in addition to the chromatic effect, greater durability and compatibility with previous layers, with greater adhesion capacity than the currently used paint solutions. Mineral pigments are more resistant than organic ones and, due to their finishing thickness, they will make the color layer more durable, avoiding the degradation that can be seen in latex paints due to their low resistance to negative pressure caused by moisture trapped in the support.

Figure 18: Lime and pigment-based mortar
Source: ALVES JÚNIOR, 2009.

According to tests carried out in this research (A2), the final plaster layer was established with a thickness of 5 mm. This layer, if added with mineral pigments, can become a colored spreader, with high durability with the solutions currently adopted due to its thickness, compatibility with the substrate, and constitution. (Figures 17, 18, and 19).

Figure 18: Finishing with a trowel
Source: ALVES JÚNIOR, 2009.

The facade painting solutions most used in the SHO are made up of PVA and/or acrylic latex paints. Such products have impermeable characteristics and, as previously noted, prevent the water cycle of old walls. Furthermore, such materials have a low resistance to moisture that migrates from the interior of the support, causing detachment, wrinkling, film breakdown, efflorescence, and discoloration, among other pathologies.

Figure 19: Final coating texture detail
Source: ALVES JÚNIOR, 2009.

Furthermore, the chromatic inconsistency verified in the SHO contributes to the construction of an artificial that distanced culture from the image of the city, from the material and historical culture of its territory, in which it originated. The lack of a color plan for the city can lead to the complete devastation of the original chromatic reading and the marks of time that identify and characterize the facades of historic monuments. As a result, in this research two compatible ways were chosen to obtain the color. The first is by painting with lime-based paints and the second is by inserting pigments in the final plaster layer. Both processes, however, must be carried out in strict compliance with the studies of the original stratigraphies of the surface of the building, which will determine the colors to be used.

May this work encourage new research related to the theme and enrich the debate in the sense of rescuing the chromatic identity of the SHO, thus contributing to the preservation of its "genius loci", and strengthening its historical and aesthetic character.

7 FINAL CONSIDERATIONS

This research sought to rescue the production and application of a lime-based coating system, for use in the recomposition of traditional facades, inspired by ancient ancestral practices. It also sought to establish a recipe that could be reproduced on an industrial scale, thus aiming to obtain greater quality and productivity in the application of external coatings, without diminishing the artistic and historical value of the building surface.

The results of the research were analyzed considering a reference standard of industrialized mortar for coating, already available in the market and that complies with the Brazilian Technical Norms. In this way, it was possible to apprehend that the product with low cement content did not present significant results that would justify its adoption when compared to lime mortar added with Metakaolin HP. The lime mortar added with Metakaolin HP, in turn, showed faster hardening, with no occurrences of cracks or pulverulence on the surface of the coating, which will possibly make it less susceptible to leaching, especially during its recarbonation period. In addition to the technical aspects mentioned, the appearance of the surface of the building is enhanced by the use of this recipe, as it maintains an artistic and stylistic reading compatible with the original coverings used in the constitution of the entire SHO, given that cement had only been introduced in Brazil after of the 1940s.

Furthermore, the introduction of inorganic pigments in the last layer of plaster allows the coating to have greater color stability and durability, in addition to being a more compatible method when compared to the use of PVA-based paints, for example, widely used and which, due to its low permeability, prevent the reasonable water cycle of traditional masonry, free of capillarity cuts. The last layer of plaster already pigmented, according to the study carried out, would therefore be a more compatible solution to the old support and the other layers of plaster due to its similarity in composition, allowing better adhesion and consequently greater durability and color stability.

Another concern that guided the conduct of the research was the search for simplification of the construction processes so that techniques and materials can be used by professionals in the civil construction sector, without the need for a deep specialization in the segment of preservation and restoration. With this, it is not intended to ignore the technological achievements of the sector, which can be observed in the numerous publications on the subject. The simplification seeks only the democratization of knowledge, so that good practices can reach the largest number of people involved in the restoration and conservation of houses and townhouses in the historic complex of the city of Olinda and, with this, reduce the distance between the academic environment and the current inadequate construction techniques that were observed throughout this research. It is also crucial to understand that this work is based on the restoration of facades of old residences inserted in the listed urban site and that, therefore, the recovery of monuments of greater historical and artistic value must be evaluated more carefully, based on tests and more specific research.

In this way, it is expected that the present research can be useful for future works about the theme, in the search for greater efficiency in the techniques of restoration of facades coated with inorganic mortar and painting. In this regard, developing a historic mortar on an industrial scale could bring numerous technical and aesthetic benefits to historic urban sites. Because covering a monument is an art that needs to be supported by safe and stable processes, to guarantee an adequate performance in technical, aesthetic, and historical aspects.

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