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Proposed Methodology for a Preventive Conservation Strategy for Stone and Raw Earth Architectural Heritage Through Routine Maintenance

Ir a la versión en español

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ABSTRACT

This methodology, proposed for a preventive conservation strategy involving the periodic maintenance of Nicaragua's stone and earth architectural heritage, aims to serve as a preservation tool for both materiality and meaning, aligning with the new paradigm of sustainability. It adopts the four phases of the ICOMOS *Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage* (2003). Still, it differs from other strategies by establishing criteria, principles, and specific guidelines for preventive conservation that are key to the profession's practice, academia, and institutional management. It sets forth guidelines that would allow those who manage heritage communities to undertake, in conjunction with them, practical actions to mitigate and control the risks of deterioration affecting this emblematic heritage. It proposes guidelines that, together with heritage communities, help preservation method schemes.

KEYWORDS

preventive conservation, periodic maintenance, religious architectural heritage, traditional building systems, risk of deterioration, Nicaragua

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

INTRODUCTION

Preventive conservation through periodic maintenance involves a level of indirect, peripheral, or environmental conservation (Muñoz, 2003, p. 23; ICOM, 2008, p. 1), aimed at eliminating, reducing, or controlling agents of deterioration that threaten the persistence and legacy of cultural heritage (Herráez, Durán & García, 2015, p. 3).

It was not until the last century, thanks to experiences and challenges in the careful handling of monuments, that reassessment procedures began to emerge in the international context of conservation and its treatment methods. This was when the paradigm of preventive conservation started to be viewed as a more sustainable strategy for conservation (Muñoz, 2022, 00:40:06).

Nicaragua boasts a rich architectural heritage, particularly in the realm of religious architecture from the 16th to 19th centuries.[1] This includes cathedrals, basilicas, parishes, chapels, hermitages, and more, which arose from cultural exchanges that took place mainly during the Colonial and Independence periods.[2] Many of these structures, constructed from materials like stone (*calicanto*[3] stone and lime masonry, and stonework) and raw earth (*adobe*[4] and *taquezal*), represent the vernacular architecture of various human settlements in the Pacific and Central regions of the country (Estrada, 2024, p. 85). Their spiritual, symbolic, historical, artistic, and technological construction qualities reaffirm the importance of preserving and safeguarding them (Estrada, 2023, p. 369).

[1] At least 60 temples are among the buildings declared as Cultural Heritage of the Nation, representing a notable 33% compared to other categories (Estrada, 2023, p. 123).

[2] Among the most relevant secondary sources dedicated to the identification of these cultural goods are: the *Catálogo provisional del patrimonio histórico-artístico de Nicaragua* (La Orden Miracle, 1971), *Iglesias de Nicaragua* (Vaughan, Avilés & Gaitán, 2000), as well as the *Catálogo de bienes patrimoniales de la ciudad de Granada* (Reyes, 2002), *Catálogo de bienes e inmuebles del Centro Histórico de León* (Oficina Técnica de Gestión del Centro Histórico de León, 2010) and the *Catálogo de inmuebles religiosos declarados Patrimonio Cultural de la Nación* (Guido, Araúz, Rodríguez, Silva, Palacios & Araúz, 2010).

[3] The inventory includes the Cathedral of Leon, which was declared a World Heritage site by the United Nations Educational, Scientific and Cultural Organization (unesco) in 2011; the Sanctuary of El Señor de los Milagros (Our Lord of Miracles) with its visible calicanto masonry head wall in Ciudad Antigua-Nueva Segovia; the walls and steps of the Saint Francis complex in the city of Granada; and the unique church of Nuestra Señora de Candelaria in the municipality of Diriomo.

[4] According to Estrada's (2023) estimates, at least 45% of the religious buildings inventoried in the Pacific region have adobe walls (16% adobe and 29% mixed; see Figure 57, p. 260). Some of these include the parish of Saint John the Baptist and the hermitage of Saint Peter in the indigenous village of Sutiaba-Leon, the temples of Saint Francis and La Merced in the city of Granada, as well as the churches dedicated to Saint Ann in the municipalities of Nandaime, Niquinohomo, Nindiri, and Chinandega.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

Nevertheless, despite their importance in shaping collective memory and national identity, there are still no means to conduct identification processes and registrations that lead to a comprehensive evaluation of these buildings.[5] Therefore, it is suggested that the starting point of any direct or indirect conservation strategy should be the understanding of the cultural good's "physical consistency and its double aesthetic-historic polarity" (Brandi, 1995, p. 15).[6]

Limited scientific and academic research has resulted in widespread ignorance about the heritage in question, which faces significant challenges and threats, such as insufficient preservation methods that hinder timely strategies, the lack of regular maintenance stemming from inadequate financial and technical resources, and the loss of traditional construction techniques due to the neglect of building knowledge, along with other issues (Estrada, 2023, p. 259). Research indicates that disregarding these assets leads to progressive and cumulative risks, as well as heightened exposure to disasters.[7]

Therefore, it is essential to identify the necessary national-level conditions to create a culture of preservation and prevention, starting with the establishment of strategies for systematic maintenance that are not only governed by the principles and criteria of indirect conservation but also adhere—without overlooking controls to assess their effectiveness—to a series of actions and therapies (also known as treatments in other parts of Latin America) that align with their constitutive materials.

Therefore, in the absence of a specific method for preventive conservation, a discipline that is rarely addressed within the Nicaraguan legislative framework and technical practice (the latter often replaced by interventions that are either costly or unsuitable for the heritage asset), contributions proposing methodologies with preservation strategies for the national context and its popular heritage are crucial. Indeed, these should be made adaptable to architectural typologies derived from different regional experiences, but with an approach that aligns with national reality (Estrada, 2023, p. 3).

[5] The national inventory, Proyecto Inventario Nacional de Bienes Culturales (PIBCN), has been carried out with technical and financial support from Spanish Cooperation since 2008, allowing the Instituto Nicaragüense de Cultura (INC) to develop the Inventario integral de recursos culturales inmuebles, muebles, arqueológicos e intangibles for the departments of Granada, Masaya, Carazo, Rivas, León, and Chinandega. Unfortunately, it has not been possible to extend this vital project to other areas of the country, which have yet to be inventoried (Rodríguez, 2011, p. 276).

[6] Editorial translation.

[7] The earthquakes of April 2024 resulted in significant damage and minor deterioration to the structures of the temples in Nagarote, León, Telica, and Quezalguaque, located in the western part of Nicaragua (Aguilar & Tamez, 2016, p. 12).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

The present work is based on the theoretical and technical foundations proposed by conservation-restoration theoreticians (Ruskin, Brandi, etc.) and the directives of international charters and conventions. This makes it possible to identify and expand principles and performance criteria specific to the discipline of preventive conservation, aspects that are typically addressed from the perspective of restoration (Muñoz, 2020, p. 169).

Furthermore, in accordance with the paradigm of coexistence of tangible and intangible heritage (UNESCO, 2003, p. 1), this methodology opts for shared tutelage, providing guidelines for its identification, registration, and valuation. It also aims to shed light on the risks of deterioration by designing an action plan that includes permanent, seasonal, and occasional treatments conceived under the compatibility of materials, utilizing traditional mixtures that help reduce environmental pollution and safeguard traditional know-how. This article aims to disseminate the findings of the major research on which it is based.[8]

BACKGROUND

This work primarily draws on the contributions of theoreticians, alongside guidelines established in charters and conventions for the conservation of cultural heritage, as well as preventive conservation methodologies presented in maintenance manuals for historical buildings that have undergone restoration.

The postulates of these theoreticians have been key to launching a debate on the suitability and mistakes in conservation conceived as restoration and consolidation. However, preservation as a criterion for action, rather than its recognition as a discipline of indirect conservation, has been considered since the 19th century by British polymath John Ruskin. In chapter six, titled 'The Lamp of Memory,' of his work *The Seven Lamps of Architecture*, he states the advantage of maintaining monuments to avoid incurring in restoration. Thus, he asserts his antagonistic stance regarding invasive and irreversible interventions: "Take proper care of your monuments and you will not need to restore them. A few sheets of lead put in time upon the roof, a few dead leaves and sticks swept in time out of a water-course, will save both roof and walls from ruin" (Ruskin, 1988, pp. 194-198).[9]

[8] This article compiles the research published in the thesis *Conservación preventiva del patrimonio arquitectónico religioso de piedra y tierra cruda en Nicaragua: metodología de estrategia para su mantenimiento periódico en el año 2023*, to obtain the degree of Master in Conservation of Cultural Heritage for Development.
[9] In González-Varas (2006, p. 205).

Nevertheless, it is the Italian Cesare Brandi and his theory of *Preventive Restoration* who are credited with disseminating a concrete method that includes the monument's aesthetic and historical valuation, a study of the state of material consistency, and an evaluation of image status (environmental threats) as a diagnostic. His strategy includes preventive and prohibitive measures directed at the material, as well as precautionary ones for the image (Brandi, 1995, p. 58).

Brandi's contributions have been incorporated into international charters and conventions as significant legal and deontological references in the field. Early on, the International Charter for the Conservation and Restoration of Monuments and Sites, or Venice Charter (ICOMOS), states that the monumental works of peoples carry a spiritual message from the past and nowadays represent the living testimony of its secular traditions; where "the conservation of monuments requires, above all, systematic maintenance" (ICOMOS, 1964, art. 4).[10]

Furthermore, the Principles for Conservation and Restoration of Built Heritage, or The Charter of Krakow (ICOMOS, 2000, p. 2), along with the Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage (ICOMOS, 2003, art. 1.6), are the instruments that introduced the premise of the preventive conservation approach by establishing action phases for built heritage. Institutionally, the Council of Europe's Towards a European Preventive Conservation Strategy, adopted at the Vantaa Meeting (ICCROM, 2000, p. 4), was the first charter to establish leadership as a strategic point for introducing preventive conservation as a fundamental principle in preserving cultural heritage.

A series of manuals from Spain, Mexico, and Peru were also consulted. The *Manual de conservación preventiva del exconvento de Tepoztlán* (Sandoval, 2010, p. 9) was key to classify the temporality of maintenance activities: permanent, seasonal, and occasional. The *Guía de conservación y mantenimiento. Monumentos históricos y artísticos de propiedad federal abiertos al público* (Arnal, 2010, pp. 52-60) introduces four criteria on actions for peripheral or environmental conservation: cleaning, protection, replacement, and substitution.

Moreover, the Manual General de Mantenimiento de Monumentos Históricos (CONACULTA-INAH Michoacán, 2003) has a typological classification of goods. It highlights the differences between construction elements in traditional and modern buildings, discusses

[10] Editorial translation.

the causes of deterioration, offers recommendations for actions to control damage, provides ratios for artisanal mixtures, and warns against using cement to treat traditional buildings. Additionally, it includes a matrix with a modest but useful program of preventive tasks. The structure of this Manual serves as the essential model upon which other guides have been based.[11]

It is equally important to highlight the pioneering experience and contributions of Spain's *Plan Nacional de Conservación Preventiva de España* (PNCP), an instrument that bases its methodological phases on the four stages of the *Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage* (ICOMOS, 2003, art. 1.6) [...] "similar to those used in medicine: anamnesis, diagnosis, therapy and control."[12]

Finally, the Instituto Nicaragüense de Cultura (INC) community booklet *¿Cómo conservar nuestras casas y edificios antiguos?* (Palacios & Silva, 2015, pp. 17-23) serves as a guide within a set of three publications focusing on historical, archaeological, and movable heritage.[13] This guide is part of a dissemination program by the Directorate for National Heritage, with support from the UNESCO Sub-regional Office for Central America and Mexico. It is the only Nicaraguan reference that includes a preventive component. Similar to the ICONACULTA-INAH Michoacán manual (2003), it highlights the significance of conserving Nicaragua's architectural heritage, its architectural typologies, and its traditional building systems utilizing raw earth and stone, alongside the agents of deterioration and their primary effects. Furthermore, it provides preventive recommendations.

It is a useful guide that fulfills its aim of warning about the need to control agents of deterioration that could affect the values and materiality of Nicaraguan built heritage. Therefore, it encourages a culture of maintenance from the basic nucleus of habitation: housing. However, since it was not conceived as a technical instrument for preventive conservation, it lacks the sequence of systematic processes that a preventive conservation methodology through periodic maintenance would offer[14] (Figure 1).

[11] The *Manual de conservación preventiva de bienes en recintos religiosos* (Morales & Cruz, 2015), *Manos a la obra: Manual de mantenimiento preventivo para la conservación de monumentos históricos del estado de Guanajuato* (Instituto Estatal de la Cultura de Guanajuato, 2019) and *Conservación preventiva del Patrimonio Arquitectónico Religioso del Ministerio de Cultura de Perú* (Benavente, Silva, Chapman & Saenz, 2017) were also consulted.

[12] Editorial translation.

[13] The other two community booklets are: *¿Cómo inventariar nuestros bienes culturales muebles?* and *El patrimonio cultural arqueológico y su conservación*, also edited in 2015.

[14] When the management offices for the historical centers of the cities of Granada and León were established at the end of the former and the beginning of the current

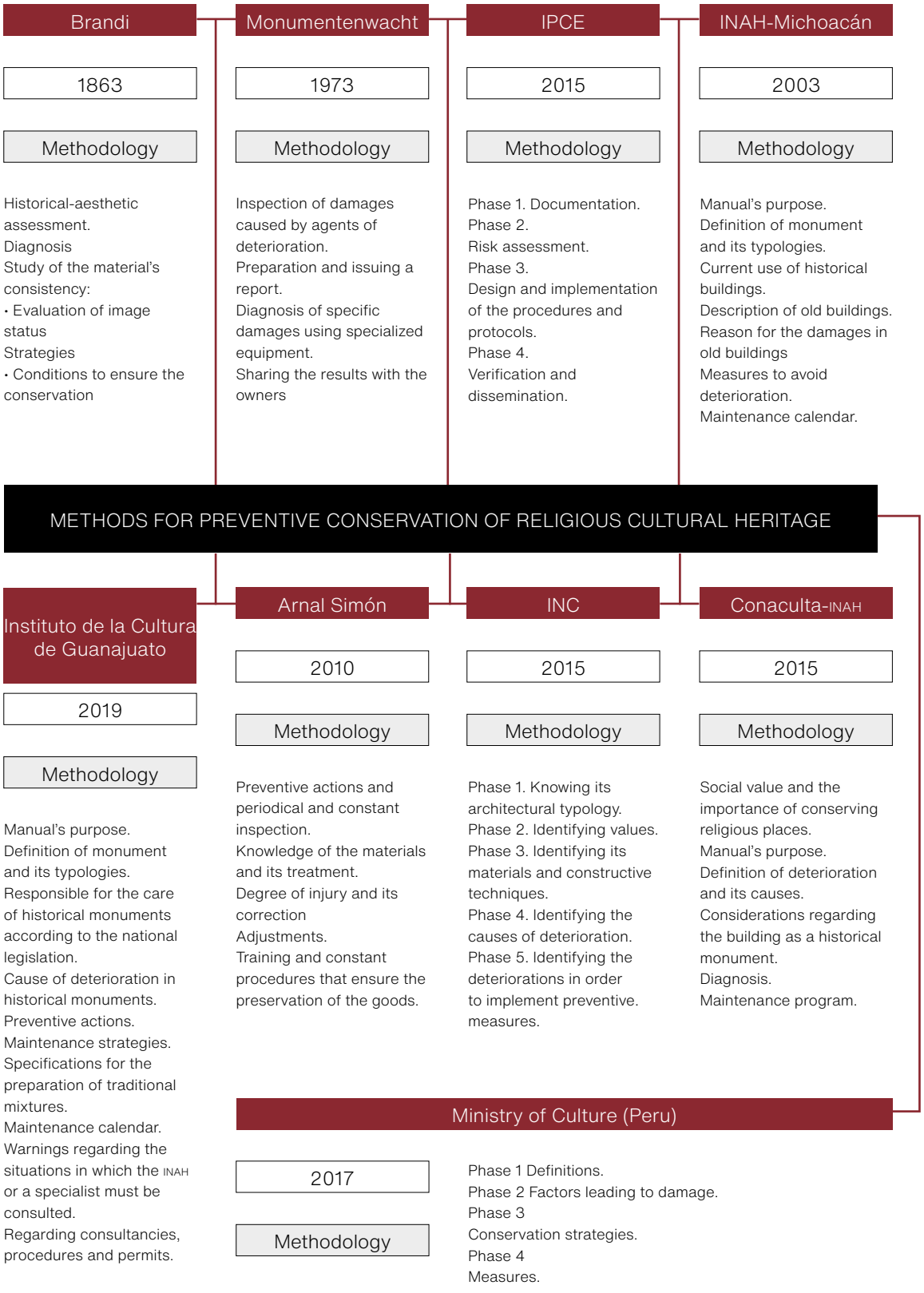


FIGURE 1. Methods of preventive conservation strategies through periodic maintenance for architectural heritage consulted (Diagram: Alicia Estrada Castillo; source: Estrada, 2023, p. 233).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

THEORETICAL PERSPECTIVE

Within the theoretical framework of preventive conservation through periodic maintenance, one must broach essential definitions such as culture and cultural heritage. The first is a universal concept defined in the 1982 World Conference on Cultural Policies as "the set of distinctive spiritual, material, intellectual and emotional features characterizing a society or social group. It encompasses not only arts and literature but lifestyles, fundamental human rights, value systems, beliefs, and traditions" (World Conference on Cultural Policies, 1982, p. 1).

The cultural policy of the Government of Reconciliation and National Unity of Nicaragua (GRUN, as its acronym is in Spanish) seemingly adopts key aspects of this conference and the Universal Declaration of Human Rights regarding cultural life in the community (UN, 2015, art. 27). It expresses crucial notions about the need to create mechanisms to ensure this right in all environments:

> The Government of Reconciliation and National Unity recognizes the right of our people to create and enjoy all forms of art and culture, for which it undertakes to work by establishing the necessary conditions, instruments, and means so that, from the local to the national level, all artistic and cultural expressions of the Nicaraguan people are recognized and encouraged (INC, 2019, p. 2).[15]

Regarding cultural heritage, there are countless definitions. The UNESCO Culture for Development Indicators state: "Cultural heritage is, in its broadest sense, both a product and a process that provides societies with a set of resources inherited from the past, created in the present and made available for the benefit of future generations" (UNESCO, 2014, p. 132).[16] This definition is closely linked to the paradigm of sustainably exploiting cultural resources to provide heritage communities, aware of the resources' non-renewable nature and the urgency of responsible management, with economic means that benefit them.

centuries, the Spanish Cooperation Agency assisted in preparing informative booklets on maintenance, such as *El mantenimiento de su casa antigua* (Oficina Técnica de Gestión del Centro Histórico, s. f.) and *Si quieres conservar tu vivienda de adobe o taquezal, lee este folleto* (Oficina Técnica de Gestión del Centro Histórico de León, s. f.). These booklets merely provided recommendations regarding the use of buildings, minor repairs, and proportions for traditional mixtures.

[15] Editorial translation.

[16] Editorial translation.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

Nicaragua has not adopted a formal concept of cultural heritage as per national legislation. However, Decree 1142, art. 1 of *the Ley de Protección al Patrimonio Cultural de la Nación* (1982) defines the following categories of goods[17]:

a) Paleontological – the study of all fossilized organisms.
b) Archaeological includes all artifacts, tools, structures, remnants, or vestiges from extinct cultures.
c) Historical – buildings or parts of them and movable goods directly related to Nicaragua's political, economic, and social history.
d) Artistic goods and objects are those that, because they originate from human activity, represent true value as Fine Arts or National Art, whether in the form of plastic, literary, architectural, or other mediums.
e) Urban or rural groups are considered to hold cultural interest and are located in Nicaraguan cities or the countryside.

The new meaning of cultural landscape is recognized as the heritage category that best links the interaction between communities and their natural environment (Council of Europe, 2000; Gómez, 2023: 02:06:20). Integrating this concept into the Nicaraguan normative framework would provide an opportunity for a holistic assessment and management of the country's natural and cultural heritage, thus overcoming the individualistic notion that the value of built heritage is separate from its physical and symbolic context. However, seeking strategic and sustainable planning on this territorial scale necessitates a strong institutional commitment, as well as support from the associated heritage communities.

Conservation, as an interdisciplinary practice, employs scientific research to ensure both the persistence and inheritance of cultural goods with minimal damage, serving as safeguards for their material and immaterial value. I believe this conservation can be divided into two main aspects: direct and indirect, with the latter guiding the present proposal. Therefore, the general definitions that help to understand the scope of preservation and its relation to preventive conservation and periodic maintenance are presented below (Figure 2).

[17] Editorial translation.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

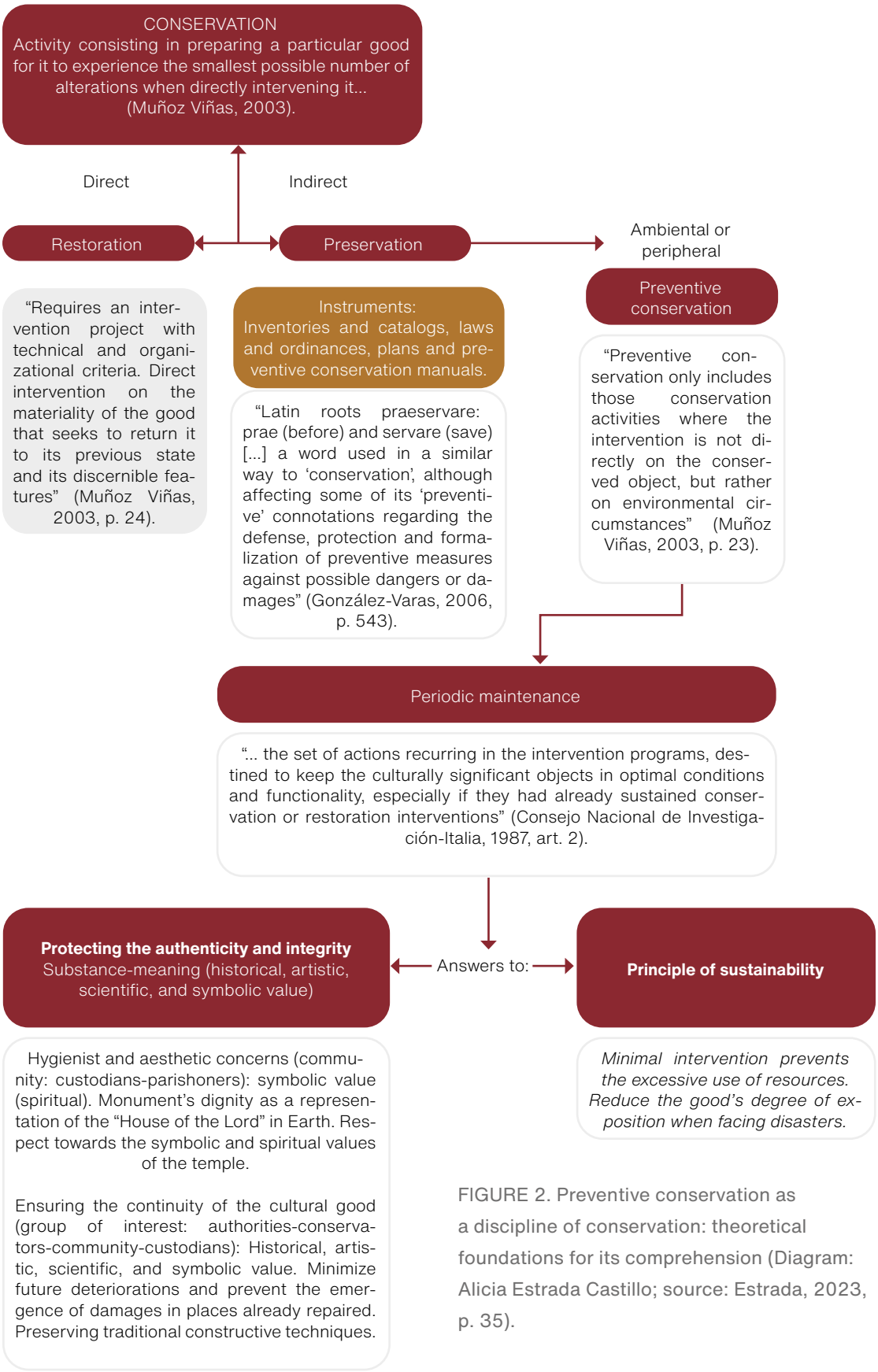


FIGURE 2. Preventive conservation as a discipline of conservation: theoretical foundations for its comprehension (Diagram: Alicia Estrada Castillo; source: Estrada, 2023, p. 35).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

RESEARCH METHODOLOGY

The developed methodological proposal is based on qualitative research regarding the state of religious buildings in Nicaragua. This investigation addressed the design of a preventive conservation methodology through periodic maintenance, conceived explicitly for built religious heritage made of stone and raw earth, thereby addressing the lack of proposed strategies for its conservation.

The variables analyzed included theories of preventive conservation (mentioned above), testimonies from Nicaraguan custodians regarding their tasks managing religious buildings, technical considerations from national and international conservators, and an analysis of case studies on general methodologies used and their application in specific contexts. These factors determined that the focus of the research should be qualitative, employing a grounded theory design. This approach facilitated the generation of knowledge based on the findings of a previously unexplored topic and helped establish relationships between the motives that impact the development of preventive conservation strategies, including legislative gaps on the matter, nonexistent methods, and insufficient technical and financial resources, among others.

With structured interviews serving as the primary source of data collection, a situational analysis of the management of religious buildings was conducted (Estrada, 2023, pp. 133-172). These interviews helped identify constraints and opportunities to develop a methodology applicable to the national context, recognize preventive actions and best practices, and establish standards for the proposal's theoretical and technical guidelines. Therefore, from March to July 2023, consultations were conducted through structured interviews with parish priests, sextons, sacristans, as well as national specialists (the head of the INC'S Dirección de Patrimonio Nacional, now Instituto de las Culturas de Pueblos y Juventudes (ICPJ);[18] and three professionals working in the areas of research, management, teaching, and conservation of built and movable heritage), and also international (a semi-structured interview with a conservator at the Consejo Nacional para la Protección de la Antigua Guatemala (CNPAG), an expert in management and conservation of this world heritage city).

Due to the limited knowledge of the national construction systems of adobe, *taquezal*, and *calicanto*[19] —along with previously

[18] The entity responsible for protecting Nicaraguan cultural heritage is named in Decree-Law 427.
[19] The most common construction solutions found in Colonial period temples (Figure 6).

mentioned factors such as partial identification, registry, and assessment initiatives, as well as a lack of research— it was decided to limit the sample to twelve temples to structure this research[20] (Figure 3) based on the following selection criteria:[21]

FIGURE 3. Temples studied through interviews: general data (Diagram and photographs: Alicia Estrada Castillo, 2023; sources: *Oficina Técnica de Gestión del Centro Histórico de León* (2010, pp. 18-185), INC-AECID (2011, pp. 47-119), INC-AECID (n.d., pp. 26-28), Reyes & Moreno (2002, p. 78), Vaughan, Avilés, & Gaitán (2000, pp. 54-56) and Balladares, Cordero, Murillo, Gaitán & Hernández (2009, p. 59).



Cathedral of Leon
Construction: 1747-1816. The frontispiece was altered in 1917.

Walls: masonry/ roof: stone, bricks, and wood.



Chapel of San Pedro, Leon
Construction: 1706-1718. Southern wall partially rebuilt in 1986.

Walls: adobe/ roof: wooden structure, and zinc cover [sheet metal].



Church of El Calvario, Leon
Construction: Rebuilt at the beginning of the 20th century.

Walls: adobe and masonry/ roof: wooden structure covered with roof tiles.



Church of San Blas, Chichigalpa
Construction: At the end of the 19th century

Paredes: adobe and taquezal/ roof: wooden structure and undulated zinc sheets (metallic roof)

[20] In addition to interviewing custodians of the religious buildings, photographs of the exteriors and interiors, including their unique elements, were taken during visits to the temples.

[21] Due to the extension of the territory covered by the Spanish occupation throughout the current macro-regions of the Pacific (19 605 km^2; 15% of the total) and Central (45 745 km^2; 35% of the total) (Forest Resources Assessments, 2000), greater importance was placed on identifying the distinctive typological conditions in the study, such as dating, zones of greater Colonial expansion, traditional building materials, and willingness of the custodians to be interviewed.



Church of Santa Ana, Niquinohomo
Construction: 1663-1689

Walls: masonry/ roof: wooden structure covered with roof tiles.

OTHER BUILDINGS VISITED IN THE DIOCESE OF LEON

Church of Nuestra Señora de la Merced
Construction: Reconstructed in the 18th century
Walls: masonry/ roof: wood with zinc cover [metal sheets].

Church of San Juan de Dios, León
Construction: 1774-1816
Walls: masonry/ roof: stone, bricks, and wood.

Church of Inmaculada Concepción de María, El Viejo
Construction: 18th century.
Walls: stone, earth, argamasa/ roof: wooden structure and roof tiles.

Leon Diocese

Granada Diocese



Church of La Recolección, Leon
Construction: Started on december 5th, 1786. Ended on 1815.

Walls: masonry/ roof: wooden structure and zinc cover [sheet metal] and roof tiles.



Church of La Merced, Granada
Construction: Half the 16th century. Construction of the second temple in 1740. Reconstruction of the bell tower in 1862-63.

Walls: adobe and masonry/ roof: wooden structure covered with roof tiles.

OTHER BUILDINGS VISITED IN THE ARCHDIOCESE OF MANAGUA

Church of Nuestra Señora de la Asunción, Masaya
Construction: started towards the end of the 18th century (1750)

Walls: adobe and masonry/ roof: wooden structured covered by clay roof tiles.



Church of Nuestra Señora de Candelaria, Diriomo
Construction: 1775-1900

Walls: masonry/ roof: asbestos sheets, cement, wooden structure.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

- Temples constructed with traditional systems, utilizing stone and raw earth, were established during Nicaragua's Colonial period in the first half of the 16th century.
- Geographic distribution for a significant sample of the Pacific region represents the territory with the greatest concentration of sites of interest, including the oldest diocese in the former Province of Nicaragua, now the diocese of Leon.
- Access to information and source availability.

PROPOSAL

Criteria and principles guiding the proposal for a methodology for a preventive conservation strategy through periodic maintenance

Criteria and principles serve as the primary action strategies aimed at preserving religious sites through the fundamental or meta-principle of the *precautionary principle*. This term, used in international environmental law, establishes standards and procedures that emphasize prevention rather than repair, due to the irreversible consequences of severe ecological effects (Andaluz, 2002, p. 143).

Its significance in the world of Nicaraguan conservation disciplines for cultural heritage can enhance the understanding of the adage "an ounce of prevention is worth a pound of cure," by prioritizing the preservation of the materiality and meanings of cultural goods. This is achieved by preventing cumulative deterioration through planned, recurring, or controlled indirect or environmental actions. Below are the criteria for the primary prevention strategy aimed at the Nicaraguan vernacular heritage of stone and raw earth (Estrada, 2023, pp. 238-240):

1. *Detection, identification, evaluation, and risk control of environmental deterioration* (Herráez, Durán, & García, 2015, p. 5): involves systematic preventive measures that support the management of cultural goods against recognized agents of deterioration as part of a conservation therapy or treatment.
2. *Routine cleaning* (Arnal, 2010, p. 52; Sandoval, 2010, pp. 10-14): includes daily cleaning activities such as sweeping, mopping, removing cobwebs, and eliminating dust particles.
3. *Disinfection (*Arnal, 2010, pp. 54-55; F. Rivera, personal communication, April 18, 2023):[22] refers to actions aimed at eradicating and controlling undesirable organisms (insects) that

[22] Architect Flor de María Rivera, national conservator and restorer.

feed on organic material, as well as microorganisms (fungi) that affect surfaces and traditional building materials. These tasks encompass fumigations and sanitation of surfaces using specific methods and products.

4. *Liberation* (ICOMOS, 1964, art. 13; Díaz & Orive, 1984, p. 7; Sandoval, 2010, pp. 18-19): suppress deteriorations affecting the conservation of religious sites, among which are the elimination of noxious flora or parasitic fauna and cleaning rainwater drainage systems (gutters, downspouts, weep holes, etc.).
5. *Protection or waterproofing* (Arnal, 2010, pp. 56-57; Sandoval, 2010, p. 20): tasks to protect constructive elements against the effects of humidity by filtration, mainly on collar beam or vaulted roof coverings. Likewise, protecting varnishes and paints on wood surfaces and walls.
6. *Reintegration or minor replacements* (ICOMOS, 1964, art. 7; Díaz & Orive, 1984, p. 7; Arnal, 2010, pp. 59-60): restituting dislodged parts of the building to their original location to ensure their conservation; for example, reintegration of original material elements such as baked clay tiles that were displaced by elements of nature such as wind or rain.
7. *Minor integration, restitution, or small repairs* (ICOMOS, 1964, art. 9-12; Díaz & Orive, pp. 7-8): insertion of clearly new and visible elements to ensure the monument's conservation. It includes minor treatments to integrate new baked clay roof tile elements that were cracked, collapsed, or caved in due to agents such as rain, wind, earthquakes, falling ashes, or acts of vandalism. On walls, minor additions to plaster or cement renderings, skimming or smoothing, filling holes, and repairing cracks (also on roofs). Moreover, replacement of wooden pieces due to rotting or irreversible damage by xylophagous insects, among others.
8. *Supervision and surveillance* (Sandoval, 2010, p. 39)*:* related to the review and monitoring of the operation of the building and its special installations**.** To cite certain instances: periodic revision of electrical and hydraulic installations to avoid malfunctioning that could cause damages; guarantee surfaces and finishes are kept clean and complete to prevent moisture penetration and, in the case of walls, to avoid the proliferation of microorganisms (fungi, bacteria, algae, lichen and mosses), and inferior organisms (insects) or superior (animals and vegetable species) organisms, etc.
9. *Installation of minor peripheral infrastructure* (Sandoval, 2010, p. 10): used to control noxious fauna by putting in netting to

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

prevent them from entering or remaining in the religious monument.

These criteria should be considered in accordance with the site's particularity, cultural significance, level of protection, and state of conservation. For the adopted strategies to be timely and coherent, knowledge of the building and identification of the agents of deterioration that are causing the effects are essential. The priorities for action must focus on: improving the sacred spaces, contributing to structural stability, isolating the building from all sources of humidity, disinfecting surfaces affected by xylophagous insects or harmful fauna. Furthermore, inspections of the installations and their adequate functioning must be carried out to avoid catastrophic damages (fires, vandalism, etc.), including those goods or elements that are irreplaceable (Estrada, 2023, pp. 248-250).

These principles are ethical considerations that guide the study and technical practice of conservation. Hence, they should be followed by specialists, managers, proprietors, and the relevant heritage community. Thanks to the analysis of conservation theories, charters, conventions, and the demands of Nicaraguan religious architectural heritage, a set of exclusive principles for the discipline of preservation was defined —a contribution that can be applied to the regional context. These are (Estrada, 2023, pp. 239-240):

1. *Study and understand the built heritage as a whole* (Brandi, 1995, p. 15). It is essential to start developing research within the full scope of the monument (typology, uses, history of the building, construction phases and materials, spatial and formal alterations, interventions, associated immaterial heritage, etc.). Knowledge of this is vital for its assessment.
2. *Recognize the buildings' natural ageing process* (Ruskin, 1944, pp. 248-249)**.** Through continuous and systematic maintenance, we must strive to achieve this condition of matter with dignity.
3. *Minimal intervention* (Ruskin, 1944, pp. 250-252). Periodic maintenance must precede direct or invasive interventions, and it must contribute, through programmed strategies, to conserving the materiality and safeguarding the historical, artistic, and symbolic values.
4. *Therapy or treatment must address the root causes of the problems, rather than the symptoms* (ICOMOS, 2003, art. 3). Because preventive conservation through periodic maintenance is the best strategy and each religious site is unique, the con-

servation strategy must be revised and updated according to specific problems.

5. *Minimize deterioration and avoid the recurrence of problems previously solved or new combinations* (ICOM-CC, 2008, p. 1; Gómez, 2023, 02:29:13). This is done through permanent indirect actions (maintenance), since they provide structural stability to the good, do not interfere with the original materials nor modify its appearance.
6. *Document and record deterioration contributes to the identification, knowledge, and treatment of damages that affect the conservation status of the good* (Herráez, Durán & García, 2015, p. 3). In addition to the diagnosis, data logging should extend to all the stages of a technical study, including the documentation and treatment of cultural goods.
7. *Respect the traditional building systems* (ICOMOS, 1994, art. 7). How? By using compatible techniques and materials in the preservation treatments, including exploitation of ancestral knowledge on ethnobotany to make conservation (lime-based paint) and treatment (pest control) products.
8. *The greater the historical and artistic importance of the site, the more the level of strategies for preventive conservation through periodic maintenance will increase their planning for the action's programming, implementation, and follow up* (Estrada, 2023, p. 240). To do so, it is essential to hire staff with knowledge of traditional construction systems with proper support of conservation specialists, along with prior authorization of the actions by the *Instituto de las Culturas de Pueblos y Juventudes* (ICPJ).
9. *Preventive attention to unique elements requires an interdisciplinary treatment* (Herráez, Pastor, & Durán, 2019, p. 77). This must be done with due consultation and approval of the strategies by the ICPJ.
10. *The universal importance of the discipline of preservation deserves a method that can be applied and extended to other categories of cultural heritage* (Gómez, personal communication, May 29, 2023).[23] Hence, the present methodology can be implemented in various typologies of Nicaraguan architectural heritage.
11. *The new vision of conservation.* Preventive conservation through periodic maintenance linked to participatory processes of the heritage communities constitutes sustainable conser-

[23] Omar Gómez, national conservator and restorer of built and movable goods.

vation — this is the new vision (Muñoz, 2022, p. 169), which is not detached from technical formation, but lowers the costs of restoration.

12. *Periodic maintenance does not substitute restoration: they are complementary* (Marconi, 1987, p. 2)**.** Following a process of direct intervention (restoration or consolidation), it is essential to establish systematic maintenance strategies to prolong the effects of the intervention or prevent the reappearance of previously treated deteriorations.
13. *Maintenance of buildings constitutes a social system*. The staff involved and the proprietors play an active role in this system (Feilden, 2003, p. 239).

Methodological proposal for a preventive conservation strategy through periodic maintenance

With the above-mentioned establishment of criteria and principles, the method put forward herein consists of a four-stages cyclic process: anamnesis (documentation), diagnosis (diagnostic), therapy (or treatment), and control (based on the ICOMOS *Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage* of 2003). This proposal aims for a comprehensive approach to Nicaraguan cultural heritage, with a focus on the discipline of preventive conservation through periodic maintenance, acknowledging the requirements and limitations that custodians face when managing these goods. Regarding this last aspect, the experience of the Spanish *Plan Nacional de Conservación Preventiva del Instituto del Patrimonio Cultural de España* (PNCP) was a significant reference to define the components of each stage.

It reinforces the importance of being accompanied by the ICPJ throughout the four stages, not only because this institution represents the highest authority in the protection and conservation of national cultural heritage, but also for its collaboration with heritage communities through technical assistance. On the other hand, parishioners contribute by manifesting their "popular piety",[24] but they also represent substantial support for the management and maintenance of temples in Nicaragua.

[24] [...] designates those diverse cultic expressions of a private or community nature which, in the context of the Christian faith, are inspired predominantly not by the Sacred Liturgy but by forms deriving from a particular nation or people or from their culture (The Vatican, 2002, art. 7).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

Architectural typology	Degree of protection	Evaluation criteria	Suggested instrument	Human resource
Good declared World Heritage by UNESCO (Cathedral of Leon).	Integral, protected by law (World Heritage Convention of 1972-Decree No. 1142).	Authenticity and integrity (Outstanding Universal Value) (Irreplaceable good)	Preventive conservation plan or maintenance program including management or handling plan.	Maintenance equipment handled by a conservation specialist
Religious immovable good declared national heritage (national or historical monument that holds "National Cultural Interest").	Integral, protected by law (Decree-Law 1142 and specific declarations).	· Historicity · Formal characteristics · Technological characteristics · Relationship with the sorroundings · Immaterial value (Goods with irreplaceable features)	Periodic maintenance manual.	Qualified supervised personnel: conservation specialist
Immovable goods not declared national heritage (basilicas and bishoprics).	-----	Analyze the cultural meaning or the importance that local communities give them (spiritual, historical, artistic value).		
Immovable goods not declared national heritage (parishes, hermitages and parochial houses).	-----		Maintenance manual or routing sheet with periodic maintenance strategies.	Routine cleaning under jurisdiction of the sacristans and concierges. The tasks of stationary and periodic maintenance must be executed by the personnel (builders and carpenters) that have verifiable knowledge regarding traditional construction systems. Stationary or periodic supervision by a specialist is recommended.

FIGURE 4. Preventive conservation instruments and general requirements for the technical workforce according to the importance of the religious site (Source: Estrada, 2023, pp. 242-253).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

Hence, the ideal scenario to implement the strategy calls for the creation of small technical committees (ecclesiastical authorities, cultural institutions, and parishioners with professions in the field of architecture or engineering), who support decision-making according to the needs of the religious building; for example, documentation and registry of the cultural goods.

It is essential to clarify that this method is not a recipe, as each cultural good has its unique characteristics. Nevertheless, these four steps can serve as a guide for systematic attention through periodic maintenance, which is the most sustainable strategy. Considering the minimal intervention and lower cost, it contributes to a reduced risk of deterioration, mainly of biological and environmental types. It prolongs the state of conservation, allowing the good to be inherited by future generations, while ensuring a dignified aging of these monuments.

Each stage of the process is detailed below, along with the work guidelines for the proposed methodology (Figure 5):

Stage 1. Documentation (Anamnesis)

This is the preliminary stage, aiming to standardize knowledge of cultural goods in their constitutive architectural aspects, history, construction systems, and urban or rural environments. Regardless of the religious typology, Nicaragua does not currently have a research base that allows the identification and knowledge of its architectural heritage; therefore, proposing the analysis of cultural goods is a starting point to recognize the urgent need to document and disseminate built heritage. The recommendations to broach the main components for analysis in the first stage are as follows:

Architectural survey and documentation

All built heritage deserves to be represented in architectural and construction plans and special installations, which can be developed gradually by either the parish technical committees that will be created or academia, with follow-up by ICPJ.[25] Registration and control of the built-in and movable goods are also essential (altars, pulpits, atrial crosses, general furniture, images, etc.). On a nation-

[25] In the situational diagnosis of the temples studied, a case of good practice was identified during the survey of the parish of Saint Ann, in the municipality of Niquinohomo, which came about while formulating a proposal to restore the roof cover of the presbytery. The initiative was led by the temple authorities and parishioners who are professional architects and civil engineers, with advice from the *Ortiz Gurdián* foundation and follow up by the ICPJ (Estrada, 2023, p. 166).

al scale, we have registration cards for built goods, a result of the *Proyecto Inventario Nacional de Bienes Culturales* (PIBCN) (INC-AECID, 2008). This instrument can be adapted to identify the specific characteristics and registration requirements of religious sites.

STAGE 1	**DOCUMENTATION** ***Anamnesis*** ANALYSIS OF THE CULTURAL GOOD • Architectural survey and documentation • Formal historical assessment • Materials and traditional construction techniques • Identifying and describing materials and traditional clay (adobe, taquezal), natural-ceramic stone (calicanto), wood and lime • Material registry • Cultural significance • Religious institution and communities identifying the heritage values. EXHIBITION CONDITIONS: MEDIUM ANALYSIS • Identifying the external risks of the urban environment ANALYSIS OF THE INSTITUTION • Organizational level • Human resource • Economic resource
STAGE 2	**DIAGNOSTIC** ***Diagnosis*** Identifying the risks of deterioration Documentation of the risks of deterioration Identifying and documenting alterations or modifications Recommendations regarding the use to avoid anthropic damages
STAGE 3	**THERAPY** Actions temporality Periodic cleaning procedures Preventive actions to avoid environmental and biological risk • Procedures, traditional mixtures and its dosage Activities scheduling (permanent, stationary, and occasional)
STAGE 4	**CONTROL** Appliance, monitoring and strategy control • Instrument for verifying the therapy's efficiency

FIGURE 5. Methodology phases of the strategy of preventive conservation through periodic maintenance for religious architectural heritage in Nicaragua made of stone and raw earth (Table: Alicia Estrada Castillo; source: Estrada, 2023, p. 255, based on ICOMOS (2003) and Herráez, Durán & García (2015, p. 7).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

> The creation and proper management of the inventory and catalogue are, doubtless, the best start so that those responsible for ancient buildings, in this case a temple and its annexes, as well as members of the community, can head or advance towards the protection of heritage in its place of origin and/or where the temple is located, besides establishing a culture of maintenance and preservation of the building itself and its artistic objects (Arnal, 2010, p. 35).[26]

It is recommended that managers of the temples prepare a "Building Book", a system to log actions taken in the heritage good, which was developed in Spain. This has yielded promising results, as both the plans and documentation of actions are beneficial for detecting problems, while also directing and redirecting therapies or treatments. The next step in this first stage is the historical and formal analysis of the Nicaraguan temples, which will provide knowledge about the historical memory and distinctive features of this architecture.

Considerations for the formal-historical assessment of religious sites

Historical assessment is obtained by observing and analyzing primary documentary sources (national historical archives, diocesan archives, reports by chroniclers of the period, and royal decrees, among others). Establishing a method for historical research is the domain of historians; however, knowledge of the past, rather than a method for specialists, concerns society, given its role in shaping identity. Furthermore, formal analysis enhances recognition and understanding of the cultural good. Therefore, the points that can be useful for historical stylistic research are (Estrada, 2023, p. 258):

- *Period during which it was built or exact date of creation.* This will enable us to situate the building in the chronology of historical stages in which ecclesiastical architecture was produced: Colonial (16th until mid-19th centuries), Independence (19th century), and Modernity (20th century). There was a building boom between the 17th and 18th centuries. The Independence period is characterized by post-war reconstruction or the creation of new edifices using the construction know-how learned during

[26] Editorial translation.

Colonial times. Indeed, at the dawn of the 20th century, certain temples reached their definitive stage, recovering techniques and materials from the Colonial period.[27]

- *Builders.* This is one of the greatest conundrums in the history of religious architecture, created with traditional construction systems. It is presumed that the main temples in the Province of Nicaragua during the Colonial period, like in most of the Americas, were built by religious orders with indigenous labor (Kubler, 1982, p. 14). Certain minor temples, such as hermitages and chapels, were constructed with the guidance of Spanish neighbors in their haciendas, as pointed out by Bishop Morel de Santa Cruz during his apostolic visit to Granada: "Among the main ones there are hermits where the surrounding neighbors attend mass[28]" (1967, p. 7). Furthermore, a significant number of churches were also erected using local labor, with the support of benefactors, except in a few cases, such as the Leon Cathedral, whose design is attributed in historical documentary sources (signed plans) to the Guatemalan Diego de Porres (Valle-Castillo, 2000, p. 62).
- *Political, religious, and cultural motives and implications of its construction.* Temples, initially as an instrument of ideological conquest and later as a manifestation of a new adopted dogma, came to be one of the primary architectural typologies in urban space. They became determining factors in the landscape and are linked to the political, economic, and social life of the Nicaraguan people (Estrada, 2024, p. 115). Researching this data provides knowledge of the original political administrative distributions and the origin of Nicaraguan human settlements (cities, towns, indigenous villages, etc.).
- *Evolution of the sacred space.* Creating plans or diagrams of the temple's spatial distribution and its liturgical and ritual uses throughout its constructive phases will give an account of this process.[29]
- *Events that took place within the heritage good or its surroundings (wars, declarations, burial of notable people, etc.).* Monuments are documents that contain historical data on the context in which they are immersed; hence, identifying their

[27] An example is the singular temple of *Nuestra Señora de Candelaria* in the municipality of Diriomo department of Granada, constructed definitely in *calicanto* with local imprint in 1900 (Vaughan, Avilés & Gaitán, 2000, p. 56).
[28] Editorial translation.
[29] Thanks to the PIBCN inventory by the then INC, carried out with technical and financial assistance from Spanish Cooperation, architectural plans of the temples in Granada, Leon, Chinandega, Masaya, Rivas, and Carazo were drafted to scale.

relationship with events can contribute to justifying their historical value. It is recommended to create written and photographic records of every inscription on the building and its movable goods, which provide a reference to the community's past life.

- *Associated immaterial heritage in the past and present (religious and social manifestations of the heritage communities).* The objective of this is to examine what comprises the manifestation, the community that produces it, their connection with the temple, and its changes over time.
- *Formal stylistic and artistic features of the temples.* Identify the stylistic characteristics evident in the building's exterior and interior. It is advisable to consider the distinctive characteristics of each of these systems. For example, the predominant features in Adobe construction, besides thick walls, include few openings, along with the use of plinths and buttresses. Moreover, consider stylistic influences, such as Colonial and Baroque tendencies, as well as classical reminiscences (Neoclassical).[30]

As mentioned above, there are significant gaps that hinder the understanding of Nicaraguan religious architectural history, which impacts collective memory due to the loss of oral and documentary sources, inadequate documentation initiatives, and limited historical research. Therefore, it is considered valuable to develop collective mappings between the ecclesiastical institution and the heritage communities, along with the ICPJ, of historians from research and academia.

Following the historical stylistic assessment, the analysis of the traditional construction systems continues.

Considerations for studying the materials and construction techniques

The study of traditional construction systems, along with their materials and techniques, facilitates an understanding of their structural behavior and the identification of endogenous and exogenous factors that cause harmful effects, including alterations and inadequate interventions, which accelerate both short-term and long-term deterioration. These systems act as bearing walls, designed

[30] In the case of the city of Leon, four architectural-stylistic stages have been identified during the Colonial and Independence periods. "Implantation (1524-1600), Early Colonial (1600-1700), Baroque (1700-1800), and Neoclassical (1800-1950)" (Oficina Técnica de Gestión del Centro Histórico, 2010, p. 82).

to sustain vertical loads (the structure's weight, living loads, roof, etc.). Their walls are stabilized by placing a sill beam, transverse beams, and a head beam for the roof covering (Bermúdez, Gómez, Loaisiga, & Silva, 2021). The following diagram displays the definitions of construction systems in the study (Figure 6):[31]

FIGURE 6. Main constructive systems based on stone and raw earth used in religious architecture in Nicaragua (Photographs: Alicia Estrada Castillo, 2023; source: author's collection).

ADOBE



(...) this technique uses raw earth to edifice walls of great proportions (0.80-1.00 mts wide), built in blocks of a mixture of earth, sand, and vegetable fiber (grass, palm, and agave fiver), placed in horizontal and transversal alternating strings with earth-based coating (Palacios García & Silva Valerio, 2015, p. 13)

TAQUEZAL



Composed of wooden walls with columns and beams typically 20 cm wide. This initial structure is reinforced with wooden beams in both sides and filling the interior with a mixture of earth-based mortar, talpuja, sand or lime, and the remains of clay roof tiles or natural stone. Covered by a foundation of strip footing, clustered with a mortar made of lime, sand, and talpuja. (Palacios García & Silva Valerio, 2015, p. 13)

CALICANTO



Calicanto construction refers to masonry pieces made of stones that range between 0.40 m to 0.80 m of height. Between each stone string there are strings of uniform bricks as stabilizers, as well as to form doors and windows apertures, arches, vaults, and other more precise elements; the walls reach 0.80 m up to 1.00 m of thickness (Bermúdez et al., 2019, p. 10)

Four points are proposed to assess these systems, followed by a registration card to facilitate identification (Estrada, 2023, p. 259):

- *Identification of the religious site's construction stages.* Building stages represent the different moments of the building pro-

[31] These materials function as lime, a binder that was widely used in Ancient Europe and pre-Columbian Latin America. Lime, or "calcium oxide, is a substance that hydrates in contact with water and when mixed with sand forms a mortar [...]" (Ceballos, 2018a). Although Nicaragua does not include adobe or other unbaked earth systems in its building norms, throughout the country an important number of goods containing them can be found, hence we resort to international norms to produce adobe. The Peruvian norm NTE E 080 gives the following percentages: clay 10% to 20%; silt 15% to 25%, and sand 55% to 70% (Neves & Borges, 2011, p. 18). Similarly, the Guatemalan conservator Mario Ceballos Espigares recommends: clay 15 to 18%; silt 10 to 28%, and sand 55 to 75% (Ceballos, 2000, p. 28).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

cess. From the primitive and perishable post to the temple's most significant technological and constructional development, various factors must be considered, including destruction by catastrophic risks, reconstructions, and so on. Keeping in mind that "Built heritage is the result of a humanizing, conscious process that develops over time" (Silva & Magar, 2019, p. 233). Research should be carried out in catalogues, constructive typological studies, scientific articles, monographs, and graduate and postgraduate theses to identify any references that help define their constructive history.

- *Identification and description of the original construction techniques and materials*. Construction materials should be differentiated in their general construction-technology solution: adobe, *taquezal,* or *calicanto*. The height and width of walls should be specified, along with their finishes, and the proportions of door and window openings. It is ideal to conduct a thorough appraisal of the construction systems for each enclosure.
- *Identification and description of added materials and construction techniques.* In a similar way to the previously made point, those construction systems that were subsequently incorporated and do not correspond to the original must be identified. These could include steel and concrete frame systems with masonry enclosures, such as concrete blocks, reinforced concrete, or soldered nets, among others.
- *Spatial and formal alterations that damage the performance of the construction system.* This concerns changes caused by disrespectful and dangerous interventions, such as altering the modulation of the site's enclosure, demolition of traditional walls, substitution of original walls with contemporary ones, changing sections of original walls, covering and opening gaps, and replacement of the roof covering, among others. These should be avoided due to the risk they pose to the occupants' safety and the building's conservation.

This is a simple way to learn about and become familiar with the temples' materials. However, due to the scientific rigor that conservation demands, it is essential to be informed about the existence of appropriate methods. Some of these involve specialists taking archeological samples from walls, foundations, and vaults. A less invasive approach is to document the building through an architectural and material survey, aided by new technologies that are likely to become available in Nicaragua shortly.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

It is also essential for custodians to recognize the importance of having architectural plans. The identified systems should be indicated at the planimetric level (floors, elevations, and details) and, if possible, in three-dimensional models. Hence, a card was created that can contribute to the identification and registry of construction systems.[32]

The following aspect is the direct responsibility of the entire community, since the valuation of cultural heritage must be exercised by each and every person, without distinction.

Cultural significance

Valuation is an intrinsic process that enables a community to enjoy its heritage, where the heritage discourse of nations must align with their practice of conservation and academia, given the significance it entails (Villaseñor, 2013, p. 6). Valuation deserves to be addressed in all proposals and at all levels of conservation, as it is also key to their acceptance.

The analysis of significance enables us to understand the importance that heritage communities assign to the religious and cultural good. However, this value can shift according to the community's perception (Elizaga, 2006, p. 78), and over time, it can even acquire new meanings (Bluestone, 2000, pp. 66-67).

Therefore, the following criteria,[33] adopted from *Metodología de bienes culturales muebles e inmuebles* in PIBCN (INC-AECID, 2008), do not aim to impose or limit a value system[34], but rather, to become a means of support for the ecclesiastical institution and community to define the values that emanate from their religious sites in different spheres of evaluation: "vernacular, scientific-academic and institutional" (Elizaga, 2006, p. 82).

[32] The dimensions given for adobe blocks are the result of samples taken by the INC from buildings in the cities of Leon and Somoto, as well as the haciendas *San Jacinto in Tipitapa and Santa Úrsula* in Rivas. A generic measurement of 60 x 40 x 20 cm was given. The registration card for material in religious buildings can be consulted in Estrada, 2023, pp. 268-272.

[33] The cards to assess Nicaraguan religious typologies: cathedrals or basilicas, parishes, hermitages, Bishops palaces, curial homes can be consulted in *Conservación preventiva del patrimonio arquitectónico religioso de piedra y tierra cruda en Nicaragua: metodología de estrategia para su mantenimiento periódico en el año 2023* (Estrada, 2023, pp. 274-279). Estrada (2024, pp. 115-119) also provides a deeper study on the significance of these sites, integrating socioeconomic and educational values to the analysis.

[34] It is necessary to analyze whether the *economic value* (Lipe, 1984, in De la Torre, 2002, p. 19) can be considered from the perspective of cultural tourism.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

- *Symbolic value.* Wherein the region, city, or locality's most important religious and cultural manifestations are produced and converge.
- *Historicity.* Tightly linked to the country's political, social, and cultural history. From its construction, it has become a milestone in historical memory.
- *Formal characteristics (aesthetic value).* The national unique character is in the sum of its formal-spatial components and the artistic heritage they protect.
- *Technological characteristics (technological-construction value).* They display the leading construction solutions learned in Colonial times as part of the European-American exchange of knowledge, demonstrating building continuity in subsequent centuries and the demand for specialized labor.
- *Relationship with the surroundings (environmental value).* Temples dominate the urban landscape, becoming significant reference points.

As a result of the enactment of the Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003, p. 1), the aim of a new vision is asserted: the search for the integration of previously overlooked intangible or living heritage into tangible heritage and its natural heritage. From this perspective, certain preservation strategies are recommended: "making inventories, implementation of awareness programs, building capacities, community participation, creation of lists representing goods in danger and best practice" (Muñoz, 2022, 00:36:18).

Analysis of the environment

The importance of understanding the environmental conditions presented invites reflection on the need to implement preventive conservation strategies to address both the natural and artificial challenges posed by the site's environment. External risks to the environment that could lead to consequences must be identified, including water leaks, damaged or abandoned neighboring constructions, urban furniture (mainly lighting fixtures that could fall), and illegal garbage dumps. The communities' capacity to reflect and prepare for decision-making is called resilience (*Secretaría Interinstitucional de la Estrategia Internacional para la Reducción de Desastres* [EIRD-ONU], 2004, p. 7).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

Analysis of the Institution

It is crucial to determine the organizational level of the human and economic resources available for the building's functioning and attention. Since the Catholic Church is a non-profit entity, it relies on collaborative mechanisms based on parishioners' "popular piety" (donations, payments collected for specific services such as baptisms and funeral masses, as well as micro-patronage in some cases).

The aim is to develop a micromanagement model that guides custodians to collect funds with the participation of congregation: the creation of a museum in the scope of the dioceses, promoting a "Parish Day" in which cleaning products are requested (some temples already do so), encouraging visits to places of tourist interest, such as bell towers, among others.

Stage 2. Diagnosis

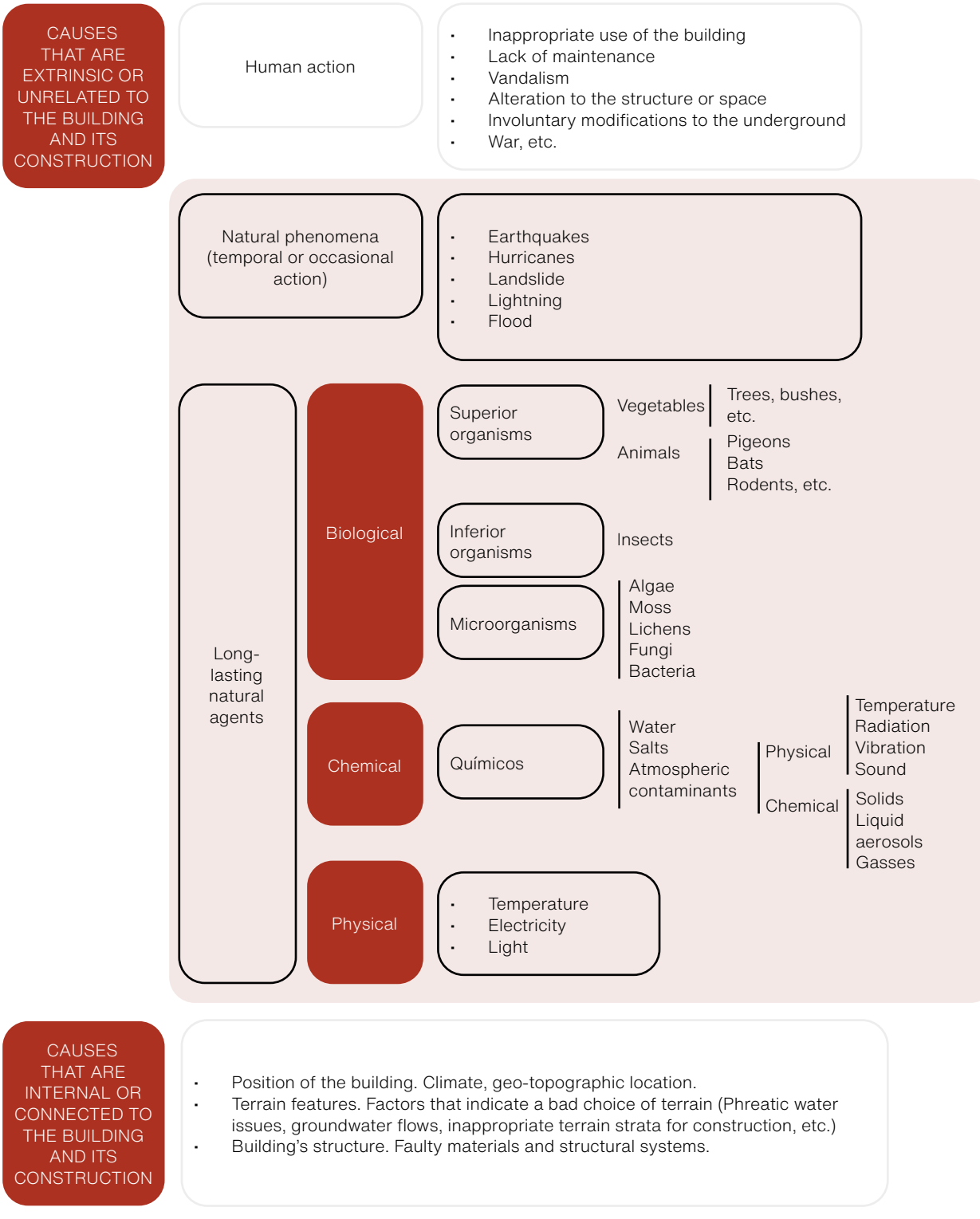
This stage is fundamental for identifying and analyzing the agents of deterioration that are detrimental to the materiality and functioning of religious monuments. Given the preventive character zof this proposal and its close link to the strategy of periodic maintenance, the method addresses the principal risks of environmental deterioration (biological, physical, chemical, and certain seasonal actions, such as precipitation) (Figure 7).

Every conservation strategy must establish guidelines for registration and identification. Furthermore, it should include the logbook of alterations or modifications, as well as anthropic factors that trigger other forms of deterioration.

A simplified method to register the risks of deterioration consists of three steps: the first is to document the agents by component (environment, materials, and area affected). The origin or cause of the alteration is second. At the same time, the third is the "wound" or sign of deterioration, accompanied by photographs and a card,[35] which the technical committee and cultural institutions involved should follow up on.[36]

[35] The *"Ficha para el registro de los riesgos de deterioro en el recinto religioso"* can be consulted in Estrada (2023, pp. 291-293).
[36] The ideal scenario involves mapping of pathologies and a technical memory of the study

FIGURE 7. Risks of deterioration in architectural heritage (Diagram: Alicia Estrada Castillo, 2023; source: adapted from Ceballos, 2009, p. 75 and D'Ossat, 1982, p. 11).



Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

The proposal provides a compilation of informative cards[37] addressing the most common risks of deterioration in materials made of stone and raw earth; these cards aim to facilitate the detection and understanding of the agents of deterioration that must be eradicated, minimized, or controlled. Equally, custodians can be guided by the strategy of periodic maintenance (materials, procedures, and proportions), as well as possible prevention methods for the risk of deterioration, and the action steps to counteract it. These become crucial in the next step.

Stage 3. Therapy or treatments

The establishment of guidelines for a preventive conservation strategy for built religious heritage through the periodic maintenance of construction systems made of stone and raw earth represents, above all, a means to safeguard the legacy of such building practices, which have existed since the dawn of Nicaraguan society. It also implies —this must be highlighted— the preservation of the most representative and high-ranking material cultural heritage nationwide.

This therapy or treatment is structured in calendars of permanent, seasonal, and occasional actions, where the first two foresee possible solutions, the leader responsible for fulfilling the task, the order of priorities, and the estimated costs.[38]

The temporality of each action is based on the classification established by Sandoval Zarauz in the *Manual de conservación preventiva del exconvento de Tepoztlán* (2010, p. 9), which states:

- *Permanent actions.* Those that must be done routinely. It concerns such simple tasks as cleaning the building's elements: floors, vault surfaces, walls, altar components, outcroppings, tombs, cornices, patios, etc.
- *Seasonal actions.* Those performed during the dry season include: revision and waterproofing of coverings, unblocking gargoyles, clearing exterior walls to eliminate parasitic vegetation, and filling cavities.
- *Occasional actions.* Attention to deteriorations in architectural elements due to natural calamities, accidents, or faults inherent to the materials.

[37] See Estrada (2023, p. 294).
[38] These can vary according to geographic location and the building's proportions and dimensions.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

The permanent action plan[39] must:

- *Foresee the monument's use* (sanctuary, parish, hermitage, etc.). The typology of the religious site, as well as the frequency of daily Eucharistic celebrations, will determine the frequency of cleaning, since a diocesan sanctuary is likely to receive more visitors than a hermitage. It is well known that Sundays are the days of most outstanding weekly attendance by congregations.
- *Consider the natural or built environment where the construction is located.* During the dry season (November to April), more dust particles are generated, which in the west of the country are associated with phenomena such as dust devils, requiring a doubling of the cleaning efforts.

Following the permanent or routine actions, seasonal[40] activities are recommended, which vary according to each building's characteristics. Special attention must be paid to the period before and just after the rainy season (May to October), since maintenance, surveillance, and control measures are probably required more frequently.

Occasional actions will be implemented[41] if natural or anthropic incidents occur, such as: detachments of fittings, graffiti, damage by lightning, leaks due to hurricanes, etc. These may be insufficient if the event or phenomenon (sudden catastrophic risk)[42] is of great magnitude, in which case emergency actions will be required; these should be covered in a safeguarding or integral risk management plan resulting from ecclesiastical authorities, specialists, institutions for the protection of cultural heritage, entities for disaster relief and civil society preparing and making decisions.

Some of the occasional tasks that can be addressed with this methodology include:[43]

- *Inspection of coverings,* to discard effects on roofs following hurricanes or in the event of heavy winds. Part of the solution for minor damage to material coverings or roofs (such as fired clay tiles) involves installing new roof tiles to replace cracked

[39] See permanent action plan, in Estrada, 2023, pp. 346-350.
[40] See seasonal action plan in Estrada, 2023, pp. 351-358.
[41] It is necessary to foresee a sensible timeline to implement tasks. Instructions from the civil protection and disaster relief authorities should be awaited and followed.
[42] Natural risks: geological (earthquakes), volcanic (eruptions), meteorological (hurricanes and cyclones). Anthropic risks: wars, social conflicts and vandalism. Based on the threats in unesco, iccrom, icomos & uicn (2014, p. 68).
[43] See the seasonal actions suggested for the Nicaraguan context in Estrada, 2023, pp. 359-360.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

ones. In the case of structural damages, help will be requested from ICPJ and professionals to evaluate and determine the relevant actions. Staff are required to wear protective gear.

- *Review the lightning rod performance* after electric storms. Possible solutions are rule out the existence of damages after lightning struck, verify the integral conservation of the lightning rod elements and verify the fixing system is in good condition, etc. The person in charge of this task must be a certified electrician.
- *Cleaning the roofs in case of volcanic eruptions.* Essential actions include: sweeping ashes, retiling in case of need, removal of ashes from storm drains (gutters, downspouts, weep holes), replacing damaged tiles, cleaning and freeing the lightning rod.

Stage 4. Control and follow up

Every strategy requires monitoring, measuring, and verification of its degree of effectiveness. Therefore, basic guidelines are essential to determine, after approximately one year of continuous and systematic treatment, the therapy's efficacy (Figure 8).

The following magnitude scale of risks of deterioration helps raise alerts on the sites' state of conservation, when the therapy has not yielded the expected results or the state of conservation has exceeded the reaches of preventive conservation through periodic maintenance. If the state of conservation of the elements analyzed surpasses the probable SUPERFICIAL SCALE, a direct conservation project must be formulated by specialists in the subject with due authorization by the ICPJ (Figure 9).

Finally, there are certain aspects that should be considered when implementing the methodological proposal:

- It requires the participation of managers and the associated heritage community in its various spheres (ICPJ authorities, professionals, custodians, sacristans, parishioners, etc.).
- Institutional planning is key. Parishes must construct long-term preventive conservation strategies, along with controlling and monitoring the strategies, manual, or roadmap derived from the plan.
- Consider creating small scale self-management models that, in turn, foster the handling of financial and technical resources to implement and follow up on the methodology strategies.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

STRATEGY MONITORING AND CONTROL SHEET							
Name of the compound					Name of the parish priest		
Name of the recorder					Registration date		
Element/ material	Nature of the agent	Source or cause (hypothesis)	Damage or effect manifested or treated	Treatment	Periodicity of the treatment	Results	Photos
Specify:						The treatment was implemented following the activity schedule: Sí: ___ No: ___ If the answer is no, explain: The results of the treatment were those expected: Sí: ___ No: ___ If the answer is no, describe the limitations or obstacles.	

FIGURE 8. Strategy monitoring and control sheet (Source: Estrada, 2023, p. 362).

Magnitude	Severe	Moderate	Superficial	Harmless
Criteria defining the scale	Total loss of the compositional material or element.	Partial loss of a compositional material or element.	Compositional materials and original elements.	Compositional materials and original elements.
	Alteration at an advanced deterioration stage. Collapse possibility.	Alteration reversible by interventions or actions.	Superficial alteration to the surface or material.	No visible alterations.
	Irretrievable materials due to advanced alteration.	Materials still retrievable with certain treatments.	Materials retrievable by easy-to-implement treatments or interventions.	Retrievable materials that must be preserved.
	Forced implementation of substances or materials that are impossible to remove.	Forced implementation of easy-to-remove substances or materials.	Absence of unrelated substances or materials.	Absence of unrelated substances or materials.

FIGURE 9. Magnitude scale of risks to architectural heritage (Source: Avendaño, 2018, p. 161 and Ceballos, 2018b, p. 7).

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

- Seek support from the private sector and academia to receive advice on topics regarding movable and immovable heritage.
- Create conservation work committees made up of parishioners (architects, engineers, overseers, among others, or other specialists in caring for heritage goods) on a municipal scale, or in major cities in the case of managers.
- Parishioners must be informed of the purpose of the preventive conservation and take part in the process.

The methodology proposed, with its prior phases, foresees actions directed at valuation and identification, at knowledge and understanding of traditional construction systems and the timely detection of possible causes of deterioration. The methodology also establishes a therapy (or treatment) governed by the annual calendar of permanent, seasonal, or occasional activities. This proposal helps avoid greater deterioration in the building's structures, contributing to a sustainable conservation.

CONCLUSIONS

Ensuring that architectural heritage of stone and raw earth remains healthy is a chance for its conservation and the endurance of a historic, artistic, and spiritual legacy for Nicaraguans, which can be reached through the creation and implementation of preventive conservation strategies with an integral approach. To do so, it is necessary to look back at traditional know-how stored in the biocultural memory of heritage communities, which include traditional construction and ethnobotany to mitigate the risks of deterioration.

The importance of developing methodological proposals for the preventive conservation of built heritage lies in preparing the conditions to establish a paradigm of sustainable conservation. It provides criteria, principles, and guidelines specifically for preventive conservation, which are fundamental aspects for the professional practice of this discipline, though barely mentioned or even ignored by restorers as direct conservation.

Finally, this method's focus exclusively on the treatment of built religious heritage, a limit of this proposal, reminding us of the need to concentrate efforts to construct and implement methods specifically for religious movable heritage, in accordance with the spiritual and symbolic values characteristic of their cultural and liturgical use, values they share with architectural heritage.

Intervención

JULIO-DICIEMBRE 2024
JULY-DECEMBER 2024

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