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Exploring the Lighthouse of *El Morro* in San Felipe: Professional Practice and Academic Collaboration for the Conservation of Immovable Cultural Heritage in Old San Juan, Puerto Rico

Ir a la versión en español

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Translated by Lucienne Marmasse

ABSTRACT

This work describes the conservation practice carried out in the Lighthouse in the *El Morro* Castle in San Felipe, Old San Juan, Puerto Rico; located in a 16th century fortification that went through two phases of construction, whose different materials now present deterioration specific to coastal environments: humidity, salinity, and wind erosion. As a building listed in the World Heritage Sites (WHS, UNESCO), coordination between local authorities and the US National Park Service (NPS) is crucial for the conservation and management of the Lighthouse in the *El Morro* Castle in San Felipe. Moreover, professional practices between academic institutions in Latin America and the Caribbean in the field of conservation and restoration of immovable cultural property are essential to deepen the knowledge and skills of professionals; however, improvements in the availability of resources and time are necessary to maximize their effectiveness.

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KEYWORDS

conservation, characterization, assesment, coastal heritage, maritime infrastructure, Old San Juan, Puerto Rico

INTRODUCTION

In 2019, the University of Puerto Rico (UPR) and the National Park Service (NPS, USA), in collaboration with the National School of Conservation, Restoration and Museography "Manuel del Castillo Negrete" (ENCRyM, Mexico), joined forces to design a conservation plan for the Lighthouse in the *El Morro* Castle in San Felipe, Old San Juan, Puerto Rico. This proposal was developed over a fortnight as part of the professional practices for the master's degree in Restoration and Conservation of Immovable Cultural Property at ENCRyM. The objectives of this activity focused on drafting a report that characterized, diagnosed, and surveyed the building, so that it can be included in the castle's documentation.

The Lighthouse is an iconic part of the coastal landscape, which relates the use and evolution of historical fortifications systems in the Caribbean. It stands out as a disruptive visual element, sparking the visitors' curiosity. This project's importance was not limited to merely documenting the origin and historicity, but also evaluating its structural stability, ensuring safety for the rangers[1] and all those who pass through the area, given the climate and seismic phenomena it is exposed to.

The project followed a comprehensive methodology of conservation and restoration of immovable heritage assets, based on normative documents of international organisms such as the International Council on Monuments and Sites (ICOMOS), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM).[2] The work-plan addressed aspects of management, theory, science, technology, archival research, and the building's historical and socio-cultural background. Furthermore, it also included a detailed analysis of the morpholo-

[1] Rangers are National Park Service employees who work in national parks and other protected areas. Their main purpose consists in protecting and preserving the environment, wildlife, and cultural resources. They also offer services of interpretation and environmental education to visitors, patrol to guarantee the safety and fulfillment of regulations, and take part in land management and conservation activities (Department of the Interior, 2024).

2 Among the methodologies used are *The Conservation Plan* (1985), the *Burra Charter* (1988), *Management Guidelines for World Heritage Sites* (2003), an adaptation of *Guide to Historical Urban Landscapes* (2011) and *Organized Visual Observation* (2014) (OVO: organized visual observation) by Corrado Pedelì.

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gical and typological features of the Lighthouse, together with the construction system in its historical stages, the types of materials used, the damage observed, and previous interventions.[3]

Taking the latter into consideration, as well as the different phases of construction, and by using documentary information, we distinguished the innate damage to the building, intrinsic to its manufacture, from that resulting from its location in a coastal, highly seismic setting, or from its use and maintenance. The final report concluded with recommendations for conservation as well as actions for restoration and maintenance in the short—, mid—, and long-term. Moreover, further studies[4] were suggested to improve the understanding of agents of deterioration and to characterize the original materials more thoroughly. We outline the work process which entailed the diagnosis to carry out the intervention of this structure, below.

CONVERSATIONS WITH THE LIGHTHOUSE AND ITS SURROUNDINGS

Characterization and assessment

The *El Morro* Castle in San Felipe is a historical fort in the north of Puerto Rico, which is part of the defense system of the bay of Old San Juan, together with the San Cristobal Fort and its walls, on which construction began in 1766. This site was inscribed on the UNESCO list of World Heritage Sites (WHS) in 1983 as part of La Fortaleza and San Juan National Historic Site, in Puerto Rico. This designation was based on criterion VI,[5] for its colonial military architecture in America and its role in the defense of San Juan between the 16th and 20th centuries (World Heritage Centre, 2024). Nowadays only those elements closest to the coast remain, including the northern wall, both forts, the governor's mansion and San Juan gate (Figure 1). In addition, on the northeastern bastion of the San Felipe fort, on a promontory (*morro*) to the east of the bay, there is a lighthouse.

[3] Some of these interventions include: replacing wind-and-salt-eroded red clay clinker bricks, applying acrylic latex paint on the exterior and acrylic white paint on interiors, installing monitors on vertical cracks, using fiberglass film on the roof to join one of the cracks caused by corrosion in type I steel beams (in a joist and vault system).

[4] For example, in the case of efflorescence, laboratory tests can be performed to obtain greater detail of the damage that is evident at visual inspection, such as optical microscopy, X-ray fluorescence spectroscopy, Ph and Relative Humidity (RH) tests.

[5] Criterion vi appeals to the representativity of a series of monuments or sites which illustrate a significant stage in human history (UNESCO, 2023).

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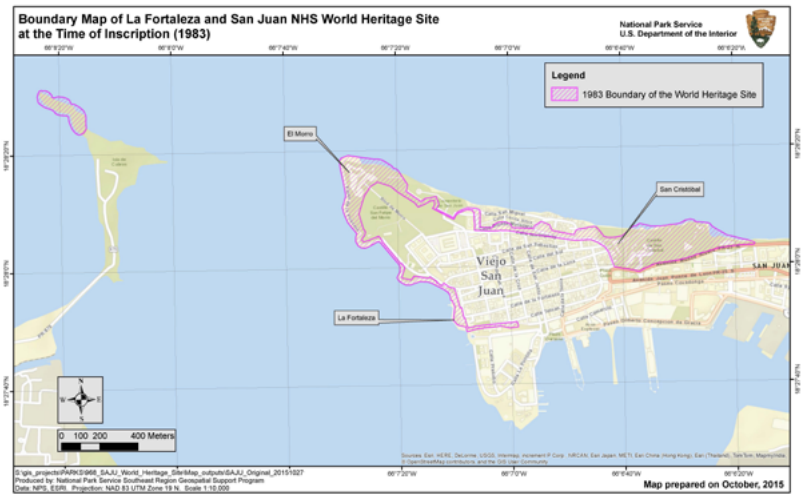

FIGURE 1. Site plan of La Fortaleza complex and San Juan National Historic Site in Puerto Rico at the time of its inscription on the World Heritage List in 1983 (Source: National Park Service, World Heritage Centre, 2024).

CHARACTERIZATION

Historical background

The history of the *El Morro* Lighthouse in San Juan is marked by several construction phases and interventions. According to the Central Archives of resource records for this heritage site protected by the National Park Service (NPS), it was built in 1846, and is considered the first in Puerto Rico. Created prior to the implementation of the maritime lighting plan put forth in 1869, which sought to install 15 lighthouses around the island to protect strategic ports and commercial routes between Europe and America, its trace can still be seen in the fort's southwestern bastion. The second building (Figure 2) of 1876, also had an octagonal plan with a clinker brickwork base, and a 174-feet-tall (53 meters) metal tower (National Park Service, 1978-88).

As described in NPS expense records (1999, pp. 98-165), in 1900, eleven years after Spain transferred control of Puerto Rico over to the United States, a second level was added. At first, a dwelling for the lighthouse keeper was not considered, as it was expected he would live in San Juan city and travel to the Lighthouse when necessary. In that building, which was damaged during the American invasion in the Spanish-American War, the original plan was to reconstruct or repair the metal tower, however, due to administrative problems and the loss of rescuable elements, it was decided to build a third light tower. The fourth and final construction phase corresponds to 1908, when the second level was rebuilt due to its bad quality and early deterioration.

During the last quarter of the 20th century, concern arose regarding the Lighthouse's state of conservation. Despite having

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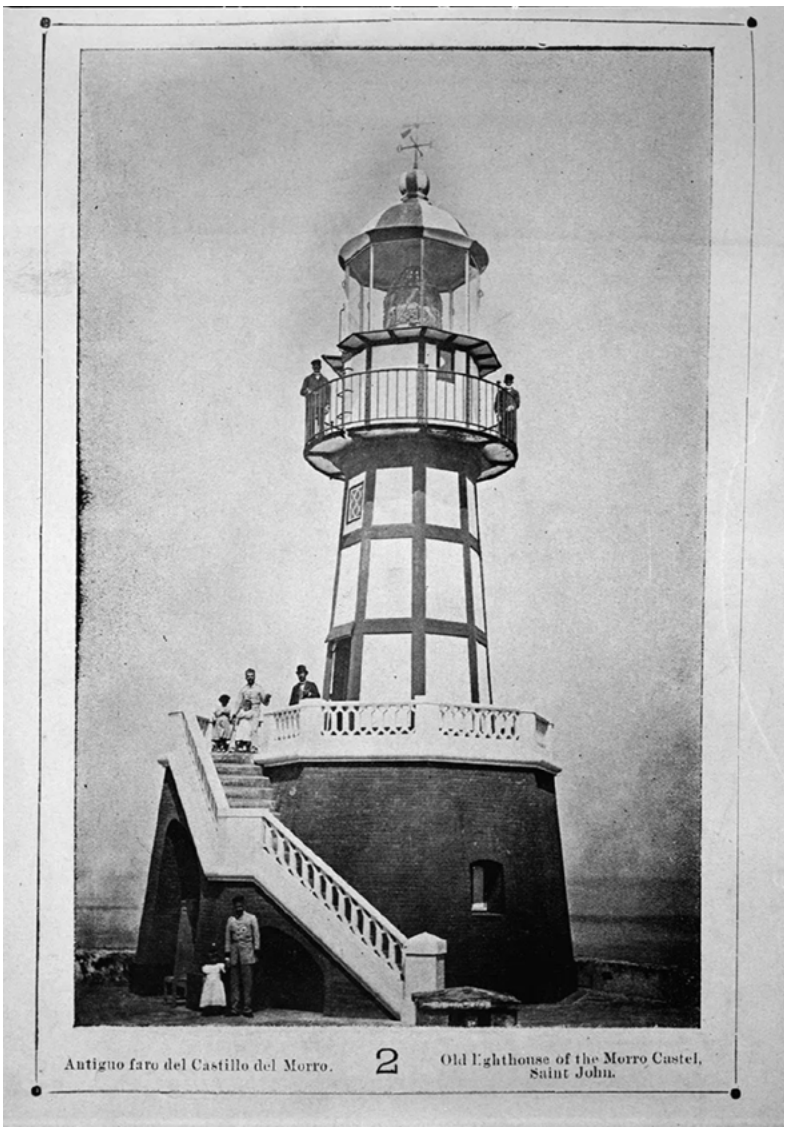

FIGURE 2. Photograph of the Lighthouse in 1895 (Photograph: Feliciano Alonso, 1985; source: https://www.geoisla.com/2017/03/antiguo-Lighthouse-del-castillo-san-felipe-del-morro-circa-1898/).

been reported as a conserved building with regular maintenance, it can be seen interventions were carried out in response to specific deterioration, rather than following a preventive conservation strategy. In 1991, a restoration proposal was relaunched, which marked the last significant intervention of the Lighthouse, although challenges in management of historical heritage and its conservation can be noted throughout its history (National Park Service, 1991, pp. 1-10).

Geographical context and the environment

The geophysical context of Puerto Rico originated from the collision of two tectonic plates, the North American and the Caribbean; this gave rise to both the formation of the Antilles and the Puerto Rico Trench, the deepest point in the Atlantic. Old San Juan is-

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let—where the geology includes artificial fillings, beach deposits, and near ground level aquifers and alluvium—has diverse topography (Figure 3) and lies on a coastal plane at sea level; however, the *El Morro* Castle in San Felipe rises on a strategic hummock, which was used to build a fort and the location of the Lighthouse (Quiñones & Torres, 2005, p. 4).

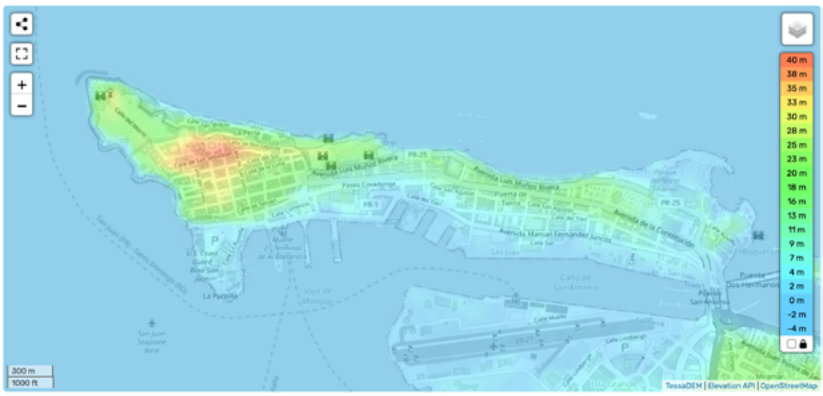

FIGURE 3. Topological diversity map of Old San Juan in Puerto Rico (Source: Quiñones, F. and Torres, S., 2012, p. 2).

Regarding climate, Puerto Rico is warm and humid as a result of its location in the Caribbean, with a maximum temperature that fluctuates between 26 and 32 °C (79 and 89 °F), and a relative humidity above 70% all year long. Temperatures vary moderately throughout the year, the warmer months (August and September) at 32 °C (89 °F), and the coldest (January) at 26 °C (79 °F). Relative humidity is generally high, with a peak in October (76.9%). San Juan experiences high sun exposure, with an average of 13.2 hours of daylight in June. Precipitations are highest in August and lower in March. The prevailing winds come from the northeast and southeast trade winds, with a windy season from June to August; the region is vulnerable to hurricanes from June to November (Quiñones & Torres, 2005). Regarding flora and fauna, the coastal zone has plants associated with mangroves, and microflora can exist due to climate conditions.

ANALYSIS AND FORMAL DESCRIPTION

Typology and morphology

The *El Morro* Lighthouse in San Felipe illustrates the evolution of lighthouse technology throughout the 18th and 19th centuries. During the 18th century, these lighting systems relied on simple mechanisms, such as weights, springs, lenses, and lamps with eclipse systems (Figure 4).

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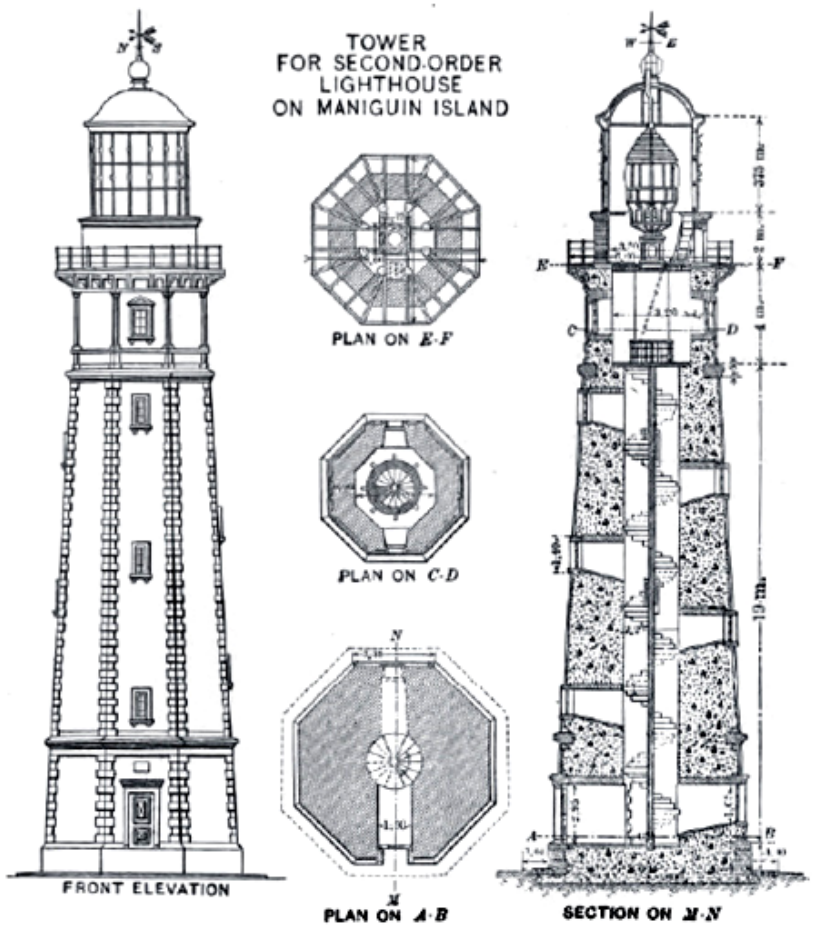

FIGURE 4. Nineteenth century Spanish design of the lighthouse to be built on Maniguin Island, Philippines. On the sketch one can see the use of eclipse systems with Fresnel lens (Source: Sánchez, T., 1992).

With modernization in mind, Spain established a Lighthouse Committee in the 19th century, which adopted building materials used in other countries. In this process, the Lighthouse structure underwent a significant change: going from the original conical masonry shaft to a cylindrical metal shaft and tower, which were made by the United States to support the lantern. Various fuels have been used for its operation throughout its history, from carbureted hydrogen to incandescent lamps, xenon gas, mercury or halogen, with electrification in 1915. The internal structure of the Lighthouse is made of iron, whereas all the external parts and frames are made of bronze and the dome of copper plates. Meanwhile, the covering, for its part, is made of glass, and the light towers of the first three classes have a platinum-tipped lightning rod.

In terms of morphology, El Morro Lighthouse in San Felipe presents ornamental elements which display the influence of Neoclassicism and are reminiscent of Neo-Mudejar style. The symmetry of the façade of the second section, including the windows and shades, together with the use of cornices that frame the building and its

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openings, establish a characteristic architectural language of these styles. One can also see valances, accents on the windows with semicircular or segmental arches in the decoration and moldings, which are repeated on the interior façades. The use of box profile merlons in the building's crenelated parapet symbolizes its role of protection; the concrete sentry boxes, which were added later, emphasize its military nature. The ground floor displays influence of its early Spanish period, through the width of its walls and the quality of the bricks, whereas the lantern, made of cast iron and glass, dates back to the Industrial Revolution (Figure 5).

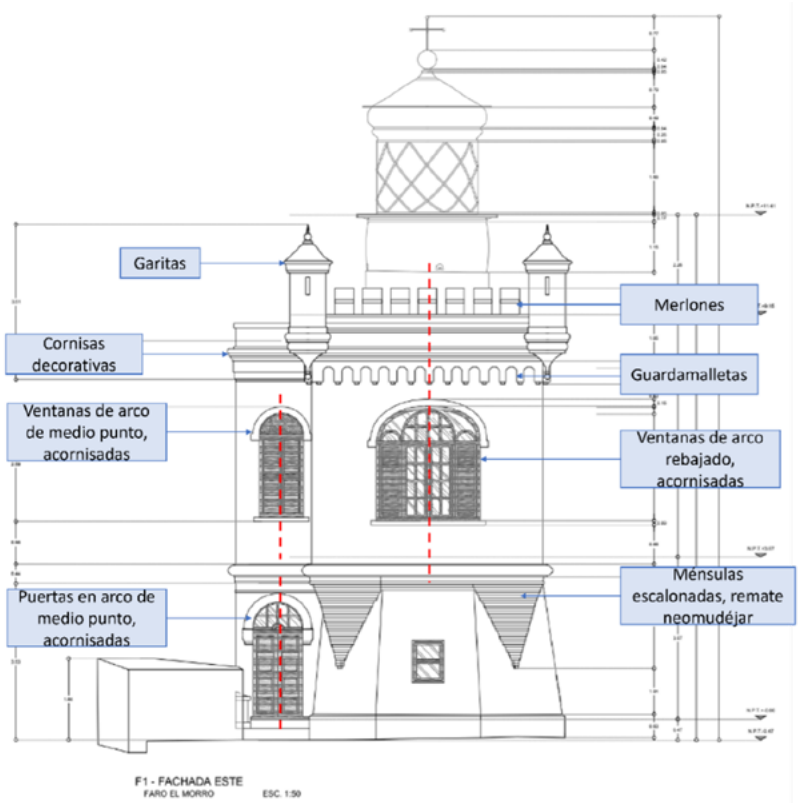

FIGURE 5. Schematic of *El Morro* Lighthouse in San Felipe (East elevation) indicating the Neoclassic and Neo-Mudejar elements. The dotted lines represent the symmetry of some of its façades and/or elements (Drawing: Sarahí Soriano and Rodrigo Sáinz, 2019).

Construction systems and materials: walls, mezzanines, covers, metals, woodworks, and fittings

Throughout its history, the Lighthouse in the *El Morro* Castle in San Felipe presents a structure with a great variety of building materials and construction techniques, according to sources consulted in central archives, among them a report of general information on the lanterns and a memoir on the building's restoration in 1978. The base, perched on ribbed vaults in the upper battery of the castle, has a volume of 79 m^3, and the ground level floors comprise a hydraulic cement underlayment and tiles from the Canary Islands. Inside, the staircase that connects the ground level with the first

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level corresponds to an addition during the fourth phase and is made of reinforced concrete with a finish of hydraulic cement; the walls are apparently covered in gray vinyl paint. However, *in situ* observation, backed by documentary data from the NPS, reveals that there have been variations in the construction materials used during the different building phases. The octagonal base ground floor pertains to the oldest phase and consists of masonry using sizable red clay clinker bricks, made in Spain, laid with lime and sand mortar. On the other hand, the quadrangular base first level, corresponding to the fourth phase, used industrial American bricks laid in a cement and sand mortar. The fittings include hydraulic systems with lead pipes, electric systems with galvanized conduit tubes, and the LED illumination is powered by solar panels installed on the rooftop of the building.

Morphological analysis: functionality and context

The formal analysis stresses the integrity and authenticity of the Lighthouse's shape, which mirrors Puerto Rico's historical transition from Spanish dominion to becoming an Associated State. Certain original elements, such as the glass panes of the lantern and the lighting mechanism, have been replaced by more modern versions. The current state of conservation enables it to remain in operation given there is no risk of collapse. Nevertheless, deterioration in the structure and finishes have led to visits inside being canceled due to safety reasons.

The building has lost certain elements of its original system, although a significant part of the early electric infrastructure is still conserved *in situ*. It is considered important that this Lighthouse continue to fulfill its function as part of the marine signaling system, because this gives continuity to the building and fort's historical value. On the other hand, the contextual analysis stresses that the heritage asset's location within a 16th century fort hinders an adequate evaluation of its foundations, owing to the constant flow of visitors. Physical damage to the building is consistent with the quality of the materials, which manifests in the various degrees of deterioration in each of the stages. For example, the 19th century Spanish red clay clinker bricks, measuring roughly 28 x 21 x 7 cm,[6] have a dense composition, while the American industrial red clay

[6] According to the *Ordenanzas de Madrid* of 1857, bricks had to meet specific measurements: one foot long, 3/4 foot wide and two fingers thick, determined by submultiples of the "*vara*" (measuring rod), with a proportion such that the length did not double the width. In Castille, the *vara* measured 864 cm, as cited in Adell (1992, p. 7).

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bricks are lighter, more porous, less dense and smaller (2 x 4 x 8"). When comparing both types of bricks, now exposed due to lack of coating,[7] the American blocks present greater erosion and efflorescence than the Spanish ones.[8]

Likewise, the marine environment, which can be very harsh, increases the erosion by friction on masonries, as well as corrosion of metallic elements and development of efflorescence on floors and walls, given the humid and saline environment. Moreover, constant precipitation and extreme temperatures have a strong impact on the deterioration of the building and the structural integrity of its materials.

CONDITION REPORT

Methodology

The following methodologies were used in this project: the OVO (*Organized Visual Observation*) method by Pedelì (2014); the guideline indicated in *The Conservation Plan* by Kerr (1985); the regulations in *The Burra Charter,* ICOMOS (1999); Ciro Caraballo's (2011) method to identify systems of values and attributes; the matrix proposed by architect Rubén Rocha (2018) to analyze the architectural and structural components of the building; as well as the De Angelis (1982) and Carbonara (1990) method for both the architectural and damage surveys. The comprehensive methodology can be summarized as follows:

1) reconnaissance of the site, approximation to the object of study and its context, photographic and sketch surveys;
2) archival research, creation of stakeholder database, and interviews;
3) architectural survey;
4) damage survey;[9]
5) data analysis;

[7] Lime is alkaline and can react with salt, which weakens the joint between the bricks and the mortar, causing loss of adherence and the gradual disintegration of the brickwork system. Likewise, in cement-sandgrouts, the presence of salt weakens the grout to the point of disintegration.
[8] Red clay clinker bricks are porous, they absorb humidity and salinity from the marine environment; over time, the salt penetrates them, leading to cracking or disintegration due to lack of salt crystallization when they expand on drying.
[9] In terms of surveying, different methodologies were employed, including the use of tape measure, laser, hose level, triangulation by cord and photogrammetry. There were certain limitations: it was impossible to use the drone due to strong wind currents; nor LIDAR, or other imagery or advanced laboratory technologies, due to the limited time of the professional practice, a period of two weeks.

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6) identification of values and attributes, value system;
7) theoretical discussion based on the intervention project proposal, and
8) reflections.

Damage analysis

Damage to the Lighthouse is predominantly related to lack of maintenance, visible in the building's finishes, both interior and exterior. These have been caused by water infiltrations in the cover and structural problems resulting from the geometry of thebuilding, which has led to cracks and fissures of cantilever elements. Furthermore, factors of the coastal environment, which promote corrosion of metal objects, the emergence of efflorescence on walls and weathering of masonry elements. Additionally, through *in situ* observation we identified that the materials used during the different periods did not react to the environment in the same way, determining that (Figures 6 and 7):

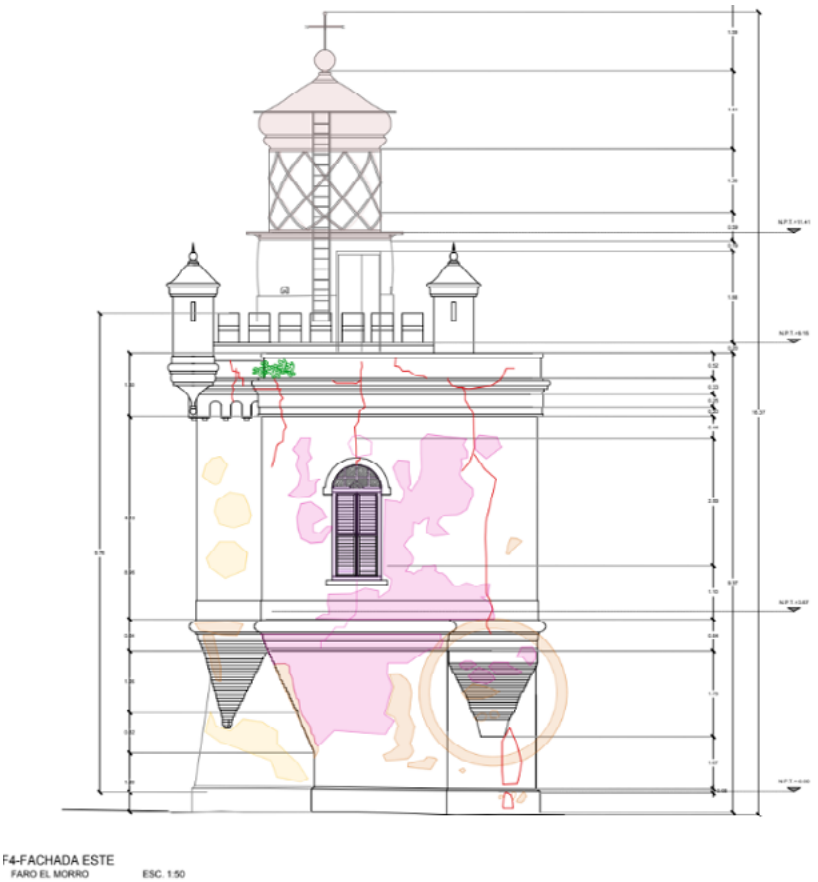

FIGURE 6. Schematic of the damage survey of *El Morro* Lighthouse in San Felipe (East elevation) (Drawing: Sarahí Soriano and Rodrigo Sáinz, 2019).

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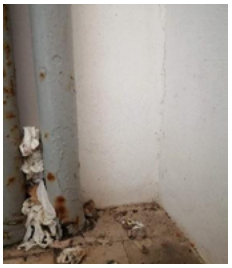
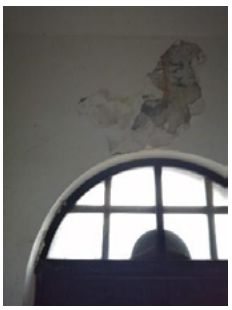
FIGURE 7. Damage characterization of *El Morro* Lighthouse in San Felipe (Compilation: Sarahí Soriano and Rodrigo Sáinz, 2019).

Photograph	Description	Location
	Exfoliation of iron elements due to humidity	The metallic elements of the lantern on the roof, mainly in those integrated during the 1991 intervention. Likewise, it is observed on interior lamps and the staircase connecting with the lantern
	Stains and runoff from elements of iron rust onto walls and floors	On walls at the footing of the lantern and on the second floor, where the structural metal elements of the mezzanine are supported. Especially at the split-level between the main room on the second level and the corridor
	Filth and accumulated rubbish as the lighthouse is unoccupied, its use as a storeroom, and lack of maintenance	Besides garbage, a great deal of dust is observed in all interior spaces of the lighthouse. There is rust on the floors due to infiltrations and pieces of wall covering and iron that have fallen from the covers
	Loss of paint and crumbling of material due to accumulation of humidity and salt formation. The waterproof paint, on finding an access point in the masonry, causes bulging	On interior and exterior walls, at no specific height, present on the three levels/stories

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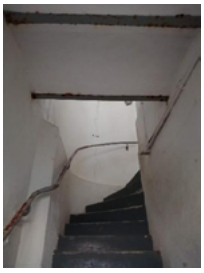	Cracks and fissures in walls caused by settlement of the building, geometry problems, inadequate material, and an increase of structural metal elements	In the inferior and superior parts of structural openings as well as in overhung elements; particularly large ones correspond to the overhang of the stairwell
	Cracks and fissures on cornices as a result of settlement of the building and deficient geometry	Mainly in the center of structural openings and overhanging elements on the second story, the largest ones being those in the stairwell
	Loss of paint on walls due to dampness and accumulation of salts which has led to crystallization, in addition to constant humidity and wind erosion	On all the building's façades, the one most affected is the southeastern, corresponding to deterioration of the first lighthouse
	Loss of material in brickwork resulting from salt crystallization and wind erosion on walls built during the 20th century	Exclusively in sections built during the early 20th century phase: upper story and inferior part of the staircase and access corridor
	Salt efflorescence on interior and exterior walls caused by atmospheric moisture and salinity as well proximity to a semicircular concrete structure (Figure 6)	Mainly on the lower parts of interior and exterior walls. On the ground level these are more evident and larger outside, whereas on the upper floor there are more on the interior walls but smaller in size

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A. Spanish phase

Foundations

The Lighthouse is built on the southeast upper battery level of the *El Morro* Castle in San Felipe. As a later addition to the construction of the fort, its foundations lie within what used to be storage chambers (currently the exhibition hall), whose cover is a masonry ribbed vault. Inside this space one can see cracks that, while apparently produced by the building's natural settlement and the region's characteristic seismic movements, do not seem to cause deterioration of the heritage asset. We also observed the presence of rising damp on walls and ceilings, hence the suggestion of performing a non-invasive radar study to assess the damage caused by this humidity without affecting the fortress and, ultimately, determine whether the foundations have cracks or fissures.[10]

Ground level

The lower level is the oldest part of the building and, compared to other areas, shows less deterioration: the masonry elements have no cracks, deformations nor erosion; the brick walls are in good conditions, though there is efflorescence and bulging due to the use of acrylic paint. The expenditure reports for the Fort and the Lighthouse (National Park Service, 1991, pp. 160-165) mention that the access was the most damaged area during the 1907 intervention, and highlight the difference in width between the walls built in 1876 and 1907. Likewise, the documentary material indicates problems in the beams and vaults of the access corridor, which persist to this day.

B. Twentieth century additions

Staircase

Although the footing begins in the first phase of the building, the current staircase corresponds to an intervention carried out during the American occupation. Hence, damage to the brick walls is consistent with the rest of the second phase, the most notable of which is a fissure that affects the structure. This damage was foresee-

[10] The use of radar makes it possible to observe a map of the subsurface, identify the layers of soil, rock, and materials existing under the current exhibition hall, and thus obtain results of the composition, density, uniformity, and compaction of the ground. Moreover, one can observe the depth of the foundations and evaluate its load capacity and stability in the face of current geotechnical conditions.

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able since it was built with the same materials that cause cracks and fissures, erosion of exterior panels, and efflorescence. Being a monolithic reinforced concrete staircase, it appears to be in good condition, the sections present constancy in their elements, with no collapsing or cracking due to the expansion of visible metal reinforcements. This element must be monitored, although it is currently not considered high priority to perform penetration resistance tests on the core or check for acidification of the concrete, in light of the risk of causing a humidity infiltration that could affect it.

First story

Active corrosion can be seen on the metal[11] elements because of seeping rain and salt water. This concerns both the beam system of the cover structure and vertical circulation. Due to the leakage, water accumulates inside when it rains, which promotes the emergence of efflorescence, bulging, and microflora on the walls. Given the different construction systems employed, this type of damage is concentrated on this story and does not affect the lower (ground) level.

Roof

The roof has elements dating back to 1845, but they are corroded.[12] Most importantly, there is cracking of metal elements and infiltration of water and damp inside the building.

Finishes

The exterior of the Lighthouse is painted in gray acrylic latex paint and the interior in white acrylic paint,[13] as mentioned in the 1991 maintenance reports, a practice that continues to date (NPS, 1991). In addition to the cover's bad condition, coastal environment and seeping moisture from the marine breeze and precipitation, efflor-

[11] The determination of metal deterioration was performed by visual inspection; however, it is recommended that laboratory tests such as ultrasound, liquids penetration, spectroscopy, or scanning electron microscopy be performed to understand the structure and morphology of the metal, its resistance to corrosion (measuring electrical impedance), observe the presence of cracks, porosity or discontinuity in the metal both superficially and internally.

[12] Elements such as the lantern date from 1845, but only the structure remains, as the glass panes were substituted with acrylic and part of the cover was replaced along with the top half of the orb, in 1991.

[13] It is recommended to carry out stratigraphic analysis of the interior and exterior as well as on the various levels of the building to determine its historicity and chemical composition.

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escence, bulging paint, and damp patches can be found in the interior and exterior of the building, because of these interventions. The lack of an adequate coating to protect the brickwork is a constant problem that affects its conservation. Water resistance of acrylic latex paint causes moisture to accumulate; thus, the base material (masonry) becomes crumbly, especially in the second phase construction.

RESULTS

The Lighthouse is currently under United States federal jurisdiction, administered by the National Park Service. This agency is responsible for establishing public policies and providing technical and financial assistance for the affiliated areas. In the past, although coordination between local authorities and the NPS has been challenging, there is potential to improve the current state of the building through joint efforts. The Coast Guard has access to the Lighthouse to keep the lamp in operation, and as it is on the World Heritage List, the site must comply with the *World Heritage Convention* (UNESCO, 2023) guidelines and executive practice.

System of values for the Lighthouse

The building's identified values are based on the analysis of retrieved archival data and examination of the social context it is set in. As a historical record, the Lighthouse (heritage asset) bears witness to the fort's evolution, maritime history, and the island's development. Through historiographic analysis, we identified the numerous modifications it has undergone to become the building it now is, as well as the different conflicts that it has lived through. Its shape has been part of the *El Morro* Castle in San Felipe since before the Spanish Crown proposed the lighting project for the island at the end of the 19th century. The fort has had a light signaling system since 1846, however the current edifice corresponds to the 1908 construction, which took advantage of elements built in 1876. Furthermore, the building is part of the history of the Caribbean, being the first lighthouse on Puerto Rico and the predecessor to its coastal lighting system (NPS, 1992).

Throughout its different construction phases, one can see the evolution of lighting systems in the Caribbean, along with lighthouses built on the island which are like each other and correspond to the same construction system and the currently observed style (Mari, 2009-2013). By means of historiographic analysis, we know

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the previous design that predated the current construction was different, since the construction system was adopted based on a metal structure that was already in the fort since the first version.

If the Lighthouse is not intervened, its load-bearing structure of walls and enclosure will be further compromised in the western façade zone, hence they could both collapse. Likewise, if the masonry, eroded grout, and mortar overlay on the southern façade are not replaced, these elements could subsequently present structural damage. Although the greatest deterioration is found in elements built in the 20th century, this can still cause future collateral damage. In other words, if the roof collapses, the 19th century lantern will too, and the historicity of the 19th and 20th centuries would be compromised. Beyond its role as an attribute of *outstanding universal value* (OUV), its conservation is important because the Lighthouse is a major element of historical Old San Juan's urban landscape. Not only is it the tallest building in the fortress, its color contrasts with the other materials on the site. Its distinctive presence is considered part of the local identity and the collective imagery of its residents and visitors, generating stories and awakening curiosity about the building. Likewise, the fact that it is currently in use as a lighthouse enables the system of fortifications to remain alive in the everyday life of neighboring social actors.

The values identified through this fieldwork and academic research reveal that, being the first and most important lighthouse in Puerto Rico, it witnessed the evolution of the defense system up until the 20th century, demonstrating the site's historical and military continuity. The latter being one of the elements for which Puerto Rico's System of Fortifications was inscribed in the World Heritage Sites list by UNESCO, in 1983.

Furthermore, it provides a distinctive and identifiable element to the cultural services, as well as an image that can promote the Old San Juan. Hence, we believe the conservation of this building represents an essential part of safeguarding Old San Juan's maritime identity, as it is the starting point for the island's development and its history.

Theoretical basis for a comprehensive intervention

The Lighthouse in the *El Morro* Castle in San Felipe, though relatively young, has elements from different periods which reflect the political and cultural history of Puerto Rico (Figure 8). Its evolution fits the concept of first and second history following the context of Brandi's

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Theory of Restoration (1995 [1963], p. 17), in which each development phase has its own importance. The proposed intervention was based on the notion that the building must preserve its original purpose, as an element of coastal signaling,[14] as well as its stability; and that access to it must be permitted to enhance its historical value. It states that modifying its current location would be contradictory to the conservation of its values. *The Venice Charter* (ICOMOS, 1964, p. 2) stresses the importance that a monument be linked to its history and location, and that its transfer should only be considered under extraordinary circumstances. This intervention seeks to recover the building's stability without altering its aesthetic appearance nor its historical and cultural context. Its focus is conserving the essence of the monument, avoiding unnecessary changes.

FIGURE 8. Photograph of *El Morro* Lighthouse in San Felipe (Photograph: Sarahí Soriano and Rodrigo Sáinz, 2019).

[14] The Lighthouse itself is a visual sign to guide and warn ships about the location of the coast, underwater perils and other important reference points at sea, thus contributing to the safety and efficiency of maritime navigation.

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The proposal is based on respecting the authenticity of each of the asset's historicity's and is justified by considering the conservation not only of the Spanish period, but also those interventions carried out during the 20th century. Although the main proposed intervention is the stabilization of the load-bearing walls and maintenance of the cover, preventive conservation is crucial to guarantee the preservation of its authenticity and historical riches.

Considering the diversity of the building's construction phases and its location in a historical asset with its own value, whose history is complemented by the Lighthouse, it is important to take care of the context in which it was built and the element itself. The dialogue between the different stages is a key factor in the significance of both the edifice and the general ensemble, including the relation that exists between the phases and the original elements. Hence, each part bears witness to its period and known characteristics, while revealing the evolution of the asset, Puerto Rico's political history, and the development of technologies for coastal surveillance.

CONCLUSIONS

The Lighthouse in the *El Morro* Castle in San Felipe, currently held by the NPS and under American federal jurisdiction, is ruled by public policies established by this federal bureau belonging to the U.S. Department of the Interior. Nonetheless, coordination between the local authorities and the NPS has not always been optimal. This relationship could improve with efforts and changes in attitude on both sides. Furthermore, the Coast Guard retains right of access to the Lighthouse to operate the lantern at any moment. Because the site is registered on the list of World Heritage Sites, it is governed by the *Convention Concerning the Protection of World Cultural and Natural Heritage* (1972) and its practice guidelines. As World Heritage that bears witness to the building's management, it requires the collaboration of the NPS, conserver-restorers, and academics for preventive and active maintenance and conservation. We suggest comprehensive cultural management that includes it in the *El Morro* Castle in San Felipe interpretation program, considering its historical importance. Though the main goal of the Lighthouse assessment has been achieved, this report was produced before the 2020 earthquakes, hence it must be updated to reflect possible recent damage or changes in its conditions due to those seismic events.

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Successfully fulfilling professional practices between academic institutions in countries in Latin-America and the Caribbean is essential for the professionalization of conservers and restorers of *immovable cultural assets*. Such collaborations contribute significantly to the study and work in restoration and conservation by providing a broader perspective, sharing best practice and enriching the knowledge and technical skills of the professionals involved. It is through this type of exchange that students compare and contrast curricula and facilities, and thereby observe the different institutions' study methods for the proposed cases.

Moreover, these exercises provide an opportunity to work with multiple actors who afford different points of view regarding the management of the case presented, as did members of the faculty at the University of Puerto Rico (a chemical engineer and restorer of immovable assets); as well as the specialists who guard and are in daily contact with the building and its context, in this case, the NPS rangers. This creates inter-institutional ties which thrive even once the professional practices are over, building bridges of understanding for future academic collaborations. Furthermore, the opportunities for improvement and growth include the need to involve more than one student to carry out a comprehensive analysis, ensure access to suitable tools and equipment from the hosting university, and adequately manage the available time to carry out effective survey and analysis activities.

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