

Article

Analysis of the Tower of Hercules, the World's Oldest Extant Lighthouse

Rubén Rodríguez Elizalde 

Faculty of Economics and Business, Universitat Oberta de Catalunya (UOC), Rambla del Poblenou, 156, 08018 Barcelona, Spain; rrodriguez@uoc.edu

Abstract: The Tower of Hercules is an icon of the city where it is located, A Coruña, and it is supposed to be the world's only surviving Roman lighthouse. Its function continues today: it provided a warning to shipping in antiquity and continues to do so now, in the 21st century. Furthermore, it is a paradigmatic case of architectural intervention in an ancient monument: in the 18th century, the Spanish engineer Eustaquio Giannini restored the tower, applying scientific criteria and maintaining the authenticity of the monument. For all these reasons, the Tower of Hercules is an exceptional benchmark through which the development and evolution of the different signaling and navigation aid systems can be studied from the beginning of our era to the present day.

Keywords: Tower of Hercules; Roman lighthouse; masonry structure; ancient tower; Roman architecture

1. Introduction

The Tower of Hercules is a highly representative Roman lighthouse (Figure 1) and the most important monument in its city, A Coruña, in Spain [1]. Spain has many old and historical lighthouses, but the Tower of Hercules is by far the most famous [2–4]. It is a Roman lighthouse built in the late 1st or early 2nd century; there is no definitive date for its original construction [5–7].

The Tower of Hercules was built on land that was part of an ancient Celtic cult space. This sanctuary was on a rocky promontory, 57 m above sea level [6,8–12].

From its construction until the present, the tower has fulfilled its function of serving as a maritime signal for navigation in the area, which is why it is considered the oldest operating lighthouse in the world [2,4,13].

Thanks to much research, we know that there were other lighthouses in ancient times on the ancient Mediterranean and Atlantic coasts. Many of these lighthouses were even older than the Tower of Hercules [14]. Thus, to name the most famous, in the eastern Mediterranean Sea, we know that the Alexandria lighthouse [15,16] and the Taposiris Magna lighthouse (a copy of the Alexandria lighthouse [14,17]) were built in Egypt, the Thasos lighthouses [14,18] were built in Greece or the Roman lighthouses of Leptis Magna [14] and Cherchell [19] were built on the coasts of present-day Libya and Algeria, respectively. Similarly, written testimonies record the construction on the Atlantic coasts of the Roman lighthouse of Dover (Turris Dubris) [14,20], in the southeast of Great Britain, the Roman lighthouse of Gesoriacum (present-day Boulogne-sur-Mer [21]) in the north of France, as well as the Tower of Hercules. Among all of them, only the Hercules lighthouse remains standing (the Dubris Tower is partially preserved but does not function as a lighthouse today) [4,14].

In Roman times it was known as *Farum Brigantium*, in the Middle Ages as “el Faro” (“the Lighthouse”) or “el Viejo Castillo” (“the Old Castle”), and in the Modern Age as the Tower of Hercules. The authorship of the lighthouse is much debated: the tower is attributed to the architect Caius Servius Lupus, from Coimbra (Portugal) [22,23]. Caius Servius left a commemorative inscription at the base of the tower, which is preserved on the base platform of the monument, protected by a building from the early 19th century.



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Figure 1. General view of the Tower of Hercules, in a photograph taken from the east.

The decline of the Roman Empire also meant a decline in trade, and thus the decline of the great maritime routes, which is why the lighthouse began a long process of abandonment, ruin, and plunder that continued throughout the Early Middle Ages [24,25]. Even though at this period it probably did not have a beacon fire (as far as we know), the tower continued to be a first-rate landmark for the navigation of small boats (coastal navigation). This type of navigation was very intense in Galician interior waters.

The second half of the 9th century brought Norman invasions, and the constant external threats exacerbated the decline of trade and port activity. For this reason, the town of *Brigantium* was virtually abandoned by its population. The citizens moved inland, away from the coast, to a safer settlement further up the estuary. The remains of the lighthouse became a defensive watchtower [24,26].

By the Late Middle Ages, the fear of an invasion by sea had lessened, leading to a reactivation of trade and a repopulation of the coast. The Municipal Charter granted by

Alfonso IX, King of Castile, in 1208 meant the foundation of a new city. The tower was still a watchtower and served as a maritime beacon.

At the end of the 13th century, King Alfonso X of Castile published his *Estoria de España* ("History of Spain"). In one passage, mixing reality, legend, and the classical myth of Hercules, he places his confrontation with the giant Geryon in the Atlantic finis terrae. After killing his enemy, Hercules buries him by the sea and builds a lighthouse tower on his tomb, as well as founding the city of Crunia [27,28]. From the 13th century, the lighthouse would be called the Tower of Hercules forever. This is how we know it today.

The ruined parts of the lighthouse were used as a stone quarry for the construction of the city. The value of its granite stone is the fundamental cause of this looting. In the 16th century, plundering was prohibited. After this, in the second half of the 16th century, an internal wooden staircase was also built, providing access to the lighthouse lantern through the chambers, as the former exterior ramp had completely disappeared (Figures 2 and 3).



Figure 2. External appearance of the tower throughout its history, ordered chronologically from left to right: Roman period (assumed elevation, **left**), late 17th century (**center**), and after the intervention carried out in the 18th century (**right**) [29].

It is very possible that at this time it was put back into operation as a maritime signal, given that maritime traffic was intensifying due to trade between Europe and America. La Coruña became a strategic port on the Atlantic.

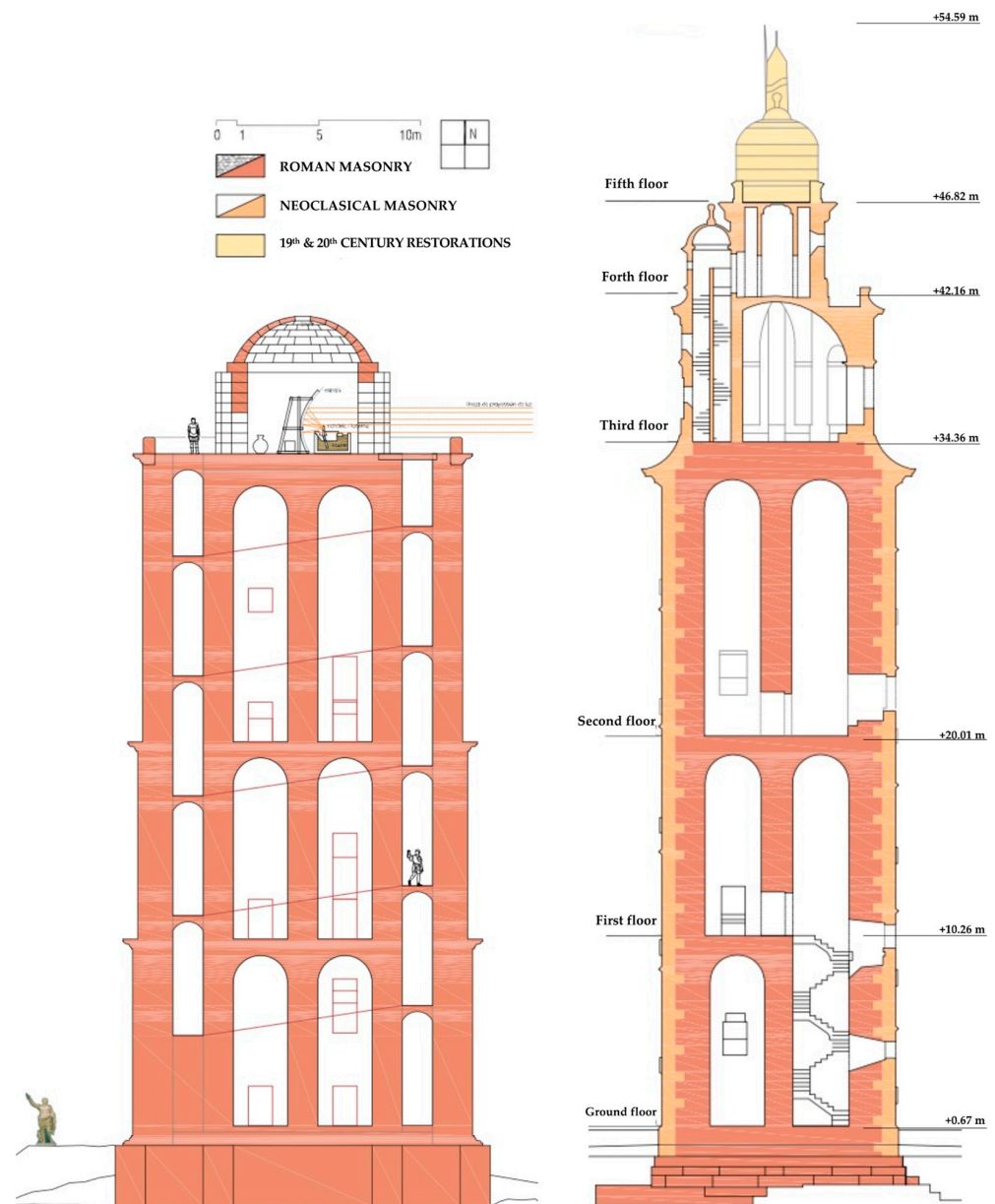


Figure 3. Sections of the Tower of Hercules. On the left, the supposed section of the lighthouse at the time of its construction, with the perimeter ramp and the vault that covered the lantern area. On the right, the section of its current state, with the successive remodelings and extensions of the building marked with different colors (graph by the author, using plans from the Master Plan 2010 [30]).

In the late 17th century, a modest restoration of the tower was suggested so that the old masonry tower could function as a beacon again. The Duke of Uceda, then governor of Galicia, entrusted the architect Amaro Antúnez with the pertinent restoration project [31,32].

The repair consisted of the construction of a new wooden staircase to replace the one made in the 16th century. This staircase had to allow access to the rotunda of the tower from inside the building through the chambers. To build the staircase, it was necessary to pierce three of the Roman vaults. With this staircase (Figure 2, center), access to the upper part of the tower was solved after the loss of the external ramp, which had disappeared due to the passage of time and the aforementioned constant looting of materials.

In this intervention, two turrets were built (Figure 2, center), crowned by two lanterns, on the platform at the top of the tower. This platform, on which the small terraces rested, still preserved the remains of the Roman rotunda.

With this intervention, the Tower of Hercules once again fulfilled its original function as a lighthouse: it provided a warning light for shipping and served as a landmark once again.

However, as we already said, this intervention was very modest, and barely 50 years later, around 1730, the need to completely reform the tower arose again. For this, different reports were made on the state of the tower, and various repair projects were proposed.

2. Materials and Methods: Historical Analysis

Building a tower means reaching a balance between what the building can support and the movements that the building can accept. Therefore, stability and resistance play a fundamental role in establishing what dimensions are possible, depending on the construction materials and height-to-base ratio.

Towers have always been among the most significant construction challenges. From the legendary Tower of Babel (Genesis 11) until today, the economic power of countries has been measured by their ability to create tall buildings [33]. If such buildings are also vital for the safety of shipping and for border defense, their importance is understandable.

It is interesting to start with an idea: among all the ancient lighthouses referred to in the Introduction, the Alexandria lighthouse was undoubtedly the most famous, interesting, and exemplary [14–16,34]. It could perhaps be a reference for the construction of the primitive tower. The Alexandria lighthouse reached 135 m in height [15]. It was higher than the Tower of Hercules.

The Alexandria lighthouse section was based on an outer tube and an inner tube, with a system of ramps in between. This double tube system is typical of the old masonry towers [35] and would continue to be so for many more centuries, in many bell towers and similar buildings [36]. This construction system simplifies the construction of any tower: the building grows as walls and ramps are built. On the one hand, the ramps guarantee unity between the two tubes and solve warpage problems; and, on the other hand, they diagonalize the tower increasing its stability. The analogy between the Tower of Hercules (Figure 3) and the Lighthouse of Alexandria (Figure 4) is evident.

With its historical, functional, and strategic importance in mind, in 1788 King Carlos III of Spain ordered the restoration of the tower. This restoration was entrusted to the Spanish military engineer Eustaquio Giannini, assisted by José Andrés Cornide [5,22,23].

By the late 18th century, all that was left of the original construction (Figure 2, left; Figure 3, left; and Figure 5, left), was the internal quadrangular structure of the chambers (Figure 3, right) and the old upper rotunda, which had been remodeled in the 17th century (Figure 6).

Giannini's project was based on the general maintenance and consolidation of the main prismatic body. For the protection of the initial core, a granite stone lining was added to the four facades; four new walls became an envelope concealing the extant Roman walls. This intervention gave the tower the appearance that we see today (Figures 1 and 7).

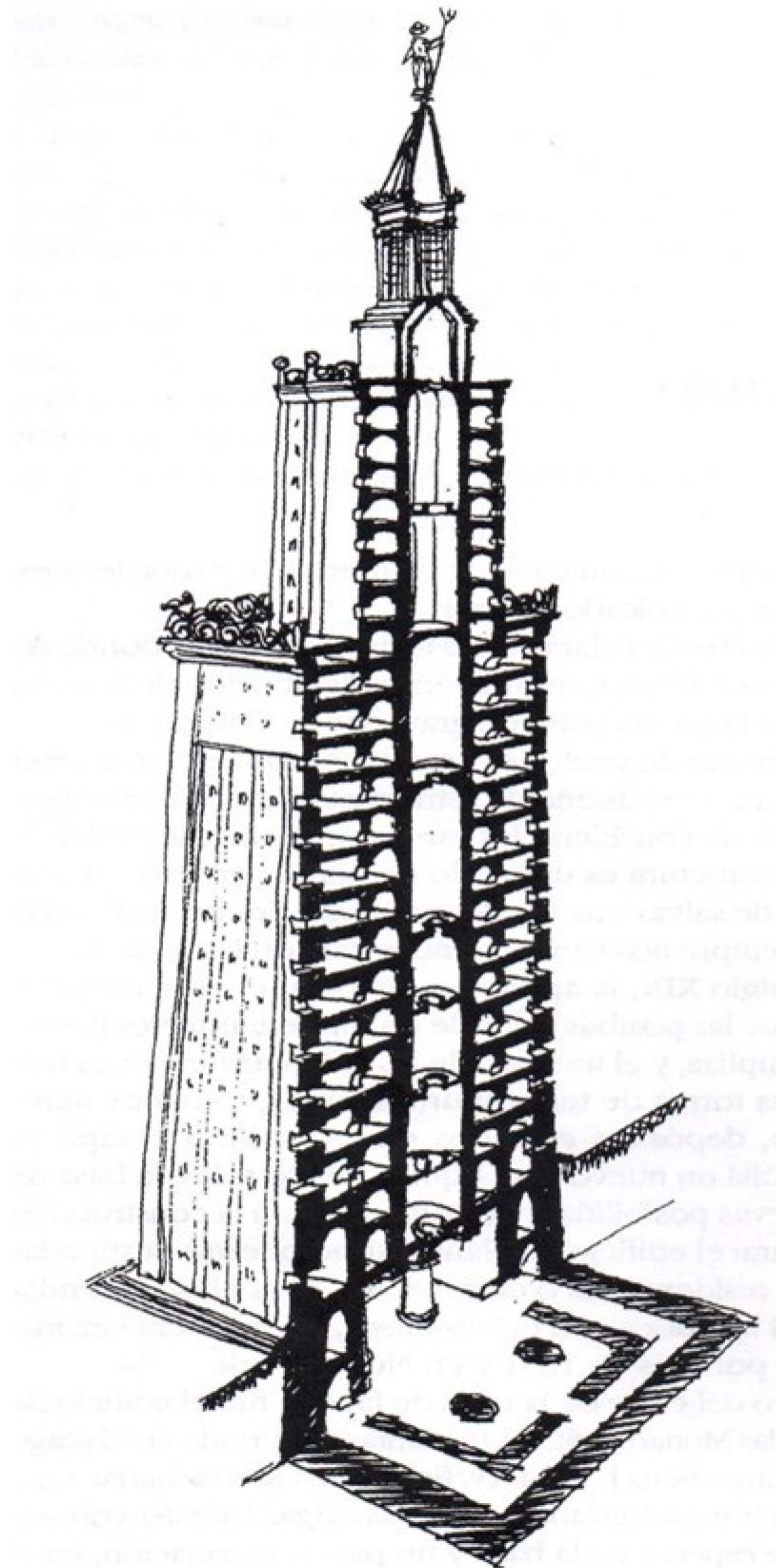


Figure 4. Central section of double tube and holes of the old Alexandria Lighthouse, not currently preserved (graphic by Doctor Cobreros Vime [35]).

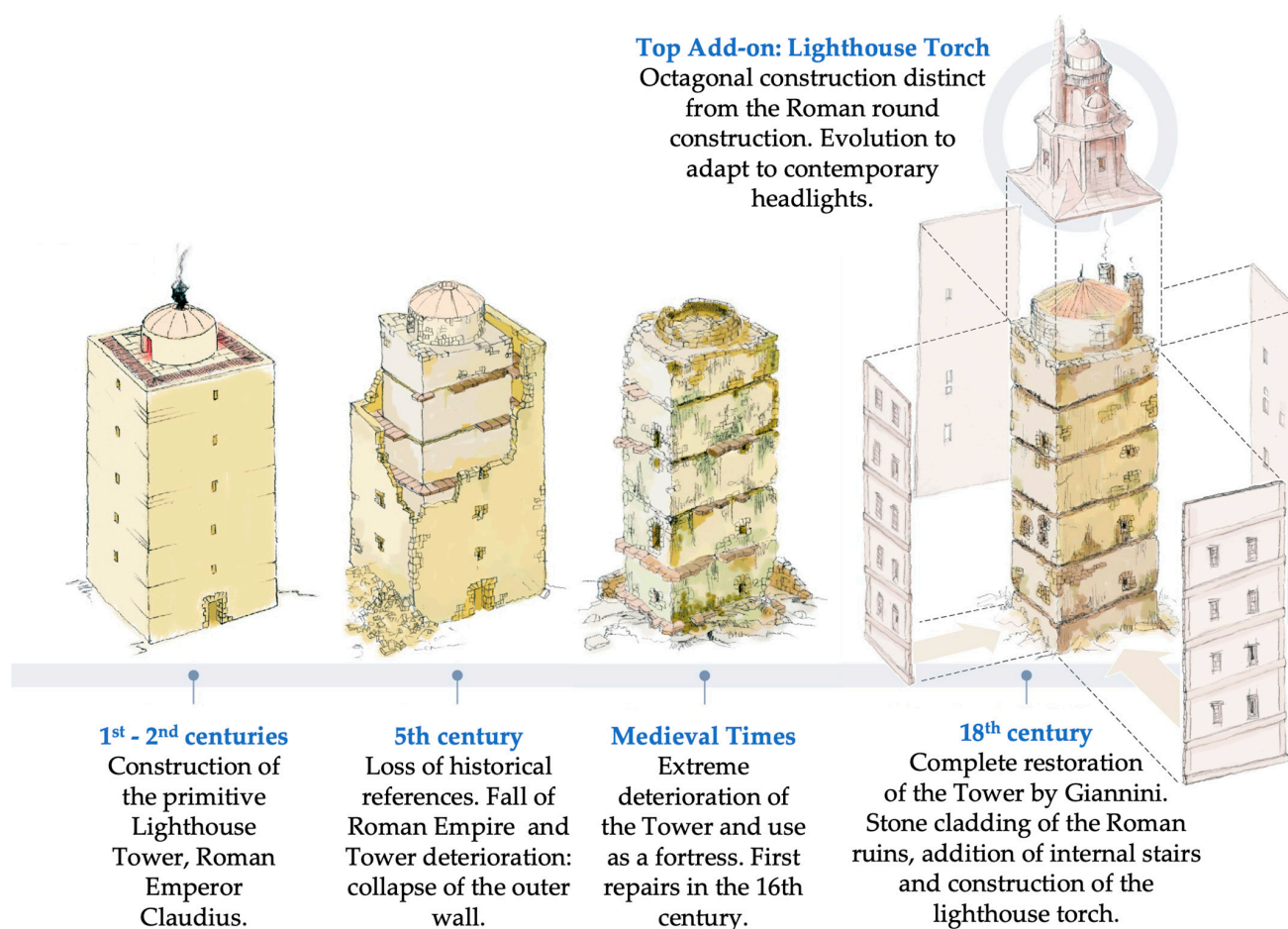


Figure 5. Constructive evolution of the Tower from its initial construction to Giannini's restoration (author's diagram on La Voz graphic [37]).

In this way, the original structure was maintained and preserved for posterity, even though its appearance was changed. The intervention respected the preserved Roman ruin, as it is a unique testimony of ancient engineering [34,38]. This admiration for what was built conditioned the intervention: in fact, some small black stones were introduced to mark the limits of the restoration, making it possible to identify the points where the original structure was modified (Figure 8).

The new walls, on the outside, included an ornament as a reminder of the former ramp that allowed access to the lantern in ancient times (Figure 5, right). This ornament was an ascending spiral strip, which runs along its facades (Figures 1, 2 and 6).

A new finial was also built. The octagonal pillars of what we now call the Giannini room (Figure 6) outline the perimeter of the Roman rotunda.

The four facades consist of a lower plinth and four smooth moldings in the corners.

An interesting point is the façade openings: Giannini designed pairs of windows with lintels, distributed along the four facades. The only open windows are those that correspond to the pre-existing niches; the rest are blind (Figures 1 and 9).

Inside, Giannini respected the configuration of the four superimposed vaulted chambers on three levels of the Roman construction (Figures 3, 6 and 10). Making the climb to the lantern comfortable and functional was a necessity. The vaults were pierced to make way for a more comfortable stonework staircase (Figures 11 and 12), replacing the one that Amaro Antúnez had built. The Roman rotunda that was still preserved (albeit heavily modified) was demolished to modernize the signaling system of the lighthouse. Not being able to take advantage of the existing structure, a new innovative composition was designed, based on the superposition of two octagonal bodies. Once the works were

finished, the two bronze plates that commemorate the restoration of the lighthouse were placed on the access doors to the tower (Figure 9).

Since then, interventions in the lighthouse have been limited to partially remodeling the upper area, improving the lantern, and repairing and restoring it (Figure 6).

The perimeter of the tower has recently been excavated. Thanks to this we have been able to study the archaeological remains that surrounded the tower, confirming the chronology of the destruction of the tower, whose ruin begins between the 5th and 11th centuries, concluding with the total disappearance of the outer wall around the 14th century [23,39].

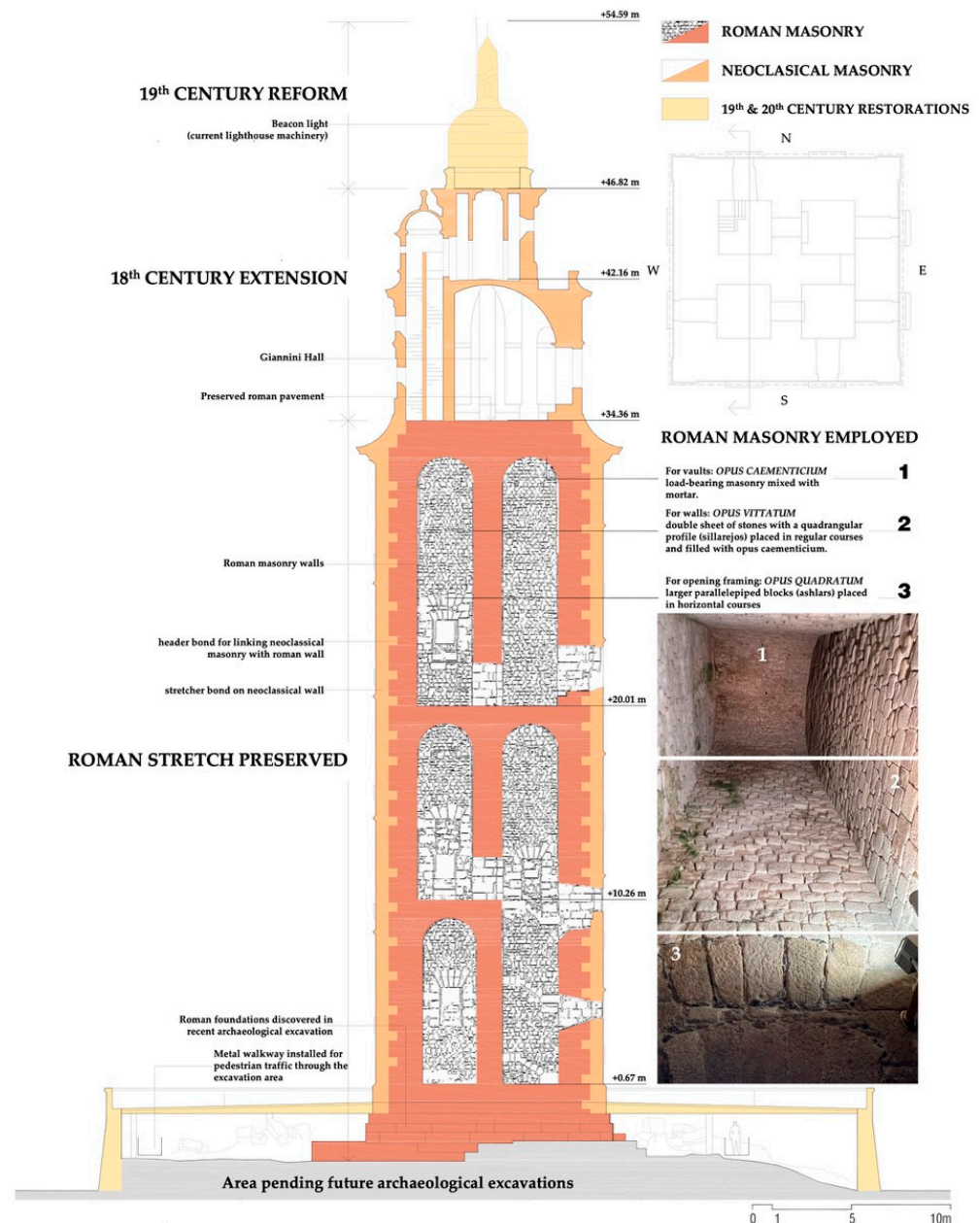


Figure 6. Cross section of the Tower of Hercules in its current state, with the successive reforms and extensions of the building marked with different colors (author's diagram on the section of the Master Plan 2010 [30]).

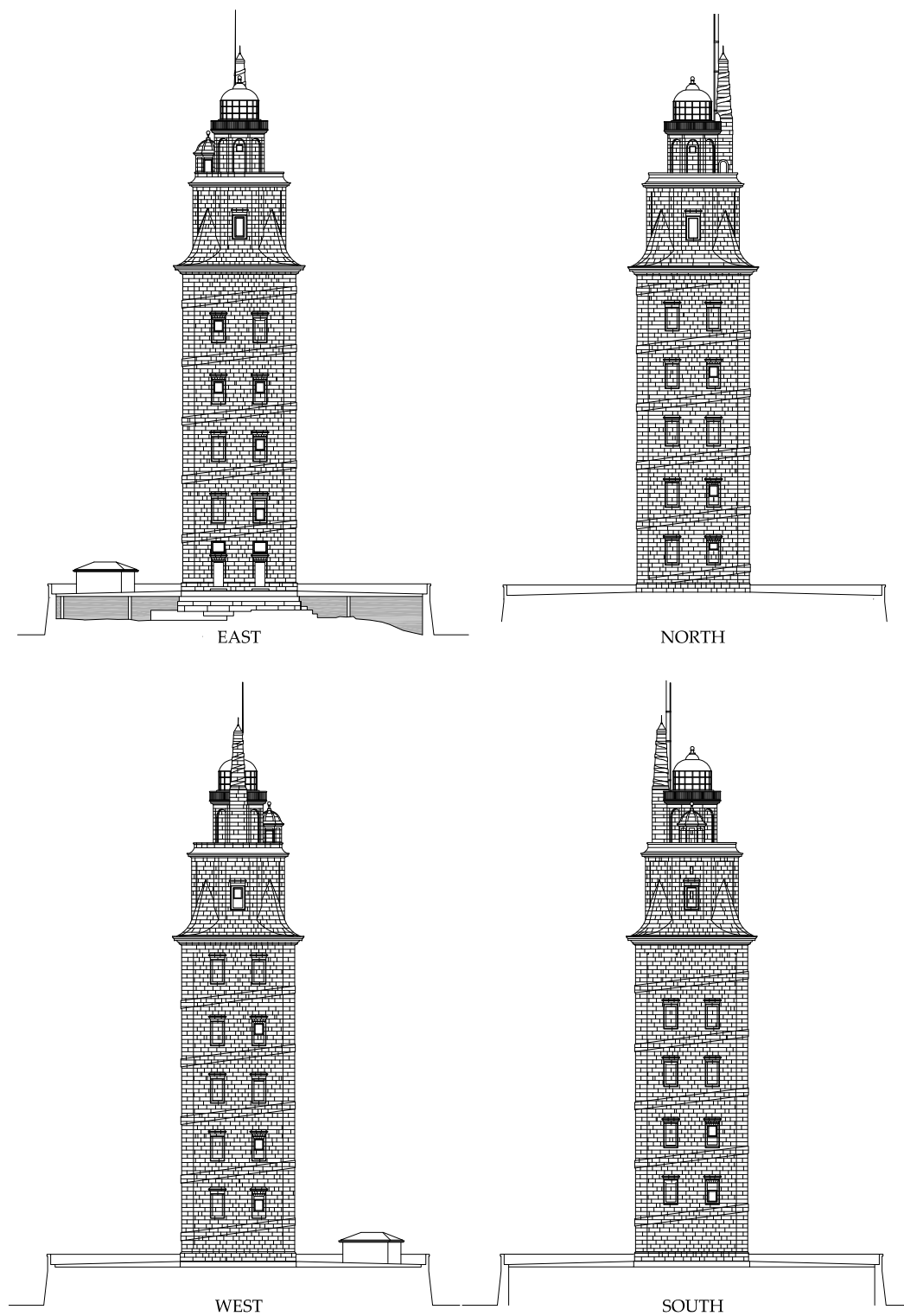


Figure 7. Current elevation plans of the Tower of Hercules [30].



Figure 8. View of a section of the stairs installed by Giannini, where you can see the black stones that facilitated the fixing of the stairs on the Roman masonry.



Figure 9. Main façade (northeast orientation) of the Tower of Hercules, where you can see the access doors, on which two bronze plates were placed commemorating Giannini's restoration.

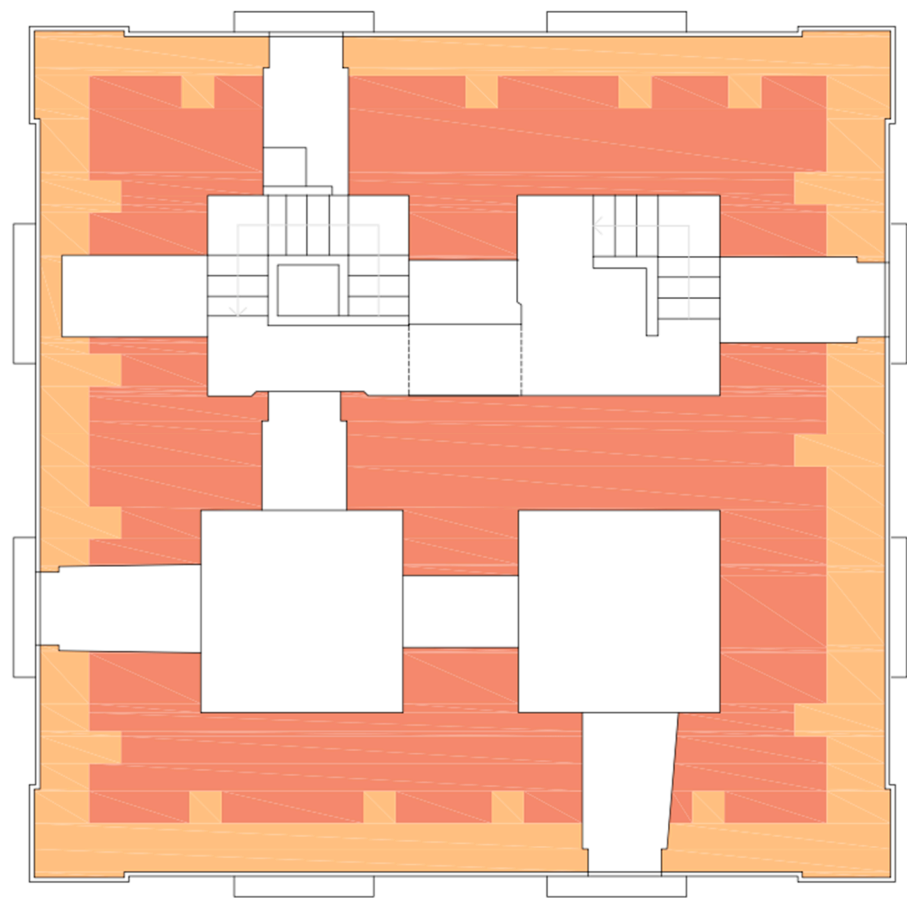


Figure 10. Standard floor plan of the first three levels of the tower, with the Roman nucleus differentiated from the current neoclassical façade by the colors used in Figures 3 and 6 (author's diagram in section of the Master Plan 2010 [30]).



Figure 11. Group of stairs from the 18th-century remodeling inside the Tower.



Figure 12. Arrival of the stairs at the level of the Eustaquio Giannini roundabout.

3. Results

Having analyzed Giannini's intervention, we know the function of the new four enveloping facades. These exterior walls are of great austerity in design and present a homogeneous structure, which is repeated on all fronts, with small variations in the organization of the openings. As we have already said, a characteristic sign is the spiral strip that runs along its exterior facades, from the base to the top of the prismatic body: it commemorates the ascending ramp that served as access in Roman times. The inner core of the lighthouse has come down to us from the ancient Roman construction. This inner core is a quadrangular building.

However, we have lost the exterior access ramp. Of this spiral ramp and the outer wall, we only have certain evidence that has appeared in archaeological excavations carried out in 1992.

In the medieval levels that are based on the late Roman level, remains of large ashlar were found (Figure 13). These large ashlars presumably belonged to the outer wall, which showed the traces of the iron staples that strengthened its solidity, as well as fragments of a monumental cornice that probably came from the top of the tower.



Figure 13. Ashlars of the Roman basement under the access platform to the Tower.

Along with all these materials, numerous Roman ashlars affected by weathering were found, which were discarded in the 13th century because they could not be reused in other constructions. The remains were also found of a construction attached to the outer wall of the tower, to the south, which probably served the building when it was used as a watchtower to warn of possible attacks by Norman and Muslim forces.

In the rest of the excavated area, it has been possible to document the existence of the foundation from Roman times, made up of large blocks of granite, remains of lime mortar, and the living rock on which the construction was based. The grooves that were carved in the bedrock to fit the ashlars have also been found, knowing the primitive layout of the outer wall that protected the access ramp to the lantern in Roman times, which disappeared due to the passage of time and plunder of materials. All this can be observed in the archaeological space that was set up for visits during the latest restoration works.

3.1. The Core Structure

The original central structure of the lighthouse consisted of a prismatic volume of approximately 10 m on each side and 34.40 m high (Figures 3, 5 and 6). This structure was organized into three levels of different heights for each one. Thus, we have a level of 9.20 m, a level of 9.60 m, and another level of 14.35 m, respectively (Figure 6). Each level presents the same distribution: four square chambers measuring 2.70 m on each floor.

All these previous spaces are covered with barrel vaults (Figures 3, 5 and 7). Three of them were dismantled when building the interior staircase.

The internal walls have a thickness of 1.5 m. It is the same width as the original perimeter walls of the preserved nucleus of the Roman masonry. After Giannini's works, the thickness of the perimeter walls was greater (2.15 m), because they were clad on the outside with a new ashlar wall (Figure 5). We must remember that the Roman structure was covered and attached to that cladding by perfectly fitted header stones (sooty ashlars [38]). Almost all the openings from the Roman period (doors and ventilation windows) that were in this wall were respected by the new neoclassical work (Figure 14).



Figure 14. Inner chamber. One of the windows of the current stairwell. The larger stones were used in the formation of holes, the smaller ones in the walls and the smaller ones in the vaults.

The visible faces of the internal walls of the lighthouse are made of banded masonry (*opus vittatum*) of 30-cm thick white granite (Figures 6 and 15). The core of the walls was filled with a concrete of sand, lime, and large unworked stones (*opus caementicium*), making the structure very strong, with a thickness of approximately 90 cm (Figures 6 and 15). The exposed surface of *opus vittatum* is made up of granite ashlar in horizontal courses, which are regularized every five to seven courses (between 90 and 120 cm high) corresponding to the compaction of the layers of concrete with which the interior was filled. The exterior *opus vittatum* constitutes, then, an exterior finish and a lost formwork for the interior *opus caementicium* [23,38–40].



Figure 15. Barrel vault of one of the chambers, showing the placement of the stones and their size in relation to the masonry of the walls.

The walls have a series of horizontal holes the size of ashlar that are arranged two by two in each of the regularization lines and that would serve to support the scaffolding during construction, later being covered with rubble (Figure 16). The window and door openings were made with large ashlar (Figures 14 and 16), rough and irregular in shape. These ashlar are placed on the jambs of the opening in the style of a running bond and support a large lintel of voussoirs.



Figure 16. Inner chamber. Closed opening detail, with jambs and voussoirs much larger than the masonry of the wall.

The vaults of the chambers were made with an *opus caementicium* of stones of different sizes placed on wooden frameworks supported by the interior walls. They were not voussoirs as such. The trapezoidal stones were placed following the guideline of the falsework, adopting the position that the voussoirs would have, being covered with lime concrete on which the same operation was repeated two or three times. The haunches of the vaults were later filled with the same concrete, building a wall and a vault at the same time, finishing off the *opus vittatum* of the walls following the guidelines of the vaults.

The four vaults on each floor and the walls that delimited them were filled with *opus caementicium*. Thus, they formed a platform on which the walls of the next level were raised. The ground was paved with large slabs.

The pavement located on the top floor of the preserved Roman structure, which was used as a base on which to support the crown vault built by Giannini, was part of the

original construction designed and executed by the architect Caius Servius Lupus. It is cut and arranged on the walls that form the central cross of the original nucleus of the tower in such a way that it serves to tie the entire structure of vaults, perimeter walls of the nucleus, and interior walls in a cross at the upper point of the construction.

The pavement is made up of slabs made with large pieces of granite carved in the shape of a double T (Figure 17), which are placed and assembled using a chained seaming system following the direction of the walls. The central piece of this bundle is located at the intersection of the axes of the walls that form the cross and has the shape of two inverted crosses with their trapezoidal arms. In Figure 17, made in the room of the first neoclassical octagonal body, we can observe the shape and placement of the pieces of this flooring, including the detail of the central slab.



Figure 17. Flooring of the upper rotunda with the double T slabs that tie the structure together.

3.2. The Lost Structure

Access from the outside to each of the chambers was through the doors located on the ascending ramp (Figure 16) that wrapped around the structural core of the tower and allowed access to the top of it. It is assumed that the firewood for the beacon fire to guide shipping was carried up that ramp.

Over time, this surrounding structure deteriorated and collapsed, until it practically disappeared in the Middle Ages. Even so, as we comment above, the existence of this envelope was confirmed during archaeological excavations carried out at the end of the 20th century, in which the foundation of the tower was discovered (Figure 13).

The foundation stood on the natural rock, once leveled, using large granite ashlar placed in a running bond. The first course is approximately 19 m long. After the second course of ashlar, courses are superimposed in a running bond style, counterbalancing at the corners with the ashlar of the adjoining facades. In this way, a horizontal masonry platform was built to support the walls of the lighthouse. Numerous U-shaped iron keys have been found that were placed in some holes in the ashlar and later filled with melted lead to tie the masonry, a technique widely used in Roman construction.

The exterior walls were made (or should have been made) of cyclopean granite ashlar, also combined with running bond, of which a small amount has been preserved that presents rough padding on its visible face from the outside. The data on the arrangement of the holes in this wall are unknown. The approximate length of the facades would be 18 m, and the width of the interior ramp could be around 2 m, a span that could have been covered with vaults with characteristics similar to those existing inside. Some authors [22,23,34,38] comment on the possibility that the ramp had slopes only on two opposing faces. If so, on

the other two faces it would be horizontal. This does not seem to agree with the marks that existed on the facades before their restoration.

The tower was topped by a cylindrical construction with an internal diameter of approximately 6.80 m covered by a dome (Figure 18) that, most likely, would be open at its key, forming an oculus that would allow smoke to escape. The height of the dome reached approximately 4.40 m. It possibly consisted of a narrowing of the base cylinder by approximation of courses from its perimeter. The upper body was demolished in 1789.

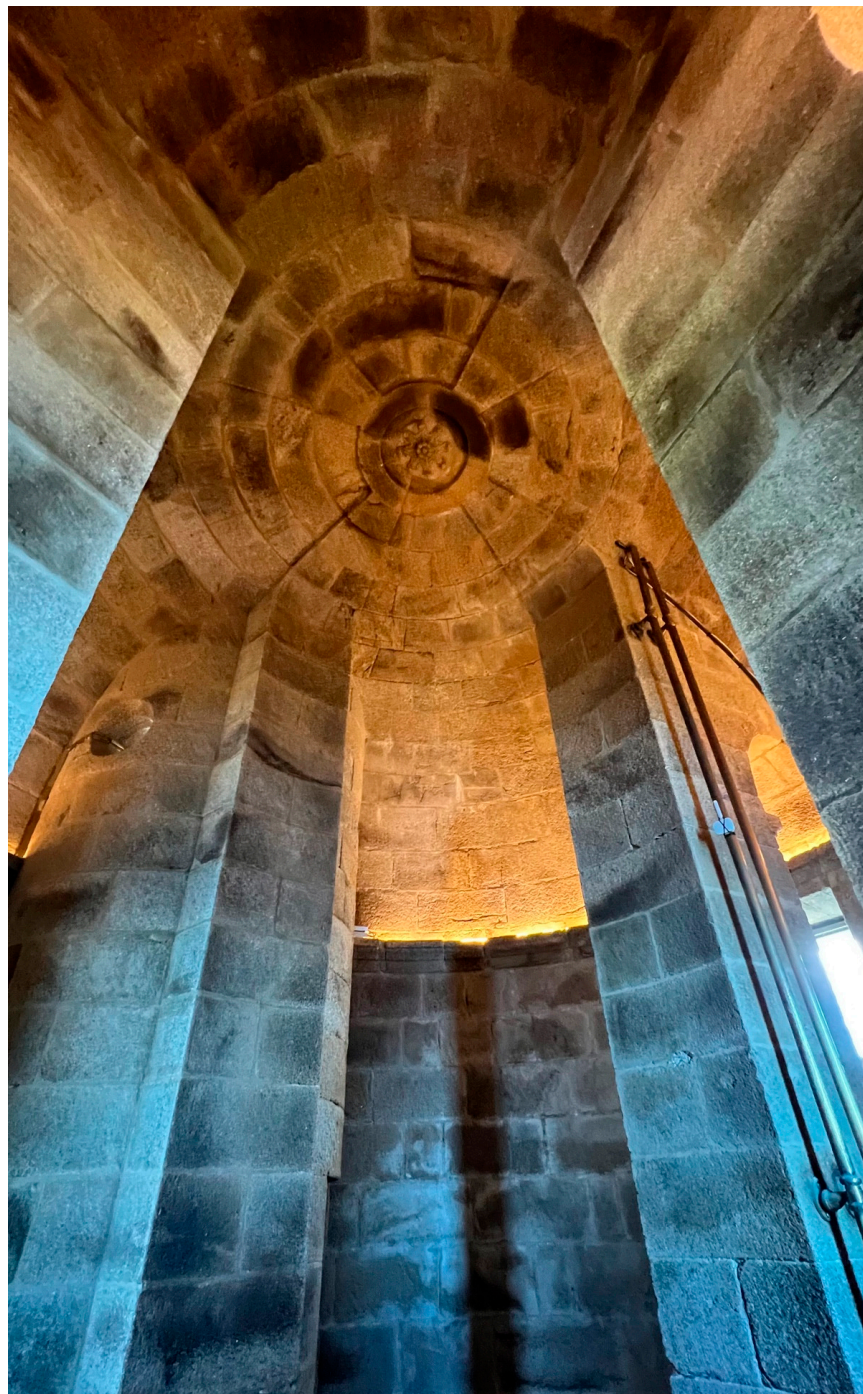


Figure 18. Cover of the Eustaquio Giannini rotunda, a false dome resting on four radial pillars that leave space for an annular corridor.

Figure 3 graphically describes the original Roman lighthouse described in this section. The description of the facades is not collected since there is not sufficiently accurate information to do so with certainty.

Figure 2, taken from an engraving from the end of the 18th century, shows the historical evolution of the lighthouse, with the first elevation of the Roman *Farum Brigantium* in which the central body can be seen surrounded by a perimeter ramp supported in turn by a second wall that surrounded the complex and that today has completely disappeared. A cylindrical lantern, covered by a vault with an oculus in its central area, houses the fire in its upper area. The engraving (Figure 2) is based on representations of other Roman lighthouses, although it is very possible that the sizes of the openings in the façade were much smaller and that they were linteled. Some authors [22,23,34,38] believe it possible that the width of the tower was divided vertically into three unequal cubic bodies that slightly decreased with the height so that its external appearance would be staggered.

The elevation of the center (Figure 2) corresponds to the late 17th century, after the intervention directed by Amaro Antúnez. In this intervention, the central nucleus of the Roman lighthouse was maintained, but the outer perimeter wall and the ramp were now lost. On this ramp, only a clearing remained at the junction of the ramp with the wall of the inner core, which was on the outside at that time. The Roman lantern was restored and covered, adding two small turrets.

The elevation on the right (Figure 2) shows the building after the intervention of Giannini, in the late 18th century, who reinforced the structure of the tower by lining the original Roman core with ashlar, leaving the current façade as it was. Giannini demolished the upper lantern of the lighthouse and built two octagonal bodies in its place. In this remodel, the internal stone masonry stairs were built, piercing the Roman vaults in the three levels of chambers.

3.3. The Stairs

As we have previously described, when the lighthouse was used again it was necessary to set up an access system to the upper part that would allow the fire to be fed. As the outer perimeter ramp had been completely lost, the solution consisted of an internal staircase, piercing several Roman vaults for it. The staircase was originally made of wood. In the design of Amaro Antúnez, hired by the Duke of Uceda in 1684 for its execution, it was decided that, for reasons of structural stability, the flights of stairs would change chambers at each level.

In 1790, the wooden staircase, in very poor condition, was replaced by a stone one (Figure 12) with a wooden handrail (Figure 11) that followed the position of the previous one but forced some modifications, since to ensure the stability of the work it was necessary to embed the ashlar of the steps in the Roman walls and establish them firmly. Giannini introduced some black stones (Figure 8) that can be seen with total clarity to document his intervention and record that he had intervened in the Roman masonry.

3.4. Giannini's Neoclassical Rotunda

On the top of the Roman structure sit the two octagonal bodies added in the extension at the end of the 18th century, maintaining the original Roman pavement in which large granite ashlar are combined, in a well-made seamed solution, which we have described above (Figure 17).

The restoration of the lighthouse had the objective of adapting the construction to the new maritime signaling techniques, for which reason the structure at the top of the lighthouse was replaced by two octagonal bodies, the second of which was conceived as a lantern, and which was modified years later.

The first body (to which Figure 18 corresponds inside) is occupied by the so-called Giannini room. We have an octagonal chamber with four radial pillars that leave space for an annular corridor and a continuous bench. The room is covered with a false dome. From this octagonal chamber, the ascent to the lantern is using a small spiral staircase.

This staircase is housed in a small gazebo-shaped temple that leads to the second body. Currently, this final room is a chamber closed to the public; however, originally it was conceived as a lantern with large glass windows on each of its faces and a small dome topped by a sphere that acted as a smoke outlet.

This last structure was remodeled by Giannini himself after a few years by modifying the lighting system and adapting the building to place a new lamp system to replace the initial coal-fired one. To do this, the small upper dome was dismantled, setting the base for a 3.20 m diameter fan on its walls.

The large windows of the initial lantern were bricked up and an internal staircase was built to access the lamp and another external spiral one, which leads to the upper balcony and is hidden under a cylinder with a frustoconical finish that gave it its characteristic profile. to the tower and that served to place the lightning rod.

4. Discussion

The Tower of Hercules is one of the few Roman lighthouses that retains part of its original factory and the only one that remains active. Durán Fuentes points out the propaganda factor of this construction [34]: this lighthouse was an example of the greatness of the Roman Empire since it was built in one of its westernmost limits, in the confines of the known world at that time.

In his work [34], Durán proposes a reconstruction of the Roman lighthouse based on the archaeological remains preserved at its base and on various documentary sources. In order to provide a solution to some structural elements, he resorted to similar constructive solutions from other constructions from the same period. In this case, the analogy with the lighthouses of Alexandria (Egyptian built before and known through documents and reconstructions) and Turrus Dubris in Dover (partially preserved and built years after the Tower of Hercules) is evident.

Latorre González-Moro points out that the structure from Roman times corresponds only to the inner core of the old lighthouse, as we have shown here; he points out that the Roman structure had a much larger volume. Based on the archaeological analysis carried out together with Caballero Zoreda [39], he concludes that, when the tower was abandoned and not used as a lighthouse in the Middle Ages, the tower was plundered by the population. Citizens used the remains of the tower as a stone quarry [38]. It caused the disappearance of the old facades of the Roman Tower and their deterioration. The building became inaccessible.

However, according to this author, this does not diminish the immense value of this construction. Despite the above, the inner core of the tower constitutes the most important remains of the lighthouses known in antiquity and one of the tallest buildings preserved in the Roman world. It leads to not knowing with certainty the true dimensions of the original tower [34,38].

Undoubtedly, the knowledge we have today of the tower, and especially of the hidden exterior facades and their condition in the 18th century, before the neoclassical restoration, we owe to José Andrés Cornide Saavedra [32], whose work [23] served as a reference for later researchers. Cornide was able to observe the monument before being covered by the neoclassical intervention. Cornide dated the construction date accepted based on archaeological findings (1st century AD); Cornide postulated that the ascent and descent ramp was supported by a perimeter structure to the stone core. This structure consisted of eight pillars joined by arches and was built on a vault similar to those preserved in the inner core but with a helical development [23,32].

Finally, we must point out an aspect lamented by Latorre González-Moro [38]: despite the importance of the Tower of Hercules as a work of Roman engineering, the tower has been removed from treatises on art and architecture. Most of the general treatises on Roman architecture hardly notice the Tower of Hercules [41–43]. This is due to its invisibility and the difficulty to understand it, since its Roman remains are hidden by neoclassical masonry. Giannini's intervention was a great technical success that made it possible to protect the

Roman vestiges of the primitive tower, but today we can only see the walls from the inside: the outer walls are hidden, and we cannot see them or study them.

After the analysis of the ancient Roman Tower, the next interesting aspect of this monument is the neoclassical intervention of Giannini. According to Latorre González-Moro, 76 rows of ashlar were used for each façade to cover the old Roman Tower, which represented 3765 pieces of carved stonework.

Cornide was essential in this process as well: In addition to leading the research about the tower, Cornide participated in the definition of the restoration project and collaborated directly with Giannini in its execution [22]. Vigo Trasancos attributes typical Roman details to Cornide [44], such as the diagonal band on the façade, the false windows on the façade, or the cornice that marks the end of the Roman construction (at the height of the third floor).

Thus, the result of Cornide and Giannini's work is an enlightened intervention: functional and, at the same time, with a view to the classical Roman tradition. According to Latorre, this intervention is a suggestive, modern proposal (for the 18th century it certainly was) and of great importance [38]. The restoration process was not systematized and should not be considered to be an isolated action over time. The subsequent nineteenth-century stylistic restoration and its subsequent conservative tradition have not paid attention to this type of work, which has never been considered as such. For this reason, this restoration has been brought here, to this article.

5. Conclusions

We have analyzed the Tower of Hercules, a unique building, supposedly the only one of its kind in the world, built almost two thousand years ago. This ancient Roman masonry tower is a lighthouse that continues to shine today in its strategic position. Despite its transformations, it has reached our era as possibly the only extant active lighthouse of antiquity.

The analysis carried out is constructive and historical at the same time: on the one hand, we have the old Roman Tower and, on the other hand, Giannini's neoclassical intervention, which made it possible to preserve the Roman ruins that were maintained until the 18th century.

The existing Roman body today has a square base of 11.75 m on each side and is divided into four chambers of 2.70 m, and a height of 37.58 m of which 34.38 m is visible (above the 32.40 m polygonal platform that today serves as its base). It has three floors of different heights. The height is 34 m, to which a further 21 m was added during the 18th-century remodel: this adds up to a total height of 55 m. Considering its function as a lighthouse, its light is 106 m above sea level.

The Roman walls are preserved, but they are not visible from the outside: the tower was clad with neoclassical granite walls in the reform undertaken by Giannini in the 18th century.

Years before, in the 17th century, a new internal staircase was installed to guarantee the safe use of the lighthouse. The following century saw an exemplary restoration: Giannini received a royal commission and for two and a half years directed the works that would give the tower its current appearance. The result was a classic and modern combination, typical of the Age of Enlightenment, where the Roman essence of the original construction was respected, and functionality was modernized with neoclassical features (Roman architecture and engineering as a model).

The structural solidity of this construction is beyond doubt: it has remained standing for almost 2000 years, enjoying excellent health according to its appearance and the most recent investigations and soundings. Its well-preserved appearance contrasts with its intense biography: for centuries it has gone through periods of abandonment when the stones of its outer wall and its ramp were stolen for other buildings, and it was used as a watchtower against invasions.

Already in the new millennium, in 2009, the UNESCO World Heritage Convention [45] included the Tower of Hercules in the World Heritage List, the culmination of recognition of a unique engineering work and perhaps eternal tower, which still shines and dazzles today.

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