02-033 – Restoration of the historical heritage using H-BIM methodology: the case of the Las Carolinas spa in Gijón – Recuperación del patrimonio histórico construido mediante metodología H-BIM: caso del balneario de Las Carolinas en Gijón

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English Spanish

The H-BIM concept aims to model and document architectural elements according to artistic, historical and constructive typologies. Typically, the H-BIM library is built using manuscripts and historical architectural documentation, laser scanning, photogrammetric techniques and other data obtained from the physical analysis of the building in question or from existing documentation. After numerous experiments that have been carried out in recent years in historical and archaeological heritage, often with different scopes, H-BIM is becoming a consolidated practice for documenting the state of artifacts, analyzing the phenomena to which they are subject, studying their construction processes, managing restoration sites and, last but not least, making known to future generations the constructions that for various reasons have already disappeared. This work aims to reconstruct as a BIM model the now disappeared La Carolinas spa, located on San Lorenzo beach in Gijón during the golden age of seaside tourism on the Asturian coast (1884-1913) and destroyed during the Civil War.

Keywords: BIM*; Historical building; Heritage*

El concepto H-BIM persigue el modelado y la documentación de elementos arquitectónicos, de acuerdo con tipologías artísticas, históricas y constructivas. En general, la biblioteca H-BIM se construye utilizando los manuscritos y la documentación arquitectónica histórica, escaneo láser, técnicas fotogramétricas y otros datos obtenidos del análisis físico del edificio en cuestión, o de aquella documentación existente. Tras numerosos experimentos que se han llevado a cabo en los últimos años en el patrimonio histórico y arqueológico, a menudo con diferentes alcances, H-BIM se está convirtiendo en una práctica consolidada para documentar el estado de los artefactos, analizar los fenómenos a los que están sujetos, estudiar sus procesos constructivos, gestionar los sitios de restauración y, por último, pero no menos importante, dar a conocer a las generaciones futuras las construcciones que por diversas causas ya han desaparecido. Esta trabajo pretende reconstruir como un modelo BIM el ya desaparecido balneario de La Carolinas, situado en su momento en la playa de San Lorenzo de Gijón, durante la época dorada del balnearismo en el litoral asturiano (1884-1913) y destruido durante la Guerra Civil.

Palabras claves: BIM*; Edificios históricos; Patrimonio*

1. Introducción

The H-BIM (Heritage - Building Information Modeling) concept was first used in the work of Murphy et al., (2009), from the Dublin Institute of Technology. According to Murphy et al., (2011) and (2017), H-BIM pursues the modeling and documentation of architectural elements, according to artistic, historical and constructive typologies.

In this way, H-BIM, as an extension of BIM (Building Information Modeling) methodologies, can help to manage the conservation of these constructions during the operation and maintenance phases, including the end of their useful life with demolition and recycling, if their conservation is not possible, as well as to reconstruct the monument in case of damage or disappearance.

It should be taken into account that historic buildings, considered as cultural heritage, provide a very tangible connection with the past, with aesthetic and community benefits, and usually have strong emotional ties with the locality where they are located and its history, so their impact on culture is very considerable.

This research presents a modeling workflow of a spa on the Asturian coast, taking into account the nature and peculiarity of this type of construction, with the aim of preserving that piece of the history of Asturias.

Usually, the H-BIM methodology would be applied using terrestrial laser scanner systems (TLS), to obtain a point cloud from which to make the 3D model as accurate as possible (Doré and Murphy, 2017), (Grussenmeyer, 2008), or by photogrammetry techniques (Heradio et al, 2019).

However, the use of these two technologies is obviously only possible if the construction to be represented is standing. In the case presented here, there is the extraordinary circumstance that the building object of this work no longer exists, because it was burned down during the first months of the Spanish Civil War, which complicates, and even compromises, the feasibility of carrying out this modeling.

1.1 Coastal seaside spas in Gijón

Since the end of the 19th century, asturian cities, like others in the rest of Spain, have undergone transformation processes, among which those aimed at making space available for apparently “unproductive” activities stand out. “Cafés”, theaters, parks and promenades became very popular places during the free and leisure time of the citizens, who could thus cover their socialization needs (De la Madrid, 1991).

Although to a certain extent provisional and ephemeral in nature, these spas strove to cultivate the concept of elegance for their clientele. Thus, the spa “La Favorita” claimed that its bathtubs were made of Carrara marble and that it had a piano and a “Restaurant”, while “Las Carolinas” boasted of being “*the only spa that has a lounge with a piano for the recreation of the bathers*” (De la Madrid, 1991).

Four spas were established on the San Lorenzo beach (see Figure 1). In order of opening, these were:

- “La Favorita”, built in 1884 and the largest since it was actually formed by two spas. Located at the height of the current *Jardines del Náutico*, it was demolished after its destruction in a fire in the winter of 1936, during the Civil War.

- “La Sultana”, designed by architect Mariano Marín Magallán and built in 1887, 70m long, was renovated in 1899. It is the least known today because of its early expropriation and demolition in 1906.
- “Las Carolinas”, built in 1887, was 87 m long. Its fate was the same as that of “La Favorita”.
- “La Cantábrica”, built in 1892, in stone instead of wood, with two floors, was located on the accesses to the Santa Catalina hill, a very unfavorable place, which required important infrastructure works.

Figure 1: Three of the four spas on the San Lorenzo beach in Gijón.

NOTE: Photograph of anonymous origin. Alvargonzález Foundation Collection.

The last two spas, “Las Carolinas” and “La Favorita” were burned down in the winter of 1936 (see Figure 3), but as De la Madrid (1991) states, the winds were already blowing at that time and, in any case, tastes and fashions had changed a lot during the half century that they remained standing, being, by then, their use very much in the minority.

1.2 “Las Carolinas” spa

This spa had its origin in a very peculiar original project: it was a building that responded to the typology of the english piers -spa bridges- formed by three bodies, the first parallel to the line of the wall, rectangular in plan and two stories high.

The second started perpendicularly to the previous one, from its central part, going into the sea -at least at high tide-, ending in a third building, parallel to the first one, where 64 sea bathing huts were located. In spite of its very high cost -120,000 pesetas- this project was carried out, although, in the winter of 1888, when it was almost finished, it was destroyed by a storm.

Of the remains of this project, only the first building could be used, which would eventually become the building that is the subject of this work.

The project, curiously, was signed by one of the three members of the concessionary society of the spa, Tomás Zarracina, despite the fact that another of the members of the society, Justo del Castillo, was an engineer. As we will see later, it was not unusual for a concessionaire to sign a project of this type, without apparent qualifications.

Figure 2 shows what is, perhaps, the best existing photograph of this construction. Its stilted structure on cast iron pillars and wooden construction can be seen. It was highly ornamented, trying to give an image of great luxury as a lure for the wealthiest clientele. The octagonal central hall, which divided the spa into two wings, one for men and the other for women, is noteworthy. It is also observed, the gallery facing the sea.

Figure 2: "Las Carolinas" spa during low tide.

NOTA:. Photograph of anonymous origin, obtained from https://gijonenelrecuerdo.elcomercio.es/2014/03/gijon-balneario-las-carolinas.html

2. Modeling strategy

As a consequence of the destruction of this spa in July 1936, at the beginning of the Civil War (see Figure 3), together with the "La Favorita" spa, it is materially impossible to know the exact dimensions of the construction. Even more so, taking into account that, at the time, what was reflected in the technical documentation by the architect, especially in this type of construction considered ephemeral, did not correspond to what was subsequently built. Roza Candás (1995) affirms that "*frequently what was built was not very similar to what was projected*", and contradictions between the plans and the reports even appeared.

Figure 3: Smoking remains of "Las Carolinas" spa.

NOTE: It can be seen that only the metal structure -pillars and beams- and the monumental access to the spa formed by two towers are still standing. The chimney of the engine room can also be seen. The structure was finally demolished two years later. Source: Collection Constantino Suárez - Photographic Fund of the *Muséu del Pueblu d'Asturies*.

A curious fact, which deepens this issue, is that not only architects and engineers seem to have participated in the drafting of these projects, but cases can be found of projects drafted by the concessionaires themselves, of which, only in the case of Justo del Castillo, an engineer from Santander who signed his projects in 1874 and 1876, can it be said that he was in possession of the qualification that today we would call habilitating.

Therefore, the reference bases to be used for the modeling can only be the photographic images that today are preserved thanks to the work of photographers such as the Vinck family or the effort of conservation of these images carried out by the *Muséu del Pueblu d'Asturies* or the Alvargonzález Foundation.

The choice of the graphic base on which to begin the modeling is a complex matter, since at the time photographs were not taken for the mere pleasure of taking them because it was a complex and costly technical activity. In most cases they were photographs taken by professionals to be marketed in the form of postcards. This fact implies several decisive issues:

a.- The techniques used to take the image were still very primitive techniques (gelatin-bromide, albumen, autochrome, etc.), so its original resolution was very low, with a large grain as a consequence of the chemical emulsions of the time.

b.- Given that what has come down to our days are postcards, this implies three important issues:

1.- That they are very small-sized photographs and, therefore, low resolution.

2.- That in these postcards, the spa appears reduced to a mere object that serves as a frame for the main motif of the postcard, which used to be the beach of San Lorenzo or some user of the same, so it is unusual for the spa to appear in these images in its entirety.

3.- For the same reason, in most of the photographs, the spa appears in perspective and never frontal to the plane of the image, which makes it difficult to identify the different elements and to take measurements.

c.- The number of images identified in different collections reviewed, where the spa in question appears, showing some aspect that helps in the modeling is exceptionally low.

For this reason, the photograph shown in Figure 2 has been selected as the principal image for the modeling, because it is one of the few images where the spa appears complete, because a good-sized digital file has been identified, and because of its high resolution, for the standards to which we are referring.

In addition to this image, other images have obviously been used where isolated elements of the spa can be seen, and which have helped to detail the model. For example, Figure 3, has been used to correctly identify the supporting structure. Figure 4, where the bracing system of the pillars, the pillars themselves, as well as the ornamental frames of windows and doors, and even the ornamentation of the eaves of the roofs, can be seen.

Figure 4: Detail of the bracing system of the spa.

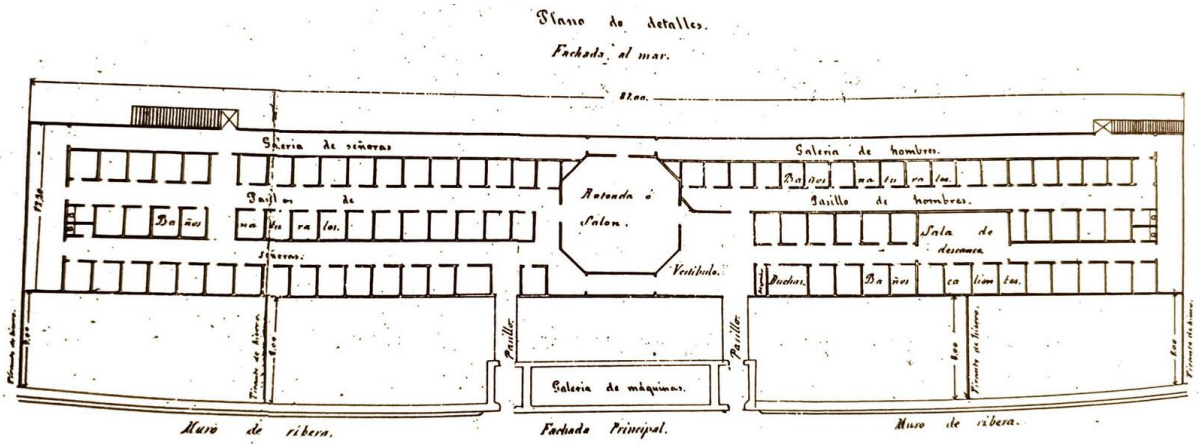
NOTE: Photograph of anonymous origin. Source: Alvargonzález Foundation Collection.

It should be clear that this work does not intend to make a dimensionally accurate model, because this is materially impossible as a result of the disappearance of the spa, nor structurally correct because the technical documentation adjusted to the reality of the construction is not available, but it is an attempt to reconstruct, as faithfully as possible, from the scarce data available, how it was, beyond what can be seen in some old sepia-colored photos, this small fragment of the history of Gijón.

But these limitations should not prevent us from trying to obtain the best possible approximations, being important to locate the corresponding technical documentation. In this sense, although there is a project, located in Madrid, specifically in the archive of the Ministry of Transport and Sustainable Mobility identified as "*Expediente promovido por D. Justo del Castillo, para construir una casa de baños de mar en Gijón. 1874-1890*", kindly located by Mr.

Héctor Blanco González, from the plans of this file published by Roza Candás (1995) it can be deduced that their precision and detail is not enough to carry out a 3D modeling (see Figure 5).

Figure 5: Spa floor plan.



NOTE: Source: Roza Candás, (1995)

In this plan, numerous inconsistencies have been identified with what is reflected in the different photographs of the time, so that only the total dimensions of the building are considered usable: 87m long and 12.30m wide.

Another very important source of information will be the project of the original pier that was executed prior to this spa and that, in spite of being destroyed by a storm, part of one of its buildings was reconverted into the building that is the object of this work, so that knowing some of its dimensions will be very useful. Thus, we have taken as valid the values of separation between the metallic pillars as well as the different heights indicated in the graphic documentation available in (Roza Candás, 1995). See Figure 6.

These dimensions have been taken on the photographs, mainly on Figure 2, in order to obtain an estimation of the dimensions of the rest of the element, by means of a proportionality factor.

For this purpose, the points between two ornamental elements that hide the rivets on the metal pillars have been taken as a measurement reference, since they have a clear punctual element where to make the measurement, also corresponding, evidently, with the distance between the pillars themselves. Three measurements have been taken on the photograph and their dispersion (D) has been calculated, being 0.08mm, as well as the percentage of dispersion (T=0.09%).

The measurements were made by printing the images on Permajet Gloss 271 photographic paper, 271gr density, using a digital caliper with a sensitivity of ±0.05mm.

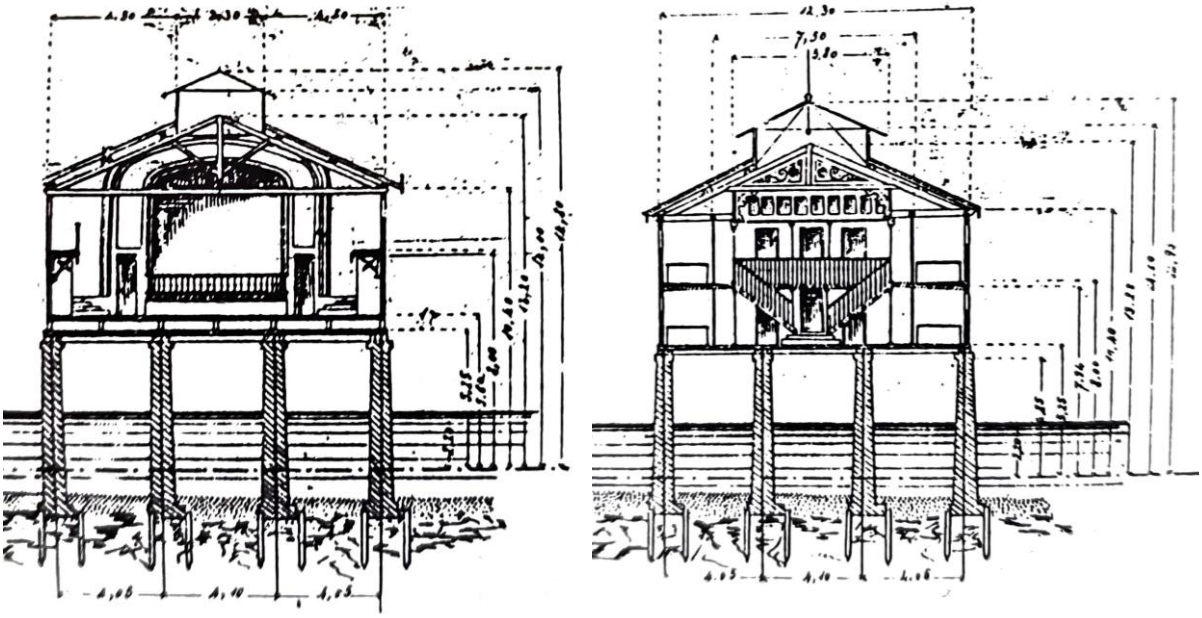
In this case, since T is less than 2%, means that the number of measurements N=3 is correct, and it can be considered that the true value is established as the arithmetic mean of the three measurements (85.59mm), and its error is equal to the sensitivity of the measuring device (±0.05mm).

Taking into account that, as shown in Figure 6, the distance measured in the photograph corresponds to 4.05m, it can be deduced that the 0.05mm of error in the measurement on the photograph corresponds to 0.23cm of error in the real building.

In addition to these two sources of information from which we have been able to obtain numerical information, we have also consulted the projects of other spas of the same period, since the construction solutions were usually common (Salinas, Luanco, Llanes, etc.), which

have allowed us to know some questions concerning the construction techniques related to these ephemeral constructions.

Figure 6: Detail of the technical documentation collected in the original project with pier typology of the building that remained standing after the storm in the winter of 1888.



NOTE: Source: (Roza Candás, 1995)

Finally, it should also be noted that in some cases, modeling was carried out according to the usual construction practices of the time, using the available documentation on them, as in the case of (Ger and Lóbez, 1898)

For the modeling of this construction, the Trimble SketchUp 3D modeling software was chosen. This is a 3D modeling program for a wide range of applications and, although it is not, strictly speaking, a BIM software, it does allow the application of the BIM methodology, being widely used to replace applications such as Autodesk Revit when facing projects where the power -and price- of Revit does not make it interesting or necessary.

Although SketchUp is a software oriented to conceptual design, it has been used in different works such as (Knock, 2024) where it is shown how the Parisian architectural firm Clé Millet has used it to restore the cinema Le Studio Raspail in Paris, built in 1932, for which they created a detailed 3D model that served as an “architectural skeleton” for the renovation. Another case is that of Brazilian architect Fábio Rakauskas, who used the software to model 14 historic buildings in São Bernardo do Campo, a city near São Paulo, in order to preserve the history of the modernist architectural movement of the 1960s. (Padoam, 2023)

3. Model development

The purpose of this work is to develop a model with a level of development where possible, and as it is logical since it is a construction that has already been executed, of LOD 500 (“*as built*” project). From LOD 400 (execution project) where it is not, never going below LOD 350 (basic project including interferences).

The scope of the modeling does not include the surroundings of the construction -San Lorenzo beach-, nor the interior of the spa, as severe inconsistencies have been identified between the

actual construction and the graphic documentation of the project. The lack of photographic information of the interior of the spa prevents even an approximate modeling.

3.1 Foundations and structure

Starting with the part of the structure that was under the sand, little is known, but it can be assimilated to what was shown in the graphic documentation of the original project with pier typology, which was destroyed by a storm.

Figure 7: Detail of the support structure modeling.

Its plans show (see Figure 5) a foundation with wooden piles on which some type of stonework sill is supported.

Continuing upwards, and in view of the photographic documentation, it can be deduced that on these wooden piles were supported, forming a matrix of 4x21, tubular cast iron pillars, braced by means of San Andrés crosses formed by metallic rounds.

On top of these piles was a structural framework that served as the base for the spa itself. In the absence of better documentation, and according to the images and construction practice, the metal beams seem to be “I” type beams, similar to the current IPE profiles, while the wooden beams were usually made of oak wood.

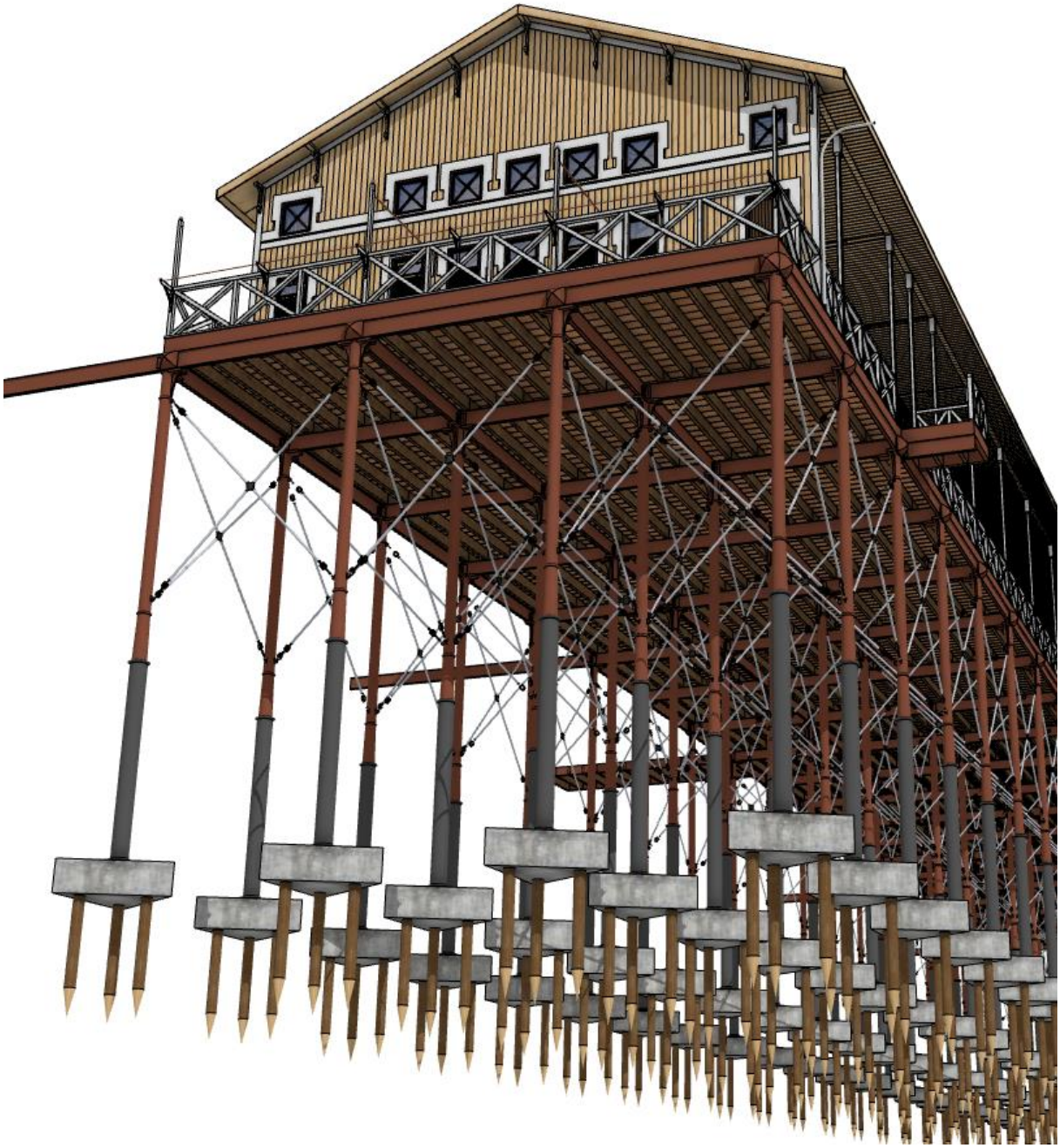
The floor, which was usually made of pine boards, not tongue and groove to facilitate the draining of water that could penetrate during the onslaught of the waves at high tide periods, was laid over this framework of metal and wooden beams.

Figure 7 shows a detail of this lattice, and Figure 8 shows the complete structure.

As for the structure of the building itself, little is known, since no photographs have been identified that show the interior of the building. But in view of the plans of other spas, such as

the Salinas spa (built by Antonio Treillard in 1916) and the Luanco spa (designed by Laureano Casalá), it can be deduced that its structure was based on “Spanish-style” wooden trusses.

Figure 8: Model of the complete support structure.



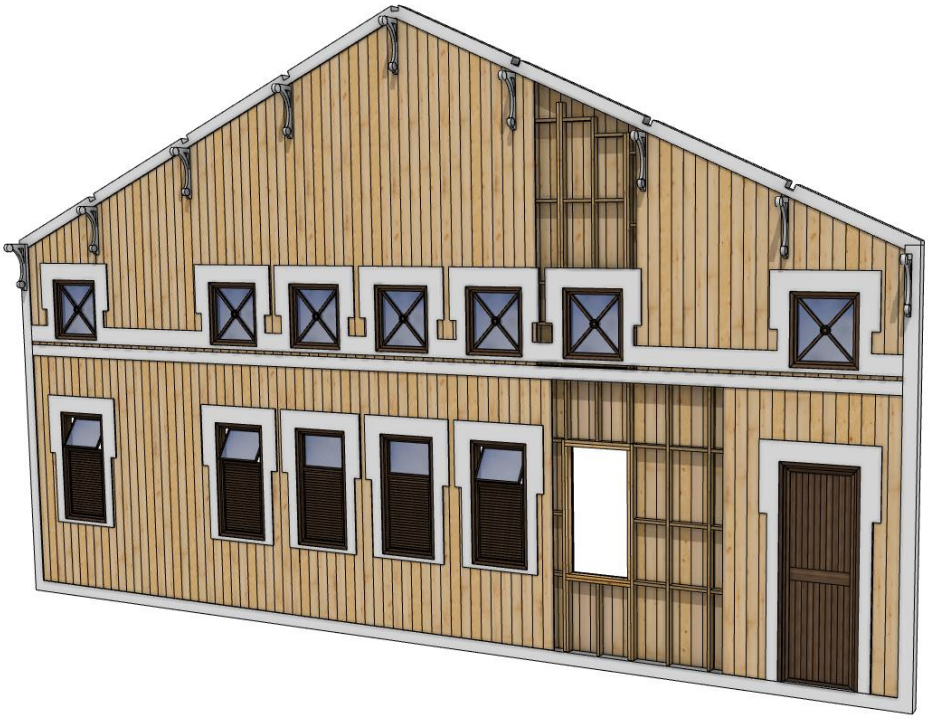
This is a very efficient solution that makes it possible to bridge relatively large spans with a very small volume of wood. Its geometry ensures that most of the elements work mainly under axial tensile and compressive forces, against which wood is known to have exceptional mechanical properties. It has been so widely used in the past and is easy to find in the roofs of old buildings.

3.2. Exterior walls and ornamentation

The exterior enclosures were made of wood (see Figure 9), using glass in the windows. The use of wood was based on the principle of economy. It should be taken into account that these

constructions were considered “ephemeral” in nature, so it was understood that it was not worth the excess investment, since it was assumed that each summer season would require reconstruction due to the onslaught of winter storms.

Figure 9: Detail of the exterior walls (east and west sides) of the spa.



NOTE: You can see how the planks are not a texture, but each plank has been modeled independently. You can see how, removing some of these planks, you can see the internal structure of the enclosure, which, despite being hidden, has also been modeled in detail.

Figure 10 shows the structure of this roof built with the aforementioned “Spanish-style” trusses.

On the other hand, the roofs were gabled, made of wood and covered with metal, being precisely this element on which the ornamentation was recharged, as well defined (Roza Candás, 1995) it was an “*epidermal decoration that was added to the structure of the building by means of hairpieces*”.

This ornamentation, which tried to attract the potential client, tried to respond to certain stylistic criteria that were very popular at the time, such as neo-Gothic and rustic, made fashionable by the Romantic aesthetic and the studies of Ruskin and Viollet and Duc (Roza Candás, 1995), with the eaves of the roofs being the places where the ornamentation was most overloaded, generally with soffits. It was also common to add pinnacles and spires to the roofs.

Another notable aspect of the ornamentation of the period was the taste for the oriental. This taste can be identified in the names of two of the spas in Gijón: “La Sultana” and “La Favorita”, but also in the spa of “La Perla” in San Sebastián“ or ”Las Delicias" in Alicante. Following this criterion, pointed or horseshoe shapes were used in the windows of the aforementioned octagonal skylight, as well as in the two towers located at the entrance to the spa, but as in other buildings, the use of this type of ornamentation was combined in an eclectic manner with other styles (neo-medieval, modernist, etc.).

Figure 11 shows this “*Mudejar*” pattern on the windows, characteristic of the oriental taste of this period. The difficulty of modeling this element was maximum due to the lack of graphic information on this octagonal skylight that covered the hall and restaurant.

Figure 10: Structure of the roof showing the "Spanish-style" trusses.

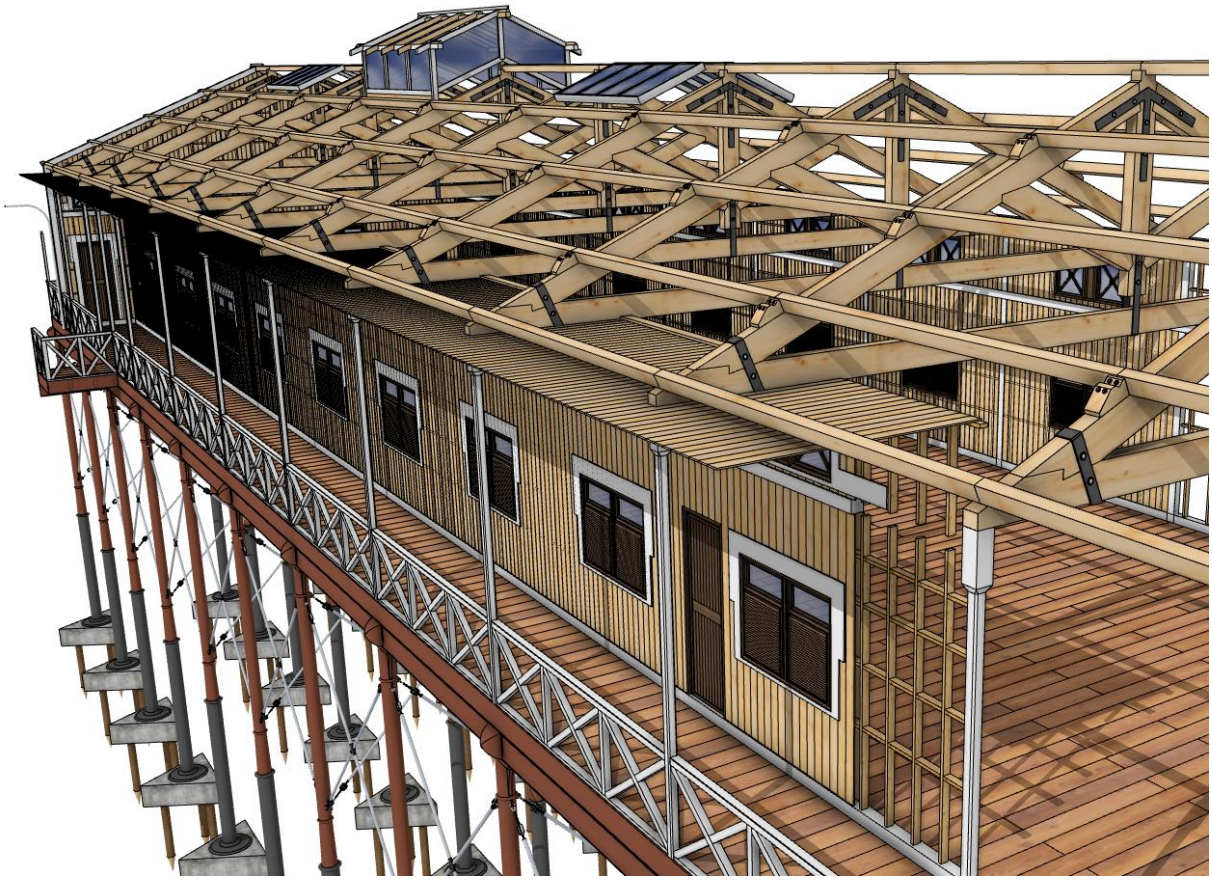
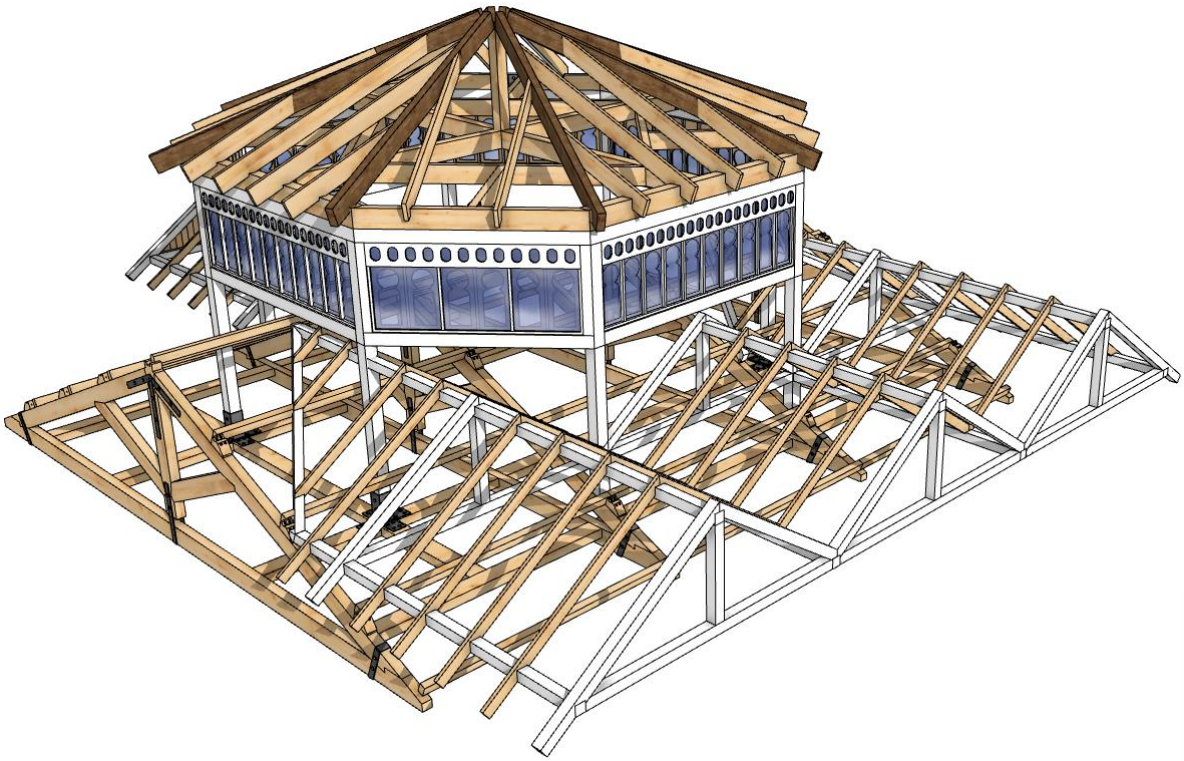


Figure 11: Detail of the octagonal skylight and its structure.



4. Conclusions

A 3D model of the spa has been obtained, which allows us to contemplate a piece of Asturian history of the first years of the 20th century as it had not been possible to see until now.

Thanks to the photographic collections, both from the Vinck family and the collections deposited in the *Muséu del Pueblu d'Asturies* of different photographers of the time (Laureano Vinck Carrió, Arturo Truán Vahamonde, Constantino Suárez, Martín Carrasco, or Pedro García Mercado among others), as well as from private collections (Vinck Family, Fernández-Villaverde Collection, or Constantino Suárez Collection), or Constantino Suárez Collection) it has been possible to carry out the model

However, but also something logical, the graphic quality of these images is very low due to the primitive techniques that these photographic painters used at that time (gelatinobromide, albumen, autochrome, etc), which prevented the definition and modeling of certain details of the construction. Attempts were made to improve the quality using AI-based tools, but the improvement was null, probably due to an inability of these tools to detect a consistent pattern in the grain that negatively affected the images, probably because of the photographic techniques used in their capture.

Within the BIM methodology a GuBIMclass classification has been tried, however it has been found that this classification is poorly adapted to a construction of this type, as it is designed for buildings constructed with other materials and with other construction techniques.

The model can be exported from SketchUp in the IFC2x3 and IFC4 standards.

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Use of generative artificial intelligence

Generative artificial intelligence has not been used in the preparation of this work.

Communication aligned with the Sustainable Development Goals