



# Chapter 167

## Typological structural features of a stucco ceiling from the early 20th century: São Bento train station in Porto (Portugal)

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### Rebecca Reis

Catholic University of Portugal Center for Research in Science and Technologies of the Arts –CITAR, Porto, Portugal; reis.leal.rebecca@gmail.com

### Martha Tavares

Catholic University of Portugal Center for Research in Science and Technologies of the Arts –CITAR, Porto, Portugal; tavares.martha@gmail.com

### Eduarda Vieira

Catholic University of Portugal Center for Research in Science and Technologies of the Arts –CITAR, Porto, Portugal; evieira@porto.ucp.pt

### João Paulo Guedes

Engineering College, CONSTRUCT, University of Porto; jguedes@fe.up.pt

### ABSTRACT

Stucco was an art considered, for many years, as a “minor art”. According to Cotrim (Cotrim, 2004), the depreciation of this decorative art resulted in the reduced number of works produced, influencing the state of degradation in which the plastered elements in old buildings are found. Still according to the same author, not long ago, adaptations of old buildings were made to accommodate offices that, for reasons of “modernization”, could not boast old decorations, so that these ceilings were hidden or, in many cases, simply destroyed. “The execution of plastered elements, following traditional techniques, constituted an artistic branch of the construction industry, whose loss of information currently makes pathological diagnosis and the choice of conservation or repair solutions difficult”. (Silveira, Veiga & Brito, 2001, p. 2)

This communication aims to present the case study of the atrium ceiling at the entrance of the São Bento train station in Porto, Portugal. Built during the end of the 19th century and opened in the beginning of the 20th century, when the value of stucco was already in decline. However, in this case, fortunately, what we find is not a technique that shows signs of depreciation, quite the contrary, the building in particular was built mixing new techniques and materials characteristic of the new century with the traditional techniques and materials of the production of the previous century, combining wood and iron, composing a mixed structure.

The investigation seeks to understand and present the constructive solutions of this ceiling, with unique characteristics, in order to disseminate them and encourage the appreciation and preservation of stuccoes and their old structures. This study is essential to understand the evolution of the structural system of stucco ceilings from the 19th to the 20th century. (Kings, 2021).

Thus, it is expected that the present work will contribute to the deepening of knowledge about these structures, of which we still lack information to properly come to preserve them, reaffirming their relevance in academic discussions. This study is part of an ongoing doctoral project at the Catholic University of Porto. Escola das Artes and CITAR, entitled Structural Typologies of Portuguese Stucco Ceilings from the 17th to the 20th Centuries.

**Keywords:** Stucco, ceilings, Structure, Constructive System, Rehabilitatin, Restoration.

## 1 INTRODUCTION

Stucco is an ancient art that reached its peak in Portugal during the 19th century, but was never really appreciated like other decorative coverings from the same period. It was still during the 19th century that the devaluation of stucco began, also leading to neglect in relation to the subject, which explains the limited production of works in this area and the scarce investments in the restoration of these decorative elements, to the point that rehabilitation interventions in old buildings, they often hide any trace of stucco, “as if it were a stigma that contemporary service spaces present old decorations.” (Cotrim, 2004, p. 1)

The works whose themes are focused on the study of Portuguese stuccoes, in general, mainly address themes focused on the coating layers and decorative motifs. From the information collected from the production of works on stucco ceilings, between the end of the 19th century and the beginning of the 20th century, what is of interest for this communication is mainly the relationship between the technological development of the time and the influence on the production of stucco. According to Silveira, “The decorative flexibility of the end of the 19th century, with its mass production, was also reflected in stucco. It has therefore become commonplace in the most common residential building to have ornamentation with plastered elements. Stucco provided greater clarity to the rooms and an idea of luxury and fashion, thus starting to decorate the salons and small rooms of society. The so-called art nouveau renovation attempt, with its exuberant decoration, once again tested the decorative capacity and creative fantasy of stucco. From the middle of the 20th century, the progressive industrialization of construction took away the importance of the elaborate ornamentation of plastered elements.” (Silveira, 2001. p.8) “Traditional stucco will, however, continue to be used to this day, either as a smooth interior coating for flat surfaces, or as crown molding or mouldings.”. (Silveira, 2001. p.9)

As far as the structure is concerned, a key point for any construction or constructive element, there is no work that addresses the supporting elements of stucco ceilings or even the influence that technological development had on these supports. However, fortunately, there are still buildings remaining from that era, which preserve the stucco ceilings. Allowing to raise surprising information. The building of the São Bento train station, located in the center of Porto, is an example of this, and its unusual features motivated the present study.

That said, the interest in this case is due to the stucco ceiling of the entrance hall of this station presenting a very unusual structure, so that its study contributes to the understanding of its structural functioning, but also to understanding the logic and technologies of the time, its evolution and the experiments carried out from the emergence of new materials and techniques. This knowledge provides historians and conservators with important information to assist in conservation and restoration interventions and contributes to filling gaps in the current state of the art in this field.

## 2 METHODOLOGY

The methodology used for this investigation includes, in a first phase, a field survey of the structure of the stucco ceiling of the São Bento train station, located in the center of Porto, Portugal. The survey consisted of drawing up sketches of the structural elements, measuring the dimensions of each element and the spacing between them, in addition to taking photos.

However, in terms of surveying the general measurements of the roof structure, we were not able to carry it out during the first phase of the research, since we did not have measuring equipment capable of determining the dimensions of a ceiling like the one at the station, with monumental proportions. It was only later, through documents from the Marques da Silva Foundation, such as blueprints of the original project, that it was possible to obtain the values referring to the general proportions of the ceiling.

Access to the station structure was made during an ongoing intervention by the company Nestor & Nestor Lda. Stucco and Decorations. The person in charge of the work, Nestor Filho, shared information about what had been observed so far, in addition to explaining the activities they were developing in the intervention. The visit, carried out by the 1st author, was quite enriching, and, together with the information shared by Mr. Nestor, allowed to develop a much richer analysis of the ceiling structure, seen as a whole.

In the second phase, archival research was carried out to remedy the information gaps in relation to what had already been found in the field during the first phase. For this purpose, research means were used, mainly digital, with one of the main sources of information being the Information System for Architectural Heritage (SIPA), an online archive managed by the General Directorate of Cultural Heritage: its inventory number is IPA. 00005559. Unfortunately, this document has little information regarding stucco ceiling cladding. Even so, some more general information about the building was obtained, such as the name of the person responsible for the station project, although they did not identify who was responsible for the stucco ceiling.

Once the collection of information in the field and in the archive was complete, a bibliographical research was carried out on the history of the station, in order to understand the scenario in which its construction took place, and to obtain new data about the structure and all its constituent elements. This collection allowed us to understand the context in which the construction is inserted and, with that, to understand certain material and structural choices made by its authors.

## 3 BRIEF DESCRIPTION OF THE BUILDING

São Bento station, in the City of Porto, was inaugurated on October 5, 1916, a project by the architect José Marques da Silva, one of the main names in architectural production in the city of Porto during the years 1896 to 1943. He acquired his architecture degree from the École nationale supérieure des Beaux-Arts in 1896, the year he returned to Portugal where he developed a large part of his portfolio with projects in the city of Porto such as: the Quatro Estações Building, in 1905, the Monument to the Heroes of the

Peninsular War, in 1909, the Teatro Nacional São João, in 1910, the Liceus Alexandre Herculano, in 1914 and Rodrigues de Freitas (formerly known as D. Manuel II), in 1933, among other great projects.

Figure 1 – Foyer of the São Bento train station in white, before the recent intervention.



The São Bento station was designed in an eclectic style, with a U-shaped plan, with French influence. The station atrium, with walls lined with 20,000 tiles by Jorge Colaço, is one of the most representative works of Portuguese tile production in the 1st half of the 20th century and in the same atrium is the stucco ceiling that is the subject of this study. essay.

“The enormous building by Marques da Silva came to occupy the site where, for almost four centuries, the female convent of São Bento de Ave-Maria was located, erected on the initiative of King D. Manuel I. The extinction of the religious orders, in 1834, came to open up the possibility that the space could have another use”. (Souza, 2016. p. 2)

The building, which has a façade in granite stonework, features volumes with 2 volumes higher on the sides, consisting of 3 floors and a lower central body, with just one floor, where the main atrium takes place. The interior space of this last body, lined with tiles, is framed by granite moldings. The ground floor floors have ceramic material and screed and the remaining floors have parquet. The walls are made of stone masonry, in some cases plastered. The supporting structure of the ceiling results from a mixture of iron and wooden supporting elements, in an unusual symbiosis. On top of this structure, there are Pratt-type trussed metal trusses (typology mainly used to span large spans of up to about 30m), autonomous in relation to the roof support structure, which receive the purlins, the slats and the ceramic covering and support the load-bearing walls. atrium masonry. As a matter of curiosity, the structure of the passenger terminal's nave is also made up of metallic elements (pillars, rafters, purlins and braces in cast iron), in this case coated on top with corrugated plates of opaque and translucent material.

Figure 2 – Photo of the lattice metallic scissors with Pratt typology on the roof of the São Bento train station.



#### 4 DESCRIPTION OF THE DECORATIVE COATING

The stucco ceiling, present in the entrance hall of São Bento station, is slightly different from a short time ago, where before the ceiling was entirely white, highlighting only the words painted in black “Douro” and “Minho”, words these are directly related to the state-owned company Caminhos de Ferro do Minho e do Douro, responsible for building and managing the railway lines. Currently, the ceiling covering is in other yellow tones in some areas. This current color is the result of a discovery made during the recent restoration work, where layers of stucco in yellow and brown colors were found.

Figure 3 – Photo of the areas with the pigments found.



According to information acquired through conversations with the specialist in stucco work Nestor Filho, yellow, in particular, is one of the most common colors found in plastered ceilings in the Minho region and, in the particular case of this building, yellow is also used. relates to the tiles, creating a contrast with most tiles in blue tone, but in common with the tiles in the range closest to the ceiling which are yellow and brown. Another very interesting information about the decoration of the ceiling, also shared by the expert, refers to the existing reliefs on the two beams that cut the ceiling and divide it into three parts. The reliefs on these beams are composed of two smaller rectangles, one at each end, followed by two circles, located a little further to the center of the beam and between them a larger rectangle. This set of geometric shapes symbolized the train, where the two smaller rectangles would be the locomotives, the larger

rectangle would be the wagon and the circles would symbolize the wheels, including a flower inside them, which was alluding to the company's symbol.

Figure 4 – Relief of the circle with the flower and the small rectangle that symbolize parts of the train.



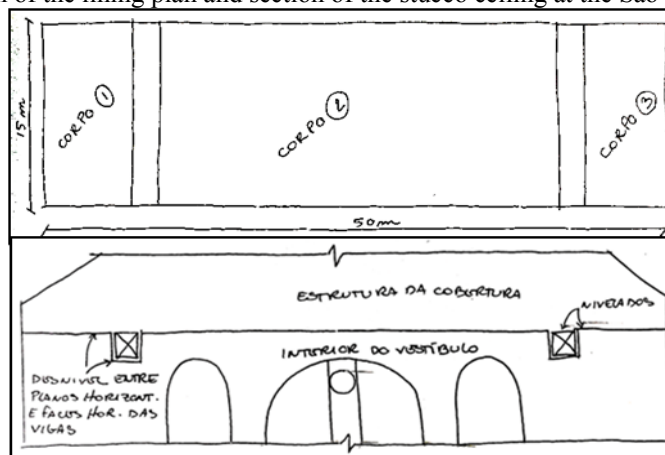
No que diz respeito à restante decoração, o teto é quite simple. In the centre, there is a finial and the words Douro and Minho are framed with friezes and volutes. In the corners, medallions occupy the space between the inner and outer frieze. In the moldings, Corinthian-style volutes are rhythmically distributed around the entire perimeter, as if alluding to the train tracks.

## 5 THE ROOF STRUCTURE

Despite the presence of moldings, the structural typology of the ceiling is not that of a ventilated ceiling, due to the absence of cranks shafts, the structural element responsible for supporting the molding in ventilated mat ceilings, which leads one to believe that the volutes present in the molding would have purely aesthetic function and the slight curve present in this area of the ceiling would be produced by the mortar itself.

The volumetry of the ceiling is divided into three parts, separated by two iron beams protruding from the level of the planes, also covered with stucco. The structure of the planes and ceiling beams is leveled on the upper, uncoated surface.

Figure 5 – Sketch of the lining plan and section of the stucco ceiling at the São Bento train station.



Despite the ceiling being volumetrically quite simple, the monumentality of its proportions (13.73m x 42.97m) requires structural reinforcement that would be difficult to achieve using only wooden elements, as was usual. The support of the station's roof lacked elements with great resistant capacity to withstand bending efforts generated by the large span without intermediate pillars, but which, at the same time, ensured the necessary lightness and rigidity in order not to add significant additional loads (weight) and guarantee both the horizontality of the ceiling and the stability of the structure.

In view of the aforementioned assumptions, the supporting structure of the ceiling presents, together with wooden elements, iron elements (plates and profiles). It is not uncommon for buildings from this era, mainly train stations, to have this type of metallic structural elements in their structure, given the capacity of this material, which, when integrated into trussed geometries, have good resistance and high rigidity, promoting safety and functionality. . What is unusual in this case is the use of both steel and wood structural elements together in the same structure.

Figure 6 – Photo of the wooden structure of the stucco ceiling of the São Bento train station.



The supporting structure of the ceiling consists of a main set of metallic elements, which receives a secondary set of wood composed of primary, secondary and counter beams, this second set is responsible for supporting the lath mat, which receives the stucco mortar. .

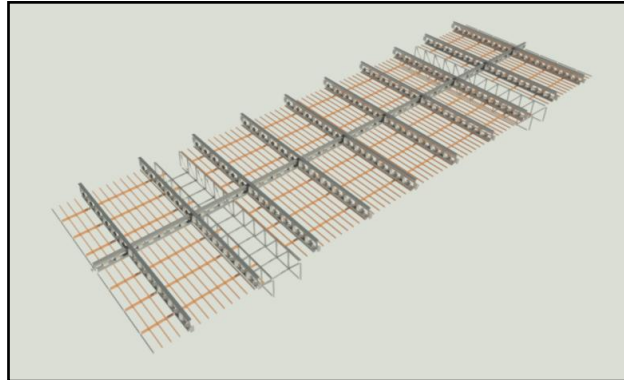
With regard to metallic elements, we find trussed beams of the first and second order and spatial trussed beams, both of the mullion composite type.

Figure 7 – Photo of the metallic structure of the stucco ceiling of the São Bento train station.



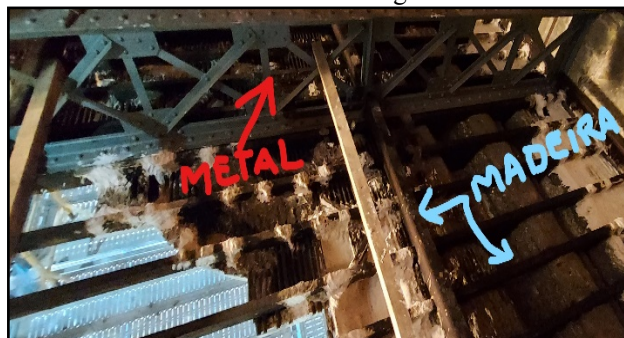
The spatial beams, which form the relief volumes that separate the three horizontal planes of the ceiling, are latticework on the lower and lateral faces, and are also of the “composed with mullions” type.

Figure 8 – 3D image of the stucco ceiling structure of the São Bento train station.



The main structure contains about ten primary trussed metallic beams, arranged in the direction of the smallest dimension (13.73m), supported by the masonry walls of the atrium. These ten beams support a large secondary trussed steel beam, centered, arranged in a transverse direction to the previous beams (42.97 m long). This beam, in the middle of the span, helps support the two spatial metallic beams, as they are positioned at a lower level than the others, so that they are not able to lean on the walls as effectively. Transverse to the main metal beams there are seven rows of wooden beams, and, transverse to these, there is another set of ninety rows of secondary wooden beams, which support the slats of the partition. Among the ninety rows of beams in the second set, there are some counter beams scattered in a not very uniform way, thus finalizing the distribution of the elements that make up the secondary wooden structure of the ceiling support. In some areas, the presence of staff boards can be observed, replacing the original partition, resulting from interventions carried out in the past.

Figure 9 – Photo identifying metallic elements and wooden elements together on the stucco ceiling of the São Bento train station.



Between the fasquium and the embossed decorative elements, sisal was found mixed with the mass, which is already known to be a common practice. But, in addition to sisal, wire strands and a metallic mesh were also found, used mainly in the so-called strong mass ceilings (ceilings that, like the crate mat, fall into the category of special mats because they are unusual) (Costa, 1955).



Figure 10 – Photo of the metallic mesh found between the lath and the cladding layers on the ceiling of the São Bento train station.



Figure 11 – Photo of the wires on the roof of the São Bento train station.



## 6 CONSERVATION STATUS OF THE STRUCTURE

A estrutura, como um todo, apresenta um estado of exceptional conservation, bearing in mind that construction was completed at the beginning of the 20th century. According to the company responsible for the last intervention, only in some points of the ceiling, where, due to infiltrations in the roof, they detected the presence of humidity, which led to the rotting of some slats, as well as the development of fungi and xylophagous insects in those areas, where the wood was more fragile.

In the first intervention carried out on the roof of the atrium of the station, the fasquium was intervened and even changed by staff plates in some areas. Recently, areas where damage has been identified have been treated using the original technique. The remaining structural elements of the support remain original, without showing any signs of oxidation of the metallic elements or gables on the long beams, nor can one notice great fragility in the wood resulting from humidity or attacks by xylophagous insects, despite the infiltration points that were recently treated. Such preservation of the original wooden structural elements is due to the quality of the wood used, since the northern region has a history of excellent quality wood, but also due to good planning and good quality of execution of the original work.

It should also be noted that the use of the building as a train station and the proximity to areas of intense traffic, not just people, but mainly cars and buses, indicate how well this project was thought out and executed, persisting intact despite the shakes and vibrations induced in the building. Unfortunately, the coating itself ends up suffering, in some way, from these vibrations, so that some cracks were found in the coating. In addition to vibration, pollution from means of transport also affects this coating, requiring interventions from time to time to remedy any damage that may appear. In addition, the structure also needs minor interventions, such as painting to protect the metallic elements, cleaning, which was one of the main

focuses of this last intervention given the accumulation of dirt on the ceiling structure and investigation of the state of the woods, with the application of protective products when needed.

## 7 CONCLUSION

As already mentioned, due to the devaluation of stucco during the 19th century, academic production focused on this type of coating, in general, but mainly on stucco structures, is practically non-existent. In this way, a lack is identified and, therefore, a niche full of interesting information to be discovered, such as the case presented on the atrium ceiling of the São Bento train station.

According to Silveira (Silveira 2001), it is precisely due to the technological development, which took place during the 19th century, that stucco coatings became less handcrafted and more industrial, which led to an increase in production, becoming an ordinary decorative coating. That said, it is curious to realize that development, also defined in the dictionary as “progress”, was not as positive as this word usually leads one to believe, at least in terms of the value attributed to the art of plastered coverings.

However, still with regard to the history of stucco development, it is during this same period that an improvement can be noted in the supports of these decorative coverings, through optimizations such as the use of wooden beams of rectangular section, which will have reduced the area to beam volumetry and consequently the amount of load it could support, but it brought a standardization of the parts and the improvement of the connection between the different structural elements. Aside from the change in the cut of the wooden structural elements, there was also the use of new materials, such as iron, a material so versatile that it showed excellent adaptation even in mixed structures, such as the one we were able to study in the case of the São Bento station, whose The state of preservation of the ceiling support is almost immaculate. Therefore, the technological advance identified in the support of the stucco lining of the São Bento train station, which also presents several industrial aspects, demonstrated a positive evolution, where the changes undergone brought excellent attributes within the structural function, which directly influence the preservation of the roof as a whole.

Figure 12 – Wooden elements in rectangular cut and use of new materials, present in the structure of the stucco ceiling of the São Bento station.



The information acquired from the study of the constructive system of the roof of the São Bento station, in particular, but also the development of research focused on this area of knowledge, that is, on stucco ceiling supports, in general, is, undoubtedly of great importance for the preservation of this decorative art.

Studying these structures, in addition to contributing to safeguarding historical knowledge and understanding development, allows a better understanding of the support itself and the logic behind its construction, which, in the case of São Bento station, made use of structural elements with great bearing capacity to withstand loads and span spans. The combination of materials and techniques, where the new and the old came together bringing their best qualities, allowed the construction of a ceiling whose monumental span to overcome does not undermine the structure, which takes advantage of the physical properties of the drawings and the positioning of each structural element. , in order to guarantee its stability and preservation for decades.

It is precisely through the knowledge acquired from the study of remaining cases of stucco ceilings that it is possible to contribute to the conservation and restoration of this type of decorative coating. But such information serves more purposes than just the preservation of our history, as it is the fuel for the development of new ideas, both in terms of restoration interventions that demand some creativity to use new materials and recent techniques in communion with the old ones. , but also as a source of inspiration for new types of structure, encouraging new possibilities with mixtures of materials, bearing in mind existing examples that show excellent results over the years.

Therefore, this article aims to provide a first overview of the study of plastered ceiling structures. It is intended to continue the research, through the survey of other case studies, also built in the city of Porto, in different centuries and with different uses, in order to compare various supports and better understand the proposal of each one, as well as the development technology over the centuries. Likewise, it is expected to stimulate the interest of the scientific community on the subject, not only to develop similar research in other areas of Portugal and the world, but also to deepen, more and more, the knowledge about stucco coatings, such an ancient and rich art whose importance deserves to be recognized and its heritage preserved.

#### **ACKNOWLEDGMENT**

Nestor &Nestor Lda. Estuques e Ornatações

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