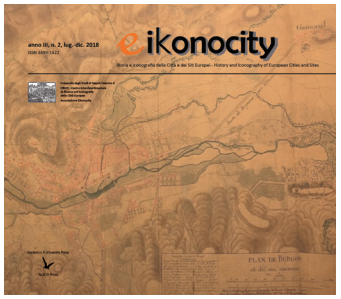

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History and iconography in the architectural work of the Galli Bibiena

From the Nancy Opera House to the Lisbon Royal Opera House of Tagus, towards a three-dimensional reconstruction methodology

Eduardo Durão Antunes, Pedro Gomes Januário Universidade de Lisboa - Lisbon School of Architecture

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History and iconography in the architectural work of the Galli Bibiena

From the Nancy Opera House to the Lisbon Royal Opera House of Tagus, towards a three-dimensional reconstruction methodology

Eduardo Durão Antunes, Pedro Gomes Januário Universidade de Lisboa - Lisbon School of Architecture

Abstract

Known as one of the most important families of architects and stage designers of the eighteenth century, the Galli Bibiena family worked for the main European courts, where they earned international notoriety. This paper aims to present a series of analyses made between the Nancy Royal Opera House (1709) and the Lisbon Royal Opera House of Tagus (1755), to deepen the current knowledge of these two buildings, regarding their use of proportion and a set of elements in the formation of a common morphological iconography, towards a methodology for the obtaining and validation of buildings' 3D reconstruction proposals.

Storia e iconografia nell'opera architettonica del Galli Bibiena. Dall'Opera di Nancy all'Opera del Tago, verso una metodologia di ricostruzione tridimensionale

Conosciuta come una delle famiglie più importanti di architetti e scenografi del XVIII secolo, la famiglia Galli Bibiena ha lavorato per le principali corti europee, dove ha guadagnato notorietà internazionale. Questo lavoro presenta le analisi fatte tra l'Opera di Nancy (1709) e l'Opera del Tago (1755), per approfondirne l'attuale conoscenza sia riguardo l'uso delle proporzioni sia per la formazione di un'iconografia morfologica comune, proponendo la sperimentazione di una metodologia per l'ottenimento e la convalida delle proposte di ricostruzione 3D degli edifici.

Keywords: Galli Bibiena, Iconography, 3D Reconstruction.
Galli Bibiena, Iconografia, Ricostruzione 3D.

Eduardo Durão Antunes has a Master's Degree in Architecture from the Lisbon School of Architecture since 2015. Currently, he's a research fellow at Sustenta – Laboratory for Sustainable Design (CIAUD), where he has participated in research projects and activities on "sustainable design".
Pedro Gomes Januário is a professor at the Lisbon School of Architecture since 1994, in the area of Visual Communication, having taught within the Geometry and Computation scope. He has also a PhD Degree in Architecture from the Superior Technical School of Architecture of Madrid since 2008.

Authors: eduardoantunes.ciaud@fa.ulisboa.pt, januario@fa.ulisboa.pt

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1 | Introduction: The Galli Bibiena

Considered internationally as one of the most important dynasties of architects and scenographers of the baroque era [Lenzi 1997, 11], the Galli Bibiena family originated from the Tuscan locality of Bibiena, having settled in Bologna in 1628 [Lenzi 2000, 20]. Ferdinando Galli Bibiena (1657-1741), described in a manuscript entitled "*Memoria della ñ[ost]ra Casa* (...)", the origins of his family [BCA.Bo, *Manuscritti e Rari*, Ms B.35, fl. 229v; *Cf.* Januário 2008, Vol.II, Doc. 75]. In this document, he identified the origin of his family while explaining the reason for the epithet, Bibiena, acquired by his father during his stay in the workshop of Francesco Albani (1578-1660). From the numerous offspring of Giovanni Maria Galli, *detto il Bibiena* (1618-1665), stood out Maria Orliana (1655/6-1749) as an excellent painter, and Ferdinando Galli Bibiena, as well as Francesco Galli Bibiena (1659-1739), as the founders of a dynasty of quadrat painters, architects, set designers, and academics. From Ferdinando's descendants, Alessandro (1686-1748), Giovanni Maria Fabiano (1693-1777), Giuseppe (1695-1757), and António Luigi (1697-1774) accompanied his father in artistic careers, particularly as civil architects and set designers. On the other hand, from Francesco's descendants, only his son Giovanni Carlo Sicinio (1717-1760) followed the artistic path as an architect and set designer. However, it was Giuseppe's bloodline that continued spreading the name Galli Bibiena by the main European courts in the second half of the XVIII century and first half of the XIX century, particularly Carlo Bernardo (1721-1787), Ferdinando António (1727-1788), and finally his grandson Filippo (1765-1842) [Lenzi 2000, *passim*].

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2 | The Nancy Opera House

Leopold I, Duke of Lorraine, invited Francesco Galli Bibiena to idealize and design the Nancy Opera House. The theatre was built between April 1708 and November 1709. It is interesting to see that the Duke resorted to an Italian architect, which might have been due to the success of his previous project for the Grosses Hoftheater in Vienna, according to Myers [1975, 15]. Or due to the presence of the Desmarest court (1661-1741) which had been called in 1707 to reorganize operatic and musical services, according to Deana Lenzi [1979, 111]. It is also pointed out that there would be a need to face Versailles and its court theater. And that the Duke would have opted for the "great Italian specialist", Francesco, who had recently achieved great success at the Vienna court [ibid], despite this taste being to the liking of the Duchess, Elisabeth-Charlotte d'Orléans [Antoine 1965, 2].

Although Leopold I of Lorraine initially chose to distance himself from the War of Spanish Succession, a conflict between the Bourbons and Habsburgs houses. Leopold decided to opt for a position of neutrality and was forced to transfer his court to Lunéville during the invasion of Nancy in 1709 by the troops of King Louis XIV, not being able to watch the inauguration of his opera house that same year. Five years later, the duke and his court returned to the city, but without additional financial means, he couldn't provide the theater with more performances. Thus, after several re-utilizations of the building for various purposes during the War of Austrian Succession between 1740 and 1748, the theater was destroyed in the year 1818 [Antoine 1965, 2-3; Myers 1975, 15; Lenzi 1979, 111].

About the Nancy Opera House, four sets of drawings are known: the first existing in Nancy, at the *Musée Lorrain*, corresponding to the proscenium, the longitudinal section and the ceiling plan [Lenzi 1979, *Cf.* Antoine 1965, 7, fig. 2, 4, 6]; the second set existing in Lisbon, in the National Museum of Ancient Art, and consisted of the drawings of the project actually built, according to Lenzi [1979, 111; *Cf.* Antoine 1965, 7, fig. 3]; the third set in Paris, at the *Musée du Louvre*, similar to the drawings in Lisbon, according to Lenzi [1979, 111; *Cf.* Antoine 1965, 6]; and the fourth and final set existing in New York at the Metropolitan Museum, with inventory no. 1972.713.61 (longitudinal section, floor plan of the audience and stage) and no. 1972.713.60 (theater plan, cross-section by the proscenium and the royal stateroom, and ceiling plan), according to Lenzi [1979, 111; Myers 1975, 14-16].

Antoine [1965], Myers [1975, 15] and Lenzi [1979, 111] agree that the drawings existing in Nancy are indeed a first version designed by Francesco. While the drawings in Lisbon correspond to the built project, the ones existing in Paris could be copies delineated by Francesco's workshop collaborators, based on the Lisbon drawings. Concerning the New York drawings, Mary Myers points out: the difference suggests that our drawings [from NY] were made on completion of the building in November 1709. With that in mind, the variation between the Lisbon sheet and ours in the details of the treatment of the strapwork railings of the boxes suggests that ours represents the final version as erected. [1975, 15]. Therefore, the latter were the ones used in the latest study.

3 | The Lisbon Royal Opera House of Tagus

In 1750, after a long agony, King John V of Portugal died, and with him his particular vision of cultural politics. In May 1743, when the monarch was affected by hemiparesis, it triggered a process of successive restrictions on almost all entertainments. Both in court and in theaters, prohibiting even the performance of private dances, the only legally exception being the liturgical ceremonies [Brito 1989, 11; Januário 2008, Vol.I, 450].

The sense and opportunity to materialize this desire for change was made possible with King Joseph I of Portugal. This desire is also shared by most of the court, foreign merchants residing in Lisbon, and the theater business. With this cultural metamorphosis, the new monarch aimed to transport to the leading European courts and circuit of operatic representations. Thus, emphasizing a separation of his kingdom regarding his father's legacy. Despite that, he still relied on the complex diplomatic network created by his predecessor at the time of the *Igreja Patriarcal* creation [Januário 2008, I, 450-451].

In virtue of the wealth provided by the Brazilian gold mines, the king did not spare any expenses regarding his cultural policy. So, he hired the best artists to gather a worldwide company, and to build, for the first time in Portugal, a court theater destined to receive the Italian opera and all the technological and artistic apparatus associated with it [Januário 2008, Vol. I, 452]. Thus, not one but three theaters were erected between February 1752 and March 1755: the *Teatro do Forte dos Embaixadores* (September 12th, 1752), the Royal Theater of *Salvaterra de Magos* (January 21st, 1753), and the Lisbon Royal Opera House of Tagus (March 31st, 1755), all designed by Giovanni Carlo Sicinio Galli Bibiena [Januário 2008, Vol. I, 84-87].

However, the attention of the king and court was centered on the latter, the *Casa da Ópera* (as it was designated) or Ópera do Tejo (as it is nowadays called, due to its proximity to the Tagus river). It began being built on July 7th, 1752, by the society of master masons Manoel Antunes Feyo, Manoel Francisco de Souza and partners, being João Pedro Ludovice the king's representative, and Estevão Pinto de Moraes the Royal Works Pointer. The carpentry work was made by Félix Vicente de Almeida, having begun in August of 1753. The building was composed of three volumes: one for the audience room, another for the stage, and a third for the outhouses. Located in the west continuation of the *Paço da Ribeira* Royal Palace (next to the present *Arsenal da Marinha*), the palace and the theater were connected by a richly ornamented stone walkway. The bell-shaped room had the capacity for 350 people in the audience and was organized in 38 cabins, hierarchized in 4 levels [Januário 2008, I, 301-302]. The theater was inaugurated on March 31st, 1755, on the occasion of the Queen's birthday, with the opera *Alessandro nell'Indie*, with music by David Perez and lyrics by Pietro Metastassio [Januário 2008, I, 540-557; Januário 2008, II, doc. 376].

The various references to the grandeur of the theater are unanimous in the exaltation of its decorative splendor, as well as the brilliance of the spectacle itself, as can be seen in the news given by Gerard des Vismes [Januário 2008, II, doc.378]. It is also remarkable that today still exists a ticket on the opening of this opera, definitively validating the discussion about the opening date [Januário e Gallash-Hall 2009, 252-253, 268].

However, the life of this theater would be ephemeral, being reduced to rubble by the earthquake on November 1st, 1755, being its memory perpetuated in one of the engravings of Le Bas on the ruins of Lisbon.

> as nãos à direita, mas achei a passagem ulterior que conduzia à rua principal, entulhada com as ruínas do Theatro, um dos mais sólidos, mais magníficos edifícios deste género na Europa, e que vinha de acabar-se com uma prodogiosa ddeste lugar [Largo do Corpo Santo] eu voltei para traz a buscar a rua que condozia para o Paço real ficando-me a Ribeira despeza. O aspecto de suas ruínas, desenhadas à vista accompanha esta narração [Januário 2008, I, 599, 226]. Um vasto montão de grandes pedras, cada uma das quaes de pezo de muitas dezenas de quintaes havia entulhado inteiramente a frente da magnifica casa de Mr. Bristow, que ficava defronte do dito [*Jornal encyclopedico* 1837, 54; Januário 2008, I, 593].

Fig. 1: Francesco Galli Bibiena, 1709. *Longitudinal section and floor plan of the audience and stage of the Nancy Opera House and cross-section by the proscenium and the royal stateroom, theater plan, and ceiling plan of the Nancy Opera House.* Dim.: 41.3 x 51.3 cm / 41.8 x 52.4 cm. Metropolitan Museum of New York, New York, Inv. no 1972. 713.61 / 713.60.

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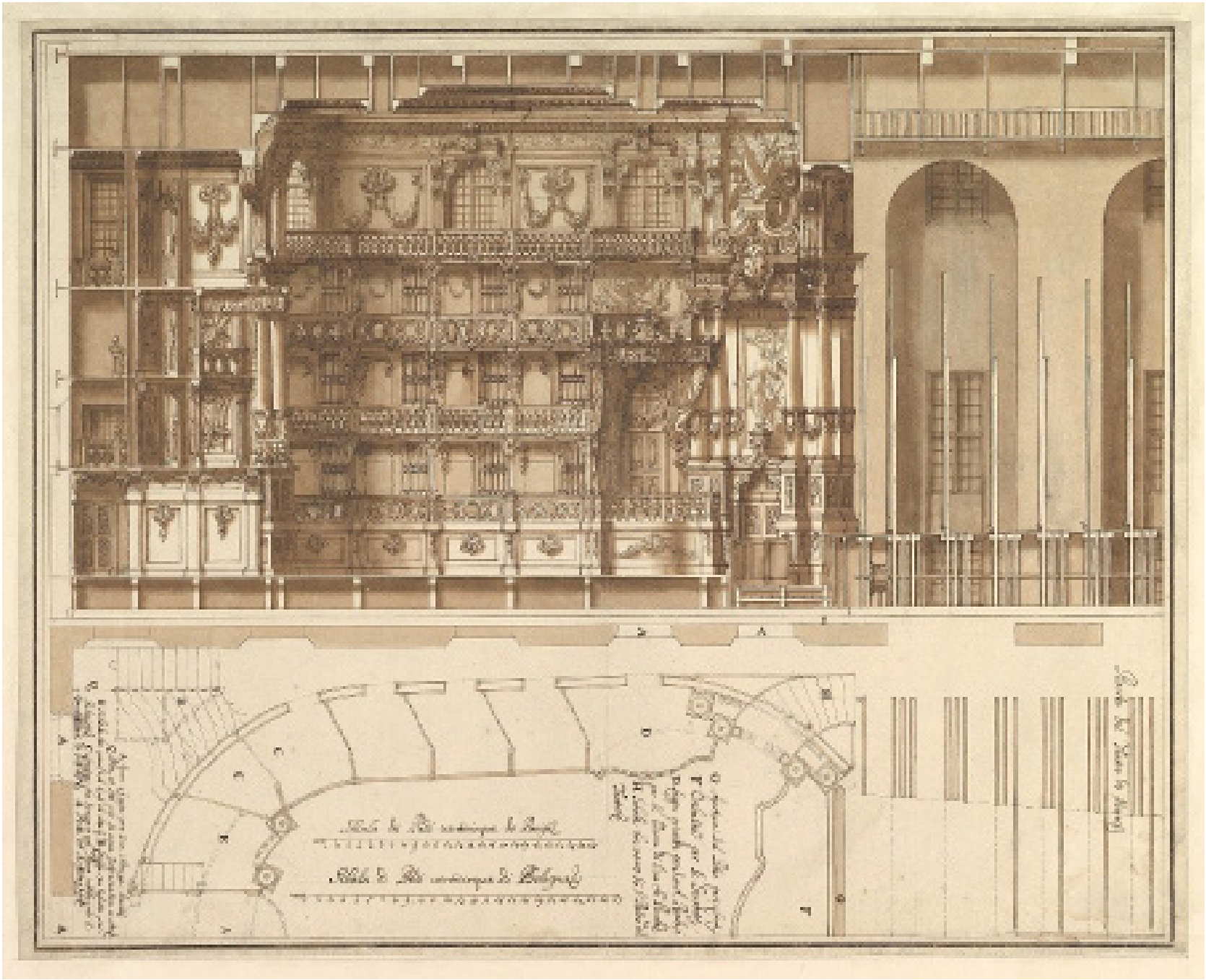

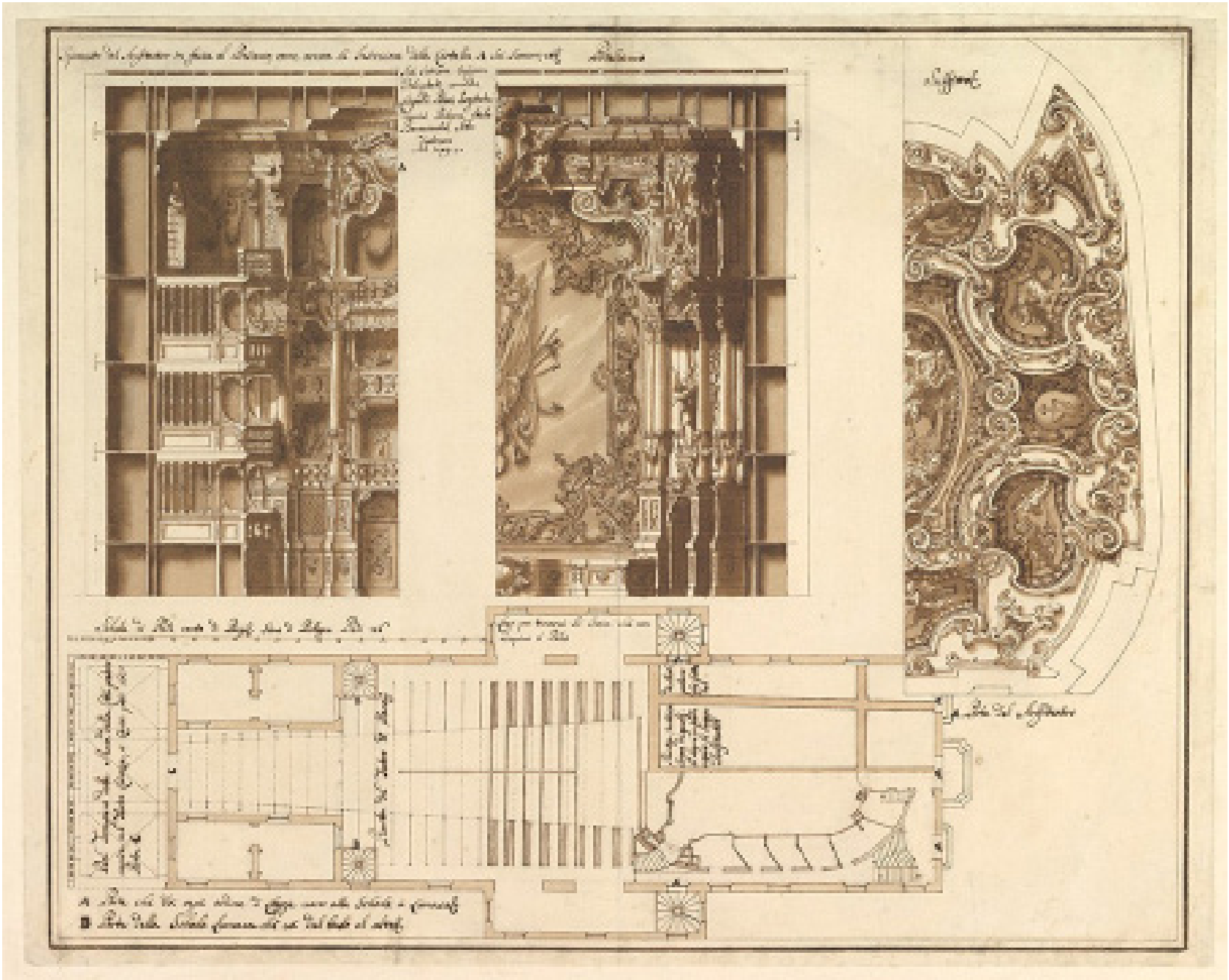

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3.1 Social and urban context

The Lisbon Royal Opera House of Tagus was intended to be a landmark, mirroring the policy that King Joseph I intended to establish, and therefore its project (conceived as a court theater, for personal use by the king and his court), as well as its location, ought to be unique. Thus, the Tagus Opera House was constructed as a continuation of a royal palace section called *Quartinho Novo* (built in the reign of King John V), as a way to associate his taste for music to his reign, and to keep attached to the King's Palace the theatre that would become the most famous representation stage in the country. The theater had an access through a large hall, preceded by a gallery, which was in front of the Patriarchal Church (located north).

> O snr. Rei D. João V acrescentou outro quarto a este palácio: é o que fica no largo da Patriarcal e corre até ao theatro da opera. […] Dous lanços d'este quarto abrem para o largo da Patriarchal, e em meio de cada um avulta um pórtico grandioso, levantado em grossas columnas marmoreadas, com capitéis corinthios,. Para o lado do theatro da opera forma este quarto uma quadra pequena com sumptuosas galerias, para a qual se entra por um grande vestíbulo fronteiro á Patriarcal; mas a serventia ou passagem para o theatro é a mais arrogante e magestatica obra de Lisboa. [Castelo-Branco 1874, 28-34].

The theater extended westward parallel to the river, from the *Beco da Fundição* to the *Arco do Ouro*, and for its construction, the *Oura* door of the *Muralha Fernandina* had to be destroyed.

Fig. 2: Jacques le Bas, 1757. *Engraving part of the "Collecção de algumas ruínas de Lisboa causadas pelo Terremoto e pelo fogo do primeiro de Novemb.ro de 1755", entitled "Casa da Ópera".* Dim.: 56.0 x 40.0 cm. Biblioteca Nacional, Lisboa, Iconografia, E.A. 352 A, n.º 4.

In the *Torre do Tombo* National Archive, the registered theater lenght is of 108 *varas*, 4 spans and $^{4}/_{10}$ (equivalent to 119,768 meters). It isn't known, however, whether this measure would include the remaining premises of the royal palace [Januário 2008, I, 101]. The theater's location in front of the Patriarchal Church can be seen as a formalized way for King Joseph I to distance himself from his father's references and from the liturgical festivities that were the public focus (whose setting for many of them was the Patriarchal Church), and with it, to depart from the influence of the Church. Thus, this would be the ideal place for the representation of his reign and the rhetorical display of a strong image of the court, looking for an action strategy that privileged the Italian opera spectacle, recognized in the main European courts [Brito 1987, 30].
Nevertheless, after the 1755 Lisbon earthquake, the theater was never rebuilt. This may have well been due to the mercantilist transformation of the society, either in the framework of the Age of Enlightenment, or in the framework of a gradual socio-cultural and economic reform, that involved the city's private and strongest corporations' participation in the city's reconstruction [Brito 1987, 35]. This also led to the symbolic transformation of the *Terreiro do Paço* square into *Praça do Comércio*, changing its "open" and informal character in a ritualized and ruled square, like the great squares of the Enlightenment urbanism (the monarch's equestrian statue became, even if belatedly, the definitive sign of this transformation into a presentiment space of power through its monumentalization rather than through ephemeral events).
In this sense, it can be understood that the Tagus Opera House, as well as the Patriarcal Church, were never rebuilt since they expressed a clear conception of the state in both its profane and religious facets. Although following the idea of a real absolutist power, this conception was less important for the statement of a state policy with the predominance of politics over religion, conducted with authoritarianism by Sebastião José de Carvalho and Melo, Marquis of Pombal. The vicissitudes of the urgency for the city's reconstruction would lead to the almost total dissipation of the musical culture that King Joseph I tried to establish in Lisbon with the Tagus Opera House, having only resumed as of 1763, although ever so modestly.

4 | Background

Compared to the four sets of drawings concerning to the theater of the Nancy Opera House, in the case of the Lisbon Royal Opera House of Tagus there are only two sets of drawings: a first set revealed by José de Figueiredo in 1933, consisting of three elements: a caption for all drawings, a lower floor structural plan, and a longitudinal structural section, located in loose folios, in an (at the time) unidentified folder, at the *Academia Nacional de Belas Artes* in Lisbon - ANBA.Lx; a second set, attributed by Januário to this theater in 2008 [I, 667-736] consisting of two elements located in the Drawing Office of the National Museum of Ancient Art in Lisbon (MNAA.Lx), with the inventories no. 1696 (longitudinal section) and no. 1670 (plan by the royal gallery); and two other elements in a collection entitled *Desenhos de Arquitecturas, Plantas de Obras em Lisboa e Rio de Janeiro*, existing in the Iconographies Section, at the National Library of Brazil in Rio de Janeiro (BN.RJ), in the folios no. 91 (ceiling plan and its ornamentation, and transversal section by the proscenium) and no. 110 (plans by the audience, 2nd and 3rd order).

4.1 Model according to Figueiredo

Since the disappearance of the Lisbon Royal Opera House of Tagus with the earthquake that several authors refer to its relevance in the Portuguese cultural and architectural panorama. António de Sousa Bastos, in his compendium on Portuguese theaters, states that:

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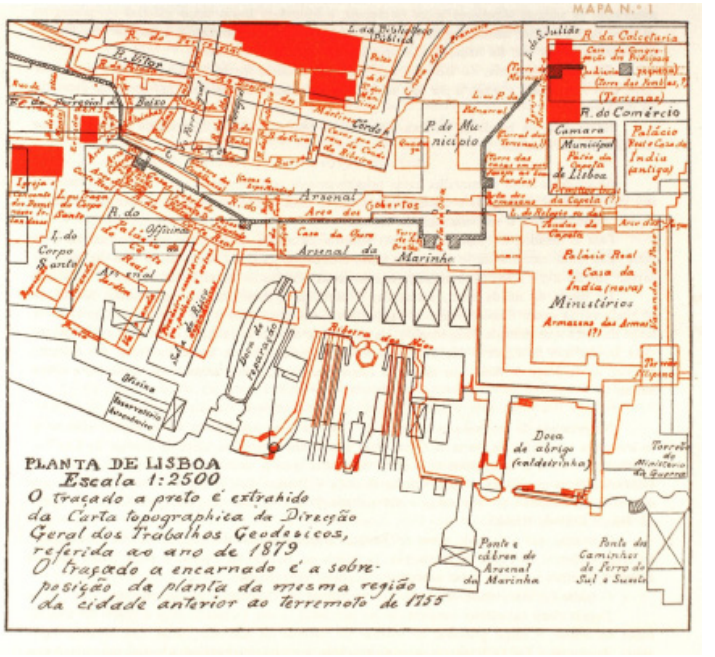
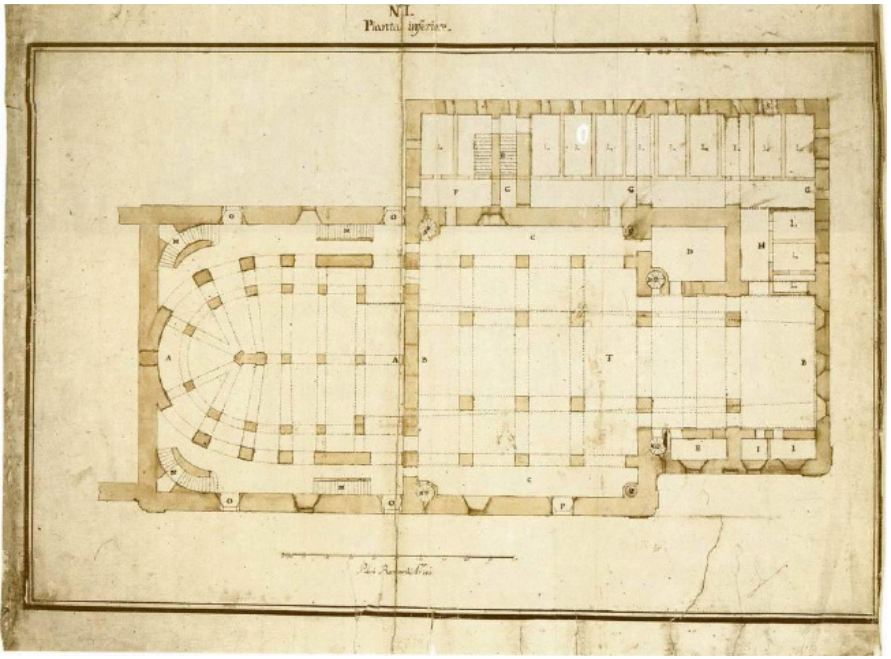
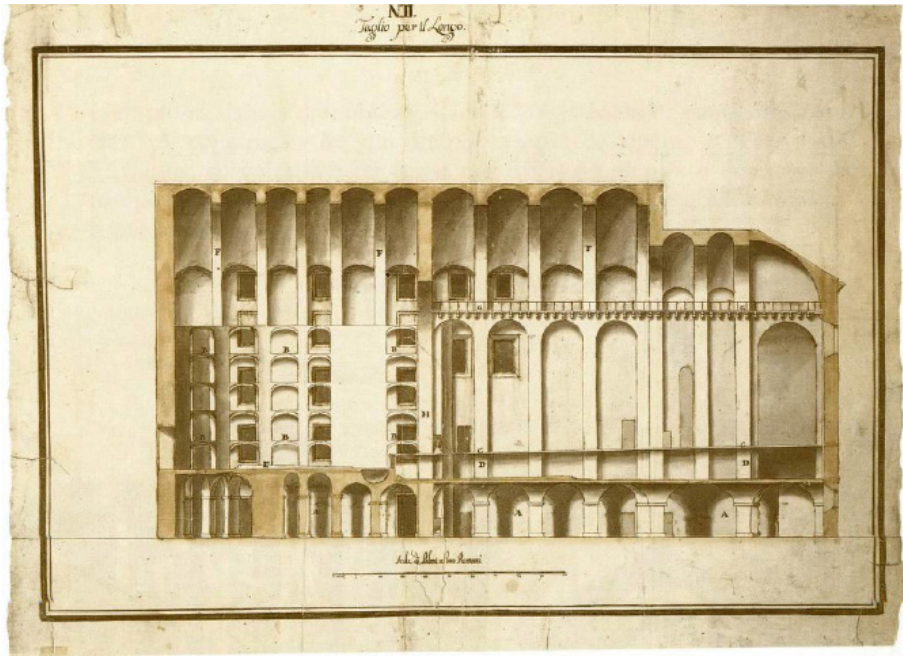
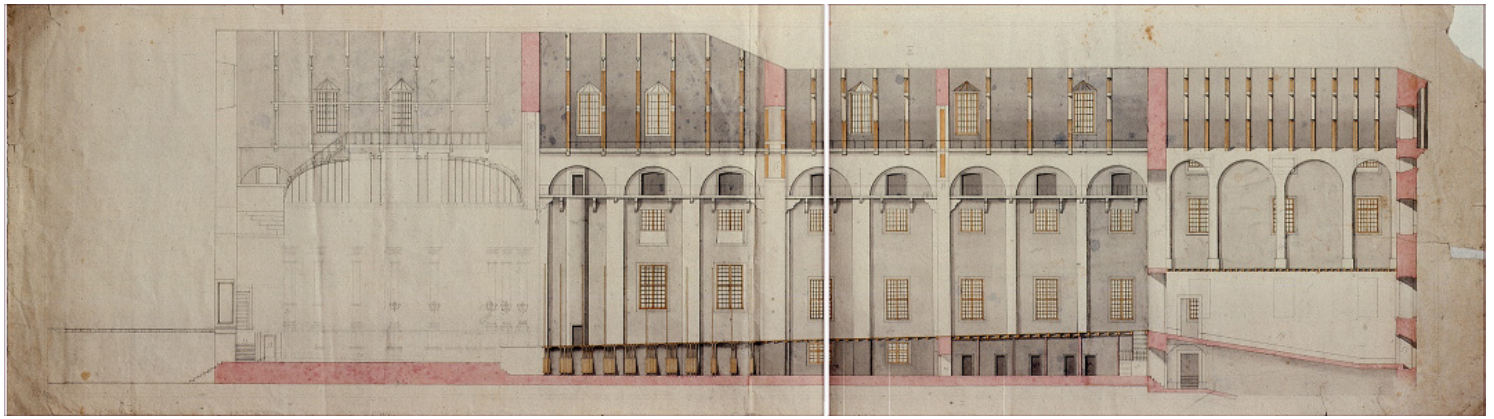


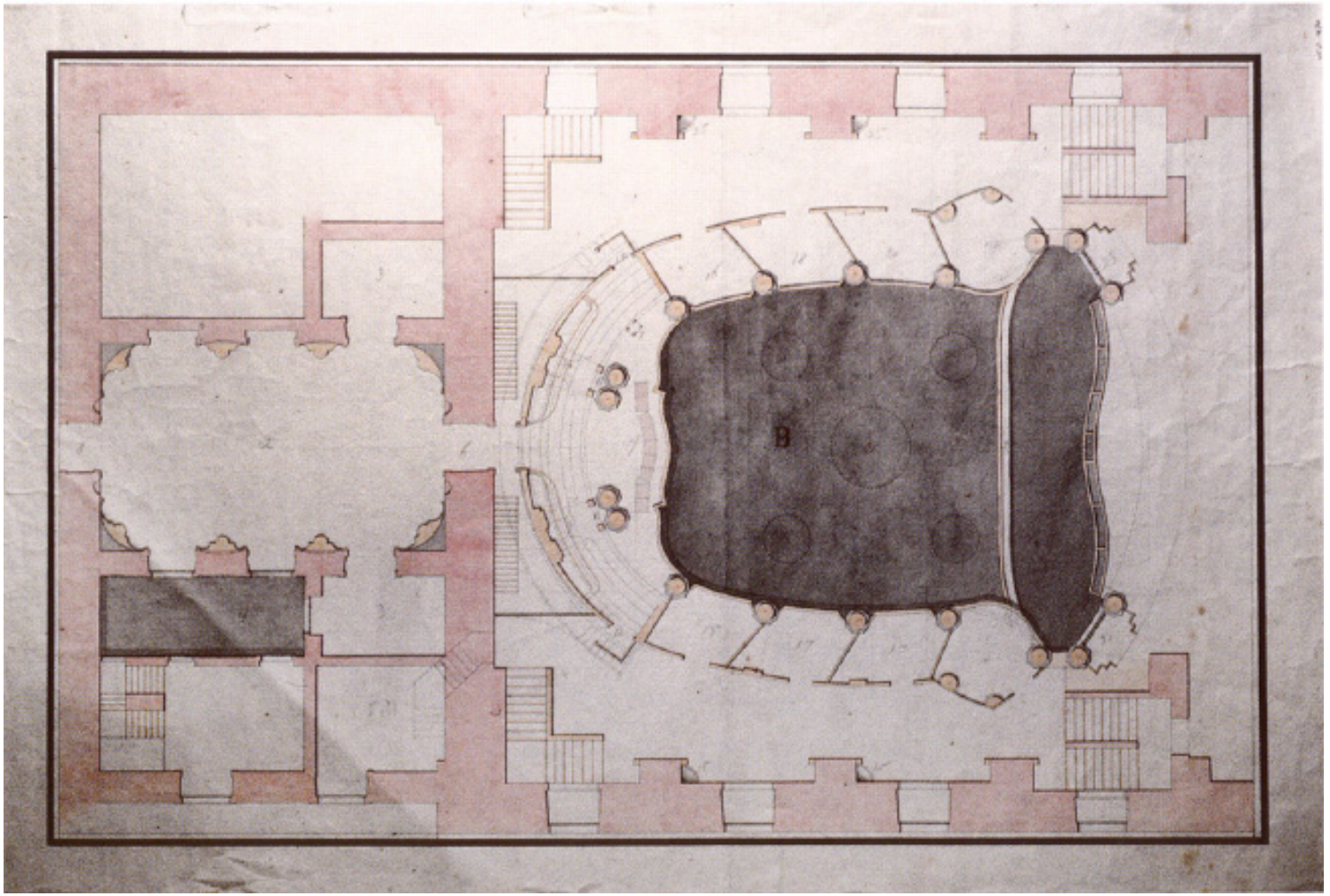
Fig. 3: Augusto Silva, 1949. *Study plan based on the Topographical Chart of the General Directorate of Geodetic Works of 1879, superimposed in red by the urban layout prior to the 1755 Lisbon earthquake.*

Fig. 4: Giovanni Carlo Sicinio galli Bibiena, 1752-1755. *Lower floor structural plan (top) and longitudinal section through the structure of the theater (bottom).* Dim.: 45,2x60,8cm. ANBA.Lx, Reservados, [s.n.].


N°I.
Pianta inferiore.


N°II.
Taglio per il Longo.

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> Não havia em toda a Europa theatro de taes dimensões e tão fabulosa riqueza […] esta monumental obra […] não tinha rival em todo o mundo [Sousa Bastos 1908, 310-311].

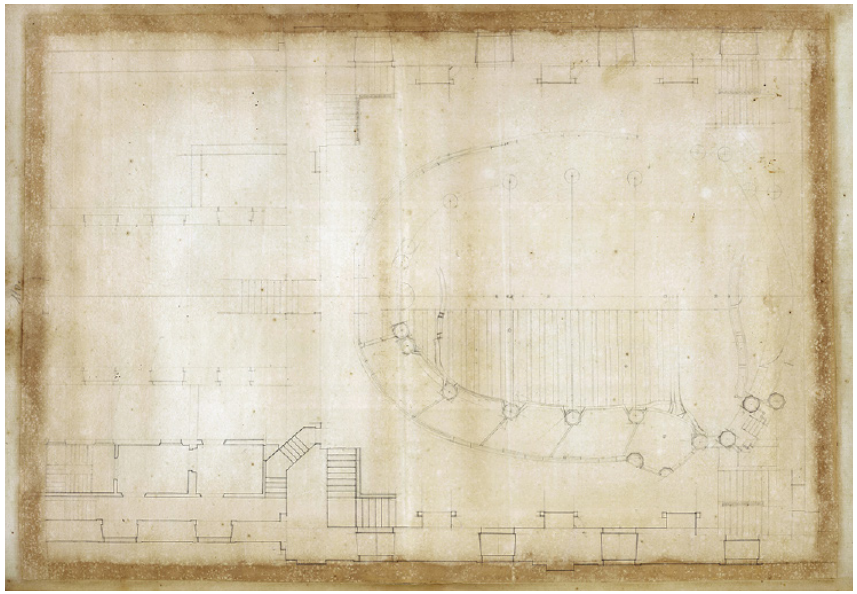
Thus, it is natural that, when José de Figueiredo discovered in 1933 two drawings belonging to a set of six, along with a folio with the respective captions, he presented them as illustrative of the theater as it had actually been constructed 177 years before [Figueiredo 1938, 30-36], stating that, from that moment, there were:

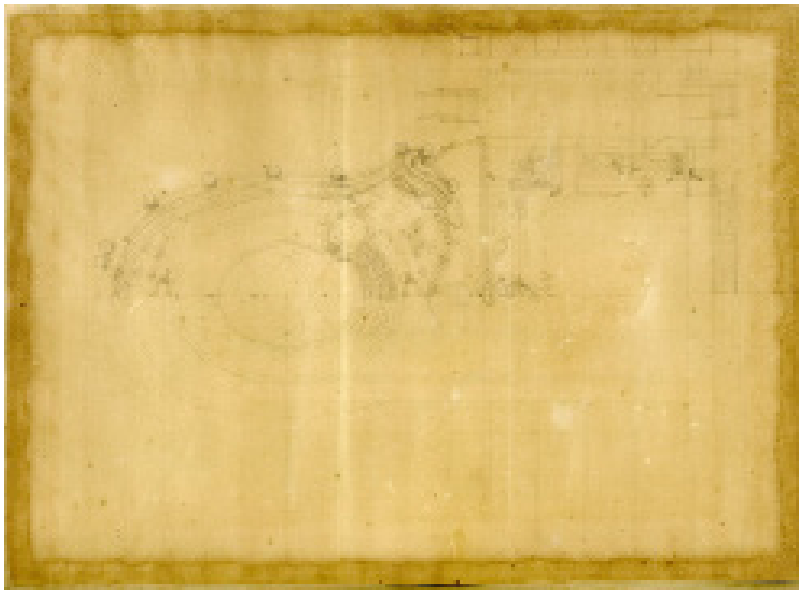
> elementos directos para a apreciação de um edifício que tão elogiado foi no seu tempo e do qual o eminente historiador de Lisboa antiga, Sr. Matos Sequeira, escreveu […] que não sabia existir dêle documento iconográfico fiel. [Op. Cit., 33].

However, since then, there have been doubts about the document's correspondence to the actual built project. One of the main scholars to substantiate this opinion was Augusto Vieira da Silva [1941, 176-178].
After having reduced the plans assigned by Figueiredo to the city plan's scale to compare them, he observed and reaffirmed that the project designs weren't in fact the built project. In that sense, the historian based his conclusions on three premises:
1ª – A medida da fachada norte do teatro que consta do Tombo de 1755, desde o beco da Fundição até à Porta dos Armazéns, é de 119^{m},76, ao passo que o comprimento da fachada correspondente no desenho, medida em escala, é de 67^{m};
2ª – Há várias plantas topográficas do local onde existiu o teatro, levantadas por ocasião do terremoto de 1755, e todas divergem do desenho do projecto, não sendo possível, reduzidas à mesma escala, sobrepô-las completamente a este. Especialmente em nenhuma se encontra desenhado o sorpo [sic] saliente para o lado sul, onde estavam os camarins, que se vê na planta do pavimento térreo ou subterrâneo do projecto;

Fig. 5: Giovanni Carlo Sicinio Galli Bibiena, 1752-1753. *Longitudinal section (top) and plan by the royal tribune (bottom).* Dim.: 156,0x43,6 / 66,0x44,7cm. MNAA.Lx, Des. Inv.º 1696 / 1670.

Fig. 6: Giovanni Carlo Sicinio Galli Bibiena, 1752-1753. *Plan for the Audience, 2nd, and 3rd cabins levels (left) and ceiling plan with decorative elements, and proscenium cross-section (right).* Dim.: 40,6x57,7cm / 39,7x54,7cm. BN.Rj, Secção Iconografia, Desenhos de Arquitecturas Plantas de Obras em Lisboa e Rio de Janeiro, fl.110 / 91.





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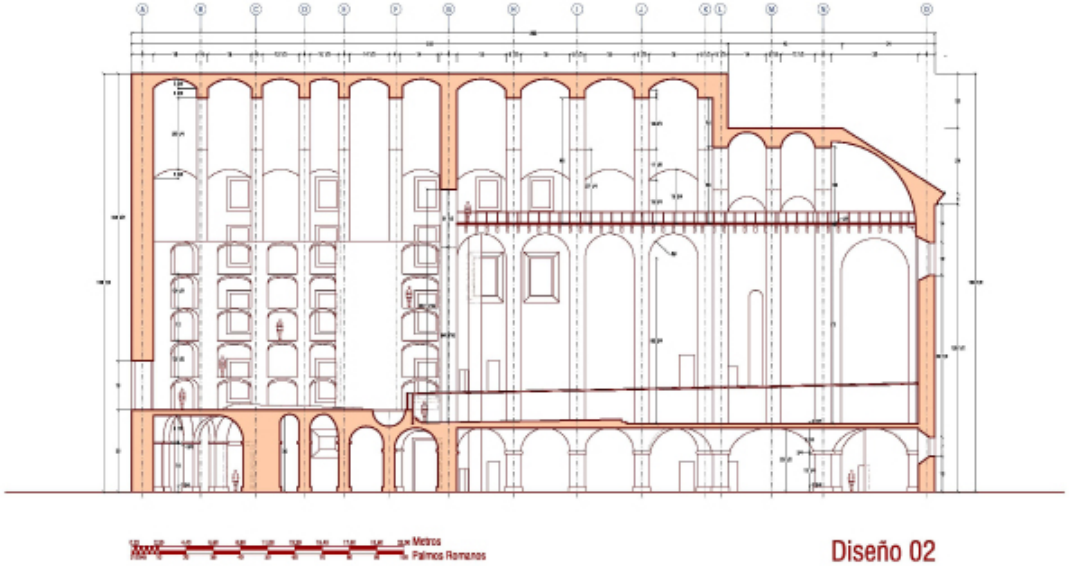
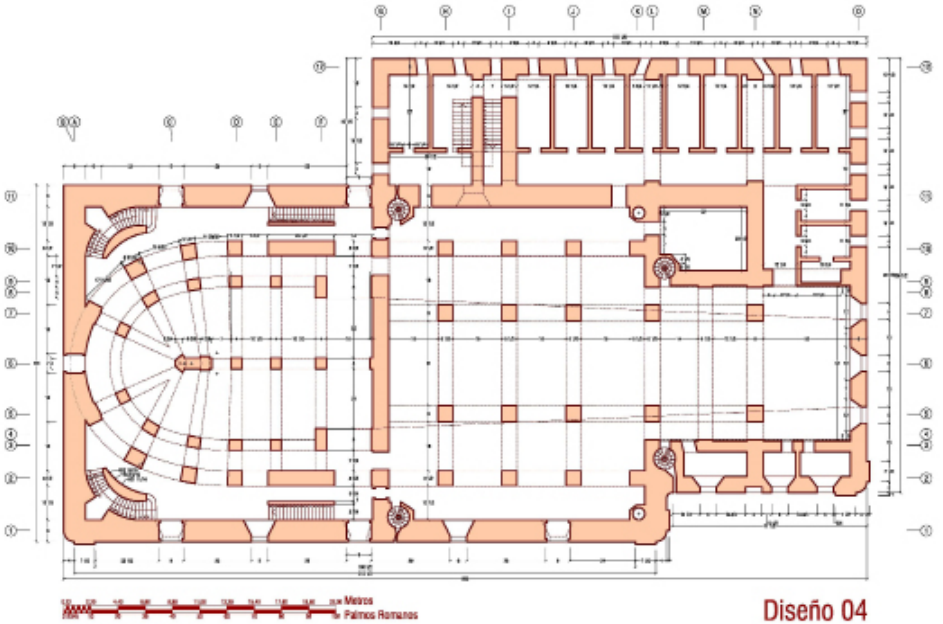
Sección Longitudinal del Teatro real de la Ópera del Tajo

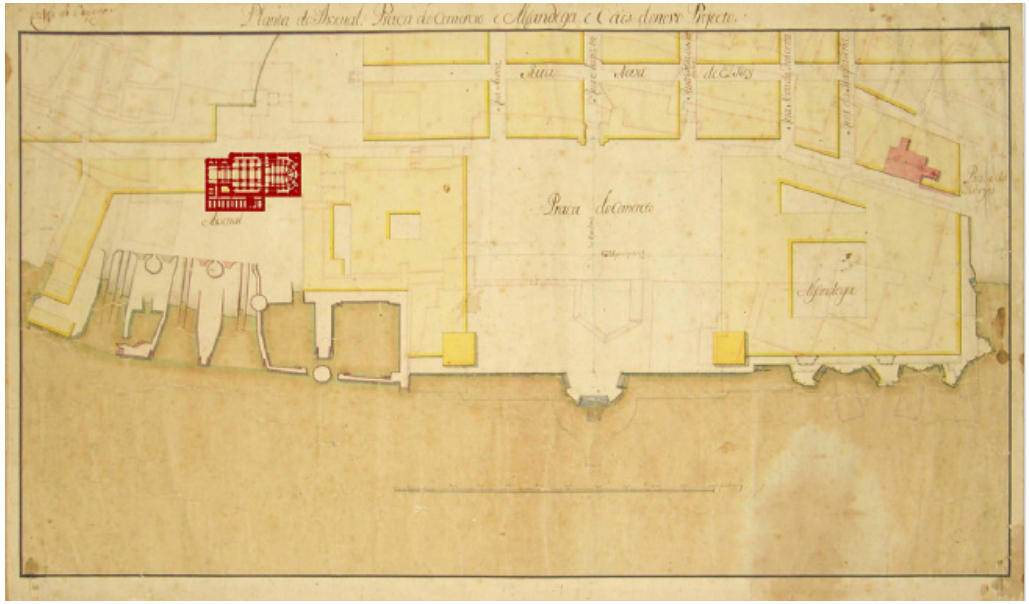


Diseño 02

Planta Estructural del Ático del Teatro real de la Ópera del Tajo



Diseño 04



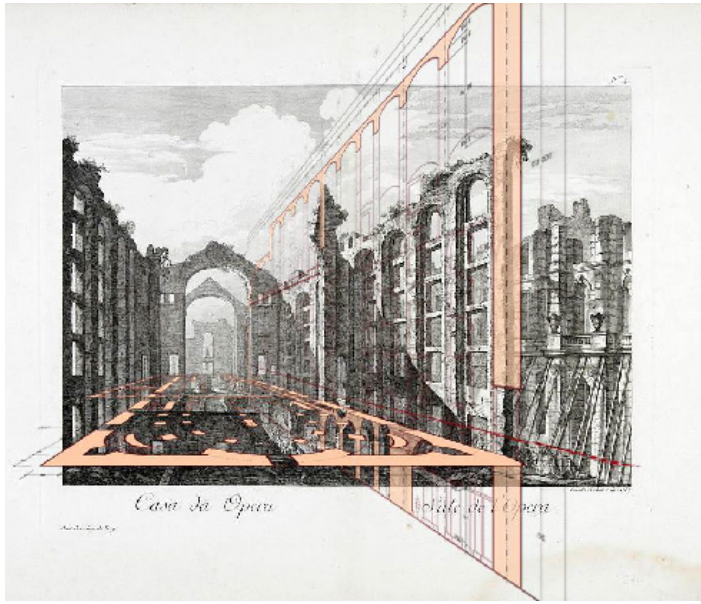


Fig. 7: Pedro Januário, 2008. Vector drawing of the cross-section (top) and the lower floor plan (bottom) assigned by Figueiredo to the Lisbon Royal Opera House of Tagus. Graphic scale in meters and Roman spans no campidoglio.

Fig. 8: Pedro Januário, 2008. Confrontation of the Tagus Opera House plans attributed by Figueiredo with the 1759 Lisbon city plan (left), and with the Tagus Opera House ruins' engraving by Le Bas (right).

3ª – Uma descrição que se conserva do teatro diz que o recanto que forma a fachada dividia no teatro a plateia do palco. No projecto vemos, porém, que o arco do proscénio ficava muito distante, cerca de 22^{m}, para nascente daquele recanto. [Vieira 1941, 178].
Despite the splitted opinions on the designs, these were taken up until 2008 as the only iconographic documents relating a project for the Lisbon Royal Opera House of Tagus.

4.2 Model according to Gago da Câmara and Gallasch-Hall
The totality of the studies conducted between 1938 and 2005 on the Lisbon Royal Opera house of Tagus always focused on a direct or indirect analysis of the drawings and captions, presenting no proposal for a three-dimensional reconstruction, except for the possible virtual evocation by Alexandra Gago da Câmara [2006, 201-211], and for the possible spatial reconstitution by Aline Gallasch-Hall [2006, 229-237], who presented 3D proposals on the occasion of the 250th anniversary of the 1755 earthquake.
The first of these works was what Silvana Moreira, under the direction of Gago da Câmara, sought to do through a virtual reconstruction [Câmara 2006, 201-211] of the Lisbon Royal Opera House of Tagus, based on the drawings of José de Figueiredo and whose aim was to:

> evocar este espaço com a ajuda das novas tecnologias da computação gráfica, investindo na recriação tridimensional do edifício em realidade virtual dinâmica [Câmara 2006, 208].

In this study, it was also proposed to recreate the theater and its ambience and materiality, simultaneously showing how it could have been the representation of a scenario in the theater, according to the vision of Gago da Câmara.
Also in this context, the architect Francisco Brandão carried out an analogous reconstruction in collaboration with Aline Gallasch-Hall, which served to try to understand the spatial norm [Gallasch-Hall 2006, 235], as well as to imagine what the opera ambience could have been, prioritizing the interior appearance. This was possible through an analysis of the drawings attributed by Figueiredo, and an interpretation of some of Ferdinando Bibiena's drawings (Giovanni Carlo Sicinio's uncle), which led to a set of illations about what could have been the Lisbon Royal Opera House of Tagus and the decoration of its entire interior [*Ibid*].

4.3 Model according to Januário
The model proposed in 2008 sought to assume the definition of Roland Barthes on the researcher. This definition indicates that he should be:

> el mago que retoma de los muertos sus actos, sus sufrimientos, sus sacrificios, y les da un lugar en la memoria universal [...] aquél que [...] recomienza su vida en un sentido claro y útil; [...] conduce hacia a tras, reagrupa sobre su mirada que decide y desvela. [Januário 2008, I, XXXVIII; Barthes 2000, 74-75].

This means that the research did not merely focus on the building, but in all its surrounding (political, spatiotemporal, social, cultural, economic, technological, conceptual, and urban), and particularly in the personal and professional scope of its author, Giovanni Carlo Sicinio Galli Bibiena. The research led to the formation of a precise and cross-cutting methodology, based on specific procedures, which together provide for the obtaining and validation of proposals for 3D reconstructions of buildings. Instead of the previous models, the analysis on the opera house began juxtaposing the plan and the longitudinal section, of the plans assigned by Figue-

iredo, to guarantee that they were part of the same project. Then, both folios were (re)drawned, through vector drawing, taking the graphic reference of the drawings scale (*palmi romano [di campidoglio]*) as a metrological standard; as well as the geometric and constructive logic inherent to that same scale, and to the modus operandi of the architect and his family of architects [Januário 2008, I, 672-674].

Consequently, a three-dimensional reconstruction was carried out, based on these two iconographies, which allowed him to carry out a wide range of analyzes (morphological, geometric, programmatic, structural, constructive, stylistic, and urban) to the model. Hence, he was able to identify several inconsistencies regarding the dimensioning of the vertical accesses to the various levels, especially of the accesses between the lobby area and the audience access [Januário 2008, I, 677-692].

There was also a confrontation with the city's current plans, but above all with a Lisbon city plan dating from 1759, where the Lisbon Royal Opera House of Tagus is represented. This 1759 plan exists at the *Academia Nacional de Belas Artes*, in Lisbon [Januário 2008, 698-702, il. 281], which was thitherto unprecedented.

From that juxtaposition, Januário [2008, I, 701] was able to understand and confirm Vieira da Silva's statements about the coincidence of one of the wedges that delimits the main stage from the technical areas with the current *Arsenal da Marinha* building; the similarity of the width between both plans; and the lack of the dressing rooms' annex to the south [Silva, 1941]. Beyond this confrontation with the Lisbon urban plan, Januário proceeded to confront the plans with the engraving by Le Bas.

From these studies it was concluded that, although they were designed for the Tagus Opera House, and despite the existence of common elements between the two documents (the position of the proscenium, the pillars topped with round arches in the north façade), the plans found by Figueiredo do not coincide with the built project, according with the theater's implantation plan and the perspectival engraving of the theatre's ruins by Le Bas (notice the structure of the lower level).

This in-depth analysis was finalized by confronting the resulting three-dimensional model according to the plans assigned by Figueiredo. In the end, it was questioned if there would be other iconographies closer to what would have been built, although they could have been attributed to other buildings or authors.

In this sense, the drawings previously attributed to the Royal Theater of Salvaterra de Magos were questioned, thanks to the investigation and analysis of the other professional and personal spheres of Giovanni Carlo Sicinio, which led to a panoramic view of the architect's work, as well as an incisive and in-depth view of each of his works. By confronting the drawings identified by Guiseppina Raggi [2000, 237, cat. 82] and Luís Soares Carneiro [2002, 73], it was firstly confirmed that this set of iconographies belonged to a same project [Januário 2008, I, 299, il.71].

By using the methodology mentioned above, the longitudinal section, as well as the plans for the audience, royal gallery, and 2nd and 3rd levels, were quickly restored, always respecting the metrology of the time [Januário 2008, I, 719-726, ill. 285-292]. This process allowed to identify common matrices between these drawings and the projects elaborated by Galli Bibiena family members. Namely in the work of Giovanni's father, Francesco; in the treaties of his uncle, Ferdinando; and in the epistolary and publicity works of his cousin, Giuseppe; either in the orbit of theatrical or scenographic architecture. These matrices are embodied in the morphological, programmatic, structural, and decorative scopes, being identifiable both in the proposed planimetric drawings and 3D model.

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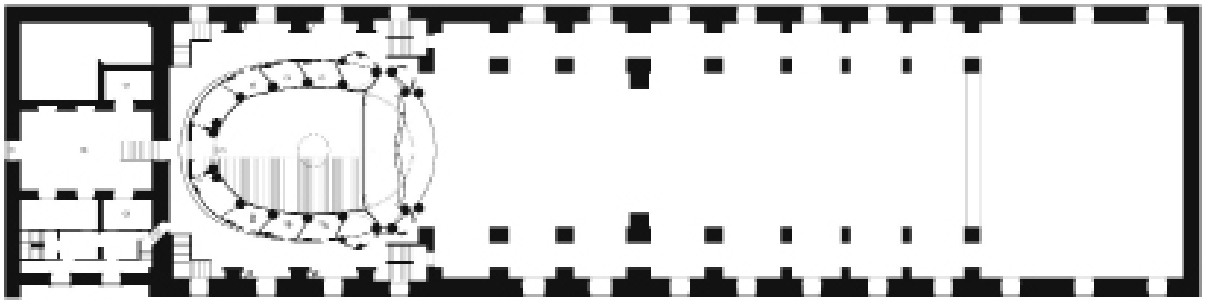
Sección Longitudinal del Proyecto preliminar para el Teatro real de la Ópera del Tajo

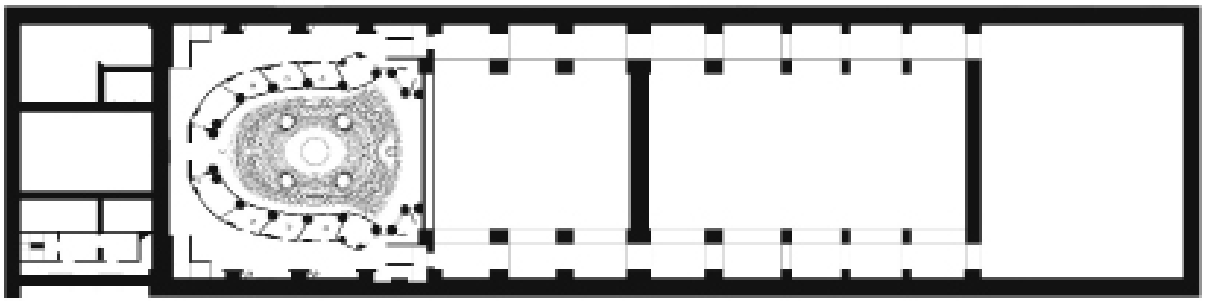
Diseño 08

Reconstitución de la Planta de la Platea y primer órden del Proyecto preliminar para el Teatro real de la Ópera del Tajo



Diseño 04

Reconstitución de la Planta del primer órden del Proyecto preliminar para el Teatro real de la Ópera del Tajo



Diseño 06

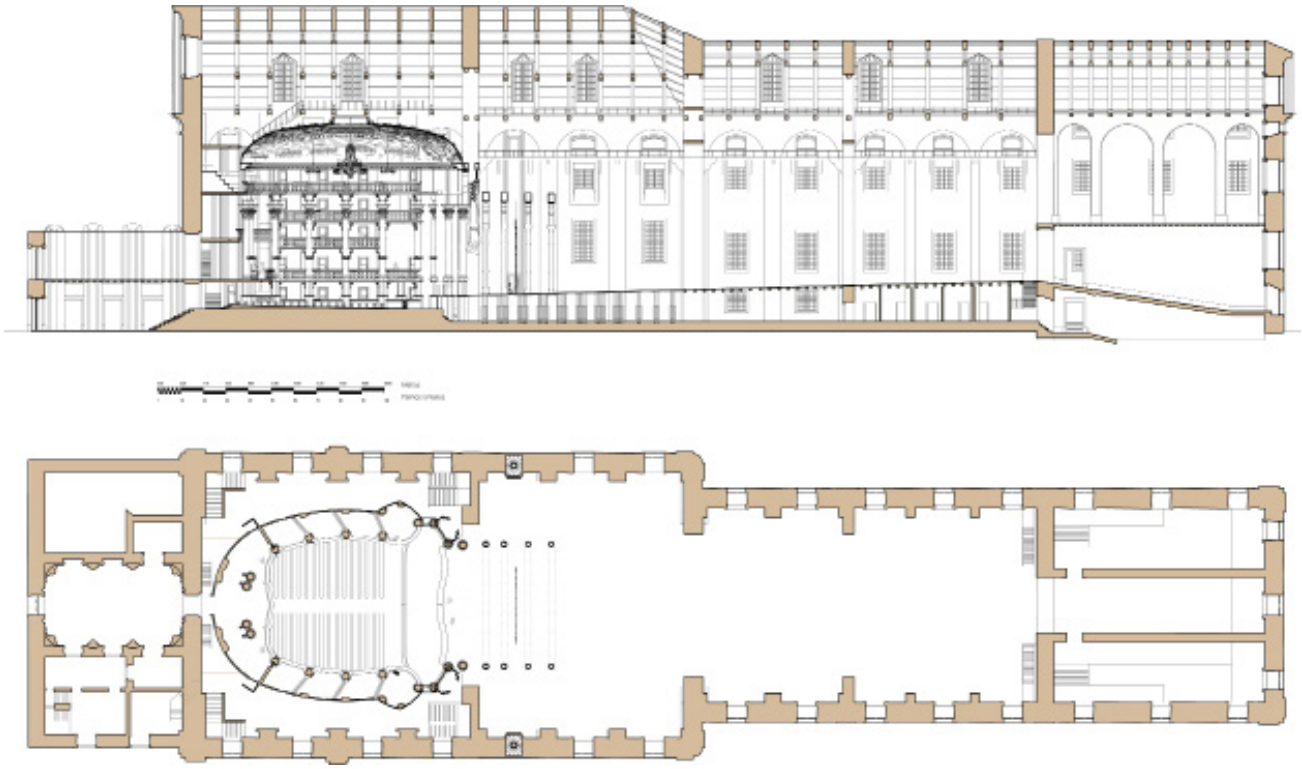


Fig. 9: Pedro Januário, 2008. Vector drawing of the set of iconographies attributed by Januário to the Lisbon Royal Opera House of Tagus, as being the closest project to the one built. From top to bottom: longitudinal section; audience and 1st level plan, royal gallery plan, 3rd level plan, ceiling plan.

Fig. 10: Eduardo Antunes, 2015. CAD Vector reconstruction of the longitudinal section and first level plan of the Lisbon Royal Opera House of Tagus project.

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5 | Model according to Antunes

In a more recent investigation [Antunes 2015] all previous investigations were analyzed, to examine specific conjectural aspects that could at the same time make sense in its own approach. Despite this, the work of Januário was followed as a starting point, although it might not be completed or devoided of some misconceptions.

A first aspect to be noted would have to be the absence of the wedges in the theater plans reconstituted by Januário, present in the Lisbon plan dating from 1759. In view of the confrontations between the unfinished plans and the pre-earthquake Lisbon plan, and despite the lack of enough evidence to prove the existence of these elements in the project, it made sense to consider them as an effective part of the project, since they seemed to constitute an essential part of the presence and urban relationship of the building with its surroundings; as well as elements of demarcation of the main body of the audience and stage as a whole, as still seen nowadays in the *Arsenal da Marinha* building, which might have been built onto the theater's ruins [Gallasch-Hall 2012].

This perspective and these plans have, therefore, served as a guide during this work which in the face of the considerable lack of information in these plans, vital to a complete understanding of the project, led to the analysis of several documents that, whether or not directly related to the Tagus Opera House, could fill certain gaps in the interpretation and reconstruction of the plans that Januário considered. This allowed to have more references to fill those gaps in the project, as well as a greater objectivity in the reconstruction of the theater's project.

A search for other examples of theatrical architecture within the same type of the Bibiena style drawing became especially necessary, since it was believed that Giovanni Carlo Sicinio would have brought to Portugal a series of drawings belonging to his family. These drawings are present in the National Museum of Ancient Art exhibition's catalog [*Desenhos dos Galli Bibiena* ... 1987]. For this reason, it was assumed that the architect would withdraw references from the works that were more familiar to him, a hypothesis already presented in the analysis of the Giovanni Carlo Sicinio's drawings for the theater of *Salegada di Strada Maggiore*:

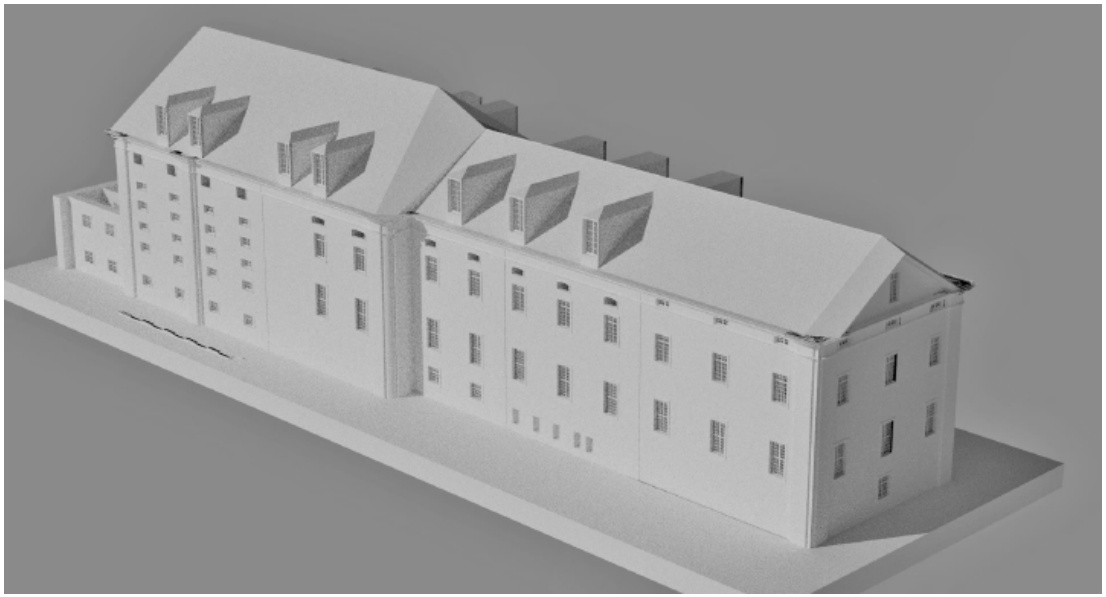
> el arquitecto […] se ha inspirado en algunas referencias familiares […]. Especialmente, en lo que respecta a la ubicación de las escaleras, al dibujo de la platea y al proscenio curvo soportado por columnas libres. [Januário 2008, I, 220].

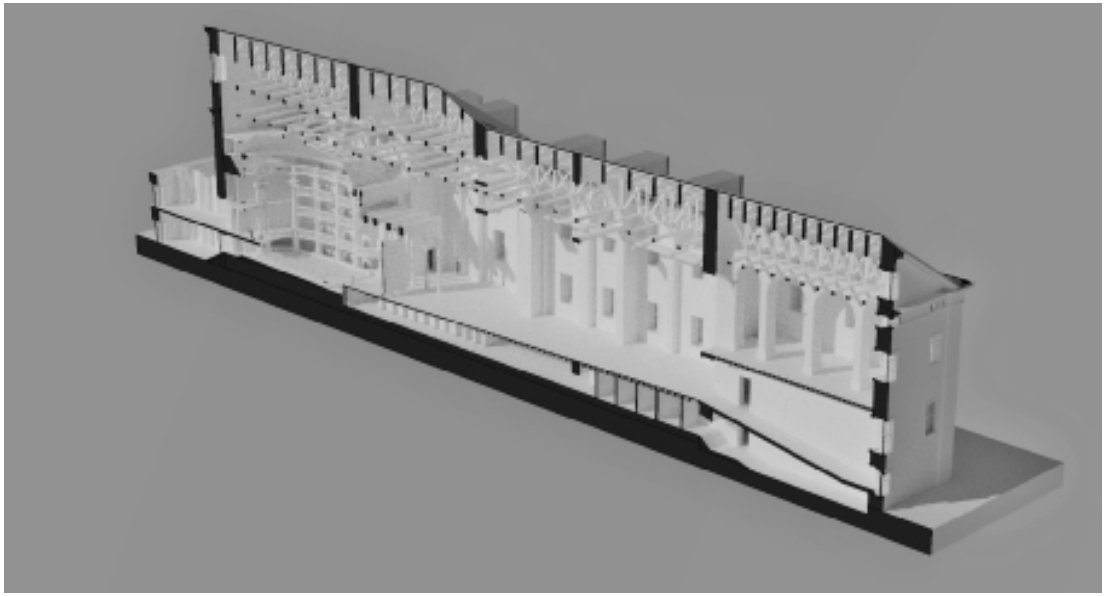
In this context, came into play the analysis of the previously mentioned Nancy Opera House, according to the project by Francesco Gali Bibiena (Fig. 1). The first factor that contributed to this choice was the fact that it was one of the projects included in the set of designs allegedly brought by Giovanni Carlo to Portugal. In addition, Raggi had already affirmed the similarities found between the designs initially attributed to Salvaterra and the Nancy Opera House:

> L'organizzazione del boccascena […] risolve la connessione cavea-palco secondo le modalità elaborate dalle innumerevoli sperimentazioni di Ferdinando e Francesco Bibiena. Inoltre alcuni elementi rinviano ad opere realizzate dal padre: il baldacchino, la presenza della tenda nella tribuna reale, il profilo dell'arco di proscenio ricordano il teatro di Nancy [Raggi 2000, 327].

Contributing, at this point, for this theater to be considered even more as a reference point in attempting to reconstitute the Lisbon Royal Opera House of Tagus in its opening.

Fig. 11: Eduardo Antunes, 2015. General view of of the virtual recreation of the Lisbon Royal Opera House of Tagus from the royal tribune (top) and from the stage area (bottom).





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5.1 Metrological analysis

In order to establish a relationship between the designs attributed to the Nancy and the Tagus theaters, a metrological analysis was necessary to determine the correspondence between the scales at which they were designed. From the direct observation of these plans, it was found that in the Nancy Opera House there's a reference to the Bologna Foot (*Piede di Bologna*), while for the Tagus Opera House this reference is to the Roman Span (*Palmo Romano di Campidoglio*). So, it was necessary to elaborate the transposition to the metric system, in order to establish a parallel, close to our reality. According to the treaty *L'architettura civile preparata su la geometria...*, by Ferdinando Bibiena [1711, 25-26]:

1 Paris Foot = 1000 parts

1 Bologna Foot = $1170\ ^{15}/_{18}$ parts

1 Roman Span di *Campidogio* = $686\ ^{33}/_{72}$ parts.

In the second facsimile edition of *Direzioni a' giovani studenti nel disegno dell'architettura...* by Ferdinando Bibiena [1745, 33] there is a physical reference, through the drawing of straight segments, one of these segments corresponding to $^{1}/_{3}$ of the Paris Foot, and the other to $^{1}/_{3}$ of the Bologna Foot. The direct reading of the facsimile (and considering any reading errors and external factors that may have affected the paper, such as moisture), it was attained that:

$^{1}/_{3}$ Paris Foot ≈ $106\ ^{3}/_{4}$ mm;

$^{1}/_{3}$ Bologna Foot ≈ 125 mm.

By multiplying the value of $^{1}/_{3}$ of the Paris Foot by the Bologna Foot proportion ($1170\ ^{15}/_{18}$), an approximate reading value was obtained, ie: 124,986458(3)mm. This validates the proportion advanced by Ferdinando Bibiena [1711, 25-26; 1745, 33] and it was concluded that:

1 Paris Foot ≈ $320\ ^{1}/_{4}$ mm;

1 Bologna Foot ≈ 375 mm ($374^{307}/_{320}$ mm).

Therefore, the size of the *Campidoglio* Roman Foot - CRF ($320^{1}/_{4}$ mm * $686^{33}/_{72}$ partes) is:

1 CRF ≈ 219, 838mm ($219\ ^{1073}/_{1280}$ mm),

dimension already used in the Tagus Opera House plans' reconstruction in 2008 [Januário, I]. On the other hand, if one also takes into account the *Métrologie française, ou Traité du systeme métrique d'après Ia fixation définitive de I'unit*é Iinéaire fondamen*tale* [Brillant-Bazaine 1802, 3-4] it is indicated that a *Toise* was equivalent to 6 King Feet, that is, to 6 Paris Feet, and that

1 *Toise* = 1,949036 meters, implying that

1 Paris Foot = 324,8393 mm.

If it is acknowledged that there is an intense family, professional, and academic relationship between Ferdinando Bibiena and Francesco, it's logical and acceptable to conclude that there was also a same anthropometric matrix shared by both, and used by his collaborators and students, among which Giovanni Carlo Sicinio.

If it is further added that Ferdinando's published works [1711; 1745] were employed in the teaching of architecture at the *Accademia di Belle Arti di Bologna*, then we are led to conclude that their tables have served several generations of architects.

In this case, if applied to the relation defined in the *Métrologie française* and the proportion between the different anthropometric standards, according to Ferdinando, it is inferred that:

1 Bologna Foot = 380,33266 mm

1 *Campidoglio* Roman Foot = 222,98864 mm

It is concluded immediately that in the reconstruction carried out in 2008 there was an error of 0,00298864m in the attributed value, that is, 1,412%, although the value attributed to the *Cam-*

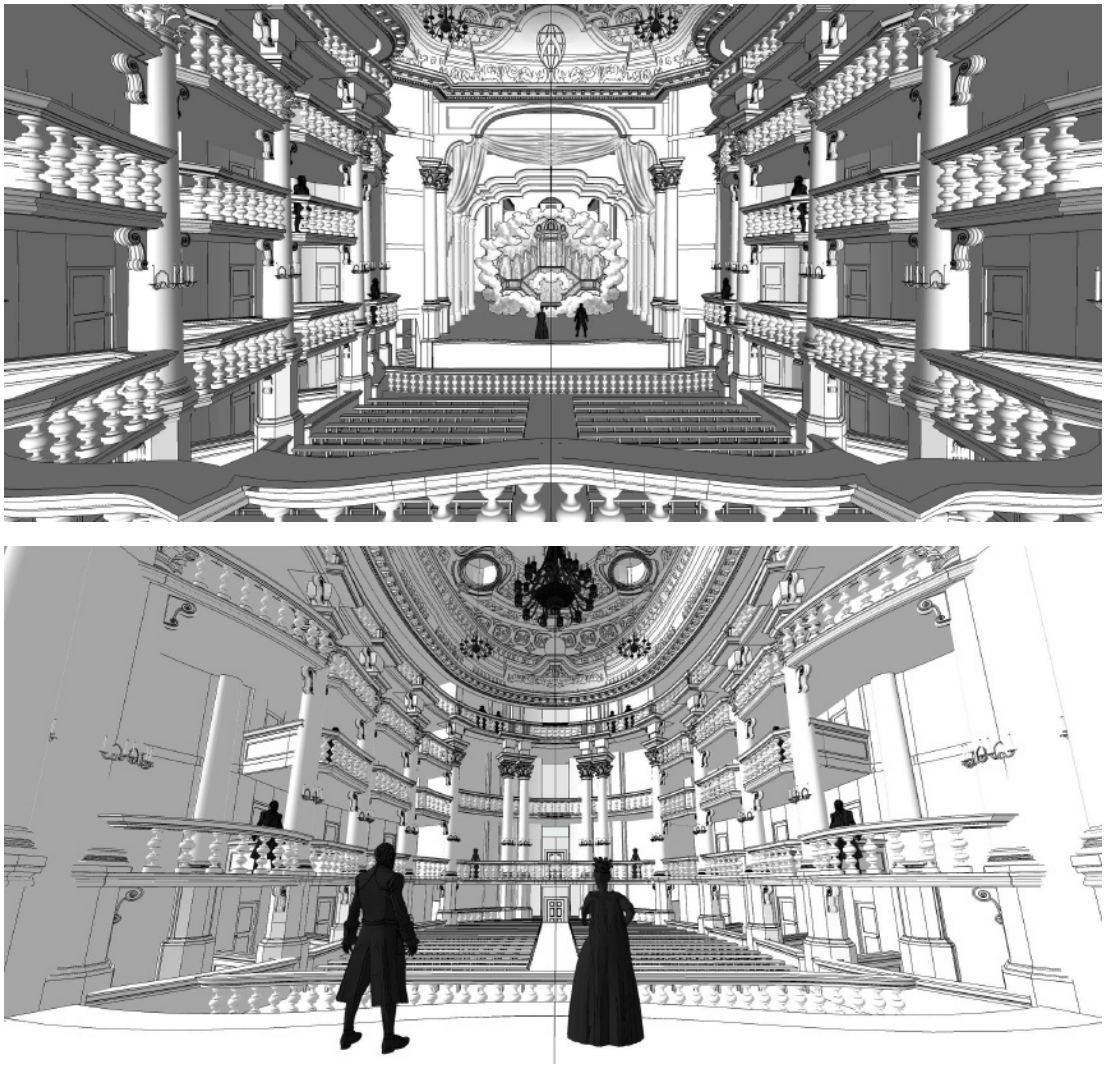

Fig. 12: Eduardo Antunes, 2015. Interior view of of the virtual recreation of the Lisbon Royal Opera House of Tagus from the royal tribune (top) and from the stage area (bottom).

pidoglio Roman Span was simplified to 0,22 m. This corresponds to standard values of the paper size variation as a function of humidity (up to 2 %) and accuracy when reading directly with a conventional ruler.

When the plans of the Nancy and the Tagus theaters were overlapped, in the allocation made in 2015, it was necessary to carry the scales defined in each of the theaters among themselves, as well as for the metric system:

1 Bologna Foot ≈ 380 mm

1 *Campidoglio* Roman Foot ≈ 223 mm

In this drawings' juxtaposition, several analyzes and readings between the two theaters could then be carried out.

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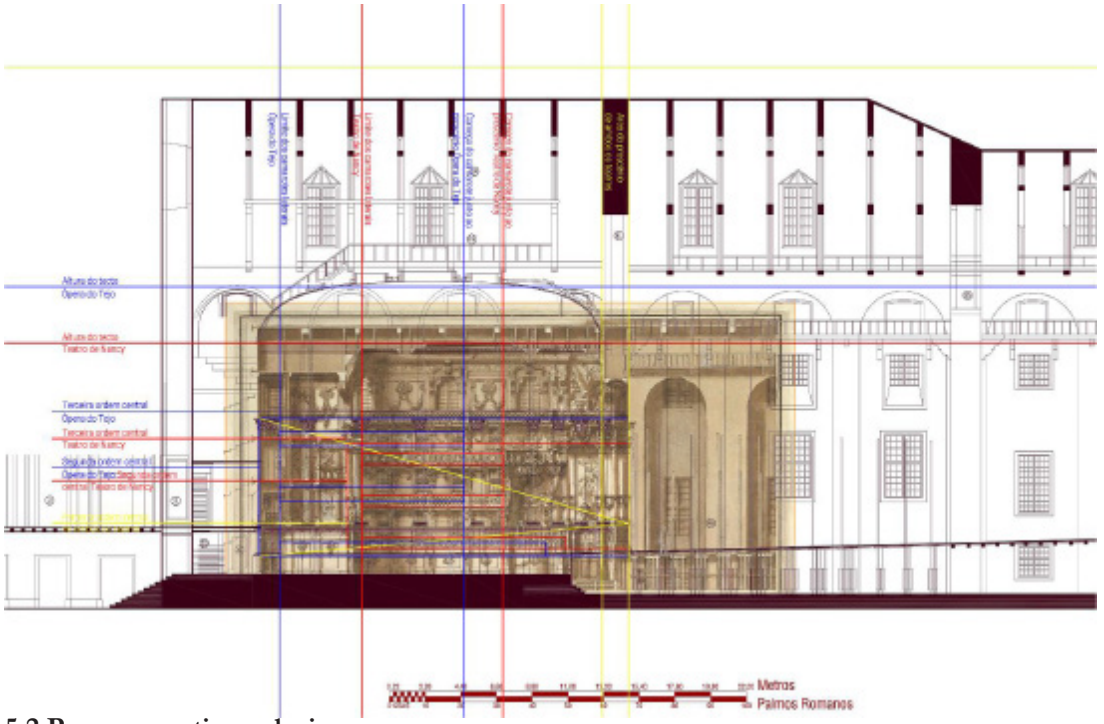
Fig. 13: Eduardo Antunes, 2015. Overlapping of the Tagus Opera House reconstructed section attributed by Januário with the Nancy Opera House section, marking the schematic delimitation of the room, guards and heights of the Nancy Theater (in red) and, proportionally, of the Tagus Opera House (in blue).



5.2 Programmatic analysis

From the analysis of the two theaters, one knows in advance that both were designed to be court theaters, and whose core function was to receive *dramma per musica* shows destined for royal amusement. That presupposes that there is a common programmatic logic, considering the specificities of Italian opera. Thus, by placing the drawings for the two theaters in parallel, we identified a set of zones common to both projects. Both have an atrium that precedes the access to the audience room, connecting with the vertical accesses and the circulation spaces destined to the public. Both rooms are composed of a royal tribune and two cabins in the proscenium, destined for royal use. The remaining cabins in the two theaters are also distributed in four levels. There can be also noted the existence of an orchestra pit between the audience and the stage.
Once again, the Nancy and Tagus theatres have four vertical accesses located in the wings and front of the stage, linking the lower and upper entrances. There is also a technical corridor that surrounds these areas at the web level. There can be verified a set of areas for technical support, where warehouses, painting workshops and dressing rooms for the various artists are located.

5.3 Morphological analysis and compositional principles

When confronting the plans of both theaters, it can be noted, almost immediately, that both rooms have a bell-like configuration, a form shared by the whole Bibiena family [Januário 2008, III, 769-794]. Nevertheless, to this peculiar room configuration is also associated: on the one hand, a set of constructive systems whose intention was to improve the acoustic effect and the temperature control, and candle smoke exhaustion; and on the other hand, the creation of visual effects based on the perspective and emphasized by an elaborate mechanical system of gears, illuminations, and sound effects, to create a whole sensorial sublimation on the presented show.

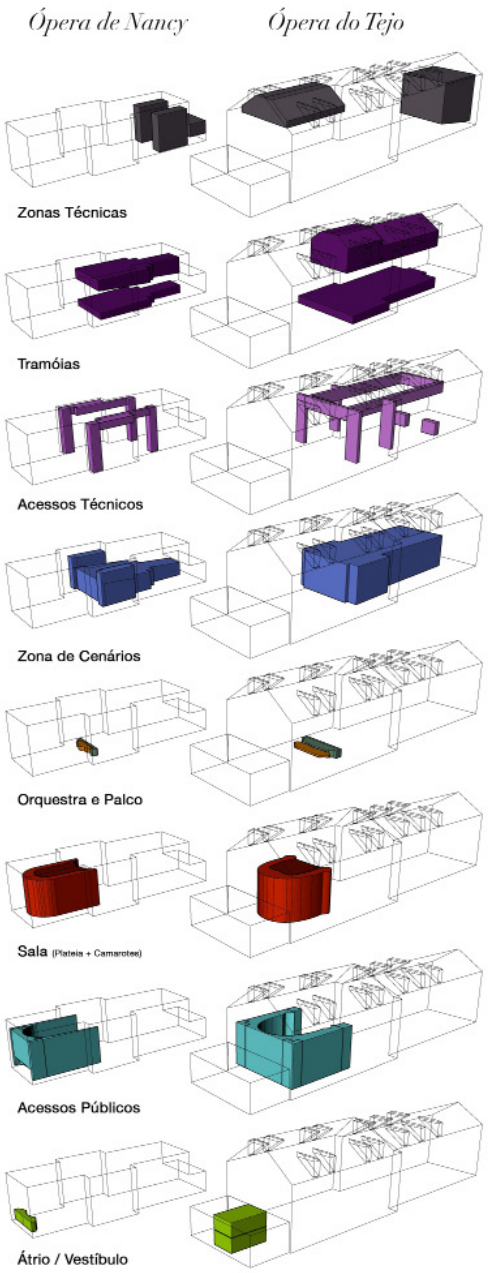
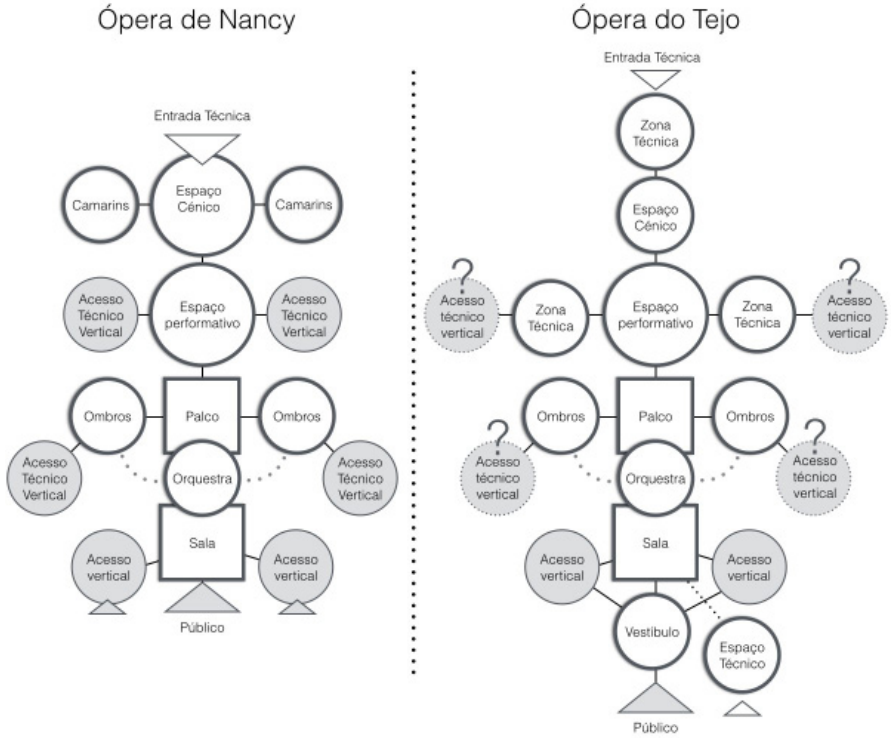


Fig. 14: Pedro Januário, 2015. Parallel between the program of the Nancy Opera House and the Lisbon Royal Opera House of Tagus, based on the volumetry of the different zones (left) and the relation between them (right).



Thus, it is identifiable in both projects the use of: air-box walls in the separation between the cabins and the traffic areas; the profuse decoration with the use of wood and plaster for sound reverberation and humidity absorption; the existence of (five) chimneys covered in the room ceiling; and the existence of a complex system of theatrical machinations to set in motion all the scenic devices, which were elaborated according to the perspective laws, to recreate more spectacularly the imagined environments. However, in terms of their compositional principles, both theaters are organized along three axes: a longitudinal axis running through the whole building, which operates on the axial principle and symmetry; a set of five transverse axes defining the atrium area, audience, stage and wings, stage extension, and the technical zones - the most important being the axis separating audience and stage (proscenium plane); and by a vertical axis, associated with hierarchy, which in turn subdivides the theater into four spaces (lower plane containing the machinations and dressing rooms, entrance plane in the audience, entrance plane of the monarch in the room, and upper plane corresponding to the web and to upper machinations).

The principle of hierarchy is used in the relation that the proscenium plane establishes between the audience and the stage, that is, between the plane of reality and the plane of the imaginary. But the proscenium is, simultaneously and metaphorically, a mirror of a society hierarchized and structured in the very image of the audience. Because all the perspicacious principles applied to the conception of the spectacle are calculated according to the position of the monarch in the royal box (point of the prince), which reinforces the axial and structured character of the audience. Finally, the principles of repetition and rhythm are used in the use of different decorative details, such as in the balustrade, or in the repetition of decorative elements on the ceiling, as well as on structural elements (Roman arches), fenestrations, or the very placement of the backstage elements.

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5.4 Structural analysis

Structurally the Tagus Opera House is organized according to a rectangular matrix of 19 transverse axes by 6 longitudinal axes. The building is composed of two distinct bodies: a connecting zone to the Royal Palace, corresponding to the Atrium or Lobby; and the body dedicated to the audience and the scenarios' zones. The second body is delimited by a thick wall (≈1,45m), being reinforced by pilasters connected to each other by Roman arches (see Fig. 2, Fig. 7 and Fig. 9). This system is also used in the Nancy Opera House (see Fig. 1), although the latter is knitted by 12 by 6 axes, having a projection along the wings area on both sides of the building, and the main walls being around 0,50m.

In terms of the audience, the structure of the two cases is similar, since both boxes' levels rest on a set of columns (6 in the case of the Nancy Opera House, 14 for the Tagus Opera House) along the cabins' balcony perimeter, and on a double wooden wall that delimits the boxes of the circulation zones, which is reinforced inside by pilasters. In the Nancy Opera House, the proscenium is supported by two free columns of composite order on each side, just as it happens in the royal box. There is still a passage from each side of the orchestra to the musicians through another pair of free columns. In the Tagus Opera House, the proscenium arch is also connected through two pairs of free columns on each side, as well as the royal tribune. However, there is a more marked presence of the columns separating the cabins throughout their levels.

Finally, it should be mentioned that the structure of the roof trusses in the Galli Bibiena's theaters are of great structural importance, since they must simultaneously bear the roof weight, the upper machinations' weight, the counterweights and all the impulses and momentum generated by the scenographic devices' various movements.

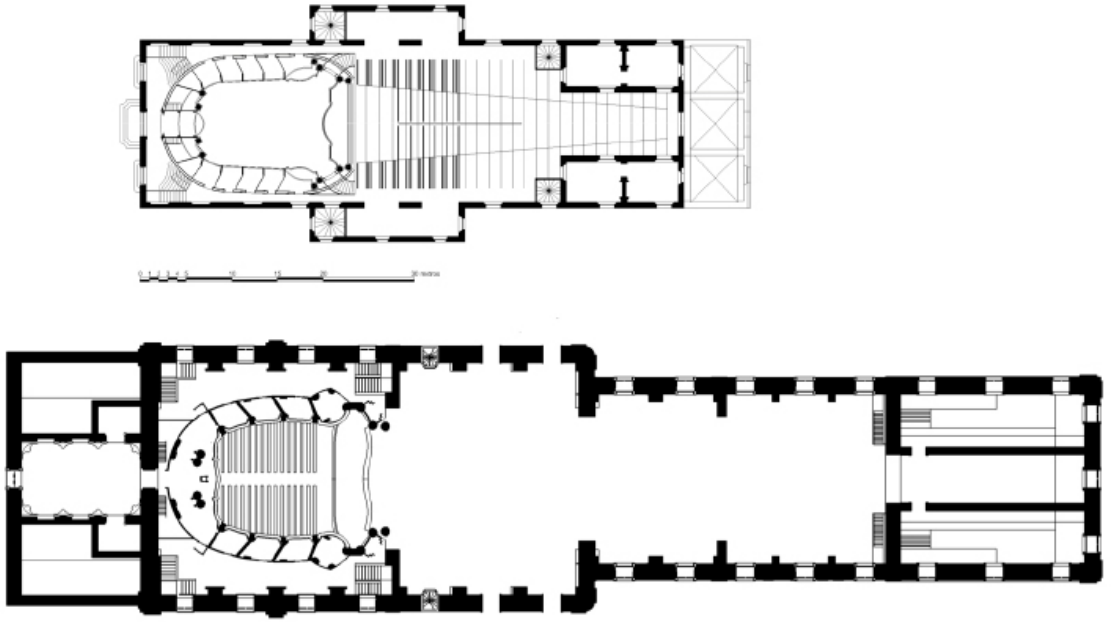

Fig. 15: Antunes-Januário, 2015. Plan at the royal tribune level, of the Nancy Opera House (top) and the Lisbon Royal Opera house of Tagus (bottom), reduced to the same scale.

5.5 Proportion and Scale

One of the similarities between the two theaters lies in the use of the Composite Order for the columns of the room and the other decorative elements. This relation between the part and the whole, which is present in the classical architectural Orders, is also transferred regarding proportional relations between the parts and the whole of both theaters. This fact isn't odd, since the structure of the teaching in the Clementine Academy aimed first to teach how to draw the parts, and later the whole [Januário 2008, I, 156].

Since Giovanni Carlo Sicinio had his father and uncle as masters, among others, it is therefore rational and evident that he also used logics of harmonious lines common to his father. That is verified through our analyzes and drawings of harmonious tracings that are relatively easy to find, both at the plan level and in their sections. In the specific example shown in Fig. 16, a set of gold rectangles which structure the cross-sectional composition by the proscenium are perceptible, being repeated at different scales, imposing recurrent compositional rules and principles. It is the same case for the relationship between the various levels, as well as the unfolding of the golden ratio, which determines the alignments of the free columns that support the proscenium and connect this with the proscenium stateroom.

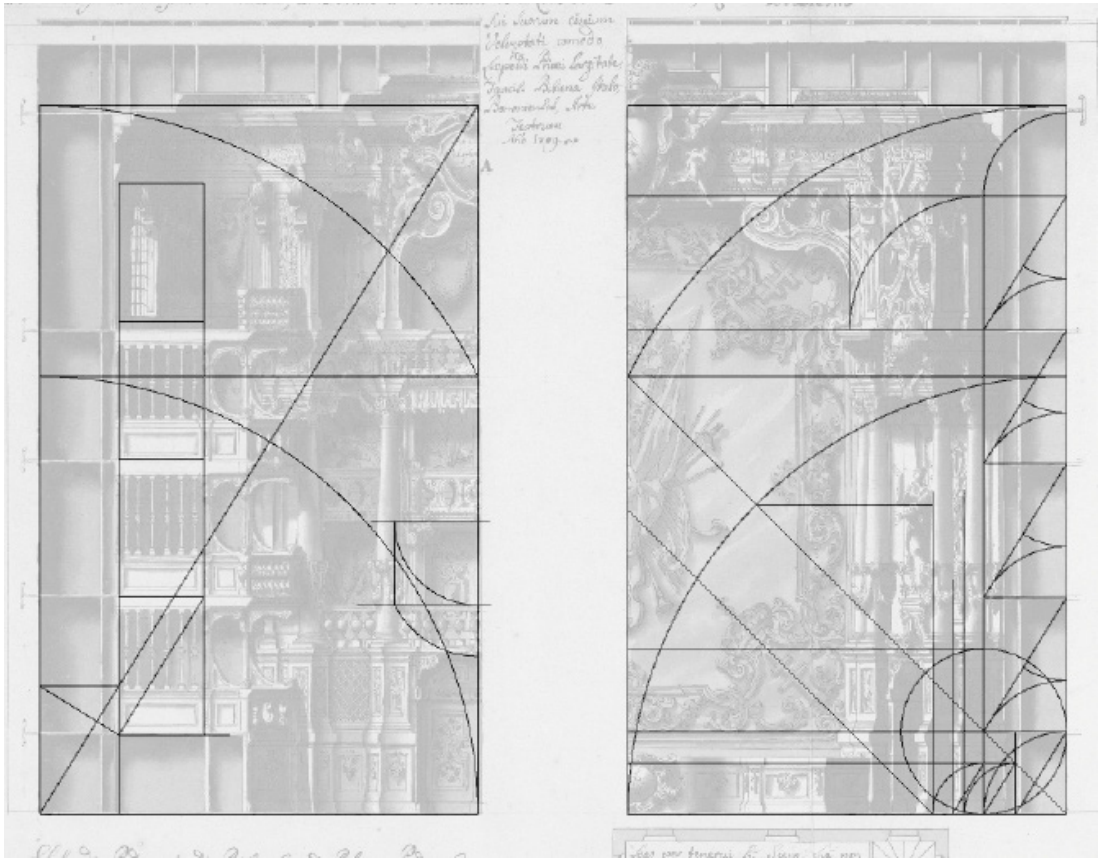

Fig. 16: Pedro Januário, 2015. Detail of the studies on the proportion and harmonious lines applied to the cross-sections of the Nancy Opera House, by the royal tribune (left), and the proscenium (right).

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Table 1: Table with the main dimensions in meters of the Nancy Opera House and the Lisbon Royal Opera House of Tagus.

Table 2: Table with the main dimensions of the room and the scenario of the Nancy Opera House and the Lisbon Royal Opera House of Tagus, with the determination of several ratios between the parties.

EXTERIOR	Nancy Opera (NO)	Tagus Opera (TO)	NO/TO Ratio
Length	**66.75m**	**119.69m**	*1.793*
Width	**18.45m**	**29.08m**	*1.576*
Height	**16.75m**	**30.99m**	*1.850*
Length/Width Ratio	*3.618*	*4.116*	
Width/Heigth Ratio	*1.101*	*0.938*	
Length/Heigth Ratio	*3.985*	*3.862*	

ROOM	Nancy Opera (NO)	Tagus Opera (TO)	NO/TO Ratio
Length	**17.66m**	**17.96m**	*1.017*
Width	**15.49m**	**18.25m**	*1.178*
Height	**13.89m**	**17.82m**	*1.283*
Length/Width Ratio	*1.140*	*0.984*	
Width/Heigth Ratio	*1.115*	*1.024*	
Length/Heigth Ratio	*1.271*	*1.008*	

AUDIENCE	Nancy Opera (NO)	Tagus Opera (TO)	NO/TO Ratio
Length	**13.97m**	**13.61m**	*0,974*
Width	**9.77m**	**12.68m**	*1,298*
Length/Width Ratio	1,430	1,073	
ORCHESTRA			
Length	**9.77m**	**12.21m**	*1.250*
Width	**2.79m**	**3.88m**	*1.391*
PROSCENIUM (plateau)			
Length	**8.48m**	**10.54m**	*1.243*
Height	**10.50m**	**11.99m**	*1.142*
Length/Heigth Ratio	*0.808*	*0.879*	
STAGE			
Length	**36.15m**	**56.67m**	*1.568*
Width	**17.11m**	**18.55m**	*1.084*
Length/Width Ratio	*2.110*	*3.055*	
STAGE/ROOM RATIO			
Length	*2.047*	*3.155*	
Width	*1.105*	*1.016*	

6 | Conclusions: for a 3D reconstruction methodology

From the outset, this work was developed as an attempt to circumvent the fact that several theatrical architecture examples survive very little and leave few or even no traces of their existence [Antoine 1965, 1]. In this sense, the idea would also be to present an organized method of approaching similar problems, with the use of digital tools in the process, in studies of historical buildings that have disappeared or were never built, but projected or delineated.

For this purpose, it is crucial to bear in mind that the Lisbon Royal Opera House of Tagus emerged at the core of an architectural style – or rather, "architectural culture" – specific and familiar to an era. In ancient times, this idea was the basis for architectural design, and there were even a set of precepts on which the architect should support when designing.

Since the architectural culture is based on the evolution of previous models, the learning and teaching of architecture are done through the study of these same models. The object of study would undoubtedly arise with references and even similar aspects to other examples of the same

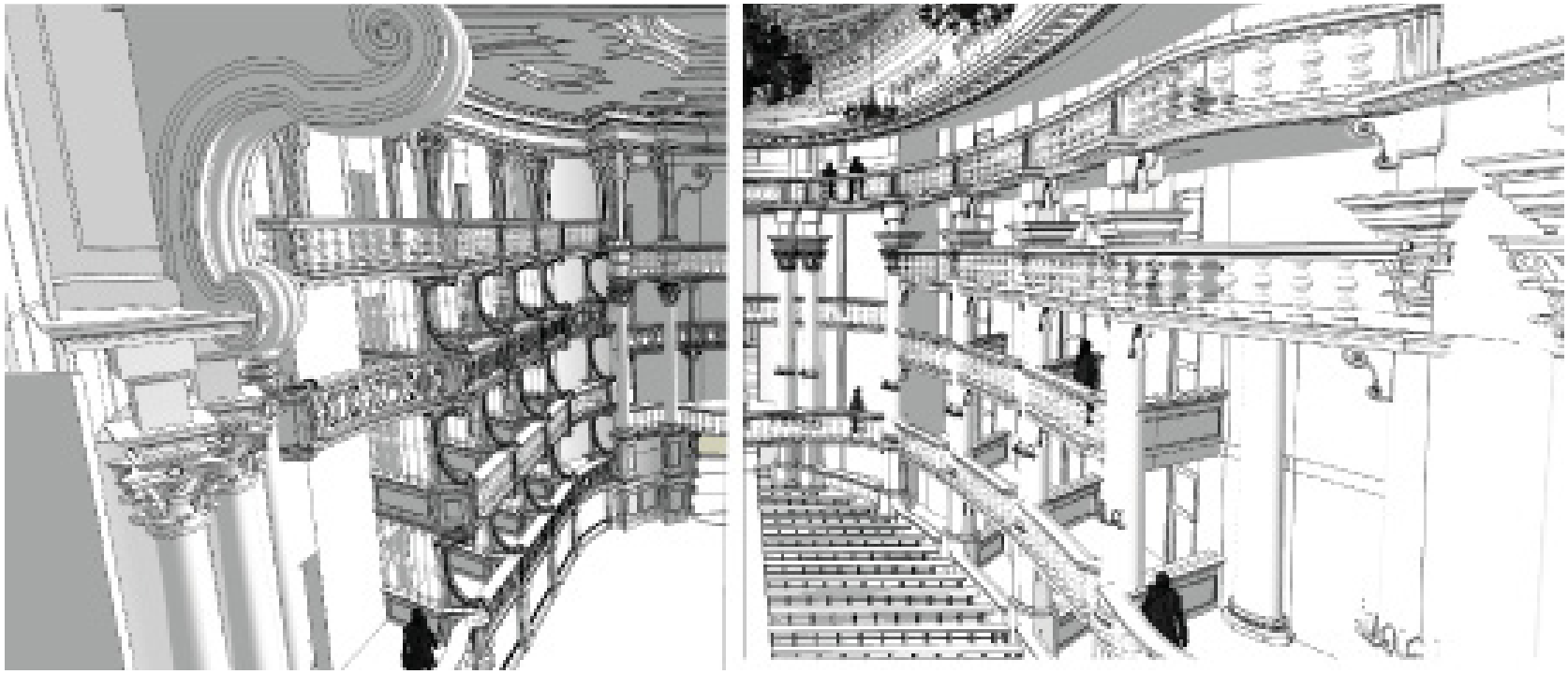

Fig. 17: Eduardo Antunes, 2015. Comparison between the three-dimensional reconstructions of the Nancy opera House and the Lisbon Royal Opera House of Tagus.

building type and elements of treaties, tradition, copy, and continuity – but also of rupture and search for new expressive solutions.

In this sense, and as demonstrated in the present article, it can be concluded that several elements are leading to a collective identity between the Nancy Opera House and the Lisbon Royal Opera House of Tagus. Not only because they were conceived by members of the same family or as court theaters in the same architectural culture, but above all because they share conceptual, morphological, formal, structural, stylistic, decorative, compositional, and programmatic identities. There can also because be found relationships at the level of their scale, proportions, and harmonious strokes.

All this allows for the elaboration of a representative model of what the Lisbon Royal Opera House of Tagus could have been, through its confrontation with the Nancy Opera House case. On the other hand, this same confrontation allows for a more in-depth analysis of its morphology, spatial structure, and program, as well as to conjecture on missing elements in the study object.

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