

Optical architecture. Interplay between perspective and space design

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In the early 18th century, Portuguese scientific, architectural and quadratura production experienced a renewal incorporating new spatial features. The contrappunto Science/ Architecture/ Quadratura is intended as action in which real (constructed) and illusion (represented) intertwine, creating a complex sensitive Truth. Throughout this approach Portuguese baroque deals with a plurality of acquisitions immersing the viewer into a bail composto where the baroque seductive potential is accentuated by integration of optical phenomena.

Professor at Lisbon's Aula da Sphera, Inácio Vieira's theoretical investigation on perspective confronts and summarizes contents from classic and modern sources. His extensive production contains the treatises on *Óptica* (1714), on *Prospectiva* (1716) and *Dióptrica* (c. 1717), where perspective is taken as vision's delusion serving the practice of painting and space manipulation.

Royal architect João Antunes combines national plain tradition with a new spatial approach according to Roman baroque models (Fontana). From his works we underline the Churches of Menino Deus (Lisbon, 1711) and Senhor Jesus da Cruz (Barcelos, 1704), where complex polygonal plans, combining longitudinal and centralizing trends.

Vincenzo Bacherelli introduces quadratura painting in Portugal. As such, the ceiling at S. Vicente de Fora monastery (Lisbon, 1710) is taken as a starting point for a new spatial feature that will mark Portuguese baroque. According to his background the work evidences the Bolognese lesson. Following the Bacherelli lesson, the work of Simões Ribeiro reveals the absolute appropriation of quadratura to national circumstances.

Inácio Vieira



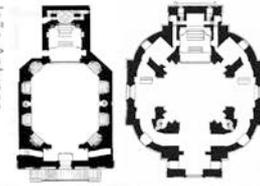
Vincenzo Bacherelli



Lourenço Quintã
João Nunes Azevedo
António Ludu



João Antunes



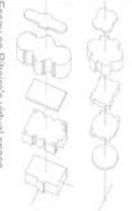
Simões Ribeiro



Real space
Gonçálves Sena



Essay on Ribeiro's virtual space



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OPTICAL ARCHITECTURE

Interplay between perspective and space design

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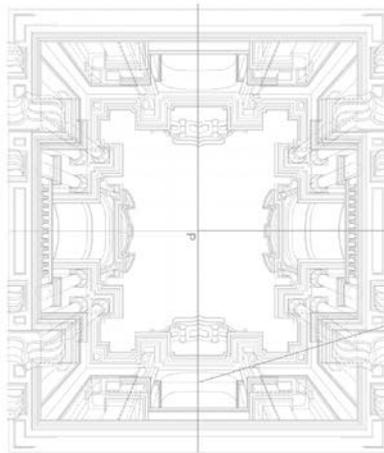
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DIPARTIMENTO
INDACO

According to the exposed context while Simões Ribeiro is credited by updating Santarém's quadratura (1719-32), Gonçálves Sena's quadratura painting (1754) should be the one regarded as a complex cultural product embodying illusion. Proximity to Pozzo's model is not satisfied by mere translation of treatise schemes, but rather the result of an accurate knowledge of perspective procedures, along with awareness of architectural composition principles. Under this light Sena is classified as "Painter a great architect, or perspective", exalting the architectural nature of his pictorial work, and his ability in manipulating instruments of delusion. Architectural substance is taken by quadratura as an operative fact applied into reconfiguration, adjustment and transformation of tectonic perception.

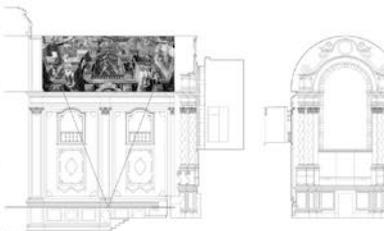
At Santarém's shrine, spatial configuration of the main chapel integrates different strata transiting from tectonic reality to illusory space. The triumphal arch and wainscots are made of stone with embedded polychrome marbles, and the upper levels of its interior walls are covered with carved painted wood simulating stone pilasters, capitals and cornices. Hence, elements at the observer's eye level, with whom a direct corporeal relation is established, are made of real stone while above feign stone mediates the chapel's structural reality with quadratura's simulated architecture. For its part, quadratura image merges with the compositional elements of constructed space maintaining alignments, measures and modulation integrating real and illusory facts as an unity within the visual field. The center of gaze captures the open sky and revelation of the transcendent. On the other hand, peripheral vision is framed by architectural construction involving the subject and amplifying the nature of the illusion.



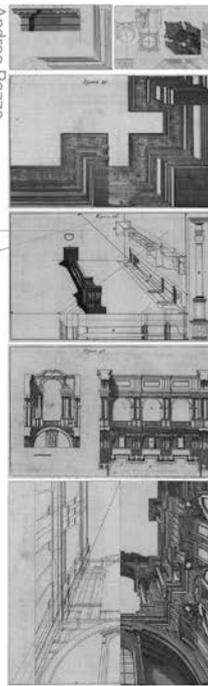
Sena's architectural proposal

Drawing of Sena's Quadratura

Section of perceived space



Andrea Pozzo



abstract

Perspective and architecture is regarded in this paper throughout *Quadratura's* simulated space. This uptake into baroque architectural culture and science seeks for spatial representation as a challenge capable of creating new assumptions over tectonic reality. Provided by perspective, the *Quadratura* by Gonçalves Sena, at the altar's vault in Santarém's Cathedral, transforms real space proposing a new impression of the architectural image. This whole artistic complex, *bel composto*, intertwining constructed and represented architectures reaches a cohesive unity among the various elements in which the viewer has the feeling of being *immersed* into a complex spatial product.

Key words

Perspective, Quadratura, Architecture, Gonçalves Sena, Santarém.

1. Introduction

Building a *Truth*

This document summarizes the scope of the author's Ph.D. research addressing the theoretical review on perspective to analyze the Gonçalves Sena's *quadratura* at the altar's vault in Santarém's cathedral (the Jesuit college church). An acknowledge of its geometrical procedures following a methodology based upon graphic survey and speculation.

Modern Age developments on perspective are established under two mutually balanced assumptions: ability to acknowledge and transform the world; reduction into the condition of reproducing sensible reality.

Based upon a metric apprehension of the cosmos, perspective enhances optical acknowledge along with Euclid's, Thales', and Apollonius' geometry to formulate models capable of translating visual image into geometric-mathematical procedures. Consequently "(...) representation gained access to a new kind of *Truth*" [1], confirming the reciprocity between visuality and representation leading to a conformity between idea/perspective fiction and object.

Instead of *imitating*, a new reality is produced under perspective procedures. As such, *quadratura*, amplifying the magical character of the Albertian window, presents itself as an architectural instrument requiring a vast scientific domain over mathematics, optics and perspective, along with a rigorous practice based upon architectural design. Whether we speak of perceptual transformation of architectural space, or the observer's submersion into the plots of visual rhetoric, Baroque's polyphonic character is fostered by perspective maneuvering perception over tectonics' metric and formal nature.

2. The research

Science, Architecture and *Quadratura* and the Portuguese baroque.

In the early 18th century, Portuguese scientific, architectural and *quadratura* production experienced a renewal incorporating new spatial features. The *contrappunto* Science/Architecture/ *Quadratura* is intended as action in which real (constructed) and illusion (represented) intertwine, creating a complex sensitive *Truth*. Throughout this approach Portuguese baroque deals with a plurality of acquirements immersing the viewer into a *bel composto* where the baroque seductive potential is accentuated by integration of optical phenomena.

Professor at Lisbon's *Anla da Sphera*, **Inácio Vieira's** theoretical investigation on perspective confronts and summarizes contents from pre-modern (Euclid, Vitruvius, Alhazen and Witelo), Italian (Pozzo and Bibiena) French (Dubreuil and Dechaes), German (Kircher, Schotto, Scheiner and Dechaes) and Spanish (Tosca) sources. His extensive production contains, among others the treatises on *Óptica* (1714), on *Prospectiva* (1716) and

Dióptrica (c. 1717), where perspective is taken as vision's delusion serving the practice of painting and space manipulation. Vieira's approach leads to dramatization of physical reality, extending senses' deception, and therefore of reason, to its limits.

Architect of D. Pedro II and D. João V [2], **João Antunes** combines national plain tradition with a new spatial approach according to Roman baroque models (Fontana). From his works we underline the Churches of *Menino Deus* (Lisbon, 1711) and *Senhor Jesus da Cruz* (Barcelos, 1704), where complex polygonal plans, combining longitudinal and centralizing trends, developed a synthesis widely repeated by Portuguese baroque architects.

Hosted by the court and ecclesiastical community, **Vincenzo Bacherelli** introduces *quadratura* painting in Portugal. As such, the ceiling at *S. Vicente de Fora* monastery (Lisbon, 1710) is taken as a starting point for a new spatial feature that will mark Portuguese baroque. According to his background the work evidences the Bolognese lesson (Vignola, Danti, Cigoli, Troili and Bibiena) and polarizes an aesthetic intermediating the sacred and profane.

Following the Bacherelli lesson, the work of **Simões Ribeiro** reveals the absolute appropriation of the Bolognese model to national circumstances, although his affiliation is immediately understandable through ornamental features (garlands, rosettes, false reliefs and *putti*) or architectural grammar (balconies, counter-curved arches and volutes).

Gonçalves Sena as illusory architect.

According to the exposed context while Simões Ribeiro is credited by updating Santarém's *quadratura* (1719-32), **Gonçalves Sena's** *quadratura* painting (1754) should be the one regarded as a complex cultural product embodying illusion [3]. Sena redirects his work towards Pozzo's theoretical and practical model fitting his patron's conception of the cosmos and exposing image's rhetorical force by integration on the overall temple's *bel composto* [4]. Proximity to Pozzo's model is not satisfied by mere translation of treatise schemes, but rather the result of an accurate knowledge of perspective procedures, along with awareness of architectural composition principles [5]. Under this light Sena is classified as "*Painter a great architect, or perspective*" [6], exalting the architectural nature of his pictorial work, and his ability in manipulating instruments of delusion. Showing an obvious ambition to foster spatial composition he matches the idea that "A good painter should be, possibly, a good architect or at least know from architecture all that was related to ornaments' design, proportions and syntax of the classical orders" [7]. Architectural substance is taken by *quadratura* as an operative fact applied into reconfiguration, adjustment and transformation of tectonics' perception.

At Santarém's shrine, a wide open rectangular space with side altars, spatial configuration of the main chapel integrates different strata transiting from tectonic reality to illusory space. The triumphal arch and wainscots are made of stone with embedded polychrome marbles, and the upper levels of its interior walls are covered with carved painted wood simulating stone pilasters, capitals and cornices. Hence, elements at the observer's eye level, with whom a direct corporeal relation is established, are made of real stone while above feign stone mediates the chapel's structural reality with *quadratura's* simulated architecture.

For its part, *quadratura* image merges with the compositional elements of constructed space maintaining alignments, measures and modulation integrating real and illusory facts as an unity within the visual field. The center of gaze captures the open sky and revelation of the transcendent (presenting a floating virgin with surrounding angels). On the other hand, peripheral vision is framed by architectural construction (virtual and factual) involving the subject and amplifying the nature of the illusion. In this merge the vault's image becomes locus of rituality, reinforcing the parallel between embodiment of facts through representation and evocative homily: "(...) words are listened, the works are seen: the words come

through the ears, the works come from the eyes, and our soul surrenders much more by the eyes than by ears" [8].

In the absence of preparatory drawings and documental funds, Sena's *quadratura* analysis, tracing geometric empirical-practical procedures, intertwines acknowledge over coeval treatises, particularly through Vieira's lessons contents at *Aula da Sphera*, with graphic survey and speculation. This methodology allows us to verify the strength of the perspective image in its obedience to projective precepts. As well as to obtain the necessary projections to evaluate the global architecture of the chapel in its successive contractions and expansions over the vertical axis that unifies real and illusory space.

According to the chapel's surveying (taking into account construction and represented facts) it is possible to identify the viewpoint (at 1.6 m height in axis with the geometrical center of the image), virtual picture plane (at the cornice's level), projective plane (vault), and vanishing points (convergence of verticals and distance point) giving bases to inverse perspective procedures. As enunciated by Vieira on the 292nd figure of his perspective treatise the projection method should take into account subordination of the image prototype to an orthogonal grid, projection of the grid over the architectural surface, and image transfer. This practical procedure on transferring a regulatory network is based upon strings stretch through space (one coincident with the viewpoint's vertical projection on the vault and other oblique drawn between this point and regular intervals along the cornice). This way the 18th proposition of the 11th book of Euclid is applied by Vieira allowing to delineate the intersection of vertical planes (containing edges of key elements of the illusory construction) with the curved vault surface.

By observation *in loco* it is possible to detect anchorage marks, one at the center of the image as well as along the vault's limit. Such incisions and marks allows us to extrapolate over model and drawing, along with coeval treatises references, retracing its author steps in the *quadratura*'s implementation.

3. Conclusion

Sena's *quadratura*, related to Pozzo's model, acts as a metamorphosis of appearances over the overall tectonic construction. Incorporating optical values *quadratura* intertwines image with space structural elements, providing materialization of an architectural idea. Perspective is imposed as an instrument to overcome limitations of space metric and formal nature. Under the structural complexity of baroque space strata, and its symbolic universe, concrete and sensitive dimensions are crossed synthesizing a continuous event that challenges space apprehension.

REFERENCES

- [1] DAMISCH, Hubert, 1995. *The Origin of Perspective*, MIT Press, Cambridge. 148.
- [2] The cultural program carried out by D. João V established a strong presence of Italian authors: **Guimac** introduces the Roman baroque of Fontana (the academic baroque seems to suite the national plain tradition); **Juvarra** presents projects for a new kings palace; the goldsmith **Ludovice** reaches the status of royal architect interfering over the most remarkable works of the reign; **Canevari**, works for the Lisbon patriarch; **Bacherelli** introduces *quadratura* painting; the decorator **Nasoni** reorients his activity incorporating upon architecture his *quadratura* and scenography practice. Authors from so-called "*minor arts*" raised their status to an higher level, integrating into the overall spatial proposals their creativity and ability in manipulating senses.
- [3] In Portugal Sena's *quadratura*, affiliated on the Pozzo's Jesuit model, remains as an isolated event since national production follows, essentially, the Bolognese model.

[4] Once a translation of the Pozzo's treatise was produced on the city's Jesuit college, Sena was certainly aware of its contents.

[5] From the constructive elements used by Sena a parallel should be drawn with Pozzo's figures in *Perspectivæ pictorum atque architectorum* (1693), stating the acknowledgement and affiliation towards this particular model: the lateral arches and 33rd figure; the Corinthian capitals and plain shaft of column with the 83rd and 86th figures; the brackets and the 78th figure; as well as the cornice modulation and the 85th figure. This combination of elements from different orders is a recurrence of Baroque architecture in which the classic elements are regrouped on the basis of a critical review of classicism and an overall optical effect.

[6] BENEDICTO, Joaquim Duarte, 1791. *Elogio do grande apelles portuguez, Luiz Gonçalves de Senna*, Officina patriarcal de Francisco Luiz Ameno, Lisboa. 9.

[7] CAMEROTA, Filippo, 2006. *La prospettiva del rinascimento. Arte, architettura, scienza*, Electa, Milão. 242.

[8] VIEIRA, António, 1655. *Sermão da Sexagésima*. In VIEIRA, António, 1984. *Sermões escolhidos*, Ulisseia, Lisboa. 5