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Geometry of Faith: a Stereotomic Reconstruction of Sainte-Anne-la-Royale in Paris

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SAINTE-ANNE-LA-ROYALE IN PARIS

by

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ABSTRACT

GEOMETRY OF FAITH: A STEREOTOMIC RECONSTRUCTION OF SAINTE-ANNE-LA-ROYALE IN PARIS

by

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Planned during the XVIIth century by the Italian architect Guarino Guarini, the church of Sainte-Anne-la-Royale was supposed to be built in Paris to honor the French Queen Anne of Austria. In an unfortunate twist of fate the church was only partially realized and later destroyed. Present history's only memory comes in three engravings by Guarino Guarini himself: a plan, a transversal section, and the main elevation.

An example of Italian Baroque Architecture, the building shines for its intriguing plan and complex system of vaults. Its execution was supposed to be realized according to the refined techniques of French stereotomy. Faithful to its original inspiration, Sainte-Anne is here rebuilt using a rational geometric system that links each element in the composition by projections and squaring of circles.

Each of the elements composing the church has been individually analyzed and reconstructed. The main reference for this process has been provided by Guarini's posthumous essay *Architettura Civile.*

Though still unbuilt, Sainte-Anne-la-Royale has been reconstructed by a new set

of drawings, both handmade (pencil on mylar, 30"x40") and computer generated, and a physical model (3d-printed; about 41” tall).

To

Thomas E. Eichman III

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CHAPTER 1 – Faith, Science, and the search for truth

1.1 The spiral of decadence

From the end of the fifteenth century until the early seventeenth, the culture of the Western world was subject to a profound reshaping. Economic change (the expansion of trading routes and the development of systems associated with the term "capitalism"),[1] intellectual readjustment (new discoveries in physics, astronomy, anatomy, mathematics),[2] political consolidations (the centralization of power and administration in the creation of a "new monarchy," like the Papal States),[3] and a religious rethinking (the Protestant Reformation by Luther followed by the Counter-Reformation, a conservative and violent repression of progressive innovation by the Inquisition's Tribunal)[4] show different and contrasting ways in which the seed of modernity started spreading out. The new world under creation was not just an over-simplistic reshaping of Middle Age thoughts with Renaissance methods; its main driver was a profound modification of scholastic education from the previous medieval universities to a new methodology known as Humanism. The past knowledge was now no more rejected (like it partially was during the Middle Ages): it became an achievement to surpass.

Like other pillars in European civilization, also the roots of Christian religion were shaken by a purification process. Using the precepts from the New Testament as principles for a religious future more suitable to the present needs, the Council of Trent (1545-1563) promoted a clarification of dogma and a reform of clerical behavior.[5] While

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1 William V. Hudon, *Theatine Spirituality* (Mahwah, NJ: Paulist Press, 1996), p. 2
2 *Ibid.*, p. 3
3 *Ibid.*, p. 4
4 *Ibid.*, p. 8
5 *Ibid.*, p. 12

Figure 01. Gaetano da Thiene
Engraving by Andrea Magliar, published by Paolo Petrini; Francesco Solimena (after). Italy, 1700.

the Council decreed the culmination of this reforming process, traces leading to it may be found ahead of time in the Order of the Clerks Regular, better known as Theatine Order, founded in 1524.[6] Aiming for a restoration of the true values of faith, Gaetano da Tiene (c. 1480-1547) promoted the creation of the Theatine Order encouraging a pastoral and spiritual outlook for parish priests and bishops. An early manifestation of the later Counter-Reformation,[7] the new born religious congregation adopted a life of interior spirituality through pastoral and charitable work counteracting the intellectual and moral decay of the contemporary clergy;[8] or at least this was the original intent of the Order. Beside Gaetano da Tiene **[figure 01]**, in fact, other three individuals helped in its creation: Gian Pietro Carafa, Bonifacio de' Colli, and Paolo Consiglieri. Among them, Carafa **[figure 02]** had a key role in shaping the future of the Order throughout the Vatican hierarchy.

Born in an aristocratic family with cleric past, Carafa became Bishop of Chieti through the intercession of his uncle, a Cardinal in the same town. Chieti's historical name was *Theate Marrucinorim* making Carafa known as “the one from Theate,” this is to say “the Theatine,” from which the Order got its name. Despite the self-denial and poverty vows essential to the nature of the Theatine Order, Carafa retained his episcopal status and the pontifical faculties associated to his bishopric (such as the authority to ordain priests). Likewise, Gaetano resigned from his curial office of *scrittore apostolico* (apostolic writer) only after his appointed successor paid him for the office. The resulting money, together with other funds coming from the sale of its founders' possessions,

6 David R. Coffin, “Padre Guarino Guarini in Paris,” *Journal of the Society of Architectural Historians*, XV, 2 (1956): 3
7 *Ibid.*, 3
8 William V. Hudon, *Theatine Spirituality* (Mahwah, NJ: Paulist Press, 1996), p. 21

Figure 02. Pope Paul IV (Gian Pietro Carafa)
Drawing by Onofrio Panvinio. Italy, before 1568. Available from:
http://www.pitts.emory.edu/woodcuts/1568Panv/00019429.pdf

enriched the new congregation whose purpose was exactly to reform such clerical abuses.[9] This, however, did not mean the founders of the Theatine Order were breaking the rules they gave themselves; they were essentially providing a personal interpretation of these very same rules, especially when dealing with the poverty vow. In a document appearing later after Carafa's death in 1628,[10] Carafa explained that holding of annual ecclesiastic incomes were allowed only if held in common.[11] The same set of rules also expressed the method for choosing and admitting new members: after three years on training, new aspirants were admitted on probation in the Order. Upon a general meeting, a final admission required the unanimous consent of the members in the Order.[12] These minor changes, however, were still far from the future changes Carafa would promote soon after. Using his family connections, Carafa aided the Theatines rise through the Vatican hierarchy until gaining Papal approbation in 1555, when Carafa himself was appointed Pope Paul IV.[13] With new headquarters in Rome, Carafa enlarged the mission of the Order through new concessions and powers. The Theatines sustained an anti-heretical activity according to Carafa's credo *"punish or, at least, condemn the wicked heretics.*"[14] Theatine priests were now able to abbreviate the divine office, hear confessions, and grant absolutions—concessions usually reserved to pontifical authority only. In the same way, duties and clerical positions of the Theatines were updated too. New tasks included the supervision of the Roman breviary, the missal, and, more importantly, the control over the Vulgate edition of the Bible. At the same time, Theatine

9 *Ibid.*, p. 22
10 *Ibid.*, p. 23
11 *Ibid.*, p. 24
12 *Ibid.*, p. 24
13 James F. Loughlin, "Pope Paul IV," in *Catholic Encyclopedia* (New York: Robert Appleton Company); Hugh Chisholm, "Pope Paul IV," in *Encyclopedia Britannica* (Cambridge, MA: Cambridge University Press, 11th edition), 956.
14 William V. Hudon, *Theatine Spirituality* (Mahwah, NJ: Paulist Press, 1996), p. 26

priests became responsible for the formation and education of missionaries and clergy in general spreading out new seeds of the Order in powerful locations in Italy, (Naples, Padua, Piacenza, Milan) and around Europe (Paris, Nice, Lisbon, Prague).

1.2 The dawn of a new world

Joining the Theatine order, a fifteen year old Guarini **[figure 03]** began his priestly education in theology and philosophy, essential to future clergy men. His education included mathematics, geometry, and natural sciences (Physics, Optics, and Astronomy) in which he excelled. This scientific background was collected in his essay *Euclides Audactus*, (the "Applied Euclid") and later applied in another essay by the Theatine priest, *Architettura Civile* (Civil Architecture). Beside remaining incomplete, the latter essay offered a new and innovative approach to architecture, even if its acknowledgment was recognized only in recent times. Until the XXth century, in fact, Gaurini's works received negative critiques due mainly to the awkward esthetics of his works. Guarini's projects can not be linked to Renaissance aesthetic precepts where space was mainly framed by standard modular elements reminiscent of Roman heritage (like in Bernini's works). Opposing this, Guarini's architecture is openly inspired by Gothic principles similar to Borromini. "Gothic" was a synonym of corruption at that time whose architectural reference recalls barbarian rules against the classical heritage.[15] A contemporary of Guarini, Borromini already included similar ideas in his own architecture. Guarini, instead, pushed his structural explorations much further than his illustrious colleague.[16] In the projects of the Theatine priest the individuality of each

15 Jake Morrissey, *The genius in the Desgin – Bernini, Borromini, and the Rivalry That Transformed Rome* (New York: HarperCollins Publishers Inc, 2005), p. 8

16 Christian Norberg-Shulz, *Baroque Architecture* (Milan: Electa Editrice, 1979), pp. 122-143

Figure 03. Guarino Guarini
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), frontispiece.

compositional element disappears to create the illusion of an evolving organism surrounding the faithful; vaults and domes are framed by slender ribs, visually nullifying their structural weight; arches are tilted, assuming sharp profiles instead of cylindrical intradoses. The apparent chaos in the resulting compositions exalts the goals of Baroque architecture. Only when looking at the bigger picture, a pristine geometric order unveils references to Universal and Cosmological utopias.

His uniqueness among Italian XVII^th^ century architects prompted several scholars to attempt hypotheses on Guarini's possible inspirations. Beside the professed Gothic influence, which Guarini will openly homage in *Architettura Civile*, a recurrent theme suggests Islamic principles. The roots for this hypothesis are based on the esthetic resemblance between Guarini's domes and Hispano-Moresque structures. Distant from classical traditions, Islamic culture appears to be the traditional setting for interlaced ribbed domes.[17] These domes moved along the Southern shores of the Mediterranean Sea spreading out from the Islamic homeland to the Iberian Peninsula in the kingdom of Al-Andalus (I^st^ century CE). Due to their location in continental Europe, these Spanish examples became testimonials of Islamic architecture in the Christian world. At the same time, small centers in Southern Italy also hosted Islamic and Arabic groups; among them, Sicily offered the most interesting site since the island, like most of southern Italy, was for a time under Spanish control. Moreover, it will be in Sicily that, centuries later, Guarini will spend part of his life as teacher for former clergy men in the Theatine Order. During the XVII^th^ century the Sicilian homeland still hosted sporadic buildings with

17 Adolfo Florensa, “Guarini ed il Mondo Islamico,” in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 637-665.

traces from an Islamic ancient past (although none have survived). Similar examples might have been a possible inspiration source for the young Guarini. Other scholars, instead, bring the Theatine priest directly in contact with the Spanish inland. While un-documented, scholars suggest Guarini took a trip to Cordoba between 1660 and 1662.[18]

Indeed the striking resemblance of San Lorenzo in Turin to the vaults in Cordoba's Mosque is undeniable **[figure 04]**. However, under the lenses of structural analysis the two buildings show a completely different structural approach. In Cordoba the arches framing the vaulting space lay on independent planes. Preserving a standard setting with intrados parallel to ground, these arches intersect one another with visible junction lines. In Guarini's compositions, instead, the whole dome is carved along a spheric surface sliced by radial planes where arches become structural ribs merging together without visible junction lines. These ribs segment the spheric surface by elements smaller in length than the total diameter of the dome itself concentrating the strength of the dome in specific structural nodes. Compared to historical counterparts like the Pantheon (Rome) or Santa Maria del Fiore (Florence), Guarini' structures appears much lighter in weight while improving the illumination of the indoor space. It is not surprising to find in Guarini such a technical advancement from the vaults in Cordoba's mosque; the two examples were in fact realized after almost fifteen hundred years from one another. However, beside their improved technicality, Guarini's domes are embedded in a compositional setting much more complex than its Islamic counterparts.

A constant theme in the architecture of the Theatine priest, interlaced ribbed

18 The same trip is sometimes used to explain projects in Nice, Prague, and Lisbon documented in *Architettura Civile*. It is not clear if Guarini really visited these locations or not. In the case of Lisbon, Guarini's project was realized and then destroyed by a fire; no documents however show traces of a trip Guarini took in the Portuguese capital city.

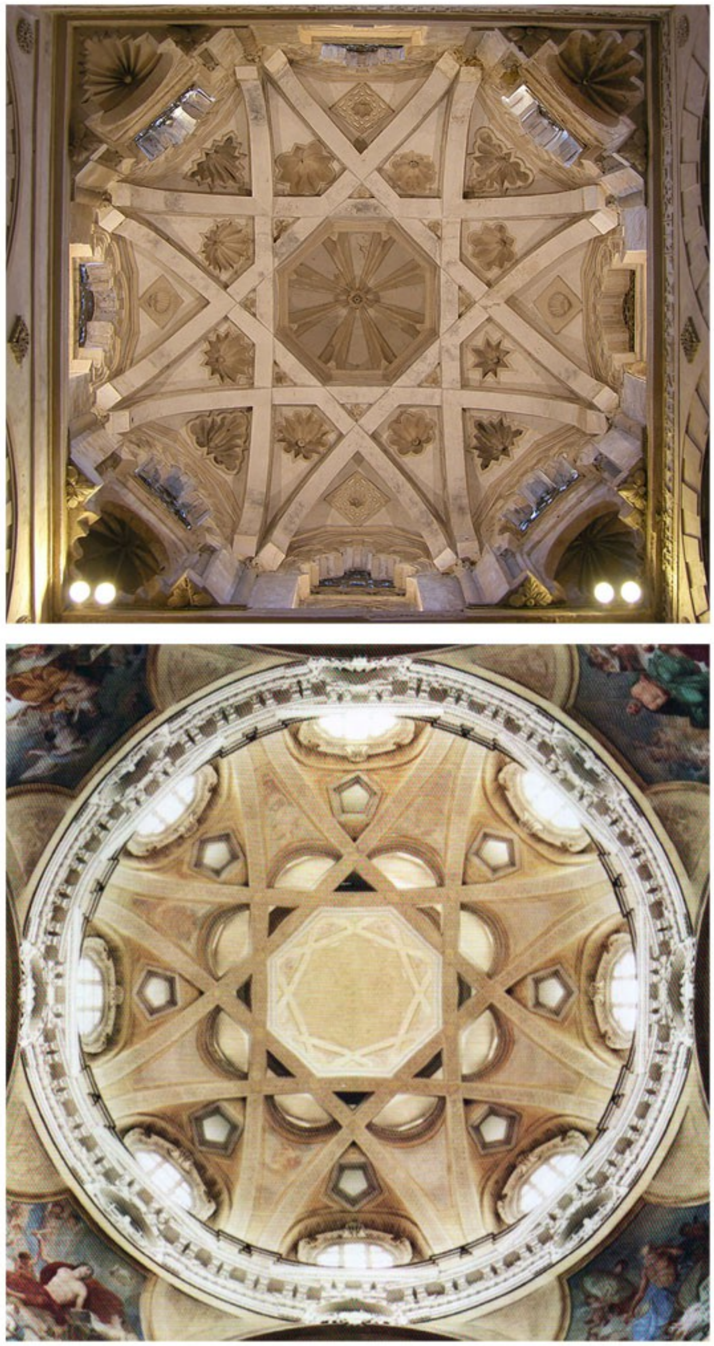

Figure 04. Comparison between the maqsura's vault in Cordoba's Mosque (at the top) and San Lorenzo in Turin (at the bottom)
Cordoba's Mosque Maqsura:
© Art en Cordoba. Available from: http://www.artencordoba.com/English/MOSQUE-CATHEDRAL/PHOTOS/INSIDE/MOSQUE_CATHEDRAL_MAQSURA_04.jpg

San Lorenzo in Turin:
© Pino Dell'Aquila. Available from: Giuseppe Dardanello, Susan Klaiber, Henry Millon, *Guarino Guarini* (Turin: Umberto Allemandi & C., 2006), fig. 51

domes are approached in a wide variety of permutations; although, only San Lorenzo in Turin shows a direct citation of the Spanish mosque. The building, realized in the maturity of his architectural career, was a commission from Guarini's new patron, the Savoy Family. Maybe through the political power of his new patronage (which will rule Italy during the XIXth century), Guarini decided to emulate the mosque in Cordoba. It is unknown how or who directed Guarini towards the Spanish mosque. Possible hints in this direction, may be suggested by the scientific formation Guarini had especially in relation to astronomy, a topic on which the priest published three books. Using mathematics and geometry to unveil the setting of the Universe, personalities like Galileo, Copernicus, and Kepler widened the boundaries of astronomic knowledge, breaking Ptolemy's geocentric theory while questioning the role of humankind in the Universal fabric.

Until that time, in fact, the Universe was commonly depicted by the secular model created centuries ago by Ptolemy: a set of concentric spheres centered on Earth. In this system, the movement of the planets was described by variable geometries alternating circles and equants. Generated by an epicycle revolving around a circular deferent, equants represent a complex figure attempting to explain the errant movement of Mars, Jupiter, and Saturn whose observations were deceived by the actual rotation of Earth around the Sun. Reminiscent of equants' convoluted profiles, Guarini's domes are framed by a set of ribs gravitating around the three-dimensional center of the composition without ever approaching it. The resulting open center becomes a window through the fabric of the Universe; the emptiness of the sidereal space outside the boundary of fixed stars (represented by a second dome superimposed to the interlaced ribbed one) and, at the top of it, the location where God himself exists, rendered by an unreachable lantern. More than other examples by Guarini, the dome in Sainte-Anne-la-Royale in Paris suggests a clear reference to Astronomic themes. Here, a double tier of arches frame the inner surface of the dome generating a structure whose complexity will be abandoned in future compositions by the Theatine priest.

On a similar scientific inspiration, George L. Hersey linked Guarini's domes to armillary spheres.[19] These devices **[figure 05]**, used during the XVIIth century to represent analytic models of Earth, were composed by a series of circles revolving around Earth's celestial axis—the circles representing the celestial spheres surrounding Earth. This hypothesis seems supported by the star-like decorations in San Lorenzo's ribs whose pattern might well represented the fixed stars contained in the outmost heavenly sphere. Hersey, however, pushes to the extreme this hypothesis suggesting that the windows opened in between the dome ribs had the purpose to trace the movement of the Sun, thus transforming the whole building in a sort of sundial. Although fascinating, this hypothesis can be hardly proved. A similar setting, in fact, should take in consideration not just the architectural composition of domes but also the original orientations of Guarini's churches. Since most of them, were never realized or, at the present time, are no more existing, it is almost impossible to collect similar information, leaving the hypothesis empty.

Greek translations of Persian scientific knowledge start to arrive in Europe at the

19 Armillary spheres were scientific representations of the Universe. They were obtained by the intersection of several rings (the *armillae*) marked with degrees, representing the great circles of heaven, including the equator, the ecliptic, the tropics of Capricorn and Cancer, the polar circles and the meridians. [See George L. Hersey, *Architecture and the Geometry at the Age of the Baroque* (Chicago: The University of Chicago Press, 2000), pp. 72-74]

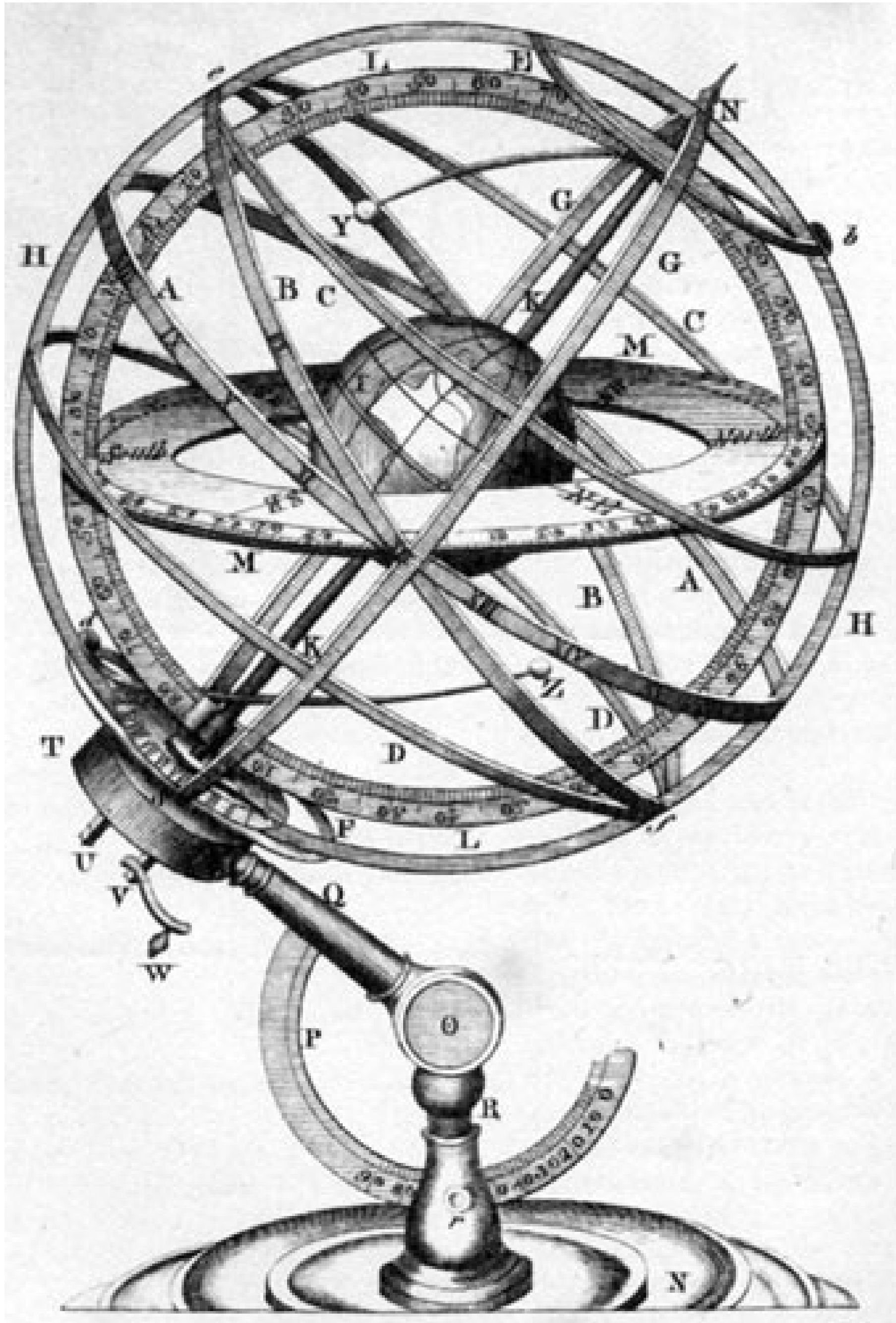

Figure 05. Armillary Sphere
AA.VV, *Encyclopedia Britannica.* 1771. Plate LXXVII. Available from:
http://upload.wikimedia.org/wikipedia/commons/3/3c/EB1711_Armillary_Sphere.png

time of the Byzantine Empire. Even if sporadically mentioned, similar sources were still available during the XVIIth century; scholars suggest they might have inspired Copernicus revolutionary work.[20] Apparently one of the main references used by the German scientist to create his heliocentric system, was the Commentary on the Almagest (1247) by the Persian astronomer and mathematician Nasir al-Din al-Tusi.[21] Linking two circles whose diameters where in the proportion of 1:2, the Persian scientist described a geometric device linking circular motions to straight lines. It can not be stated if Guarini came in contact with the work by al-Tusi although, due to his three publications in the field, the hypothesis can not be immediately discarded, especially taking in consideration that a copy of the text was held in Rome (where apparently Copernicus had the chance to consult it).[22] In this case, a connection with Spain does not surprise; the peninsula hosted in ancient past Islamic cultures and, at Guarini's times, it was much more approachable than the Islamic homeland. According to historical records, Guarini had several connections with Spain; first of all because of his office in Sicily, which was for a long time under the Spanish control together with most of Southern Italy;[23] his friendship with Antonio Ricci, artist at the Spanish court who introduced Guarini to the Salomonic Order (used in the project for Lisbon); a close relationship with Francisco De Mello,[24] Portuguese Ambassador at the French court, might have provided Guarini with travel

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20 Norriss S. Herherington, *Planetary Motions: a historical perspective* (Westport, Conn.: Greenwood Press, 2006), p. 80 according to which a XIVth century copy of al-Tusi was stored in the Vatican Library itself.

21 George Saliba, "Whose Science is Arabic Science in Renaissance Europe" http://www.columbia.edu/~gas1/project/visions/case1/sci.2.html

22 *Ibid.*

23 Jake Morrissey, *The genius in the Desgin – Bernini, Borromini, and the Rivalry That Transformed Rome* (New York: HarperCollins Publishers Inc, 2005), p. 19.

24 Aurora Scotti Tosini, "Testo e Immaigni nell'Architettura Civile e nelle Opere Teoretiche di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), p. 90; Paulo Varela Gomes, "Guarini e il Portogallo," *Ibid.*, p. 515.

accounts. Maybe through these connections Guarini was directed towards Cordoba's mosque, obtaining an indirect knowledge of the building, which may explain the visual similarities but structural differences between the Spanish mosque and San Lorenzo in Turin. If such a connection with Cordoba really existed, it is not surprising the lack of documentation. If already the word "gothic" lead to negative assumptions, reference to Islamic cultures would scream heresy in an era demanding obedience. Guarini was never accused of such sinful acts, of course. Instead he seems always to take the side of Roman Church—although the impossibility of openly talking may be grasped in some of his literary works. Likewise, his personal interpretation of faith (which, however, was never questioned) seems to take shape in his architecture only.

1.3 The Structure of the Universe, the Geometry of the Soul

Copernicus' heliocentric theory removed Earth from the center of the Solar System and substituted it with the Sun. The new pristine architecture for the Universe was thus purged of the complex geometry of equants.[25] The heavenly bodies were now all revolving along circular orbits expressing the perfection of God's creation. Later revised by Kepler in terms of its geometric setting (circles were substituted by ellipses due to the data Kepler inherited from Tycho Brae),[26] the overall structure of the Universe from Ptolemy's geocentric system did not change—beside reconsidering the location of Earth, Moon, and Sun. Its proportions, however, were updated. Kepler established the position of each celestial spheres by inscribing in each of them a platonic solid with increasing

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25 An equant is a curve generated by a point rotating on a circumference along a circular trajectory.

26 Kitty Ferguson, *Tycho & Kepler – The Unlikely Partnership That Forever Changed Our Understanding of the Heavens* (New York: Walker & Company, 2002), pp. 304-305. According to the source, Kepler got from Tycho Brea over 40 years of observation of the planet Mars revealing its divergence from a circular orbit in what will become the perielium and aphelium in elliptical orbits.

complexity thus justifying the sidereal distance between them. Still revolving one inside the other, the celestial spheres created harmonies whose musical tones translated the mathematical principles ruling the whole system. If Universal order might be expressed through music, its geometry might have been replicated in architecture. Maybe it was through these lenses that Guarini critically read the Architectural Orders. Referencing Vitruvius and his Renaissance interpretations, Guarini promoted the creation of a unique parametric system aimed at mathematical architectonic compositions.[27] Previously, in fact, different modular systems were used to translate the complex nature of architectural orders. Proportions in Tuscan, Doric, and Ionic orders (whose module was divided in twelve parts) were usually not compatible to the ones in Corinthian and Composite (whose decorative nature suggested a module divided in sixteen parts). In the same way, the use of mathematical devices like the golden section were mainly ascribed to visual tricks for balancing a composition more than rooted in their mathematical significance. Already before Guarini, Vivante, an Italian scholar, tried to connect architecture, music, and astronomy aiming for a total system inspired by Universal order.[28] However, Vivante failed in his attempt to use Vitruvian modularity. His system, in fact, interpreted architectural modules as musical tones reflecting the Universal proportions. Defining a tone as the distance between Earth and Moon, Vivante constrained the solar system in seven musical tones compacting and destroying the Universal order unveiled by scientists.

27 Conventionally, in fact, the architectural orders were proportioned according to two different modular systems; one system for Tuscan, Doric, and Ionic order; a second for Corinthian and Composite whose decorative nature required a further division of the column radius.

28 Quirico Viviani, “Giunta III: Della Musica Riferita all'Architettura,” in *L'Architettura di Vitruvio* (Udine: Tipografia Pecile, 1831), pp. 111-123

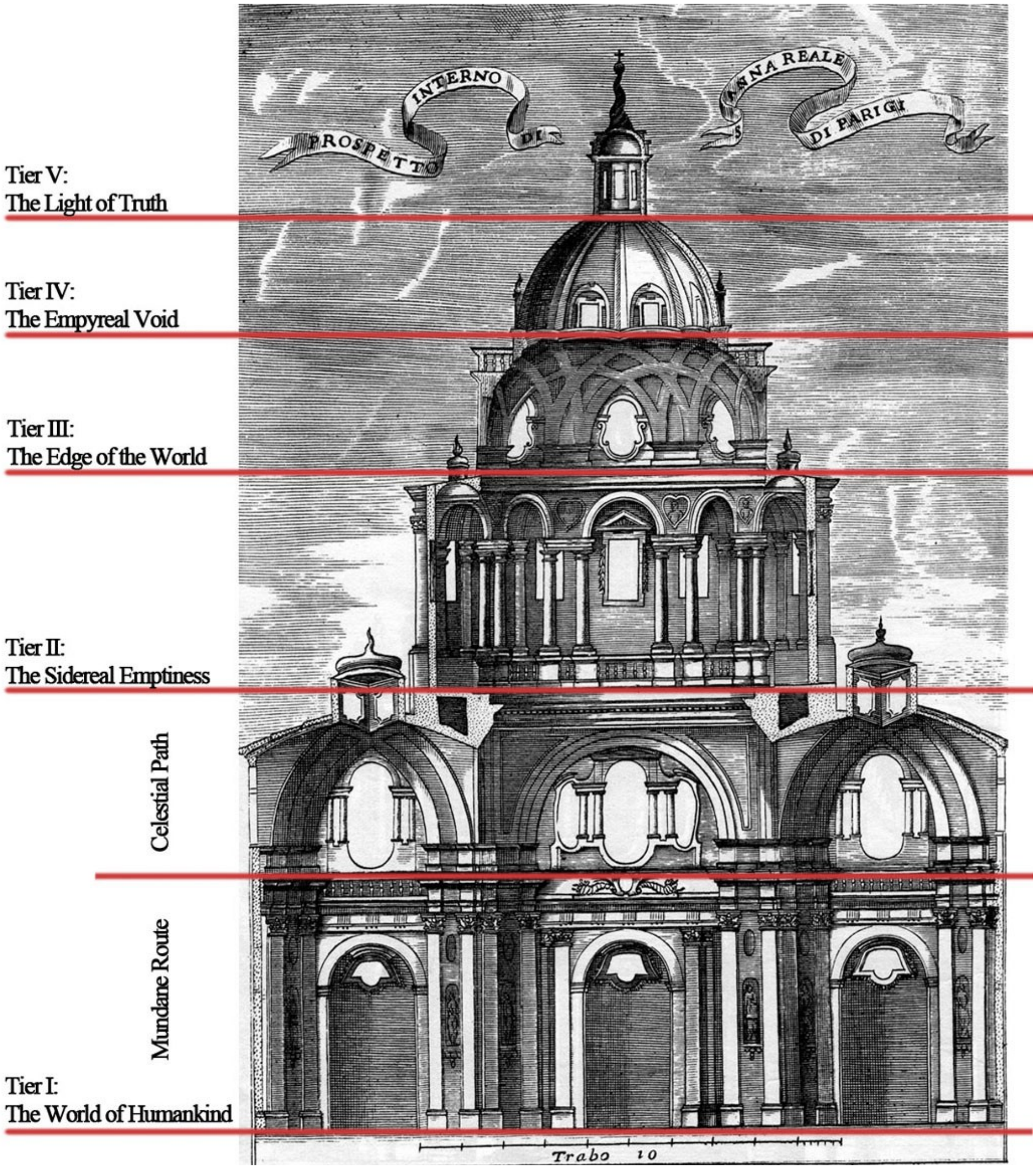

Figure 06. Tiers of faith in Sainte-Anne-la-Royale in Paris
Original engraving from: Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per g'Eredi Giannelli, 1686), Plate 11. Additions by the author.

Luckily, Guarini did not follow a similar path. Taking inspiration from Ptolemy and Kepler's works, Guarini embedded his architecture in a mystical meaning where the soul progressively levitates towards Heaven. The resulting ascensional path can be compared to the one described by Dante in the *Divina Commedia*. It pervades most of Guarini's buildings although its depiction happens through constant variations and alterations. The soul follows a path composed by tiers of faith and corresponding to different levels in each building **[figure 06]**:

- *Tier I - The World of Humankind*

  First level in Guarini's buildings, represents the daily world in which the soul is entrapped in a flesh body. It is further divided in two layers: the *Mundane Route* (the area containing the architectural orders) and the *Celestial Path* (the vaults, usually framed by structural ribs). The two paths follow different orientations; the *Mundane Route* moves along horizontal and vertical axes while the *Celestial Path* develops along diagonally oriented routes. Beside its name, the *Celestial path* does not represent Heaven (located much higher in the composition); it is a place of devotion where the soul, temporary purified by the word of God, elevates itself from its terrestrial existence. The temporary cleanse is rendered by the ribs framing the vaults which always connect columns and pillar in the

Mundane Route thus rooting the soul in his terrestrial life.

- *Tier II - The Sidereal Emptiness*

  Finally free from its flesh body, the soul may purify itself. This level suggests a sidereal location between Earth and Heaven where the soul ponders about the Terrestrial Life left behind (the level below) and the new existence that will come after (the levels above). It is a special and privileged location accessible only to selected people. Not always rendered in Guarini's churches, this level suggests solitude; a place where faith does not require words to be expressed; a place where the soul glimpses a distant Heaven while purging the corruption and disbelief tangling humanity.

- *Tier III - The Edge of the Universe*

  On the top of the previous level, the interlaced ribbed dome embodies the Edge of the Universe, the boundary of God's Creation. Its structure is usually referred to as “first dome” although, to a better analysis, it represents a gigantic pendentive. The ribs framing the dome transform the spheric profile into a polygonal one, reminiscent of Kepler's solids between the heavenly spheres. According to armillary spheres, these ribs represent the outermost boundary of the Universe containing the fixed stars (as visible from the star-shaped carving decorating the ribs in San Lorenzo in Turin). The eternal light of these heavenly bodies comes by viola shaped windows (reminiscent of the musical tones played by the heavenly spheres) which, because of their location, are not visible from the bottom of the church,.

- *Tier IV - The Empyrean Void*

  A second dome laying on the top of the interlaced structure embodies the "unknown" beyond the heavenly spheres. Heaven. Following a raised arched profile, this level floats at the top of the composition with a telescopic effect. Its light sources, however, are smaller in size than the windows in the levels below providing an untraditional depiction of Heaven. It is not a place full of light and singing angels but a physically unreachable place where the soul can finally rest in peace. In its partial shadow, this place is finally disconnected by the world below. Its view, however, is still directed towards the top of the composition, where God himself resides.

- *Tier V - The Light of Truth*

> The lantern towering the Universal utopia finally shows the light of faith and devotion; this is the place where God, the Creator, resides. Compared to the other light sources in the building, the light from the lantern appears to be dim; it does not pierce throughout the whole composition; it does not blind or flash to grab attention; it is omnipresent yet not overwhelming. It is a light visible only to who has eyes to see; a light that talks directly to the soul.

The Universal balance expressed by a harmonic display of tones and sounds is translated by Guarini in architectural proportions and ratios. The module provided by columns' diameters become a parametric element organizing the whole three-dimensional space. The resulting composition becomes part of an evolutionary process in which both success and failure equally contribute. Here dissonances are included too. Beside the negative properties associated with them, in fact, also dissonances contribute to the crescendo leading the soul towards a final apotheosis. Similar ideas are expressed in Mannerist architecture more than in Baroque. Mannerist compositions, in fact, actively show overlapping layers witnessing the lifespan of a building. The traces of this evolutionary process became visible in selected locations only. Here the observer is shocked by deformed anthropomorphic details reminding them that no living organisms can be entirely controlled. Irregularities and imperfections, however, become variations and alternatives which, in the long run, will lead to the creation of a better organism or composition. While philosophically justified by a similar mind setting, imperfections in

Guarini's work cannot always be directed to Mannerist principles. Most of the times, these imperfection appear to be not intentional but the result of errors and imprecisions due to technical and executional difficulties, especially when dealing with stereotomic details.

Stereotomy, in fact, was still in development at Guarini's time and seldom applied in Italy while reaching its peak in France. Because of the reduced size of Guarini' projects, their execution was usually matter of local workers following standard building procedures far away from stereotomic perfection. The Chapel of the Holy Shroud shows, more than other buildings, the lack of experience in this field in Italy; arches are segmented and joints describe unaesthetic patterns. In other projects, similar imprecisions could be ascribed to design issues or overlooked details. San Lorenzo in Turin shows awkward solutions when connecting primary and secondary orders. Maybe to prevent similar issues Guarini promoted in *Architettura Civile* the use of a unique modular system even if its incomplete and poor graphics make it difficult to perceive Guarini's extents. In more than one occasion, the plates from *Architettura Civile* do not match properly their text counterpart or other drawings. The plates illustrating Sainte-Anne-la-Royale, for example, show several imprecisions and mismatching elements between section and elevation. Likewise, the architectural orders in the project engravings hardly match the proportional setting suggested in the text. Whether a general setting of proportions was at the base of Guarini's compositional process or it was an idea later introduced in *Architettura Civile*, the works of the Theatine priest show the difficulties of its rendition in both their physical and graphic applications; their final results are distant from the Universal order which might have had inspired them.

1.4 ...and yet it moves

Regardless of their lack of perfection, Guarini's works share an undoubted sense of mystery. References are never mentioned; words never confirm possible hypotheses. It can not be answered whether this silence might have been a personal choice or a consequence to the asperity of the times. Already in his *Placita Philosophica*, Guarini talked in defense of Ptolemy's geocentric system against the theories by Galielo and Copernicus. While Wittkover already mentioned how a similar affirmation was particularly late for the time,[29] the recent analysis of Guarini's Astronomic essays by Patricia Radelet-de-Grave change the lenses through which a similar affirmation may be interpreted. According to the French scholar, in his astronomic essays Guarini never takes a clear position in regards to geocentric and heliocentric theory.[30] Of course, the thoughts expressed in the *Placita Philosophica* might have changed in time, although that is never clearly stated. A similar affirmation, in fact, would have been considered heretical at that time, especially after Kepler's works considered Copernicus's heliocentric theory no more a mathematical hypothesis but as a reality. However, it is not in its revision of Copernicus that Kepler set the fire for a revolution but for a much smaller publication tied to a celestial event witnessed in 1604, when a new star was born in the sky **[figure 07]**.

Located in the constellation of Ophiuchus (the Serpent Bearer) the event was instead the explosion of a supernova rather than the supposed birth of a new star **[figure 08]**. Close to the end of its life cycle, the star now classified as SN1604 ejected its

29 Rudolf Wittkover, Joseph Connor, and Jennifer Montagu, *Art and Architecture in 1600-1750* (New Haven: Yale University Press, 1999), III, p. 30.

30 Patricia Radelet-de Grave, “Guarini et la Structure de l'Univers,” *Nexus Network Journal* Volume 11, Number 3 (2009): 393-414

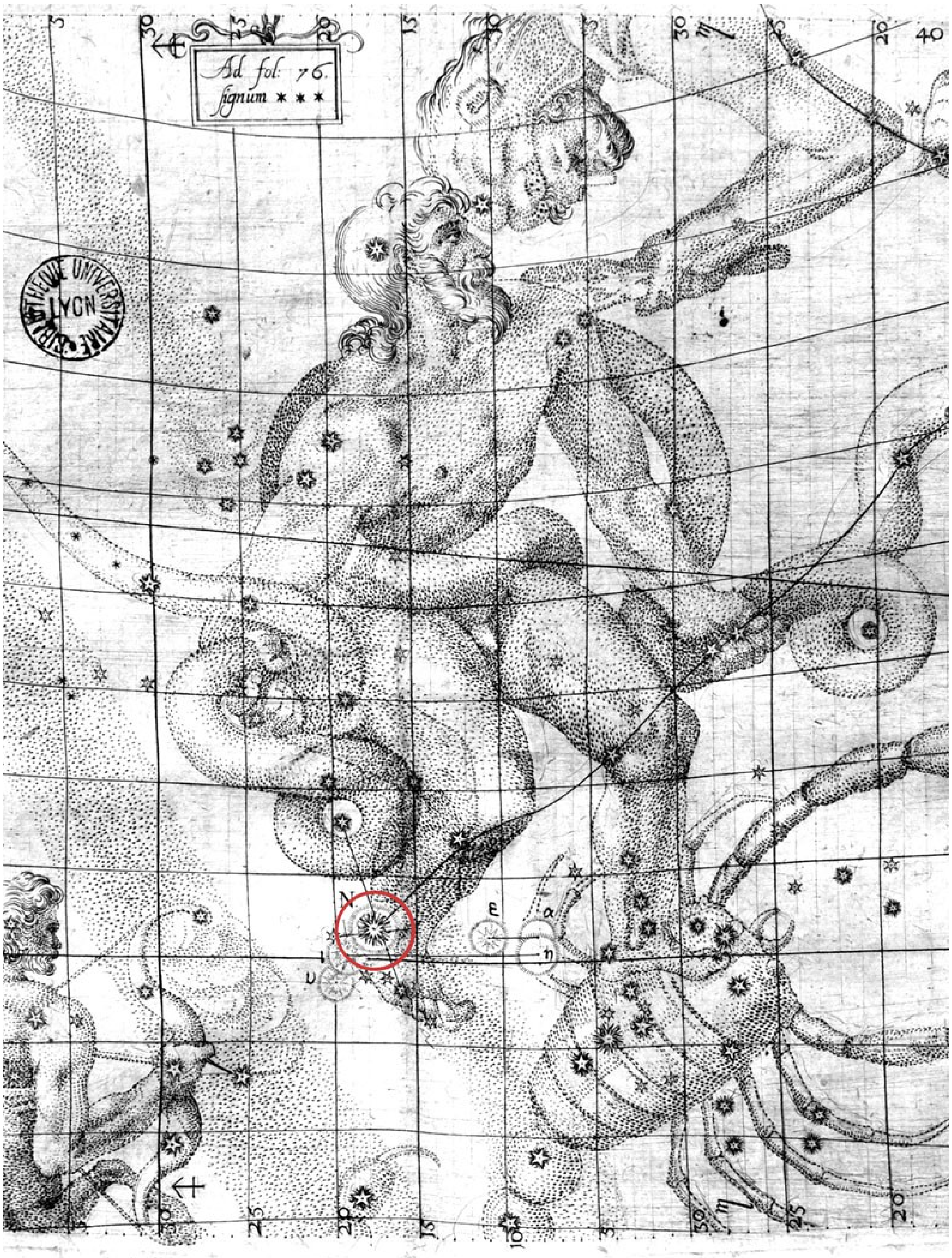

Figure 07. Kepler's drawing about the “new star” witnessed in 1604
Johannes Kepler, *De Stella Nova in Pede Serpentaris*. 1606. Available from:
http://bibulyon.hypotheses.org/files/2011/10/Kepler_DeStellaNova1.jpg

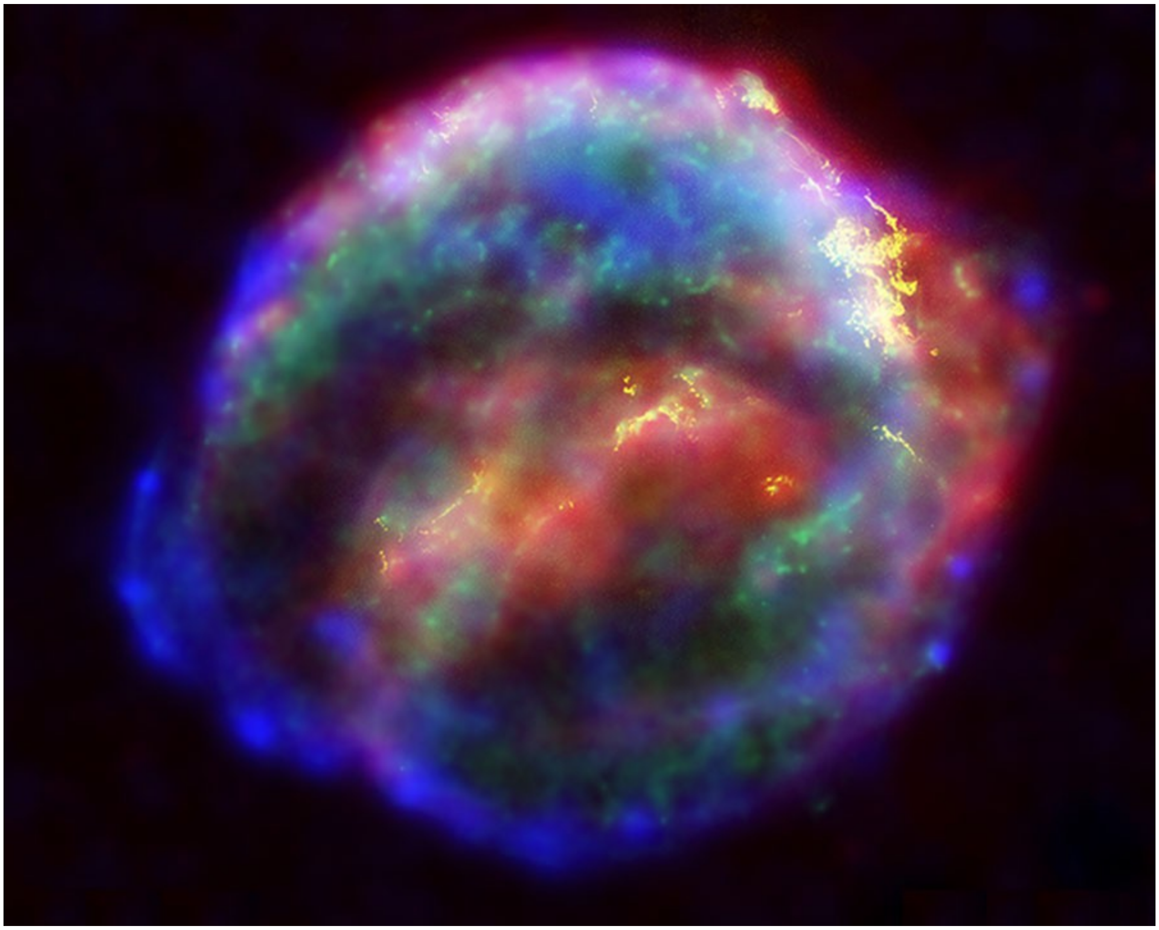

Figure 08. Kepler' supernova.
NASA/ESA/JHU/R.Sankrit & W.Blair, X-ray, Optical & Infrared Composite of Kepler's Supernova Remnant. Available from:
http://en.wikipedia.org/wiki/Kepler's_Supernova#mediaviewer/File:Keplers_supernova.jpg

outmost layers creating a nebula still visible at the present time and known as Kepler's Star. Visible to the naked eye, the remnants of this celestial event lighted Earth's night skies for almost eighteen months in 1604, creating a revolution in science. The event, in fact, proved without doubts that fixed stars were not immovable and, as a consequence, that the whole Universe was not immutable and eternal. The birth of a new star implied that the Universe was an evolving organism. When documenting the unprecedented event in his *De Stella Nova in Pede Serpentaris* (About the New Star in the Foot of the Serpent Bearer), Kepler embedded his work with Astrological and Mystical notions tying the event to the comet that, according to the Bible, lighted the skies at Jesus's birth. Kepler, in fact, considered the supernova part of a cosmic cycle of death and rebirth echoing the vicissitudes of humankind.

That Guarini knew directly about this information, can not be confirmed; although, his three publications about Astronomy seems to imply his knowledge on the topic was deep. According to Guidoni, Guarini's works show, in fact, hidden traces of an unspoken struggle—probably related the impossibility to openly talk or profess his own faith. Several hints seem to be present in the *Triumphant Piety*, a theatrical play by Guarini focusing on the trial of a heretic. In the lines of the main character, a heretic, Guidoni recognizes unthinkable thoughts impossible to express at the time without severe consequences:

> "[...] *it is not possible to express celestial respect through terrestrial love.*"
>
> (*The Triumphant Piety*, Act III, sc. VI)

"[...] *I always thought it was an exorbitant error to have a suffering, scorned, and dead God.*"

(*The Triumphant Piety*, Act IV, sc. II)

"[...] *and if my thoughts will reach foolhardy highs, do not look at my guilt only, but at our common guilt*"

(*Dedication ode to Alfonso d'Este*)

" […] *like doves fly in hosts, a guilt has never been alone*"

(*The Triumphant Piety*, Act V, sc. I)

Likewise, open accusations about the Inquisition's methods:

"[...] *when a wrongdoer is entrapped, his guilt is invented*"

(*The Triumphant Piety*, Act IV, sc. VIII)

"[...] *and if you will not call yourself foolish and mentally insane that hand will kill you instantly*"

(*The Triumphant Piety*, Act II, sc. I)

The references to acting mentally insane relates to an Italian philosopher and theologist, Tommaso Campanella (1568-1639). Condemned to death because of his thoughts against the Roman Church, Campanella escaped death sentence by acting mentally insane. Also Galileo Galilei followed a similar fate; although not sentenced to death, the Vatican forced the Italian scientist to profess the fallacy of his scientific discoveries whose purpose would have been to gain undeserved notoriety by spreading lies.[31] As member of the Theatine order, Guarini was aware of consequences he might have faced upon openly expressing his real thoughts. In the face of this reality, he chose to remain silent while continuing to keep his truth for himself only:

> "[...] *but my blindness excluded me from the victims, and it condemned me to live by myself*"
>
> (*The Triumphant Piety*, Act III, sc. VI)

> "[...] *Do you argue about those quarrels? You may have beliefs my friend,*
> *you may believe in them without arguing.*
> *A believer does not look beyond his eyes;*
> *a believer does not question his thoughts.*
> *A believer has no reason to doubt about his beliefs*"
>
> (*The Triumphant Piety*, Act V, sc. III)

Expressing his feelings and conditions through metaphors was the only way Guarini reacted to strict rules and obedience demanded at that time. The Vatican's authority, however, had been already questioned before Copernicus and Kepler were

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31 Laura Fermi and Gilberto Bernardini, *Galileo and the Scientific Revolution* (New York: Basic Books, 1961), pp. 85-86

appointed as heretics and it came directly from the inside of the Roman Church itself. During the XVIth century, in fact, religious devotion encouraged reading the Holy Scriptures outside the mass, bringing to light portions of them conventionally omitted. In the perplexity such alterations and omissions caused, the Church explained them as errors in unofficial translations of the sacred texts. Pope Julius III, in fact, prohibited reading the Evangelic texts outside the mass because "*some of their contents express ideas opposite to the traditions of the Roman Church.*"[32] The Theatine Order played an important role in checking Bible translations and controlling distribution. In addition, the order was responsible to educating and instructing the new clergy, establishing a total control of the information provided not just to the public but to the clerical staff too. As member of the Theatine Order and teacher for former priests, Guarini was probably aware about such events; while his status might have had granted him access to part of that sealed knowledge. This may explain the hints of sadness and constrain identified by Guidoni. Although, while Guarini might have questioned some methods adopted by the Roman Church, he never refused his own faith or abandoned his clerical duties. Already the Vatican's behavior caused scandals and critiques. Indulgences, for example, brought Luther to the Reform, drawing a clear line separating him from the Roman church. Guarini never aimed for such a drastic outcome but suffered in silence about the whole situation—maybe to avoid the Inquisition or because of a profound understanding of Jesus examples to not judge and accuse other people because of their own actions. Guarini himself, in fact, can not be considered exactly a saint; his life shows several traces of disagreement (a direct attack on the Spanish artist Caramuel contained in

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32 Jacopo Fo, Sergio Tomat, and Laura Malucelli, *Il libro nero del cristianesimo: duemila anni di crimini nel nome di Dio* (San Lazzaro di Savena, Bologna: Nuovi Mondi Media, 2005)

Architettura Civile) and signs of reaction to power abuses (a quarrel with the count of Modena, who exiled Guarini from the city; an open refusal to follow the orders of the King of France, who ordered him to go back in Paris and complete the church of Sainte-Anne-la-Royale). However, none of these events seems to have diminished his faith or its role as priest; instead, he continued to profess the holy word through real dedication and a humble, but not subdued, nature.

1.5 A deceptive parallax

"Original," "unexpected," "puzzling" and even "awkwardly disgusting." These are comments Guarini's architecture elicited throughout history because of its uniqueness. The works of the Theatine priest, so different from anything else in Italy at that time, leaves the critic wondering about the source of his originality. No official references or inspirations have ever be mentioned by Guarini himself, keeping analysis trapped in a labyrinth of hypotheses and speculation. A review of historical critiques yields two different periods: critiques before and critiques after 1846. At first, Guarini's works were repeatedly dismissed. Maybe because of its references to Gothic architectural principles; or its unclear inspirational sources; or just for its use of geometries not focused on human proportions (as was common in the Renaissance), Guarini's architecture received a negative reception. By 1846, however, critics developed a renewed interest in Guarini's architecture.

The first recorded comments on Guarini's architecture were provided by Gian Lorenzo Bernini. Invited by king Louis XIVth in Paris for planning an expansion to the Louvre (which was never realized by the Italian artist),[33] Bernini was guided to the site of

33 Silvia Bordini, "La Critica Guariniana," in *Guarino Guarini e l'internazionalità del Barocco*, ed.

the Theatine church on the opposite shore of the Seine from the Louvre. Still far from its completion—which will happen only partially almost one hundred years later—the church of Sainte-Anne-la-Royale received only situational gratification from the Italian artist ("*I think it will look pretty*") together with a few suggestions to increase the scenographic properties of the entrance bay.[34] Later in history, French neoclassicists berated Guarini's church because of its awkwardness, disconnected to anything else on the site and discordant with French architectural traditions.[35]

Sebastiano Locatelli (1664-5) found Guarini's architecture flooded by "*bizarre and fantastic elements.*"[36] Milizia described Guarini as "*supreme enemy of straight lines*," author of "*horrific decorations*" and "*coarse elevations*" plaguing "*peevish, irregular, and strained factories*" from of which "*the stomach is disconcerted.*" According to him, appreciation for Guarini might have come only from the mentally insane.[37] Similarly, Ticozzi sympathizes with the "unlucky" cities hosting Guarini's works where everything is "*arbitrary, strained, and irregular*;" commenting on the death of the Theatine architect as "*an advantage for the Arts*."[38] Mainly focused on aesthetics, the eyes of these critics did not look beyond decorative patterns (questionable indeed) in Guarini's works. They did not attempt to decipher any of the meanings, principles, or ideas embedded in those works. That will happen only from 1846 onward, starting with Cibrario Luigi.[39] He

AA.VV. (Turin: Accademia delle Scienze, 1970), II, pp. 283-305.

34 P. Fréart de Chantelou, *Journal de voyage du chevalier Bernin en France (1665)*, (Paris: L. Lalanne, 1885), p. 33 (June 14th).

35 Frédérique Lemerle and Yves Pauwels, *Baroque Architecture 1600-1750* (Paris: Flammarion, 2008), p. 89; David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 3

36 Adolphe Vautier, *Voyage de France (1664-1665). Relation de Sébastein Locatelli* (Paris: Alphonse Picard at Fils, 1905), p. 141.

37 Francesco Milizia, *Memorie degli architetti antichi e moderni* (Parma: Stamperia Reale, 1781), II, pp. 260-262.

38 Stefano Ticozzi, *Dizionario degli architetti, scultori, pittori* (Milan: Luigi Nervetti, 1831), pp. 223-224.

39 Luigi Cibrario, *Storia di Torino* (Turin: Alessandro Fontana, 1846), II, pp. 398-399.

pointed out the Gothic influences in Guarini's works which would open the way for several interpretations.

Still influenced by the aesthetic properties of Guarini's buildings, scholars analyzed them through de-contextualized symbolic meanings, like numerology. The main focus of their analyses has been the Chapel of the Holy Shroud in Turin. Planned as an addition to Turin's cathedral, the Chapel hosted the Holy Relic until 1997, when it was moved to Rome after being damaged in a fire. Covered in grey marble, the circular plan of the Chapel is framed by three arches sustaining a telescopic dome. Framed by smaller arches organized in superimposed tiers, each level starts from the keystones of the level below. As a result, the dome is entirely pierced by windows creating one of the most luminous structure Baroque architecture ever produced. In the intricacy of these patterns, Gurlitt (1887) envisioned references to astrological and cabalistic symbols;[40] while Wittkower (1958) recognized in the recurrent use of the number three and its multiples a constant reference to the Holy Trinity.[41]

It is only from 1961 that historians move away from numerological notions for the symbolism in Guarini's architecture to an actual context. Studying and analyzing the historical context surrounding the Theatine architect, Hager Werner emphasized the Mathematics and Geometry Guarini was so fond of.[42] The notions which had inspired the scientific revolution during the Enlightenment were now recognized in Guarini's works as a set of rules controlled by a rational mind.[43] The constant alternation between straight

40 Cornelius Gurlitt, *Geschichte des Barkostilen in Italien* (Stüttgart: Verlag von Ebner & Seubert, 1887), pp. 447-458.

41 Rudolf Wittkover, Josph Connor, and Jennifer Montagu, *Art and Architecture in 1600-1750* (New Haven: Yale University Press, 1999), III, pp. 31-33.

42 Werner Hager,“Guarini zur Kennzeishnung seiner Architektur,” in *Miscellanea Bibliothecae Hertziane,* ed. Leo Bruhns, Franz Wolff Metternich, Ludwig Schudt (Vienna: A. Schroll, 1961), pp. 418-428.

43 Alberto Pérez-Gómez and Luoise Pelletier, *Architectural representation and perspective hinge* (Cambridge, MA: MIT University Press, 2000), p. 172.

and curved lines translated into a metaphor for human nature and divine perfection respectively.[44] Each volume in the composition acquired a cosmological meaning echoing the architecture of the Universe, whose rhythms and movements drive even dissonances to a final apotheosis.[45]

The absence of documents or direct references by Guarini himself (with the exception of an appreciation for Gothic architecture contained in *Architettura Civile*) leave the road open to many hypotheses and interpretations on which scholars continue to debate. In this pantheon of possibilities, scholars have focused their attention to four possible roots for Guarini's works: references to his Italian architectural heritage, citations of Gothic themes, possible inspiration from Islamic patterns, or architectural translations of the new scientific laws ruling the structure of the Universe.

Influences from the Italian architectural heritage can be found in architectural examples from Guarini's era, the XVIIth century. Vitruvian proportions pervaded buildings from the Italian Renaissance which, to Guairni's eyes, appeared constrained by strict rules and regulations. Like Borromini, Guarini attempted to follow an alternative path where proportions were no more based on the human scale but suggested by geometric proportions. Like Milizia and Ticozzi did in the past, Brinkmann suggested in 1915 an architectural link between Guarini and Borromoni. Instead of focusing on the negative comments from centuries before him, Brinkmann noticed how Guarini extracted

44 Deilbor Vesely, *Architecture in the age of divided representation: the question of creativity in the shadow production* (Cambridge, MA: MIT Univeristy Press, 2004), pp. 196-197, 200-212.

45 Enrico Guidoni, “Modelli Guariniani,” in *Guarino Guarini e l'internazionalità del Barocco,* ed. AA.VV. (Turin: Accademia delle Scienze, 1970), II, pp. 229-282.

and gave new life to Borrominian geometric principles. The blurry individuation of pristine geometric forms in Borromini's architecture become much more visible in Guarini's compositions; each element preserve its own independence while still contributing to a global uniqueness. In the eyes of Norberg-Schulz, Guarini surpasses Borromini in complexity. Defined as "*pulsating juxtaposition,*"[46] Guarini's architecture exalts the plastic properties of volumes molded together in an alternation of concave and convex profiles. In their struggle to identify an architectural precursor for Guarini's domes, scholars scrutinized several buildings. Continuing their comparison to Borromini suggested a connection to the Magi's Chapel[47] whose pavilion vault is framed by interlaced, decorative ribs. When joined to the lunettes keystones, in fact, the ribs reduce to a single point, revealing their structural purpose. The realization of the Chapel is documented between 1660 and 1665 (only its decorative patterns were completed later in time); while in 1662 Guarini was already in France for the church of Sainte-Anne. It is not clear if Guarini had the chance to see Borromini's vault partially or entirely realized or even to look at its drawings. Likewise, it is not even clear whether Guarini passed through Rome on his way to Paris or not. It would have been much easier reaching France from Sicily by sea than traveling all the way along Italy, passing through the Alps. The possible connection to Borromini, however, was just the tip of the iceberg; the list os Guarini's possible inspirations goes on, referencing most of the Italian architects, Renaissance to Baroque: Bernini,[48] Serlio, Pietro da Cortona, Palladio, and Baldassarre

46 Christian Norberg-Schulz, *Baroque Architecture* (Milan: Electa Editrice, 1979), pp. 123

47 Susan Klaiber, "La Formazione di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), 22-27; Andrew Morrogh, "Alcune Fonti per le Cupole di Guarini," *Ibid.*, pp. 50-57; Augusto Roca De Amicis, "Guarini e Roma," *Ibid.*, pp. 462-469.

48 Henry A. Millon, "Bernini-Guarini: Parigi-Torino Louvre-Carignano," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 440-451.

Longhena.

Based Guarini's interest in Gothic architectural principles in *Architettura Civile*, Cribrario (1846) began to suggest alternative sources of inspiration for Guarini's domes.[49] In the rationality of Gothic architecture, Marconi (1970) identifies the elements of Guarinian compositions. Inspired by early Baroque principles, Guarini overlaps two structures: one with bearing purposes and hidden at the view, and a second layer, slender and almost weak, creating the illusion of a levitating mass over the viewer.[50] The search for a precursor opened critic's eyes to a myriad of possibilities: sketches of gothic vaults by Leonardo da Vinci,[51] Michelangelo's drawings for Saint Peter's dome,[52] or buildings with local relevance—like Santa Barbara in Mantova.[53] Mentioned by Florensa, Santa Barbara seems a hybrid between gothic and renaissance traditions. Its vaults transition from a cross vault setting (at the springer) to a web vault (at the top). Individuated by flat ribs, the junction from the cross vault is slowly hidden from view while moving to the top, where the ribs merge in a flat profile.

In the early XX[th] century, with a focus on vernacular architecture, Schubert

49 Luigi Cibrario*, Storia di Torino* (Turin: Alessandro Fontana, 1846), II, pp. 398-399.

50 Paolo Marconi, "Guarino Guarini e il Gotico," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 613-635.

51 Andrew Morrogh, "Alcune Fonti per le Cupole di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 50-57; and Dardanello, Giuseppe, "La Costruzione della Visione nella Cappella della Sindone," *Ibid.*, pp. 58-87. According to Bérchez and Marías, the original attributions came from Leopoldo Torres Balbás [cfr. Joaquín Bérchez, and Fernando Marías, "Guarini e le Spagne d'Europa e d'America," *Ibid.*, pp. 494-513].

52 Sandro Benedetti, "Guarini ed il Barocco Romano," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 705-750.

53 Adolfo Florensa, "Guarini e il Mondo Islamico," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp.637-665.

hypothesized Islamic influences in Guarini's works.[54] Sporadic examples of this have been recognized in Northern Italy. Like Schubert, Florensa directs our attention towards the church of Sant'Evasio in Casale Monferrato,[55] reminiscent of a mosque's design. Rectangular in its setting, the composition is framed by arches slightly tilted in space so that their junction become seamless. The several cells created by those intersections, however, are created by barrel and cross vaults, making the small church not nearly as complex as Guarini's domes.

It will be in the Southern Italian peninsula, however, that scholars will center their analysis—specifically to Sicily and to the Muslim past it experienced (827).[56] Moreover, it will be here (in Messina) that Guarini will spend part of his life after the exile from Modena. According to Verzone (1970), during the XVIIth century the Italian island might have still have traces of Islamic buildings[57] of a similar style that culture left in Spain, and specifically in Cordoba. With the Treaties of Blois (1504-5), in fact, the Italian island was given to Spain together with the Kingdom of Naples, which included most of Southern Italy. Both Naples and Palermo hosted viceroys establishing for two centuries a Spanish control on the Italian peninsula.[58] In addition, Guarini's accounts show an indirect connection to the Iberian peninsula due to the friendship with the Spanish artist and theorist Juan Andrés Ricci, who introduced Guarini to the Salomonic order.[59] We know

54 Otto Schubert, *Geschichte des Barok in Spanien* (Esslingen: Paul Neff Verlag, 1908), p. 176.
55 Adolfo Florensa, "Guarini e il Mondo Islamico," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp.637-665.
56 Philip K. Hitty, *The Arabs: a short history* (Princeton, NJ: Princeton University Press, 1943), p. 204; David Abulafia, *The Great Sea* (Oxford: Univerisity Press, 2011), p. 250
57 Paolo Verzone, "Struttura delle Cupole del Guarini," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp.401-413.
58 Jake Morrissey, *The genius in the Design – Bernini, Borromini, and the Rivalry That Transformed Rome* (New York: Harper Collins Publishers Inc, 2005), p. 19
59 The Salomonic Order is composed by sinusoidal columns/pilaster strips. Andrew Morrogh, "Alcune Fonti per le Cupole di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 50-57.

Guarini was updated about artistic and architectural knowledge from Spain (in *Architettura Civile* Guarini criticizes the work of the Spanish artist Juan Caramuel De Lobkowitz in regards to Oblique Architecture). Finally, Guarini's project for Santa Maria della Divina Providenca was constructed in Lisbon. While not directly in Spain but in Portugal, the project leaves several questions unanswered. Did Guarini visit Lisbon? Did this visit imply traveling through Spain too? Or was the project (which was destroyed by an earthquake in 1755) realized without a direct contact with the site? The connection to Portugal is strengthened by Guarini's friendship with the Francisco de Mello, a Portuguese nobleman serving as ambassador for his home country to England.[60] Maybe through these connections Guarini had access to indirect information about Spanish architecture, like descriptions or sketches, including the already mentioned Cordoba Mosque in whose vaults several historians saw a precursor for Guarini's interlaced, ribbed domes.

Or maybe these connections had a secondary importance in the architectural growth of Guarini, whose first source of inspiration may have been the sciences of which he was so fond.[61] Guarini's proficiency in those subjects has been always recognized even from the earliest critiques.[62] Ricci (1860) links Guarini to Gaspard Monge,[63] who bought to perfection the method of the double orthographic projections; while, almost fifty years

60 H. A. Meek, *Guarino Guarini* (New Haven and London: Yale University Press, 1988), p. 13.

61 Rudolf Wittkower, "Introduzione al Guarini," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 20-32.

62 Francesco Milizia, *Memorie degli architetti antichi e moderni* (Parma: Stamperia Reale, 1781), p. 260-263; Antonio Francesco Vezzosi, *I scrittori de' chierici regolari detti Teatini* (Roma: Stamperia della sacra congregazione di Propaganda Fide, 1780), pp. 432-435; Quatremère de Quincy, *The true, the fictive, and the real: the historical dictionary of Quatremère de Quincy*, trans. Samir Younés (London: Samir Younés and Andrea Papadakis Publisher, 1999), p. 91.

63 Antonio Ricci, *Storia dell'architettura in Italia dal sec. IV al XVIII* (Modena: Regio-Ducal camera, 1860), III, pp. 717-718.

later, in 1914, Brinkmann connects Guarini's architectonic experimentation to the French research in stereotomy.[64] In 1914 Giedion exalts the synthesis between mathematics and art in Guarini's architecture, considering the Theatine architect an anticipator of modern science.[65]

Beside these nice words, however, traces of Guarini's architectural influence seldom appear in the Italian homeland. Sporadic "guarinian" examples may be found in vernacular architecture from Veneto, but it is not widespread.[66] In France, Klaiber suggests the Theatine might have inspired François Mansart for the facade of Sanit-Germain-l'Auxerrois and for some portions of the Louvre[67] (to which it is conventionally connected a project for a Parisian palace with no name in *Architettura Civile*). Grabar, instead, suggests Guarini's influence in few buildings in Le Puy (in the Auvergne region).[68] But, even if Guarini was close to the French world, the strong traditional roots of French architecture did not leave space for the architectonic experiments of the Italian architect. Moreover, though Guarini studied stereotomy in *Architettura Civile*, his essay was only published posthumously in 1737, when the discipline developed much further than it was at Guarini's time.

The late publication of *Architettura Civile,* and especially of its engravings transformed Guarini in an inspirational source for Baroque experimentation in Austria,

64 Alberth Erich Brinkmann, *Baukunst des 17. und 18. Jahrhunderts in den romanischen Ländern* (Berlin-Neudabelssberg: Akademische Verlagsgesellschaft Athenaion, 1915).
65 Sigfried Giedion, *Space, time and architecture: the growth of a new tradition* (Cambridge, MA: Harvard University Press, 1941), pp.121-126.
66 Susan Klaiber, "Guarini in Veneto," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 480-485.
67 Susan Klaiber, "La Formazione di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), p. 26
68 Oleg Grabar, *Islamic Visual Culture, 1100-1800: constructing the study of Islamic art* (Burlington: Ashgate Publishing Company, 2006), II, p. 385.

southern Germany,[69] and Boehmia.[70] Likewise, Bérchez and Marías point out frequent quotations from *Architettura Civile* in Spanish architectural essays from the XVIII[th] century[71] which in turn exported Guarini's style to Brazil and Mexico.[72]

69 Vincenzo Fasolo, "Sistemi Ellittici nell'architettura," *Architettura e Arti decorative* X (1931): 390 ss.

70 Christian Norberg-Schulz, *Kilian Ignaz Dientzenhofer e il barocco boemo* (Rome: Officina Edizioni, 1968), p. 22.

71 Joaquín Bérchez and Fernando Marías, "Guarini e le Spagne d'Europa e d'America," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 494-513.

72 Joaquín Bérchez and Fernando Marías, *Ibid.*; Grabar, Oleg, *Islamic Visual Culture, 1100-1800: constructing the study of Islamic art* (Burlington: Ashgate Publishing Company, 2006), II, p. 385.

CHAPTER 2 – Touching the Sun

Inspiring, questionable, even despicable: human history is colored by myriad events, blurring light and shadow. Some people may think architecture free from such a kaleidoscopic view since architecture deals with constructed artifacts. However, like works of art, constructed environments embody the historical events they witnessed. Sainte-Anne-la-Royale is no exception, opening a window on events and personalities from a dark period. Usually connected to the name of its main architect Guarino Guarini, Sainte-Anne's roots dig deeper in French history and evoke the name of its patron Jules Mazarin **[figure 09]**. Like Icarus' wings, the church would have represented the apex of Mazarin's career, a symbol of his eternal devotion and loyalty to France and her ruler, Queen Anne of Austria. Unfortunate events, however, prevented such outcome until the rise of the Sun King, Louis XIV, dissolved Mazarin's wings.

2.1 Icarus' wings

The myth of Icarus describes the personalities and events revolving around Sainte-Anne-la-Royale well. However, it is not often remembered that the wings from the Greek myth were not just the pursuit of a dream but a means to freedom. Contrary to the popular idea of Icarus as a foolish child driven by the wish to overcome human limitations and fly in the sky, the actual myth tells a different story. Icarus had almost no role in it; nothing is known about his dreams, if he had them at all. The story, instead, revolves around Daedalus, Icarus' father, the most renowned architect of Ancient Greece. Having reached Knossos with his son, Daedalus worked for King Minos and played a

Figure 09. Jules Mazarin
Robert Nanteuil, *Cardinal Jules Mazarin in his private library.* 1659. Available from: http://upload.wikimedia.org/wikipedia/commons/9/99/JulesMazarinNanteuil.jpg

decisive role in the birth and death of the Minotaur. The outcome of these adventures will see Daedalus and Icarus imprisoned in a tower in Knossos having only the sky as their way out of Crete. It is at this point that the wings appear in the story: a device created by Daedalus in order to save himself and his son. However, despite the clear warnings from his father, Icarus will abuse the wings and aim for a much higher power: moving the Sun like Apollo. Icarus' end is well known.

The metaphor echoes Mazarin's situation: Aside from hints of Icarus' ingenuity, it is really Daedalus who fits Mazarin's personality in the attempt to control a life already planned by others.

Despite his (misleading) French name, Cardinal Mazarin's roots were in Italy. Born in 1602 in the town of Pescina (at that time, part of the Kingdom of Naples), the future cleric was baptized as Giulio Raimondo Mazzarino. Pushed by his family into a clerical formation (which happened in Rome) Mazzarino later refused to embrace clerical vows, abandoning theological studies. However, he was able to gain a future in the Vatican due to his diplomatic skills.

In 1631, Mazzarino solved a tedious territorial conflict between Spain and France upon the succession of Mantua, offering a successful mediation that caught the attention of Pope Urban VIII. As a result, the Pope sent Mazzarino to France as papal *nuncio* in 1634. Here Mazzarino obtained the favor of Cardinal Richelieu; and devoted his services to France and the king in 1639 as a naturalized French citizen under the name of Jules Mazarin. Even if his loyalty shifted from the Pope to King Louis XIII, Mazarin's connection to the Roman Church was never forgotten. Two years after his naturalization, the Vatican appointed Mazarin as Cardinal,[1] despite his lack of clerical training and, in 1644, sent the Theatines to Paris, for which Mazarin will guarantee a constant sponsorship until his death in 1661.

It is at this point that Mazarin's flight to the height of French politics will take a sharp turn downward. After gaining the position of Chief Minister upon Richelieu's death, Mazarin attempted to follow the example of his illustrious predecessor by healing the royal economy. Already under Richelieu, French citizens were paying taxes four years in advance.[2] Following this line, Mazarin brought back a decree from 1548 forbidding the construction of houses outside Paris walls. The original military reasons for this ancient decree by Henry II were conveniently overlooked while a new tax (*la taxe du toise*) was applied to all the buildings that flourished outside the city walls for a span of almost one hundred years. Discontent with the new tax led to a four year struggle remembered as the *Fronde* rebellion. During this time not just Mazarin, but also Queen Anne (ruling the country in place of her young son) and the future King Louis XIV were forced to abandon Paris until the King's return in 1659.

Prior to the Fronde, in 1647 Mazarin purchased a lot in Quais Malaquais n.23 (now Quais Voltaire) for the Theatines' mission **[figure 10]**. Located on the Seine shore opposite the Louvre, the site hosted at first a canonical house and a small chapel. After the Fronde, between 1659 and 1661, Mazarin donated additional properties to the Theatines (the adjacent lot at Quais Malaquais n. 25 and an additional property reaching

1 Anthony Levi, *Cardinal Richelieu and the Making of France* (New York: Carroll & Graf, 2000), p. 198
2 Mitchell B. Garrett, *European History, 1500-1815* (New York: American Book Co., 1940), p. 279

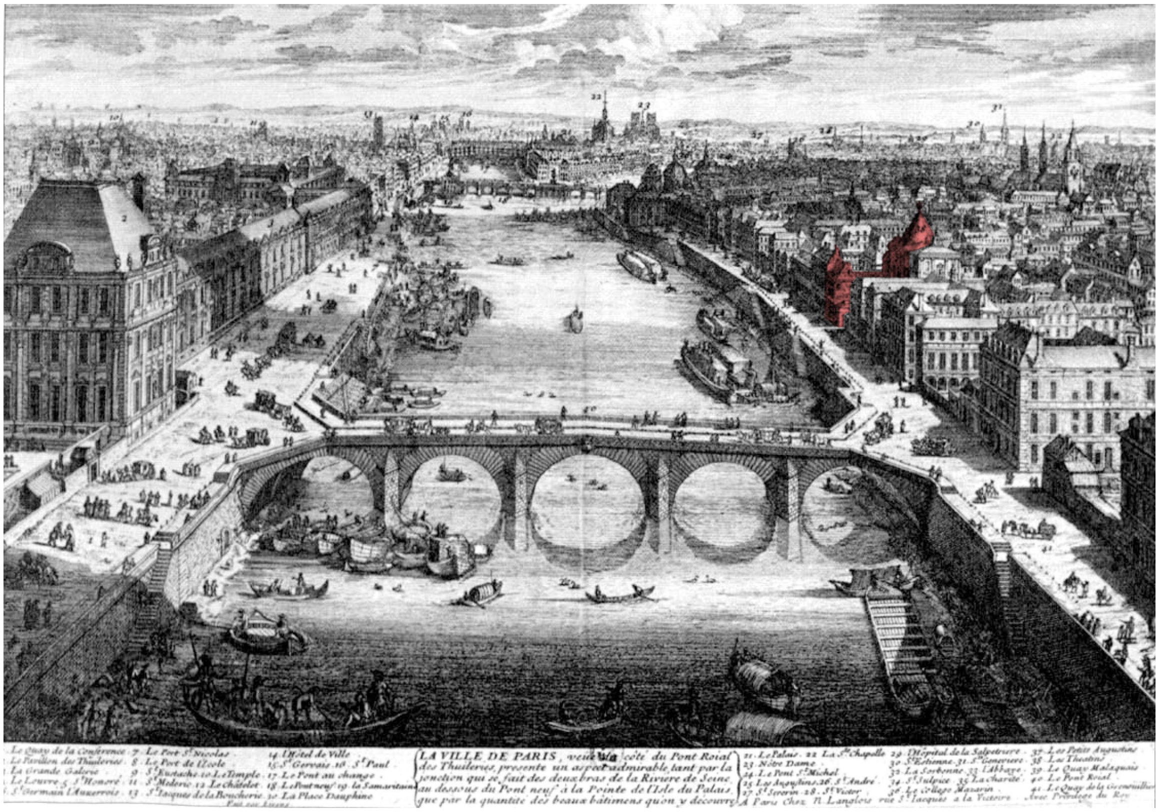

Figure 10. Sainte-Anne-la-Royale (in red) according to a sketch by Lieven Cruyl (1675)
Lieven Cruyl, *View of the Sienne from east of Port Royale in Paris* (Paris, Bibliothèque Nationale, Est. Va 216c), 1675 c.

the back alley)[3] aiming to create a resting place for his mortal body.[4] In his will, in fact, the Cardinal donated 100,000 écus to the Theatines of Paris for funding the construction of a church dedicated to Queen Anne of Austria.

Sainte-Anne-la-Royale made its first appearance amid this turbulence. The Theatines, of course, were not involved any of these political events. But their direct connection to the Vatican and the patronage of the French Chief Minister Mazarin put the monastic order at a disadvantage in France, foreshadowing the tormented history the church will suffer in the years to come. Today, only an access gate realized during the last attempt at completing the church remains **[figure 11]**. Radiant in execution, these ruins make one wonder about the astonishing experience the original church might have provided under the experienced hands of French stereotomy. Its hollowed out foundation left a scar in Paris's urban tissue—a bitter wound in French history.

2.2 1661: Valperga

While Sainte-Anne-la-Royale is seldom mentioned in history of architecture, its documentation is sparse. In the rare occasions in which few words are spent about the Parisian church, they usually recall the sour critiques received in France ("an abstruse example of Italian baroque")[5] and the economic misjudgments preventing its completion

3 David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 4

4 Louis Hautecoeur, *Historie de l'architecture classique en France,* (Paris: A. et J. Picard, 1948), II, pp. 245-247.

5 Louis Hautecoeur, *Ibid.*; Frédérique Lemerle and Yves Pauwels, *Baroque Architecture 1600-1750* (Paris: Flammarion, 2008), p. 89; David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 3; Adolphe Vautier, *Voyage de France (1664-1665). Relation de Sébastein Locatelli* (Paris: Alphonse Picard at Fils, 1905), p. 141; Francesco Milizia, *Memorie degli architetti antichi e moderni* (Parma: Stamperia Reale, 1781), II, pp. 260-262; Stefano Ticozzi, *Dizionario degli architetti, scultori, pittori* (Milan: Luigi Nervetti, 1831), pp. 223-224.

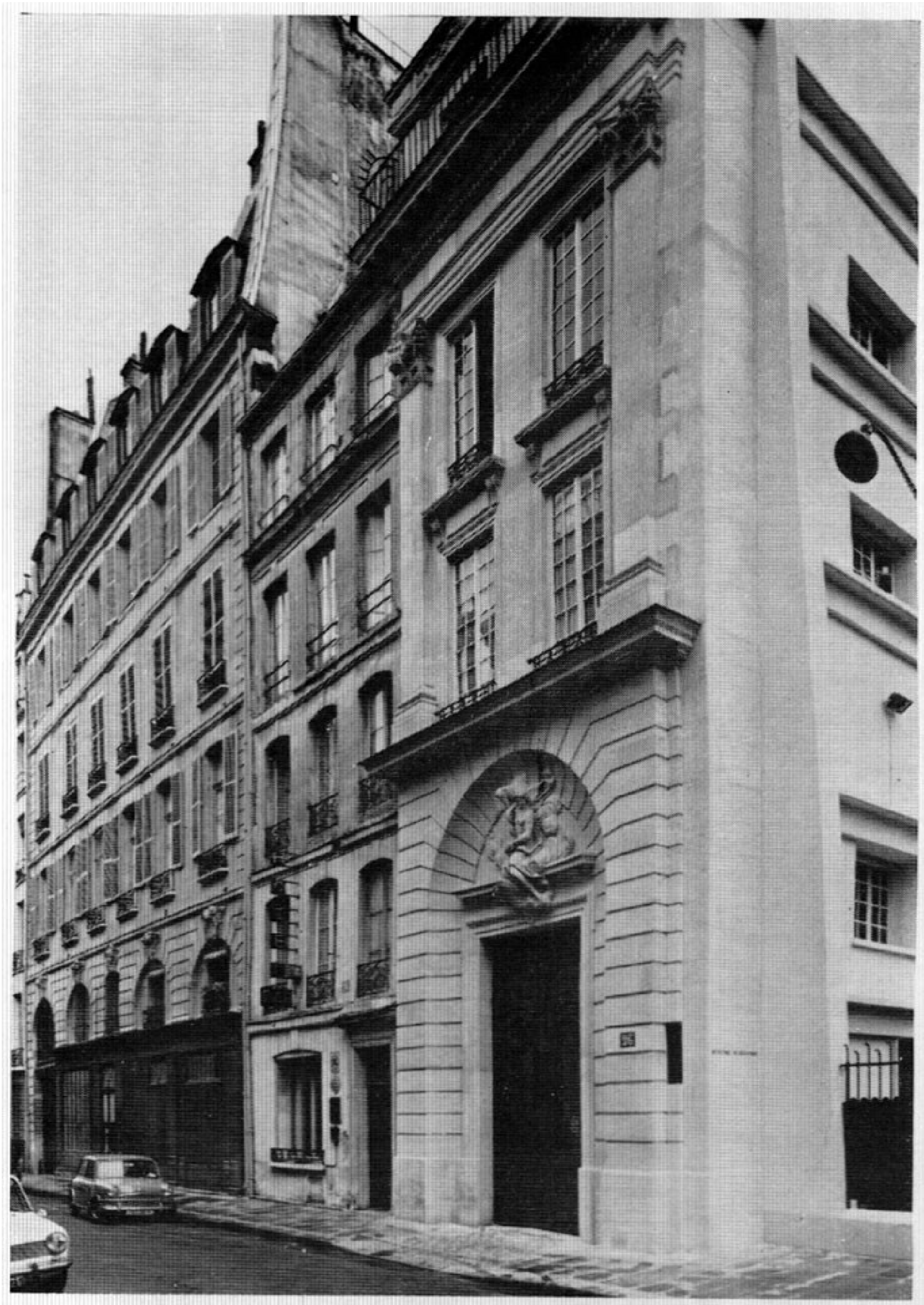

Figure 11. Secondary entrance gate to Sainte-Anne-la-Royale (Rue de Lille, 26)
© Alan Boase. Available from: Alan Boase, “Sant'Anna Reale.” In *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), fig. 4, p.375

(mentioned by Guarini himself).[6] While correct in content, this information reveals only part of the vicissitudes surrounding the building.

The original setting of the church was realized between 1659 and 1661 by Antonio Maurizio Valperga, an Italian artist under the patronage of Cardinal Mazarin **[figure 12]**. Guarini will be put in charge of the project only later after an appeal from his monastic order. The appointment of Valperga is an exception to Theatine habits, who preferred designing their own buildings internally. In January 1662, Valperga's project was accepted by the religious congregation, five months after the death of their patron Mazarin. By March 1662, the first stones of the foundation were put in place by Conte on behalf of King Luis XIV—a gesture which finalized Mazarin's rule and marked a new period in French history.

Almost nothing survived from the first version of this building. According to Meek, Valperga's church was "oval in plan, with a cross vault and cupola." It is not exactly clear where this information comes from considering Meek also mentions in 1989 that Valperga's plan was lost in time. However, in a recent publication (from 2010) a plan of Valperga's first project for Sainte-Anne-la-Royale appeared.[7] Different from Meek's brief description, the church shows a central plan with emphasis on the longitudinal axis. The elliptical geometry mentioned by Meek seems related to the layout of the central bay, apparently a malformation of a circle due to the low quality of the print. Projection lines in plan show traces of cross vaults above, while stairs carved in the pillars suggest the

6 David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 7

7 Giuseppe Dardanello, Susan Klaiber, Henry Millon, *Guarino Guarini*, (Turin: Umberto Allemandi & C., 2006), p. 136, Pl. 22

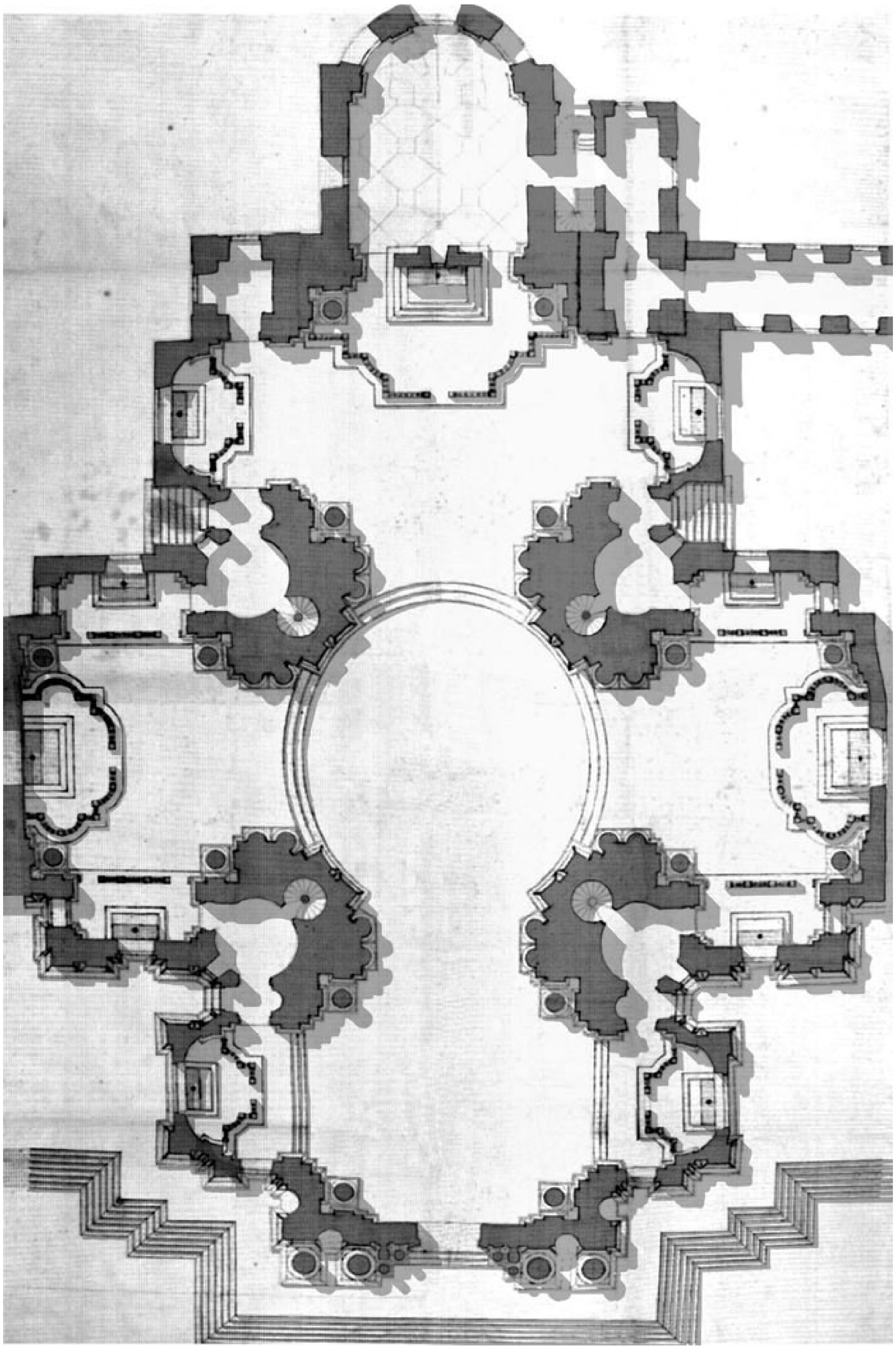

Figure 12. Valperga's plan for Sainte-Anne-la-Royale
© Biblioteca Nazionale Universitaria, Torino. Available from: Giuseppe Dardanello, Susan Klaiber, Henry Millon, *Guarino Guarini* (Turin: Umberto Allemandi & C., 2006), fig. 25
Additions by the author

presence of an upper level.

The overall composition captures the austerity and severity of counter-reformation churches. The indoor space is divided into three segregated areas. Upon entering the building, the entrance bay is guarded by two shallow side bays where an altar is located at the top of three steps. Proceeding inside the building, the space expands upon reaching the central bay whose dilation creates a circular space contained by three gothic-like pillars connected by three steps. This architectural barrier suggests an invisible boundary separating the first area, dedicated to common people, to the next one, dedicated to the clergy.

Covering most of the remaining surface in the building, the clergy area moves around the whole building through hidden corridors and stairs carved in the massiveness of walls and pillars. The segregation above mentioned becomes visible in the transition between central and side bays. Here the space is narrowed by two sets of paired columns. Above them, two arches might have strengthened the alternation of compressed and expanded volumes. The same pattern of double supports appears also around the central bay whose pillars host four couples of pilaster strips. On top of them, the transitional arches towards the side bays would have probably sustained a drum. The spiral staircases in plan suggest a possible transitional space between drum and dome, maybe similar to the one in Guarini's project.

At last, contained by railings in the clergy area, the altars individuate the final sancta sanctorum in the building. Framed by a profile mixing curved and straight lines, these railings change their pattern along the transversal axis which, with a simple straight layout, direct the clergy towards their hidden route.

At the far end of the composition, two squared rooms guard the altar. The one at the right provides access to the chancel which, according to the stairs in plan, would have had at least two levels. Additionally, this space is connected to a corridor leading towards an unknown location. Because of the windows in the corridor, the areas at its sides should have been open spaces—maybe courtyards. The other squared room at the left of the altar seems not to have a specific function beside serving symmetric purposes. Marked in plan by lines darker then the other ones, these spaces might have been a later addition due to the expansion of the site.

No information survived about the main elevation of Valperga's church. The entrance bay, protruding from the building core, leaves at both sides two open areas. Although it is not clear how these spaces would have been managed. Similar spaces will appear also in Guarini's project, becoming two enclosed courtyards (even if deprived of a direct access), fitting the building to Valperga's plan at its sides. Interestingly, a later variation on Guarini's project opens again these two spaces breaking the continuity of the street facade.

2.2 1662~1665: Guarini

Guarini's project preserves the guidelines set up by Valperga. Apparently, in fact, the foundations of the four main pillars from the previous project were already in place when Guarini was put in charge of the factory. Following the requests of the Theatines, Guarini overhauled the plan putting emphasis on the dome, aiming to outdo in size and grandeur other buildings in Italy and France.[8] The Theatine's did this for more than scenographic goals[9] but also for the survival of the order itself. Their journey to France, in fact, happened only due to Mazarin; beside his questionable future after the Fronde, when the Cardinal would have been passed away the Theatines might have been left without supporters. An interesting building would have helped the congregation gain attention and possibly the favor of Parisian citizens.

The pre-existing foundations constrained the first level of the church in a setting clearly inherited by Valperga's project. At its top, instead, Guarini was able to follow his own inspiration creating a telescopic structure enhancing the illusion of depth. The effect, perceivable from the interior only, is hidden in the main elevation by superimposed volumes alternating cylindric and prismatic shapes[10] (resembling for Meek[11] a wedding cake). Striking and innovative in composition, Guarini's dome did not convince entirely the Theatines who were uncertain of its structural soundness. Interlaced ribbed domes, in fact, were pretty much original for the Christian world and were usually associated with Moorish architecture. These precursors, however, came in sizes smaller than in Guarini's buildings and, above all, were not standing at the top of such towering structures.

8 David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 3

9 *Ibid.*, 4

10 Because of the gossip around Mazarin and Anne of Austria, the suggested cake elevation may be considered the celebration of a hidden wedding which, according to some historians, might have happened between the Cardinal and the Queen of France after the death of King Luis XIII. The dedication of the church to the Queen, also, may be read as a gift Mazarin did to Queen Anne. Formally the dedication was a request from the young Luis XIV; however, the future King was just 5 years old at that time, making questionable the fact he understood about the dedication and that it was really his own idea. It may be argued that the idea was suggested by someone else – maybe Mazarin himself – in order to please the Queen.

11 H. A. Meek, *Guarino Guarini* (New Haven and London: Yale University Press, 1988), p. 33

Compared to their plan, in fact, the structure at the top of the drum in Sainte-Anne appear almost oversized—a celestial temple floating in the sky.

Modifying Valperga's planimetric setting, Guarini abolished the segregation of the space in the building. The new plan emphasizes a latin cross setting now composed by six circles with equal radii: four of them from the longitudinal axis, while the other two individuate the transept. When reaching the central bay, this geometric matrix is upscaled by a new circle passing from the vertexes of the square circumscribed on the original elements. The new geometry individuates the diameter of the gallery upstairs. The difference between basic and upscaled radii is used to variate the proportions of the side bays, now framed as irregular octagons. The same octagonal shape appears also in the plan of the chancel, composed by a double wall following two different geometries along inside and outside skin.

* * *

Looking at the composition as a whole, the first level (the Mundane Route) revolves around the central bay **[figures 13, 14, 15]**. At its corners four diagonal pillars open the view towards octagonal side bays, whose geometry is deformed while moving around the central bay. Along the transversal axis pre-existing buildings constrain the building compressing the bays. At the opposite, on the longitudinal axis, the same elements expand stretching their geometries. The spacial dilation is contained by convex steps in the entrance bay and by the polygonal chancel in the back. Subjected to these

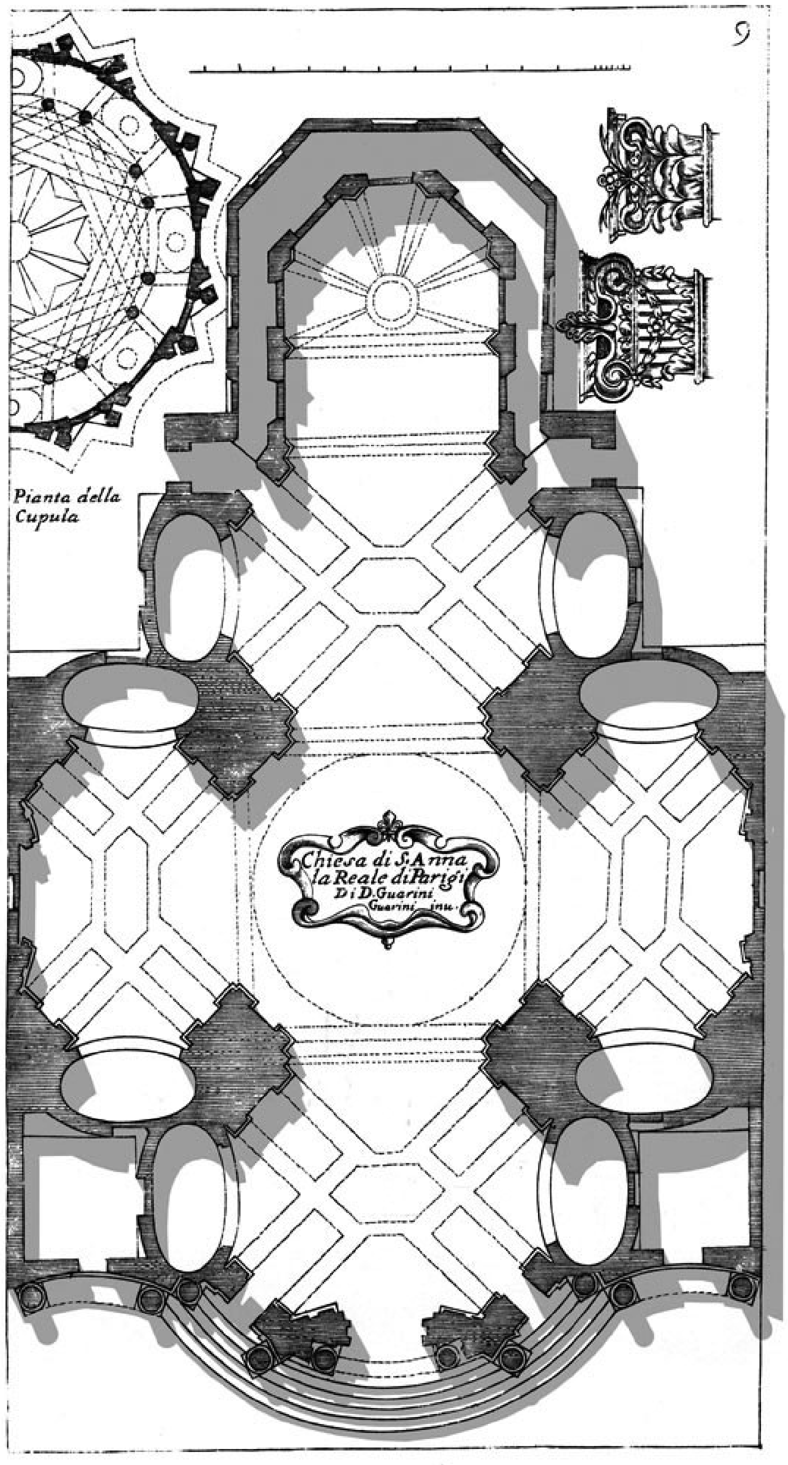

Figure 13. Guarini's plan for Sainte-Anne-la-Royale
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 9.
Additions by the author.

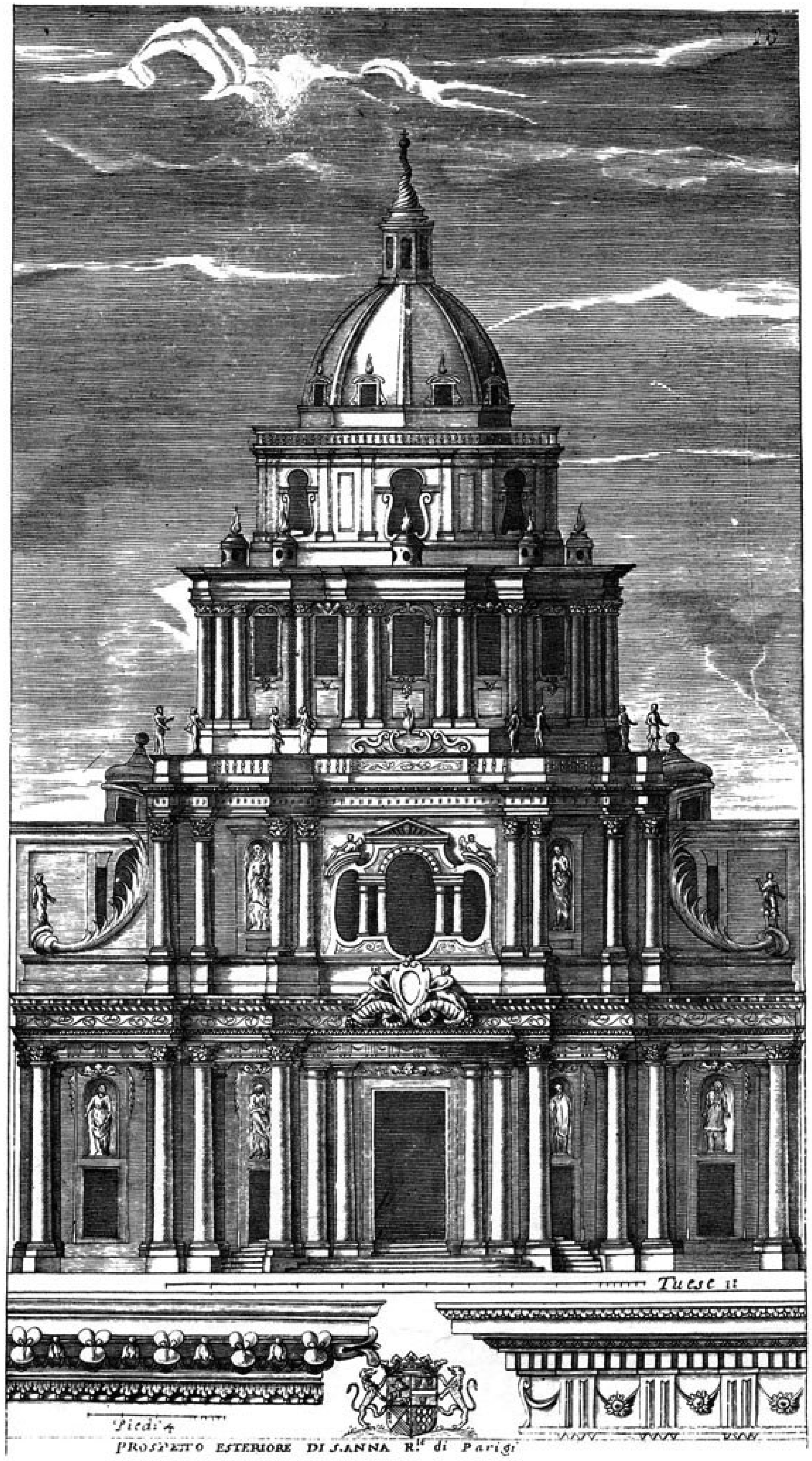

Figure 14. Guarini's main elevation for Sainte-Anne-la-Royale
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 10.

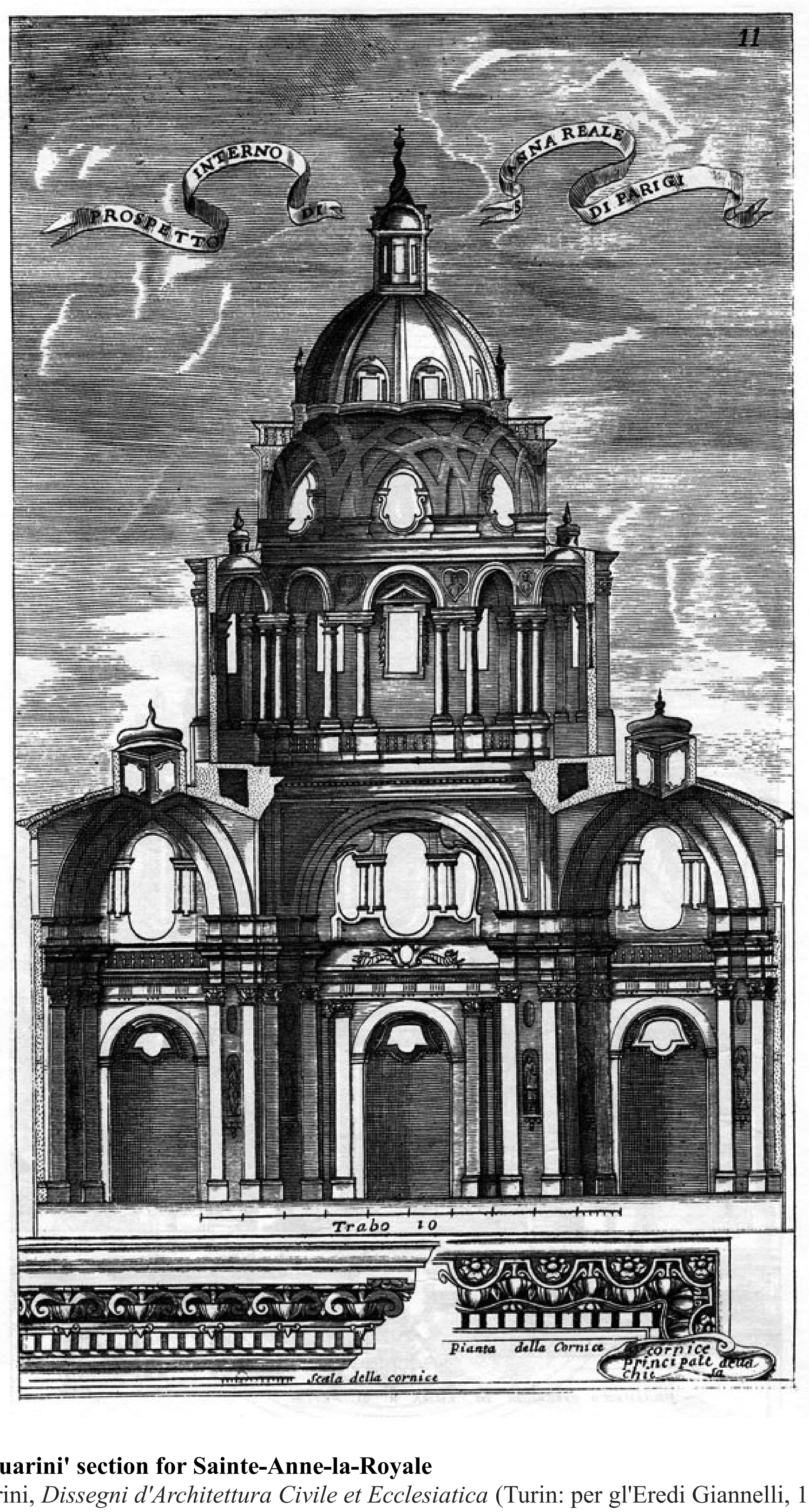

Figure 15. Guarini' section for Sainte-Anne-la-Royale
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 11.

distortions, the church becomes a breathing organism expanding and contracting its bays like an accordion. The results of this process become perceivable in the variable distance between the paired pilaster strips framing the main pillars and by the elliptical chapels closing the bays. While these elements preserve their proportions throughout the whole building, their intersection is affected by the building's organic nature causing uncontrolled intersections in their windows, fused on both first and second level. These extents, however, are revealed via enclosed squared courtyards, deprived in plan of a direct access.[12] In the back of the building, the corresponding spaces lose their enclosure, opening in private spaces probably accessible by the Theatine community only (which may also be why the back facade is so simple compared to the voluptuous layout in the main elevation).

Above the first level, the horizontal and vertical axes are rotated by forty-five degrees, bending along the curvilinear surfaces of the vaults (the Celestial Path) **[figure 16]**. The route of the level below is resumed only when approaching the central bay. Here the ribs preserve in section their diagonal setting, thus evolving their standard cylindric profile into a conic one. As a consequence, the transition between central and side bays is perceived by the ephemeral line of the arches' lower edge. Sharp as a razor, this element negates the weight of the volumes above the pendentive evoking an illusion of a floating space. The only difference distinguishing the composition along the two axes appears in the number of foldings at the pillar corners: one single folding on the transversal axis, three along the longitudinal one.

12 The doorway in plan appears inaccessible from the main elevation. While located at the same height of the main gate, these smaller doors at the sides do not show steps connecting them to the street level.

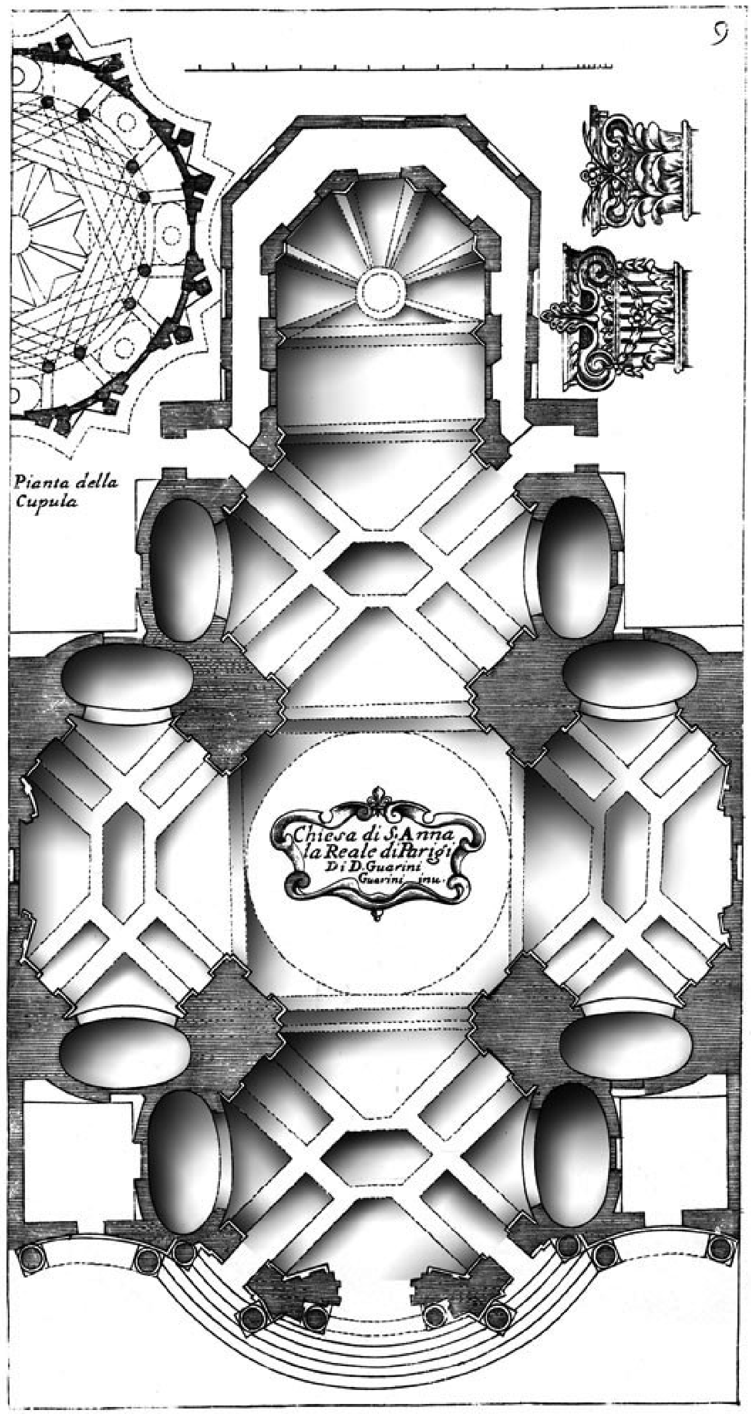

Figure 16. Reversed plan of the vault at the second level of Sainte-Anne-la-Royale
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 9.
Additions by the author.

Moving up in the building, the routes from the previous two levels are now fused together evolving along a circular pattern **[figure 17]**. In correspondence of each path an arch (bent along the circular profile) is framed by two paired columns. Behind this skin, the central bay extends its radius defining a gallery, the first level of a celestial temple superimposed on the previous structure. At its top, an annular barrel vault alternates to elliptical domes in correspondence of each arch and, like those, is bent along the profile of the gallery. The link between these small domes and the annular barrel vault happens through a sinusoidal pendentive, linking the height of vault and arches. Interestingly, this complex space appears to be unapproachable. It may be argued that eventual spiral stairs might have been carved inside the pillars, like in Valperga's plan. However, because of the setting of Guarini's building, similar stairs would have ended outside the gallery thus impacting on the setting of the main elevation in Architettura Civile. In order to avoid the issue, these stairs should have been composed by two segments. A vertical one, carved in the massiveness of the pillars, followed by an inclined one bending along the profile of the pendentive. Only in this way, eventual staircases would have not disturbed the outside skin of the building.

Above the gallery, the geometric pattern determined by its arches reappears in a set of double ribs. The spheric volume hints at the celestial spheres mentioned by Copernicus and Kepler. In fact, at their bottom, harp-shaped windows seems to refer to the celestial harmonies resulting from the the rotational “music of the spheres.” These windows are also the only element unaltered while passing from the spheric volume

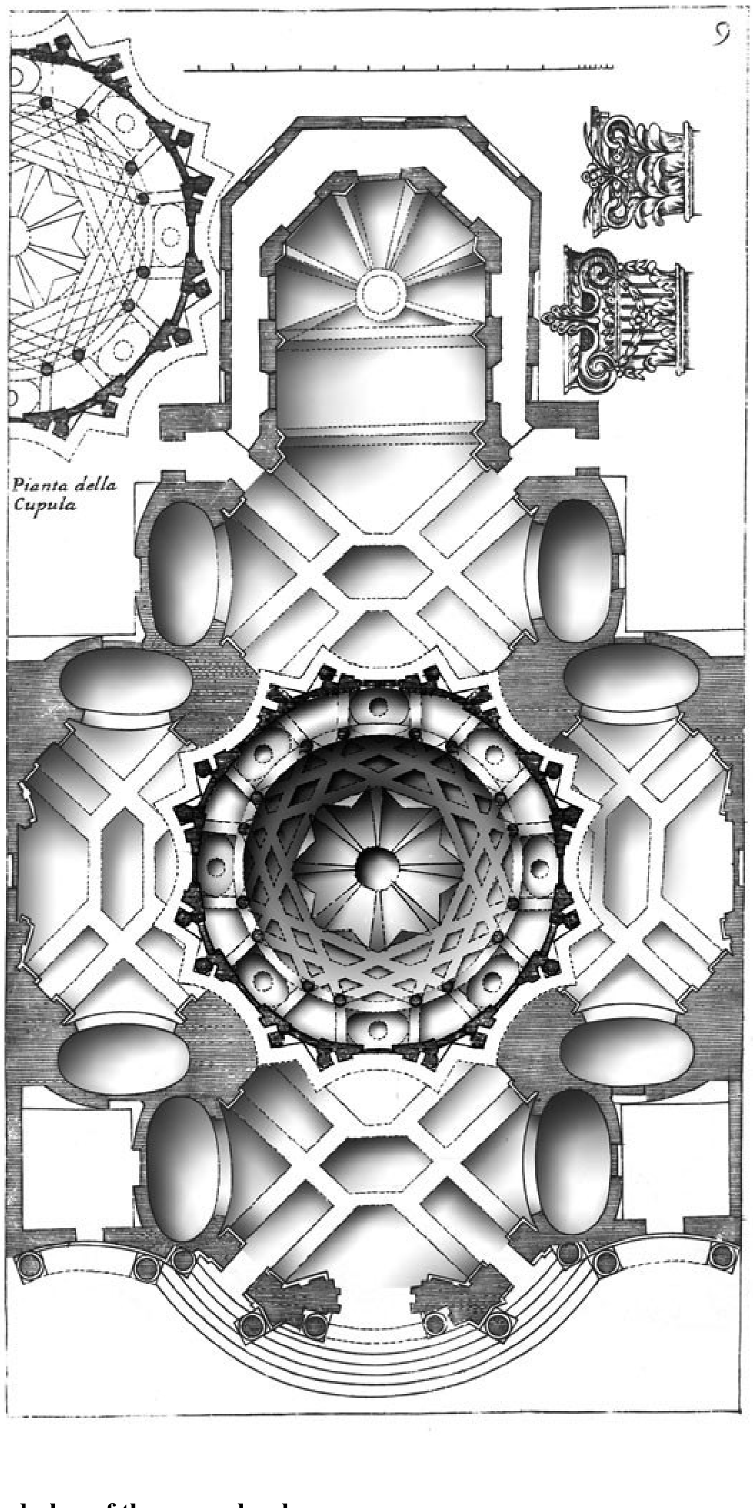

Figure 17. Reversed plan of the upper levels.
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 9.
Additions by the author.

inside the building to the correspondent cylindrical layout in the main elevation. At the top of the sphere, the ribs create a polygonal opening, a base for a pavilion vault on an octagonal base and raised arched profile. At last, the whole building is crowned by an octagonal lantern closed by an hemispheric dome incased in elevation by a fluted sinusoidal spire ending in a sphere holding a greek cross.

When compared to the first two levels in the building, the proportions of the celestial temple appear overwhelming—almost unbalanced. Its purpose, however, is to enhance the illusion of height inducing a forced perspective probably in response to the scenographic effects requested by the Theatines.

2.3 1666~1823: Lievain

Exceeding the funds left by Mazarin, the church of Sainte-Anne-la-Royale was abandoned until 1714. The realized portions of the building included the lower level of the transept and the vaults in the side bays. The Duke of Mazarin, successor of the Cardinal, abandoned the patronage of the Theatines refusing to donate additional funds to complete the building.[13] A source of embarrassment for the French capital, the unfinished church stood incomplete for 48 years. It was only in 1720 that a funding lottery was organized and a new architect for the church appointed, the French Lievain.[14] Based on the limited funds available and the conditions of the surviving remains of the church (clustered by new buildings), Lievain transformed the pre-existing structure in a one-nave

13 Tommaso Sandonnini, *Atti e Memorie delle regie deputazioni di storia Patria per le Provincie Modenesi e Parmensi* (Modena: T, Vincenzi e nipoti, 1888), III, V, p. 499

14 The project was modified on purpose since Coffin mentions that a sectional wooden model of Guarini's project was preserved in the library of the Theatine Order in 1787 [David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 7; Luc-Vincent Thiéry, *Guide de Amateurs et des étrangers voyageurs à Paris* (Paris, 1787), II, 537].

church, thus shifting the original orientation of the building **[figure 18]**. According to the new setting, two semicircular apses were open on the North and South sides of the central bay. In addition, narrow corridors connected the elliptical chapels to circular rooms carved in the pillars' mass. The original telescopic dome was scrapped together with the facade, now entirely missing because of the new buildings clustering the site.

Later in time, an actual access to the building was realized thanks to a donation by Francois Boyer, a French member of the Theatine order. The project, realized in 1747 by the French architect Pierre Des Maisons, opened a corridor connecting the eastern bay of the mutilated church to Quai Malaquai, site of the original main elevation. Likewise, a secondary exit connected the same bay to Rue de Lille in the back (at that time Rue de Bourbon) **[figure 11]**.

According to a drawing in the Archives de France at Paris (F13 849),[15] during the French Revolution Sainte-Anne might have been converted into a storehouse for military supplies. Beside the omission in plan of Lievain's apses (Coffin suggests their absence is due to the questionable quality of the mentioned drawing), no alterations were done to the church. Its vast indoor space hosted two stories of wooden galleries maximizing the available surface.

After the French Revolution, there are no more traces of Theatines in Paris and France in general. Brief notes about the church mention its conversion into dance hall first (around 1800) and in a cafe (the Cafe des Muses) in 1815. Between 1821 and 1823

15 David R. Coffin, "Padre Guarino Guarini in Paris," *Journal of the Society of Architectural Historians*, XV, 2 (1956): 8

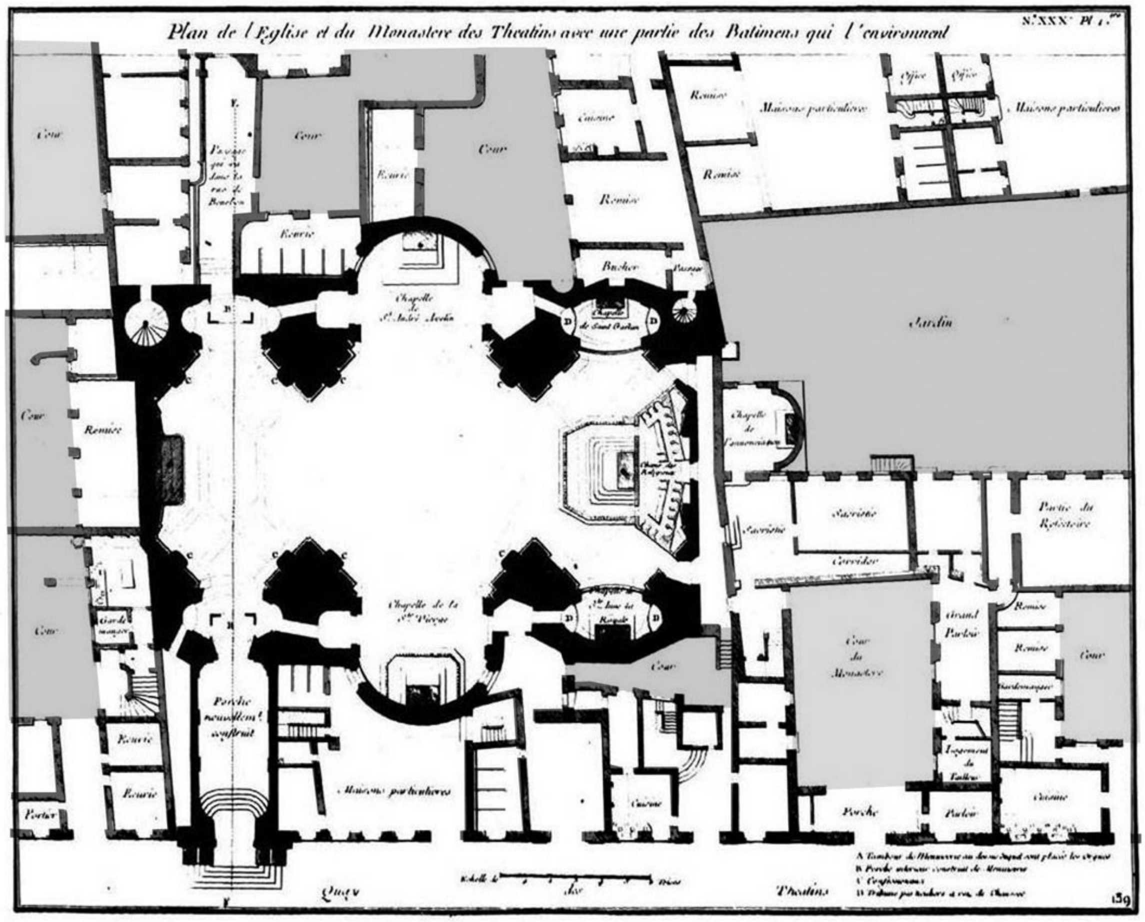

Figure 18. Lievain's plan for Sainte-Anne-la-Royale
Jacques François Blondel, *Architecture Francoise* (Paris: 1752), II, n. 30, TAV. 1.
Additions by the author.

the remains of the Theatine building were at last erased from Paris grounds—its site occupied by private houses. At the present time, the only remains of Sainte-Anne-la-Royale still on site is in 26 Rue de Lille. Here, merged by later buildings, still stands the secondary gate realized in 1747 by Pierre des Maisons. Though exquisite in execution, this gem of French stereotomy is not included in the present reconstruction since it is not part of the original project by Guarino Guarini.

CHAPTER 3 – The ashes of rebirth

Several Baroque buildings follow ideas of cosmic order embedded in geometric and mathematical proportions. Aiming for the perfection of a divine creation, architectonic compositions during the Baroque explored a wide variety of geometric applications. Inside this architectural panorama, Guarini suggested his own views of space and volumes. Mixing information from different sources, he created original compositions and personal interpretations of the architectural orders. Differently from the traditional interpretations of Vitruvius by Palladio and Serlio, Guarini suggests a twelve base module for every architectural order. Thanks to this modular standardization, Guarini invented an easy way to scale the elements in each order according to compositional needs. This method was mainly used in elevations and three-dimensional setting of the architectural orders but not as a grid ruling building plans. Following the organic ideas at the base of Baroque architecture, Guarini realized compositions where curved and straight lines coexist by simple projections and devices like the squaring of a circle. In fact, while circles expressed divine perfections, their mathematical description can not happen without the irrational π; likewise, the diagonal of a square can not be always expressed by a finite number. In order to get rid of these irrational measurements, graphic solutions allow one to express curves through rational lines.

Following these guidelines, the reconstruction for both section and elevation in Sainte-Anne-la-Royale adapts Guarini's variations of architectural orders to his own original drawings for this church. Starting from the pilaster strip (whose dimensions need to be constant throughout the building), the proportions used for the architectural orders in Sainte-Anne have been matched to the information in *Architettura Civile.*

The reconstruction here hypothesized tries to follow as much as possible all the sources mentioned above; however, it is not possible to expect an exact overlapping between reconstruction and original plan. Guarini did not leave information about the creative process for Sainte-Anne. Moreover, it needs to be mentioned the questionable quality of Guarini's drawings for this project. Straight lines are not precisely rendered; and, possible distortions might have affected the original incision. Compared to contemporary digital projects, it is unreasonable to expect the precision of a CAD drawing from a four-hundred-year-old handmade drawing. Because of these considerations, the geometric rules used in the present reconstruction try to regularize Guarini's plan while keeping as much as possible the original design of the church.

In the past, three scholars offered a few words about Sainte-Anne-la-Royale: Harold Meek, Mario Passanti, and Sandro Benedetti. While respecting the work of these eminent scholars, their contributions for Sainte-Anne do not fit the geometric reconstruction here hypothesized. Differently from the present work, which looks at the church as a whole, Meek, Passanti, and Benedetti focused their works only on selected portions of Sainte-Anne.[1]

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1 Among these three scholars, Passanti only suggested a possible proportion connecting central and side bays; however, other elements framing the composition (like columns and pilaster strips) are not taken in consideration in Passanti's hypothesis. [Mario Passanti, *Nel Magico Mondo di Guarino Guarini* (Turin: Toso, 1963), pp. 75-81; Mario Passanti, “Disegni Integrativi di Lastre del Trattato della «Architettura Civile»,” in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 425-428.]

Finally, a note about the measurements: the present reconstruction highlights a geometric system ruling the whole building independently from physical measurements. The forty steps listed below guide the reader through the creation process of the plan for Sainte-Anne-la-Roayle starting from the circle at the base of the dome (whose radius may be randomly chosen). However, this does not mean that Guarini worked without pre-set measures. The historical account states the existence of several variables constraining the composition (like the pre-existing foundations of the pillars, and the dimensions of the site). However, technological advancements introduced in the profession by digital drawings give us the ability to disconnect Sainte-Anne from its real dimensions while focusing only on the geometric relationships and ratios at the base of the building. After completing the plan, the whole building may be scaled to its real measures using as a reference the width of a pilaster strip. The design of the capital crowning the pilaster strips implies a specific measure for this element constantly appearing throughout the building; moreover, its dimensions give the possibility for linking plan and elevations in a unique geometric system.

When Guarini accepted the work for Sainte-Anne the foundations of the four main pillars from Valperga's project were already constructed. However Guarini innovated the standard setting of Counter-Reform churches used by Valperga (a main body with chapels carved on both sides, a short transept, a choir beyond the apsis). The main focus of the new composition becomes the dome which appears to float above a slender galleria illuminated by hidden lanterns.

In this analysis of Guarini's drawings, the dome becomes the starting element for the reconstruction. The circle π_1 introduced in STEP 01 is not the most inner circle in the central bay but the one immediately after it (this is to say, the circle tangent to the outside of the arches framing the central bay).

3.1 Reconstruction of the first two levels

STEP 01 [figure 19]:

Draw a circle representing the one in the central bay tangent to the farther sides of the arches framing the central bay itself. The circle obtained will be called π_1 and its center will be O_1.

STEP 02 [figure 20]:

Move a copy of π_1 to its bottom, creating the entrance bay; likewise, move two copies of π_1 to its top individuating the bay with the altar and, at the very top of the composition, the chancel.

(The final layout of the church may be drawn only after STEP 05).

At this point the re-construction focuses on the square circumscribed by π_1. This square may be quartered by its horizontal and vertical axis; because of the symmetry of the composition, only the instructions for the square at the top right will be given.

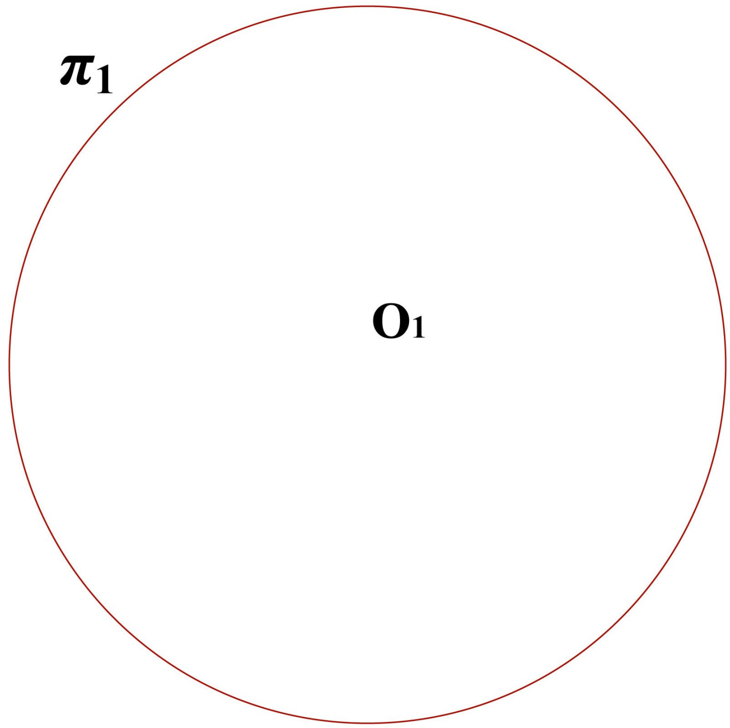

Figure 19. Step 01.
Drawing by the author.

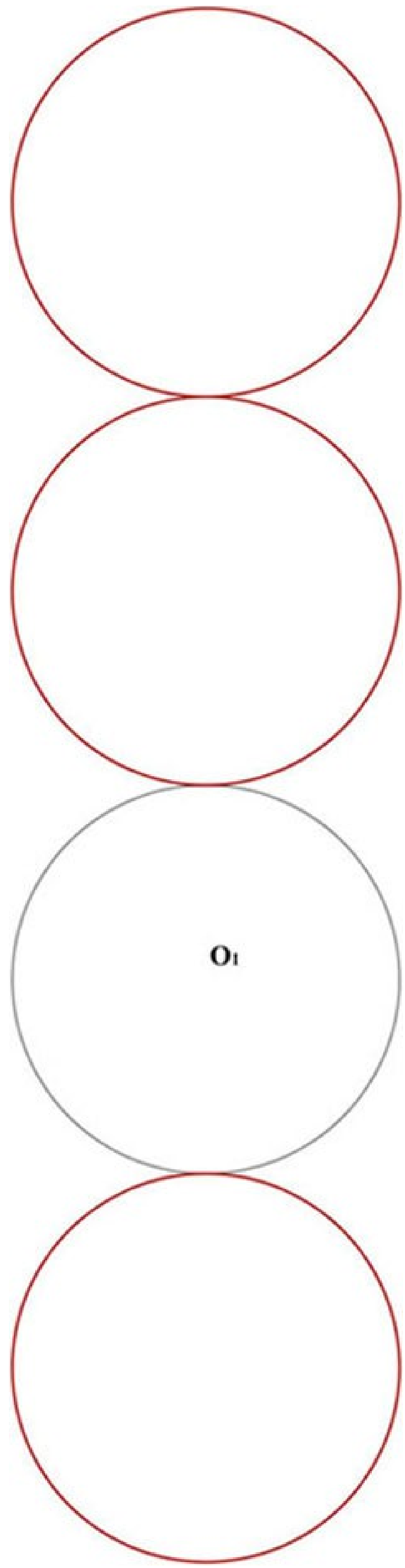

Figure 20. Step 02.
Drawing by the author.

STEP 03 [figure 21]:

From O_1 draw the diagonal of the square circumscribing π_1 until reaching the vertex A. OA intersects π_1 at B. From B draw a horizontal and a vertical line intersecting the square in C and D respectively.

STEP 04 [figure 22]:

Draw CD, the second diagonal of the square ABCD; its intersection with AB individuates E, the center of the square. From E draw a horizontal and a vertical line intersecting the square in F and G respectively. With A as the center and passing through F and G draw the circle π_2. π_2 intersects AB in H.

STEP 05 [figures 23, 24]:

The segment BH (which will be the diameter of π_3) represents the distance between π_1 and the circle projection of the pendentives (drawn by Guarini with a dashed line). To draw this new circle π_4 (which is concentric to π_1), π_3 needs to be reflected along BO_1.

In between π_1 and π_4 there will be the columns framing the galleria above the central bay. Concatenating π_4 on both sides of π_1 it is possible to see a preliminary layout for the side bays at the East and West of the central bay. The resulting shape of the church looks like a reversed latin cross.

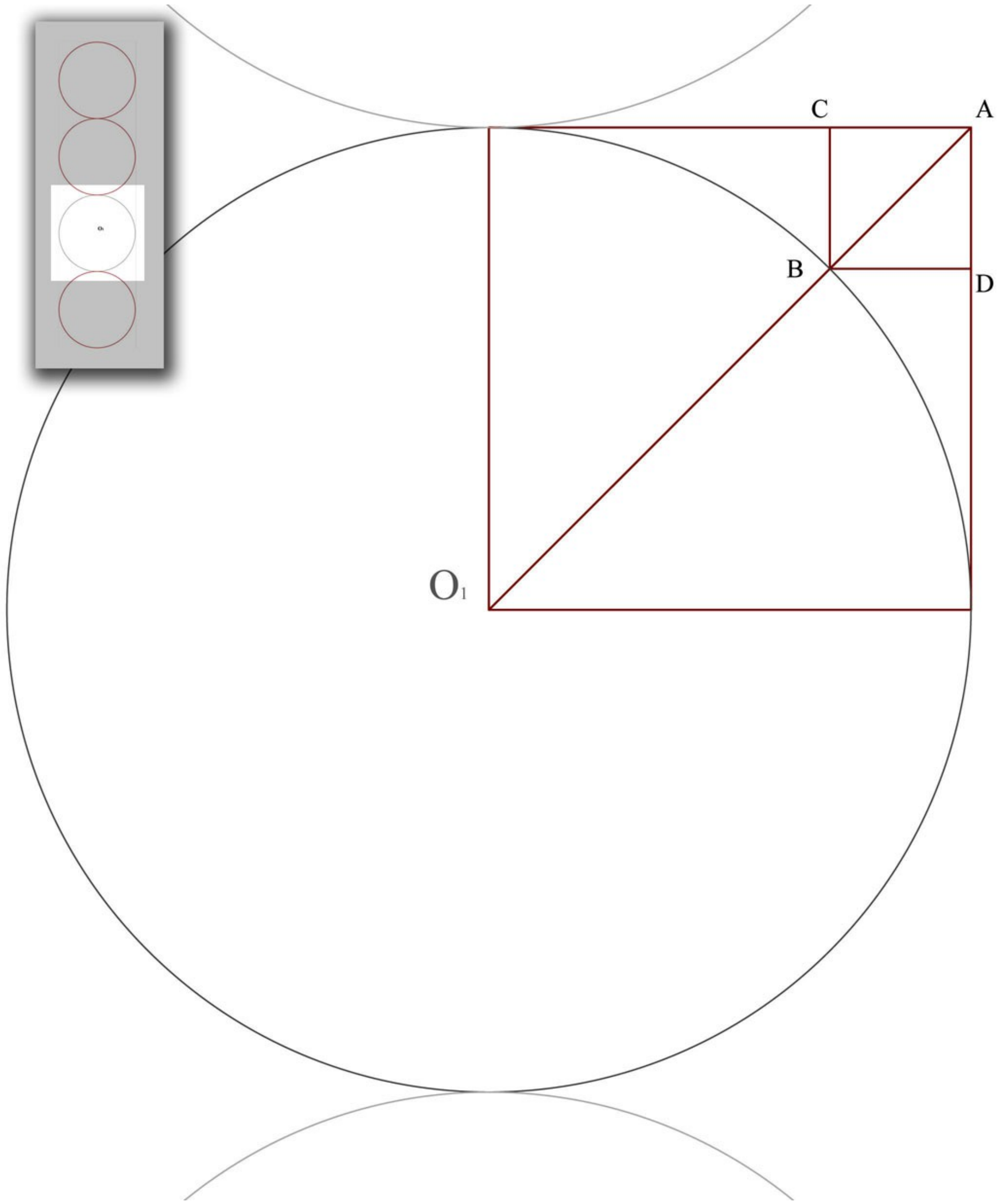

Figure 21. Step 03.
Drawing by the author.

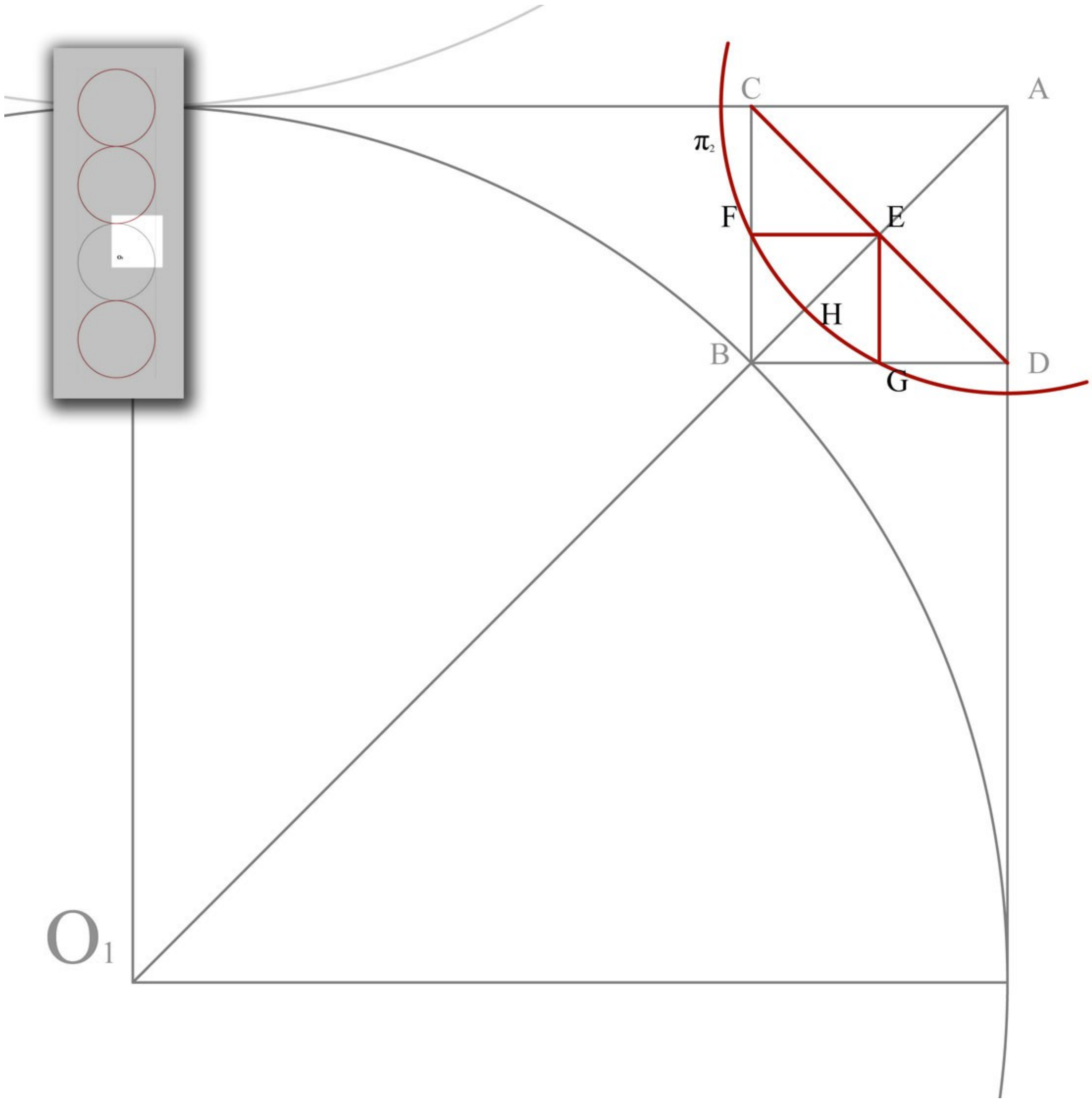

Figure 22. Step 04.
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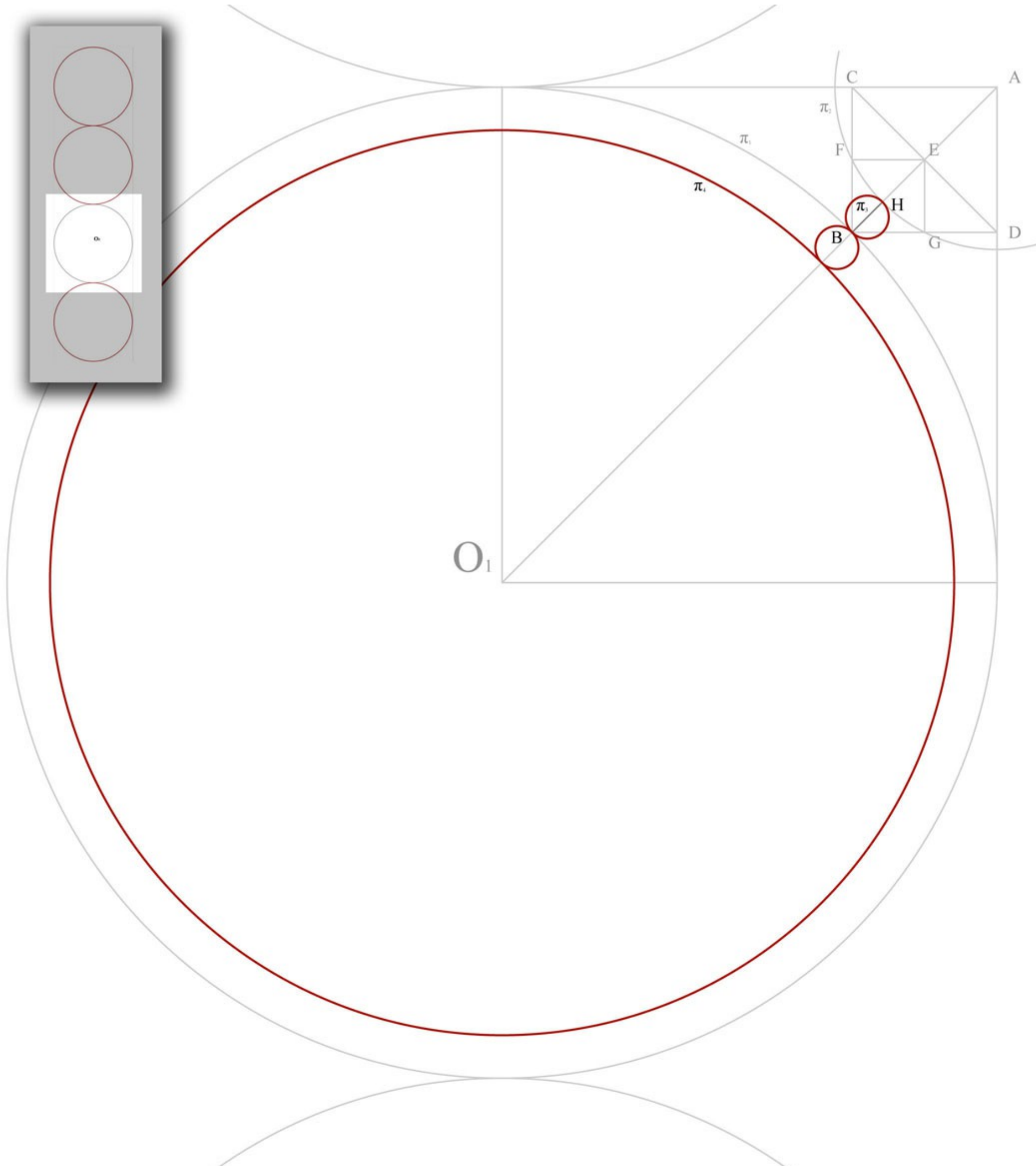

Figure 23. Step 05.
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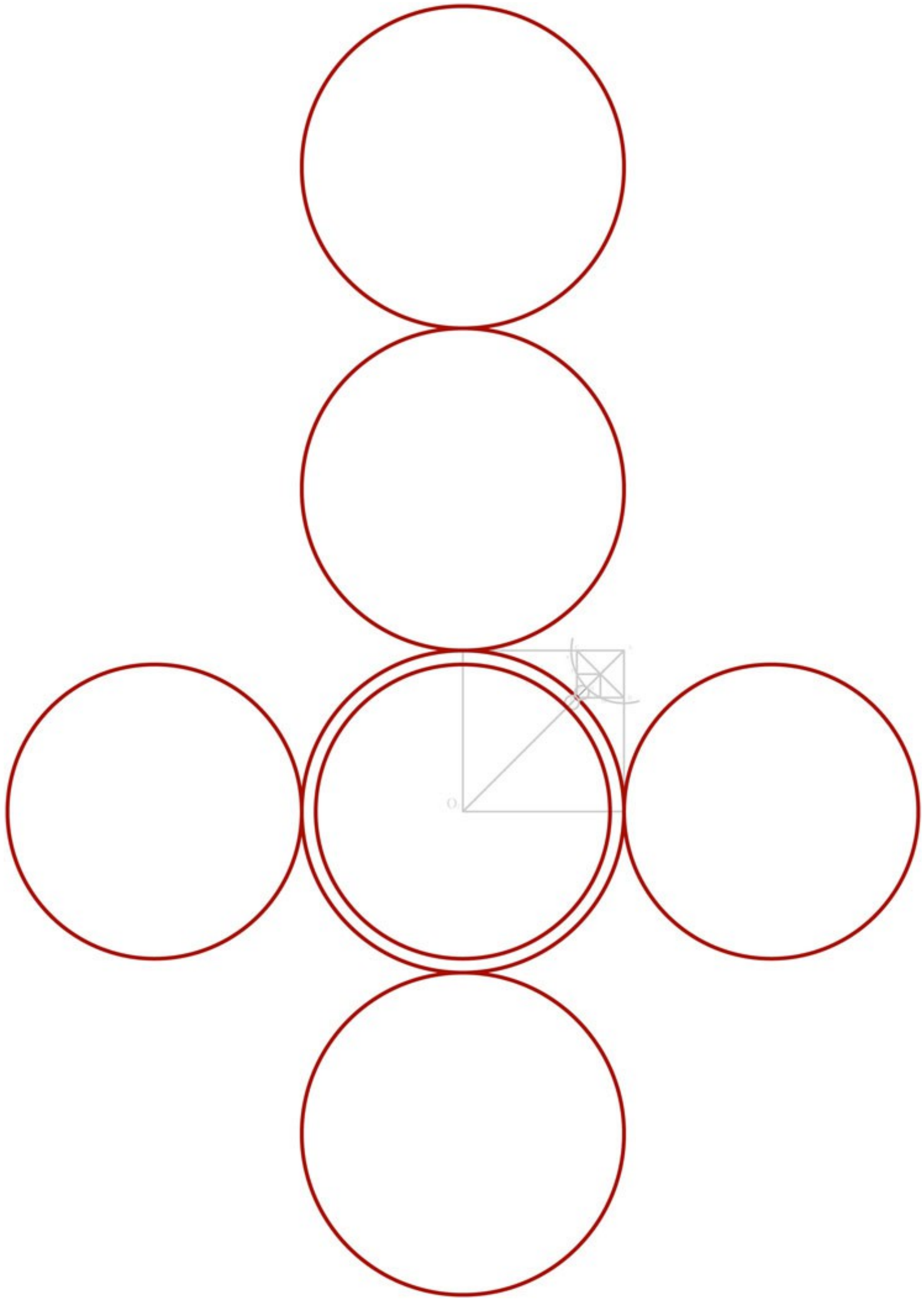

Figure 24. Step 05 overview.
Drawing by the author.

STEP 06 [figure 25]:

Move the circle π_3 along BA until A is on the circumference of π_3, marking the point I along BA. With center O_1, draw the circle passing through I (π_5) and the circle passing through A (π_6). These two circles represent the thickness of outside galleria wall.

Looking at the plan so far, π_4, π_1, π_5, and π_6 individuates the galleria; π_4 and π_1 show the position of the colonnade inside; while π_5 and π_6 show the location of its outside wall.

At this point, it is possible to lay out the side bays. This layout will take in consideration the lines and points where the side bays are tangent to the central bay and where the elliptical chapels start. STEP 07 relates to the North and South bays; the tangent points between central bay and North and South side bays lie on their own vertical axes; the tangent points between elliptical chapels and the North and South side bays lie on their own horizontal axes.

STEP 07 [figure 26]:

Draw a vertical line from O_1 intersecting π_4 at J and π_1 at K (the distance between J and K is still π_3). The Apsis Bay (at the North of the central bay) is individuated by the circle π_7 with center O_2 and passing through K (π_7 is a copy of π_1 drawn in STEP 02). Centered at O_2 draw the circle π_8 passing through J. The horizontal line passing through O_2 intersects π_7 in

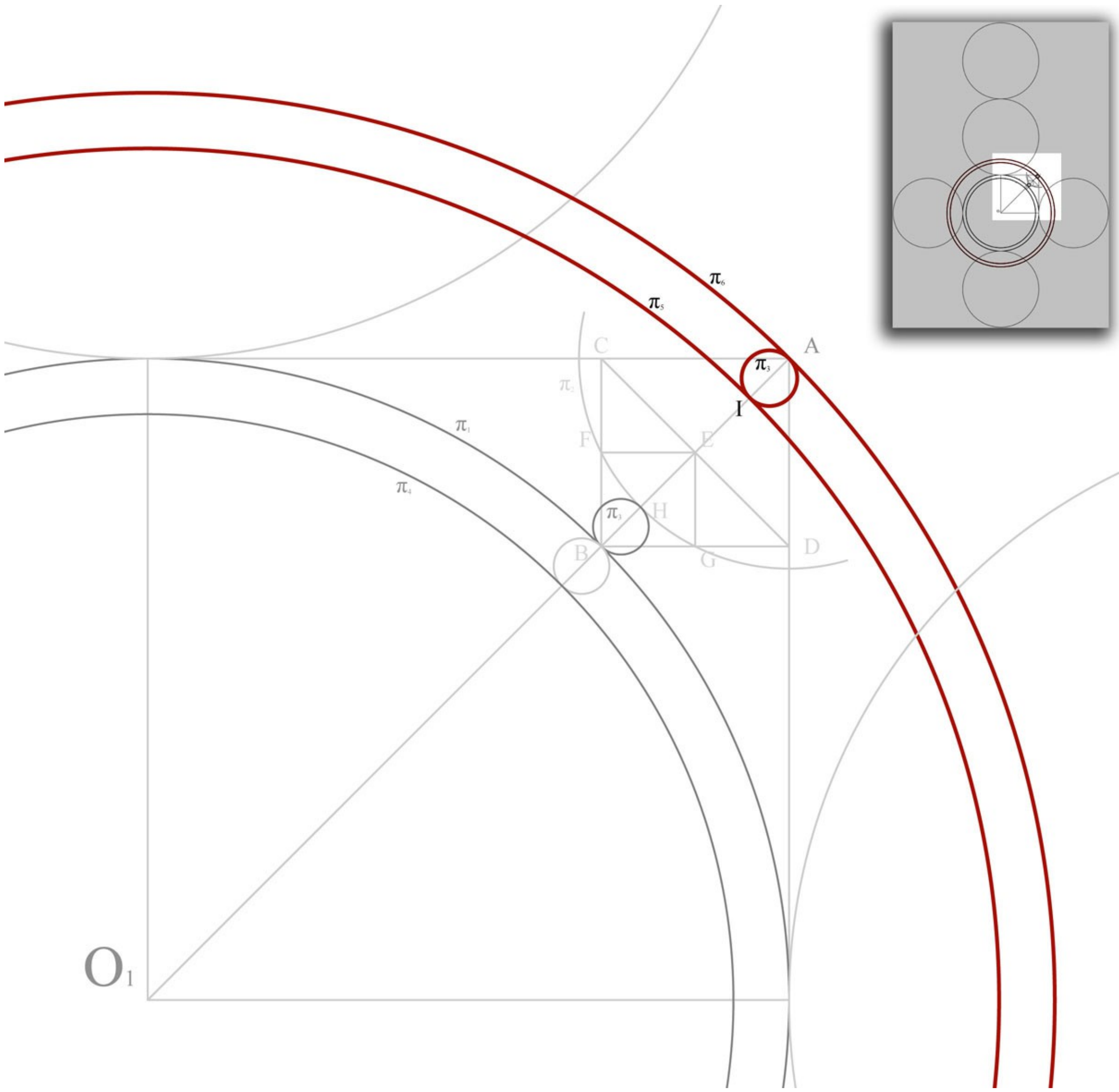

Figure 25. Step 06.
Drawing by the author.

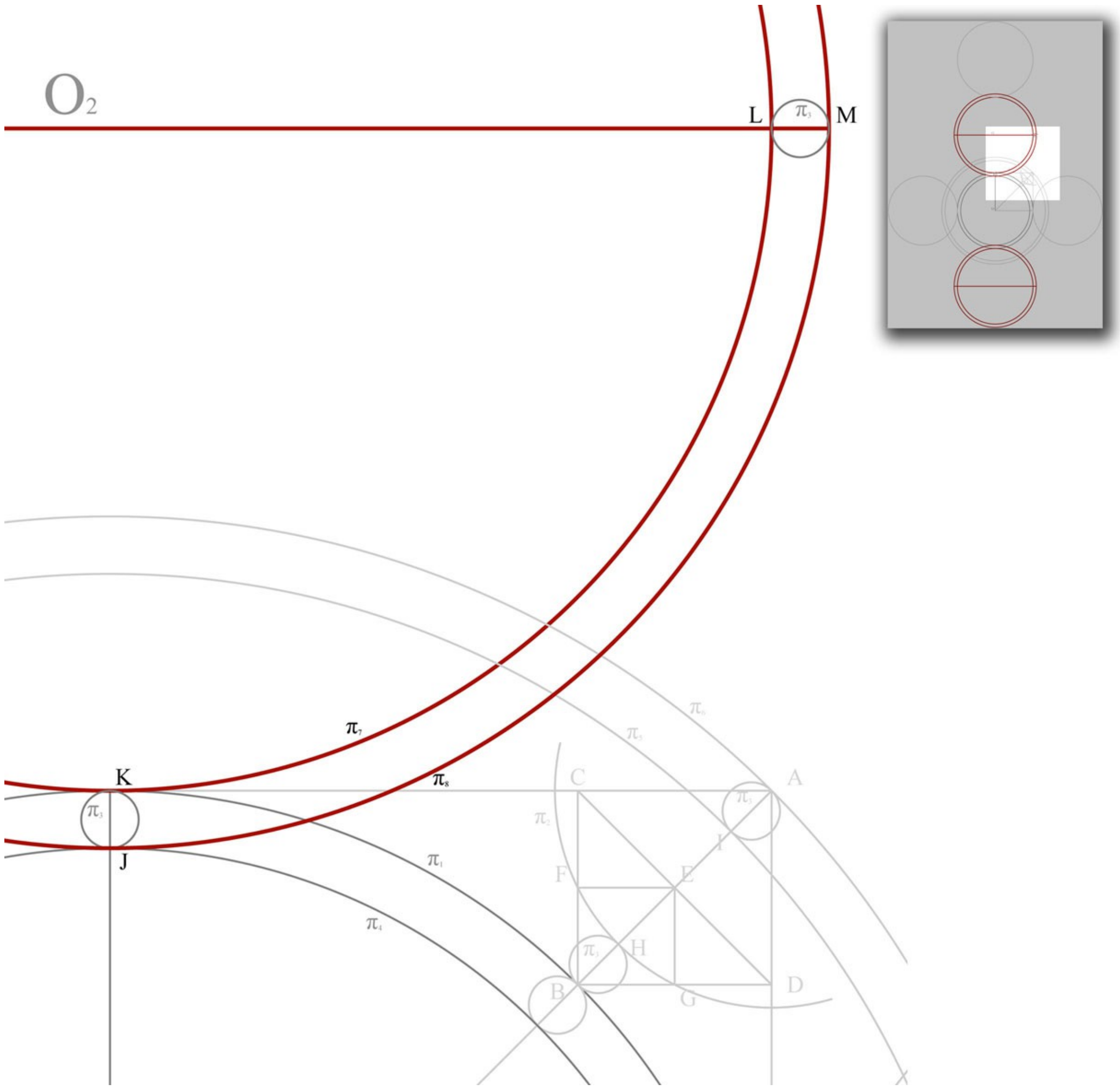

Figure 26. Step 07.
Drawing by the author.

L and π_8 in M. These two points individuate the edges of the minor axis in the elliptical chapels opening at the side of the North and South bays (this is to say of the Apsis and Entrance Bays).

The same construction needs to be mirrored on the left of the Apsis Bay and repeated in the Entrance Bay.

The side bays at the East and West of the central bay require a different construction. These bays, in fact, have a layout more compressed than the North and South bays which may be represented by an ellipse. This time the tangent points with the central bay lie above the horizontal axis of the East and West side bays; while the tangent points with the elliptical chapels lie above the vertical axis of the selected side bays.

STEP 08 [figure 27]:

Let N and P be the intersections between π_1 and π_8. From these two points draw the horizontal *line α* on which will pass through the tangent point with the elliptical chapels in the side bays. From O_3 (the center of the circle related to the East side bay) it has been already drawn the circle π_9 after STEP 05 (π_9 is a copy of π_4). π_9 is tangent to π_1 at Q. From Q, draw the diameter of π_9 through O_3 to R. QR intersects also π_6 at S. QS, which has the same length of AB, is the diameter of π_{10}.

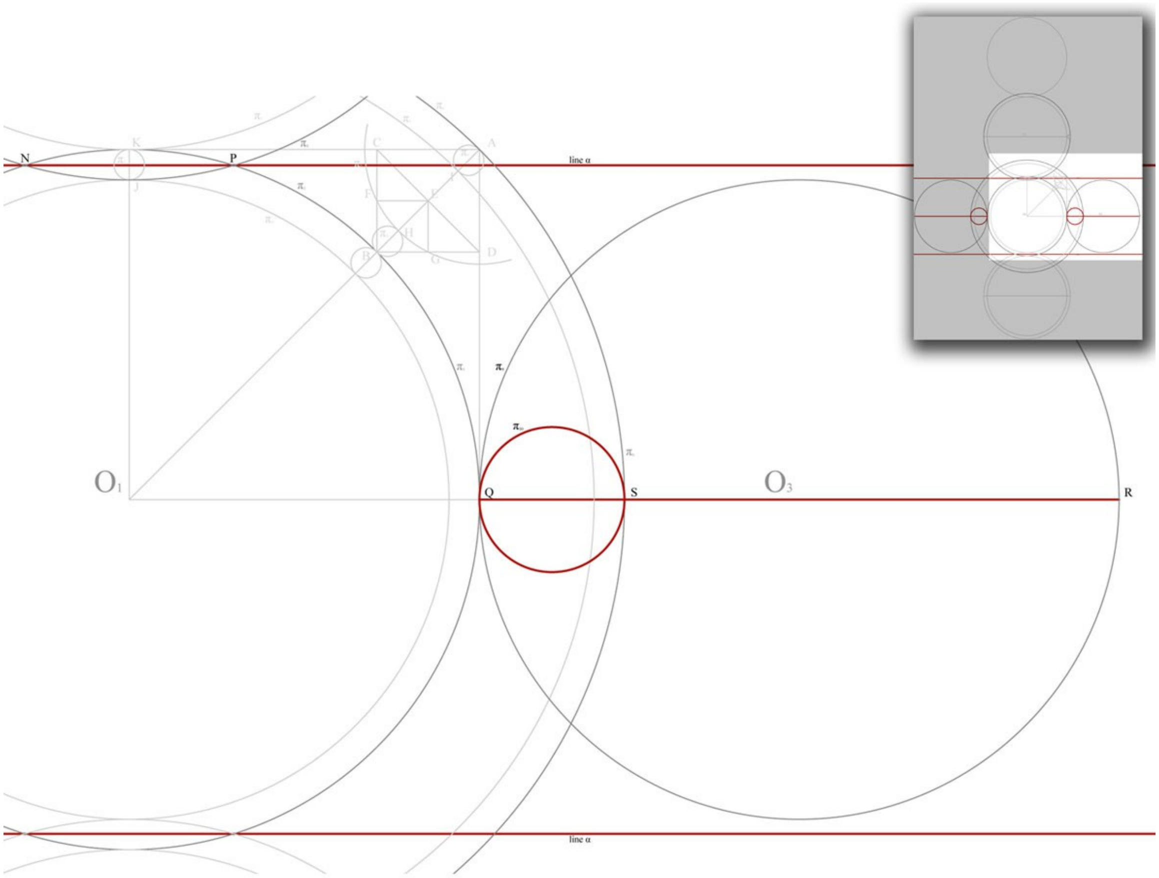

Figure 27. Step 08.
Drawing by the author.

STEP 09 [figure 28]:

From R draw the circle π_{10} marking T on O_3R. The segment TQ is the transversal axis of the ellipse describing the layout for the East bay. U, the middle point of TQ, is the center of the side bay ellipse. From U draw a vertical line until *line α* (which has been mirrored over π_9's horizontal axis) individuating the two points V and W; the segment VW is longitudinal axis of the ellipse. Draw the ellipse φ_1 passing through T, Q, V, and W (see the appendix about drawing an ellipse given its major and minor axis). To find the thickness of the wall in the elliptical chapels, add the diameter of π_3 from Q, T, V, and W outside φ_1 finding the ellipse φ_2.

At this point, it is possible to see the layout of the four pillars framing the central bay. The construction will be described here for the pillar located north-east of the central bay. To avoid confusion, from here the tagging of the points along the real lines in the plan will be done using numbers instead of letters—the letters then represent the geometric constraints on that plan.

STEP 10 [figure 29]:

Let point *1* be at the intersection between O_1A and π_4. From *1* draw a vertical line until KA marking point *2* and a horizontal line until QA marking point *3*. From *2* and *3* draw the diagonal of the square *1*-*2*-A-*3*; intersect the diagonal *2*-*3* with the horizontal line from J and the vertical

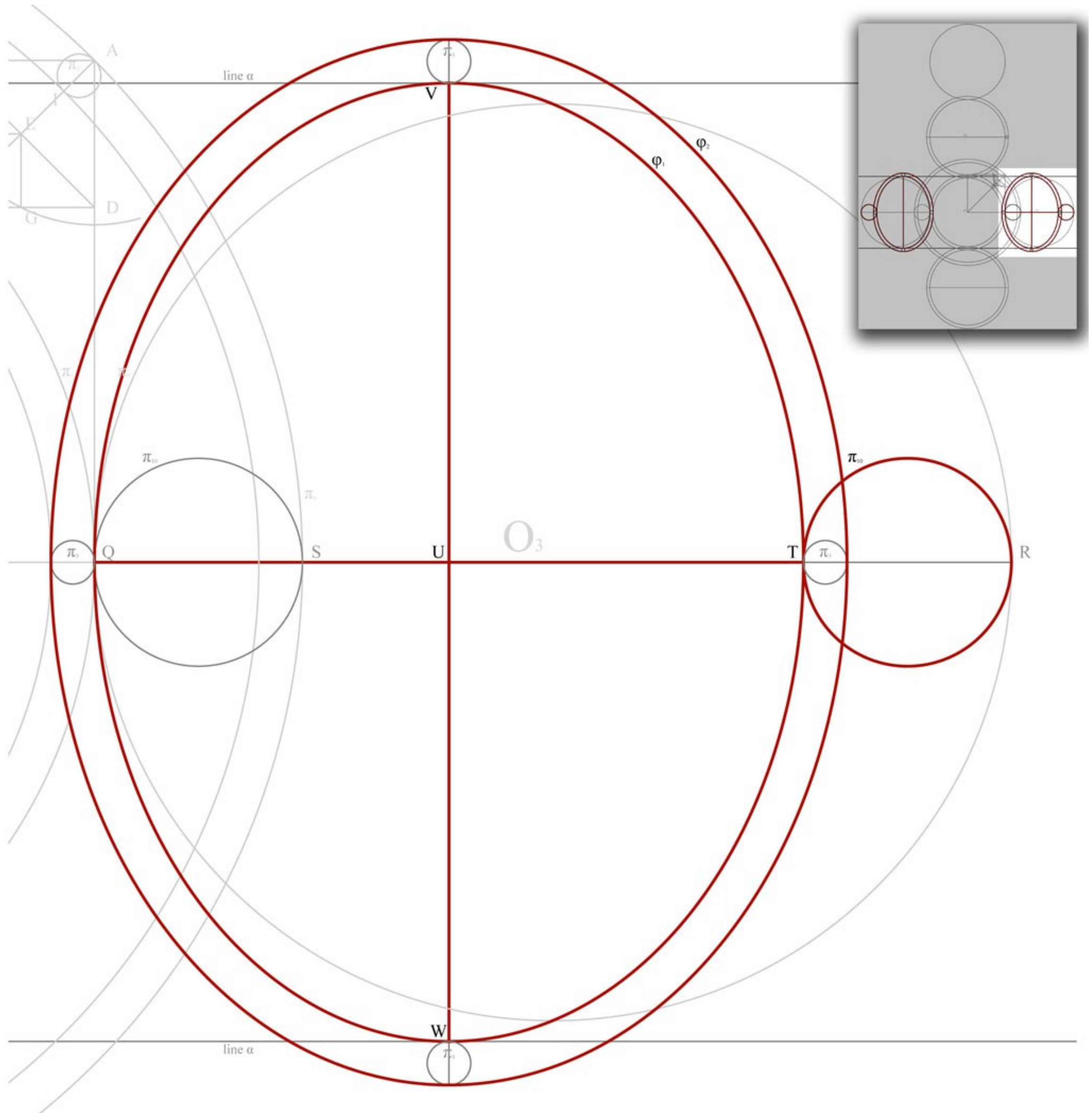

Figure 28. Step 09.
Drawing by the author.

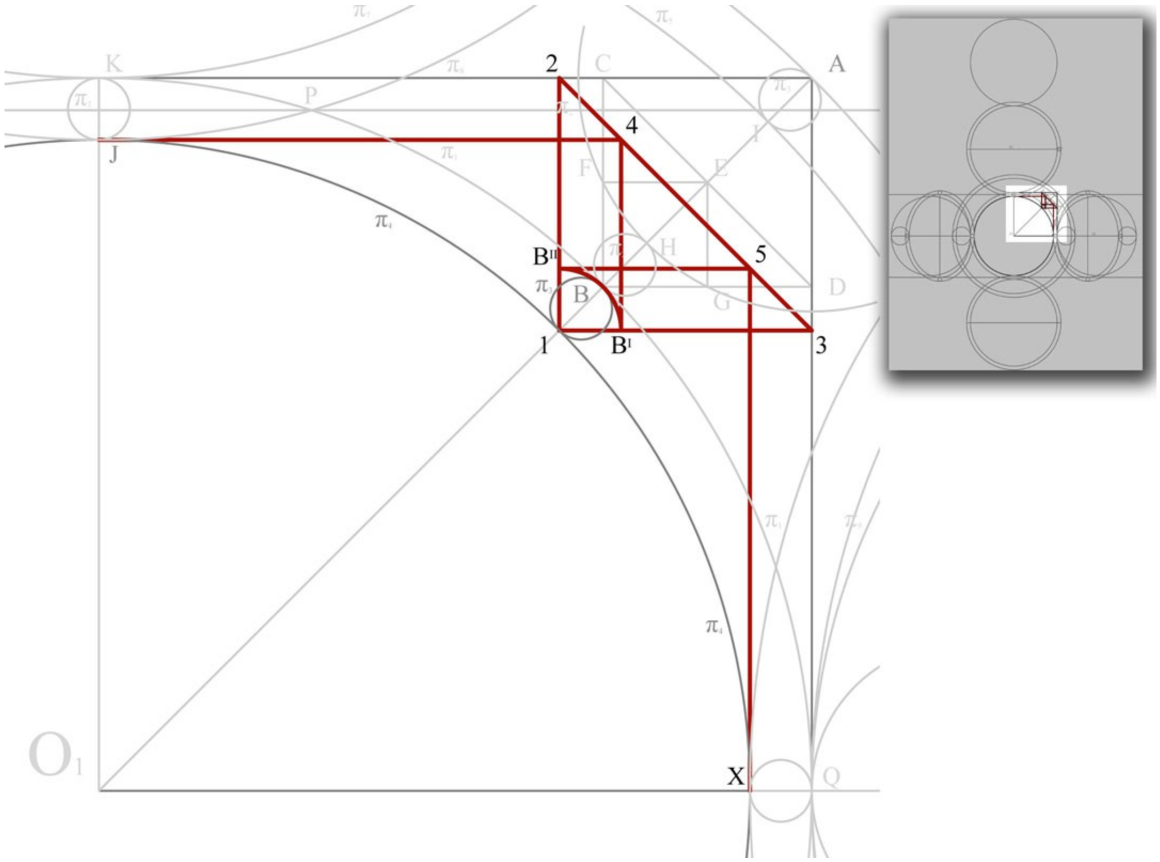

Figure 29. Step 10.
Drawing by the author.

line from X (intersection of the horizontal line from O_1 and π_4) individuating the points *4* and *5* respectively *2-4* and *5-3* are the length of the two pilaster strips facing the central bay.

Segment *2-3* was chosen as a reference for the latter scaling of the whole building according to the measurements indicated by Guarini in his drawings for Sainte-Anne-la-Royale.

An alternative method for finding the points *4* and *5*, takes in consideration the circle π_3. Starting from *1* with span π_3 (this is to say *1*-B) move B on *1-3* and *1-2* individuating B^I and B^{II} respectively. From B^I draw a vertical line until *2-3* individuating point *4*; in the same way, from B^{II} draw a horizontal line until *2-3* individuating point *5*.

STEP 11 [figure 30]:

From the middle point of *2-4* (which does NOT lie on *line α,* since π_1 and π_8 have different radii) draw the circle π_{11} passing through *2* and *3* and intersecting *line α* at *6* (the other intersection point on the left side is not involved in the construction). From *6* draw *line β,* parallel to *24* and, from *4* and *5*, a line perpendicular to *β* individuating the points *7* and *8*.

The points *2*, *4*, *7*, *8*, *5*, and *3* individuate the portion of the pillar facing the central bay.

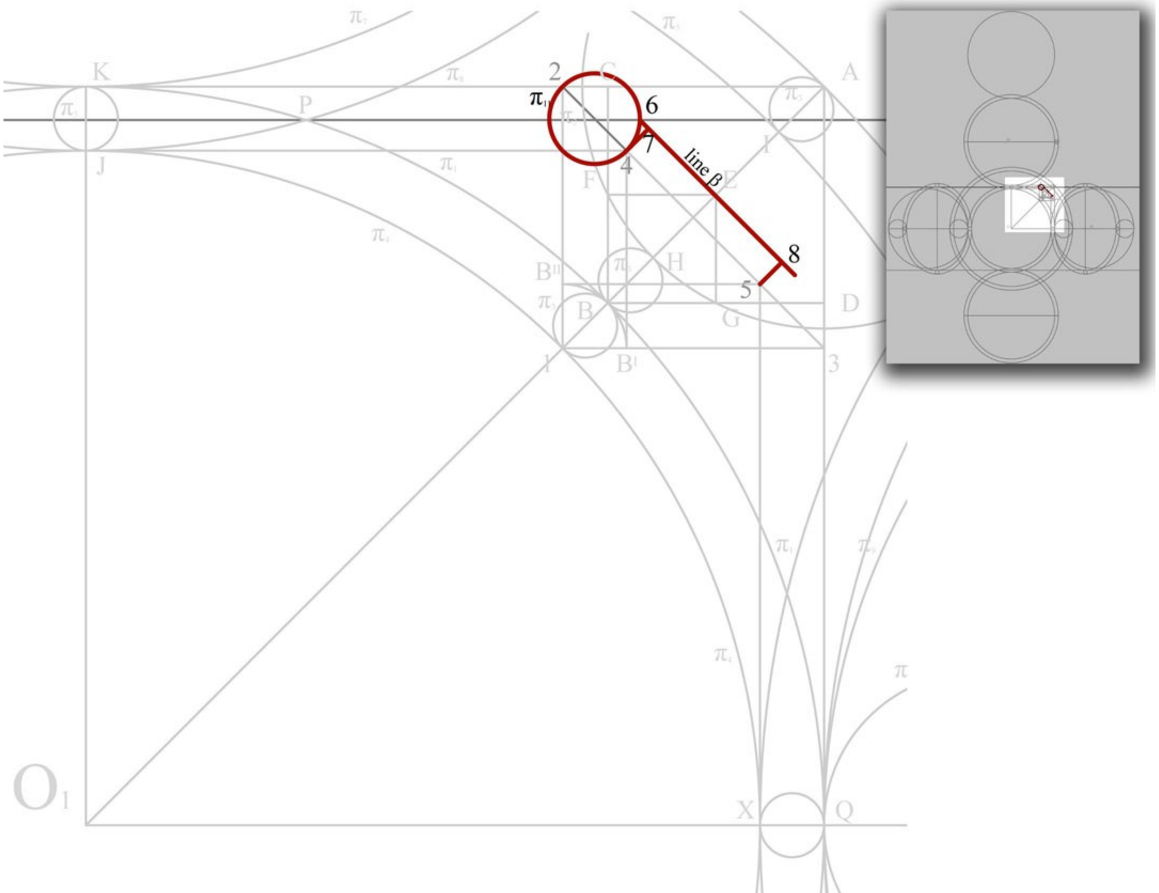

Figure 30. Step 11.
Drawing by the author.

STEP 12 [figure 31]:

From O_2 draw the diagonal going to A (which will be perpendicular to O_1A since π_1 and π_7 share the same radius, their centers O_1 and O_2 are aligned, and they touch one another in K). O_2A intersects π_7 on *10* and π_8 at *11*. From *10* draw *line ε* perpendicular to O_2A; in the same way, draw from *11 line ζ* also perpendicular to O_2A. From *10* move π_{11} along *line ε* individuating point *12*. From *12* move perpendicularly to *line ζ* individuating point *13*. The intersection between *line δ* and *line ζ* individuates point *14*.

The points *10*, *12*, *13*, and *14* are the four irregular edges of the pillar framing the passage between the central bay and the north/south bay.

STEP 13 [figure 32]:

Extend *line ε* until intersecting π_8 at *15*. From *15* draw π_{11} on the same *line ε* individuating point *16*. The segment *15-16* individuates the Northernmost pilaster strip of the pillar. Let π_{12} be the circumference with diameter *5-8* (equal to *4-7*), which represents the depth of the pilaster strips side facing the central bay. Move π_{12} to point *10* over O_2A individuating point *17*. From *17* draw a line parallel to *line ε* and intersect it with a line perpendicular to it from point *16* individuating point *18*.

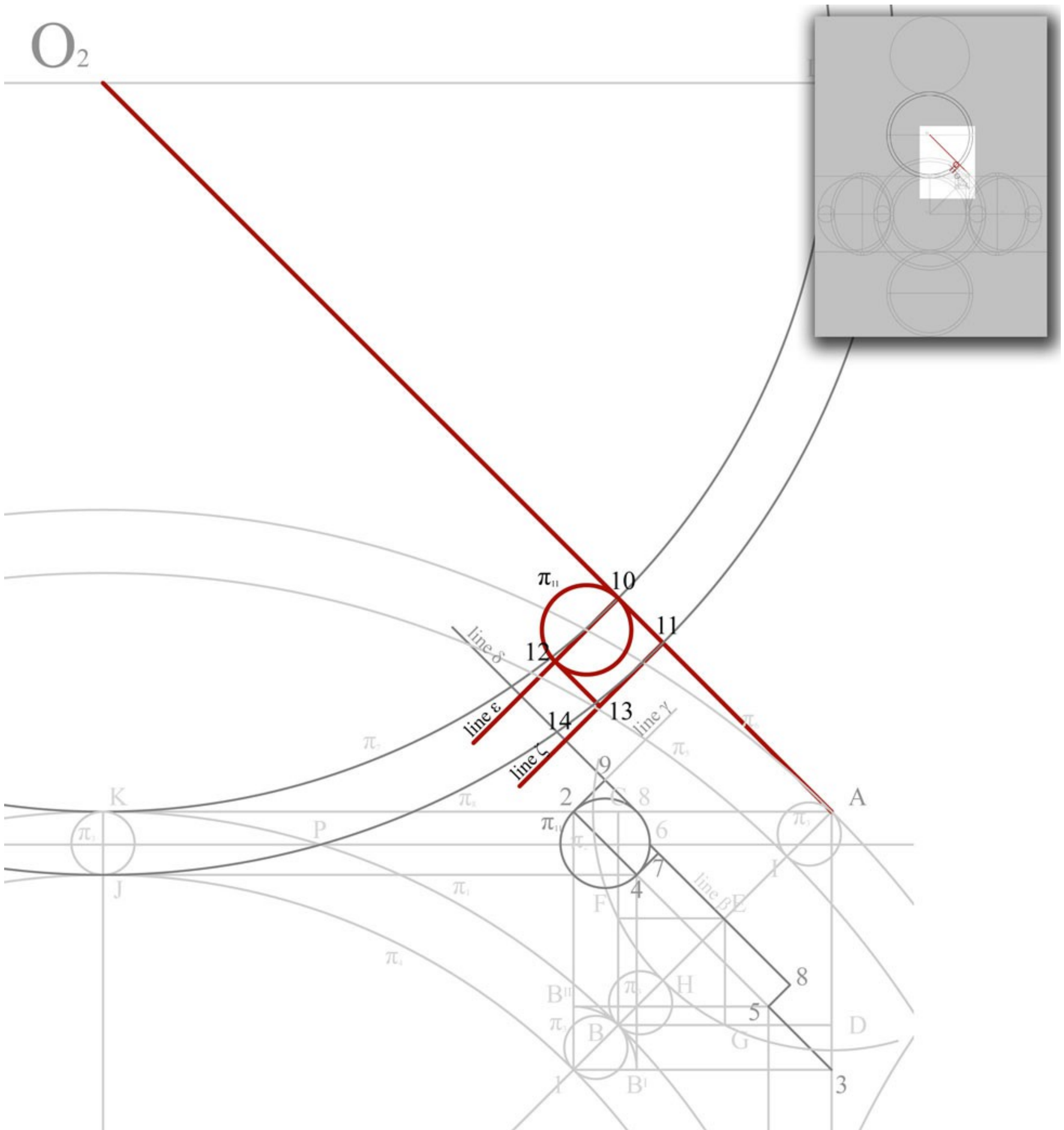

Figure 31. Step 12.
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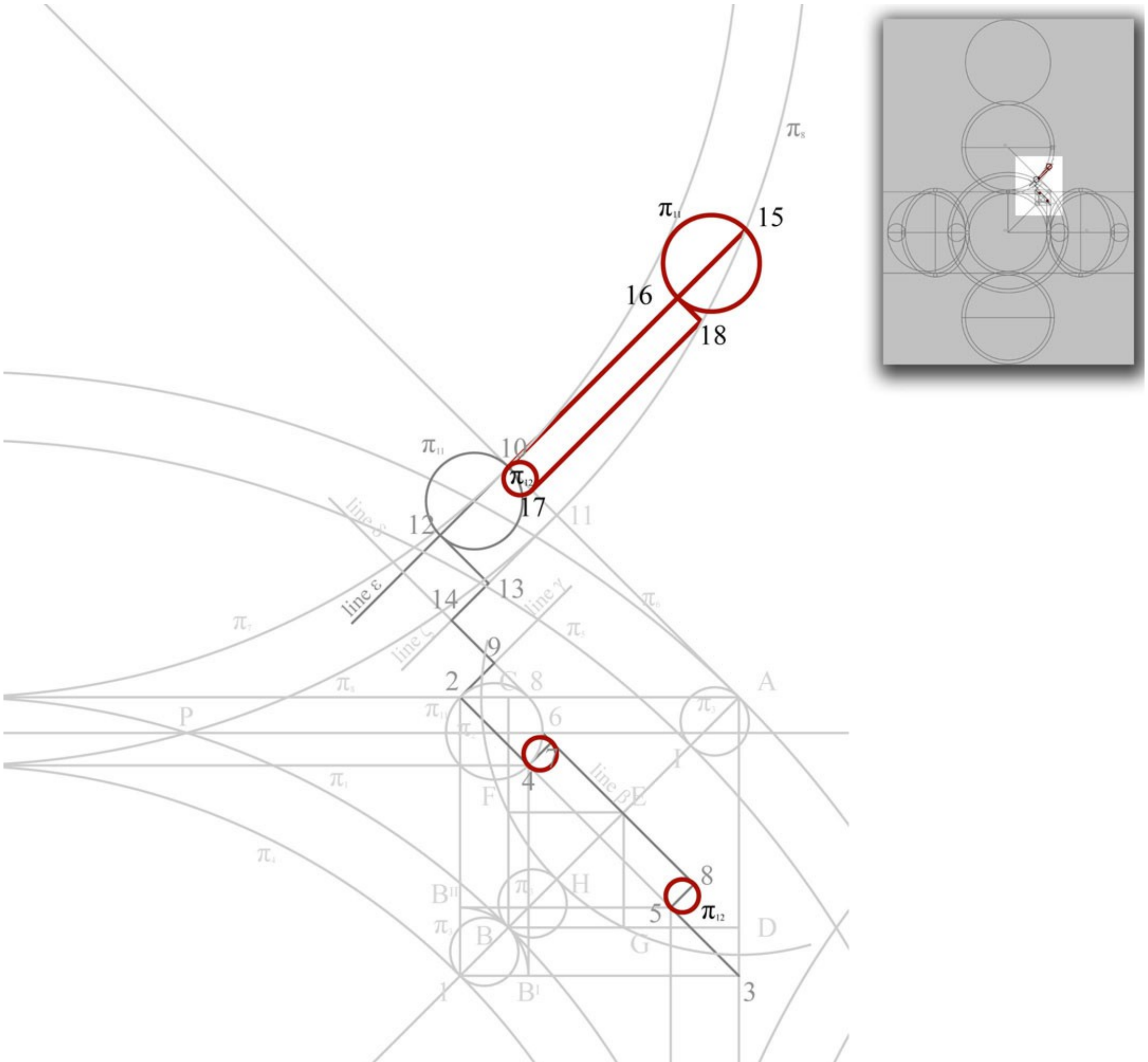

Figure 32. Step 13.
Drawing by the author.

The points *12*, *10*, *17*, *18*, *16*, *15* individuate the face of the pillar facing the north and south bays.

STEP 14 [figure 33]:

From point *15* draw a line perpendicular to *line ε.* Intersect this line with the vertical line from M individuating point *19*, the last edge of the pillar facing the North and South bays.

With the completion of the northern portion of the pillar, it is possible find the layout of the elliptical from point *19*, which individuates their major and minor axes.

STEP 15 [figure 34]:

The segment M-*19* individuates half of the major axis of the elliptical chapels. The minor axis, instead, may be easily obtained by drawing a horizontal line from *19*, named *line η*. From the side bay, extend O_3V individuating point Y^I (at the intersection with π_3) and point Y^{II} (at the intersection with *line η*). The segment Y^IY^{II} individuates the minor axis of the elliptical chapel. Be O_4 the middle point of Y^IY^{II}; move on both sides of O_4 the segment M-*19* (half of the major axis) individuating the points Y^{III} and Y^{IV}. Draw the ellipse φ_3 from Y^I, Y^{II}, Y^{III}, and Y^{IV} representing the inside profile of the elliptical chapels. To find their wall thickness, move π_3 at each edge of φ_3 individuating the points V^{II}, V^{III}, V^{IV} from which it is possible to draw the ellipse φ_4.

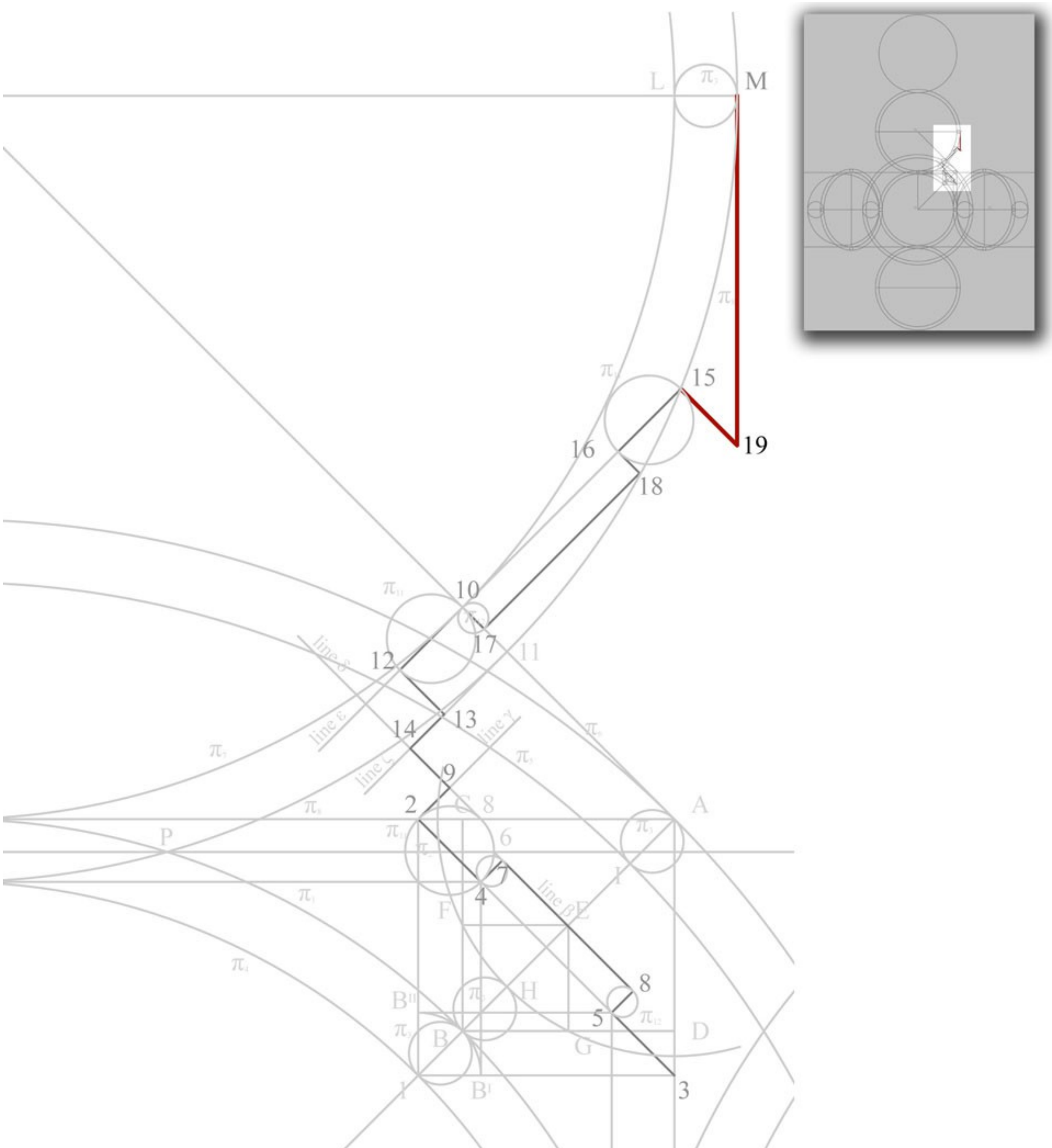

Figure 33. Step 14.
Drawing by the author.

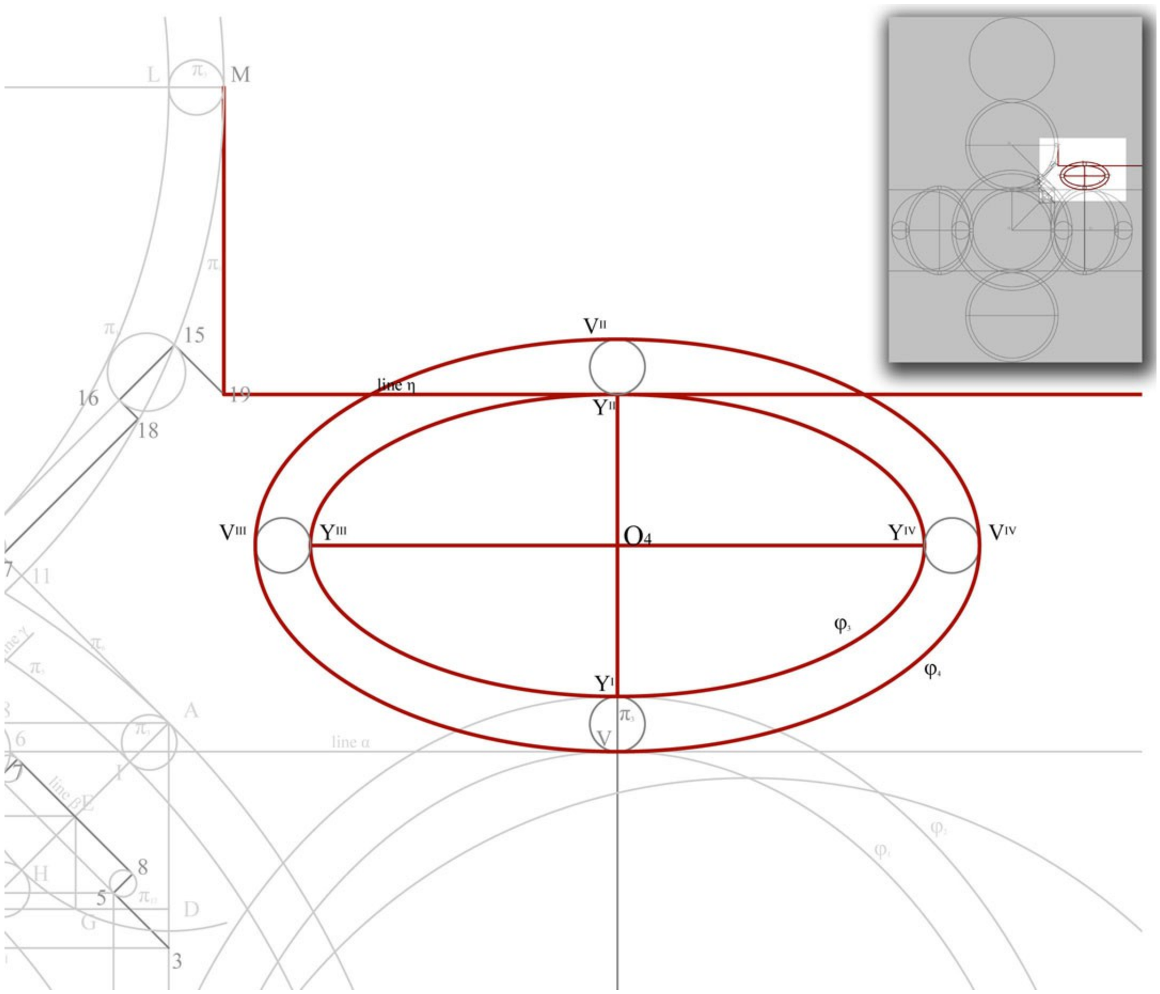

Figure 34. Step 15.
Drawing by the author.

The layout obtained for the elliptical chapels may be moved to the top and bottom of the side bays and, likewise, to both sides of the entrance and altar bays. As visible from the drawing, each couple of perpendicular elliptical chapels partially overlaps implying an irregular profile for the wall separating them; however, the same irregularity may be seen in Guarini's original plan; this construction chooses to keep the awkward profile.

At this point, it is possible to proceed with constructing the third and last profile of the pillar facing the East and West side bays, which will also find the connection between pillar and elliptical chapels in both East/West and North/South bays.

STEP 16 [figure 35]:

Go back to the pillar side facing the central bay and extend *line β*. From point *3* draw a line perpendicular to *β* and a second line moving horizontally individuating the points *20* and *21* respectively. Points *21* and *22* represent the depth of the pilaster strips facing the side bays; the length of *21-22* is still π_{12}; likewise *3-20*. To get the final edge of the same pillar face, extend the line *3-20* until the horizontal line from A (this is to say the extension of KA, the line tangent to the first circle π_1) individuating the point *22*. From *22* add the depth of the pilaster strip, this is to say π_{12}, individuating the point *23*. Connect *23* with *21.* On this line will be the lengths of the pilaster strips facing the side bay. These lengths are expressed by π_{11} similar to the other sides of the pillar.

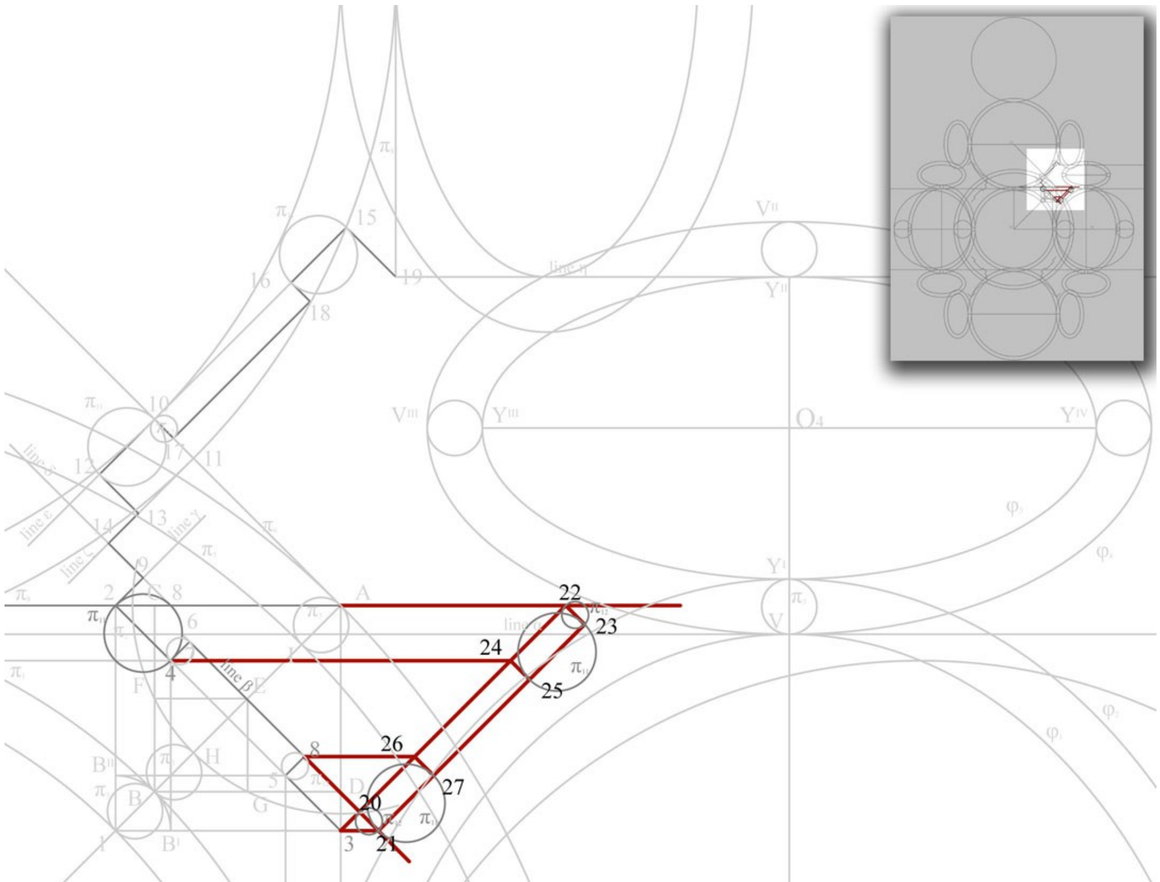

Figure 35. Step 16.
Drawing by the author.

To complete the pillar, draw from *4* a horizontal line until *20-22* (point *24*) and from here a line perpendicular to *20-22* itself (point *25*). Likewise, from *8* draw a horizontal line until *20-22* (point *26*) and from here a line perpendicular to *20-22* itself (point *27*).

The points *20*, *21*, *27*, *26*, *24*, *25*, *23*, and *22* individuate the side of the pillar facing the side bays. The last two steps for completing the pillar come from its connection to the elliptical chapel, which happens in two different ways in East/West bays and in North/South bays.

STEP 17 [figure 36]:

Let F^{I} and F^{II} be the foci of φ_3 ; from point *22* draw a line perpendicular to φ_3 individuating the points *28* (intersection with φ_4) and *29* (intersection with φ_3). The points *28* and *29* are the thickness of the threshold of the chapel. To connect it to the pillar, draw a horizontal line from *28* and intersect it with the extension of *22-23* to find the point *30*.

STEP 18 [figure 37, 38]:

On the North side bay, from point *19* draw a line perpendicular to *15-19* until intersecting the outer ellipse at *31*. To find the threshold points for the elliptical chapel on the North bay, move the threshold *2 8-29* to the

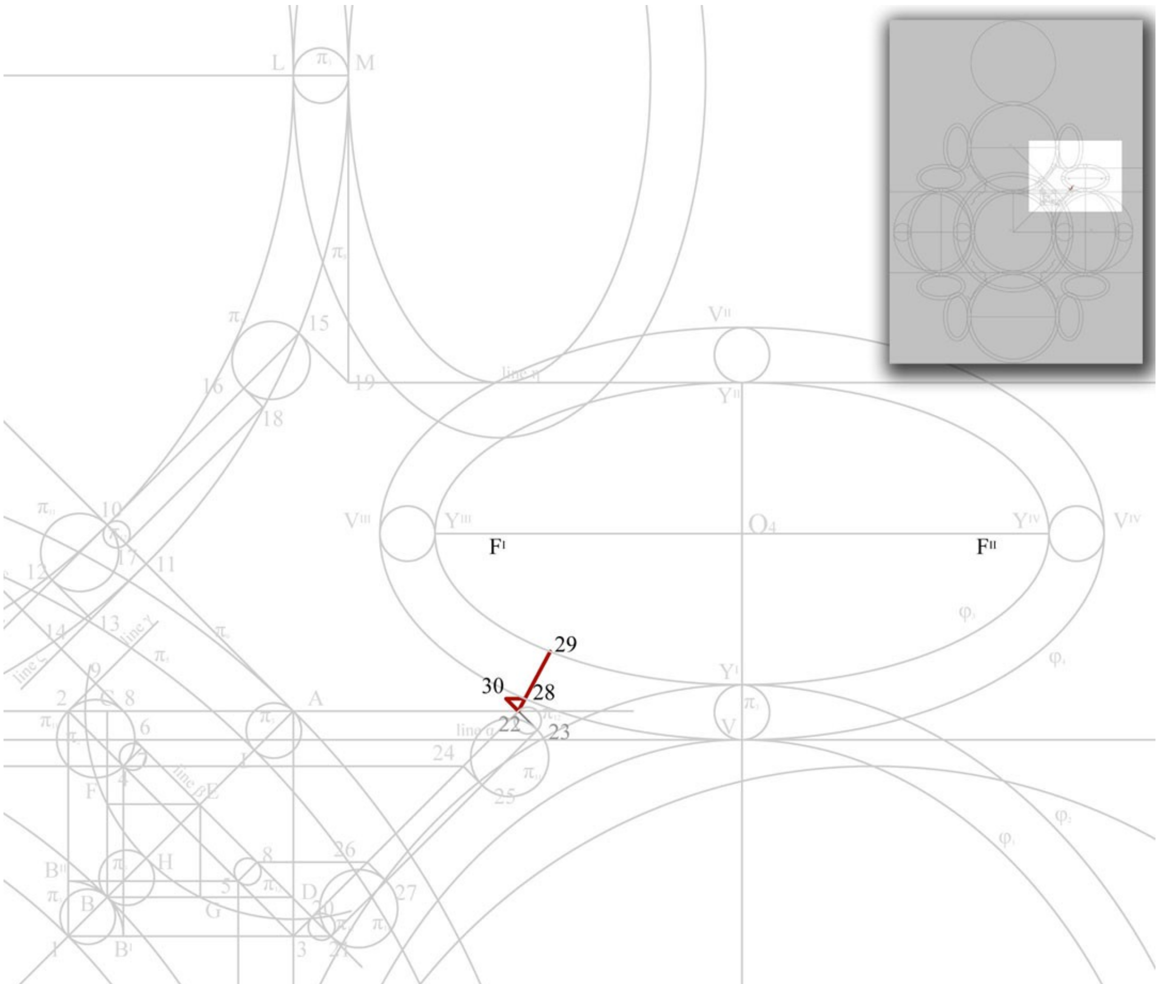

Figure 36. Step 17.
Drawing by the author.

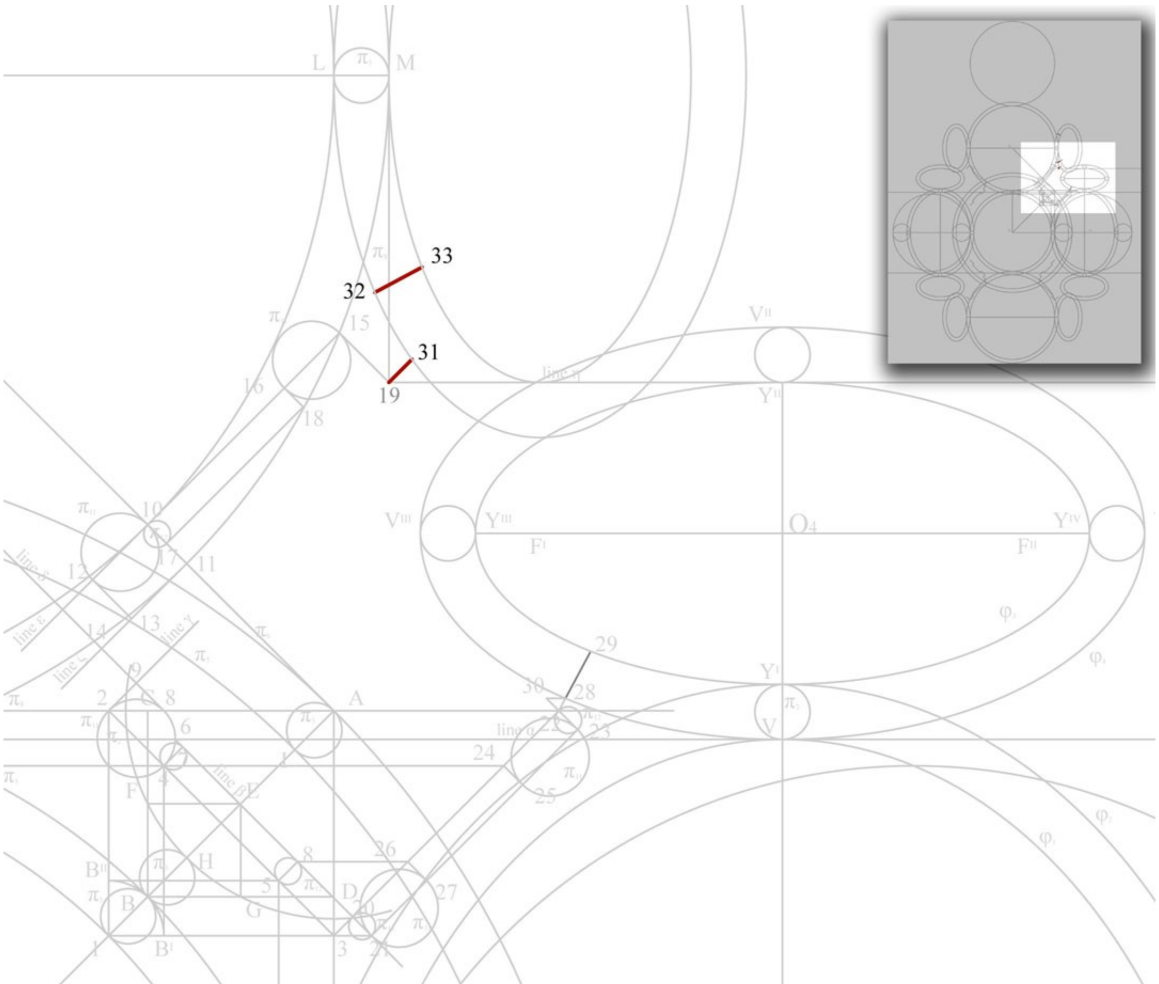

Figure 37. Step 18.
Drawing by the author.

proper elliptical chapel individuating the points *32* and *33*.

At this point, the geometric relationships proportioning the pillars and the elliptical chapels together with their mutual linkage are found. The pillar and the chapel may be copied to their other location. It is important to note that the pillar surfaces have different proportions from the other two depending on which bay it faces; however, each bay (Central, East/West, North/South) is always framed by a similarly-proportioned side of the pillars.

To complete the layout of the side bays, draw the reversed plan of the vault in the bay and the profile of the niche in the same bay **[figure 38]**.

STEP 19 [figure 39]:

The reversed plan of the ribs framing the vault may be easily found by extending the width of the pilaster strips in the side bay perpendicularly to their own elevations. The intersection of the ribs in the center of the bay comes from the intersection of *line* θ and *line* ι with *line* κ individuating the points *34* and *35*. From these two last points draw a vertical line until intersecting the points *36* and *37*, which are symmetric to *34* and *35* from QT, the minor axes of the ellipse φ_1.

STEP 20 [figures 40, 41]:

Let *38* be the last edge of the pillar on the up-right corner of the East side

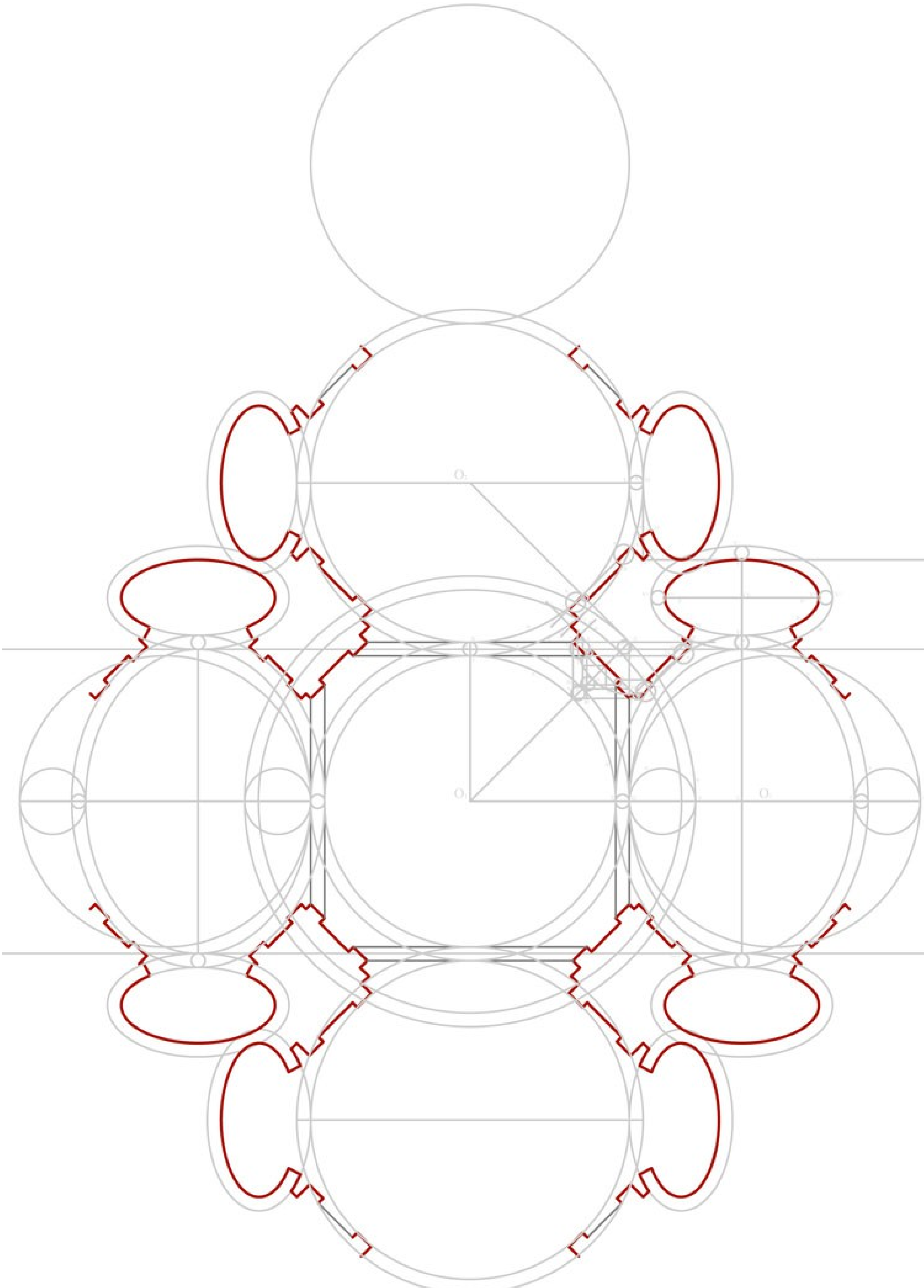

Figure 38. Step 18 overview.
Drawing by the author.

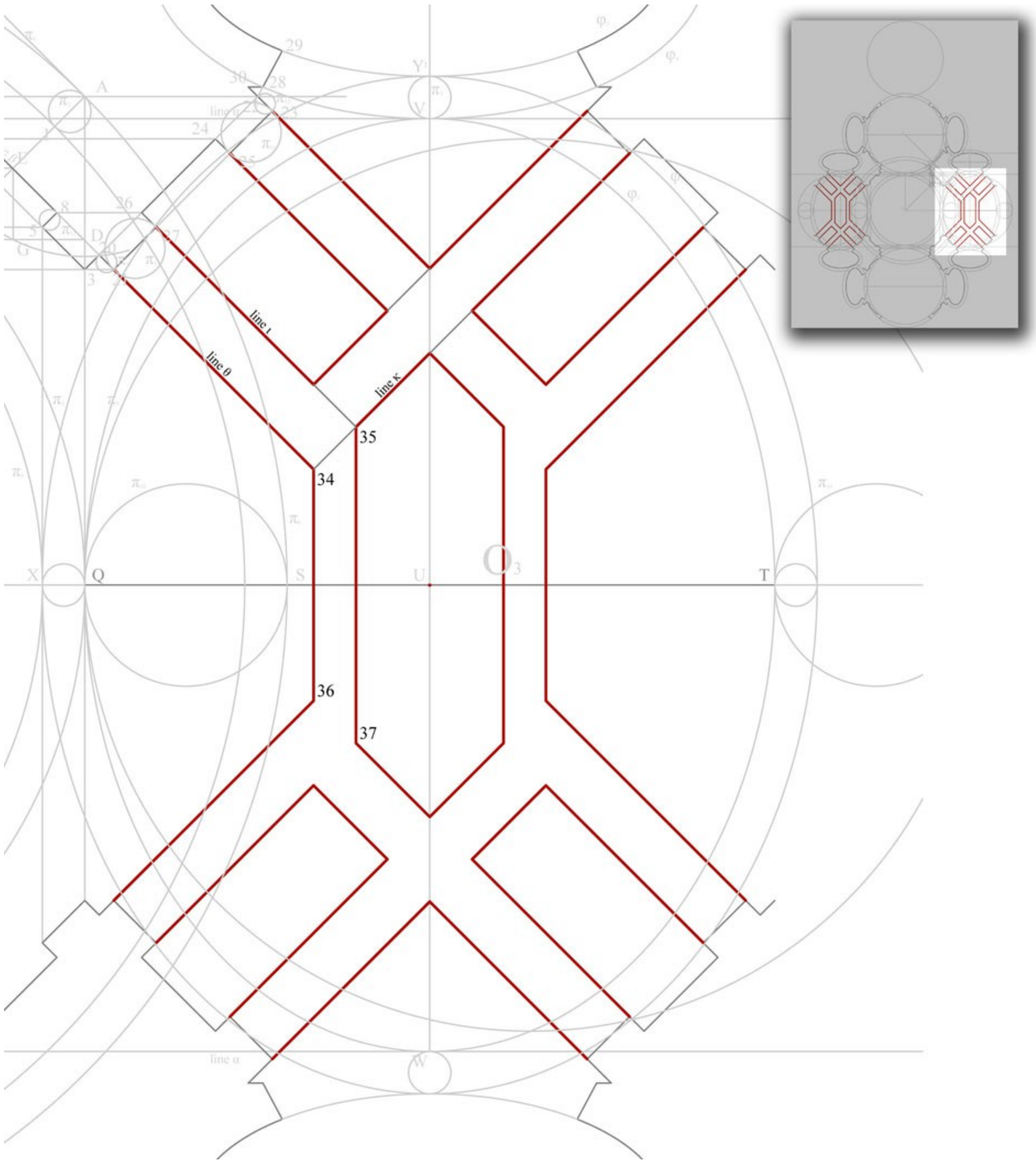

Figure 39. Step 19.
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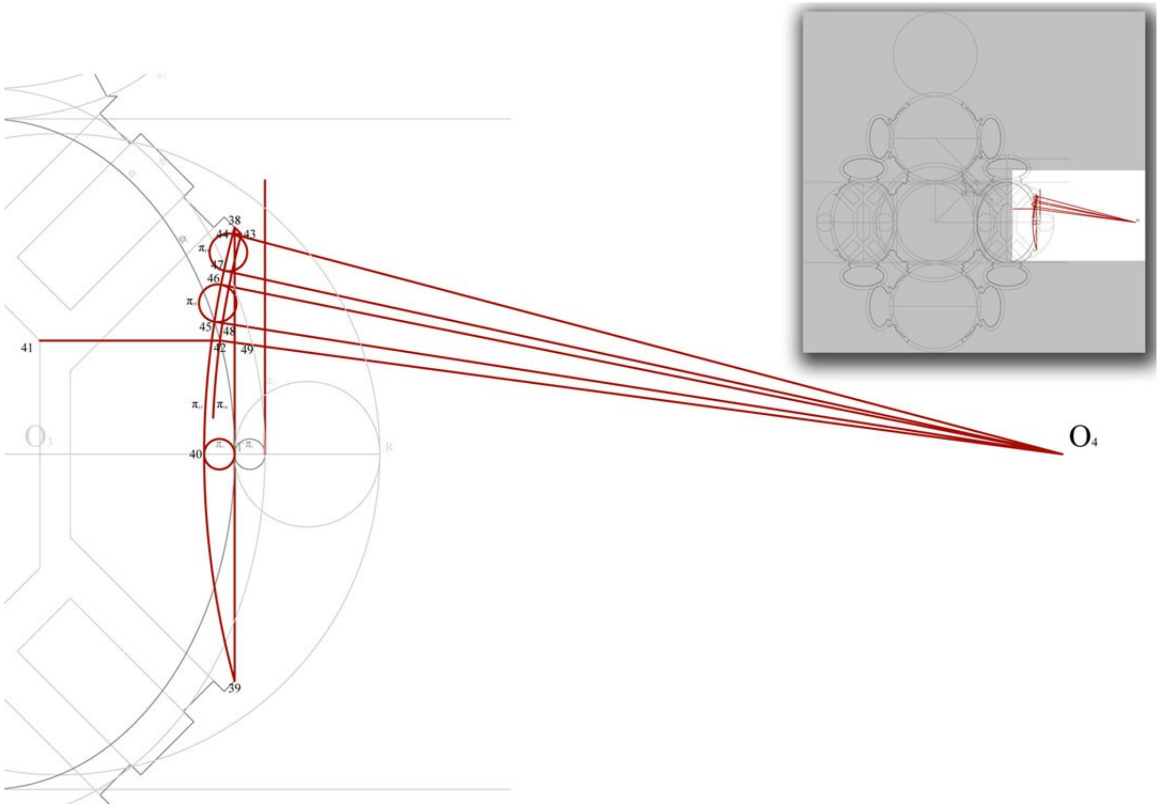

Figure 40. Step 20.
Drawing by the author.

> bay; *39* is the point symmetric to *38* from QT, the axis of the side bay. Because of the geometric construction, *38*, T, and *39* are aligned. From T, draw the circle π_3 on QT individuating point *40*. Draw the circle passing through *38*, *39*, and *40* (which will be called π_{13}) whose center is O_4. On π_{13} there will be the pilaster strips framing the alcove in the side bay. To find the depth of these pilaster strips, individuate point *41* (from the intersection of the ribs in the vault and point symmetric to *35* from the major axis of the ellipse individuating the layout of the side bay). From *41* draw a horizontal line until intersecting φ_1 at point *42*. Centering on O_4 with span O_4-*42*, draw the circle π_{14} which intersects at point *43* with the extension of the pillar from point *38*. From *43* draw a horizontal line until π_{13} individuating the point *44*, from which will start the first pilaster strip framing the alcove. The ending point of the second pilaster strip is found by point *45*, the intersection between π_{13} and φ_1.

The width of the pilaster strips framing the alcove is different from the ones framing the whole space inside the church. From the section, in fact, the pilaster strips in the alcoves have a shorter height than the ones framing the main bays. The dimension of these new elements, however, can not come directly from Guarini's plan since here these pilaster strips show variable dimensions. However, on the side of the plan, Guarini drew two capitals: the ones with the larger dimensions relate to the pilaster strips framing the main bays; as such, the smaller ones should be related to the shorter pilaster strips. Since the width of the bigger capital is known (it is the diameter of π_{11}), using simple proportions it is possible to find the dimension of the smaller capital directly from Guarini's capital detail.

This new measure will be the diameter of the circle π_{15}.

From *44* and *45*, add radially the circle π_{15} individuating the points *46* and *47*. The last two points of the alcove are *48* (intersection between the radius O_4-45 and π_{14}) and *49* (intersection between the radius O_4-*42* and the line *38-39*).

Completing the central and side bays, it is possible to analyze the three bays along the longitudinal axis of the church. The construction will analyze the North bay first, then the chancel, and finally the South bay **[figure 41]**.

STEP 21 [figure 42]:

In both North and South bay, it is possible to draw the ribs framing the vault by extending the lines of the pilaster strips and intersecting them like has already been done in the side bays. Since North and South bays are wider than the two side bays, the result of the rib intersection in North/South bays will look slightly different from the one in East/West bays.

The North bay shows a door among the pilaster strips in the northernmost pillars. There

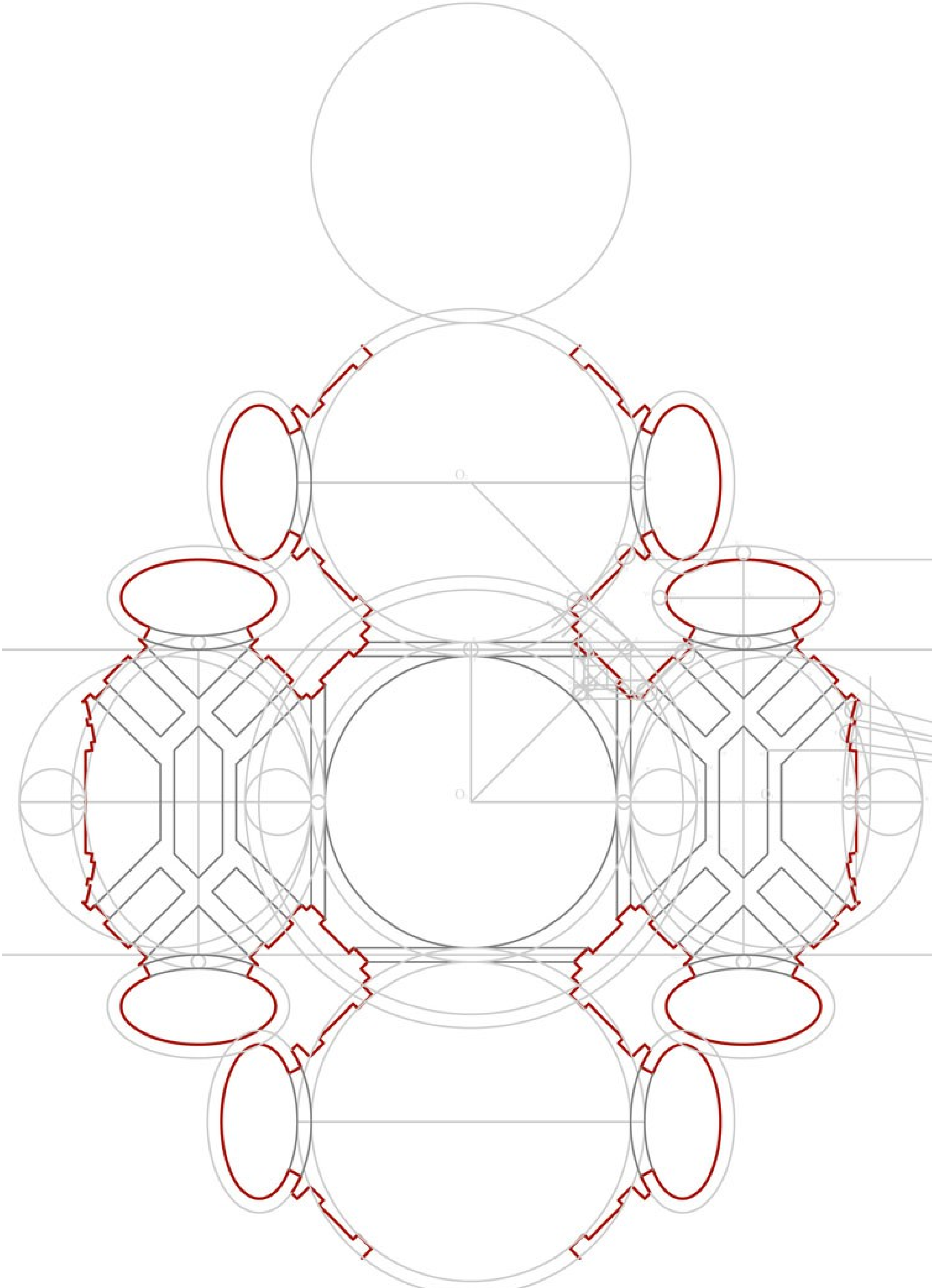

Figure 41. Step 20 overview.
Drawing by the author.

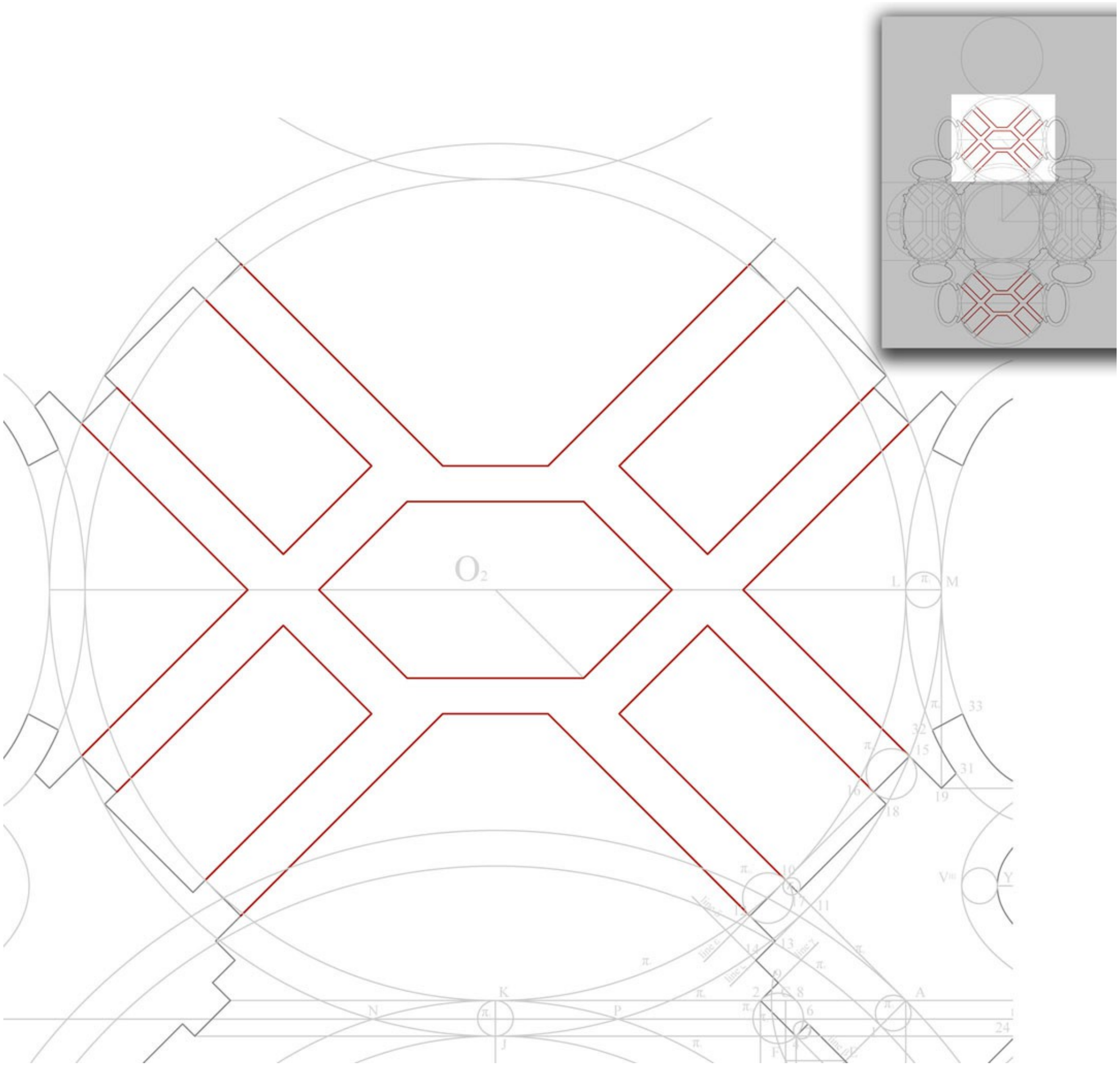

Figure 42. Step 21.
Drawing by the author.

doors open in a corridor wrapping the chancel and connected to the outside.

STEP 22 [figure 43]:

To find the doors in the Northernmost pillars of the North bay, draw a horizontal line from *50* until intersecting the pillar itself at *51*. From *51* draw a line perpendicular to the pillar; the length of this line is π_{11} (the width of a pilaster strip) and it individuates point *52*. The segment *51-52* represents the first threshold of the door. To get the second threshold, draw a vertical line from *53* individuating point *54*. From *54* draw a line perpendicular to the pillar and with length π_{11} individuating point *55*. The segment *54-55* is the second threshold.

STEP 23 [figure 44]:

From O_5, the center of the circle showing the preliminary layout if the chancel, draw a horizontal line until intersecting the circle itself at *56*. From *56* draw a vertical line until intersecting the extension of the rib from *50*, individuating point *57*. Similarly, from *53* extend the rib until the line *52-55*, individuating point *58*, which will be the lower corner of the corridor leading outside the church. The corresponding point on the other side of the corridor is point *59*, which is found from the intersection between a vertical line from *58* and, from *57*, a line parallel to *52-55*.

The horizontal lines from *58* (*line* λ) and *59* (*line* μ) individuate the width

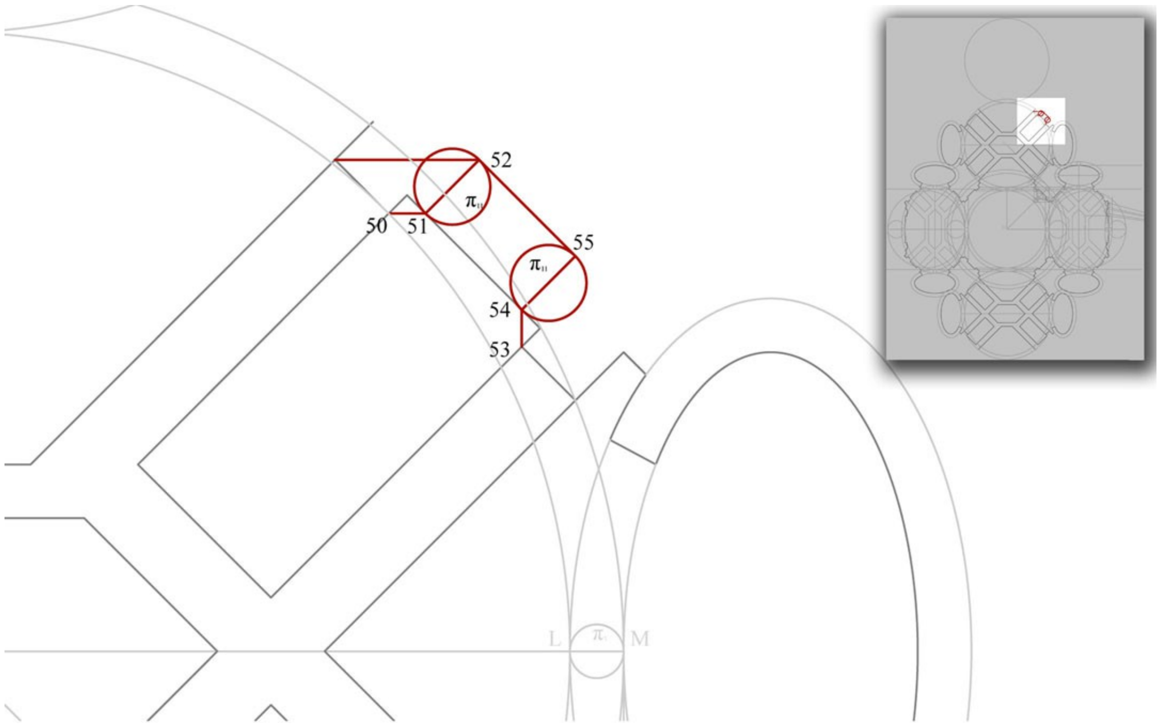

Figure 43. Step 22.
Drawing by the author.

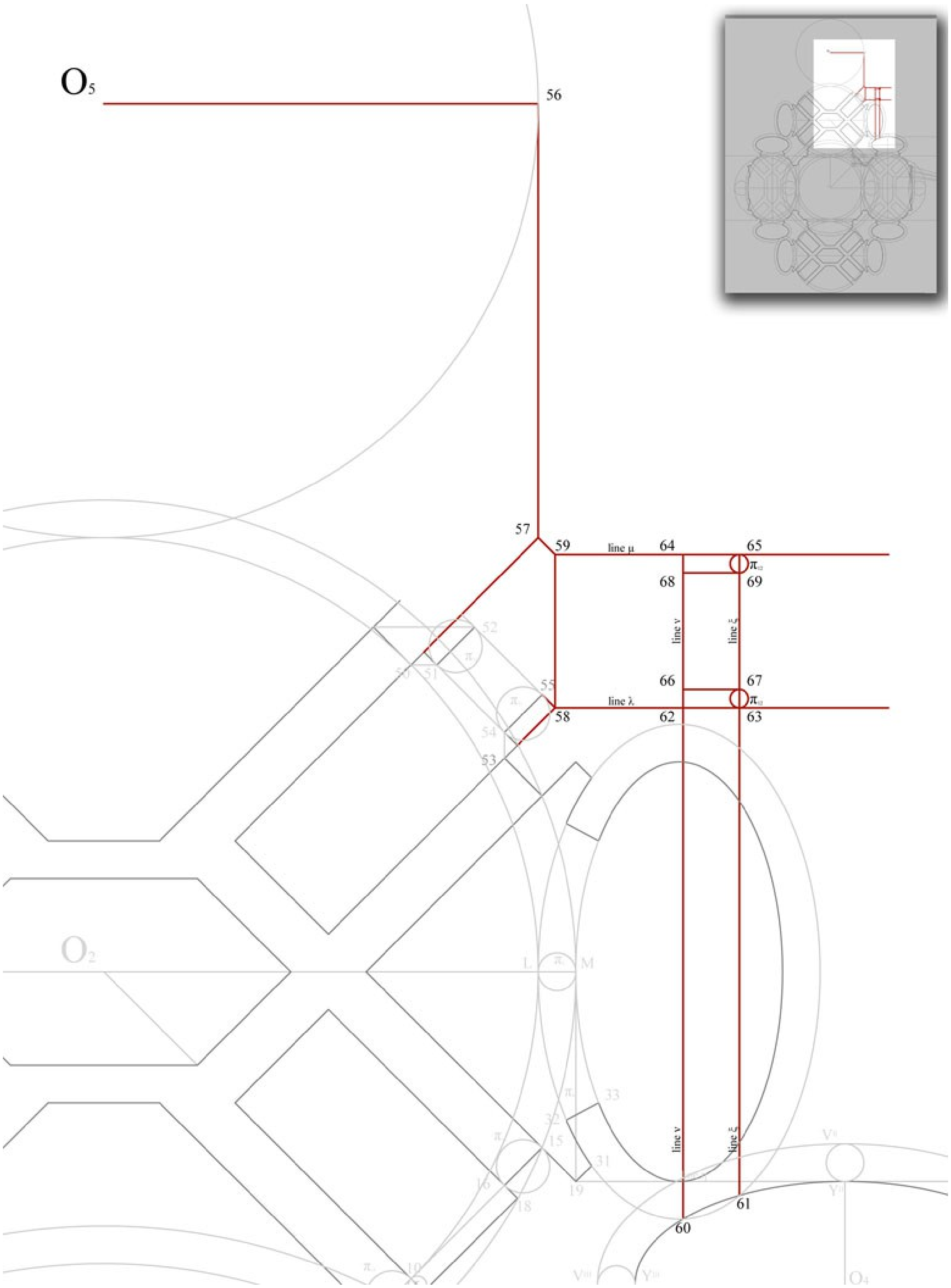

Figure 44. Step 23.
Drawing by the author.

of the corridor. The location and thickness of the threshold is given by points *60* and *61*, the intersections of the outer ellipse in the North bay and the inner ellipse in the East bay. From these two points, *60* and *61*, draw two vertical lines (*line* ν and *line* ξ). Their intersections with *line* λ individuates the points *62* and *63*; while the intersections with *line* μ individuate the points *64* and *65*. The depth of the threshold instead follows the same proportions of the pilaster strips: it is expressed by π_{12} individuating the points from *66* to *69*.

STEP 24 [figure 45]:

Let $\varkappa^{I}$ be the tangent point between π_7 (the circle with center O_2 in the North bay) and π_{15} (the circle with center O_5 in the chancel). Draw a vertical line from $\varkappa^{I}$; its intersection with the vertical line from *50* individuates point *70*. From *70* starts the chancel while the extension of the vertical line *50-70* individuates the inside wall in the chancel. The thickness of this wall is expressed by π_3 (the distance between the inside/outside profile in the elliptical chapel and the thickness of the arches framing the central bay) individuating point *71*. The segment *71-57* shows the width of the corridor around the chancel (which, according to Guarini's plan, is shorter than the width of the same corridor leading towards the outside doors).

To connect this thickness to the portion of the corridor already drawn and,

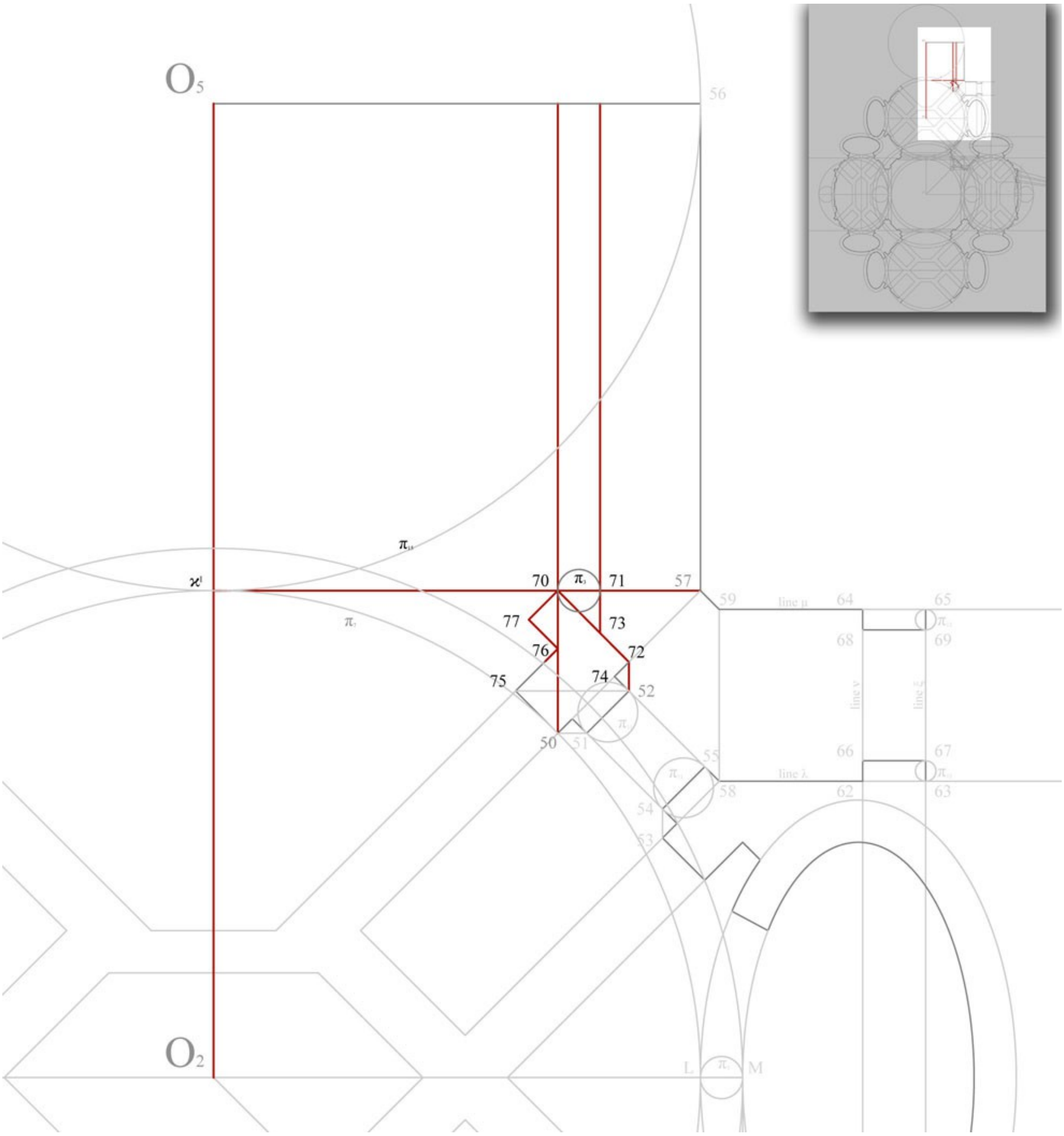

Figure 45. Step 24.
Drawing by the author.

from the other side, to the pillar facing the North bay, proceed as described below.

Profile facing the corridor: draw a vertical line from *52* until the segment *50-57* individuating point *72*. Connect *72* to *70* and, on this line, extend the vertical line from *71* individuating point *73*. (Note: extending *55-52* on *50-57* it is possible to find point *74*, the edge of the threshold *55-52*).

Profile facing the North bay: Let *75* be the edge of the Northernmost pilaster strip in the North bay. Extend the rib from *75* until the line *50-70* individuating point *76*. From *76* draw a line parallel to the face of the pilaster strip *50-75* and intersect its own perpendicular from *70*, individuating the edge at *77*, and separating the chancel from the North bay.

STEP 25 [figure 46]:

Square the circle π_{15} individuating point *78* (on the vertical) and *79* (on the diagonal—point *56* on the horizontal was already found). Let *80* be the intersection point on the diagonal O_5-*79* and π_{15}. From *80* draw a line tangent to π_{15} (which is perpendicular to the diagonal O_5-*79*) individuating the points *81* and *82* on the squaring of π_{15}. The poly-line from *56*, *81*, *82*, and *78* individuates the inside profile of the corridor wrapping the chancel. To find the thickness of this wall, add to *56*, *80*, and *78* the

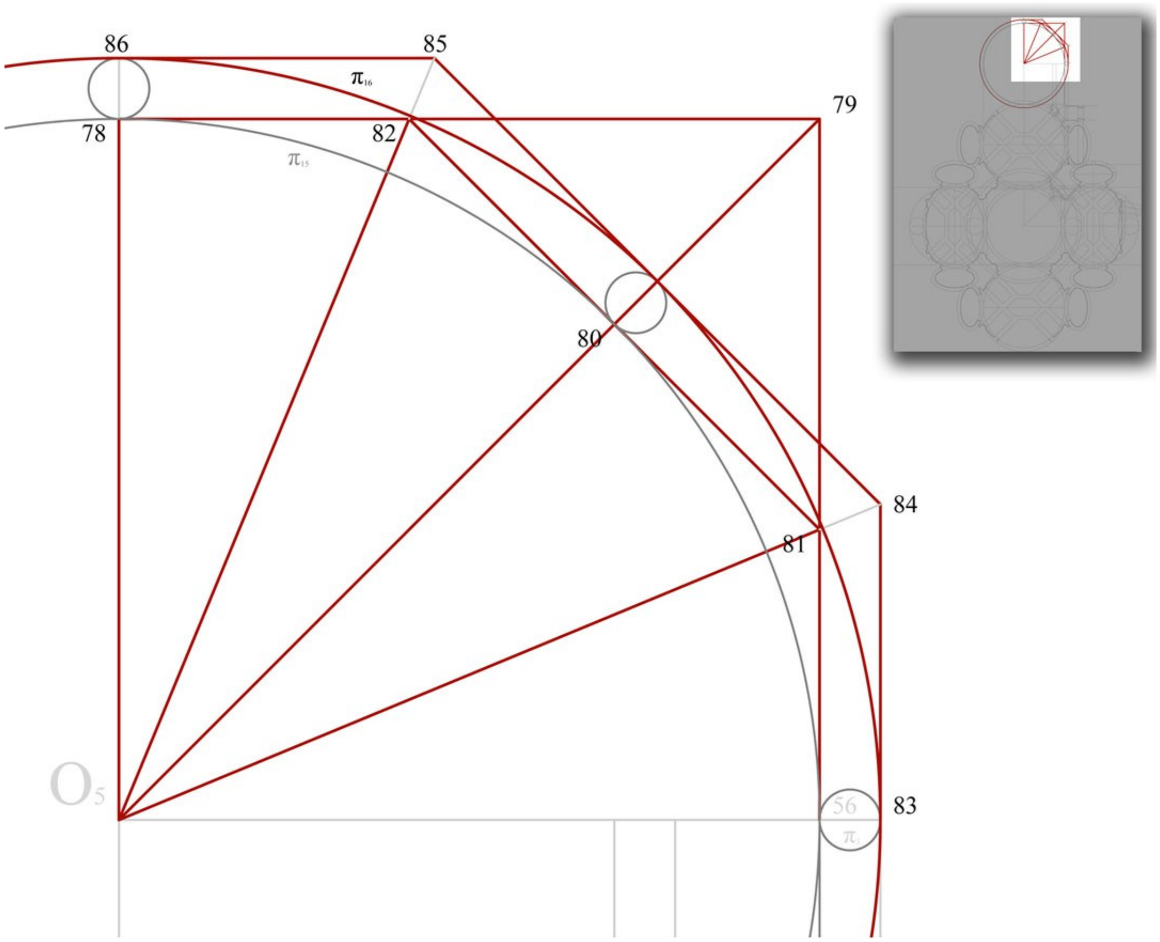

Figure 46. Step 25.
Drawing by the author.

diameter of π_3, which is the circle π_{16} with center O_5. The outside profile of the corridor (and outside profile of the church) is individuated by the line from *83* to *86*.

The inside profile of the chancel does not follow exactly the outside profile. While the inside walls may be inscribed in a circle, its center is in a lower position than the circle for the outside walls. Because of this, the corridor wrapping the chancel becomes progressively bigger while approaching the northernmost portion of the church.

STEP 26 [figure 47]:

Let $\varkappa^{II}$ be the intersection between π_8 and O_2O_5. Draw a horizontal line from $\varkappa^{II}$ until the vertical line from *71* individuating the point $\varkappa^{III}$. Draw a diagonal line from $\varkappa^{III}$ until O_2O_5 individuating point O_6. This very last point will be the center for the inside profile of the chancel. Centered on O_6 draw the circle from $\varkappa^{II}$ (π_{15}), which represents the outside portion of the wall of the chancel. The inside profile comes from π_{16}, obtained by adding the measure π_3 to $\varkappa^{II}$ (point *87*) and drawing the circle with center O_6 and passing thorough *87.*

The traces of the lantern at the top of the chancel, instead, are individuated by π_{17} and π_{18}. π_{17} is the circle with span O_6O_5. The squaring π_{17} individuates point *88*. Centering on O_6 with span O_6-*88* creates the circle π_{18}.

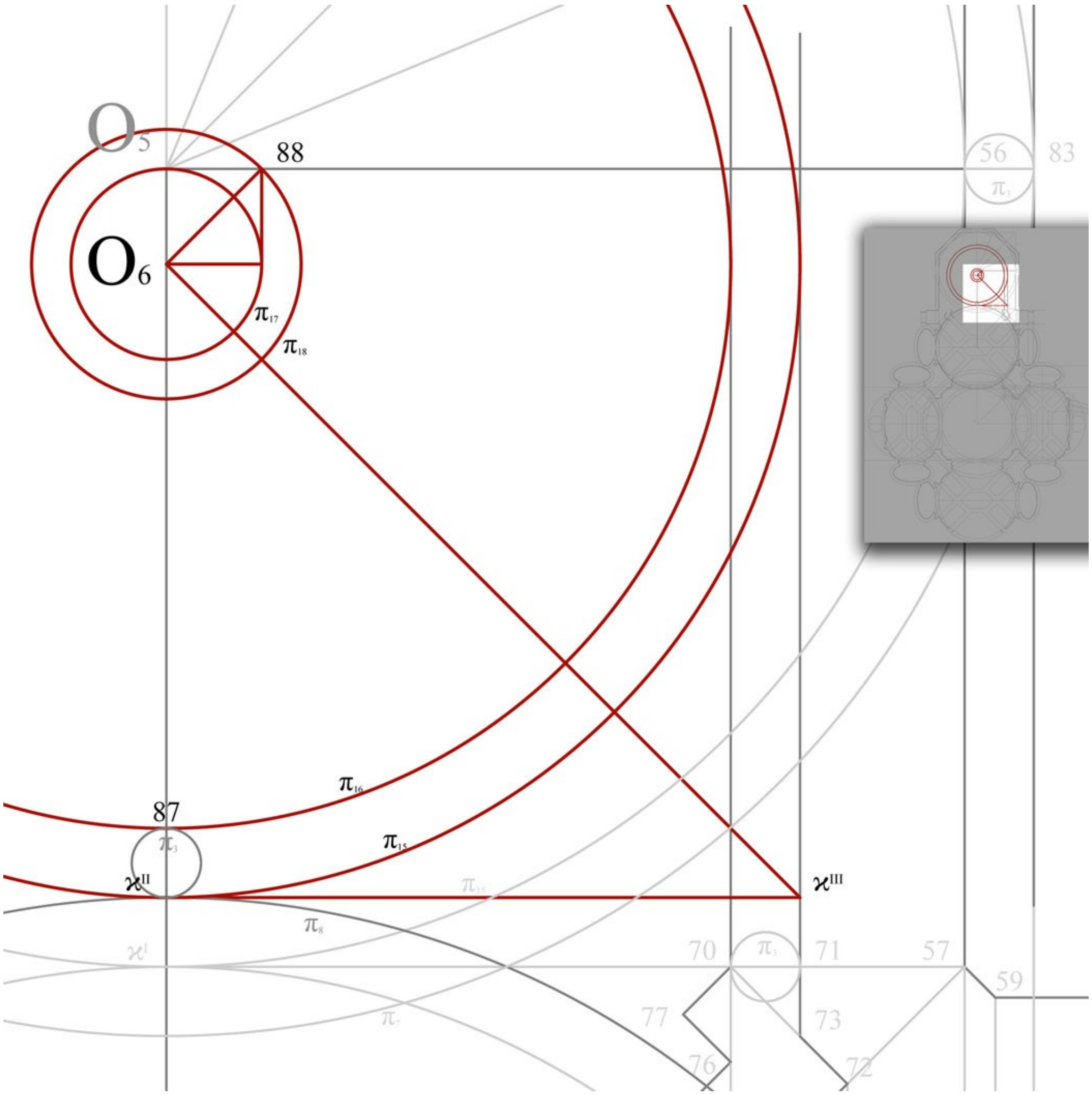

Figure 47. Step 26.
Drawing by the author.

STEP 27 [figure 48]:

To get the shape of the walls framing the inside chancel, draw a horizontal line from O_6 intersecting π_{15} and π_{16} individuating the points *89* and *90* (which also lay above the vertical lines from *70* and *71*, spaced by π_3). Repeat the same process from O_6 using a diagonal line (points *91* and *92*) and a vertical line (points *93* and *94*). From *89*, *91*, and *93* draw the tangent lines to π_{16} which will intersect at *95* and *97*. Likewise, from *90*, *92*, and *94* draw the tangent lines to π_{15} which will intersect at *96* and *98*.

In order to complete the chancel, the supports to the dome need to be drawn.

STEP 28 [figures 49, 50]:

From *77* draw a vertical line until intersecting π_{16} at *99*. From *99* draw two diagonal lines until the line from *70-89* individuating the points *100* and *101*. The triangle Δ*99-100-101* individuates the first support of the chancel's dome. Let π_{19} be the circle with center *99* and radius *99-100*. To get the other supports of the chancel's dome, π_{18} needs to be moved along the inside corners of the chancel itself. Let *102* be the intersection point between O_6-*96* and π_{16}. Centered on *102*, draw π_{19} which will intersect the inside profile of the chancel at *103* and *104*. Repeat the same construction for *105*, individuating the points *106* and *107*. Mirror the whole construction along the longitudinal axis of the church to complete the chancel.

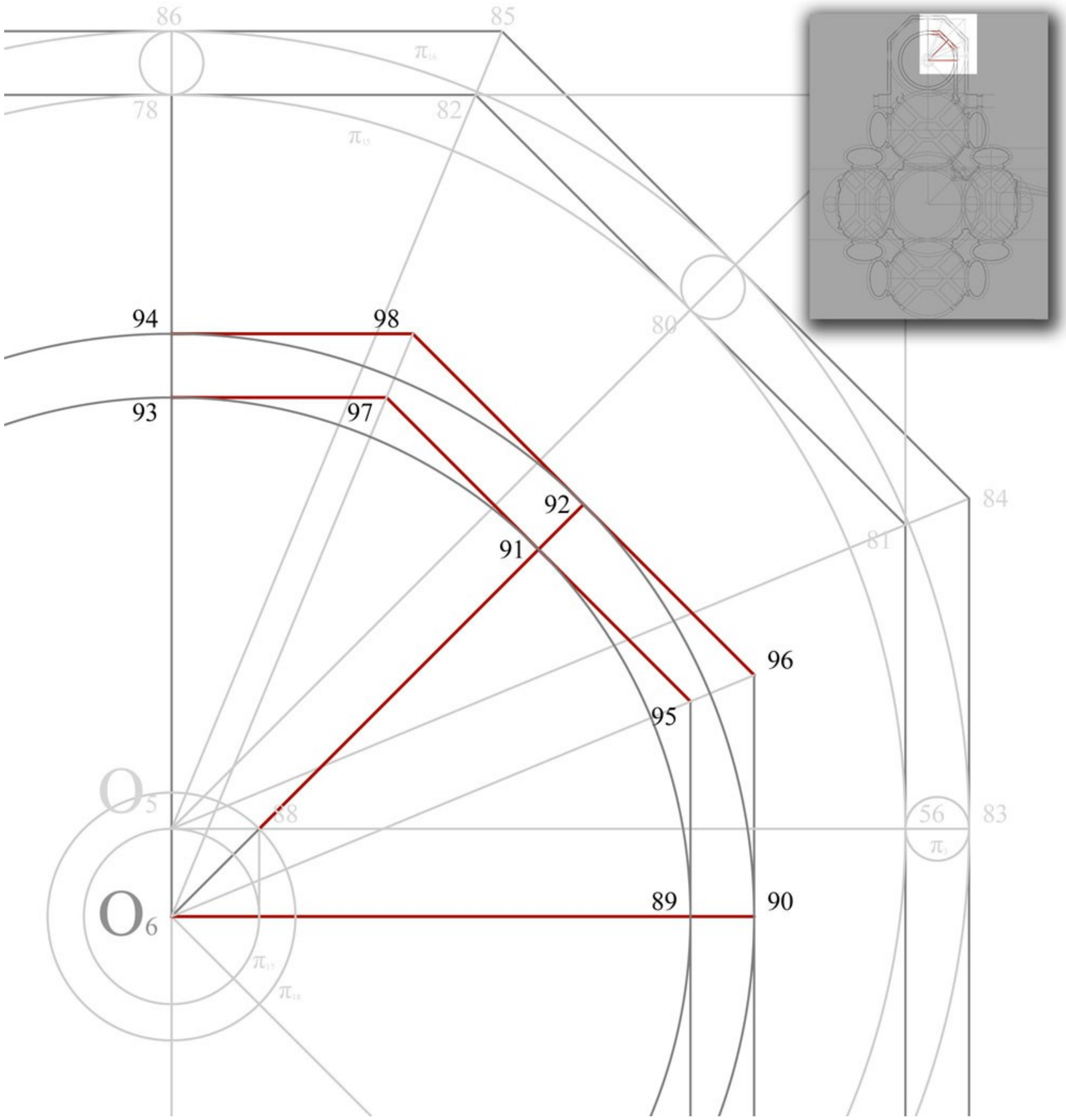

Figure 48. Step 27.
Drawing by the author.

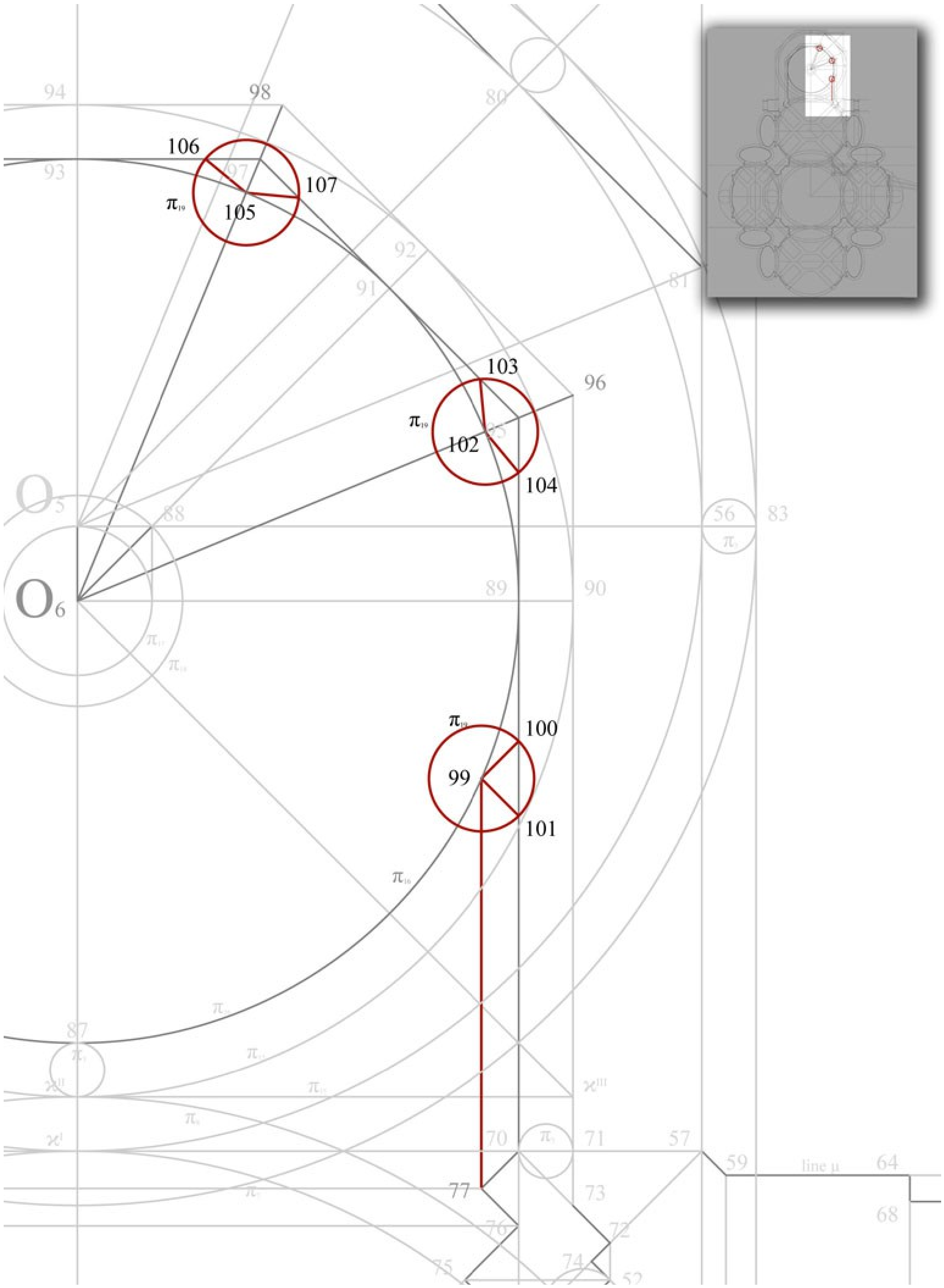

Figure 49. Step 28.
Drawing by the author.

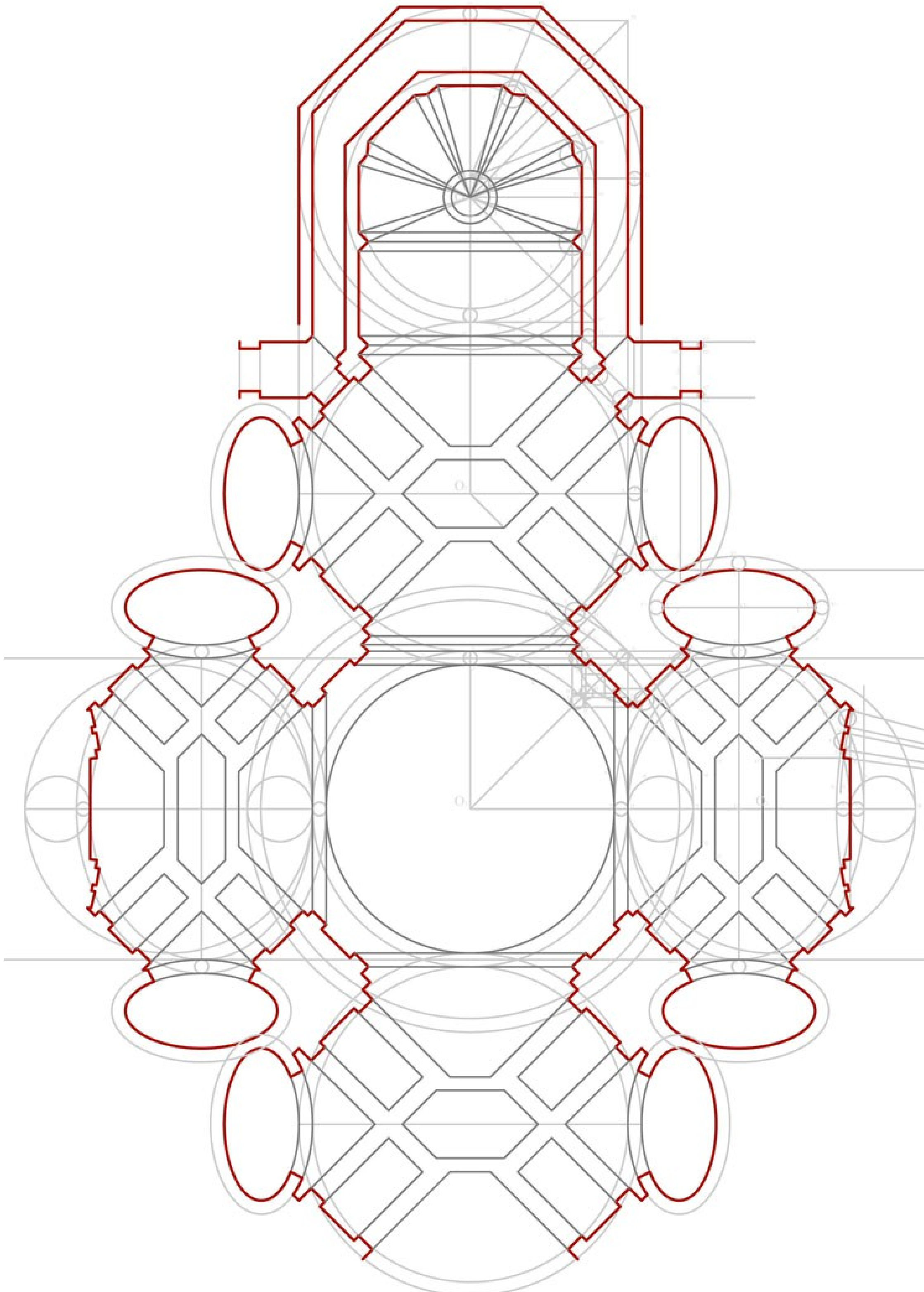

Figure 50. Step 28 overview.
Drawing by the author.

To complete the upper portion of the church, draw the profile of the outside walls.

STEP 29 [figure 51]:

From *64* draw a diagonal line until intersecting the extension of *65-69* at *108*. From *108* draw a horizontal line until the vertical line from *83* (the outside profile of the corridor wrapping the chancel.

Move down to the elliptical chapels. Their outside profile does not match exactly the inside one; from Guarini's drawing it appears that the outside layout of the ellipses has a longer longitudinal axis. In the chapel on the side of the North bay, this extended profile of the chapel starts from *110* (on the minor axis of the outer ellipse) and extends until *63*; on the opposite side of the same chapel, instead, the profile stops at the intersection with the next chapel. The chapel on the East bay though shows a different elongation; it starts from V^{II} (on the minor axis) and extends until *111* (the projection of V^{IV} above *line* η). The intersection between the outside profiles of the two elliptical chapels happens at *112*.

The eastern wall closing the church is the point *112* on the minor axis of φ_2 (the ellipse describing the layout of the East side bay). Draw a vertical line from *112* until *line* η individuating point *113*, which closes the upper wall of the church. At last, Guarini's plan shows a line (probably a

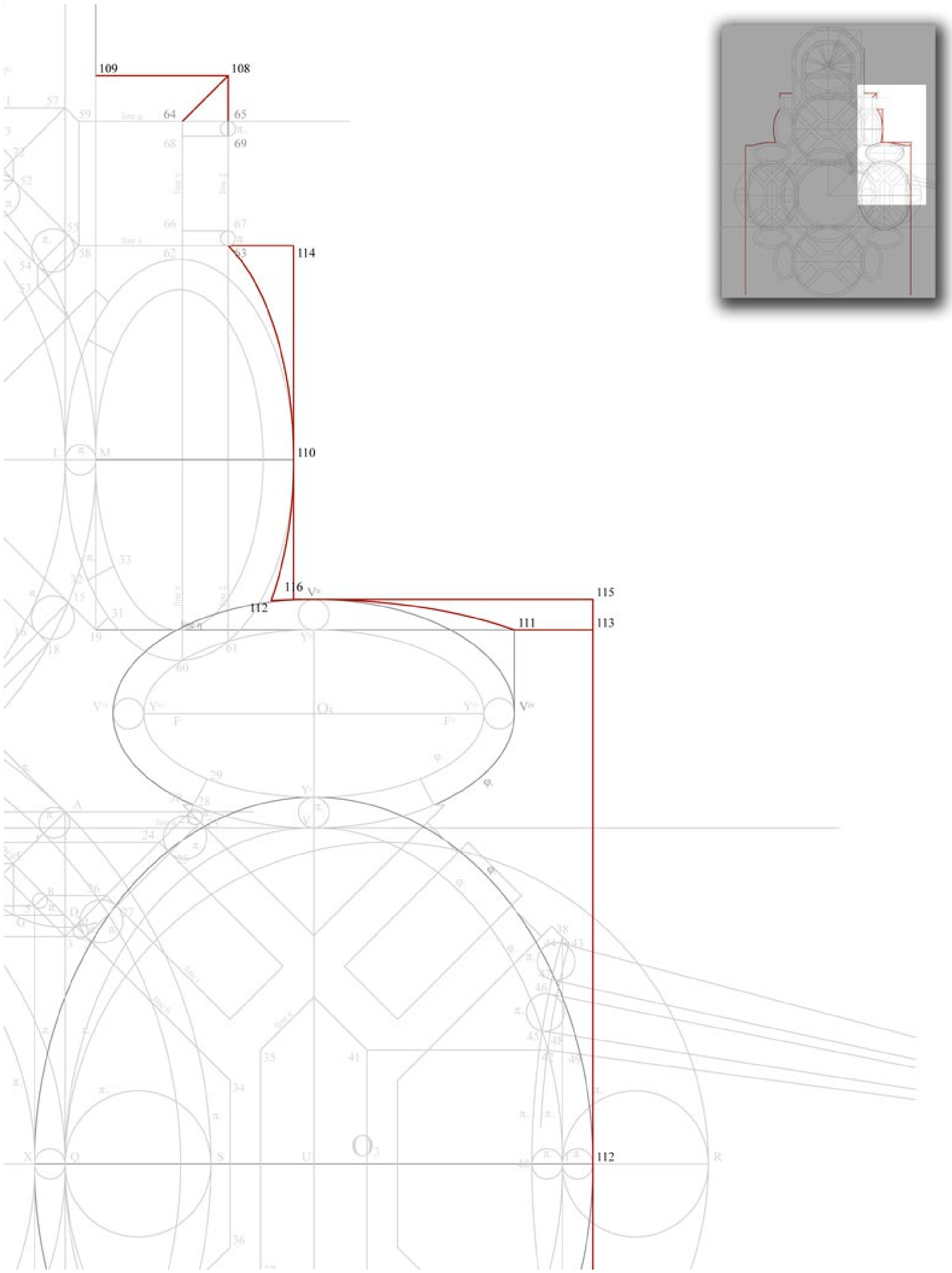

Figure 51. Step 29.
Drawing by the author.

sidewalk) squaring the elliptical chapels. From *110* draw the vertical line tangent to the chapel intersecting the horizontal line from *63* at *114*. Likewise, from V^{II} draw a horizontal line tangent to the chapel intersecting the right border of the church at *115* and the previous line at *116*.

At this point, the only part missing from the church is the entrance bay: the South bay. While its layout may be represented by a circle (whose center is O_7), the front steps of the same bay develop along an elliptical profile.

STEP 30 [figure 52]:

Let *117* be the lower edge of the circle O_7, the layout of the entrance bay; on the horizontal axis of the same circle, let *118* be the center of the elliptical chapel on the right of the entrance bay. The ellipse from *117* and *118* (φ_5) individuates a proper profile for the facade of the church in the entrance bay.

The layout of the farther steps in the facade is obtained increasing φ_5 by the measure of the minor axis of the elliptical chapels. From *120*, the edge of the elliptical chapel on the right of the entrance bay, draw the circle π_{20} (whose diameter *118*-*121* equals *119*-*120*), individuating the point *121*. In the same way, add π_{20} below *117* individuating point *122*. The ellipse from *121* and *122* (φ_6) describes the farther step of the facade of the church.

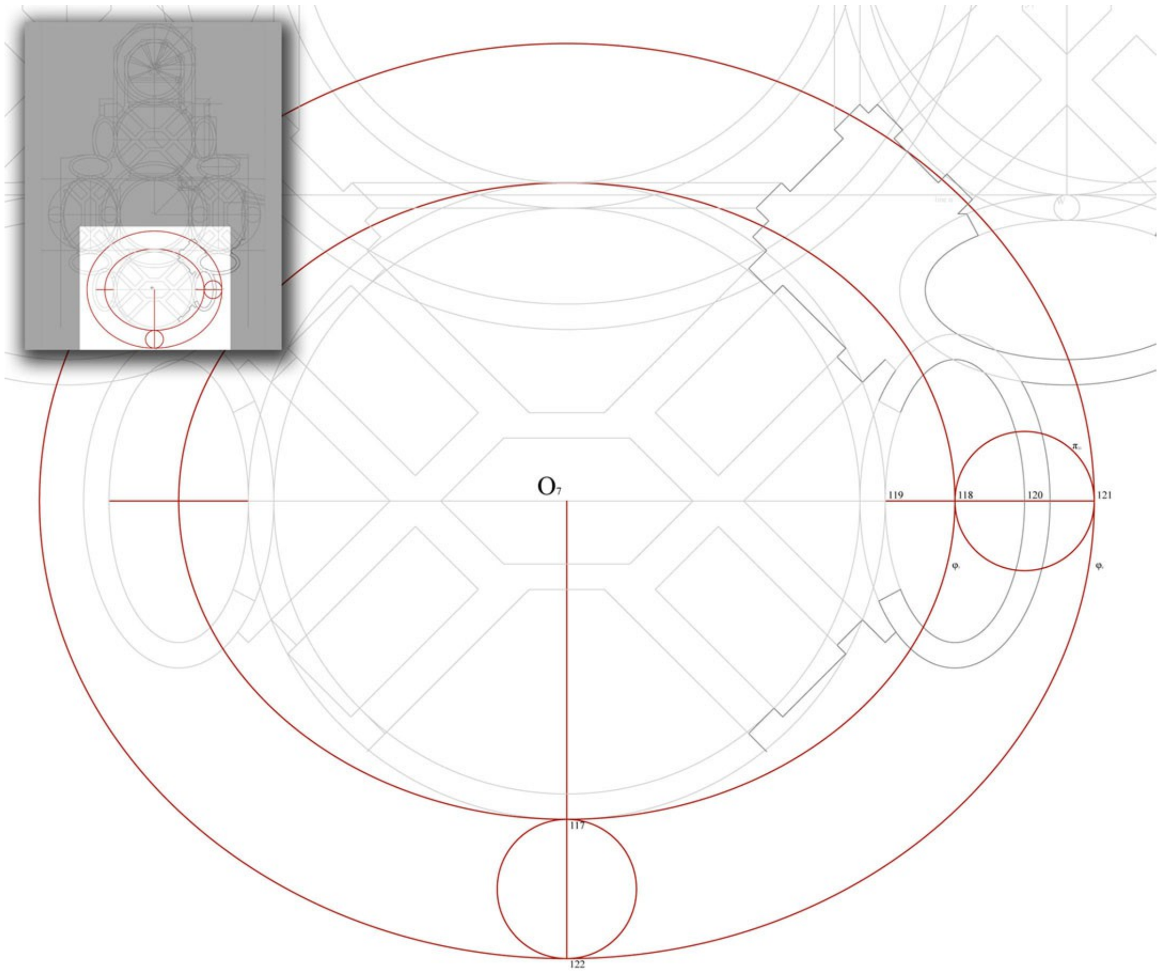

Figure 52. Step 30.
Drawing by the author.

STEP 31 [figure 53]:

To draw the four steps in the church facade, from *121* add the measure π_3 four times (one for each step) individuating the points *123*, *124*, *125*, *126*. Let π_{21} be the circle whose diameter spans from *121* to *126*. Add a copy of π_{21} onto *122* and divide the diameter of this circle in five parts individuating π_{22} and the points from *127* to *131*. (Note that the same circle has been divided in four parts along the major axis of φ_6 and in five parts along the minor axis). Draw the ellipses passing through *123* and *127* (φ_7); *124* and *128* (φ_8); *125* and *129* (φ_9); *126* and *130* (φ_{10}); *126* and *131* (φ_{11}) (the last two ellipses both pass through *126)*.

Before going in more detail with the elements in the entrance bay, the profile of the facade individuating the layout at the side of the entrance must be completed.

STEP 32 [figure 54]:

Extend the vertical line from point *39* (which, together with the vertical line from *112* individuates the thickness of the wall closing the East side of the church). From the edges of the minor axes of the south-eastern elliptical chapels, draw the lines tangent to the external profile of the chapels individuating the segment *131* and *132.* From its middle point (*133*) draw the vertical *line ρ* on which it will be located the center for the concave facade of the church.

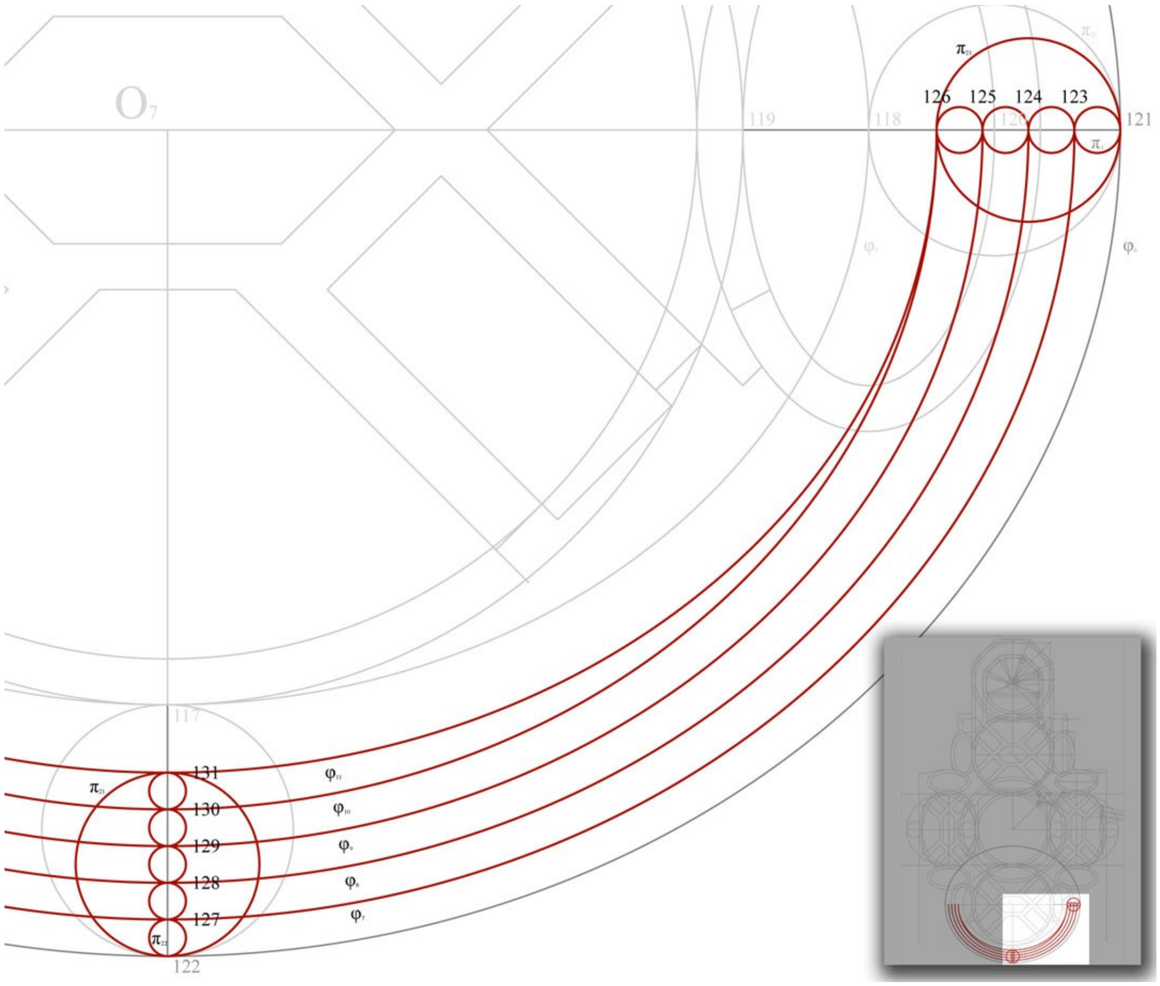

Figure 53. Step 31.
Drawing by the author.

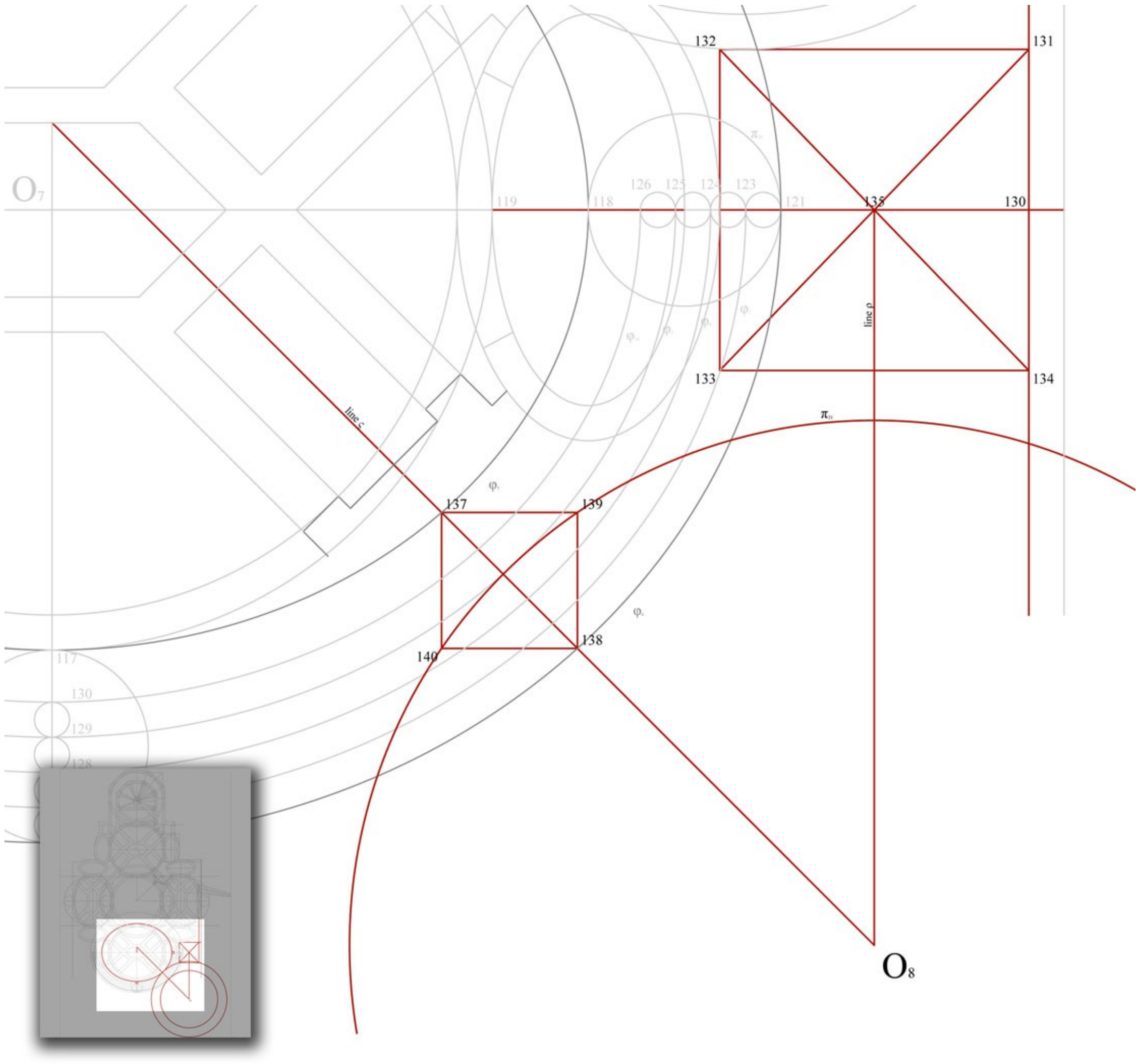

Figure 54. Step 32.
Drawing by the author.

Move back on point *126* and draw another copy of π_{22} individuating point *134*. Repeat the same procedure from point *131* individuating *135*. Centered on O_7, draw the ellipse φ_{12} passing by *134* and *135*. From O_7, draw a vertical line until intersecting the vault rib in *136* and, from here, draw the diagonal *line ς* intersecting φ_{12} in *137*, φ_7 in *138*, and *line ρ* in O_8. Centered on O_8, draw a circles π_{23} passing from *137* and π_{24} from 138.

These two circles individuate the curvature in the facade; π_{23} shows the back profile of the column plinths in the entrance bay while π_{24} show the front profile of the column plinth at the far side of the elevation, in front of the quadrangular courtyards.

To complete the profiles of these courtyards, draw a vertical line from the points *131* and *132* intersecting π_{24} in *139* and *140* respectively.

STEP 33 [figure 55]:

Draw the circle π_{25} using *137-138* as diameter. The center of this circle will be the point *141*. Centered on O_8 draw the circle π_{26} passing through *141*; this circle separates the bases of the two sets of columns in the facade of Sainte-Anne. The diameter of these columns is given by π_{27} (the circle with diameter *137-141*, equal to *141-138*).

The position of the columns plinth starts from point 142 (intersection between π_{26} and the vertical line from *112*). Draw the radius O_8-*142*,

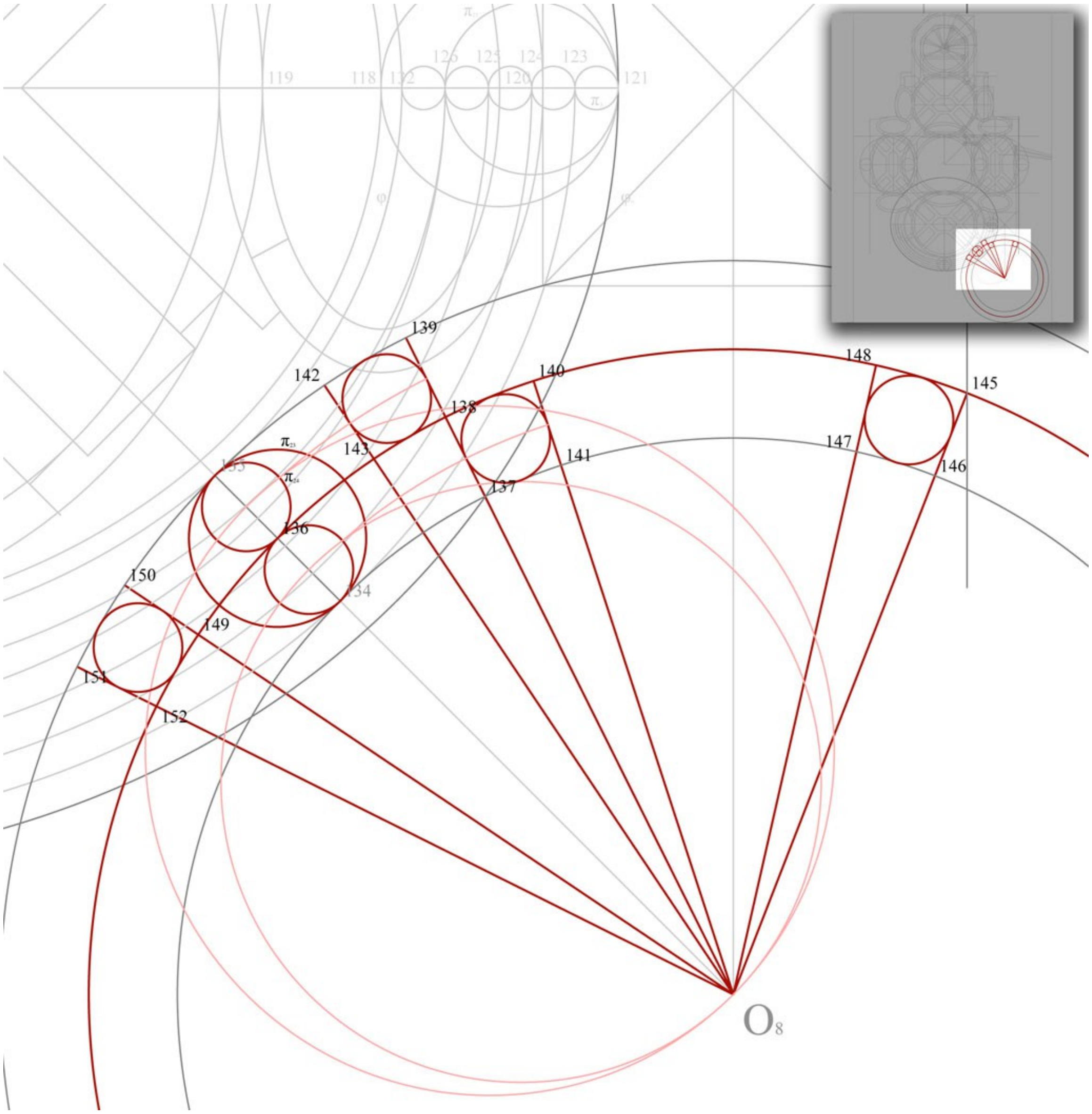

Figure 55. Step 33.
Drawing by the author.

intersecting π_{24} at *143*. The segment *142-143* individuates one side of the plinth. The column contained in this plinth will maintained π_{27} as diameter. Contained between π_{24} and π_{26}, the column diameter π_{27} needs to be tangent to *142-143*. In order to properly locate π_{27} go back on point *141* individuating *144*, middle point of *141-138*. From *145*, middle point of the segment *144-O_8*), draw the circle π_{28} passing by *144* and O_8 and intersecting π_{27} in *146*. Centered on O_8 draw the circle π_{29} by *146*. All the copies of π_{27} contained between π_{24} and π_{26} will admit a tangent directed to O_8 along π_{29}.

Intersect π_{29} with *142-143* obtaining point *149.* Here π_{27} will be tangent to 142-143. The other intersection point between π_{27} and π_{29} individuates *150* which, connected to O_8, individuates the points *151* and *152*, completing the profile of the column plinth.

The column paired to the ones just drawn is not located symmetrically to the courtyard behind but starts from *153* (intersection between π_{24} and φ_6). Connect 153 to O_8 individuating *154* on π_{26} and proceed repeating the same procedure described for the plinth above, thus obtaining the curvilinear trapezoid *153-154-155-156*.

Likewise, extend *153*-O_8 until π_{23} individuating *157* and, applying the construction above, the trapezoid *154-157-158-159* and, symmetric on *137-138,* the additional trapezoid *160-161-162-163.*

STEP 34 [figure 56]:

To get the diameter and the position of the columns framing the main entrance in Sainte-Anne, extend *162-163* until φ_{11} individuating point *164*. Construct circle π_{30} on *164* with span *164-163*, which intersects φ_{11} at *165*; this very last point is one of the four corners of the column's base. Connect *165* to the foci of φ_{11} whose bisector line intersects φ_{14} (ellipse with center O_7 an passing by *117* and *118*) at *166*. The circumference with diameter *165-166* (π_{31}) individuates the diameter of the secondary column base framing the main entrance to the church.

To find the correct position of this secondary column, it is required to draw π_{31} tangent to *165-166* from the left. To do this, extend *165-166* until the longitudinal axis of the church (point *167*) and draw the circumference π_{32} with diameter *167-139* (*139* is the middle point between *131* and *117* belonging to φ_{14} and φ_{11} respectively). Individuate the intersection between π_{31} and the circumference with diameter *117-131*; using the distance of these intersection points, draw a new ellipse (which will be very close to φ_{13}). The new ellipse will locate the points of circumferences between φ_{14} and φ_{11} tangent to the bisector lines connected to the foci.

NOTE: in the drawing this very last ellipse has not been tagged since it is only a construction device used to properly position the bases of the columns.

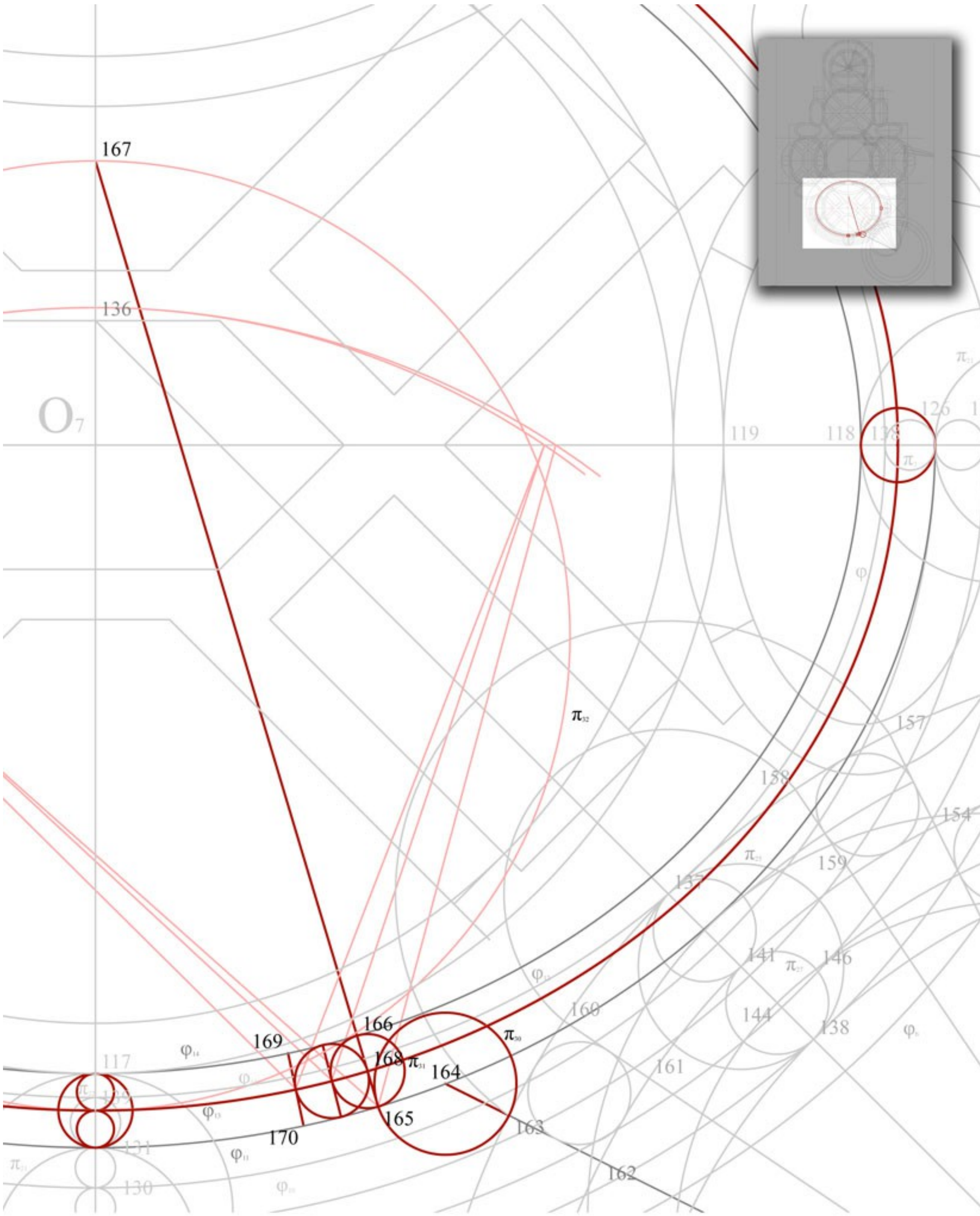

Figure 56. Step 34.
Drawing by the author.

The intersection between the new ellipse and *165-166* individuates the tangent point *168* from which it is possible to locate π_{31} in its proper position, gaining the points *169* and *170*. The points *165*, *166*, *169*, and *170* individuate the base of the column framing the main door in Sainte-Anne.

STEP 35 [figure 57]:

The portion containing the main door in Sainte-Anne, develops above two convex profiles facing the inside and outside of the church. The convex profile in the inside is obtained by drawing a circle with center *136* and passing from O_8. Extend the circel until reaching the longitudinal axis itself individuating O_9, the center of the convex profile facing the inside of Sainte-Anne. Centered on O_9, draw the circumference passing through *160* (π_{33}), which individuates one of the lines defining the entrance. The trace of the inside convex wall may be obtained by taking in consideration the profile of the pillar framing the side door from the left; its intersection with π_{32} and φ_{14} individuate the points *171* and *172*. From *171* draw a line perpendicular to the pillar itself and intersect it with the horizontal line from *172* (point *173*). Centered on O_9, draw the circle through *173* (π_{34}), which individuates the convex profile of the entrance wall from inside the church. To find the profile from the outside, draw a vertical line from *173* until intersecting π_{33} at *174*. The horizontal line from *174* individuates the symmetry axis (*line σ*) between inside and outside convex profiles in the entrance wall. Symmetrize π_{33} from *line σ* gaining π_{35}.

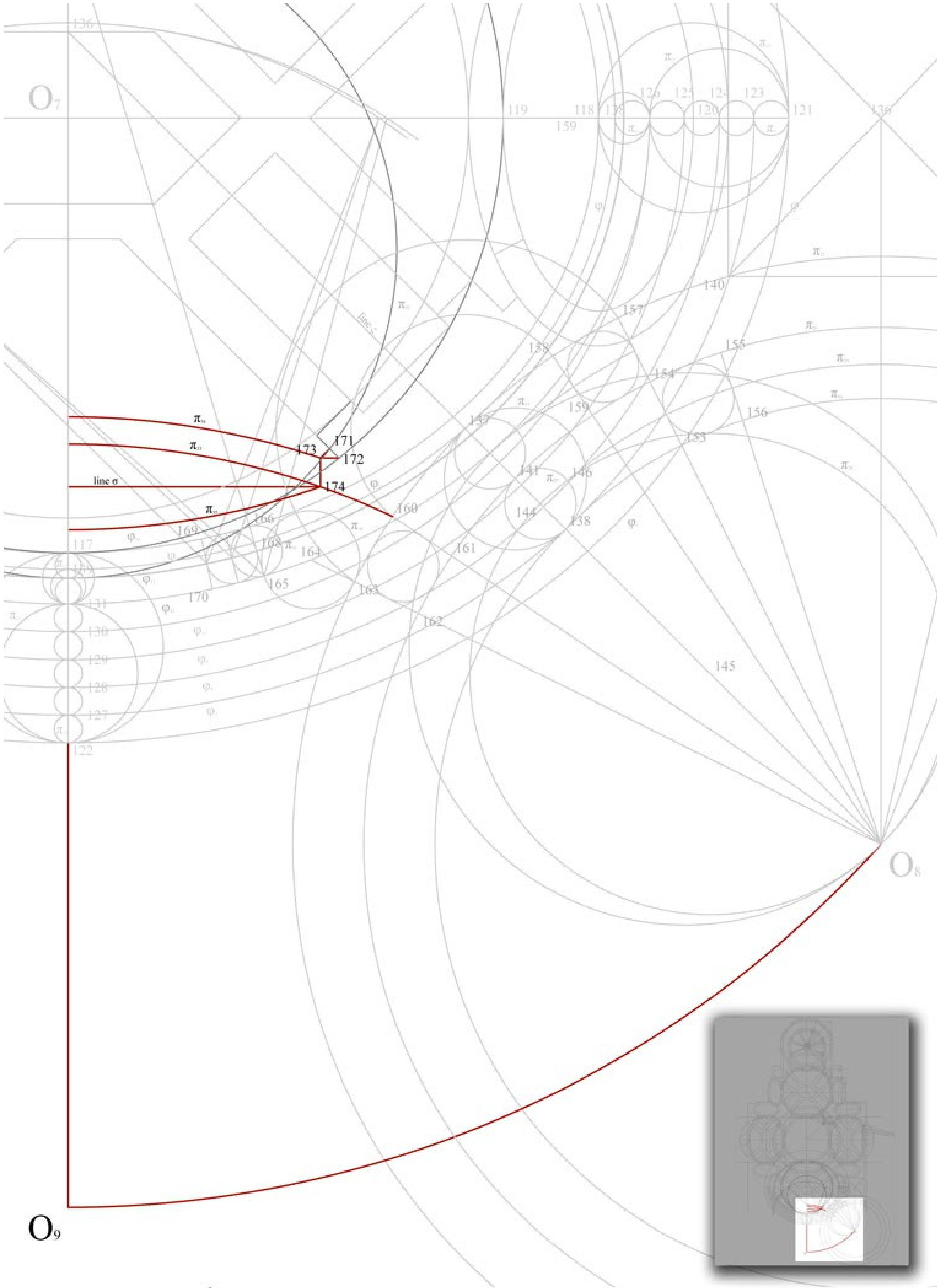

Figure 57. Step 35.
Drawing by the author.

STEP 36 [figure 58]:

To find the other points from the inside profile of the entrance wall, extend *166-167* until π_{34} (point *175*). Connect *175* with O_9 individuating point *176* from the intersection with π_{33}. Let *177* be the middle point of the segment *175-176* (center of the circle π_{36}). Centered on O_9, draw the circle passing through *177* (π_{37}). Center on *164* and draw the circumference π_{38} passing through *178* (edge of the pillar from the side door in the entrance bay). The intersection between π_{33} and π_{38} is the point *179*; connect *179* with O_9 individuating point *180* from the intersection with π_{37}.

Centered on *179*, draw the circle passing through *173* (which is π_{36}) individuating on π_{33} point *181*; from here, construct a circle with span *181-179* individuating on π_{33} point *182* (like above, the circle with span *181-179* is π_{36}).

Connect *175* with O9 and, centered on *182*, draw a circle from 179 individuating 183. Connect *183* with *174* intersecting *170*-O9 in 184.

STEP 37 [figures 59, 60]:

To complete the entrance wall, draw vertical lines from *179* and *181* to π_{35} individuating *185* and *186* at the intersections respectively. Likewise, reflect over *line σ* the points *183* and *184* individuating *187* and *188*. At last, extend the line *169-170* until π_{35} individuating point *189*.

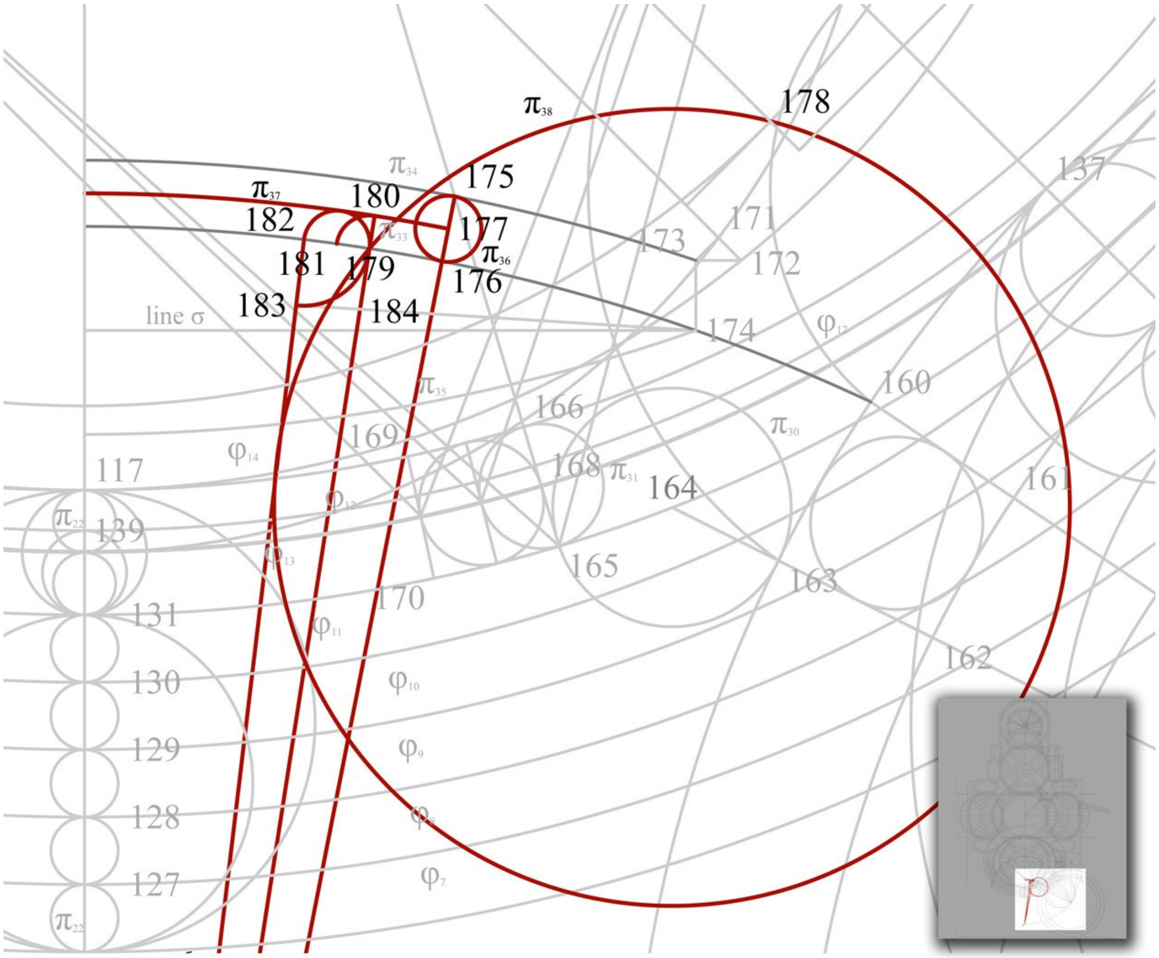

Figure 58. Step 36.
Drawing by the author.

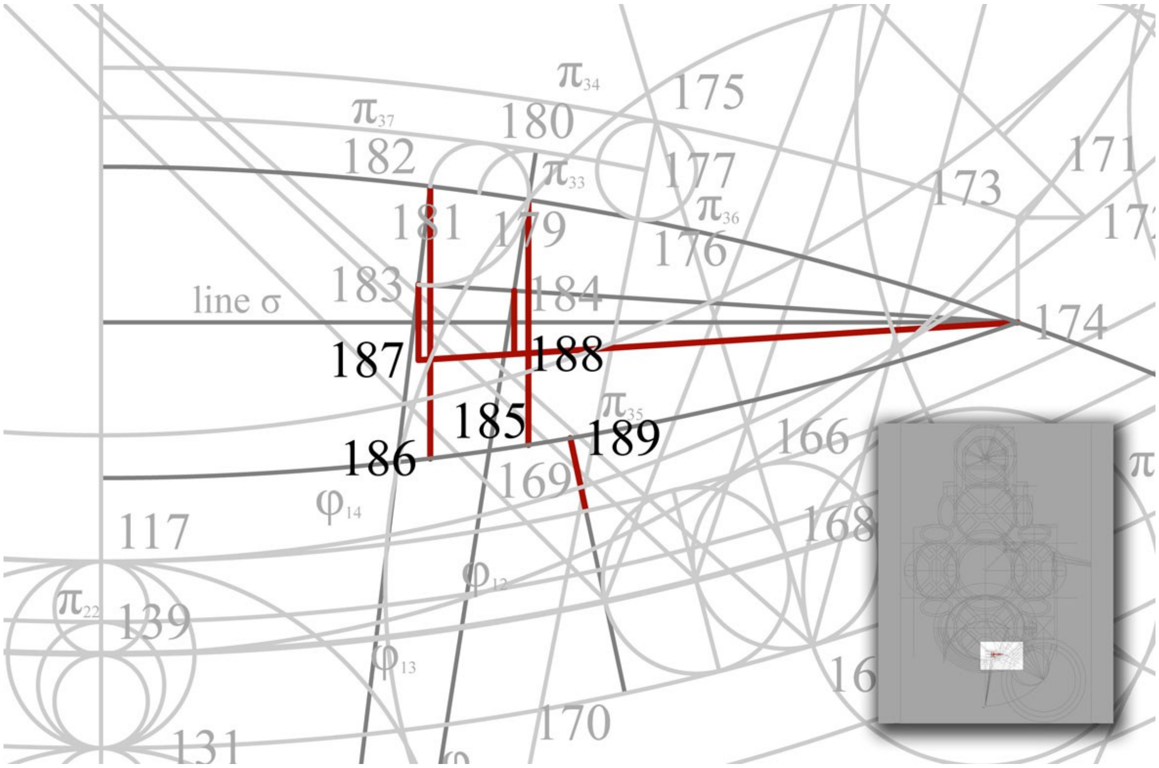

Figure 59. Step 37.
Drawing by the author.

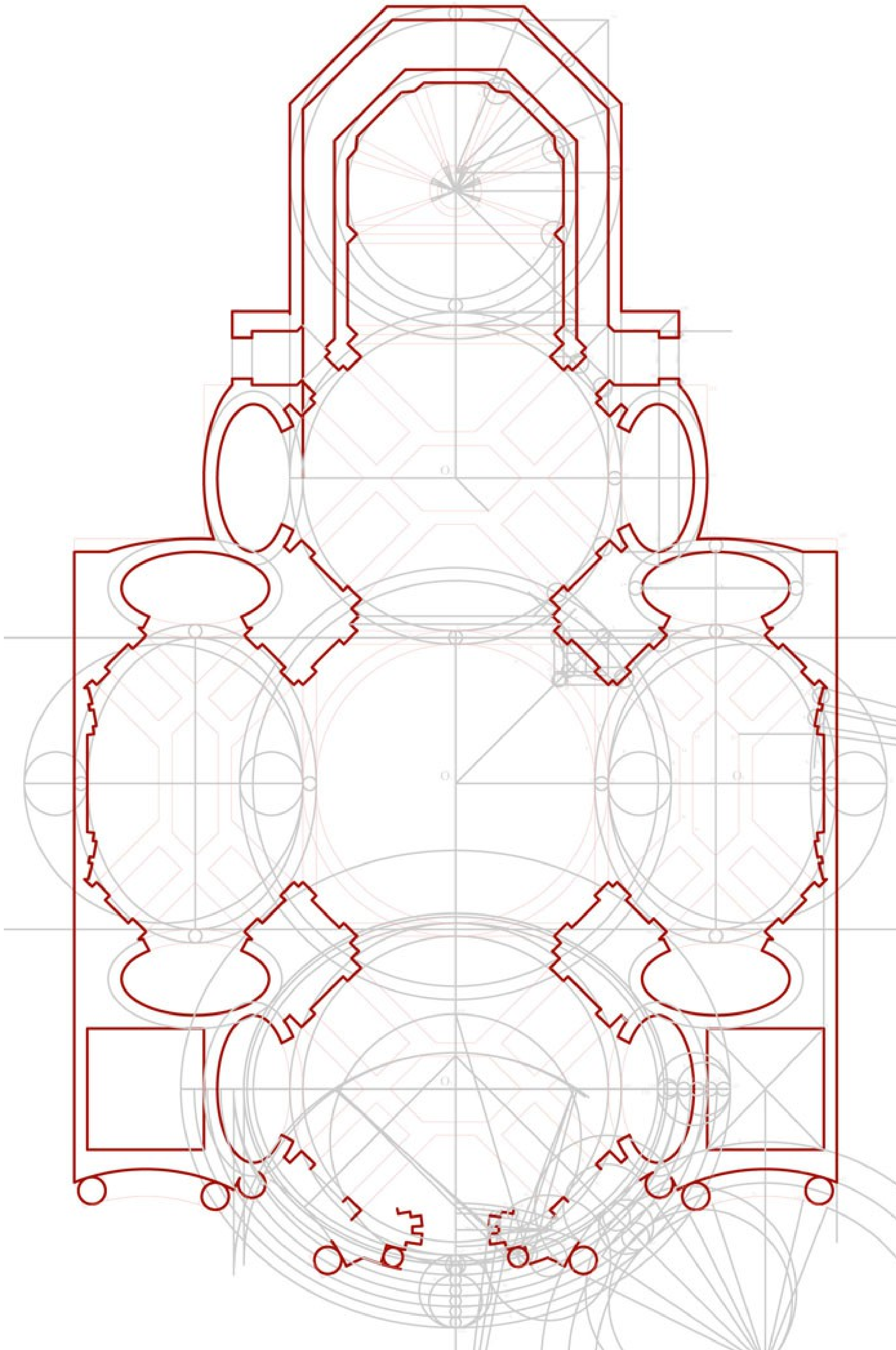

Figure 60. Step 37 overview.
Drawing by the author.

The profile passing through *164, 165, 166, 169, 189, 185, 186, 187, 188, 184, 183, 181, 179, 180, 177, 175* defines the shape of the entrance wall in Sainte-Anne **[figure 60]**.

STEP 38 [figure 61]:

To complete the inside profile of the entrance wall in Sainte-Anne, it is required to draw the pilaster strip framing the inside door. However, these pilaster strips do not match the ones in the pillars but the ones framing the niches in the side bays.

Starting from *175*, draw a copy of π_{15} (the diameter of the pilaster strips framing the niches) individuating on π_{34} point *190*. Likewise, from *173*, draw π_{15} individuating point *191*. Connect *190* with O_9 and move on this line the dimension of the segment *45-48* (the depth of the pilaster strips in the side bays) individuating point *192*. Centering on O_9, draw a circle passing through *192* (π_{39}); intersect π_{39} with the lines connecting *191* and *173* with O_9 finding the points *193* and *194*. Extend π_{39} until φ_{14} finding the point *195*, last point of the profile.

STEP 39 [figures 62, 63]:

Finally, we can find the position of the side doors in the entrance bay and their outside profile. Let *196* be the intersection point between π_{23} and π_{38}. Centered on *136*, draw a circle passing through *158* and *160* (π_{40}). From

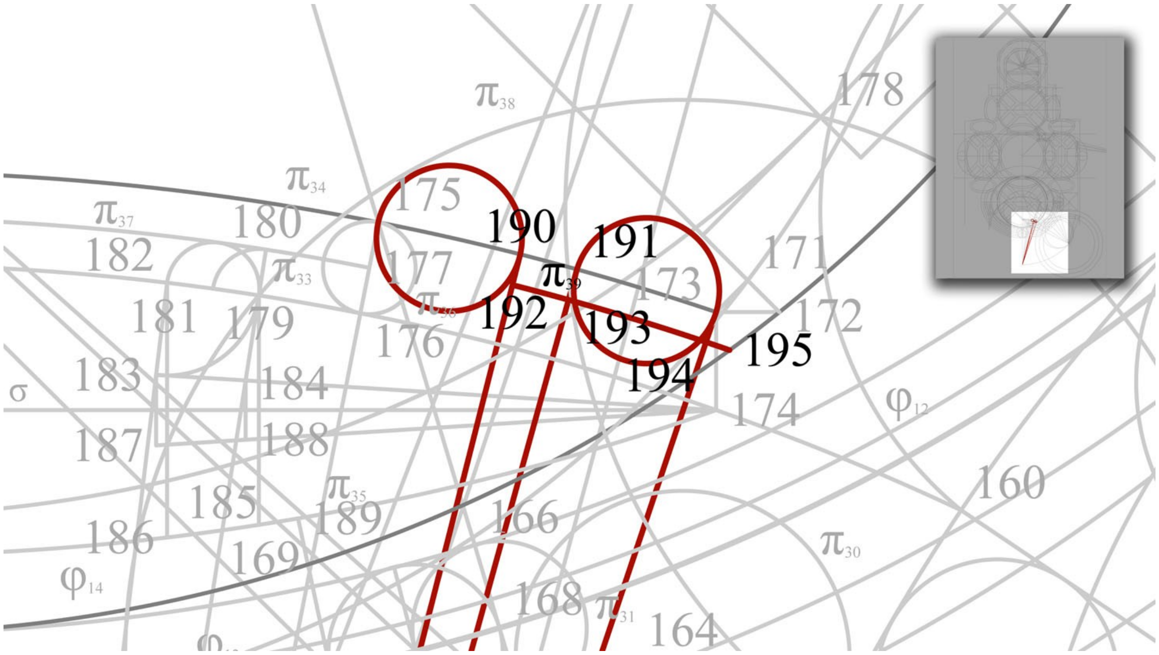

Figure 61. Step 38.
Drawing by the author.

Figure 62. Step 39.
Drawing by the author.

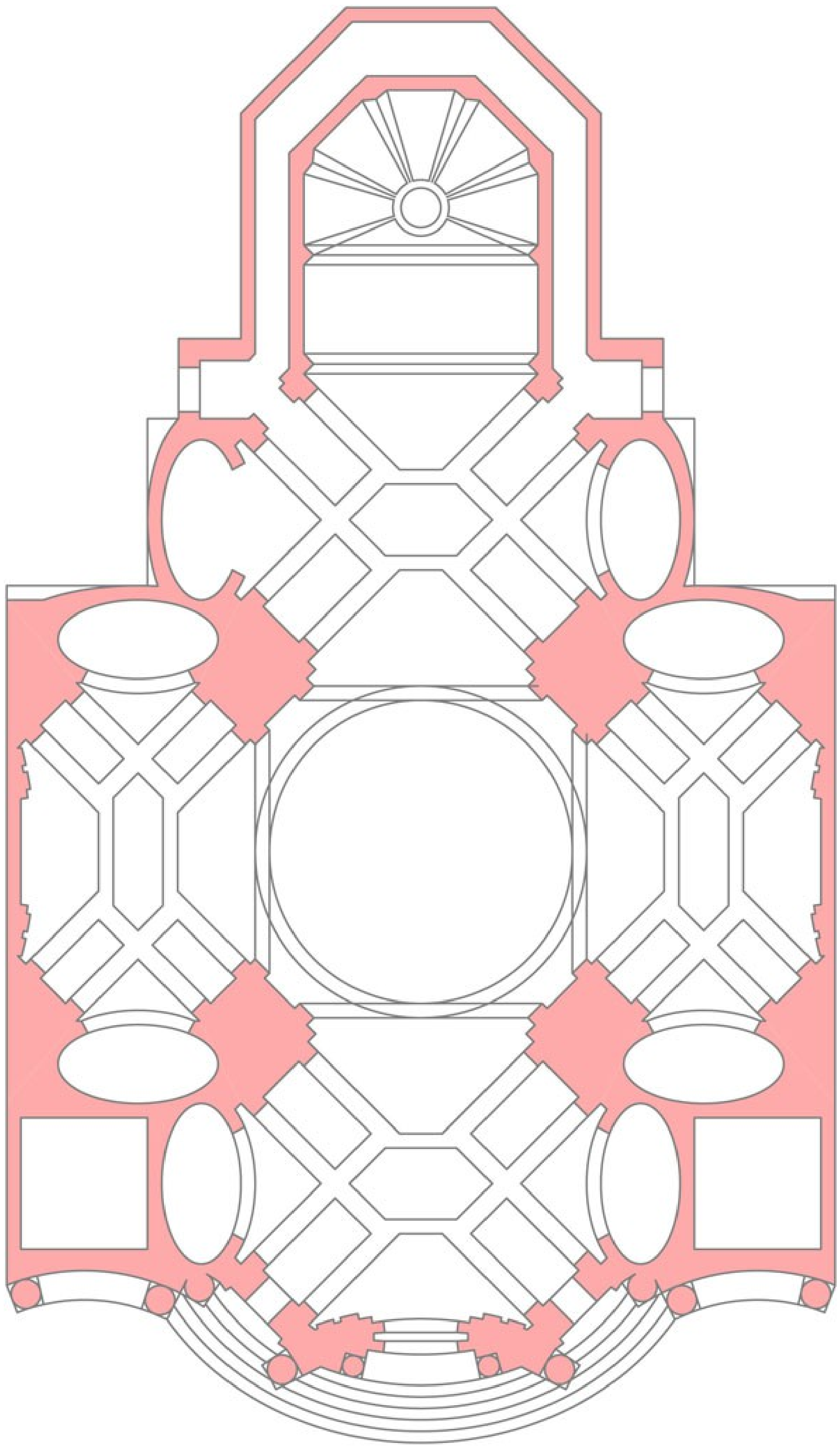

Figure 63. Step 39 overview.
Drawing by the author.

196 draw a line perpendicular to *197-198* (the portion of the pillar between the pilaster strips) individuating point *199*. Again from *196* draw a line this time parallel to *197-198* until intersecting the extension of π_{34} (point *200*). Connect *200* to *136* and extend this line until intersecting π_{40} in 201. Using line ς as symmetry axis, mirror the points 199, 196, 200, 201 individuating 202, 203, 204, 205 respectively thus completing the plan of Sainte-Anne-la-Royale **[figure 63]**.

3.2 The Celestial Temple

At the top of the first two levels of Sainte-Anne-la-Royale, the gallery and the domes are still linked to the overall geometry in the building while compositionally evolve independently. The central plant hints found in the ground floor of the church develop in a circular temple at the top of the pendentive. The geometric link between this new structure and the lower levels in the church are represented by the very same circle inscribed in the central bay which was used as generative element from the plan. Together with the circle, the projections in plan of the pilaster strips in the transversal side bays define the diameter of the columns in the gallery and the thickness of the gallery space.

Using these fixed elements, the following construction will provide a geometric setting for the upper levels in Sainte-Anne-la-Royale. In order to offer a clear construction process, the traces of the lower levels are removed, starting from a blank background. Because of this, also the labels for the several points, lines, and circles will start anew. In order to avoid confusion in the present construction, the generative elements coming form the ground floor will keep the same labels while the new ones will use different letters. Note that, among other elements, the first step for the new construction will show π_1, π_3, and π_4 while π_2 will be missing. The new set of greek letters used for circles will be Σ while the lines will use latin letters.

STEP 40 [figure 64]:

As starting elements for the construction of the upper levels of Sainte-Anne-la-Royale, there will be used:

– O_1, the center of the central bay;

– π_4, the circle inscribed in the central bay;

– π_3, the circle corresponding to the projection of the pilaster strips (which are oriented diagonally to the diameter of π_3);

– π_1, the circle with center in O_1 and passing through the edge of π_3 opposite to π_4.

Starting from O_1, draw the line r_1 laying on the transversal axis of he church. The center of the circle π_3 on r_1 is marked with *1*.

STEP 41 [figure 65]:

Centering on O_1 with span O_1-*1* draw the circle Σ_1 on which the centers of the columns in the gallery will be located.

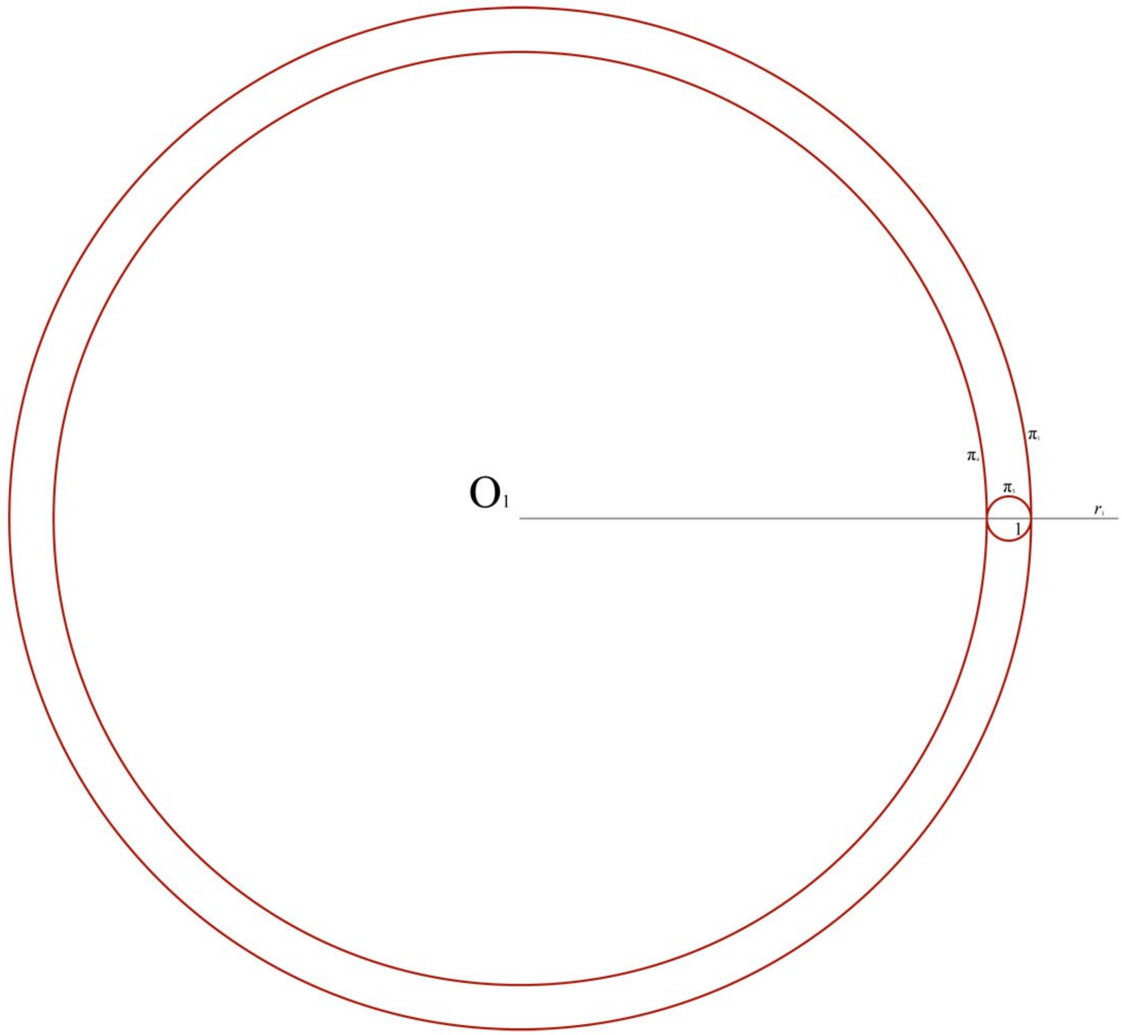

Figure 64. Step 40.
Drawing by the author.

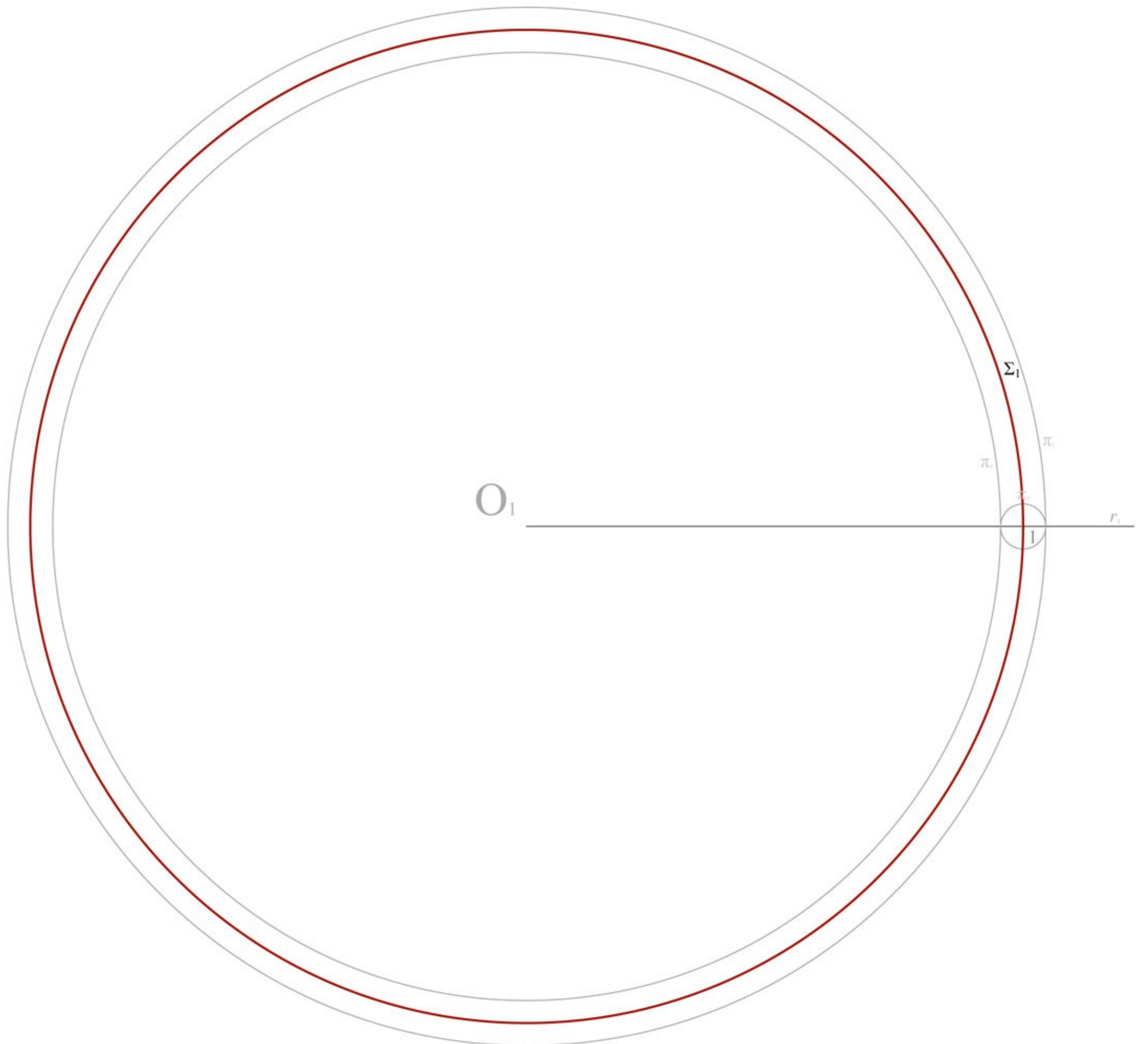

Figure 65. Step 41.
Drawing by the author.

STEP 42 [figure 66]:

Starting from O_1, draw the lines r_2, r_3, r_4, r_5, r_6, r_7, and r_8 located along the horizontal/vertical and diagonal directions. The angle between each line is a 45 degree angle.

STEP 43 [figures 67, 68]:

Divide the angle between r_1 and r_2 in three equal parts individuating the lines r_{1-1} and r_{1-2}. The intersection between these lines and Σ_1 will provide the points *2* and *3*. From *2* and *3*, draw the circle π_3 individuating the location for two of the columns in the gallery.

Repeat the same construction between all the eight portions in which the starting circles π_1 and π_4 have been divided, finding the whole set of columns in the gallery.

STEP 44 [figures 69, 70, 71, 72, 73, 74, 75, 76, 77]:

To start working on the setting of the ribs in the first dome (or second pendentive), draw a line connecting points *8* and *13* and extend until intersecting r_4 at *18* and r_7 at *19*. From here, draw a line passing through *14* and *3* until reaching r_2 at *20*. From here, continue drawing a line passing through *4* and *9* until intersecting r_5 at *21*, and so on until finding the the additional points *22, 23, 24,* and *25*. At last, the line connecting *25* to the starting point *18* will pass through *2* and *7*.

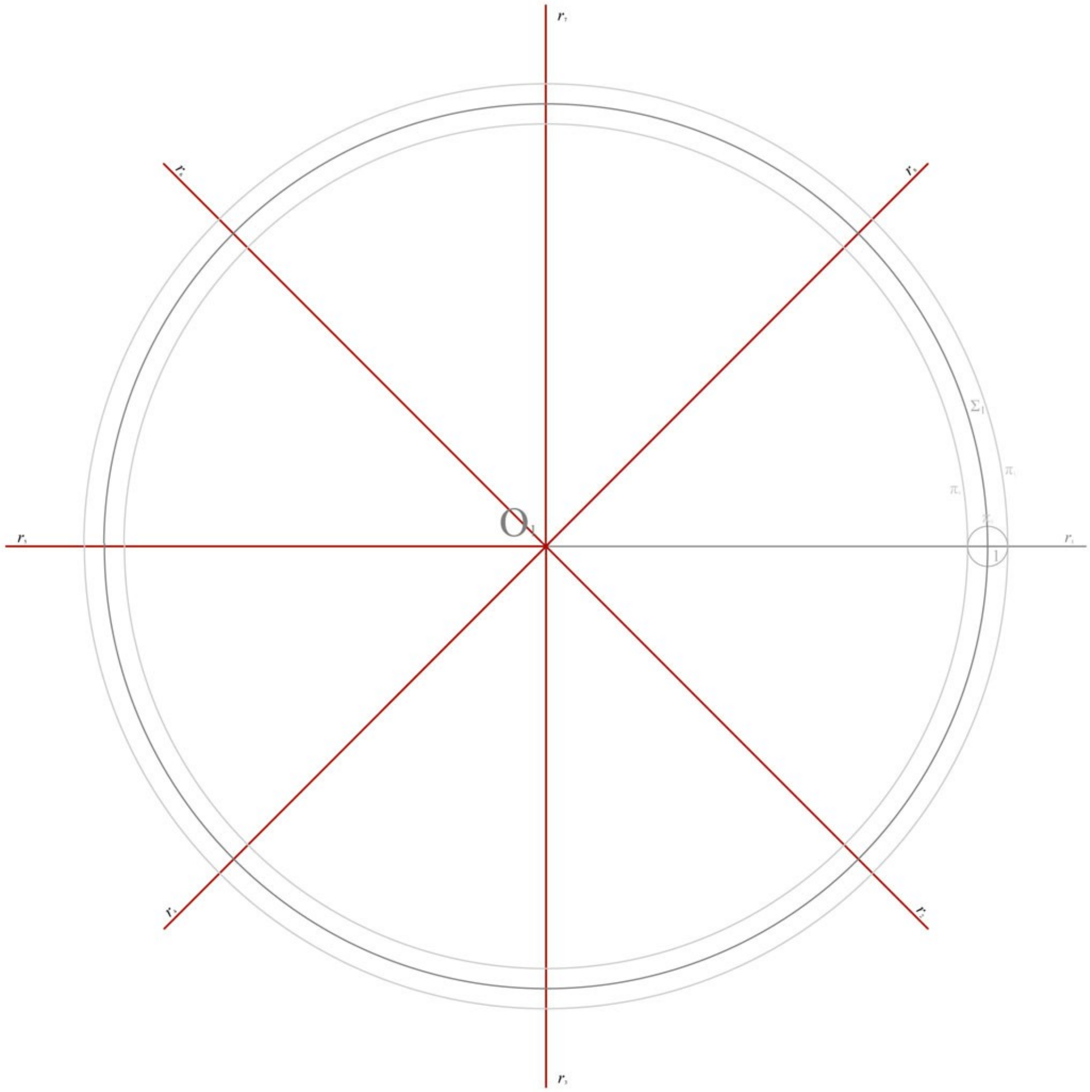

Figure 66. Step 42.
Drawing by the author.

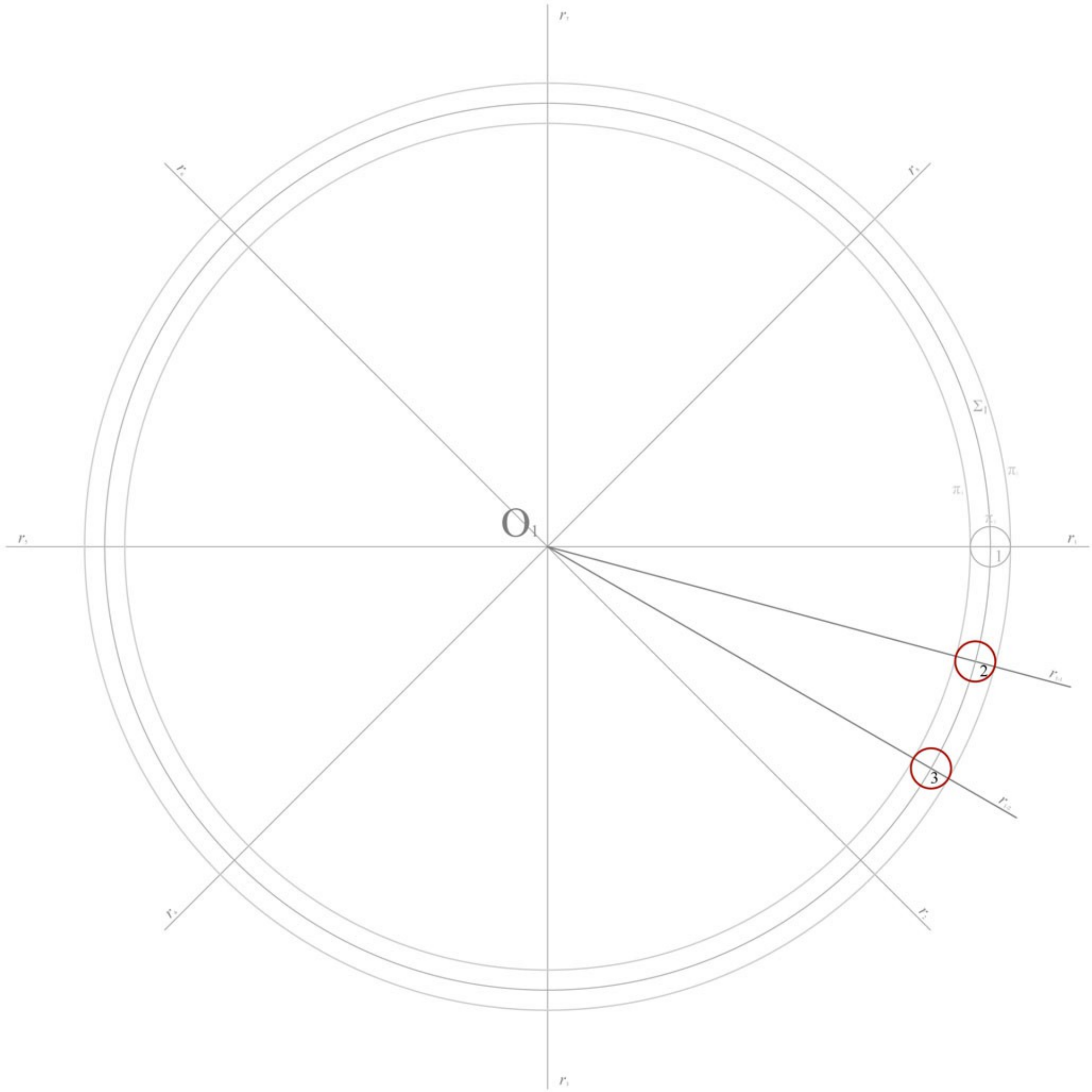

Figure 67. Step 43.
Drawing by the author.

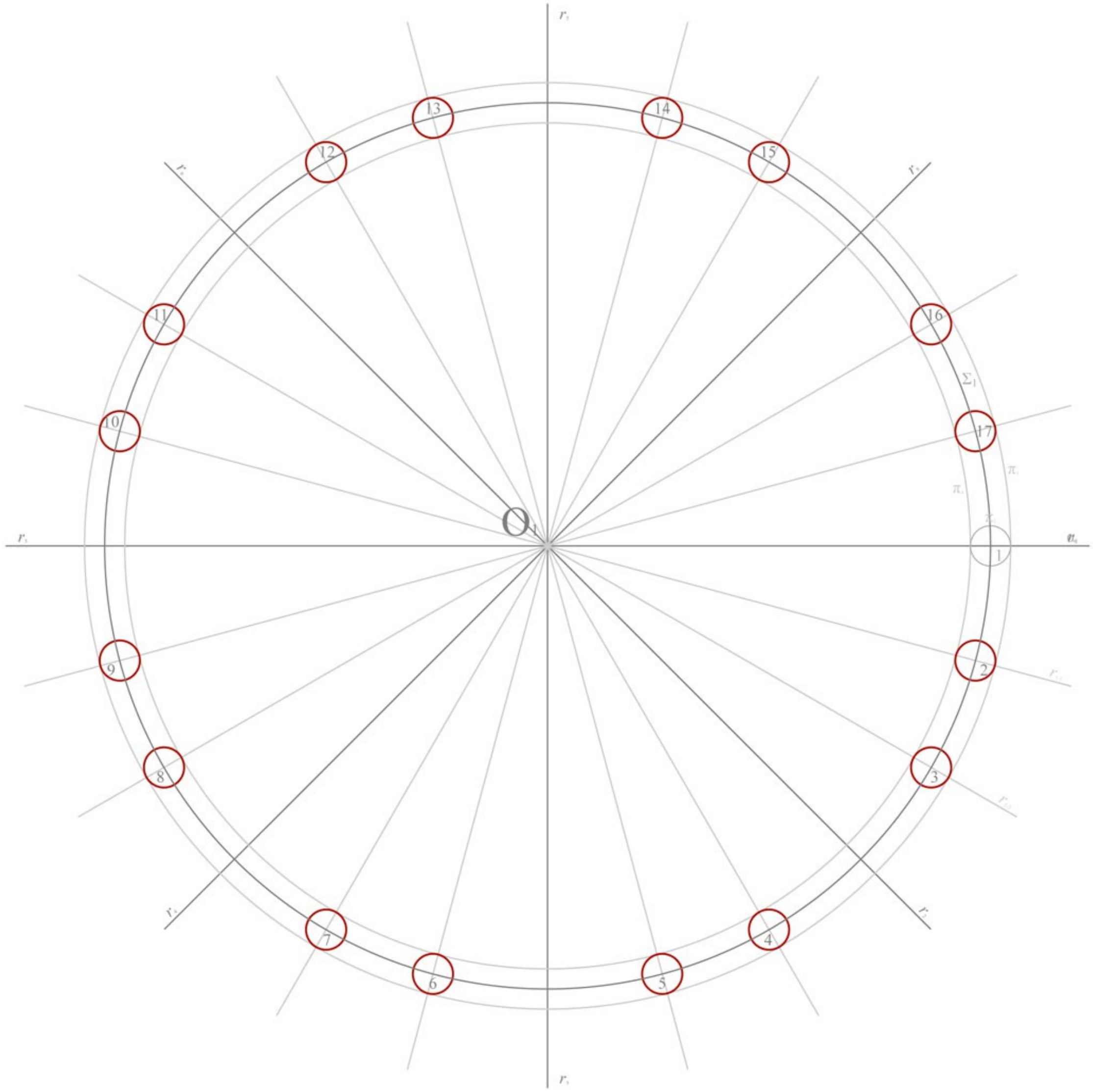

Figure 68. Step 43 completed construction.
Drawing by the author.

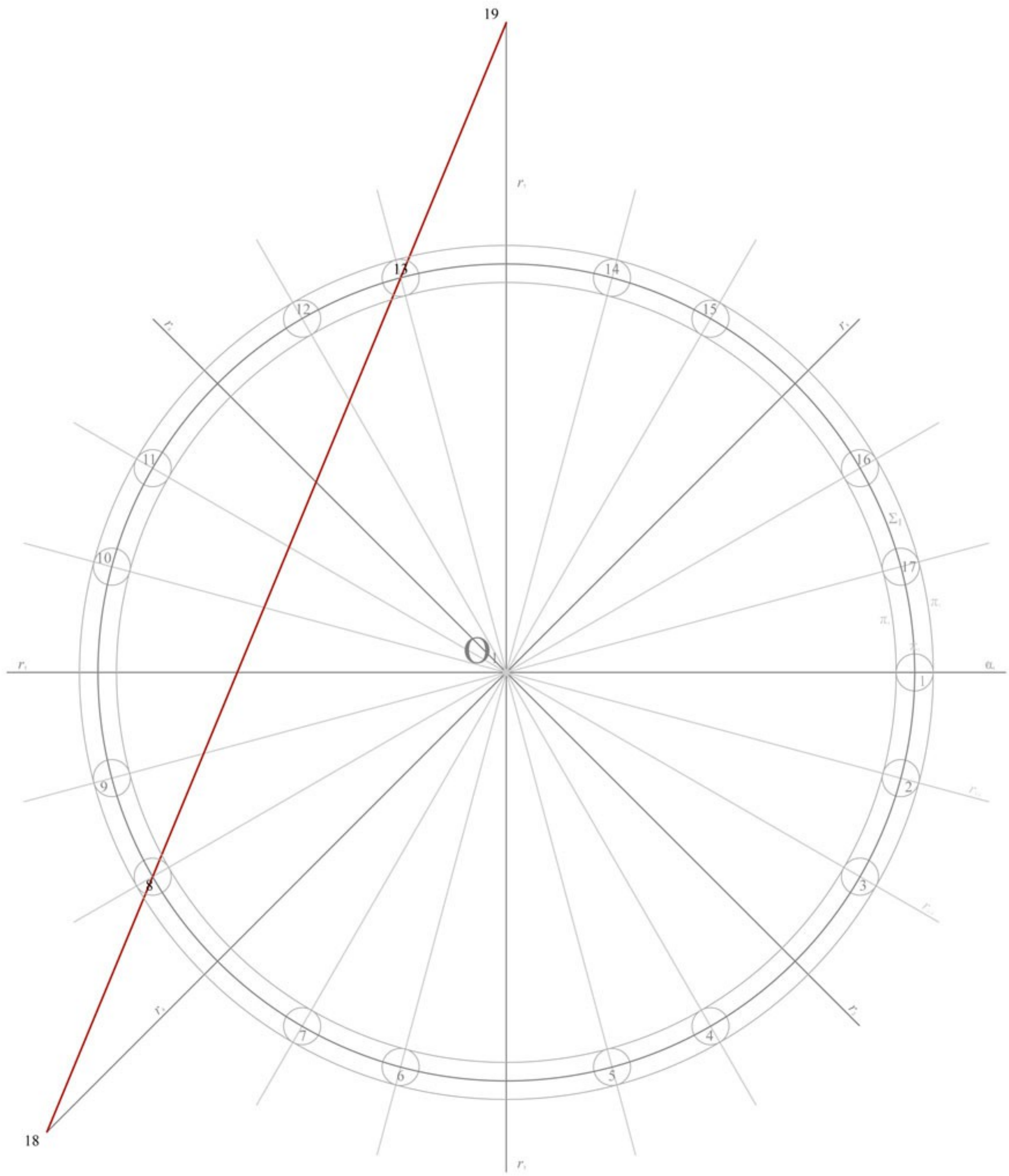

Figure 69. Step 44a.
Drawing by the author.

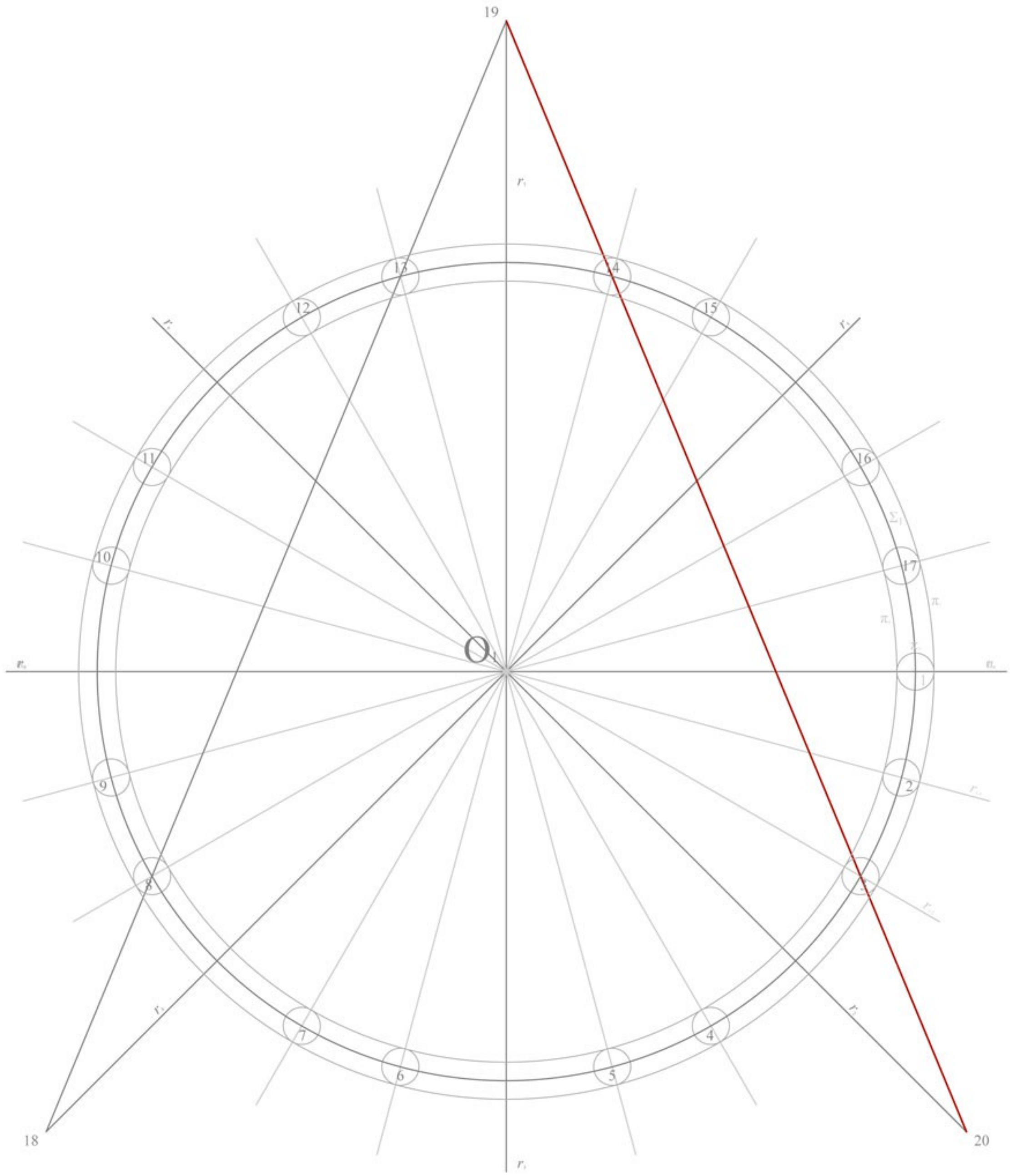

Figure 70. Step 44b.
Drawing by the author.

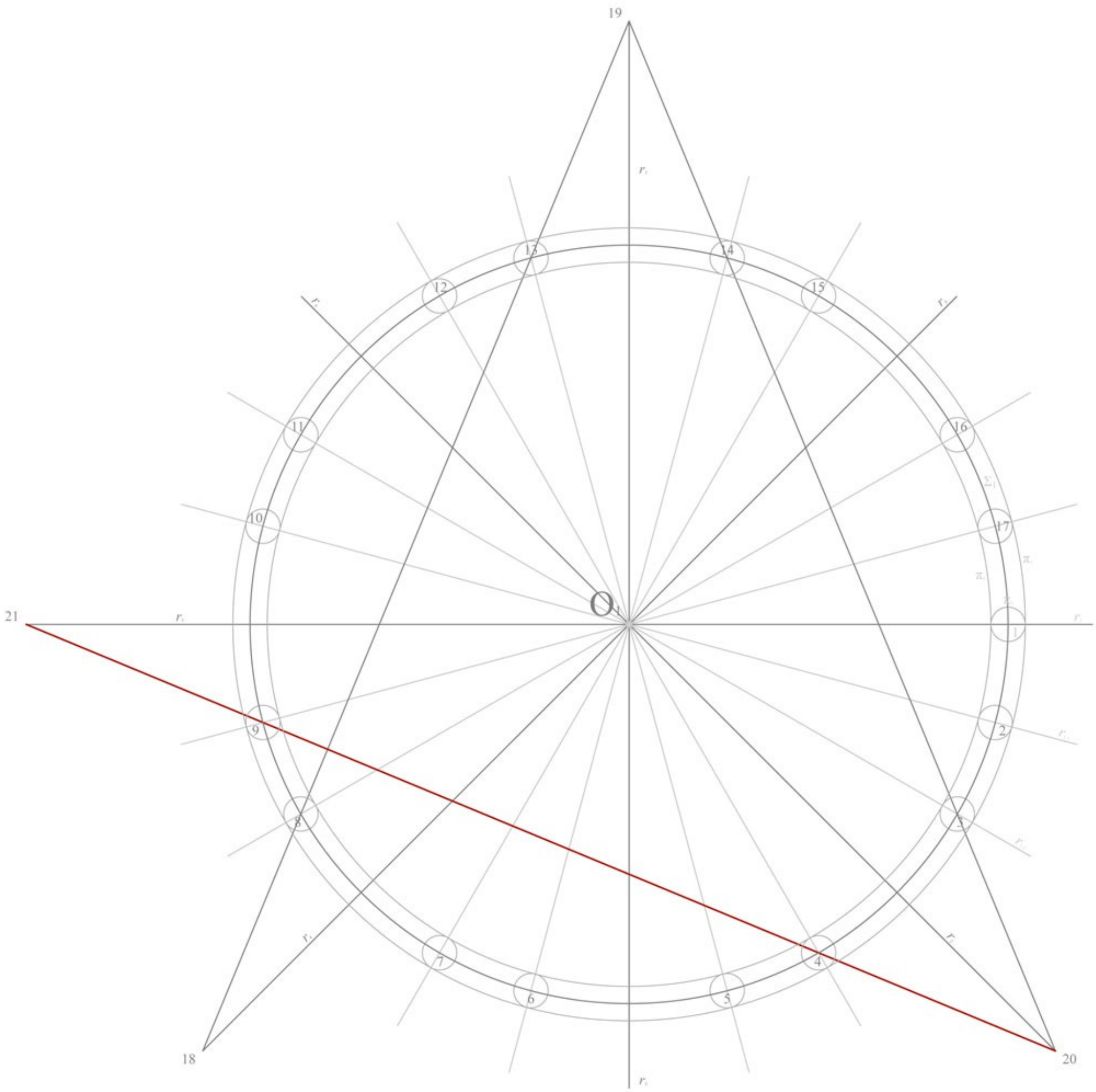

Figure 71. Step 44c.
Drawing by the author.

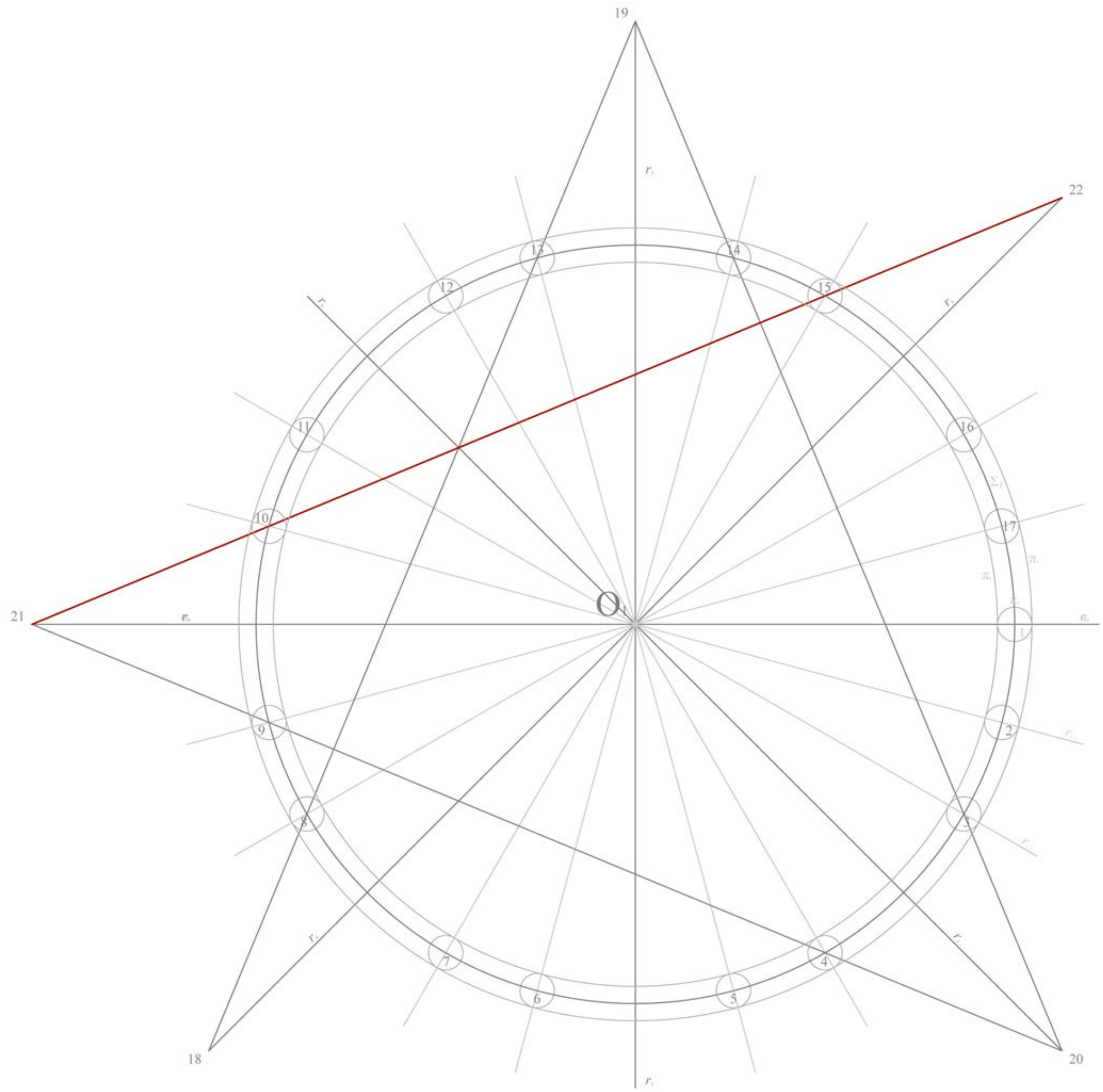

Figure 72. Step 44d.
Drawing by the author.

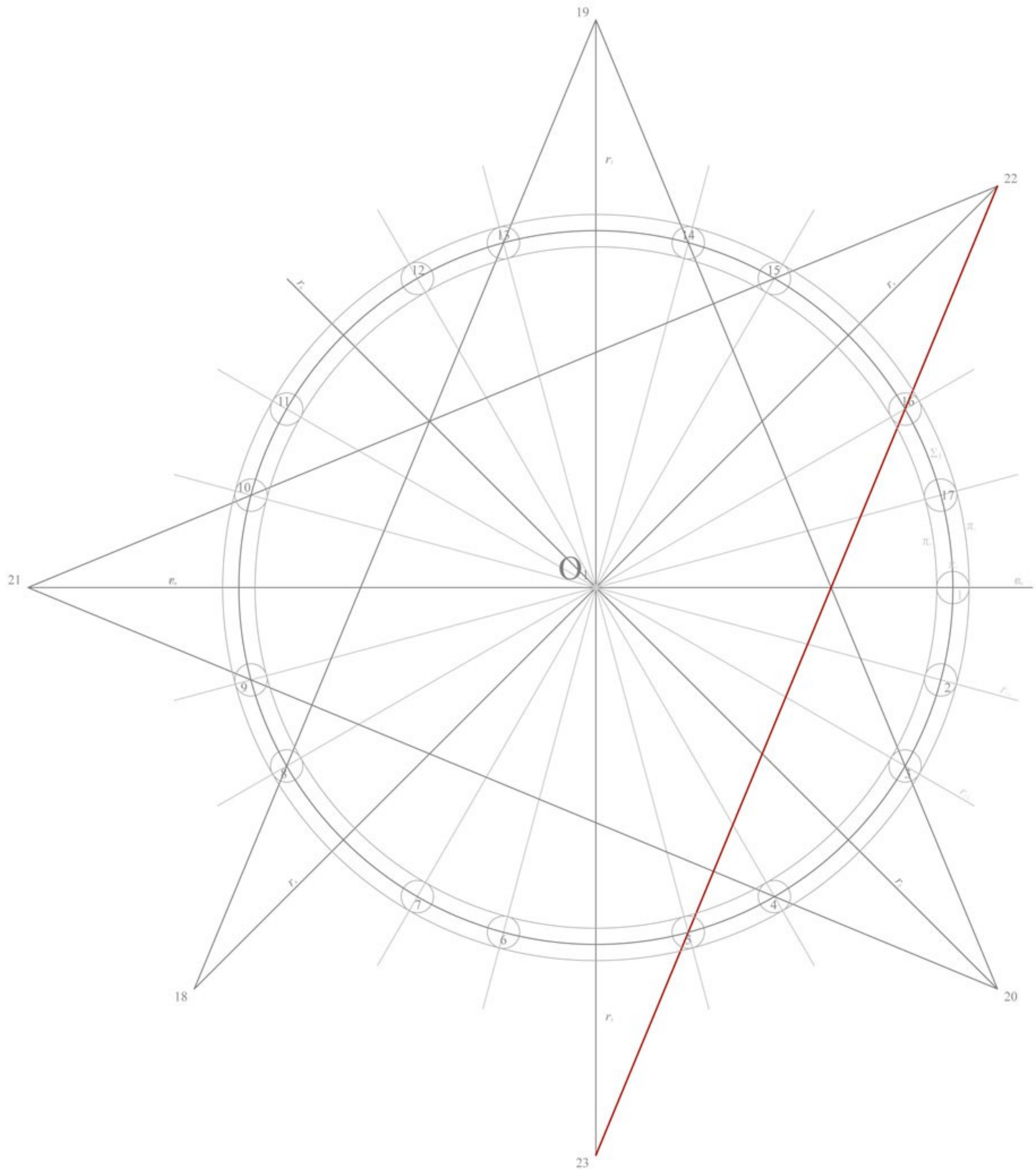

Figure 73. Step 44e.
Drawing by the author.

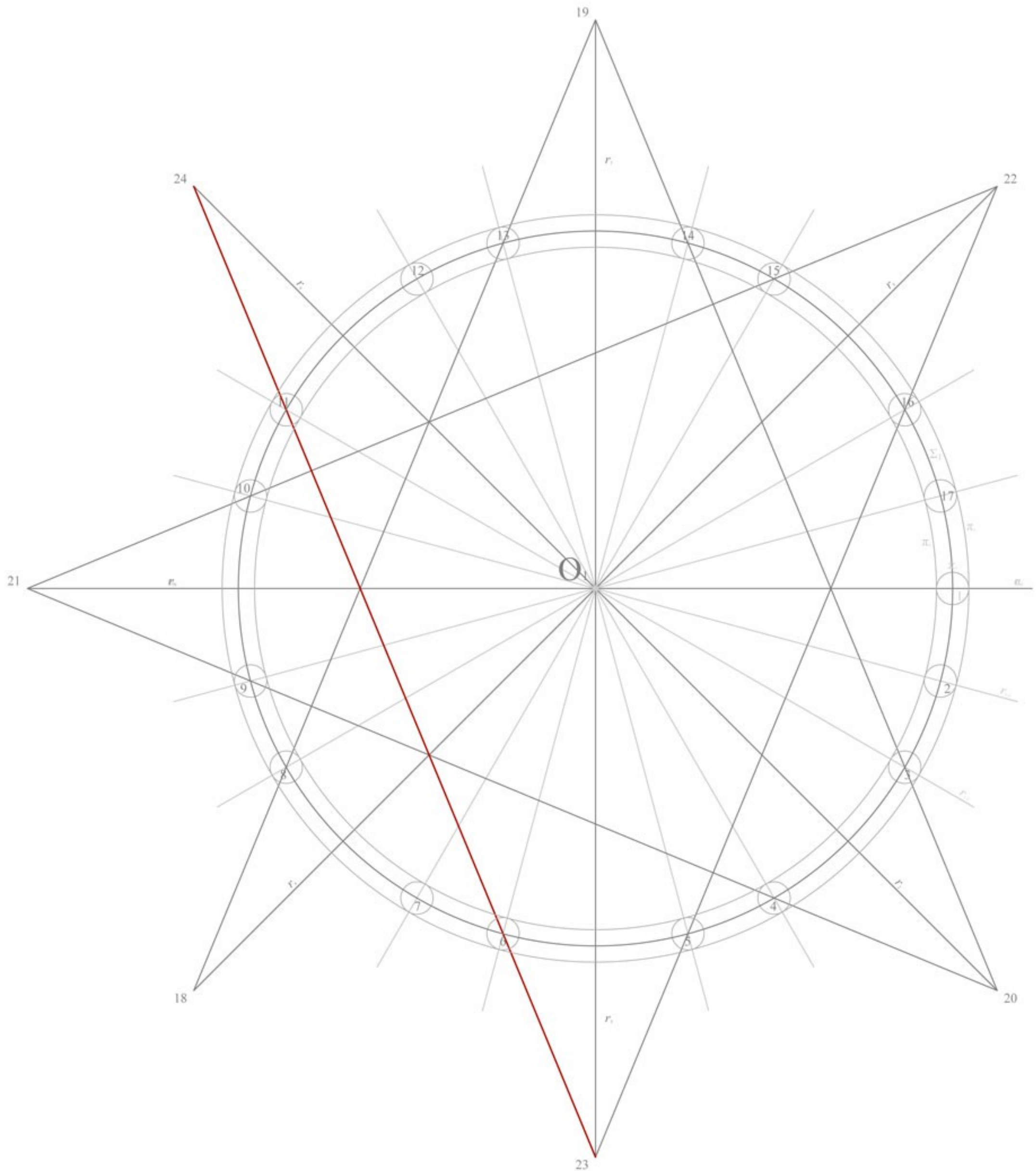

Figure 74. Step 44f.
Drawing by the author.

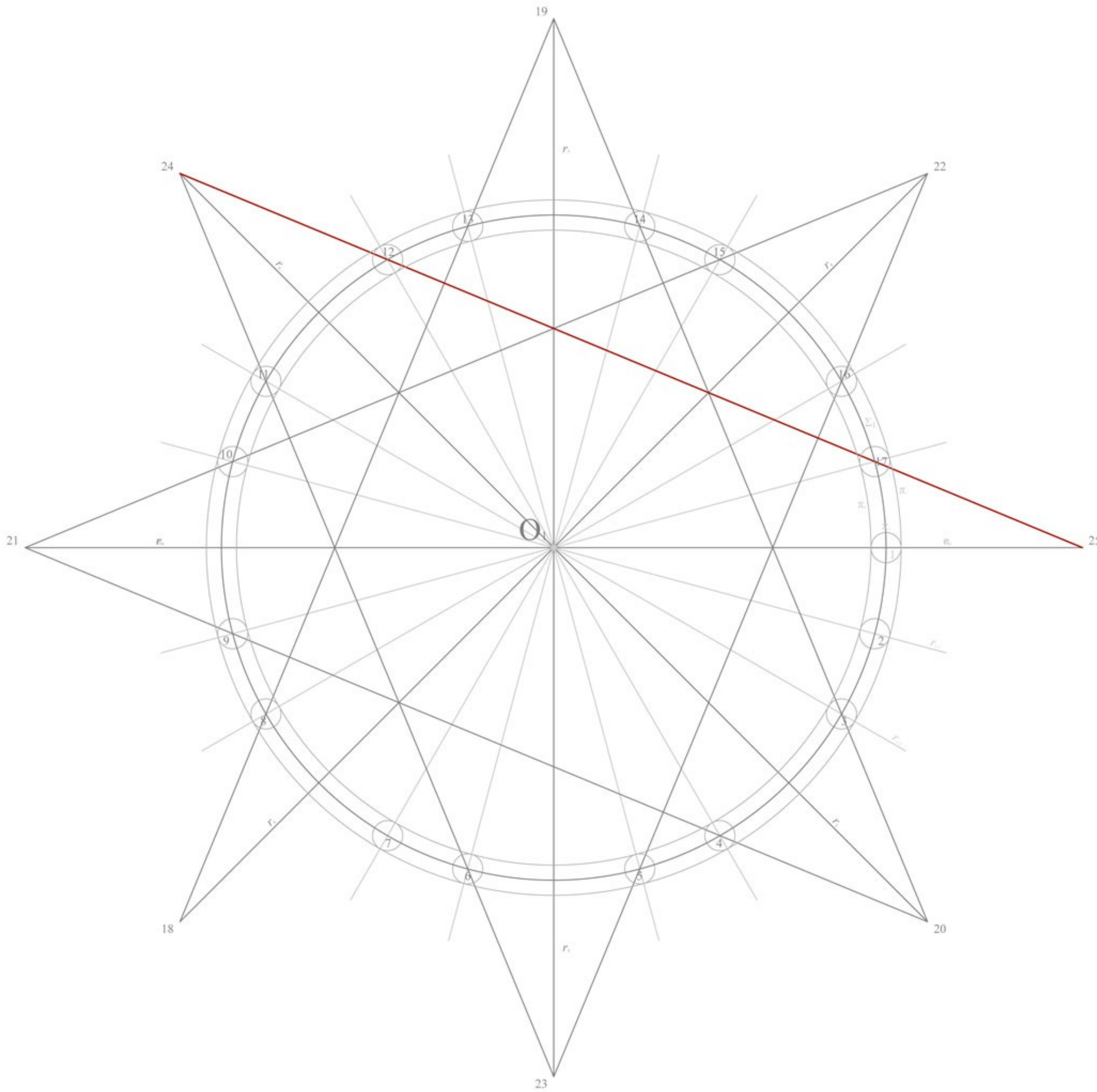

Figure 75. Step 44g.
Drawing by the author.

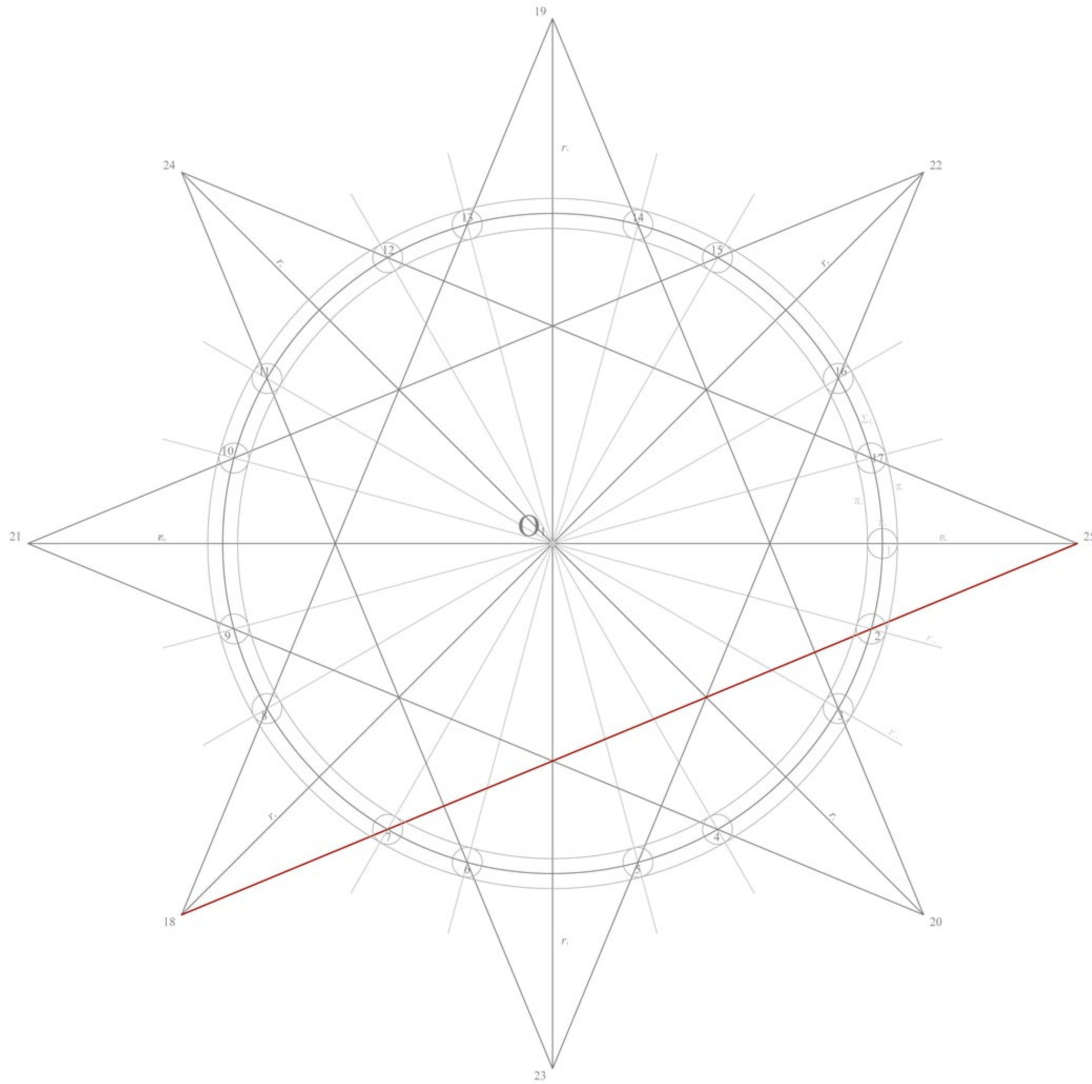

Figure 76. Step 44h.
Drawing by the author.

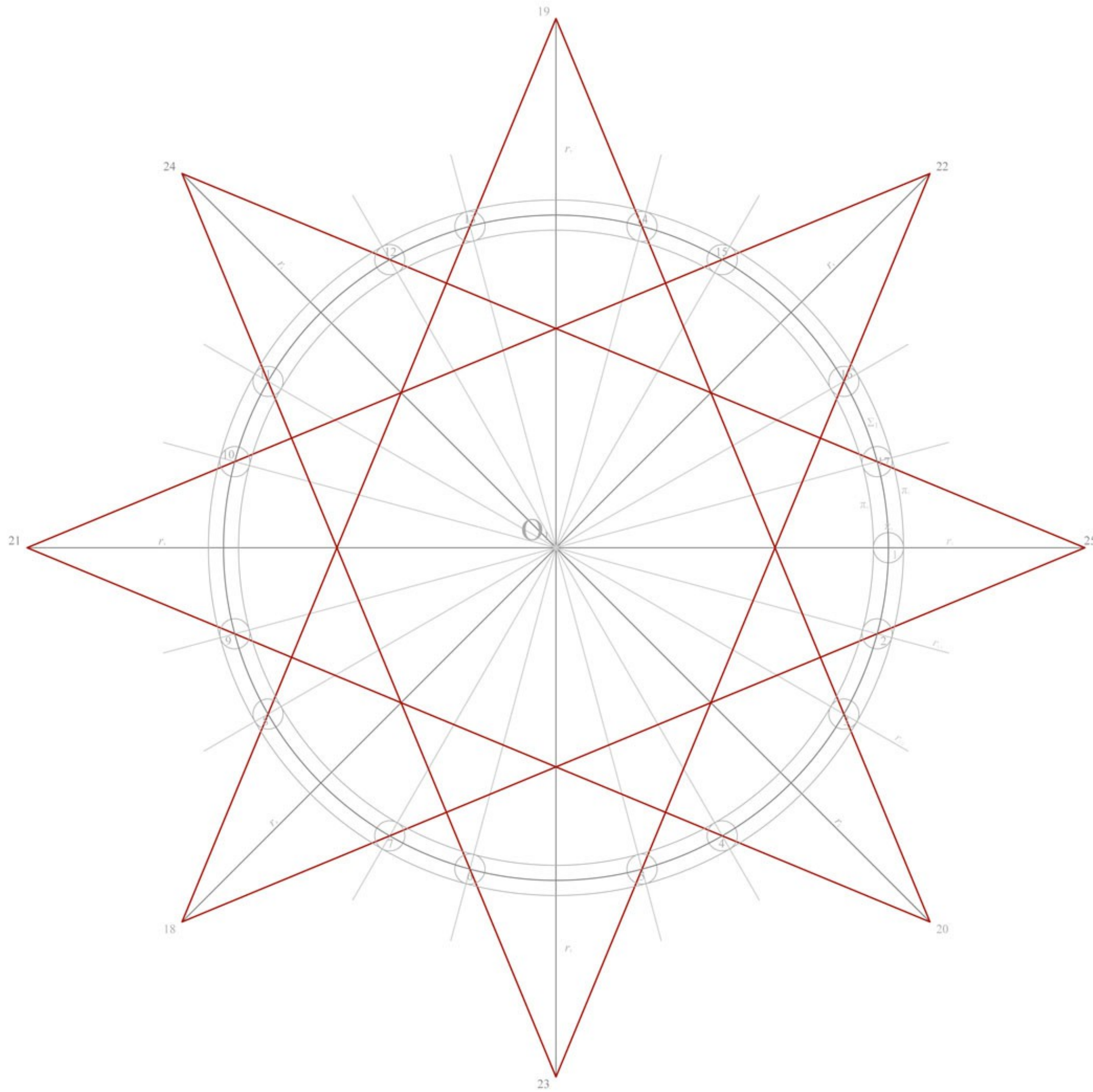

Figure 77. Step 44 - Completed construction.
Drawing by the author.

The resulting shape **[figure 77]** is an eight-pointed star. The portion of this geometric figure contained inside Σ_1 will individuate the outline of one tier of arches in the ribbed dome.

STEP 45 [figures 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88]:

The second tier of arches in the dome follows a construction similar to the one used above.

Connect *9* to *12* and extend the line until intersecting r_4 at 26 and r_7 at *27*.

From *27* draw the line passing through *15* and *2* until intersecting r_2 in *28*.

From *28* draw the line passing through *5* and *8* intersecting r_5 in *29*.

Continue in the same way to find the points *30, 31, 32,* and *33*. The resulting geometric figure for the second tier of arches is again an eight-point star.

Upon their combination, the two tiers of arches individuate the layout of the ribbed dome in the area inside Σ_1. The portions of the double eight-point star outside Σ_1 instead will be used to find the outside profile of the gallery and ribbed dome. It will also contribute to the geometry for the second dome and lantern.

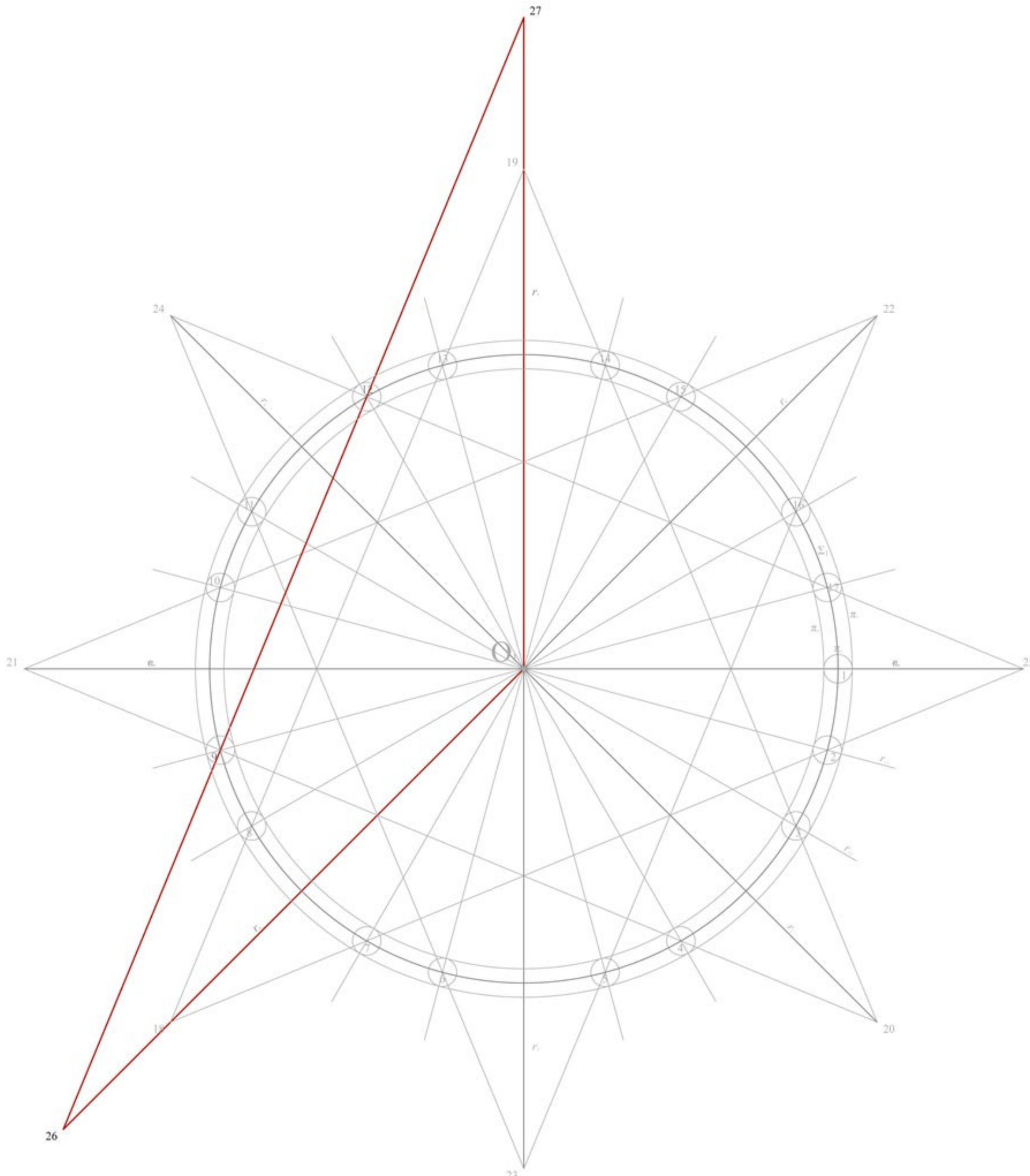

Figure 78. Step 45a.
Drawing by the author.

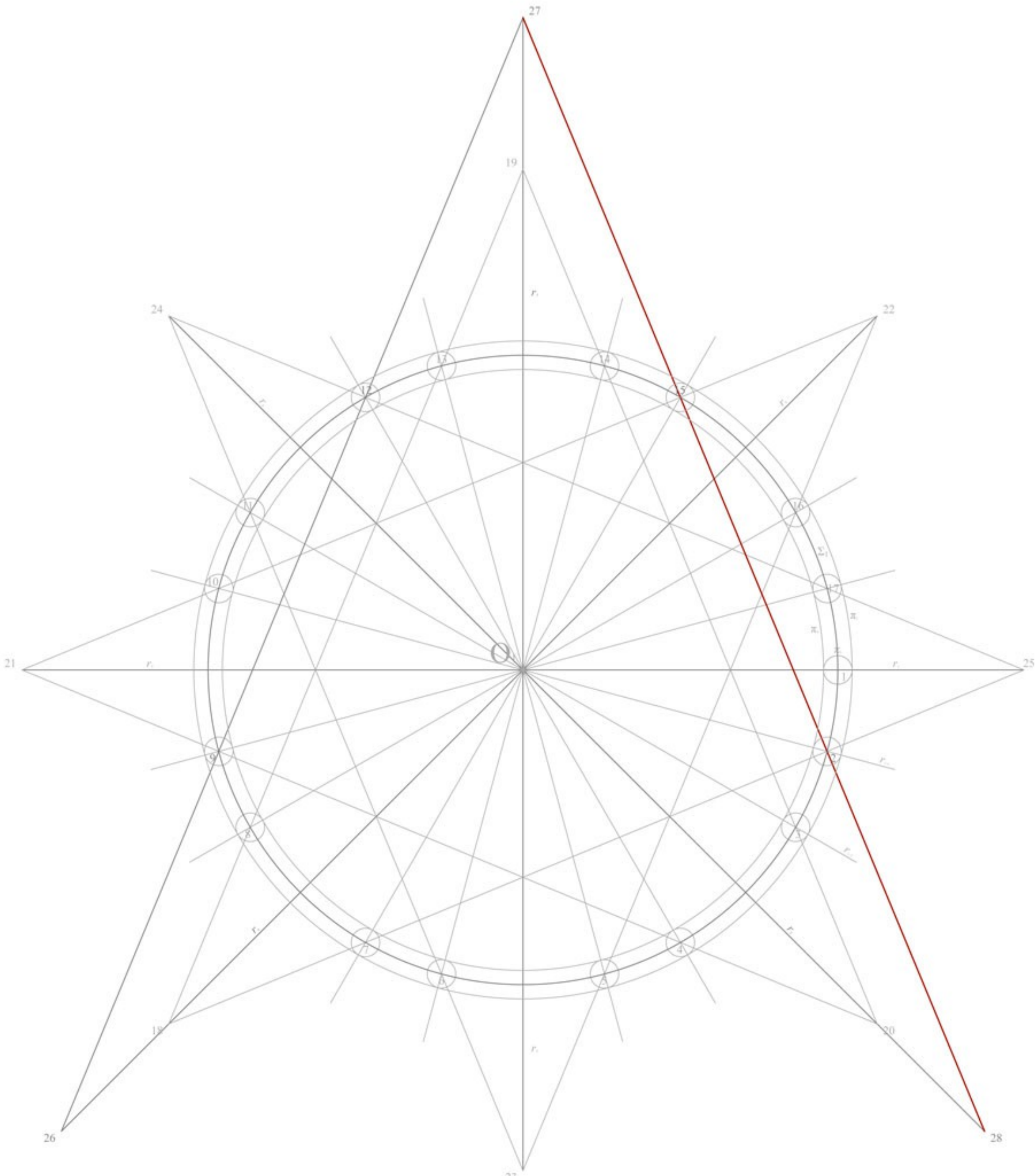

Figure 79. Step 45b.
Drawing by the author.

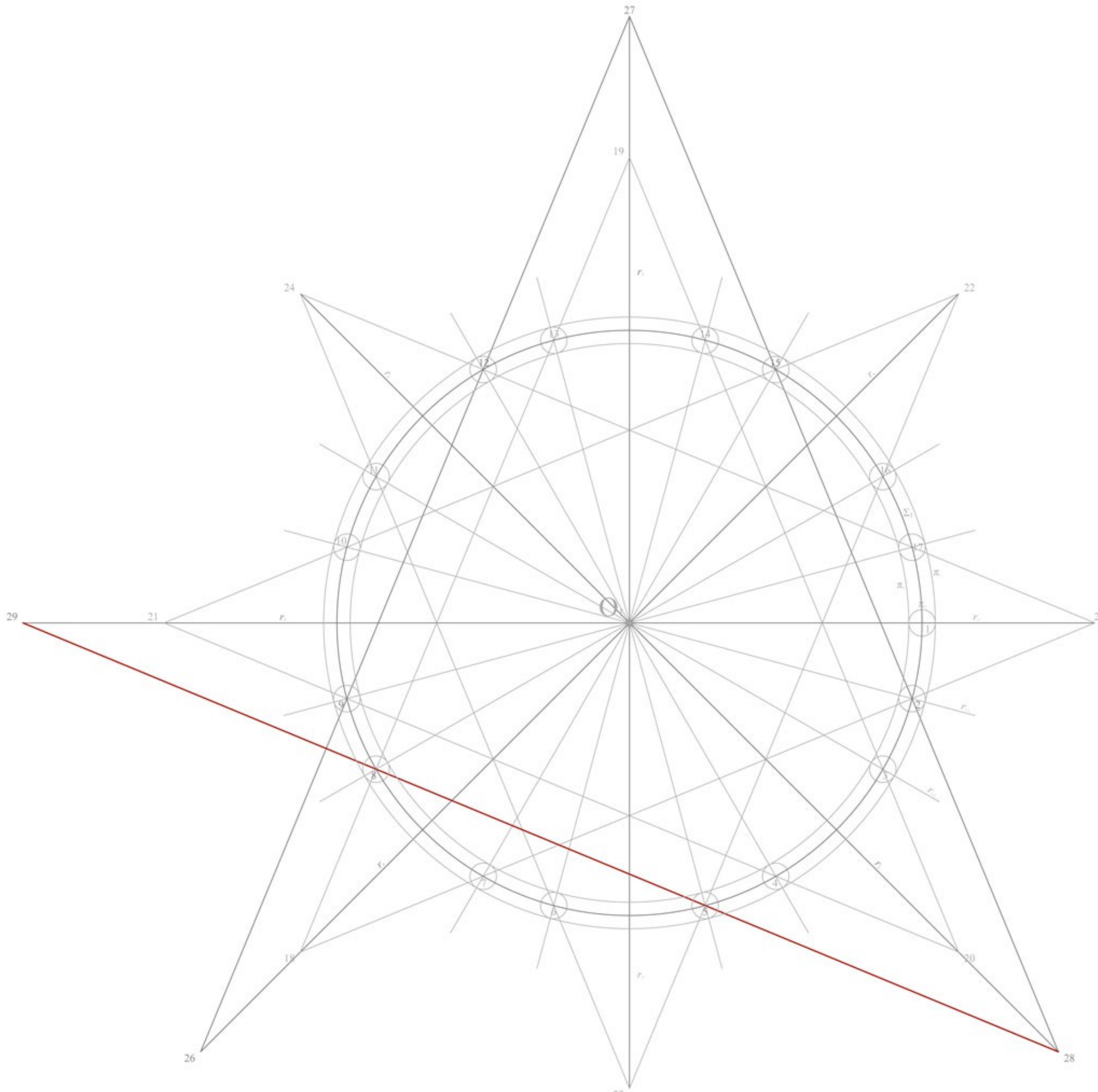

Figure 80. Step 45c.
Drawing by the author.

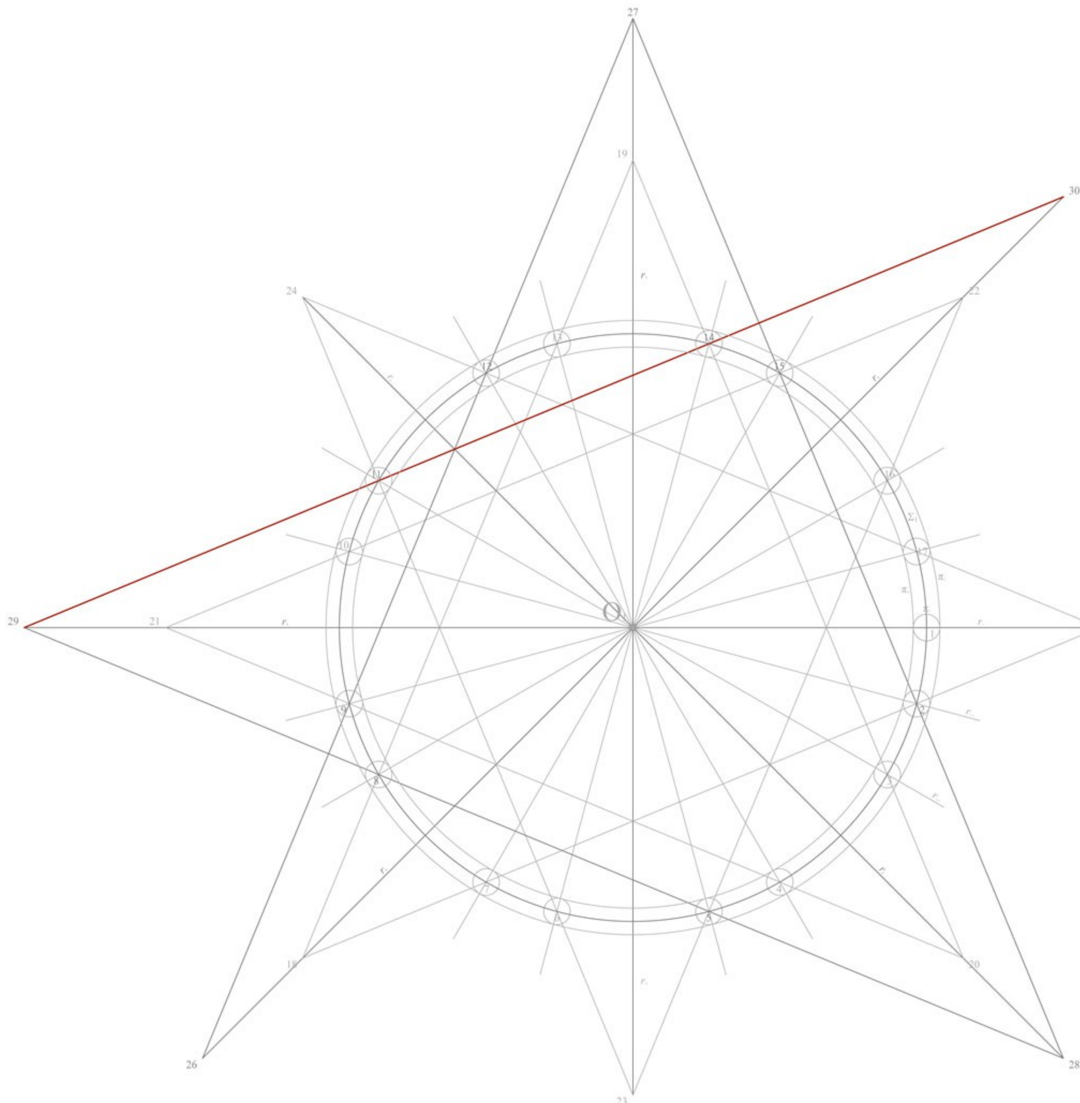

Figure 81. Step 45d.
Drawing by the author.

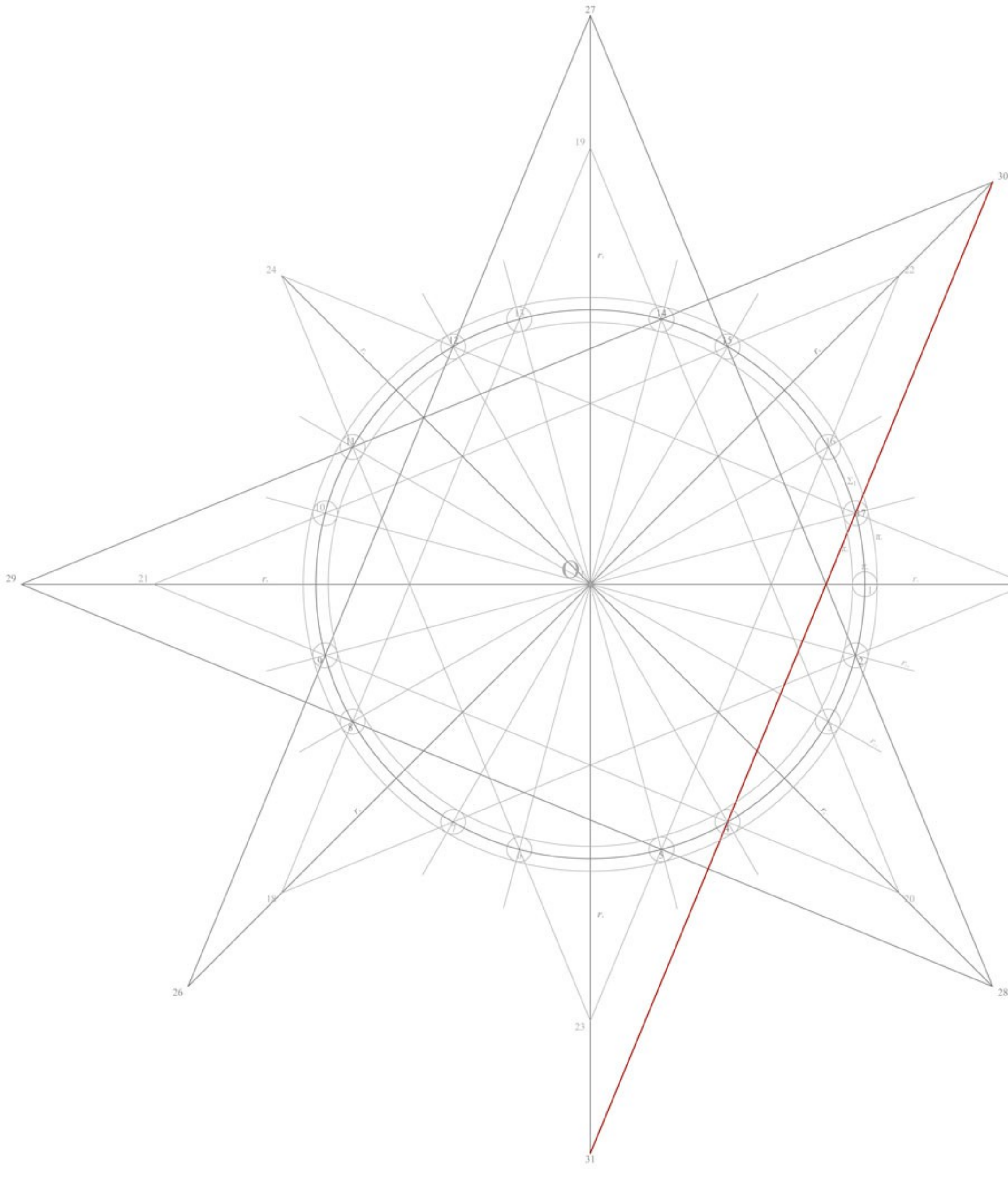

Figure 82. Step 45e.
Drawing by the author.

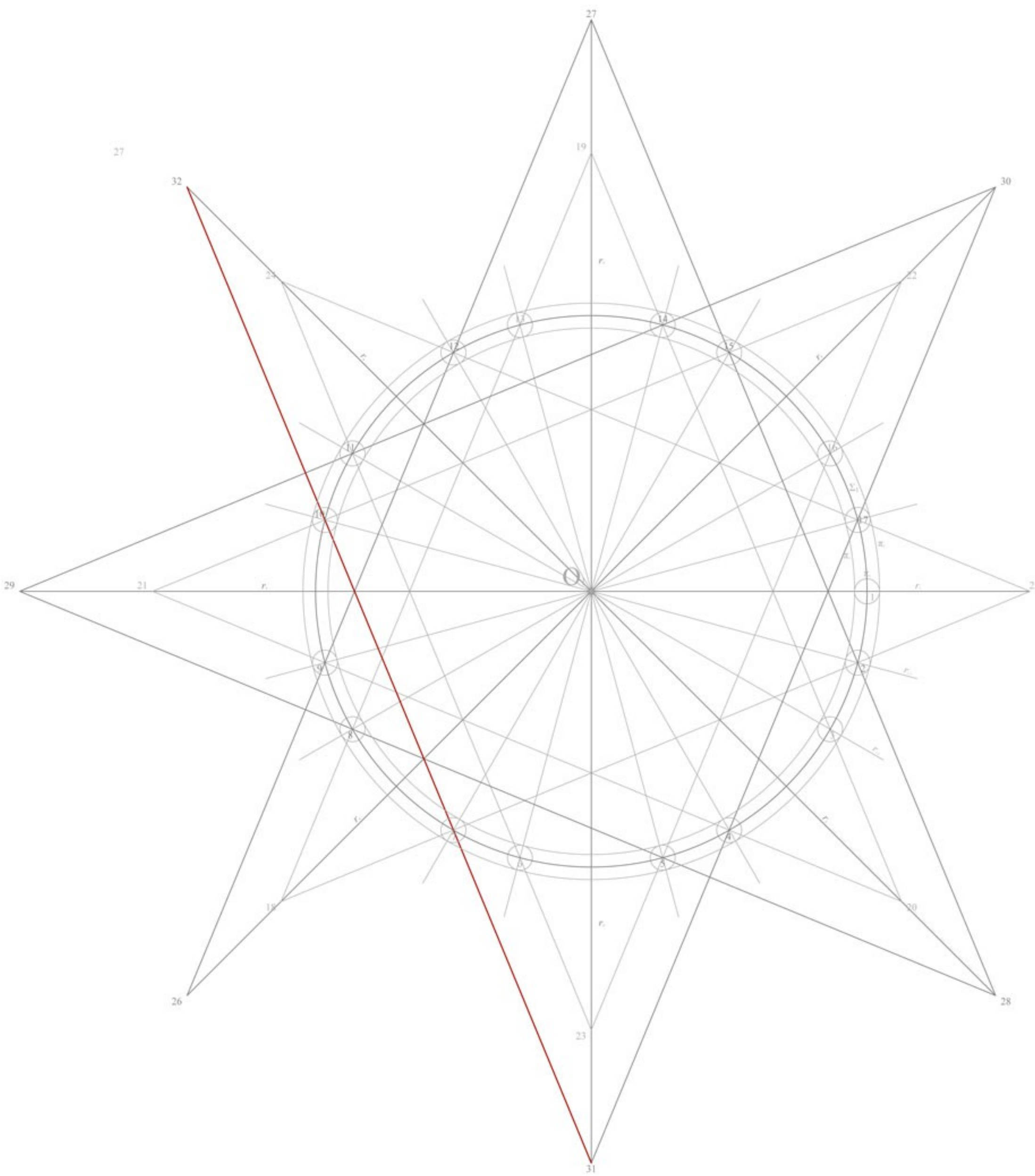

Figure 83. Step 45f.
Drawing by the author.

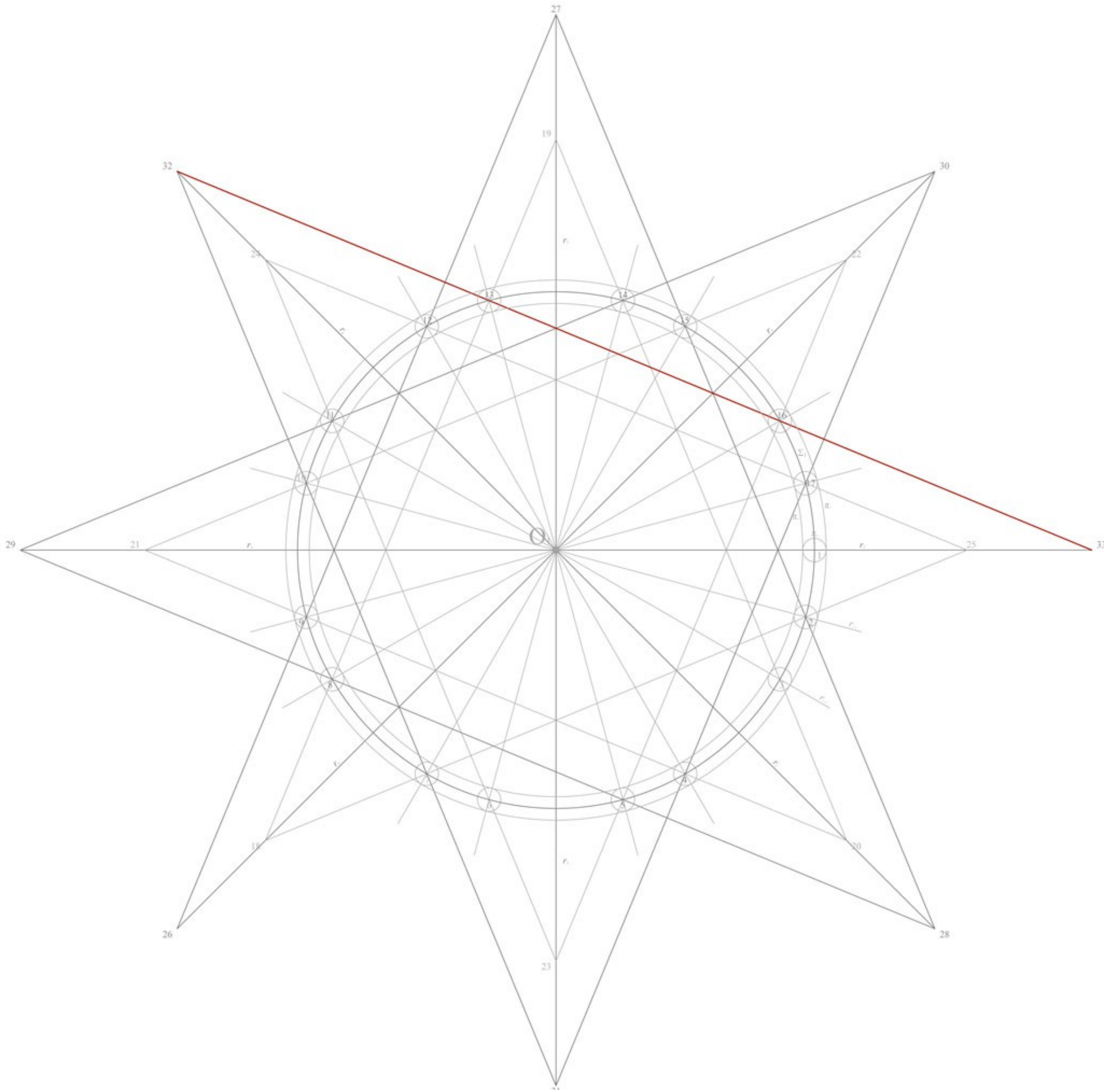

Figure 84. Step 45g.
Drawing by the author.

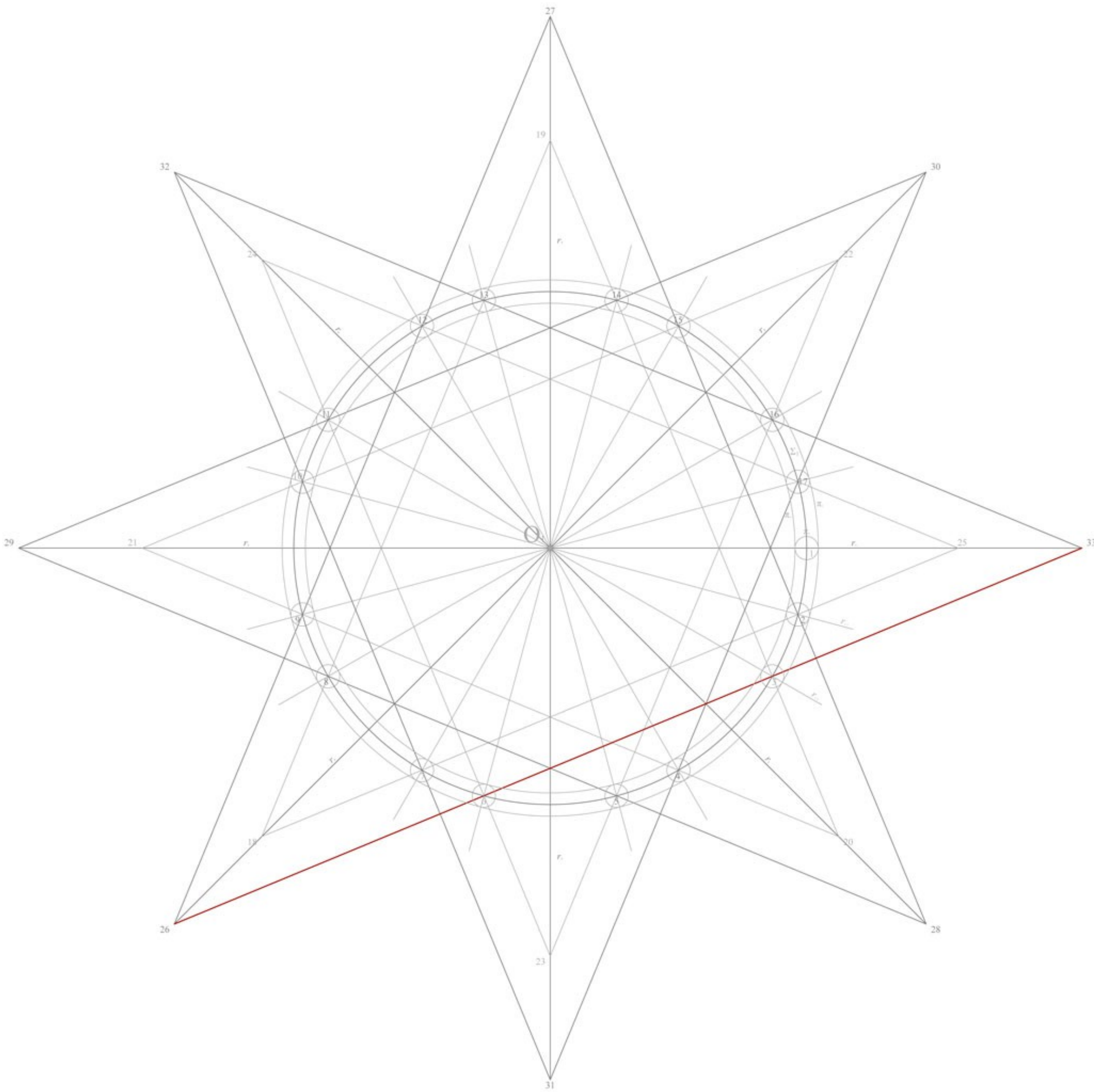

Figure 85. Step 45h.
Drawing by the author.

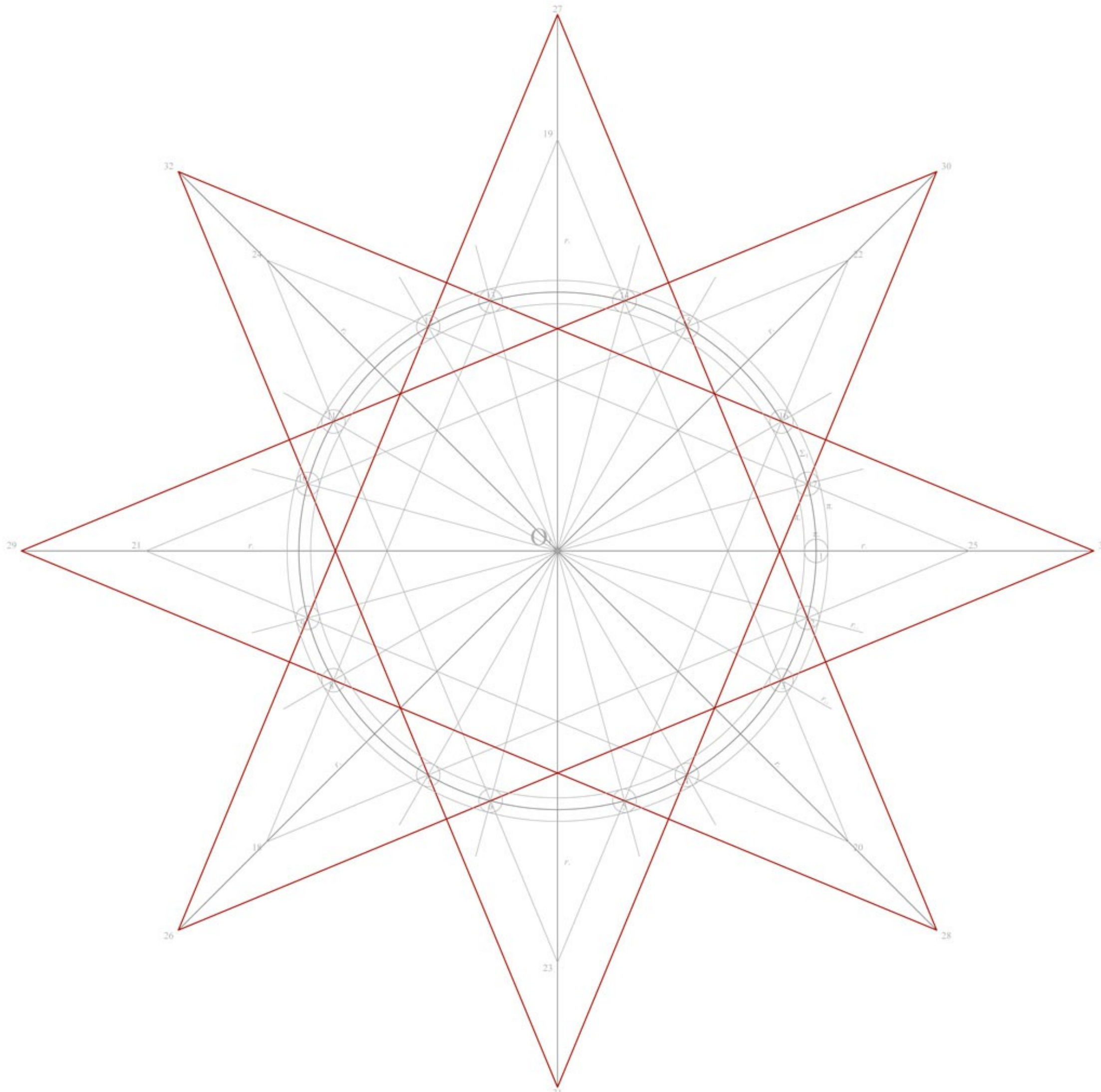

Figure 86. Step 45 - Completed construction.
Drawing by the author.

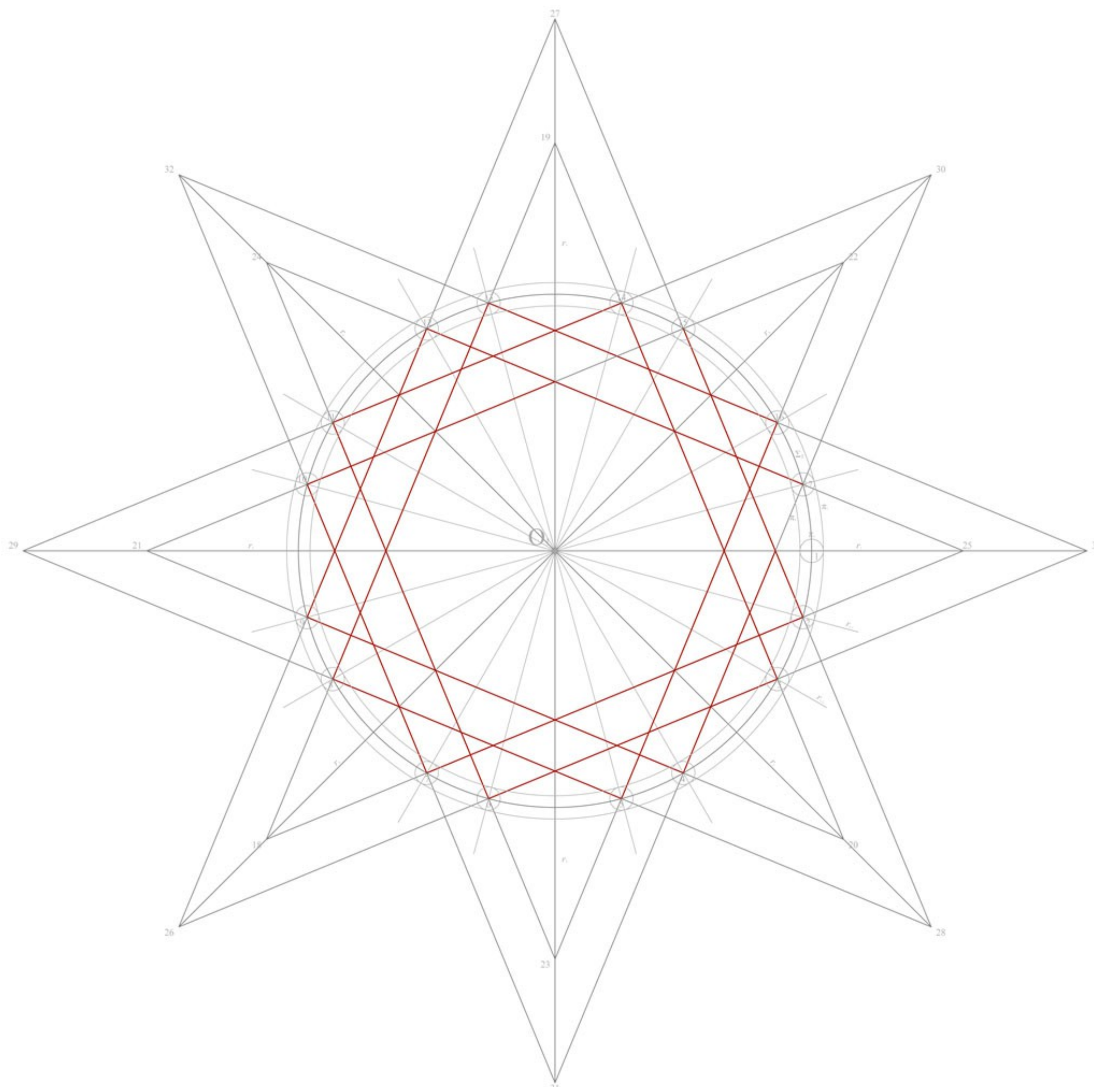

Figure 87. Step 45 - Ribs inside the gallery walls.
Drawing by the author.

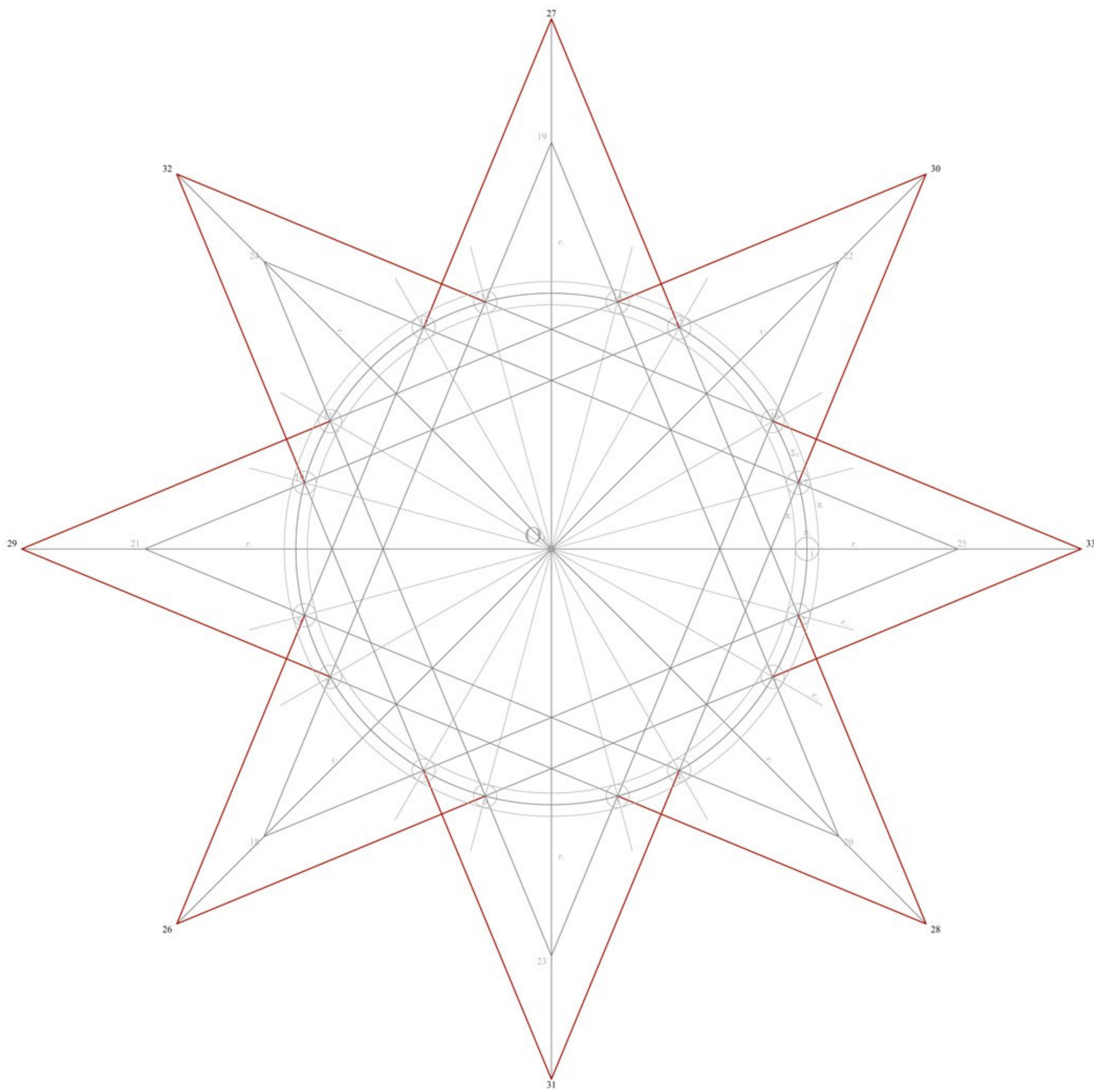

Figure 88. Step 45 – Centers for the outdoor gallery walls.
Drawing by the author.

STEP 46 [figure 89]:

To find the thickness of the gallery and the location of the walls of its perimeter, it is required to take in consideration the traces of the pillars in the lower level of the church. The projection of the Easternmost pilaster strip in the right side bay (on the transversal axis) individuates on r_1 the points *34* and *36*. Their distance corresponds to the diameter of π_3, centered on *36*.

STEP 47 [figure 90]:

Centered on O_1, draw the circles passing through *34* (Σ_2), *35* (Σ_3), and *36* (Σ_4). Among these, Σ_2 and Σ_3 individuate the thickness of the outer wall in the gallery (even if its final profile will be more complex than the present one). In between Σ_2 and Σ_3 the circle Σ_4 passes through the center of π_3. This third circle will be used to locate the pilaster strips in the wall at the perimeter of the gallery.

STEP 48 [figure 91]:

To find the locations of the pilaster strips on the wall at the perimeter of the gallery, extend $r_{1\text{-}1}$ until intersecting Σ_4 thus individuating point *37*. Likewise, extend $r_{1\text{-}2}$ until Σ_4, gaining point *38*.

Repeat the same process for all the other lines radiating from O_1 individuating the points from *39* to *59*. All of them will mark the location for a pilaster strip.

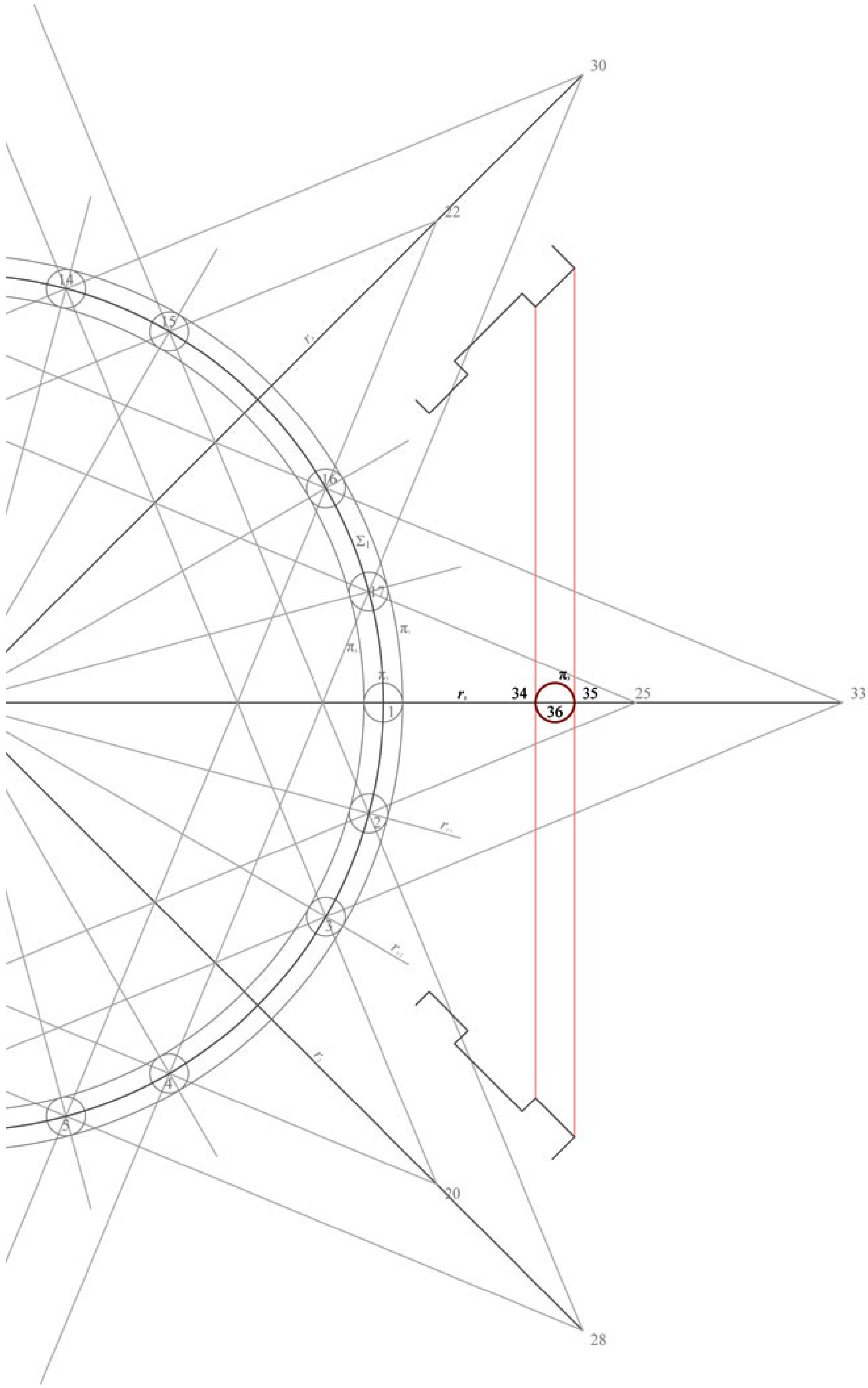

Figure 89. Step 46.
Drawing by the author.

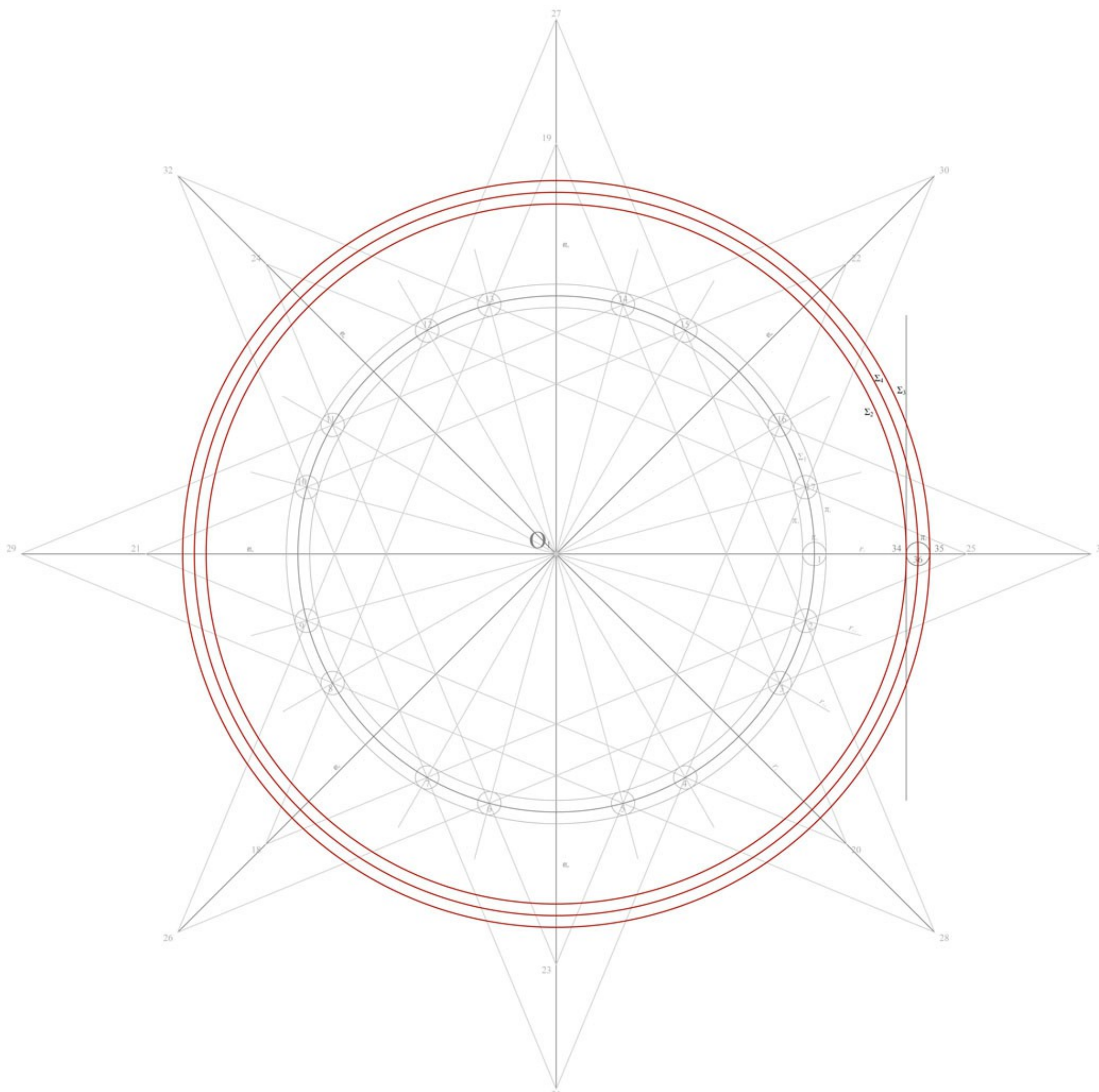

Figure 90. Step 47.
Drawing by the author.

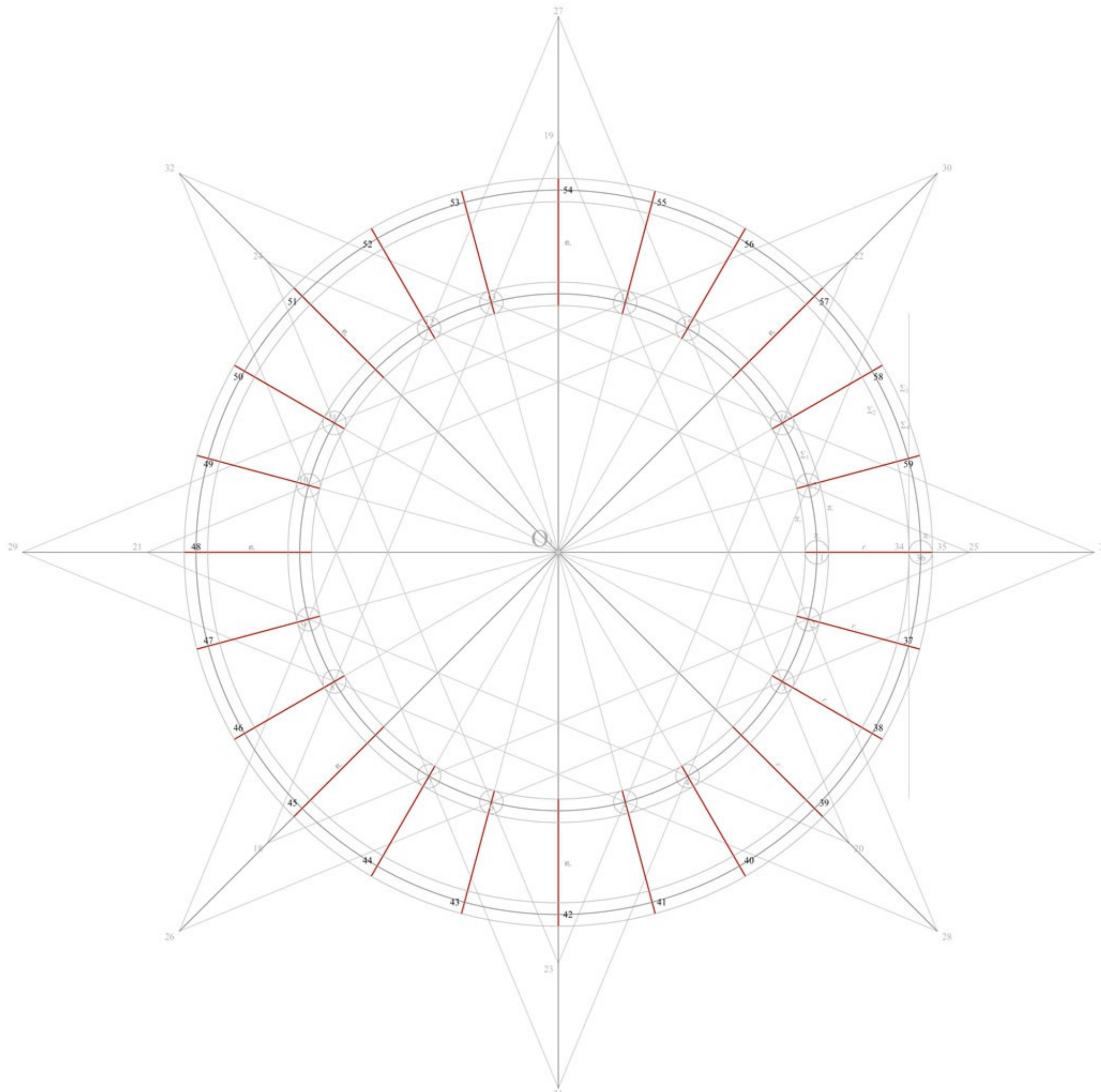

Figure 91. Step 48.
Drawing by the author.

STEP 49 [figure 92]:

Using as centers the points *37, 38, 40, 41, 43, 44, 46, 47, 49, 50, 52, 53, 55, 56, 58,* and *59* draw the circle π_3 repeatedly.

STEP 50 [figures 93, 94]:

To find the profile of the pilaster strips in the outer wall of the gallery, draw from *2* a line perpendicular to r_{1-1} intersecting the circle π_3 centered on *2* at the points *60* and *61*. From each of these points draw a line parallel to r_{1-1} towards the outer wall of the gallery. The line from *60* will intersect Σ_2 at *62* and Σ_3 at *63* while the line from *61* will intersect Σ_2 at *64* and Σ_3 at *65*.

The profile *63-62-64-65* individuates the layout for one of the pilaster strips in the outer gallery wall.

Proceed in the same way for the other points, marking on Σ_1 the columns in the gallery (from *3* to *17*) which defines the indoor layout of the gallery's outer wall.

STEP 51 [figure 95]:

Centered on O_1, draw the circle passing through *26, 27, 28, 29, 30, 31, 32,* and *33*, this is to say the points of the outer eight-point star individuating the circle Σ_5.

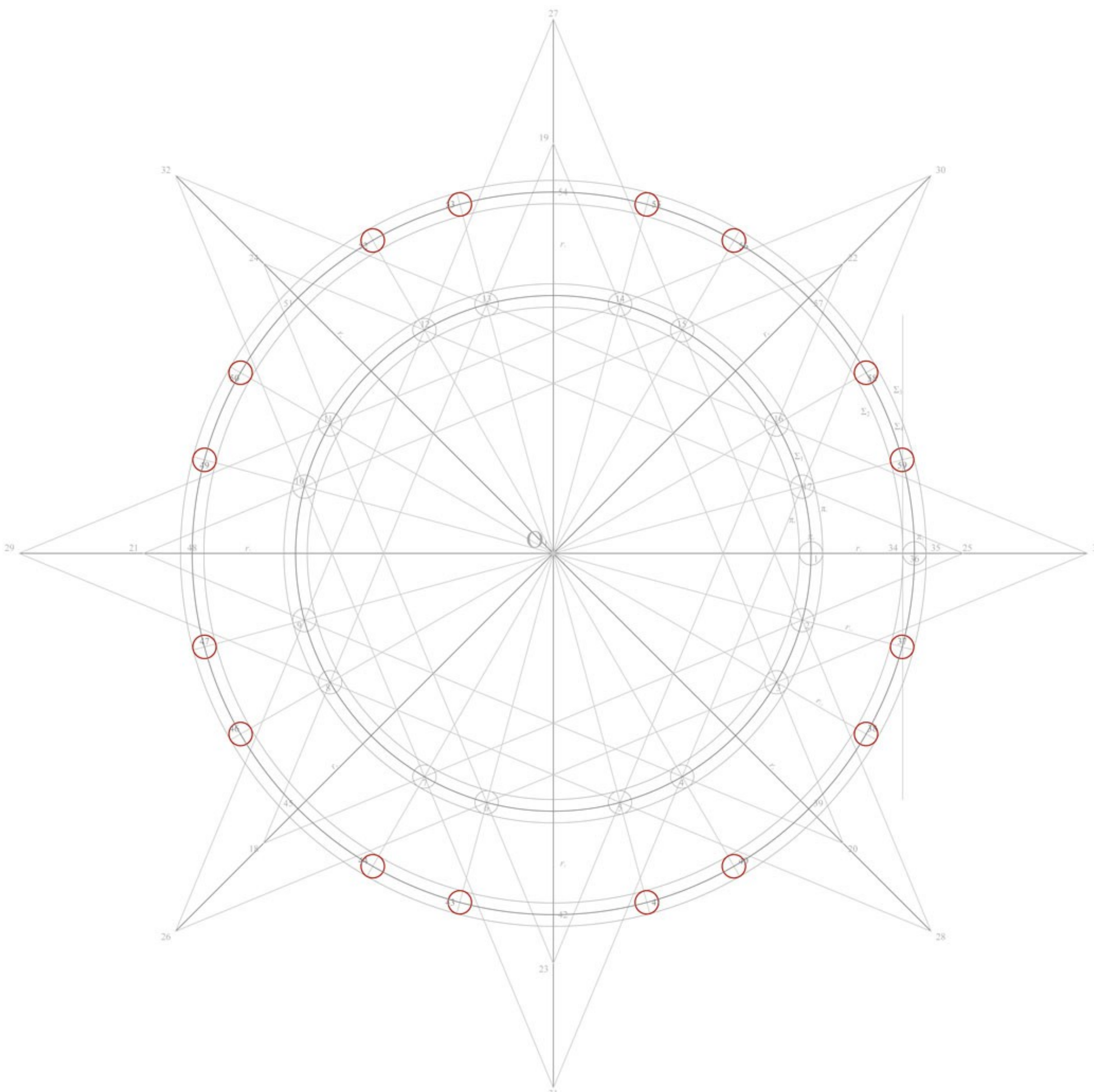

Figure 92. Step 49.
Drawing by the author.

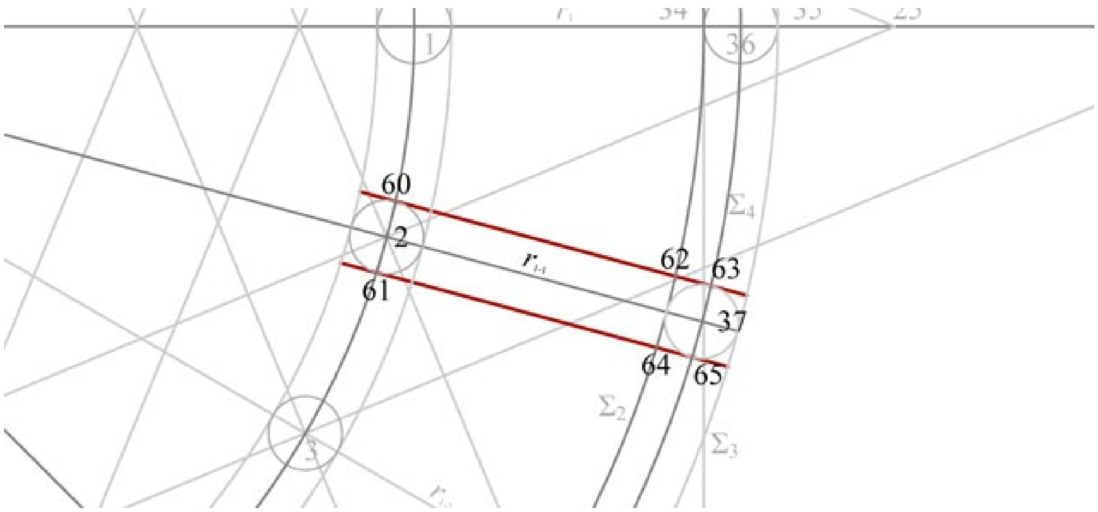

Figure 93. Step 50.
Drawing by the author.

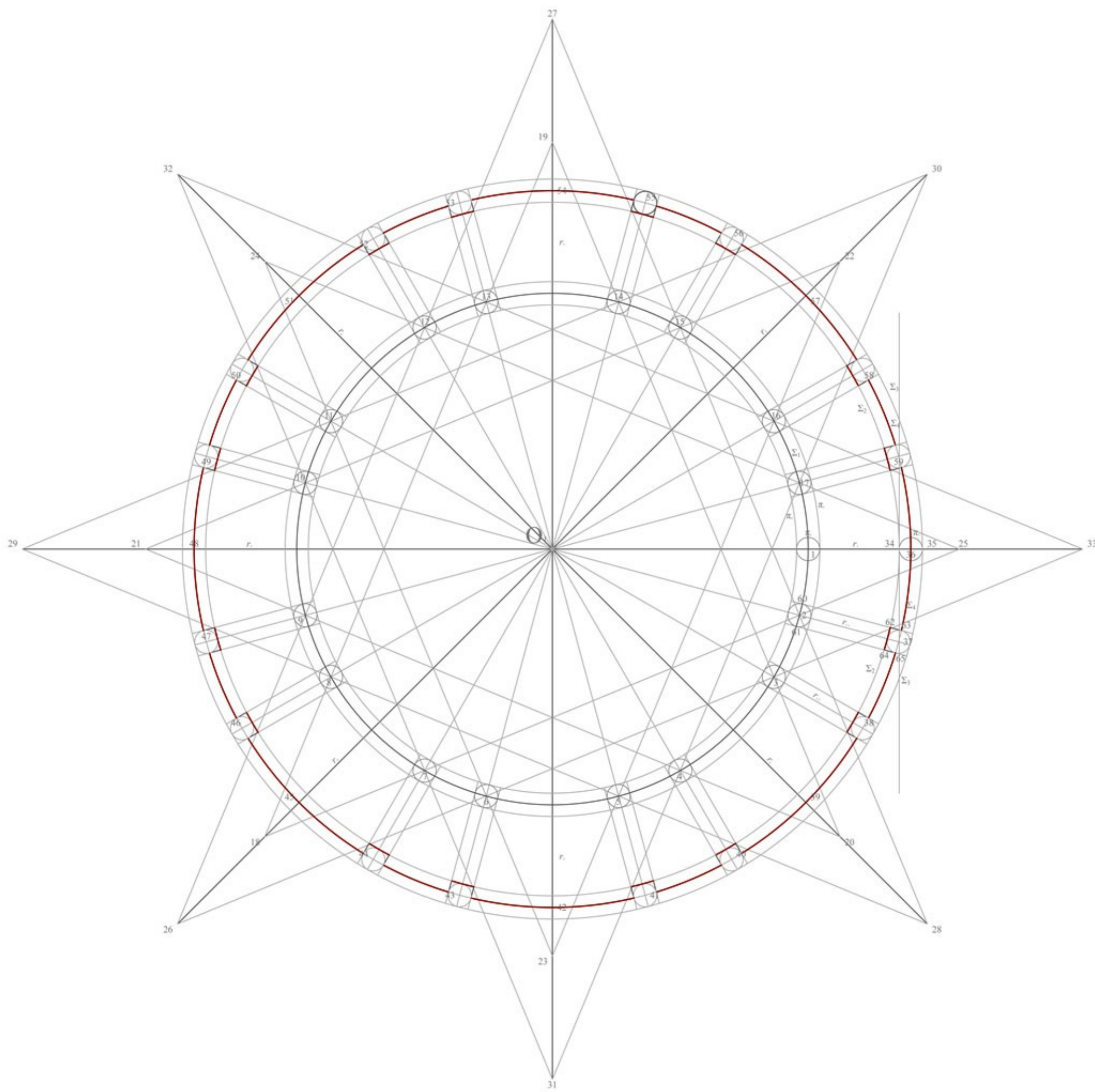

Figure 94. Step 50 – Completed construction.
Drawing by the author.

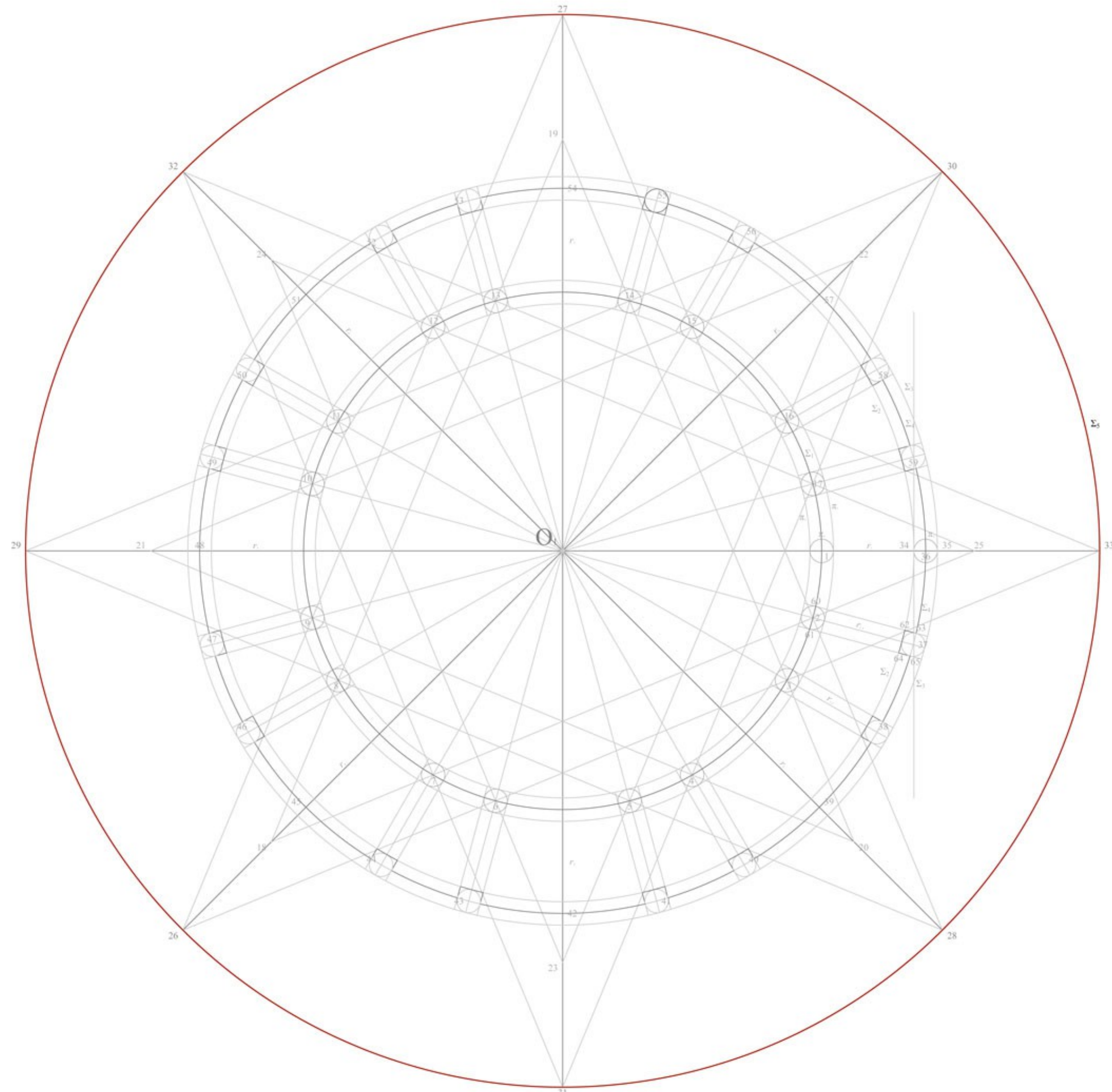

Figure 95. Step 51.
Drawing by the author.

STEP 52 [figure 96]:

From *30* and *33* draw the tangent lines to Σ_5 which intersect at *66*. Connect *66* to O_1 individuating a line intersecting Σ_3 at *67*.

STEP 53 [figure 97]:

Centered on O_1 draw the circle passing through *66* (Σ_6).

STEP 54 [figures 98, 99]:

Center on *68* and draw the circle passing through *35* (Σ_6). This last circle will intersect the line $r_{8\text{-}2}$ at *69*. Connect *69* to *67*. The profile *35-69* (curve), and *69-67* individuates the outdoor profile of the gallery wall.

Repeat the same construction all around Σ_5 to find the complete layout of the gallery.

STEP 55 [figure 100]:

Let *70* be the intersection point between $r_{8\text{-}2}$ and Σ_3. On the segment *69-70* find the middle point *71*. From this point, draw the line perpendicular to *69-67* individuating point *72*. Centering on *71* with span *71-72* create the circle Σ_7 which represents the base diameter of the columns adorning the outside of the gallery.

Connect *71* with *68* and extend this line until intersecting Σ_7 at *73*.

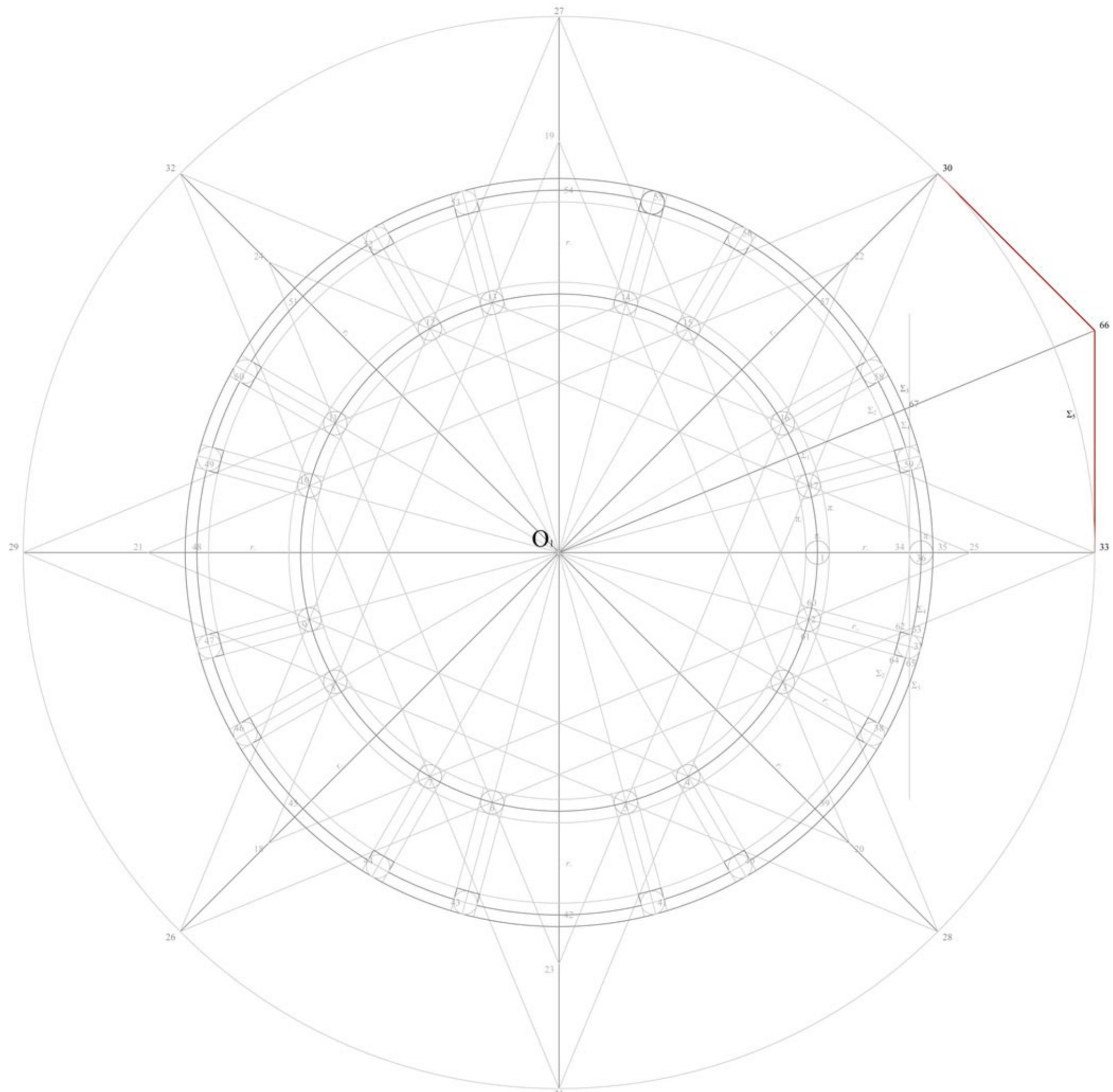

Figure 96. Step 52.
Drawing by the author.

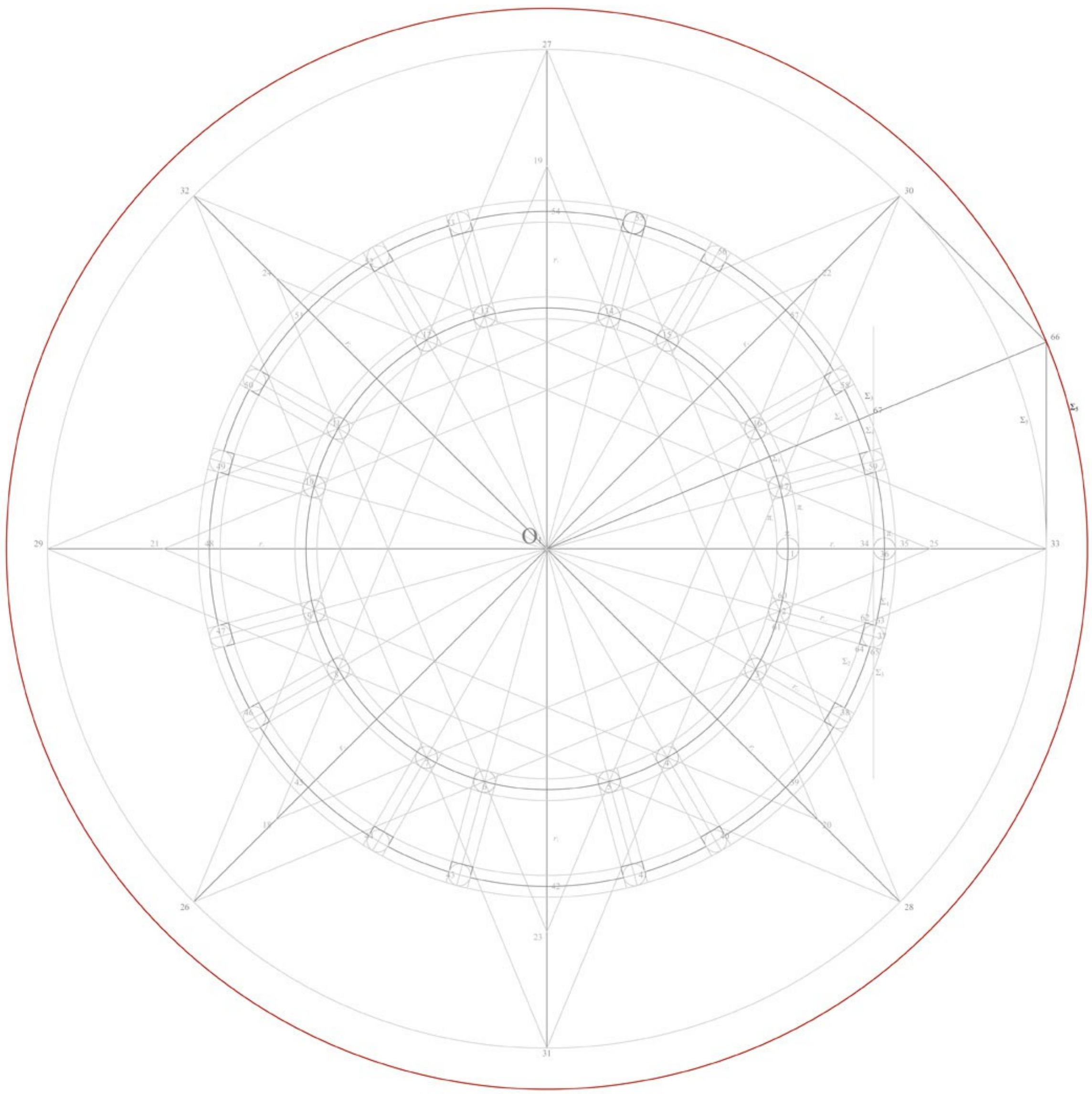

Figure 97. Step 53.
Drawing by the author.

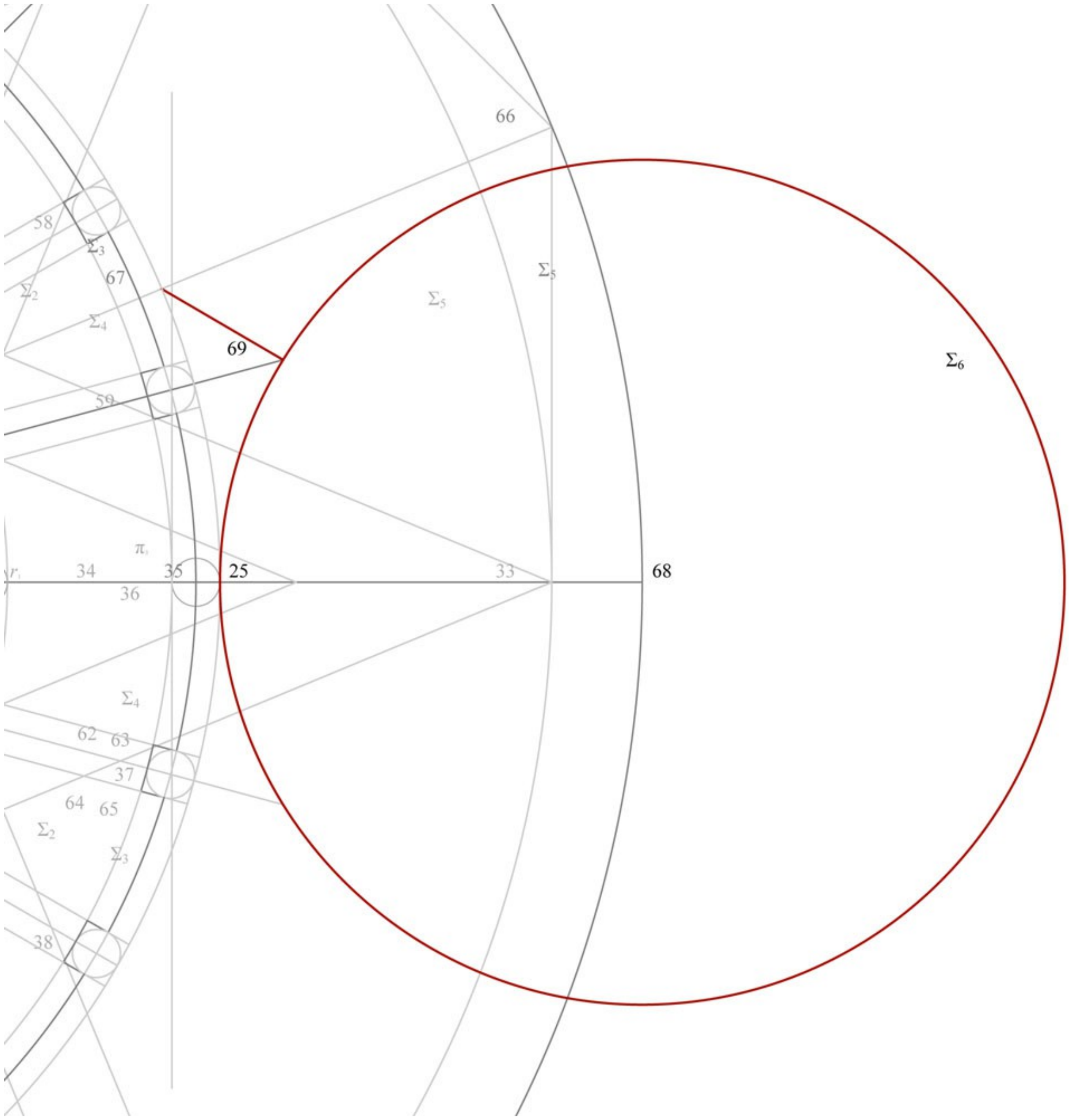

Figure 98. Step 54.
Drawing by the author.

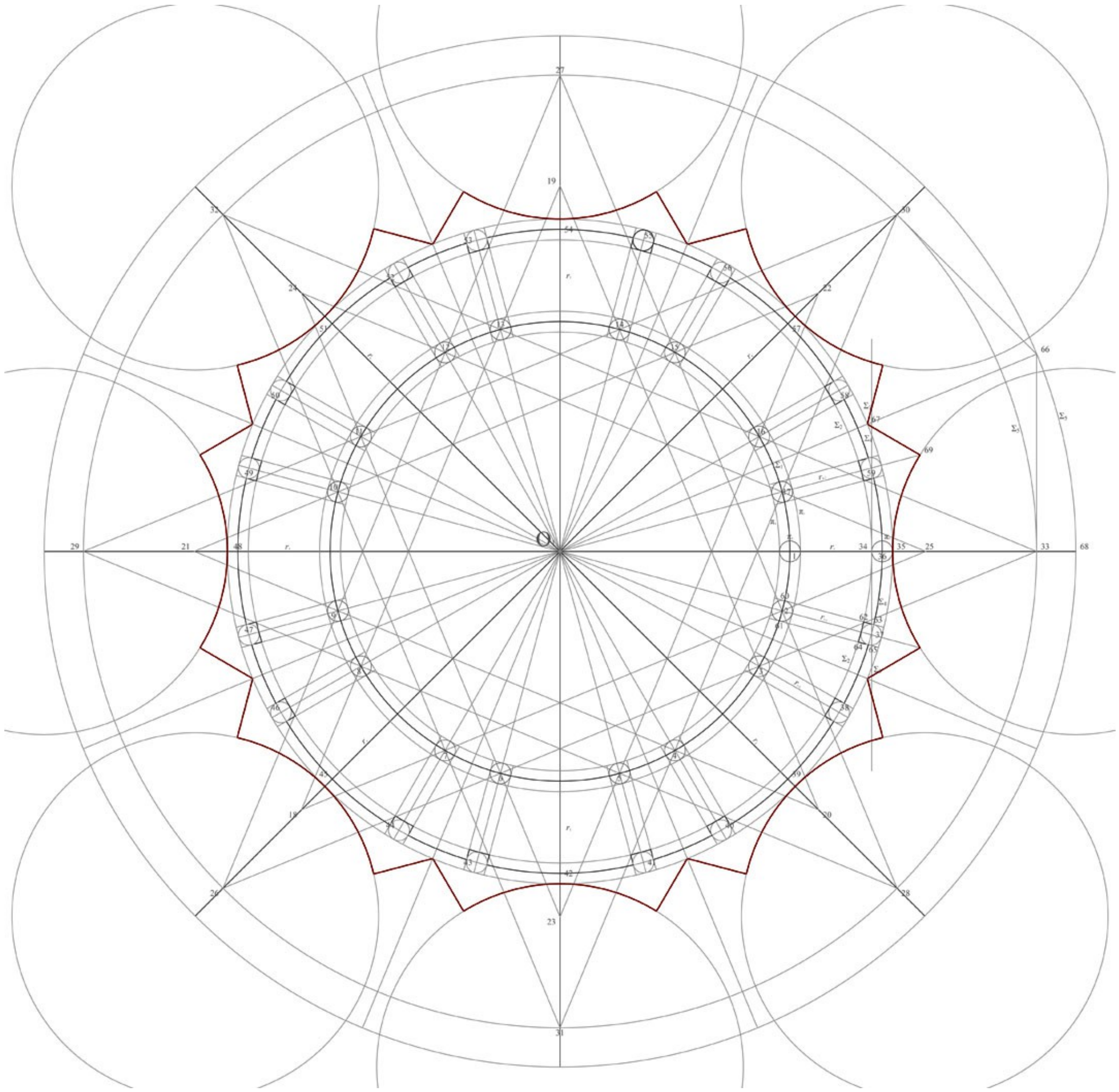

Figure 99. Step 54 – Completed construction.
Drawing by the author.

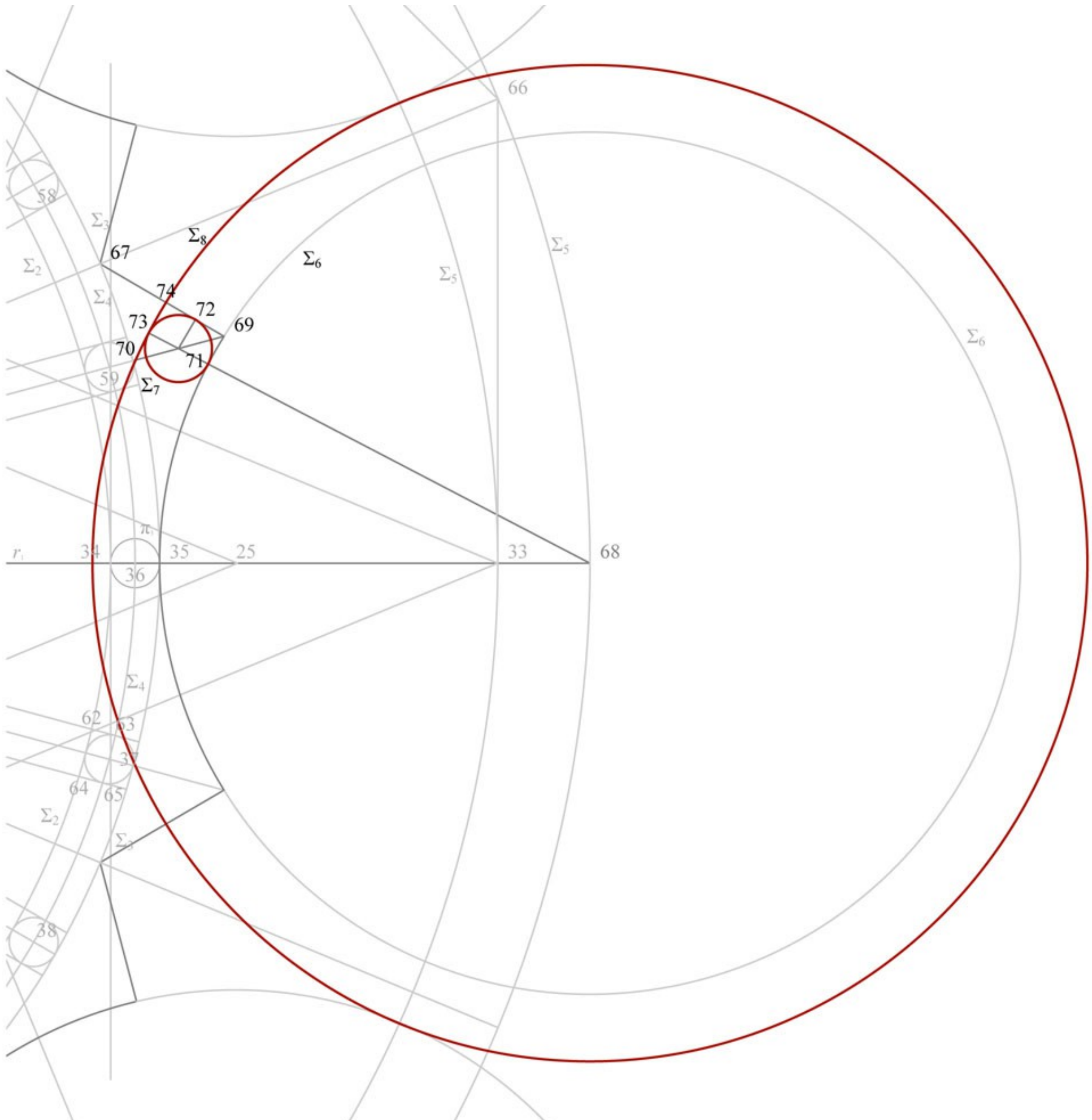

Figure 100. Step 55.
Drawing by the author.

Centered on *68*, draw the circle passing through *73* (Σ_8). The intersection between Σ_8 and *61-69* defines the point *74*. The space between the two circles Σ_6 and Σ_8 will contain the columns adorning the facade of the gallery. These columns are very close to Σ_8 but not exactly tangent to it. Their setting, however, has not been modified since the diversion of the columns from Σ_6 is minimal while keeping clear the relationship between each element in the composition.

STEP 56 [figure 101]:

To complete the trapezoidal plinth circumscribed to the circle Σ_7, extend the lines *61-69* and *73-71-68* which will intersect at *75*. From *75* draw the line tangent to Σ_7 (this is to say the line mirroring *61-69* along *73-71-68*) which will intersect Σ_6 at *76*, Σ_7 at *77*, and Σ_8 at *78*.

The outline *69-74-78-76* individuates the profile of the plinth at the base of the column Σ_7.

STEP 57 [figure 102]:

Center on *68* and draw the circle passing through *71* (Σ_9) and intersecting r_1 at *79*. From here, draw a vertical line until Σ_8 (point *80*). Connect *80* to *78* and connect its middle point (*81*) to *68*. The line *81-68* intersects *78-68* at *82*.

Connect *82* to *80* intersecting Σ_6 at *83*. The segment *80-83* shares the same dimensions of *76-78* and *69-74*; like these last two segments, *80-83*

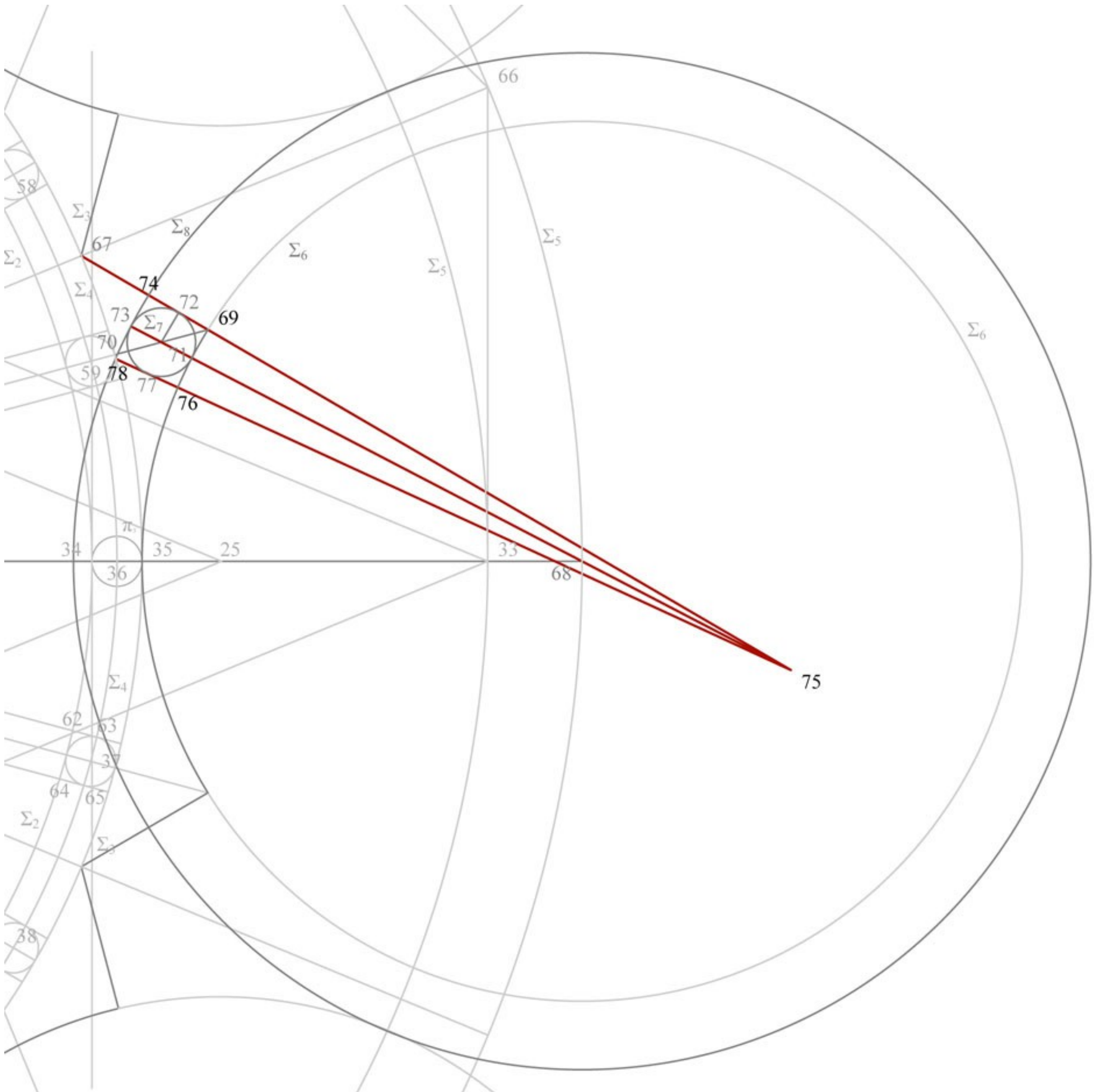

Figure 101. Step 56.
Drawing by the author.

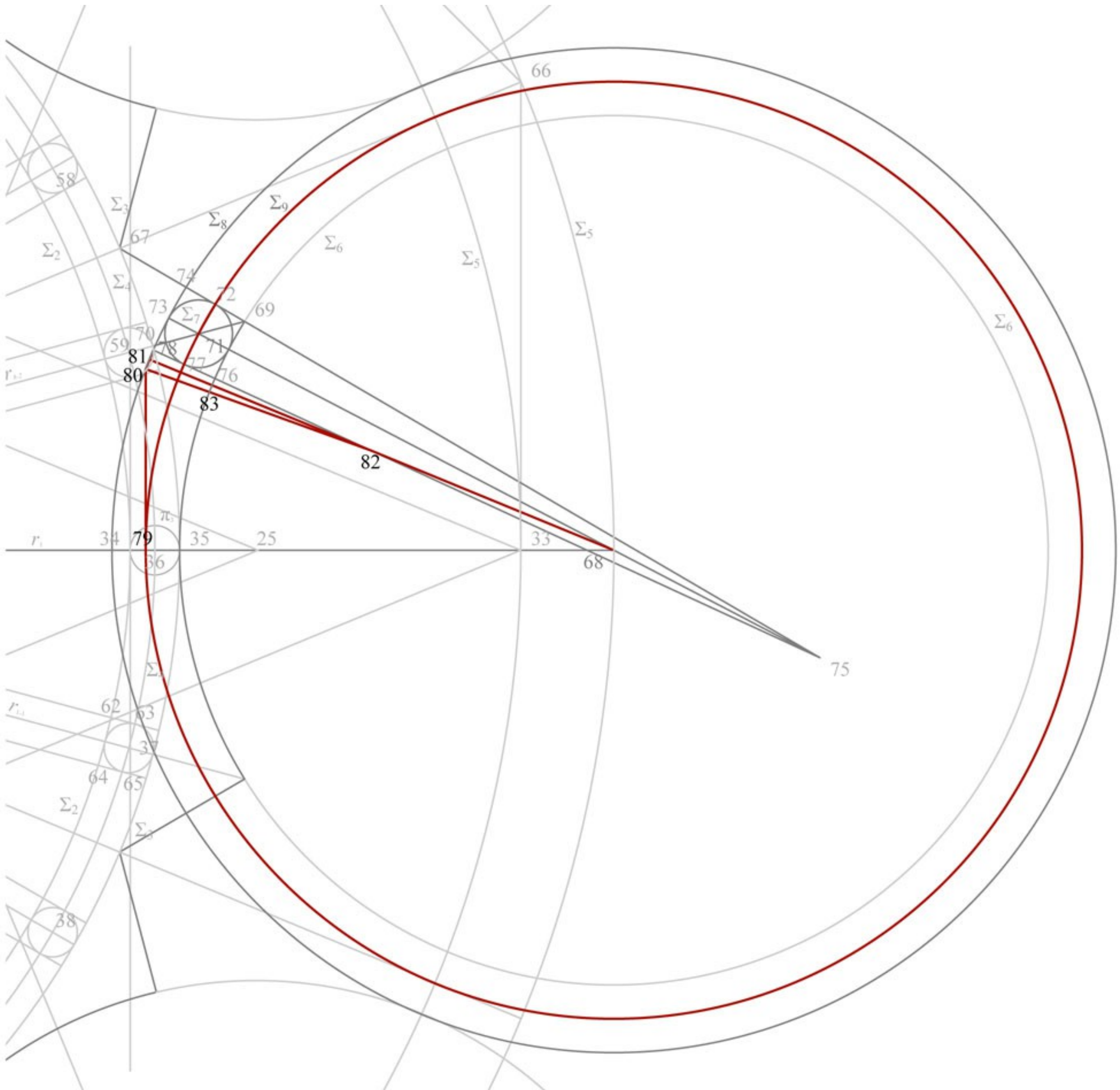

Figure 102. Step 57.
Drawing by the author.

defines the first portion of the plinth belonging to the column adjacent to the one centered on *71*.

Formally the segments *76-78* and *69-74* should have been parallel to the line *71-73* (the axis of the column). However, in order to absorb the irregular inclination of *69-74*, it is here decided to maintain its inclination (also for *71-73*) instead of regularizing along the column axis.

STEP 58 [figures 103, 104, 105]:

Let *84* be the intersection between *81-82* and Σ_9. Centering on *84* draw the circle passing through *71* intersecting Σ_9 at *85*, the center of a second column with diameter Σ_7. From *85* draw Σ_7. Connect *85* with *68* (the axis of the column).

In order to get the side of the plinth opposite to *80-83*, extend both this line and *85-68*. From their intersection point (*86*) draw the the tangent to Σ_7 centered on *85* individuating the points *87* (on Σ_6), *88* (tangent point on Σ_9), and *89* (on Σ_8).

The profile connecting *80-83-87-89* individuates the plinth for the column centered on *85* **[figure 104]**.

The profile of these two columns may be mirrored along r_1 defining the setting for the gallery bay. However, the profile of these columns needs to

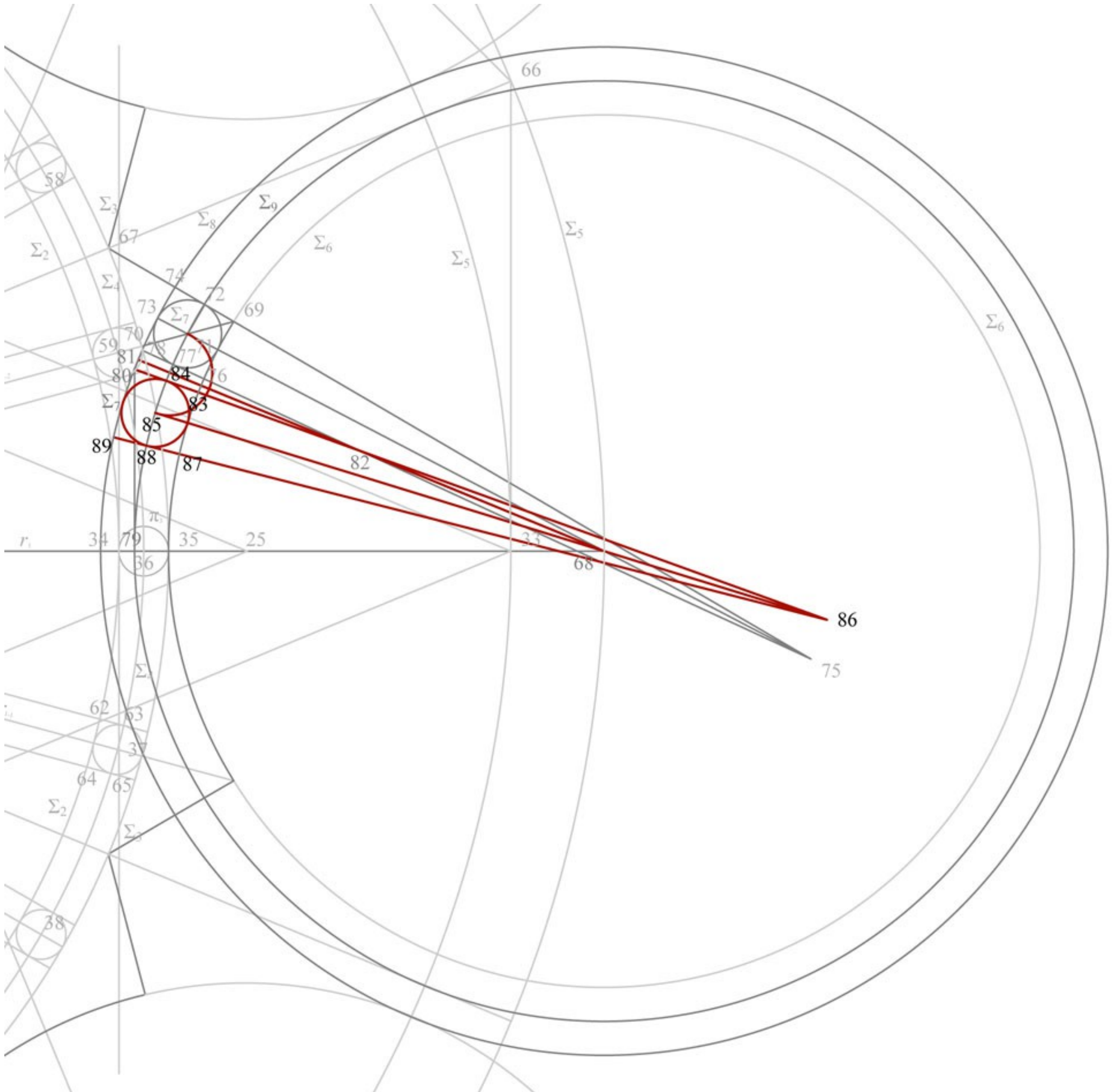

Figure 103. Step 58 .
Drawing by the author.

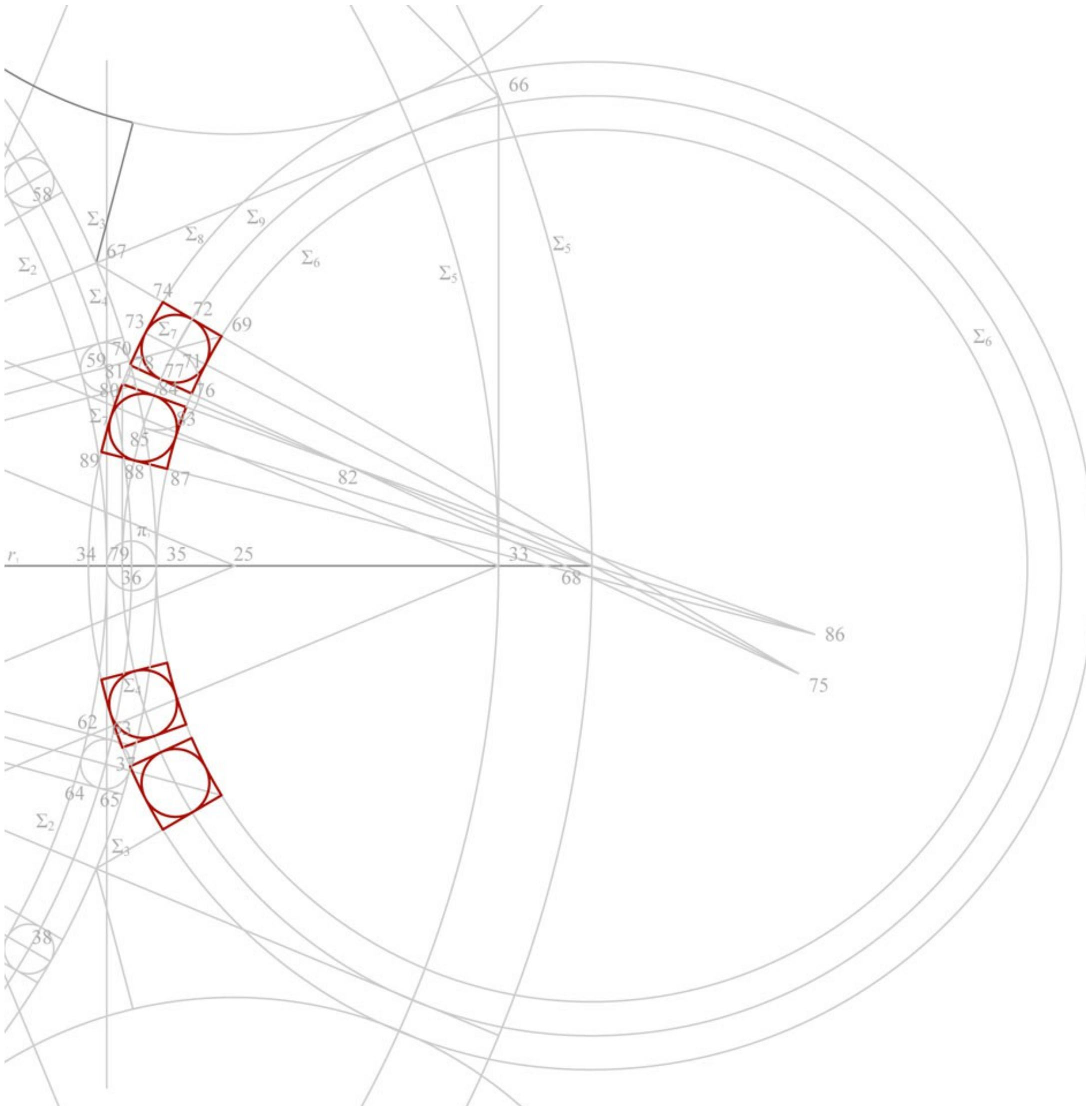

Figure 104. Step 58 – Completed plinths .
Drawing by the author.

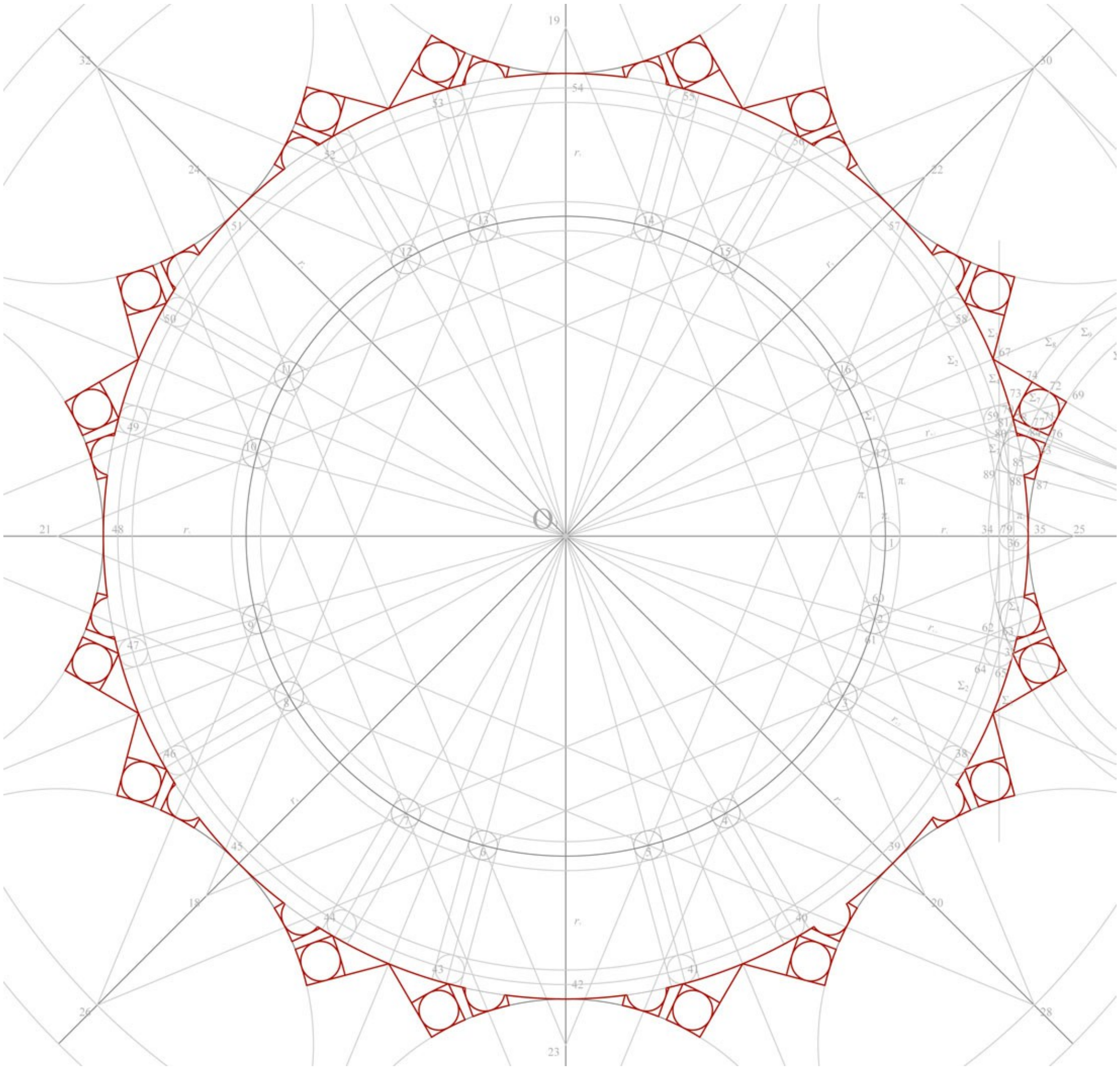

Figure 105. Step 58 – Completed construction.
Drawing by the author.

be cut along the circle Σ_3, the outside perimeter of the gallery **[figure 105]**.

STEP 59 [figures 106, 107]:

In order to draw the layout of the ribs in the first dome, the profile of the ribs at the top of the columns in the gallery must be found.

Starting from the circle π_3 with center *17*, there are already drawn two lines tangent to π_3 and parallel to $r_{8\text{-}2}$. Extend these two lines until intersecting Σ_1 at *90* and *93*, and π_4 at *91* and *92*.

The profile connecting *90, 91, 92,* and *93* individuates the layout of the rib at the top of the column in *17*.

Repeat the same construction for all the other columns in the gallery.

STEP 60 [figure 108]:

The setting of the ribs is defined by the eight-point stars in the construction. Start drawing them from the ribs connecting the points *5, 8, 13,* and *16*. To determine the profile of the ribs, taking in consideration their thickness and orientation along the spheric surface of the dome, connect the correspondent vertexes in the rib layout found in the previous step 59.

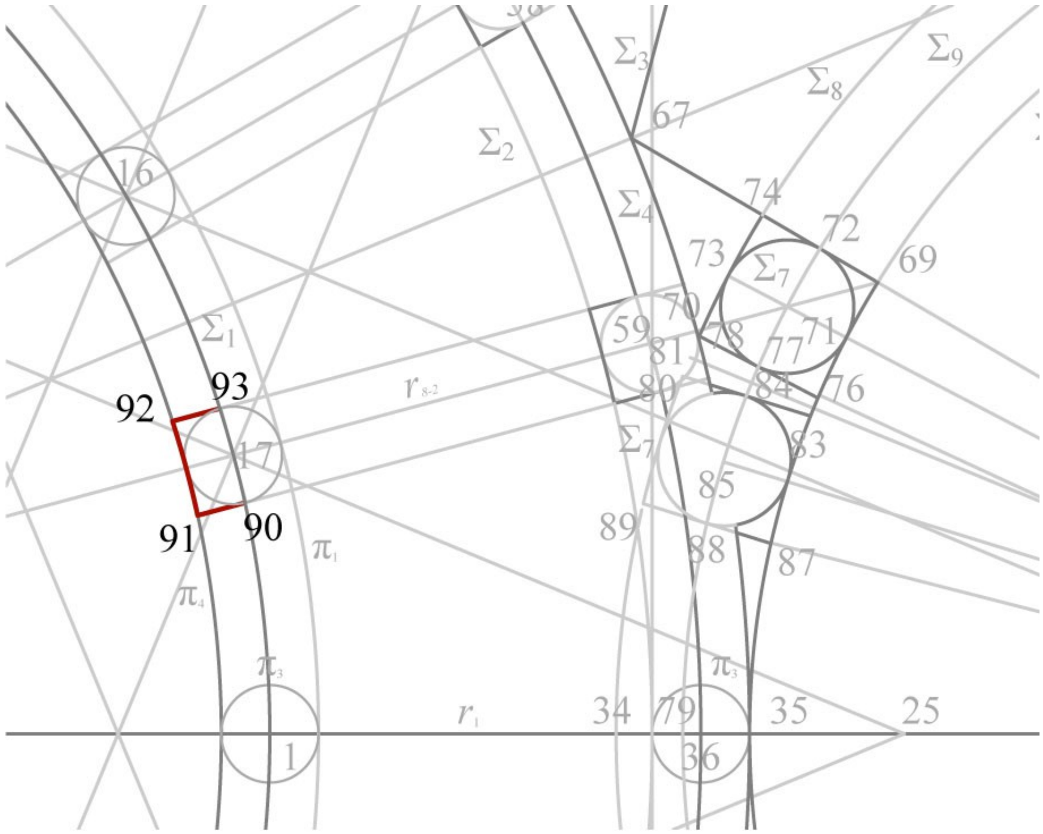

Figure 106. Step 59.
Drawing by the author.

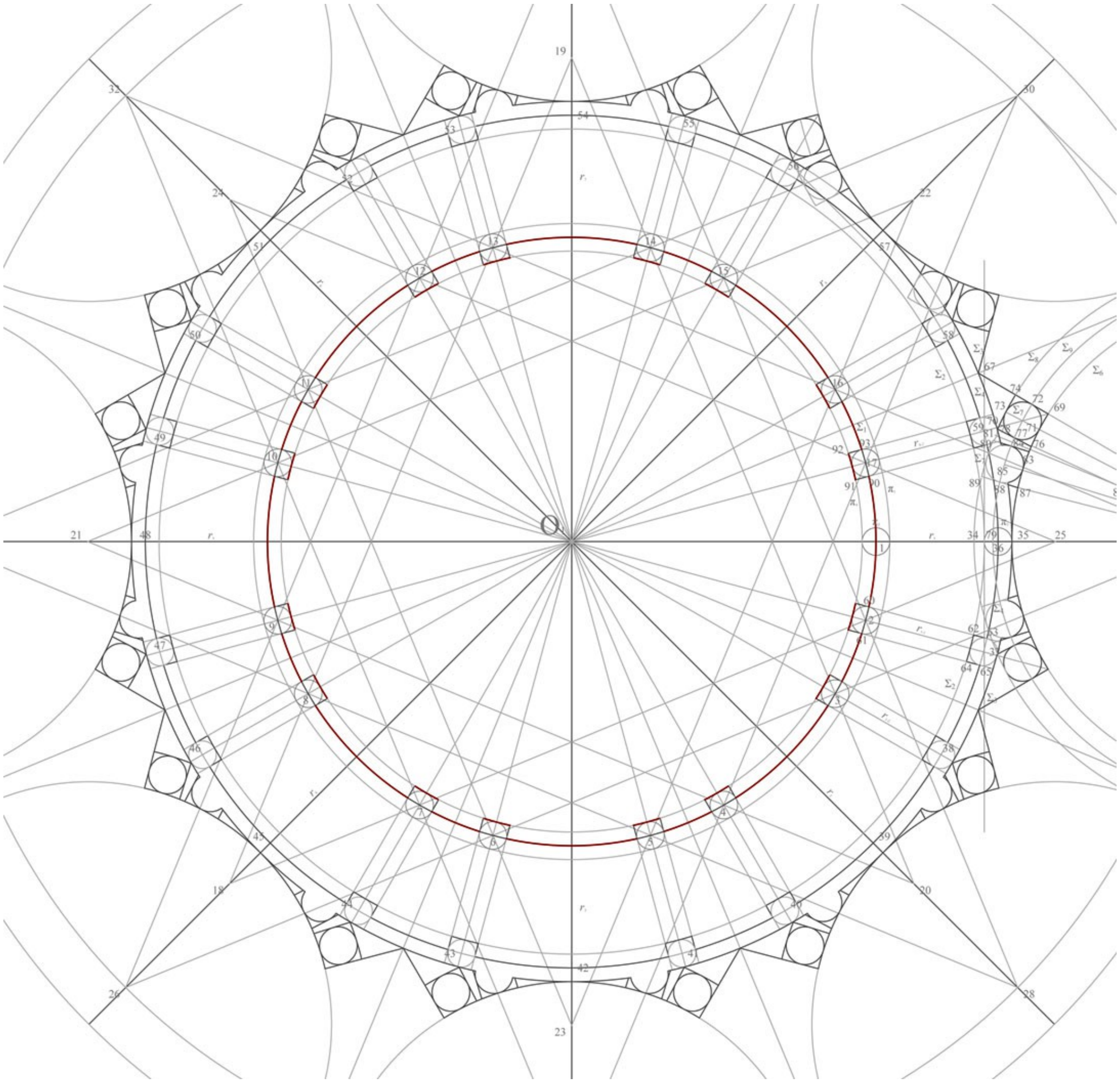

Figure 107. Step 59 – Completed construction.
Drawing by the author.

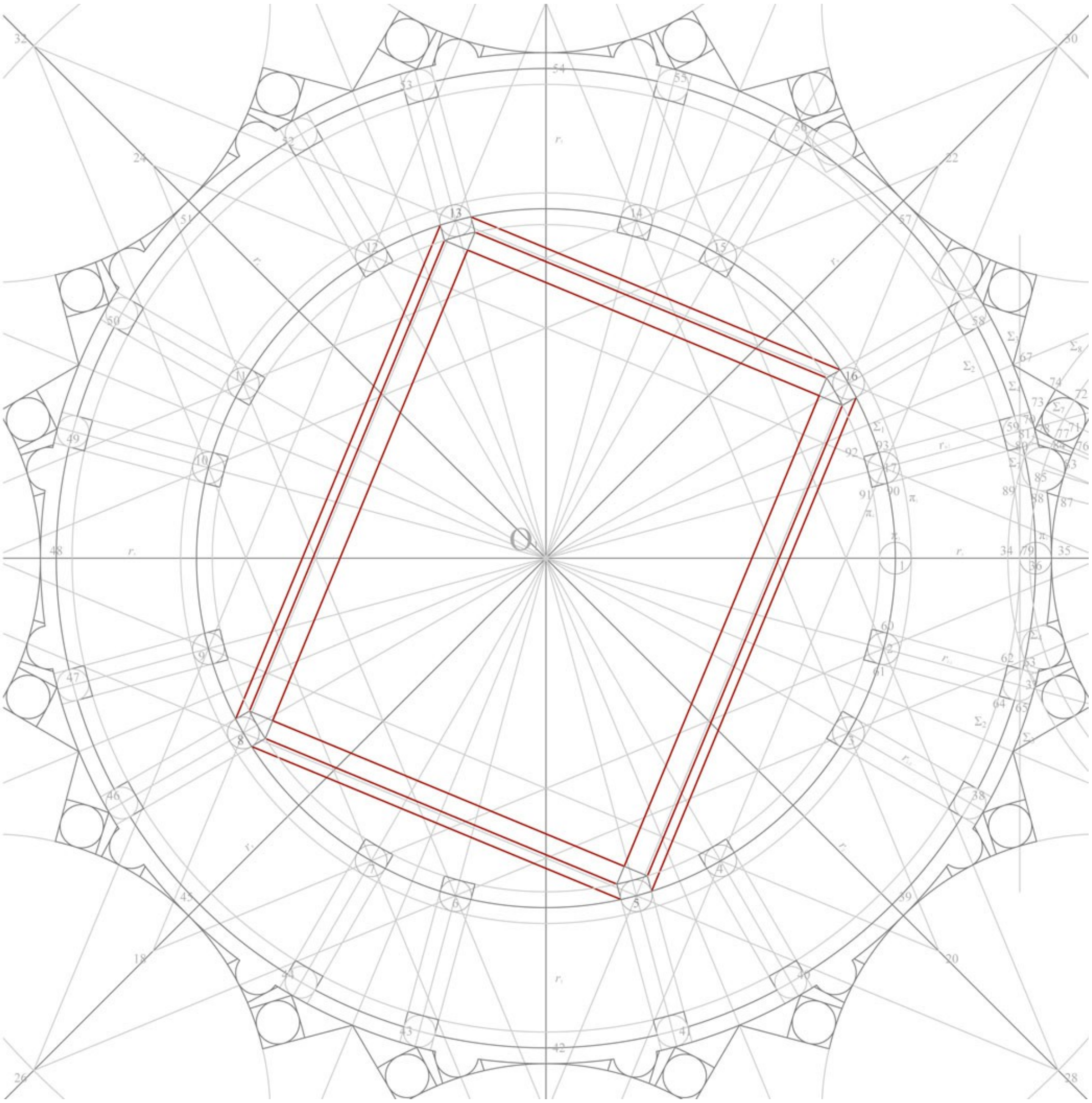

Figure 108. Step 60.
Drawing by the author.

STEP 61 [figure 109]:

Draw the ribs connecting the points *3, 6, 11,* and *14* taking in consideration their intersection with the previous ribs.

STEP 62 [figure 110]:

Continue with the ribs, connecting the points *4, 9, 12,* and *17* checking their intersections with the previous two sets of ribs.

STEP 63 [figure 111]:

At last, draw the ribs on the points *2, 7, 10,* and *15* completing the reversed projection of the first dome.

STEP 64 [figures 112, 113]:

Because of their tilted setting, the arches individuating the ribs show at the top and the bottom a sharp edge instead of a traditional flat surface. In order to find the geometry of the second dome at the top of the interlaced one, it is necessary to individuate the topmost edge of the upper tier of arches (rendered in red in the picture).

STEP 65 [figure 114]:

The geometry of the second dome is linked to the setting of the columns in the gallery.

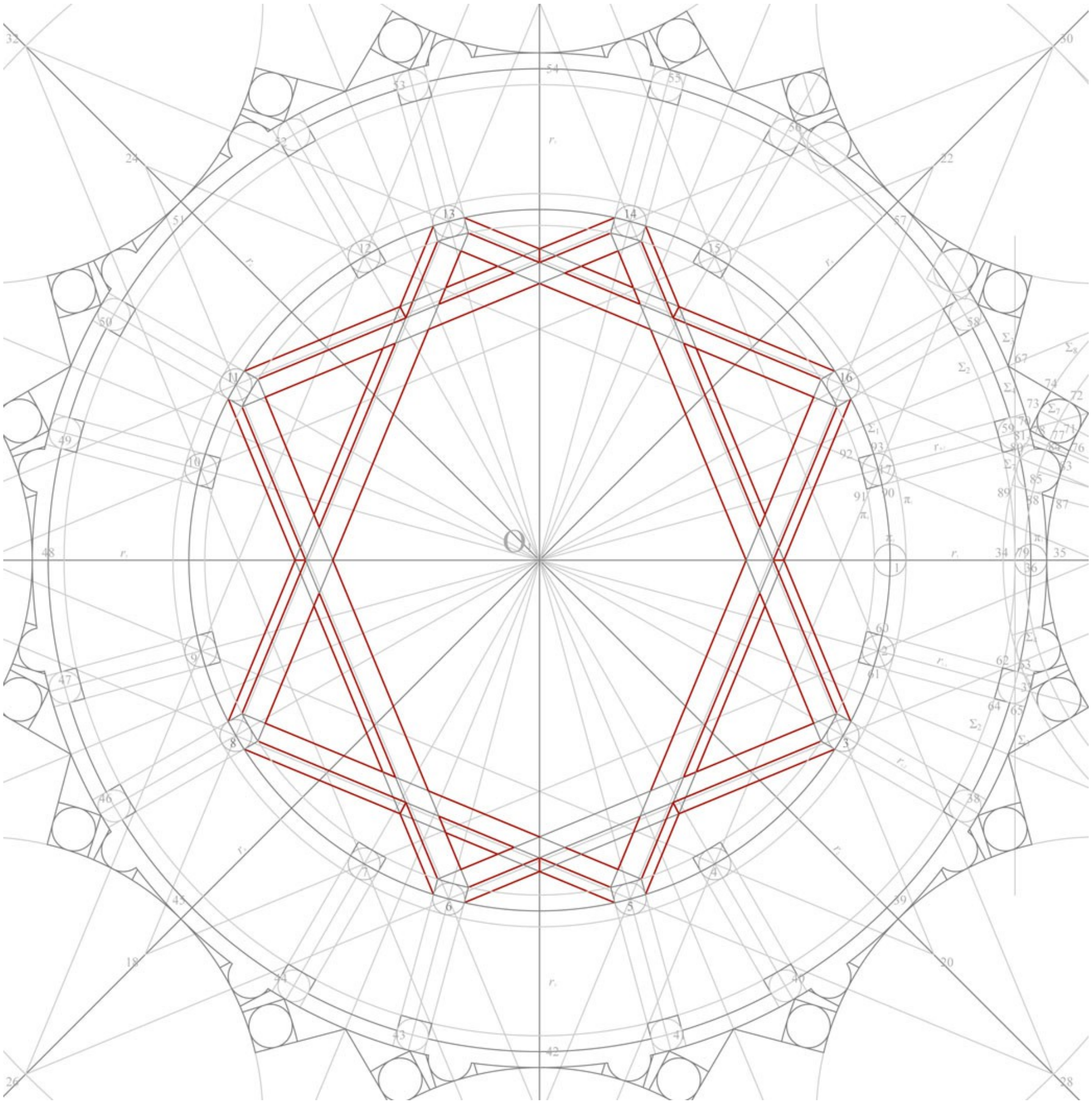

Figure 109. Step 61.
Drawing by the author.

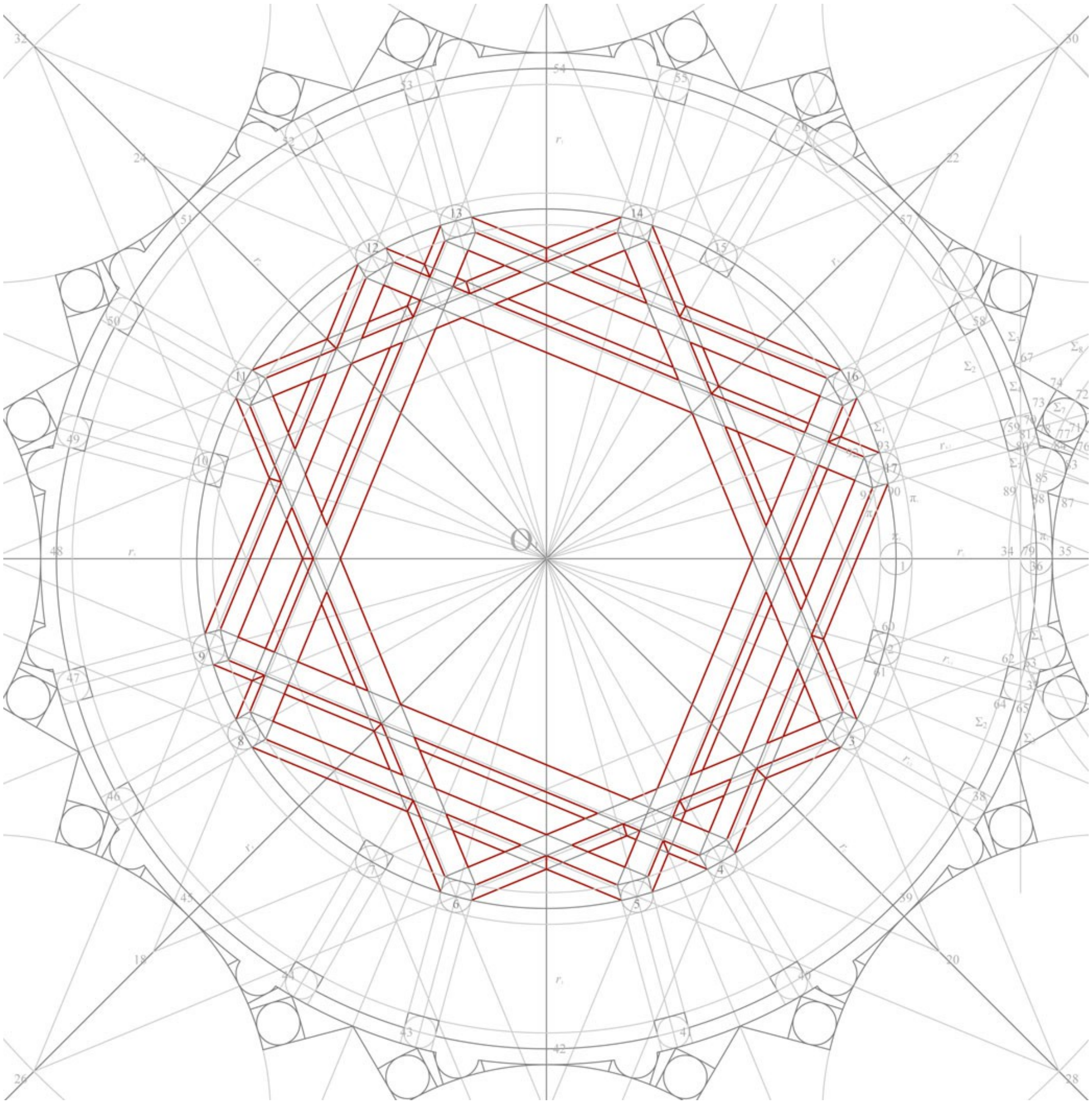

Figure 110. Step 62.
Drawing by the author.

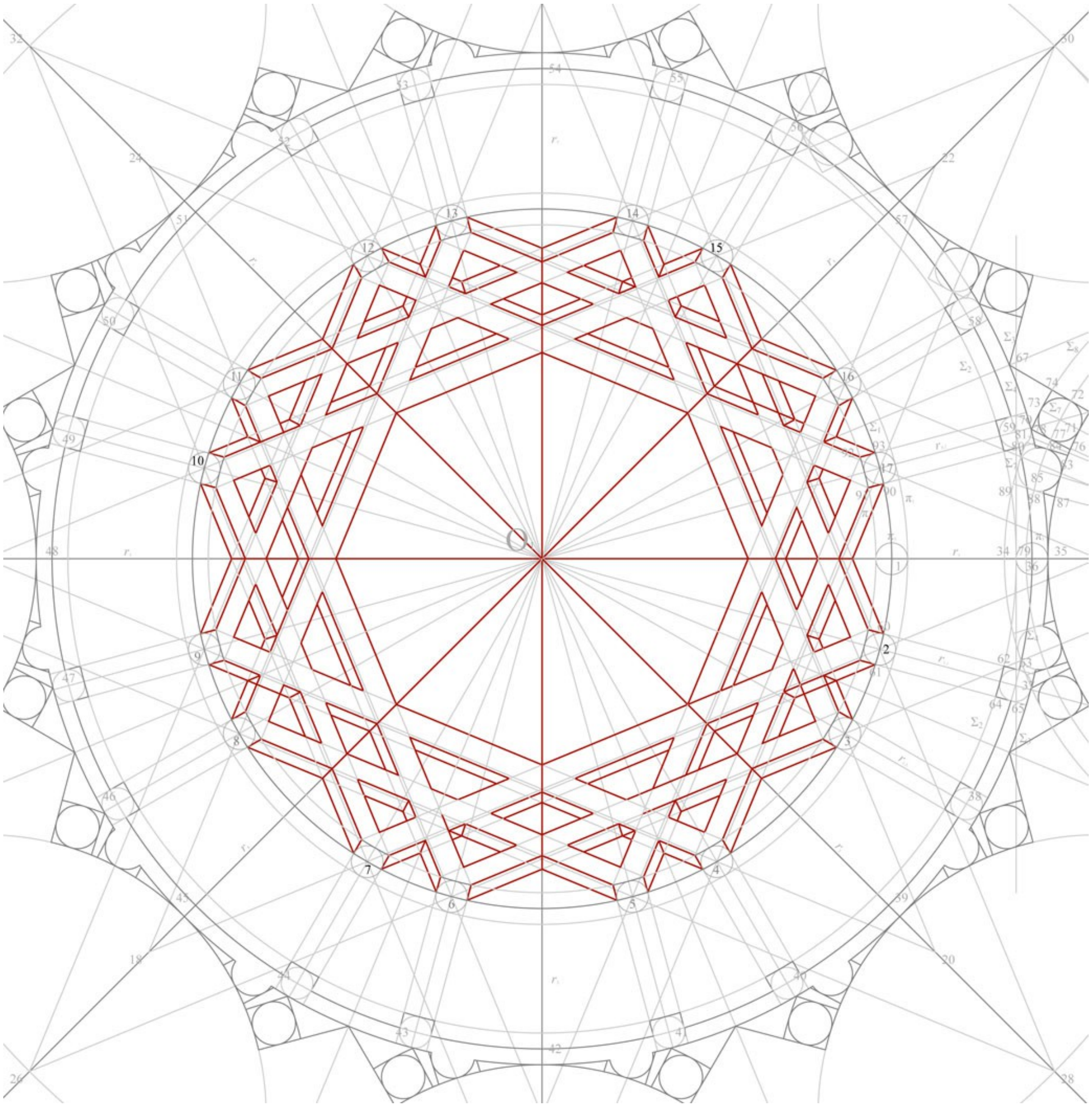

Figure 111. Step 63.
Drawing by the author.

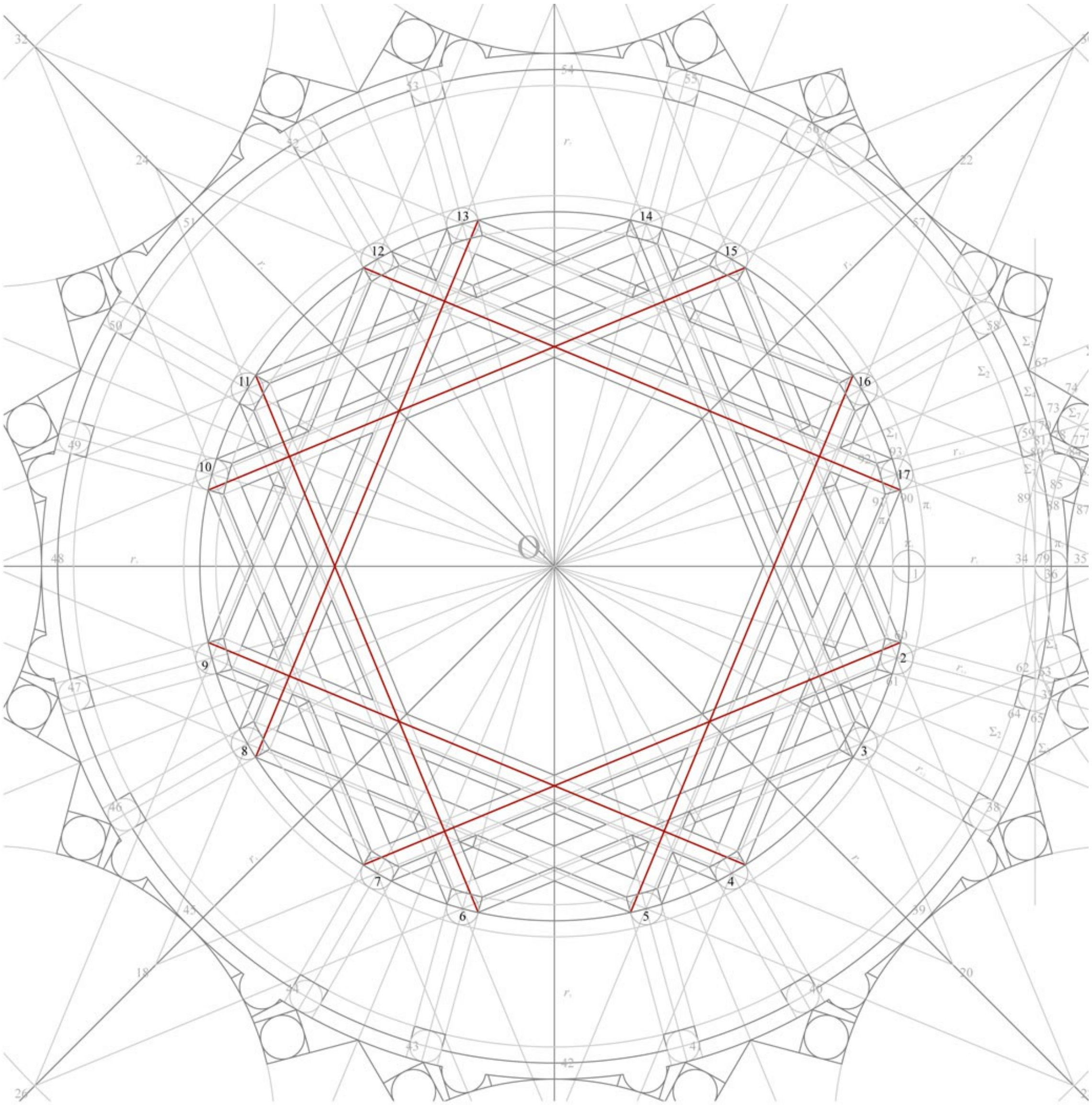

Figure 112. Step 64.
Drawing by the author.

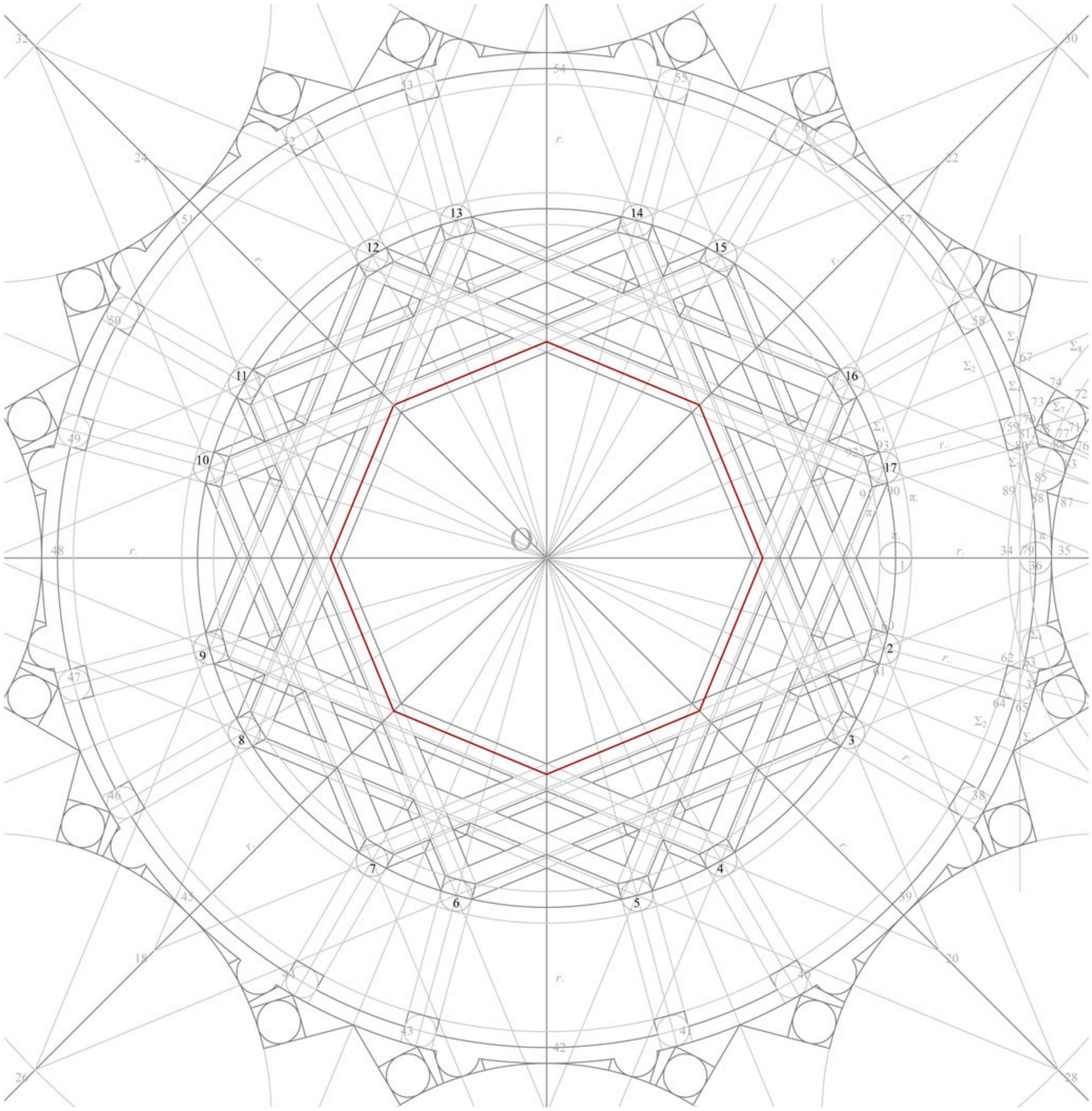

Figure 113. Step 64 – Inner octagon.
Drawing by the author.

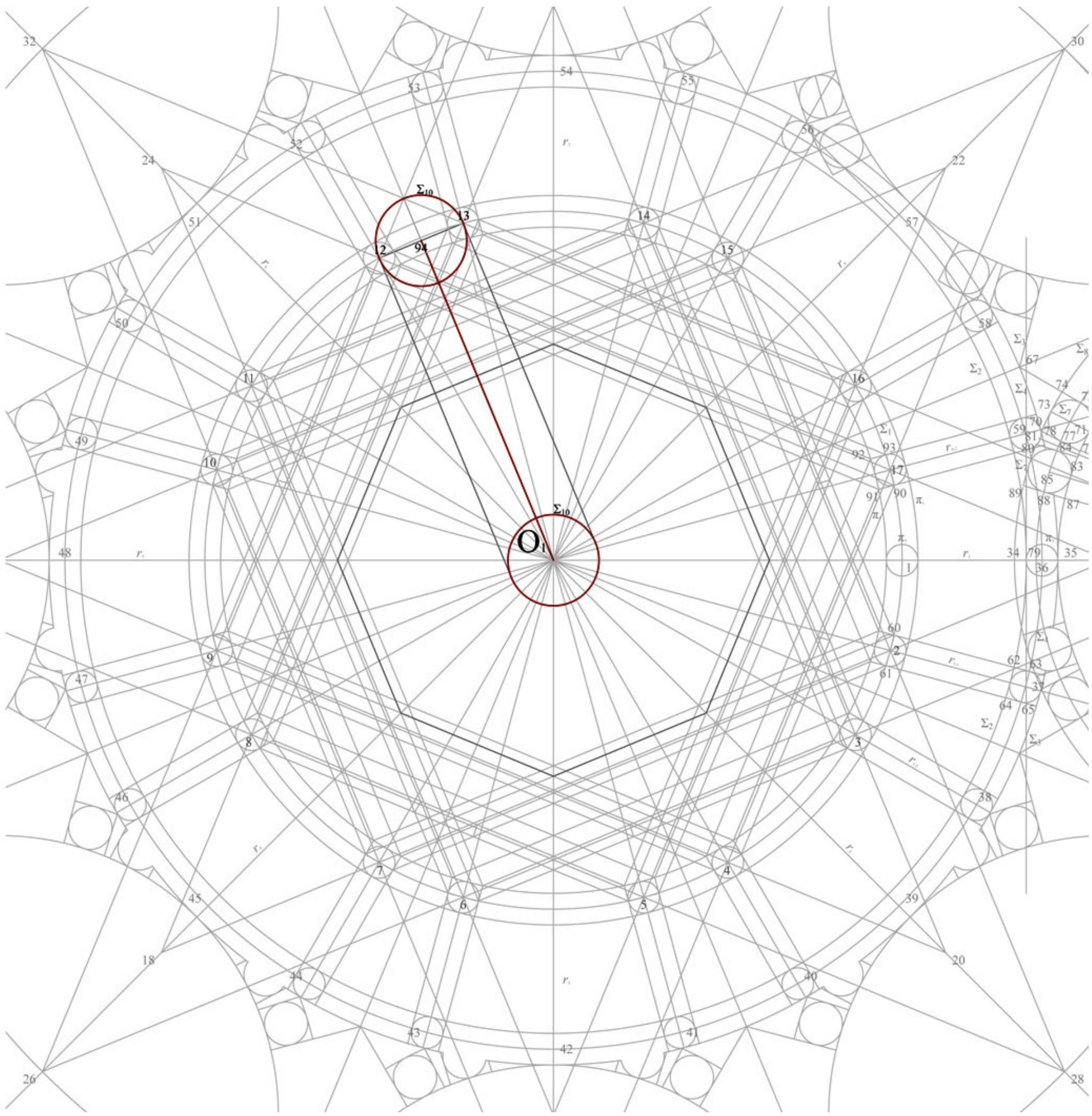

Figure 114. Step 65.
Drawing by the author.

Connect the points *12* and *13* individuating their middle point (*94*). Centering on 94 draw the circle Σ_{10} passing through *12* and *13*. Using as center O_1 draw another copy of Σ_{10}.

STEP 66 [figures 115, 116]:

Let *95* be the intersection of Σ_{10} on r_5. Similarly, let *96* be the intersection of the octagon in Step 66 with the line r_1. From the middle point of the segment *95-96* (point *97*) draw the circle Σ_{11}. From *96* draw a copy of π_3, already used for the diameter of the columns in the gallery. Intersect π_3 with Σ_{11} individuating the points *98* and *99* and connect them to *95*. These two last lines define the projection of the ribs in the second dome (which preserves the octagonal profile found by the intersection of the ribs in the first dome).

Repeat the same construction for the edges of the octagon to find the complete setting of the second dome, which occupies the area in between Σ_{10} and the octagon from the first dome. In addition, the circle Σ_{10} shows the diameter of the lantern at the very top of the church.

STEP 67 [figure 117]:

To find the thickness of the molding circling the lantern in the second dome, draw the circle Σ_{12} with center *95* and tangent to the second dome ribs above and below point *95* itself. The intersection between Σ_{12} and the

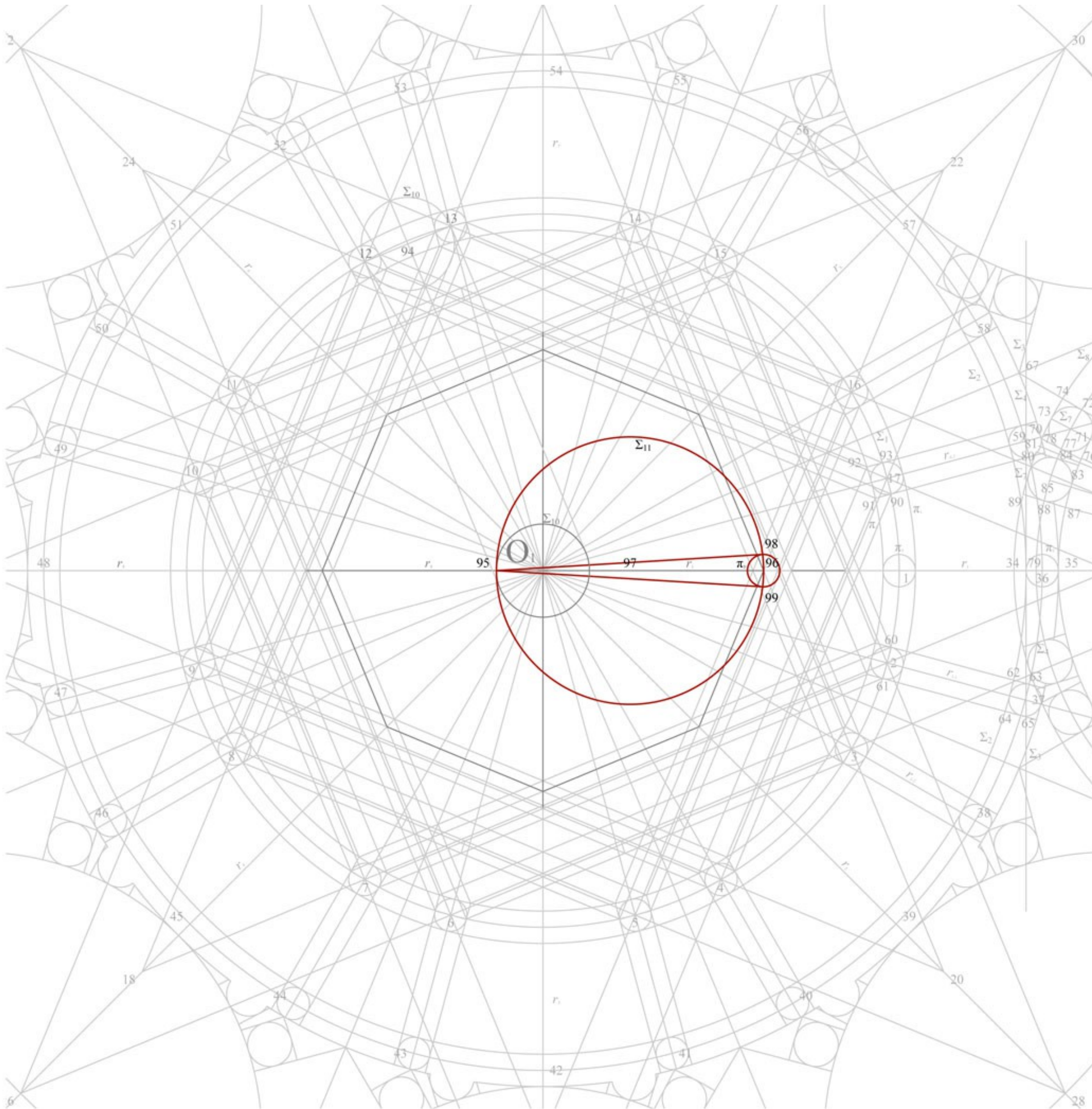

Figure 115. Step 66.
Drawing by the author.

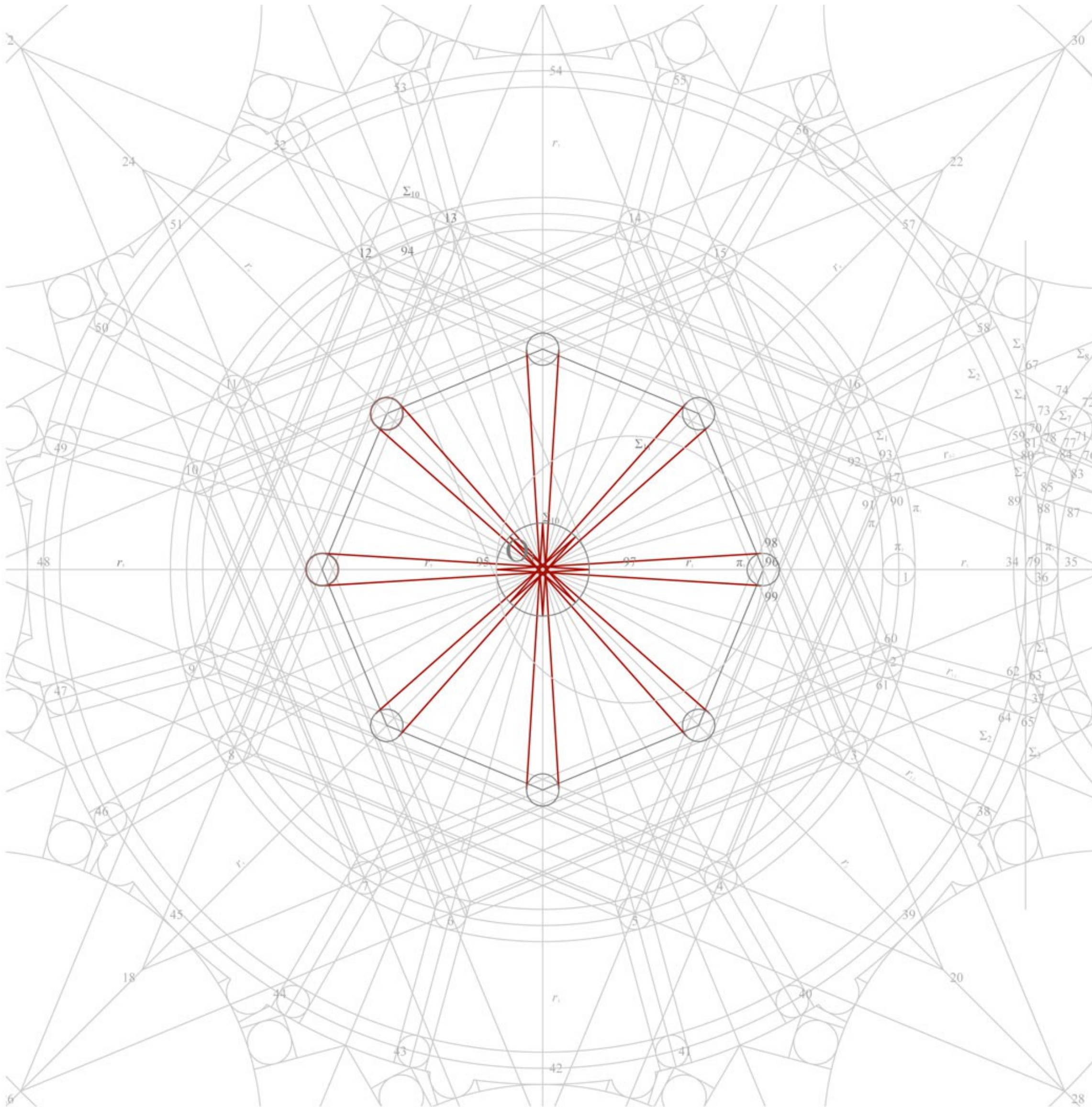

Figure 116. Step 66 – Completed construction.
Drawing by the author.

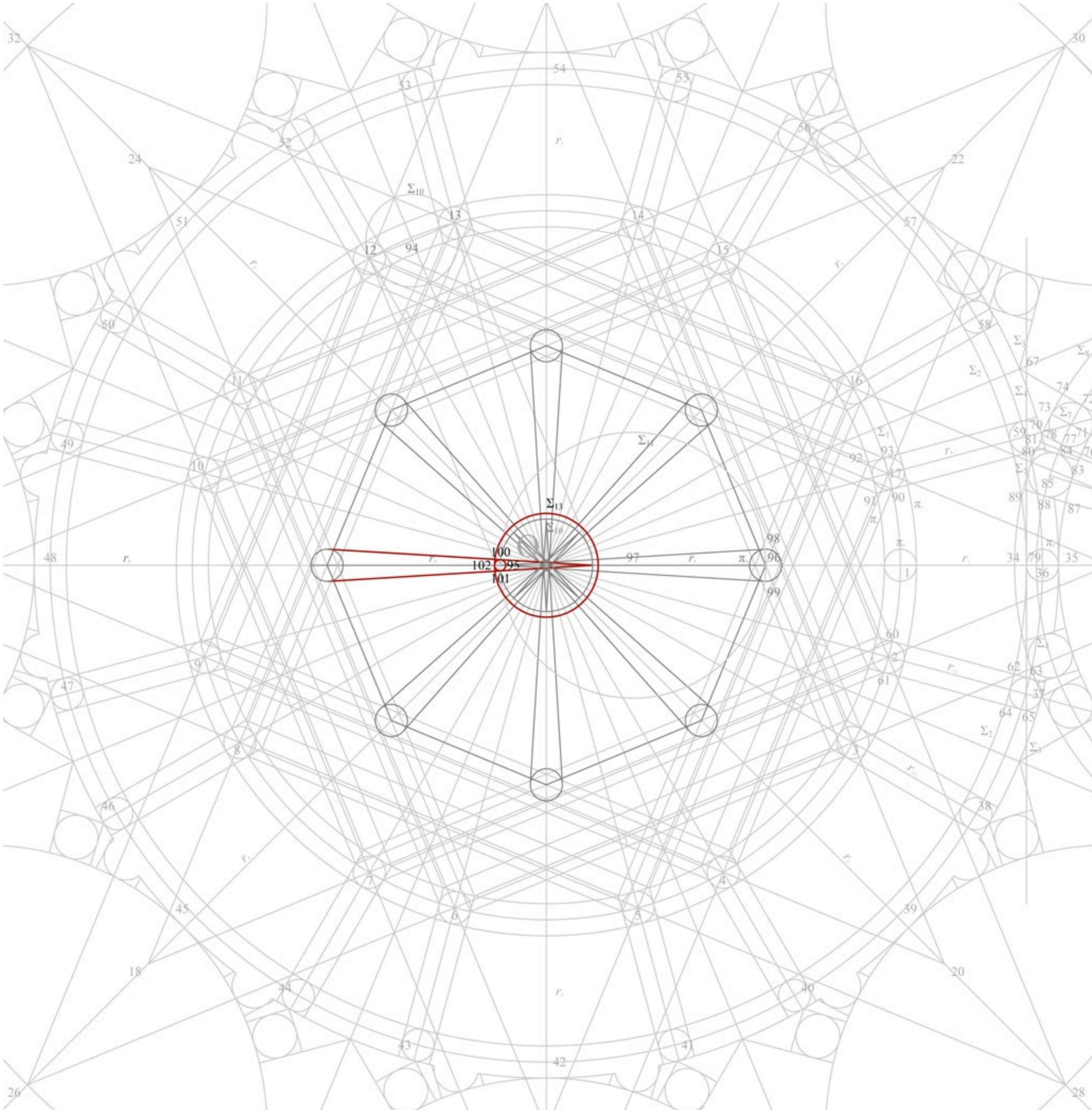

Figure 117. Step 67.
Drawing by the author.

second dome ribs will happen at *100* and *101*. The same circle Σ_{12} will intersect also r_5 at *102*. To get the projected thickness of the molding circling the lantern, draw the circle Σ_{13} with center O_1 and passing through *102*.

STEP 68 [figures 118, 119]:

Cut the profile of the ribs in the second dome accordingly to the lantern, completing the geometric setting of the church.

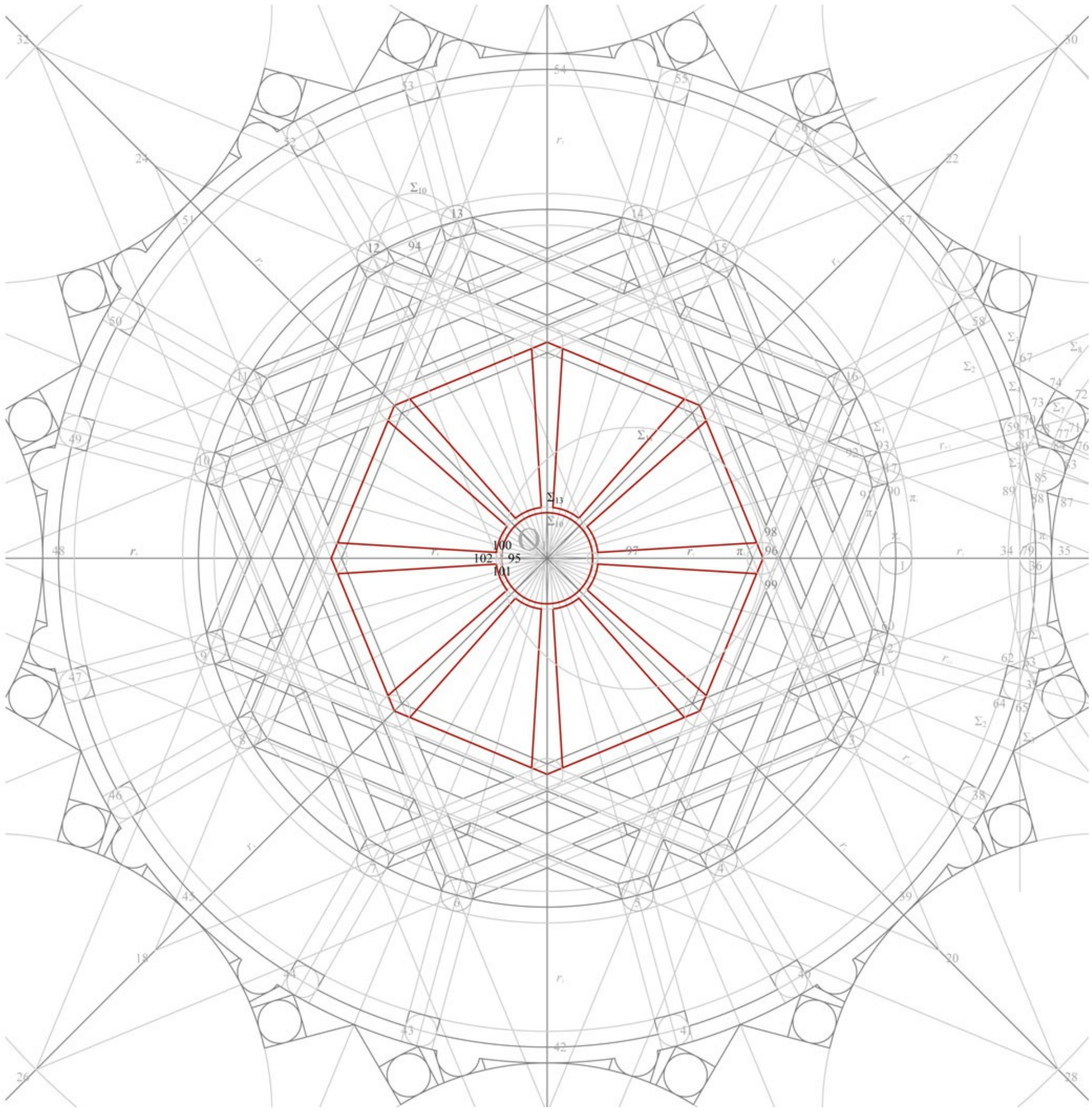

Figure 118. Step 68.
Drawing by the author.

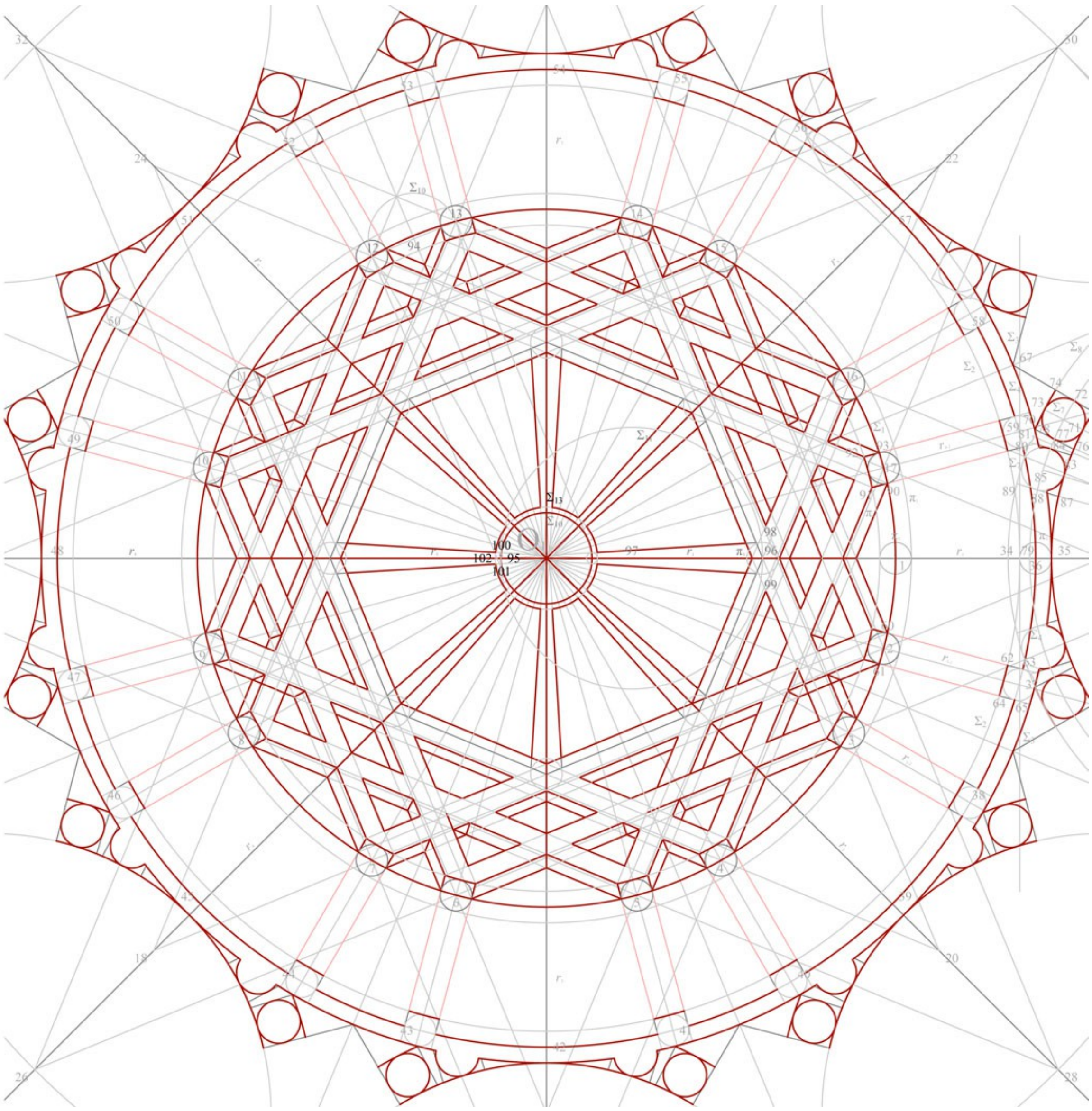

Figure 119. Step 66 – Completed construction.
Drawing by the author.

CHAPTER 4 – Geometric harmonies

The geometric setting structuring Sainte-Anne-la-Royale's plan plays a secondary role in shaping both section and elevation of the church. In fact, the modular nature of the architectural orders are altered from not just Renaissance rules but even from the directions Guarini himself will later suggest in *Architettura Civile*, his incomplete architectural essay. Therefore the method used for reconstructing the plan of the church needs to take in consideration the personal version Guarini created for the architectural orders. Such information may be partially supplied by *Architettura Civile*. Sainte-Anne-la-Royale, in fact, was planned by Guarini several years before the essay mentioned above. Therefore, several solutions in the Parisian church rarely follow the directions in *Architettura Civile*. Because of this, eventual irregularities in Sainte-Anne's architectural orders have been preserved, inscribed into a modular system proportioned on the columns and pilaster strips obtained by plan geometric analysis. Following Guarini's directions, a basic module corresponds to half the length of a column or pilaster strip. Through a further subdivision of this module in twelve parts it was possible to create a grid in which the church can be proportioned. As a result, the reconstructed building preserves as much as possible the very same proportions illustrated in the original engravings while embedded in a constant parametric measure.

Alterations to the original layout are introduced only when dealing with incompatibilities and incongruences in the sparse graphic sources. The proportions of the main order capital, for example, is not constant in the original section while, at the same time, not matching the information in the detail contained in the same plate. Likewise, the original section on the transversal axis shows an improbable joint between side bay vaults and gallery which does not take in consideration the increased size these vaults produce along the longitudinal axis. As a consequence, it was required to raise up the gallery by introducing an additional entablature at its bottom.

Finally, several details not rendered in the original engravings for graphic reasons have been restored, bringing the building in line with Guarini's architectural style. *Architettura Civile* and Guarini's surviving buildings are used as a main source for such missing details. The final result, however, is not a patchwork of elements from other sources and buildings. Each reference provided a set of profiles and overall proportions which have been modified and adapted to the compositional nature of Sainte-Anne-la-Royale. It needs to be remembered, in fact, that this church was one of the first projects by Guarini while the composition of *Architettura Civile* happened at the end of Guarini's career. The information is more mature than the ones used in Sainte-Anne-la-Royale. From this point of view, it is not surprising to find architectural orders with hybrid natures and awkward proportions in this building. At the same time, Guarini was an innovator. Away from rigid Renaissance rules, the Theatine priest embraced the compositional variety of ancient architecture defined by Vitruvius, creating new architectural orders original in nature, proportions, and decorations. The new pantheon of solutions came also with new spacial control; regardless of their compositional nature, all the new architectural orders were developed according to one modular system only—a twelve base module.[1]

1 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), p. 89;

4.1 The attuning diapason

Modules in architecture have been used for a long time to proportion both decorative and structural elements. Partially abandoned during the middle-ages, this practice blossomed again in Renaissance Italy thanks to a renewed interest in masterworks from the past. Among several architects, Palladio and Serlio successfully analyzed and applied these ancient notions to their needs, creating a standardized set of rules to follow in the centuries after.

Guided by the same interest for masterworks from the past, Guarino Guarini too was inspired during the XVIIth century by an architectural milestone: Vitruvius's *De Architectura*. However, the feature which caught Guarini's attention was not the codification of modular elements but the variable proportions used in ancient architecture.[2] Vitruvius noted among the masterworks of ancient Greece a wide range of compositional variations.[3] At that time, in fact, the task of an architect was to vary and modify the proportions of architectonic elements, aiming to create a composition with perfect and delightful balance.[4] Inspired by such goals, Guarini attempted a personal analysis and exploration of architectural orders, creating a personal set of proportions free from the standardization of the Italian Renaissance. The traditional five architectural orders (Tuscan, Doric, Ionic, Corinthian, Composite) were reduced by Guarini to three only (Doric, Ionic, Corinthian), each edited in three variations with different proportions,

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2 *Ibid.*, pp. 82-89. Giorgio Rocco, *Guida alla lettura degli ordini architettonici antichi. I. Il Dorico* (Napoli: Liguori Editore, 1994), p. 13, 18.

3 Giorgio Rocco, *Guida alla lettura degli ordini architettonici antichi. I. Il Dorico* (Napoli: Liguori Editore, 1994), p.63 (Table XIV).

4 *Ibid.*, p.13.

sequences of moldings, and interchangeable capitals. At the side of these main orders, a wide variety of hybrid entablatures were introduced to increase compositional range. Traditional decorations were enriched by innovative and extravagant themes inspired by natural elements and heraldic insignias. Coherence and functionality throughout this new architectural syntax was guaranteed by a single modular system on a base-twelve system:

> "*Each module will be divided in twelve parts or fingers in order to proportionate every single element in the order. This choice relates to the traditional foot division; in case half-diameter of a column will measure one foot, one part of the module will correspond to one twelfth of a foot.*"[5]

According to Renaissance traditions, architectural orders were proportioned on two different modules reflecting the amount of detail in each order. Tuscan and Doric orders, which are associated with strength and heaviness, had a limited number of moldings, suggesting a base-twelve module. Ionic, Corinthian, and Composite orders, instead, shared a sculptural nature embodied by a wide set of profiles proportioned on a base-eighteen module. Due to this difference, linking two or more architectural orders created complex compositional issues for both architects and stonecutters. A unique modular system, instead, would have simplified the situation. In case of need, each part of the module would have further divided in 2, 3 or 4 segments thus accommodating any possible junction between different parts of a composition.

5 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), p. 89.

A modular system may help in proportioning sections and elevations. However, it does not directly affect plan compositions. In some cases, specific compositional elements may suggest a pattern to follow. In Doric entablatures, for example, triglyphs imposed a compositional grid by setting up the columns' distance (called *intercolumnium*). Barely followed in Roman architecture already, such principles started fading during Renaissance. Architectonic contaminations between orders, especially Doric and Ionic, became standard practice while corner solutions overlooked Greek compositional issues like angular contractions and optical corrections. As a result, the linkage between plans and elevations blurred, although both were still geometrically developed. However, it was only in later in time that the rigidity of Renaissance compositional grids would be broken by new and engaging scientific discoveries of the Enlightenment. Embracing the incommensurable vastness of the universe circles and spheres were introduced in architecture to recreate on Earth the perfection of the heavenly spheres. However, the impossibility of mathematically representing these shape without the irrational π doomed these perfect shapes by the awareness of the unknown. In the attempt to purify their hybrid nature, curves were approached by graphic methods like the squaring of the circle. At the same time, the visual difficulty in perceiving circles' perfect shape due to the perspective deformation of the human eye, renewed an architectural interest in conics. Featuring ellipses and ovals, new and original architectonic compositions adapted divine principles into a mundane world. Compositions blossomed with a series of self-sufficient but yet interconnected organisms, suggesting an apparent chaos whose rational nature lay hidden from view by an opulent layer of decoration. Only an eye trained by the light of knowledge would have been able to perceive the truth behind such deceptive skin.

Following these principles, Sainte-Anne-la-Royale was proportioned in section and elevation by the modular proportions of its architectural orders. As visible from the reconstructed plan, in fact, at least two main proportional sets appear in the building: a first one structuring the first level, and a second one used from the gallery and above. Their superimposition implies a progressive reduction of the ground floor module, thus creating a geometric link through the church [see **figure 06**, page 17].

Module	Tier	Partial measures	Total measures
1	I – The World of Humankind *Path I – The Mundane Route*	29 M, 6 p	49 M, 2 ½ p
	I – The World of Humankind *Path II – The Celestial Path*	17 M, 4½ p	
	Added Pedestal	*2 M, 4 p*	
2	II – The Sidereal Emptiness	33 M, 9 p	100 M, 11 p
	III – The Edge of the Universe	22 M	
	IV – The Empyrean Void	18 M, 9 p	
	V – The Light of Truth	26 M, 5 p[6]	

Table 1: Individuation of the two main modules in Sainte-Anne-la-Royale

Each level in the church is further divided according to its main compositional elements first and to its details after. Such measures, however, can not always be expressed in perfect modules. The curvilinear nature structuring portions of the building introduces the irrational π, thus introducing imperfections in both partial and total measures. Beside

6 The measure of the last level includes also the height of the spire at the top of the church lantern.

these mathematical irregularities though, the overall geometry of the building is not corrupted, preserving its coherency.

Finally, a note about the building's scale: the present reconstruction of Sainte-Anne-la-Royale is parametrically conducted according to the modular system geometrically individuated in plan. Because of this, the whole building may be rescaled to its actual measures—which are unclear in Guarini's engravings. Here, in fact, the Theatine uses an awkward measuring system noted as *tuese*. While no more used at the present time, this metric system seems to refer to a French system mainly used for urban planning. One could hypothesize that Guarini took such measures by the maps of the church lot. The site, in fact, was part of an already developed portion of Paris; with the exception of the street front, the other three borders of the lot were already occupied by pre-existing buildings. Guarini's choice to preserve measures in *tuese* might have been justified by the practical need to maintain coherency between project and site. However, no information was left by the priest about the conversion of this system into common measures. The process of converting *tuese* to meters and feet seems to suggest different possibilities. So far, Mario Passanti offered an actual conversion from *tuese* to meters[7] although his results are shown by graphic means only. Translating the graphic scale drawn by Passanti into a mathematical equation, the following results are obtained:

1 *module* = 0.789 *meters* = about 2/5 *tuese*

7 Mario Passanti, “Disegni Integrativi di Lastre del Trattato della «*Architettura Civile*»,” in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV., I, 426-427 (Turin: Accademia delle Scienze, 1970)

The uncertainty of the conversion process, however, leads to the choice to preserve Sainte-Anne's reconstruction with a parametric system, thus facilitating a future possible rescaling of the project. Additionally, it needs to be taken in consideration that Guarini proportioned the base of a column or pilaster strip into two modules. Therefore, the measure above represents half the length of a pilaster strip.

4.2 Tier I – The World of Humankind (The Mundane Route)

First level in the building, the Mundane Route is volumetrically partitioned by the main architectural order in Sainte-Anne-la-Royale. The nature of this order, however, is not properly clear. Guarini described it as Corinthian; but its overall proportions do not match any of the information in *Architettura Civile*. Likewise, elements with Doric and Ionic roots suggest a hybrid nature for its architectural order. Such hybrid essence reflects in an arrhythmic composition of the main pillar framing the building's ground floor. Diagonally oriented, these pillars transform the squared core of the building, the central bay, into an irregular octagon. The same composition is preserved in the side bays and the peripheral walls creating the illusion of a never-ending space. Like in a mirror house, each side of the pillar is framed by a similar pattern which is constantly stretched, animating an otherwise sterile repetition. The overall geometry of the central bay is further altered along both longitudinal and transversal axes. The original square at the center of the church becomes now a rectangle while its secondary volumes protrude into the main space by convex profiles. Secondary and tertiary orders structure these additional volumes suggesting a biological nature pervading the overall composition. Contrasting the progressive reduction of these volumes, the architectural orders essentially grow in details and decorative patterns whose proportions are still linked to the module of the main architectural order.

From a three-dimensional point of view, the first level of Sainte-Anne does not present serious geometric challenges. With the exception of the elliptical chapels in the side bays, covered by an elliptical dome intersected with a convex arch, the other portions of the level are essentially an extrusion of the profiles individuated in plan. In this setting, the central bay shows pristine volumetric properties unaltered by the secondary order in the side bays. The variations of the pillar sizes does not follow a precise pattern but follows the geometric definition of the plan. Additionally, such variations do not affect the proportions of the hosted niches. In order to preserve their measures constantly throughout the three sides of the pillar, their proportioning happens at the side with the shortest distance between the pilaster strips—this is to say, in the transversal side bays.

4.2.1 The main architectural order

The hybrid nature of the architectural orders of Sainte-Anne-la-Royale is visible in the detail Guarini included at the side of the engravings of the plan and section of the church **[figure 120]**. Understanding its nature is essential for reconstructing the building and filling the several gaps in the original engravings. The historical distance between Sainte-Anne and other sources (like *Architettura Civile* and other buildings by Guarini still existing) do not guarantee their full compatibility. Additionally, the prolific imagination of Guarini provided wide variety of architectural orders only partially included in *Architettura Civile*. The main discrepancy between these sources does not lay

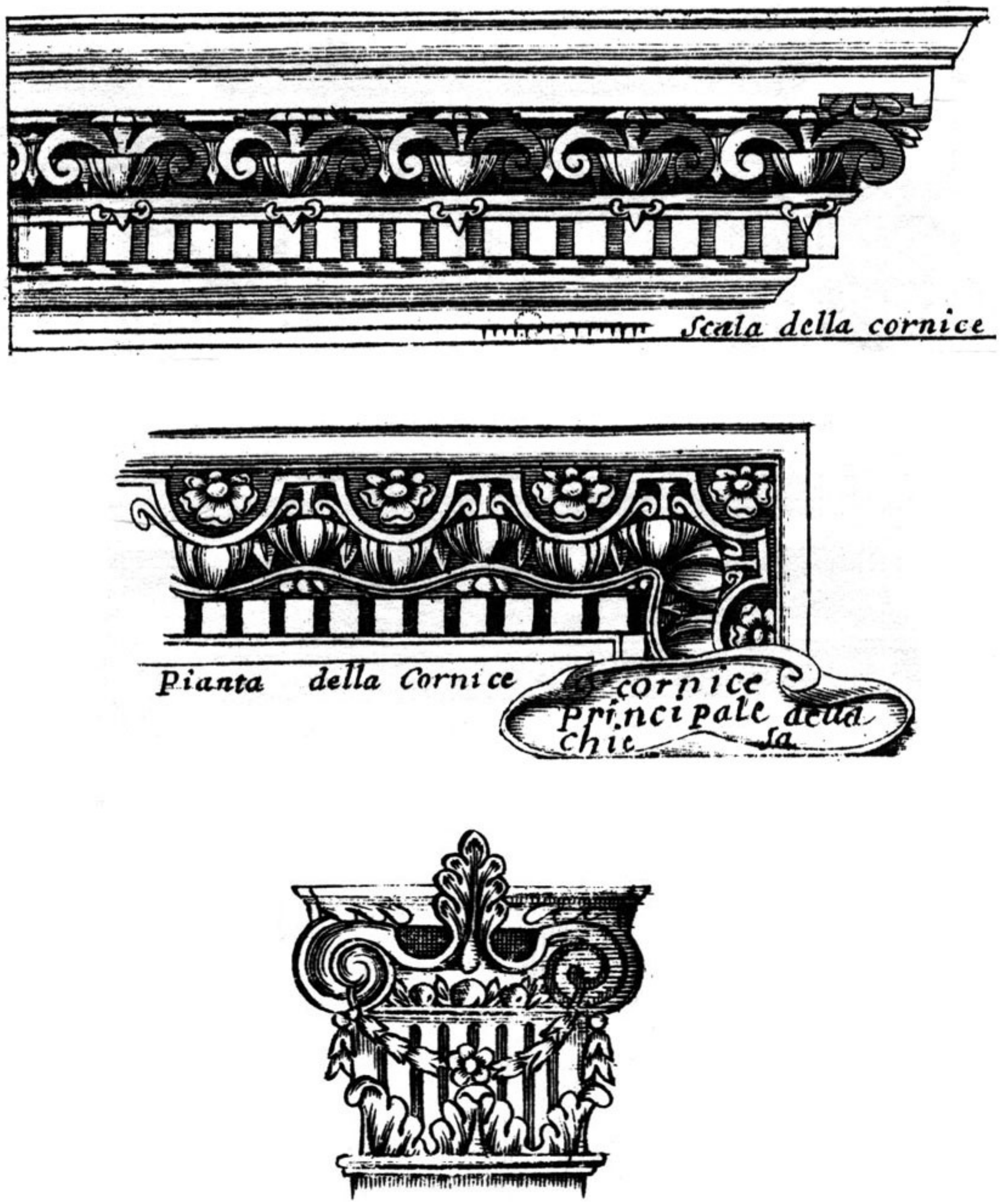

Figure 120. Details for the main indoor architectural order in Sainte-Anne-la-Royale
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plates 9 [capital], 10 [entablature]

in the nature of the details or in the decorative patterns (which Guarini used to customize from building to building) but in the proportions of their generative elements.

In *Architettura Civile*, Guarini spends a few lines about the capitals in Sainte-Anne's main order, defining them as a “third Corinthian order.”[8] The brackets in the order's entablature shown in detail at the side of the section seems to confirm such an assessment. Its capital, however, suggests a different interpretation. The element appears to be divided into two portions:

- a bottom portion decorated by leaves and flowers. The set of moldings separating it from the shaft below (a *cavetto* and a *tondino*) is repeated at the top. The flutes carving its surface introduce the very same pattern decorating the order shafts;

- a top portion hosting an Ionic capital. Differently from standard Ionic capitals, the volutes now show an inversion in their curvature while approaching the pilaster strip axis. Additionally, the *ovolo* sustaining the volutes is unconventionally decorated by flowers and gems instead of a traditional egg and dart theme.

In Guarini's interpretation of these capitals, their upper portion may be understood as an

8 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), p. 123.

innovative rendition of *caulicoli* (the vegetable elements decorating the top of Corinthian capitals). Their inverted curvature, in fact, suggest a nature different from the sheet of acanthus leaves rolled at the sides in Ionic capitals. The set of moldings at the base of the capital (*ovolo*, *tondino*, and *cavetto*), however, brings back an Ionic nature.[9] In addition, below the volutes, the typical *kalatos* adorned by leaves of Corinthian style is replaced by a fluted surface wrapped at its base by leaves. Since flutes usually adorns shafts only, it is possible to consider this lower portion of the capital as a shaft extension. One could argue that the actual shaft might have had flutes, although not rendered in the engraving because of this,[10] thus transforming the main order into an Ionic-Corinthian hybrid. Where the capital contains Ionic traces, the entablature reminds us of its Corinthian nature. Such hybrid nature is mainly embodied by the capital, whose segmentation suggests a metamorphosis of the element to the proportions of a Corinthian capital. Traces of its dual nature pervade other portions of the main order too. Both base and entablature, for example, show unusual sets of moldings and innovative overall proportions in line with Guarini's kaleidoscopic style, aiming to free architecture from the sterile repetitions of the Italian Renaissance.

Inscribed in the main lines containing the first level of Sainte-Anne-la-Royale, the main order may be further segmented according to its main compositional elements:

9 Formally the set of molding at the base of an Ionic capital should have an astragal instead a tondino; however, these two moldings differ for their decorative pattern only (pearls and spools in astragals; pearls only or a plain surface in tondini) while sharing the same profile (half of a circle). Even if a tondino might be considered unusual for an Ionic order, it is necessary to remember Guarini's personal interpretation of architectural orders and his love for compositional variations.

10 Likewise, also the segmentation of the capital is two portions is omitted in the engraving containing the section.

Element	Modular measure	Measure in parts
Base	2 M, 2 p	26 p
Shaft	19 M, 3 p	231 p
Capital	2 M, 7 p	31 p
Entablature	4 M, 6 p	54 p
Total dimensions	*28 M, 6 p*	*342 p*

Table 2: Modular division of the main architectural order

4.2.3 The base of the pilaster strips

The section engraving the base appears to be composed by a plinth topped by two moldings. For both composition and proportions, this base does not seem to match any of the Corinthian bases from *Architettura Civile*. Their standard solution shows the plinth followed by a tore, two scotiae, and a second tore (which may be occasionally omitted). According to *Architettura Civile*, a solution as simple as the one in the engraving is used for Doric bases and to the first Ionic order too. Because of the hybrid nature of the main architectural order in Sainte-Anne, it would have appeared excessive applying a Doric base to an Ionic Capital and a Corinthian entablature. It is here decided, instead, to preserve the base with Ionic roots of the capital by using an standard Attic base. Composed by three moldings (tore, scotia, tore) at the top of a plinth, Attic bases were commonly used for Ionic orders in ancient Greece and mentioned by Guarini in the ruins of Solomon's Temple in Jerusalem. According to the Theatine, such bases might have been applied to pilaster strips. While not connected to any specific architectural order, Attic bases are described by Guarini when introducing Ionic orders.[11] Because of this, they become a valid candidate for this reconstruction, matching the hybrid nature of

11 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), p. 110, Plate 2-III number 29

Sainte-Anne's main order—which is additionally composed by pilaster strips instead of columns.

The proportions for this reconstruction of the Attic base **[figure 121]** follow *Architettura Civile* instead of Saint-Anne's engraving due to its questionable quality. The plinth is the only element deviating from these references. Its unusual height is found directly from the engraving, adapting it to the modular system identified in plan by the length of the pilaster strips. Its elements have been collected in the table below together with their proportions. The order of construction proceeds from bottom to top.

Element	**Dimensions in section**	**Distance from the shaft**
Plinth	1 M, 7 p[12]	5 p
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 ~ 1½ p
Smoothed List	½ p	2 ~ ½ p
Tore	2 p	2½ p
Base dimensions	*2 M, 2 p*	*5 p*

Table 3: Base of the main architectural order

4.2.3 Geometry of the main order base

The geometric reconstruction of the base uses a double notation system:

- numbers highlight the geometry squaring the actual profile;
- letters individuate the constructions through which the final profiles are obtained.

12 In the referenced base from *Architettura Civile*, Guarini suggests a plinth 3½ parts tall.

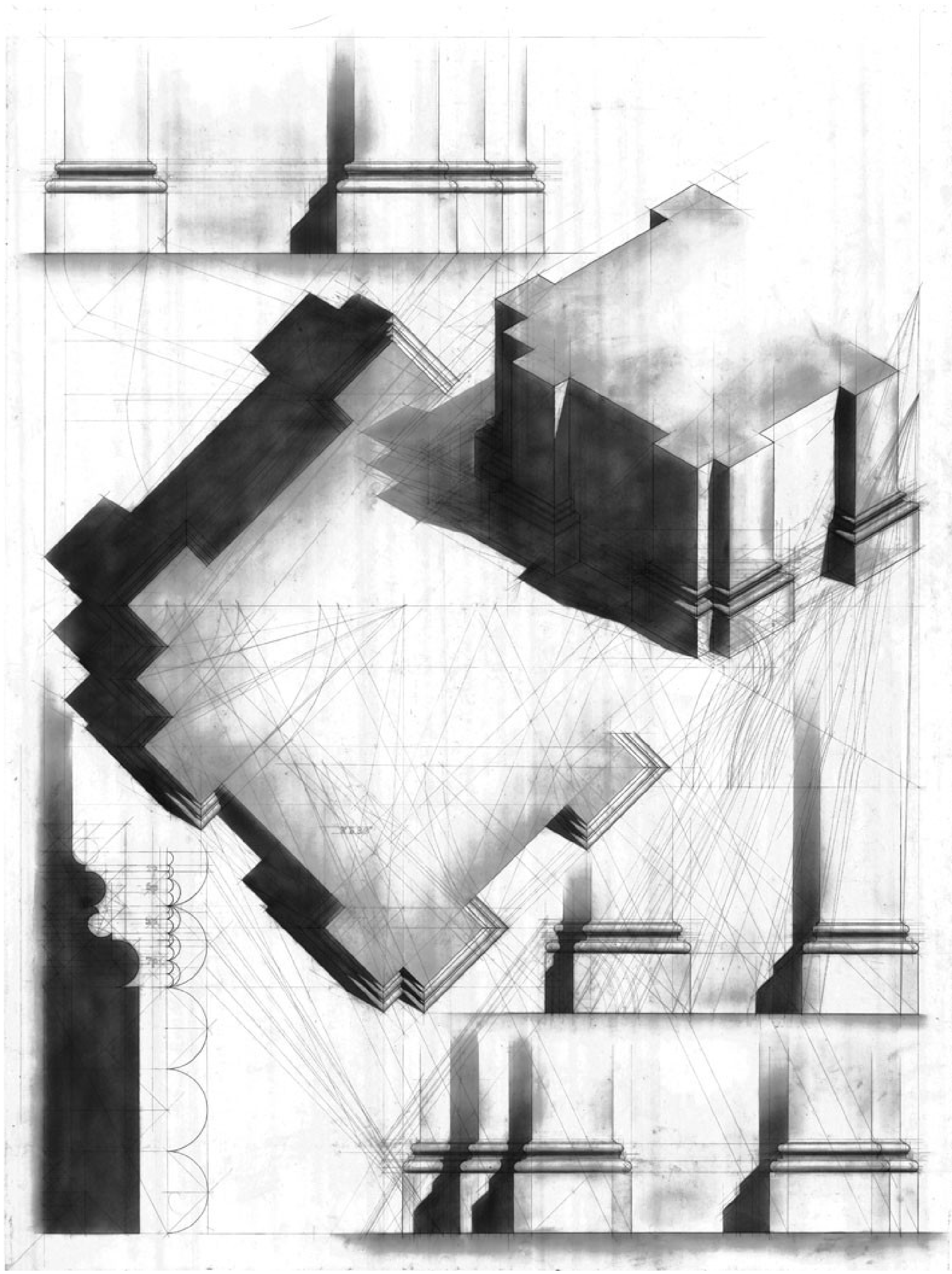

Figure 121. Analysis of the base for the main indoor architectural order in Sainte-Anne-la-Royale. Drawing by the author.

Because of the simple profile of the plinth (a parallelepiped), this element has been omitted in the construction. The drawing show the upper portion of the plinth only. The overall base geometry is approached from below to above **[figure 122]**.

The first tore is inscribed in the rectangle *1-2*. The semicircular profile of the tore is obtained intersecting the diagonal lines from *1* and *2* at a, the center for the tore profile. The following list (*3-4*) is carved by the convex profile of the scotia (*4-5*). To define the scotia, Guarini suggests in *Architettura Civile* a concatenation of two poly-centric arcs. Staring from point *5*, the diagonal to the mid line between points *4* and *5* (line *α*) individuates *b*, the inner-most point of the scotia. The upper profile of the scotia is the quarter circle *5-b* whose center *c* comes from the intersection between line *α* and the vertical line from *5*. The lower portion of the scotia, instead, will connect *b* to *4.* Draw the axis of the segment *4-b* individuating point *d* (on *4-b*); extend the axis until reaching line *α* getting point *e*, the center of the lower profile of the scotia. Point *e* has to be on line *α* because the scotia needs to have a vertical tangent line at *b*. If the scotia profile is drawn by concatenating circles, a vertical tangent in *b* is admitted only if the two centers of the scotia belong to line *α*, a horizontal line passing from *b***.**

At the top of the scotia, Guarini suggests a smoothed list (*5-6*) described by a quarter of circle. A diagonal line from *6* individuates point *f*, the center of the quarter circle *5-g*. At last, the final tore (*7-8*) is again a semicircle (like the tore *1-2*). This time, the center of the tore profile (point *h*) belongs to the vertical line from *g*.

Since the main order is composed by pilaster strips, the profile described above turns by ninety degrees while wrapping around the rectangular profile of the pilaster

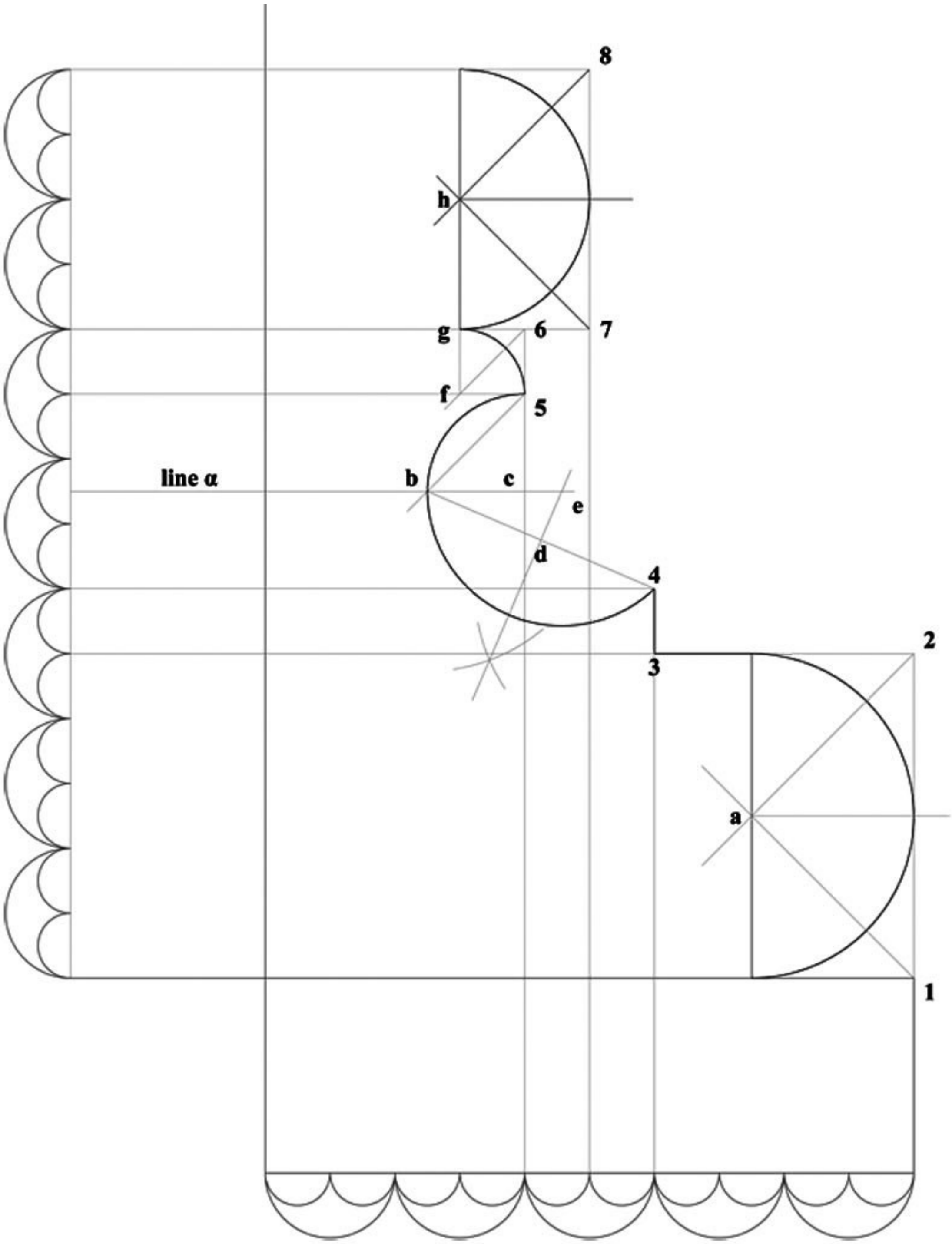

Figure 122. Profile for the base in the main indoor architectural order in Sainte-Anne-la-Royale.
Drawing by the author.

strips. Because of this, the original profiles described above are diagonally stretched. In order to provide a complete set of information about the stereotomy in the building, these deformed profiles also need to be properly described. The process is just a matter of orthographic projection where the already constructed base profiles are now projected on a plane inclined by 45 degrees to the previous vertical plane **[figure 123]**.

4.2.4 The shaft of the pilaster strips

Similar to the base, the pilaster strips also do not follow proportions any of the architectural orders in *Architettura Civile*. According to the engravings, the pilaster strips in Sainte-Anne measure nineteen modules, a measure exceeding even the third Corinthian order, as shown in the table below:

	Doric order	**Ionic order**	**Corinthian order**
First type	10 M	13 M	15 M
Second type	11 M	14 M	16 M
Third type	12 M	15 M	17-18 M[13]

Table 4: Comparison between Guarini's architectural orders

Additionally, the height used here for the pilaster strips is even slightly shorter than the one in the original engraving. The reason for this reduction comes from the mismatched proportions of the capital between section and detail. When rendered in the section, the capital appears shorter than its detailed depiction. The capital proportions in

13 The Corinthian order of third type is called by Guarini "supreme Corinthian order." It is characterized by spiral columns like the one used by Bernini in San Peter's baldacchino in Rome. For this type of Corinthian order Guarini suggests a basic height of 17 modules which may be raised to 17 ¾ or to 18 modules.

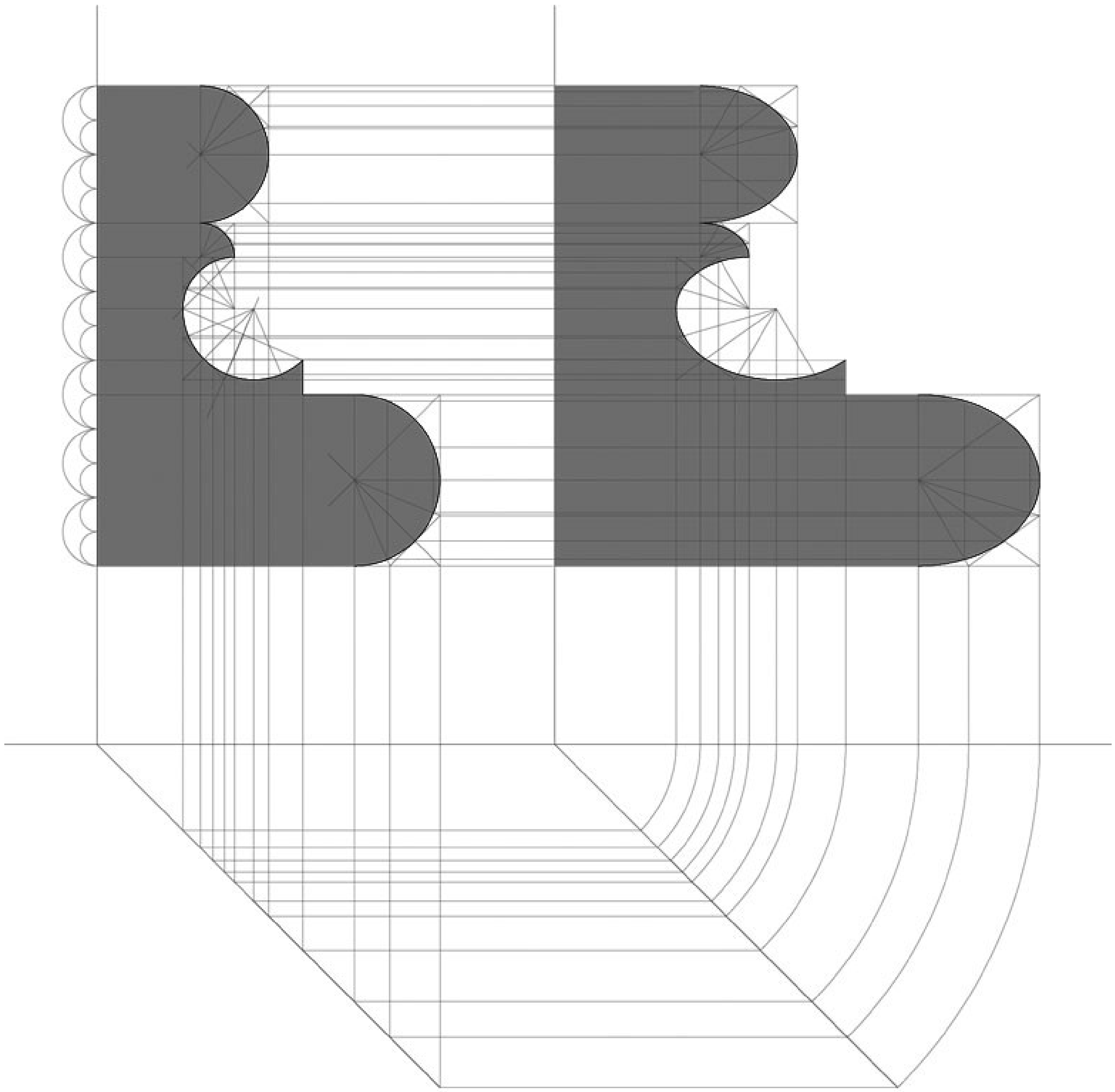

Figure 123. Deformation of the main order base on a diagonal plane.
Drawing by the author.

the detail are resized into the section, matching the width of the pilaster strip, thus providing the actual reduced length of the shafts.

A second interesting detail in the pilaster strips shafts as rendered in the section relates to their flat surface [see **figure 15**, page 55]. While it is possible to have pilaster strips without flutes, their absence in Sainte-Anne does not seem to fit Guarini's use of these elements. As visible from the two most representative projects by Guarini (San Lorenzo and the Chapel of the Holy Shroud, both in Turin), pilaster strips have flutes when constituting the main order in the building.[14] When a secondary order, pilaster strips preserve the properties of the main order when in direct relationship to it.[15]

In the case of Saint-Anne, the first condition applies. Pilaster strips constitute the main order in the building. Their extension at the bottom segment of the capitals show a fluted profile which, for coherency, may be extended to the whole shaft. Additionally, the secondary order framing the elliptical chapel in the side bays appears composed by fluted pilaster strips, making plausible their application to the main order too.[16] Seven in number, these flutes (rendered in the bottom segment of the capital) are in a proportion of 1 to 1 to the lists separating them—dividing the shaft in fifteen parts (seven flutes plus eight lists). Because of their odd number, flutes and lists divide the shaft in segments not compatible to the main module (since the module is scaled on twelve parts in even portions) **[figure 124]**.

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14 This is the case of the Chapel of the Holy Shroud (Turin). In this case, however, it is necessary to note that the flutes in the pilaster strips are rendered in the engraving too.

15 This second case relates to San Lorenzo in Turin. The free standing columns have flutes in lower third of their shaft only. In the same way, the pilaster strips show flutes in their lower third of their shaft; the upper two thirds of the shaft are decorated with colored patterns marbles in geometric shapes.

16 Likewise, the niches in the Chapel of the Holy Shroud are framed by a second order (composed by Corinthian columns) contained by the main fluted pilaster strips.

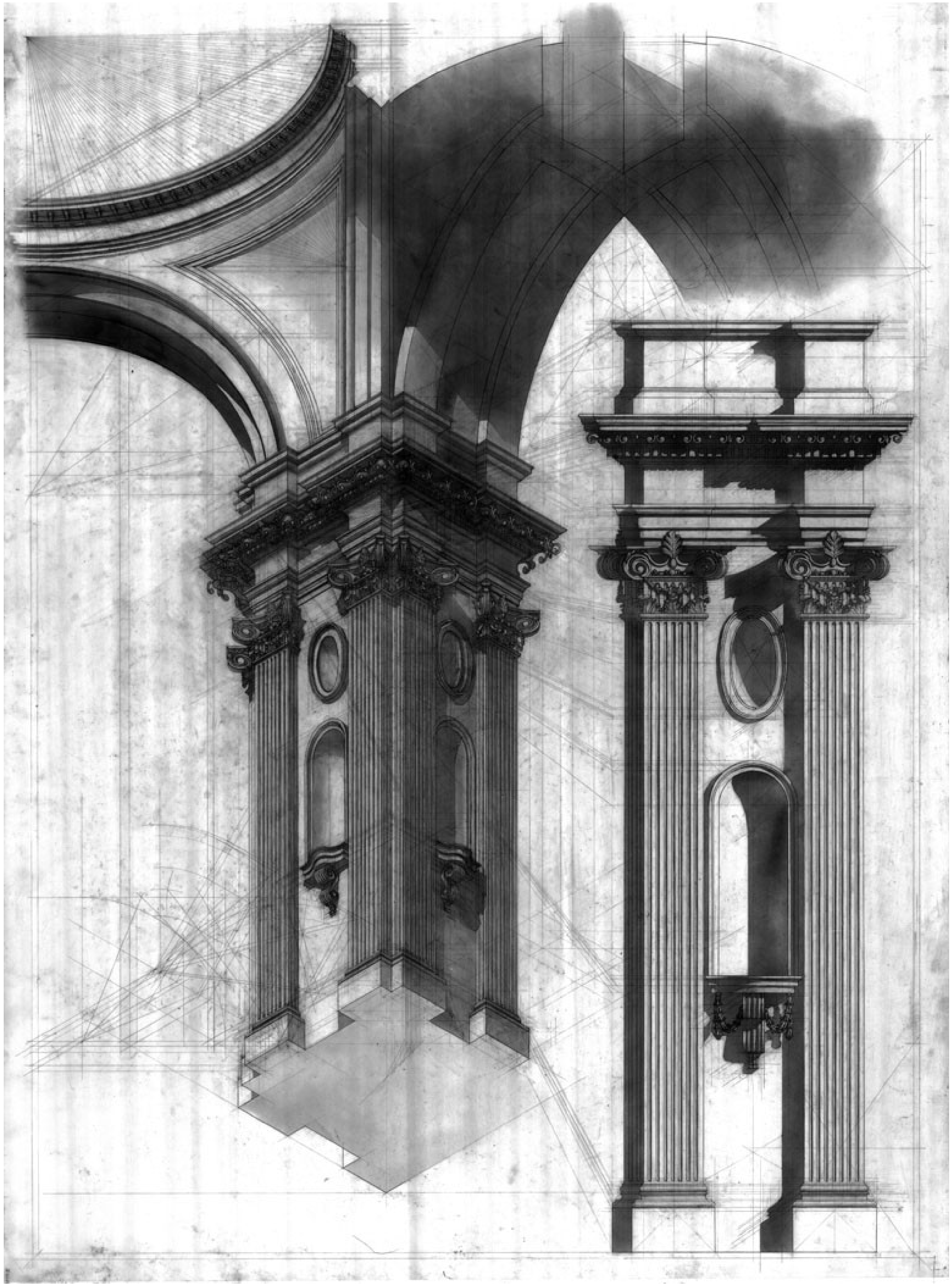


Figure 124. Analysis of the pilaster strips in the main indoor architectural order in Sainte-Anne-la-Royale.
Drawing by the author.

Regardless of the flutes issue, the other elements composing the shaft have been referenced to the moldings located at the top and bottom of Ionic orders in *Architettura Civile*.[17]

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	19 M	-
Apophis	1 p	0 ~ 1 p
List	½ p	1 p
Shaft dimensions	*19 M, 3 p*	*3 p*

Table 5: Shaft of the main architectural order

The *apophis* mentioned above is a quarter circle profile. It does not constitute a molding by itself but individuates the link between list and shaft at bottom and top of the latter. When appearing outside of shafts, the combination of list and apophis constitutes a traditional *cavetto* profile. However, while listing moldings in architectural orders, Guarini uses several times the word *apophis* also when not related to the shaft. Because of this, the listing of *apophis* has been preserved throughout this reconstruction too.

4.2.5 Geometry of the main order shaft

Volumetrically described by simple parallelepipeds, the shafts vary their depth from the back surface of the pillar according to the bay they face. Due to the irregular geometry of the pillars, the shaft side elevations show a variable number of flutes. The

17 Keeping in mind that the very same molding sequences are used also for Doric and Corinthian orders.

pillar at the north-eastern corner of the central bay has been taken as reference for showing such variations. Its three sides have been labeled as follows:

- Side A: facing the side bay on the longitudinal axis;
- Side B: facing the central bay;
- Side C: facing the side bay on the transversal axis;

A plan showing all the three pillar sides in rendered in both **figures 121** and **126**. On each side, the pillar shows two pilaster strips between which are located two niches. Looking from the front view of each of these three sides, the pilaster strips framing them have been labelled "right" and "left." Additionally, each pilaster strip has been divided into left, front, and right elevations in order to describe its variable protrusion from the pillar surface behind.

Pillar side	**Pilaster Strip at the left**			**Pilaster Strip at the right**		
	Left	Front	Right	Left	Front	Right
Side A	~21½ p	2 M	8¼ p	8¼ p	2 M	17 p
Side B	11 p	2 M	8¼ p	8¼ p	2 M	8¼ p
Side C	8¼ p	2 M	8¼ p	8¼ p	2 M	~13½ p

Table 6: Proportions of the pillar sides

The standard depth for the pilaster strips is 8¼ parts which corresponds to the pillar surface contained by two adjacent pilaster strips. When turning the corner, this dimension increases to accommodate the irregular geometry of the pillar in the plan construction. Because of this, the pilaster strip's sides are not always proportioned according to precise modular measures. Such irregularities do not affect the alternation of flutes and lists: only their number varies according to the different lengths along the pilaster strip sides.

Pillar side	**Pilaster Strip at the left**			**Pilaster Strip at the right**		
	Left	Front	Right	Left	Front	Right
Side A	6 flutes	7 flutes	2 flutes	2 flutes	7 flutes	5 flutes
Side B	3 flutes	7 flutes	2 flutes	2 flutes	7 flutes	2 flutes
Side C	2 flutes	7 flutes	2 flutes	2 flutes	7 flutes	4 flutes

Table 7: Flutes in the main pillar

In section, the flutes follow a traditional semicircular profile closed at top and bottom by a carving with a quarter circle section. According to Guarini's direction, the shaft's *apophis* takes place at the top and bottom of this carvings while, conventionally, these carving partially overlaps the *apophis*.

4.2.6 The capital of the main order

Information about the main order's capitals are contained in a detail at the side of Sainte-Anne's plan engraving [shown in **figure 120**]. Additionally, Guarini spent a few lines about these capitals in *Architettura Civile*, describing the nature of flowers and leaves decorating the capital: poppies and carnations. Looking at the capital detail, the laurels hanging from the volutes are clearly carnations while the one in the center can be interpreted as a poppy flower **[figure 125]**. According to Guarini's detail, two sets of the laurels start from the bottom of the volutes—one connects to the poppy flower in the

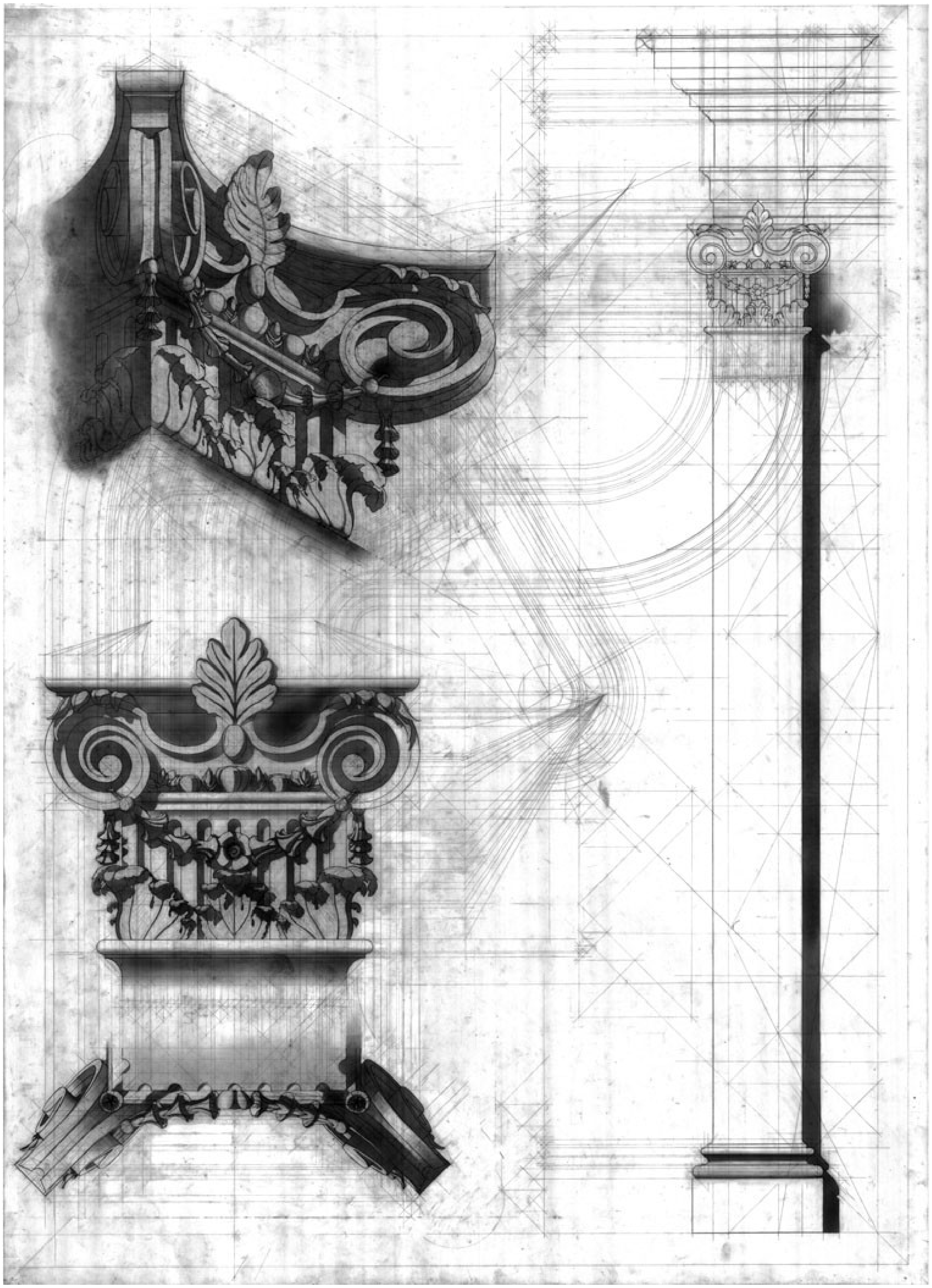


Figure 125. Analysis of the capital in the main indoor architectural order in Sainte-Anne-la-Royale. Drawing by the author.

center of the capital while the second one hangs vertically from the volutes themselves.

It is hypothesized that these elements would have been carved in stone, and their partially free-standing nature would have make them extremely delicate. An eventual size increase of the flowers might have extended the junction surface with the shaft behind for the laurels directed towards the poppy in the center only. Because of the diagonal setting of the volutes, the carnations hanging vertically from the volutes would have had no additional supports. A possibility might have been having the capital composed by mixed materials like wood or iron—similar to what happened in the Chapel of the Holy Shroud, whose capitals are composed by slender and delicate elements. Regarding Sainte-Anne's capitals, in between the volutes, poppy blossoms, and gems appear the conventional “egg and dart” motif. At the top, the list framing the volutes changes its curvature while approaching the pilaster strip axis. Here, an elliptical gem is crowned by a poppy leaf covering the abacus and part of the entablature above. At the bottom, additional poppy leaves wrap the fluted surface of the shaft similarly to Corinthian capitals.

4.2.7 The entablature of the main order

According to the proportions in section, the main elements composing the section are individuated by four main lines:

Reference Lines	Partial measure	Total measure
Line 1	0	24 M
Line 2	1 M, 4 p	25 M, 4 p
Line 3	1 M, 6 p	26 M, 10 p
Line 4	1 M, 8 p	28 M, 6 p

Table 8: Composition of the main order entablature

In between these references, are distributed the main elements of the entablature; the architrave (from Line 1 to Line 2); the frieze (from Line 2 to Line 3); and the cornice (from Line 3 to Line 4).

The Corinthian nature of the main architectural order mentioned by Guarini makes sense in relation to its entablature's composition. A detail of its cornice at the bottom of the section, in fact, shows the presence of brackets which, independently from their original profile, are an element typical of Corinthian orders. While no direct reference is specified to one of the three Corinthian orders listed in *Architettura Civile*, the excessive length of the pilaster strips (19 modules) suggests a reference to the tallest among the three, the Supreme Corinthian order. Its information has been referenced mainly in relation to the moldings composing the architrave and the frieze. However, the sinusoidal profile characterizing this order has been omitted in Sainte-Anne-la-Royale. With the exception of cornice, where such movement is clearly documented, the other engravings clearly show straight profiles in both plan and elevation.

The only alteration to the proportions and reference lines coming from the engraving analysis happens at Line 2. Separating the Architrave from the Frieze, this line has been moved up by two parts in order to contain the three fasciae composing the architrave. Consequently, the other reference lines above it have been translated up by the same measure. According to the engraving, the architrave appears to be composed by two fasciae only—a solution typical of Ionic order but not of Corinthian one, which counts three fasciae instead. In a recent publication, however, a preliminary drawing for Sainte-Anne-la-Royale's section engraving clearly shows a third fascia at the bottom of the architrave thus validating the true Corinthian nature of the entablature.[18] Introducing these elements into the Supreme Corinthian orders causes an extension of the architrave by two parts. Because of such minimal deviation from the original engraving, this reconstruction tries to restore an adequate height for the architrave, moving up by two parts its upper profile. Such proportions give the chance to reduce the size of the list closing the architrave. In the original engraving, in fact, this element appeared oversized, even exceeding the measure of the upper fascia. As a result, the architrave become composed by the following elements **[figure 126]**:

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	3 p	-
Astragalo	½ p	½ p
Fascia II	4 p	¾ p
Reversed Kyma	1 p	1 p ~ 1½ p
Fascia III	5 p	2 p
List	½ p	2½ p
Astragalo	1 p	3 p
Reversed Kyma	2 p	3 p ~ 4½ p
List	1 p	5 p
Architrave dimensions	*1 M, 6 p*	*0 p ~ 5 p*

Table 9: Architrave of the main architectural order

The extension of the architrave by two parts, also has the advantage of restoring the size of the frieze above (1 module and 6 parts) as suggested by the three variations of Corinthian orders in *Architettura Civile*. Simple in details, the frieze is composed as

18 Giuseppe Dardanello, Susan Klaiber, Henry A. Millon, *Guarino Guarini* (Turin: Umberto Allemandi & C., 2006), p. 136 (figure 22)

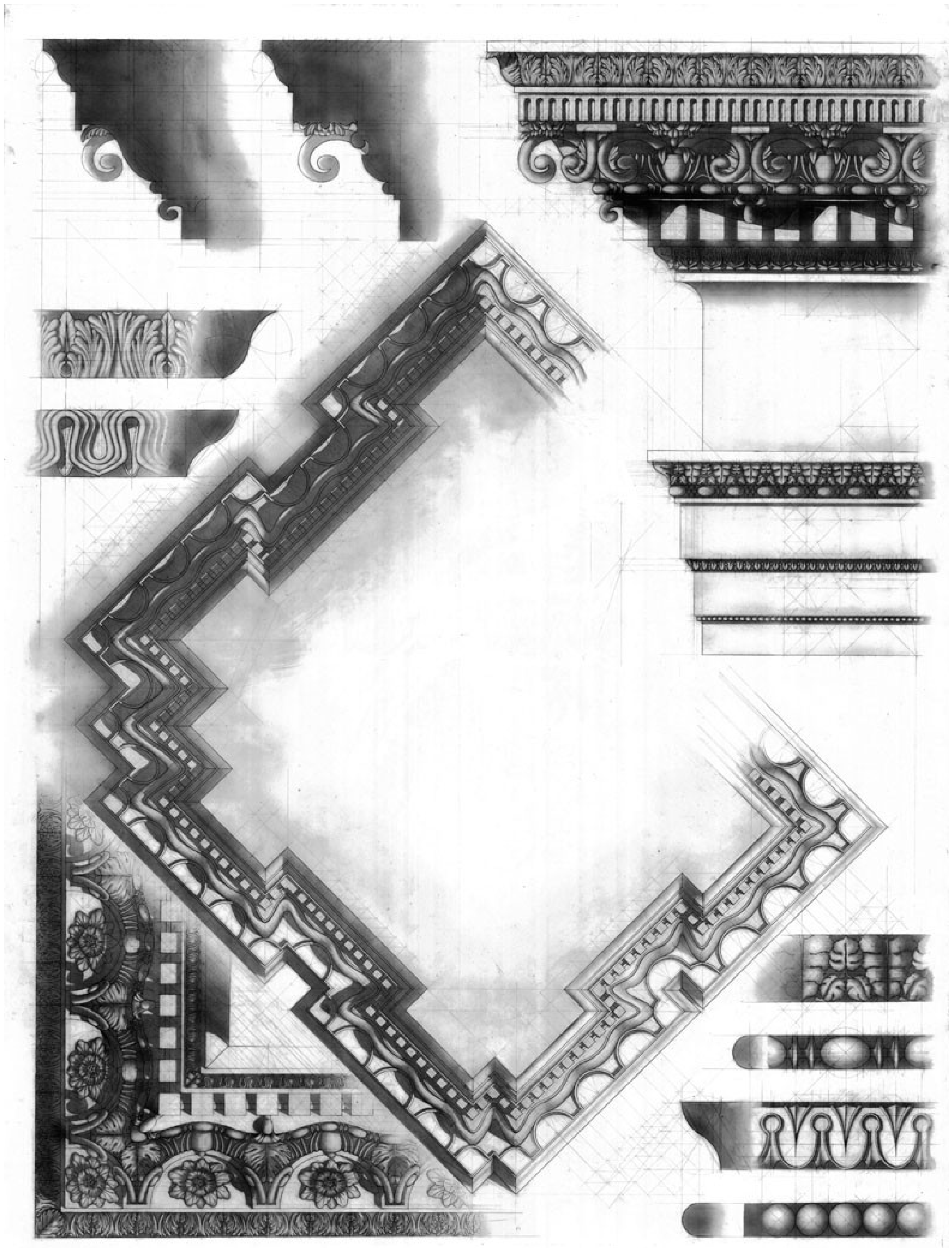


Figure 126. Analysis of the entablature in the main indoor architectural order in Sainte-Anne-la-Royale.
Drawing by the author.

follows:

Element	Dimension in section	Distance from the shaft
Cavetto	16 p	0 p ~ 2½ p
Reversed Kyma	2 p	3 p ~ 4½ p
Frieze dimensions	*1 M, 6 p*	*0 p ~ 4½ p*

Table 10: Frieze of the main architectural order

Formally the frieze would have been completed by a list. This element, however, has been moved together with the cornice since, together with the two lower moldings of the cornice itself, it follows a sinusoidal profile instead of a standard straight path.

Indeed, the most original element in the entablature, the cornice, shows similarities to the correspondent element in the Supreme Corinthian order. With few variations from its reference, the elements composing Sainte-Anne's main order cornice may be proportioned directly according to the detail Guarini included at the bottom of the section engraving. In the recesses of the sinusoidal molding a rosetta is inscribed into a semicircular niche. In between two niches, two *cauliculi* join in front of a leaf shaped bracket. At the bottom of the sinusoidal molding, decorative elements appear below the list convexity. Their shape is not entirely clear from the engraving. A taurine-like triangular element shows two curls at its top corners. According to the zoomorphic nature of the details in the main order, it is more plausible to provide a vegetal identity to these elements too. Similarly to the *caulicoli* in the cornice, the decoration below the list may be similarly interpreted. Reminiscent of the *caulicoli* adorning the upper portion of the cornice, these decorations are interpreted as a *caulicolo* curling downward while, at its top, two leaves curve upwards to wrap the list above. Eventually, these elements might have been a rendition of French *fleur-da-lis*, since the church was dedicated to the queen Anne of Austria.

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	5 p
Dentils	3⅓ p	7⅓ p
Sinusoidal List	½ p	8 p
Sinusoidal Tondino	1 p	8½ p ~ 9 p
Sinusoidal Ovolo	2½ p	8½ p ~ 11 p
Brackets	2½ p	9 p (back surface)
Fascia	3 p	18 p
List	½ p	18½ p
Kyma	3 p	19 p ~ 22 p
List	1 p	22 p
Cornice dimensions	*1 M, 6 p*	*22p*

Table 11: Cornice of the main architectural order

There is a discrepancy between plan and elevation in the engraving: the caulicoli below the sinusoidal list are misplaced between plan and elevation. Their location in plan appear compositionally coherent; the *caulicoli* are located below the convex protrusion of the list while aligned to the brackets above. In the elevation of the same detail, however, the *caulicoli* are now moved below the *rosettae* in between the brackets, a compositionally impossible alignment. In this location, in fact, there is no space for hosting the *caulicoli* below the list.

Additionally, the plan and elevation details do not show the decorative patterns in the cornice moldings. The absence, however, may be ascribed to graphic choices only. It is unlikely that a Corinthian order would have been deprived of its distinctive decorative pattern. Because of this, the moldings in the entablature have been updated with decorations coherent with their profiles. Through similar analyses, *Architettura Civile* became a thesaurus for supplying information missing in the original engravings. In sporadic cases, additional sources were taken in consideration—mainly the architectural essay by Vignola, which has been referenced for the decorative pattern in the cornice drip molding.

A geometric analysis of the entablature focuses mainly on the composition of the sinusoidal moldings in the cornice and in their relationship to the other elements in the order. Such analysis starts by the positioning and proportioning of the dentils. In *Architettura Civile* Guarini suggests proportioning the dentils with a height equal to one and a third times their measure in plan (which is squared). In between two adjacent dentils, a list takes a squared profile and section corresponding to half the dentil plan size. This is to say, a list is a cube whose size is 1 half of 2 dentils. According to these proportions, at least other five dentils may be put in place until reaching the edge of the pilaster strip. However, the relationship between the several elements in the cornice imply some alterations to these perfect measures[19]. According to the detail, the alterations result in:

19 It is true that previously, while analyzing the architrave, a couple of moldings have been slightly modified in order to fit the information from *Architettura Civile*. In that case, however, the engraving was not providing the same amount of information available for the cornice. Additionally, the cornice itself is not listed among the ones Guarini mentioned in relation to Corinthian orders thus making the detail its only reference.

- one dentil has to be aligned to the rosetta;
- a second dentil has to be aligned with the brackets;
- a third dentil has to be located in between the two mentioned above;
- one of these “in between” dentils has be located at the entablature corners.

Such a rhythm, however, is not compatible with the length of the pilaster strips. In order to preserve both the dentil alignment and the proportions of the pilaster strips, the space in between the dentils had to be altered. In this way, it is possible to maintain all the required alignments. The only exception from Guarini's directions is the length of the list in between the dentils. While its measure has been kept constant, it is now found by equally spacing nine dentils at the top of each pilaster strip (thus being out of the module). Such spacing is constantly repeated around the pillar profile.

In between two pilaster strips, the entablature holds a rosetta (and thus its correspondent dentil) at the center of each segment. From here, the dentils were replicated, preserving the same spacing used in correspondence of the pilaster strips but avoiding irregularities in the semicircles containing the *rosettae*. However, this choice results in two dentils intersecting into a polymorphic element located at the inner corners of the pillars.

4.2.8 Geometry of the main order entablature

With the exception of the cornice, the entablature does not present a complicated profile. One of its moldings, a *kyma*, appears again in both architrave and frieze. Composed by two adjoining circular segments sharing the same radius, a *kyma* appears in both its standard and reversed version.

4.2.8.1 Kymas

The following construction builds the first appearance of this molding in the main order entablature: a reversed kyma above the second fascia of the architrave **[figure 127]**. The points *1* and *2* individuate the location where the profile will respectively start and end. From *3*, the middle point of the segment *1-2*, draw the circle π_1 with radius *1-3*. Centered on *2*, draw another copy of π_1 (passing through *3*) individuating *4*. Centered on *4* draw the circle from *2* and *3*—it will individuate the upper portion of the reversed kyma.

To find the lower portion of the molding, center on *1* with radius *1-3* individuating point *5* and, from here, draw the circle passing through *1* and *3*. Since *2-3* = *4-2* = *4-3* and *1-3* = *5-1* = *5-3*, all the circles used to define the reversed kyma are copies of π_1.

Beside variations in the position of their starting and finishing points, the other kymas in the building follow the procedure described above. The only difference between a standard and a reversed kyma, in fact, is the location of the circles centered on *4* and *5*. They create the profile of a standard kyma from the construction above (representing a reversed kyma) by mirroring the centers of the circles from *4* and *5* according to the segment *1-2* generating the molding profile.

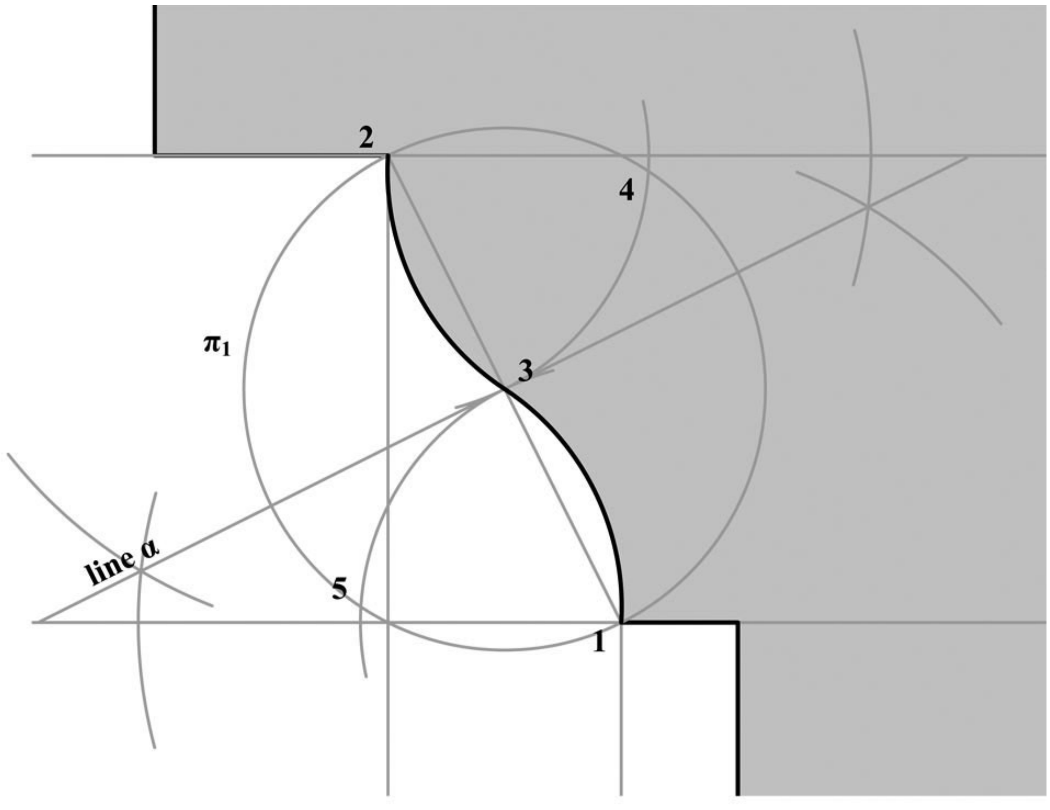


Figure 127. Construction of the kyma in the main order architrave.
Drawing by the author.

4.2.8.2 The sinusoidal cornice

Much more complex than the *kyma* above, the sinusoidal overhanging of the cornice requires combining information in section with the reversed plan. The length of a pilaster strip (segment AB) will serve as a main reference for describing the composition of the cornice. The additional straight profiles parallel to AB may be drawn in the reversed plan by simple orthographic projections from the cornice section (or directly from the table containing the cornice information).

The first element that needs to be put in place to set up the sinusoidal moldings are the dentils **[figure 128]**. Draw the axis of the segment A-B (*line a*). Project the dentils in plan and find point *1* on the dentil aligned to the pilaster strips axis. According to the cornice detail in the engraving, five more dentils can fill the pilaster strip until reaching the entablature corner. To find the position of the last dentil, draw from B a forty-five degree line (*line b*) on which point *2* (aligned to point *1*) individuate the corner of the corner dentil. Fill the space between the dentils from *1* and *2* with an additional four dentils creating their spacing along the pilaster strip length. Aligned to the dentils axes additional elements from the cornice will be put in place. A rosetta will be located in correspondence of lines *a* and *d*; a bracket in correspondence of *line c*. The rosettae are contained in a semicircular niche with center on *3* (on *line a*) and *4* (on *line d*). These two points (*3* and *4*) are found by applying in plan the information provided in the cornice section. Likewise, using the very same information, it is possible to draw the lists framing these niches. In between niches and dentils, the sinusoidal molding will be set up. The centers of these moldings will change location according to their profile. When concave,

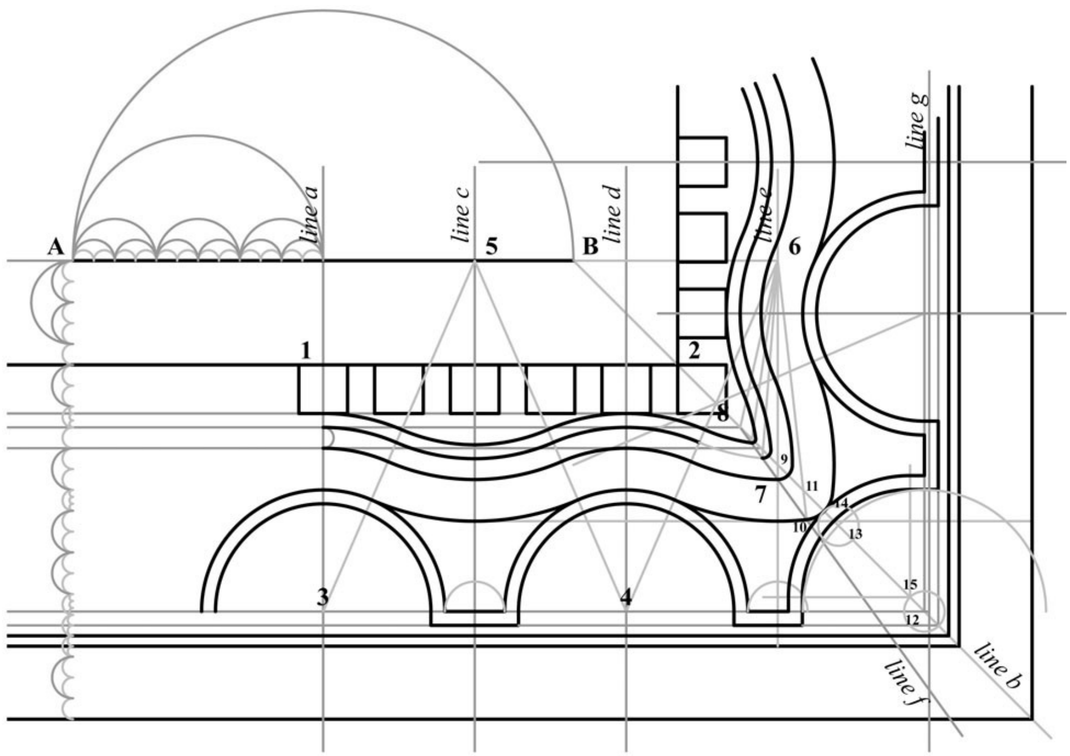


Figure 128. Construction in plan for the sinusoidal cornice.
Drawing by the author.

the centers will be at *3* and *4*. When convex, the curvature will be centered on C, the intersection between segment A-B and *line c*. The curvature change in the sinusoidal molding will happen on the flex lines *3-5* and *5-4*.

At the corner, the sinusoidal rhythm is altered. The constant pattern of the curve, which would have virtually continued until *line e*, needs to extended until the diagonal *line b*. Therefore, a new reference line needs to be introduced linking *7* (the intersection of the sinusoidal edge of the *tondino* centered on *6*) to *8* (the intersection between the straight projection of the *tondino* and *line b*) in *line f*. Here the curves in the sinusoidal patterns will approach the entablature corner. In order to do this, each profile will have its own center gained joining each point of the curve on *line f* to point *6*. The intersection of the sheets of lines with *line b* provide the location of the centers for each profile in the sinusoid. For example, the curve from *7* will turn the corner centering on *9*; point *10* will achieve the same result centering on *11*. Like for the sinusoids, also the semicircular niches containing the *rosettae* are altered when reaching the entablature corners. In this case, the niches will be reduced from semicircles to quarter circles. The center of this quarter circle, however, needs to be replaced. Following the pattern in the cornice, in fact, the corner niche would have been centered on *12* (on *line g*). This circle intersects the diagonal *line b* at *13*, which is not in contact to the outermost sinusoid in the cornice at *14* (corresponding to the *ovolo*). In order to find this alignment, the circle with center *12* has been transferred, moving point *13* to point *14*. The new circle will have its center on *15* and will connect to the list framing the cornice by straight lines.

4.2.8.3 Caulicoli

At last, the *caulicoli* in the entablature provide the illusions of brackets for the upper moldings. The actual brackets sustaining the cornice, in fact, are hidden behind these elements. Extending from the *ovolo*, the brackets are shaped as acanthus leaves using a solution Guarini will later use in San Lorenzo in Turin. The actual shape of the *caulicoli* highlights a quite complex volume. According to the engraving details, the *caulicoli* start from the top of the *ovolo* following in plan a quarter circle path around the *rosettae* while, in side elevation, they follow a spiral path. The three-dimensional rendition of these elements is obtained by extruding the spiral profile of the *caulicoli* along a vertical cylindric plane, over which the spiral has been projected.

4.3 The composition of the side bays

4.3.1 The secondary architectural order

Similar to the main architectural order, the secondary order does not follow specific compositional rules, showing a hybrid nature **[figure 129]**. Its capital follows Corinthian principles while details in the entablature suggest references to both Doric and Ionic orders. Among these elements, the only details provided by Guarini are regarding the capital. Shown at the side of the building plan, the capital show a double tier of leaves wrapping their bottom section. At the corners, the conventional *caulicoli* are now reversed, facing the inside of the capital instead bending outwards while their cores are

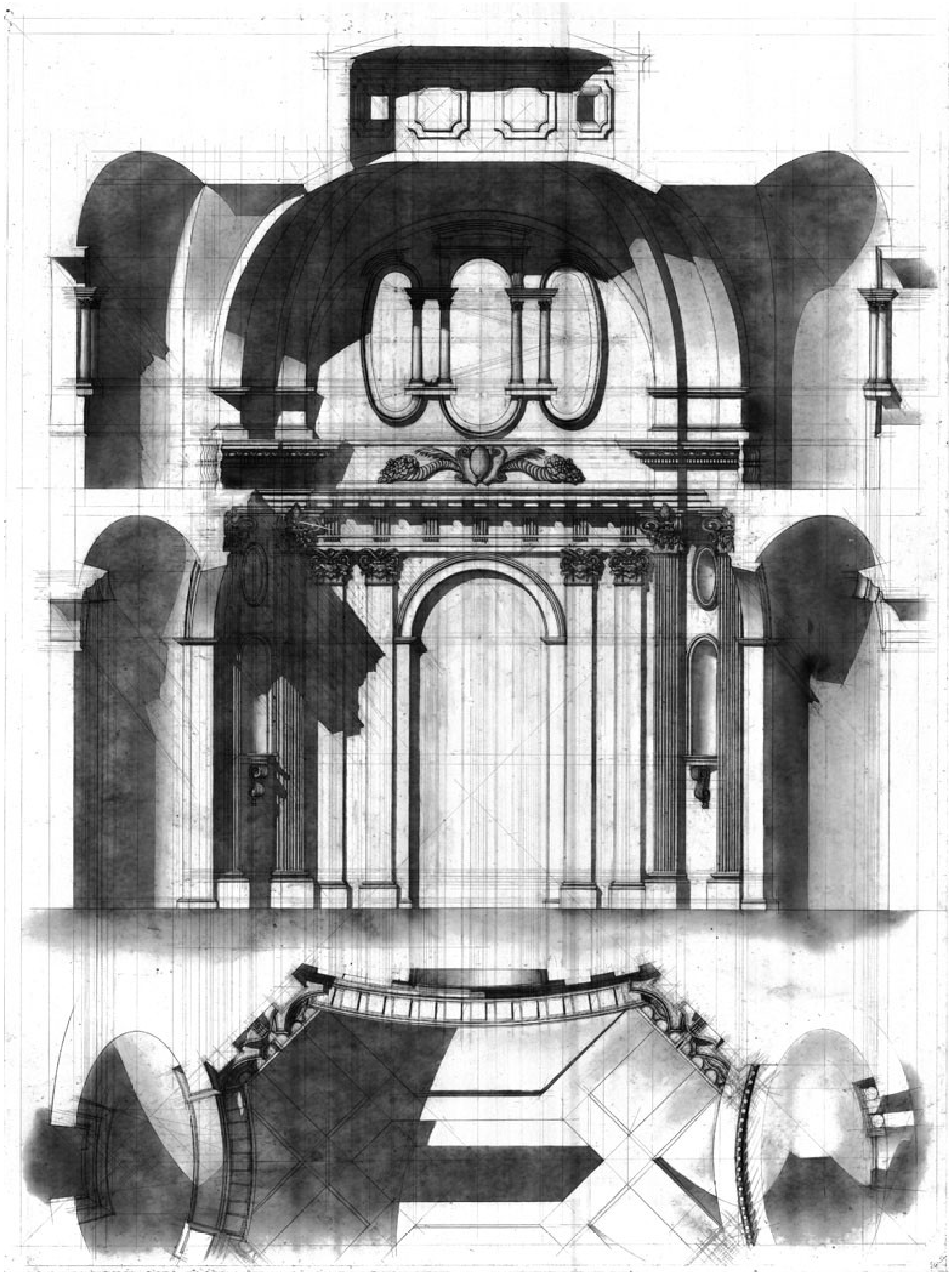


Figure 129. Section of the eastern side bay in the transept along a plane passing the axes of the elliptical chapels.
Drawing by the author.

connected by a laurel of fruits. At the center, a bouquet composed by a flower and two branches take the place of a conventional rosetta. At the top, the architrave show a division in two fascia, as typical of Ionic orders. However, at its top, the frieze is composed by triglyphs according to Doric traditions.

The overall proportions of the order appear altered too. Instead of following standard directions, the secondary order is in direct relationship to the main architectural order. Its architrave and frieze are contained in the main order capital. The cornice matches the architrave of the main order. The railing crowning the secondary order occupies the space corresponding to frieze and cornice of the main order. Similar pairings are not uncommon in Guarini's architecture. Such goals, in fact, were on the main reason for introducing a single modular system in the pantheon of the architectural orders. However, compared to later examples like San Lorenzo in Turin, the intersections in Sainte-Anne appear to be much more controlled, avoiding almost entirely awkward joints by un-matching moldings. Such relationships between the main and secondary orders is here preserved and, when necessary, enhanced for the present reconstruction. One of its consequences, however, is to alter some of the suggestions from *Architettura Civile*.

4.3.2 The base of the secondary architectural order

The base of the secondary order is not exactly clear in composition. However, because of its graphic similarity to the base of the main order, it is interpreted as an Attic base too. Because of this, the module is shared between the two orders instead being re-proportioned according to the pilaster strip size. Therefore, the base preserves the main order proportions for its elements. The only exception is on the plinth above which the base stands. The original engraving shows the bases of both main and secondary order sharing the same measure. Such solutions, however, appears to overlook the different roles the two orders play in the composition. The main order, in fact, lays on the pillars framing the church. The static nature of these elements is interpreted in the project by a sense of massiveness; the spaces between the pilaster strips is just carved in niches never hosting subsidiary spaces or opening. The secondary order, instead, appears only along the perimeter of the building, protruding in its indoor spaces. Here the secondary order frames convex volumes carved into elliptical chapels whose access is marked by simplified pillars below the chapels' arch springers. In between these framing pillars (in direct contact with the church floor) and the main order pilaster strips (on a plinth) the secondary order should lay on a middle measure. The new alignment preserves the relationship between main and secondary order, moving the top moldings of the latter at the plinth quote of the main order.

Element	**Dimensions in section**	**Distance from the shaft**
Plinth	1 M	5 p
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 ~ 1½ p
Smoothed List	½ p	2 ~ ½ p
Tore	2 p	2½ p
Base Dimensions	*1 M, 7 p*	*5 parts*

Table 12: Base of the secondary architectural order

The length of the shaft is obtained by subtraction like for the main order. Because of the base, it is known where the shaft starts. Its finishing measure, instead, is obtained by resizing the secondary order capital to the pilaster strips' length, thus obtaining the correct measure of the shafts.

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	1 part
Apophis	1 p	1 part ~ 0
Shaft	17 M, 10½ p	0
Apophis	1 p	0 ~ 1p
List	½ part	1 part
Shaft dimensions	*18 M, 1½ p*	*3p*

Table 13: Shaft of the secondary order

As visible, no flutes have been added to the secondary pilaster strips in order to keep a visual hierarchy between main and secondary order. This choice also matches the possible Doric roots of the secondary order; in *Architettura Civile*, in fact, Guarini deprives the Doric order of flutes.

4.3.3 The entablature of the secondary order

A hybrid between Doric and Ionic orders, details about this specific entablature are not contained in *Architettura Civile*. Similarities may be compared to the engraving rendered in Plate VI number 27 of Guarini's essay **[figure 130]**. The detail, however, is not accompanied by a description or an analysis of its moldings. It is just listed among "freestanding Doric entablatures."[20] The detail shows order contaminations: architrave in fasciae (Ionic), triglyphs and metope (Doric). The missing proportions of these elements

20 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), p. 105.

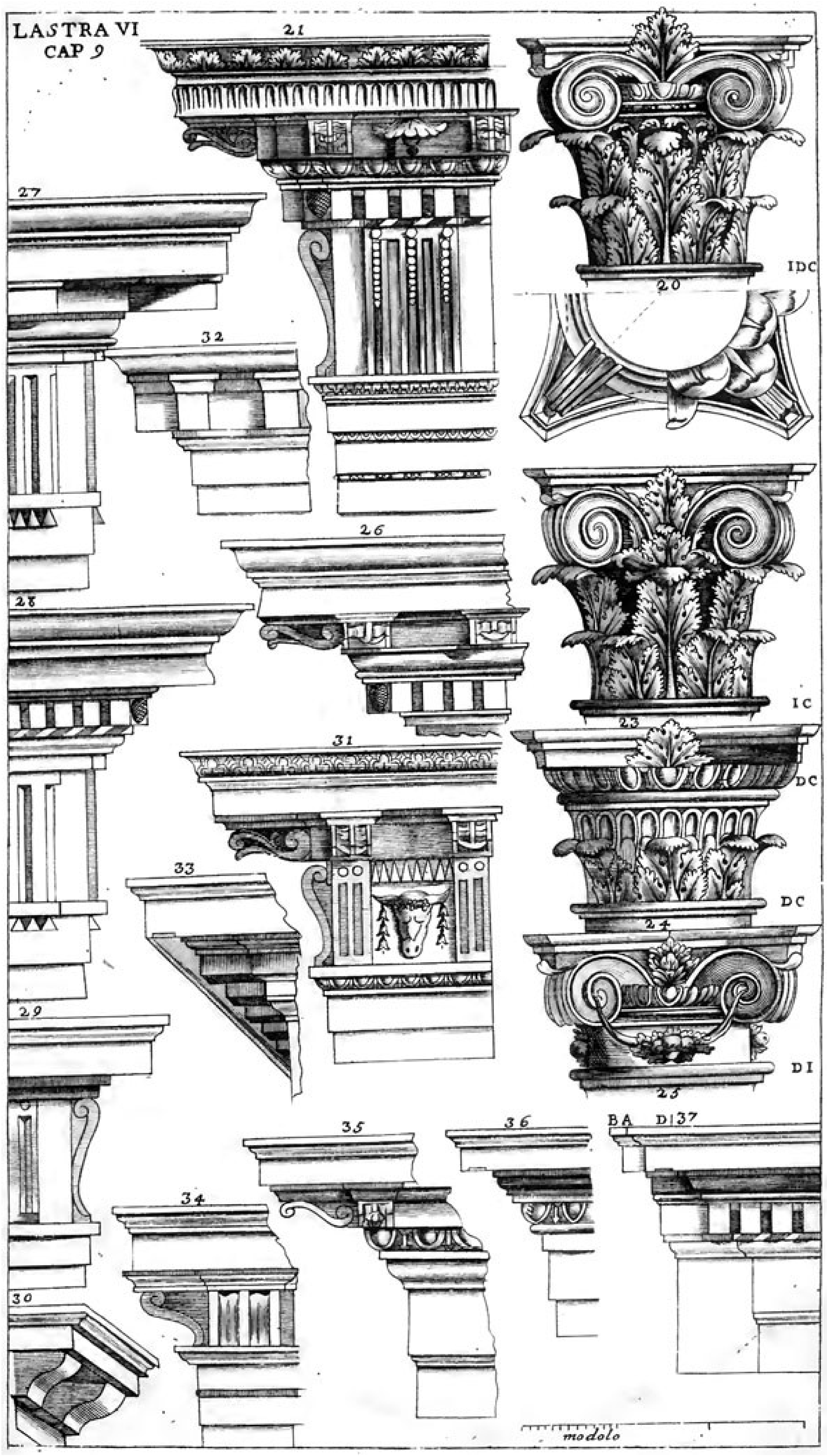


Figure 130. Detail for the entablature of the secondary order by Architettura Civile.
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate VI cap 9

(which are referenced to their respective architectural orders) has been adapted to their relationship to the main order, suggesting the resulting proportions:

Element	**Dimension in section**	**Distance from the shaft**
Architrave	1 M	0 ~ 1½ p
Frieze	1 M, 5½ p	0 ~ 6½ p
Cornice	1 M, 7½ p	6 ½ ~ 2 M, 2/3 p
Entablature dimensions	*4 M, 1 p*	*2 M, 2/3 p*

Table 14: Entablature of the secondary order

Additional details for the architrave is based on Ionic orders. This element, in fact, appears to be divided in two fasciae topped by a *tenia*. Typical of Doric orders, a *taenia* had the purpose of linking the architrave to the *triglyphs* above. The conical elements hanging from it (the *guttae*) were originally bronze nails which, passing through the architrave, were keeping the *triglyphs* in place. Because of their conical shape, these elements were called *guttae*, which means *drops*. The overall proportions of the architrave, according to Ionic order, matched the corresponding moldings from the main order. Therefore, no alterations were done to any of its elements.

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	4 p	-
Fascia II	6 p	½ p
Taenia	2 p	1½ p
Architrave dimensions	*1 M*	*1½ p*

Table 15: Architrave of the secondary order

The alteration of *triglyphs* and *metope* in the frieze suggests Doric roots, in contrast to the Ionic nature of the architrave below. According to the engraving, the *triglyphs* appear to be traditionally composed by 4 lists and 4 glyphs (the fourth glyph is divided in two halves at both sides of the element).

Element	**Dimension in section**	**Distance from the shaft**
Metope / Triglyphs	1 M, 3½ p	0 metopa; 1 p triglyph
Fascia	2 p	1 p (metopa); 2 p (triglyph)
Frieze dimensions	*1 M, 5½ p*	*2 p*

Table 16: Frieze of the secondary order

The fascia at the top of *metope* and *triglyphs* preserves a constant overhanging of one part. The same measure is maintained also when moving to the sides of the *triglyphs*. The composition of the triglyphs follows traditional rules with triangular carvings in section. They overhang the *metope* by 1 part. In this way, the *triglyphs* may be contained in the *taenia* below (which shows an additional overhang of a half part from the triglyphs).

In order to match the proportions of the main architectural order, the secondary order frieze has been reduced by half a part. In this way, it was possible to align the *ovolo* from the cornice above to the to the same element from the main order entablature **[figure 131]**.

Finally, the cornice shows mixed roots between Doric and Corinthian orders. At its bottom, a set of moldings (list, *tondino*, *ovolo*) are reminiscent of the sinusoidal

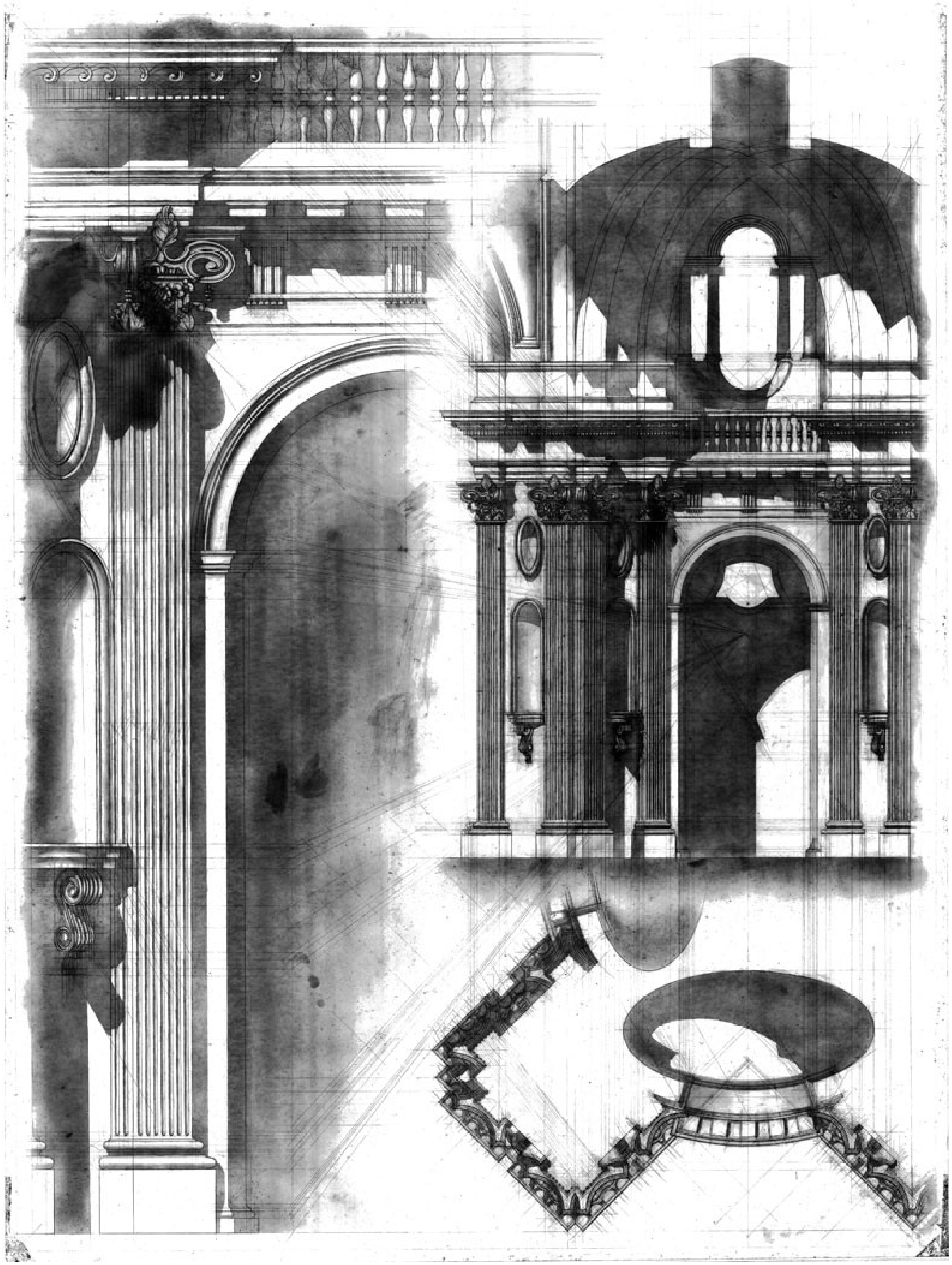


Figure 131. Relationship between main and secondary order in Sainte-Anne-la-Royale.
Drawing by the author.

elements in the main order cornice although now they follow the profile of the wall. Above them, an overhanging drip molding introduces brackets reminiscent of Doric orders. Away from the naturalistic layout of Corinthian brackets, these elements preserve instead the volume of a parallelepiped reminiscent of the *reguli* used in Greek Doric orders. Centered on both triglyphs and metope, the *reguli* were originally used to attach the roof structure to the rest of the entablature. Therefore, their profile contained more than one layer of *guttae*, similarly to the *taenia* in the architrave (where only one layer of *guttae* was used). In Sainte-Anne, however, the *reguli* show a plain profile deprived of the *guttae*.

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	2½ p
Tondino	1 p	3½ p
Ovolo	3 p	6 p
List	½ p	6½ p
Drip Molding	4 p	7 p ~ 1 M, 7 p
Ovolo	1 p	8 p ~ 1 M, 8 p
Fascia	5 p	1 M, 9 p
Cavetto	1½ p	1 M, 9½ p~ 1 M, 10 p
Reversed kyma	2 p	2 M, 2/3 p
List	1 p	2 M, 2/3 p
Cornice dimensions	*1 M, 7½ p*	*2 M, 2/3 p*

Table 17: Cornice of the secondary order

Compared to the other two portions of the entablature, the cornice has been subjected to several alterations in order to guarantee its compatibility with the main order. The first three elements in the cornice (list, *tondino*, and *ovolo*) have been moved down by a half part according to the frieze reduction mentioned above. The drip molding, list, and reversed *kyma* closing the secondary entablature, instead, have been re-proportioned to match the last fascia and molding in the main order architrave.

The junction between main and secondary order is solved by moving back the drip molding after covering the triglyphs at the far side of the entablature. In this way, the surface of the joint between the main and secondary orders is reduced in size while partially covered by the overhanging reguli in the secondary drip molding.

Lastly, a railing at the top of the secondary order occupies the volume of the main order frieze and cornice. Once more, the engravings do not offer much details for this element. Likewise, *Architettura Civile* does not show traces of spindles shaped like Sainte-Anne. The volume of these spindle is reconstructed as close as possible to the original engravings. Additional details are inspired by the set of moldings used in the main order entablature, to which the railing is directly connected. The sequence of moldings closing the railing (list-fascia-list) follows the proportions of the main top cornice (list-reversed *kyma*-list) while the profiles are simplified to follow the plain nature of the secondary order. The total height of the moldings at the railing top is preserved at the bottom of the same element. Here, however, the number of moldings is reduced in size (two instead of three) in order to provide a more solid appearance.

Element	**Dimension in section**	**Distance from shaft**
Plinth	3 p	2 p
Fascia	1½ p	3 p
Spindle	2 M, 3 p	-
List	½ p	2 p

Fascia	3 p	2½ p
List	1 p	3 p
Railing dimensions	*3 M*	*3 p*

Table 18: Railing at the top of the secondary order

The spindles are interpreted as rotation solids. A globular core is connected by the *scotiae* to pin-like elements connecting the spindles to the top and bottom portions of the railing.

Element	**Dimension in section**	**Distance from the spindle axis**
Pin-like volume	12 1/6 p	Because of the sculptural nature of these elements, their distances have not been constrained into modular measures
Scotia	1/3 p	
Globular core	4 p	
Scotia	1/3 p	
Pin-like volume	12 1/6 p	
Spindles dimensions	*2 M, 5 P*	

Table 19: Proportions of the railing spindles

4.3.4 The archways in the secondary order

The secondary order closes the gaps between the main pillars. The walls hosting the secondary order, however, do not develop along a straight surface. They follow the convex profile of the elliptical chapels in the side bays, whose volume protrudes into the volume of the side bays. Framed and topped by the secondary order, these chapels become accessible through arched gateways sustained at the side by an essential pilaster strip [see **figure 131** on page 254]. While following the compositional patterns of the secondary order, the archways show simple details in relation to their tertiary role in the architectural hierarchy in the composition. Once again, the original engraving deprives these gateways of compositional details. Apparently deprived by a base, the pilaster strips show plain shafts topped by essential capitals divided in three portions. In the same fashion, the arch above them shows a plain surface. In order to match such simple surfaces, the archways are referenced to Doric orders. From *Architettura Civile*, in fact, the plate analyzing Tuscan/Doric orders (Plate I, number 23)[21] shows a detail for arch springers similar to the one in Sainte-Anne. According to this information, the missing base of the pilaster strips has been restored. Composed by plinth and a tondino, the base references the simple composition used in the capitals of the very same pilaster strips.

In light of these adaptations, a modification was introduced to the reconstructed plan. The keystone in the archway has to be in contact with the secondary order entablature while its extrados needs to align in plan to the outermost edge of the main architectural order. As for the secondary order, these archways do not have a module of their own but still relate to the proportions of the main architectural order.

Element	**Dimension in section**	**Distance from the shaft below**
Fascia	7 ½ p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	½ p ~ 1¼ p
Ovolo	2 p	¾ p ~ 2¾ p
List	1 p	3¼ p

21 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), Plate 1-III number 23.

Arch moldings dimensions	*1 M, ½ p*	*3¼ p*

Table 20: Moldings framing the chapels arches

Sustaining the arch above, two plain pilaster strips match in elevation the thickness of the arch at its springers. In reality, however, the alignment is only an illusion visible in elevation; the pilaster strips below the arch, in fact, extend in plan until reaching the other architectural orders framing the archways.

Element		**Dimension in section**	**Distance from the shaft**
Base	Plinth	4 p	4 p
	Tondino	2 p	3 p
	List	1 p	2 p
Shaft	Apophis	1 p	1 p
	Shaft	~ 15 M, 10½ p[22]	-
	Apophis	1 p	1p
Capital	List	1 p	1 p
	Tondino	2 p	2 p
	Reversed Kyma	3 p	2 p ~ 4 p
	List	1 p	5 p
Plater Strip dimensions		*17 M, 2½ p*	*5 p*

Table 21: Pilaster strips framing the chapels

4.3.5 The geometry of the archways

While moving from one side to the other of the elliptical chapel, the arch follows

22 The shaft length does not show a perfect modular measure. Like for the shafts in both main and secondary order, this length is obtained by locating the pilaster strips in plan first, thus gaining the diameter of the arches above them. Moving the arches' keystone in contact with the secondary entablature gave the chance to properly locate the length of the pilaster strips.

a convex profile in plan. Constantly used by Guarini, similar arches have been identified by historians as "three-dimensional arches." In this configuration, in fact, the arch intrados is not identifiable by a cylinder but bends along a cone. In the case of the elliptical chapels in Sainte-Anne, the pilaster strips framing the archways are projected towards the center, in plan, of the chapel itself. However, since the the chapels have an elliptical layout it is not proper talking about their center. The pilaster strips' tilting is found by connecting their edge to the ellipse foci; the bisector line of the angle between the foci shows the amount of tilting to which the pilaster strips are subjected. Such tilting is followed by the arch above the pilaster strips too. Because of this, the arch intrados transforms from a cylinder to a cone while its three-dimensional extrusion bends along the curvature of elliptical chapels.

The positioning of the arch along the elliptical profile of the chapel individuates some reference points on the arch profile **[figure 132]**. Let *1* and *2* be the edges of the arch moldings. Centering on *1* with radius *1-2* create the circle π_1. Project point *2* to the top of the arch molding gaining point *3*—it will be the reference locating the arch along the curvilinear profile of the chapel.

Moving now in the chapel plan **[figure 133]**, its outer profile intersects *line* α, the edge of the main order pilaster strip and thus boundary into which the arch will be contained. Point *1* has to belong to this line, which intersects the outermost ellipse at *4*. Connect *4* to both the foci F_1 and F_2 and draw *line* β, bisecting the angle between *4*-F_1 and *4*-F_2. Using *4* as starting point, draw on *line* β the circle π_2 with radius *1-3*, gaining point *5*. From here, draw a line perpendicular to β until intersecting α at *6*.[23] The positioning of

23 It would have been more precise gaining point *6* by drawing an ellipse concentric to the reference one

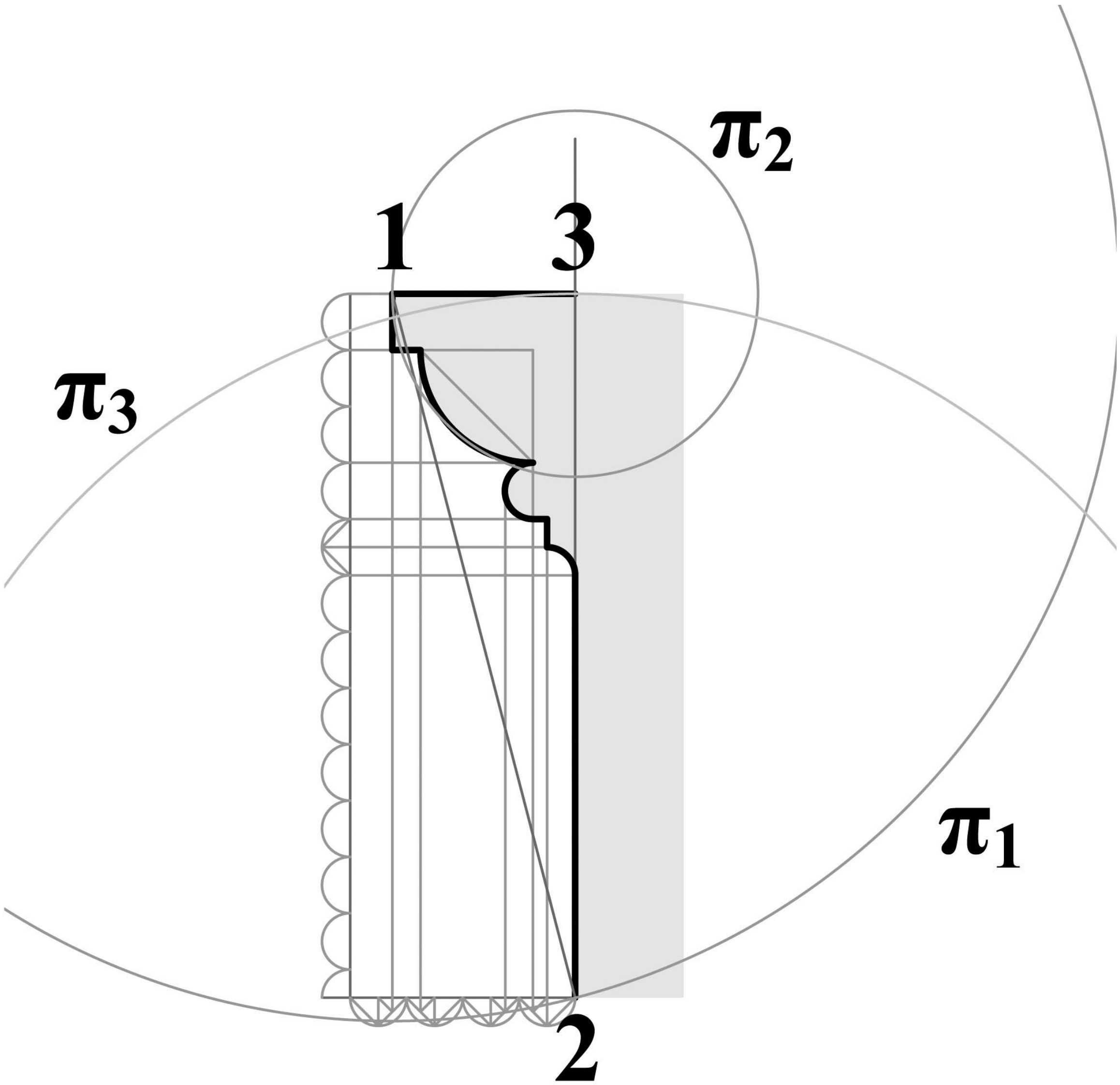


Figure 132. Molding profile in the elliptical chapels archways.
Drawing by the author.

and passing through *5*. However, because of the short distance between points *5* and *6*, the misplacement of point *6* according the method here adopted is minimal.

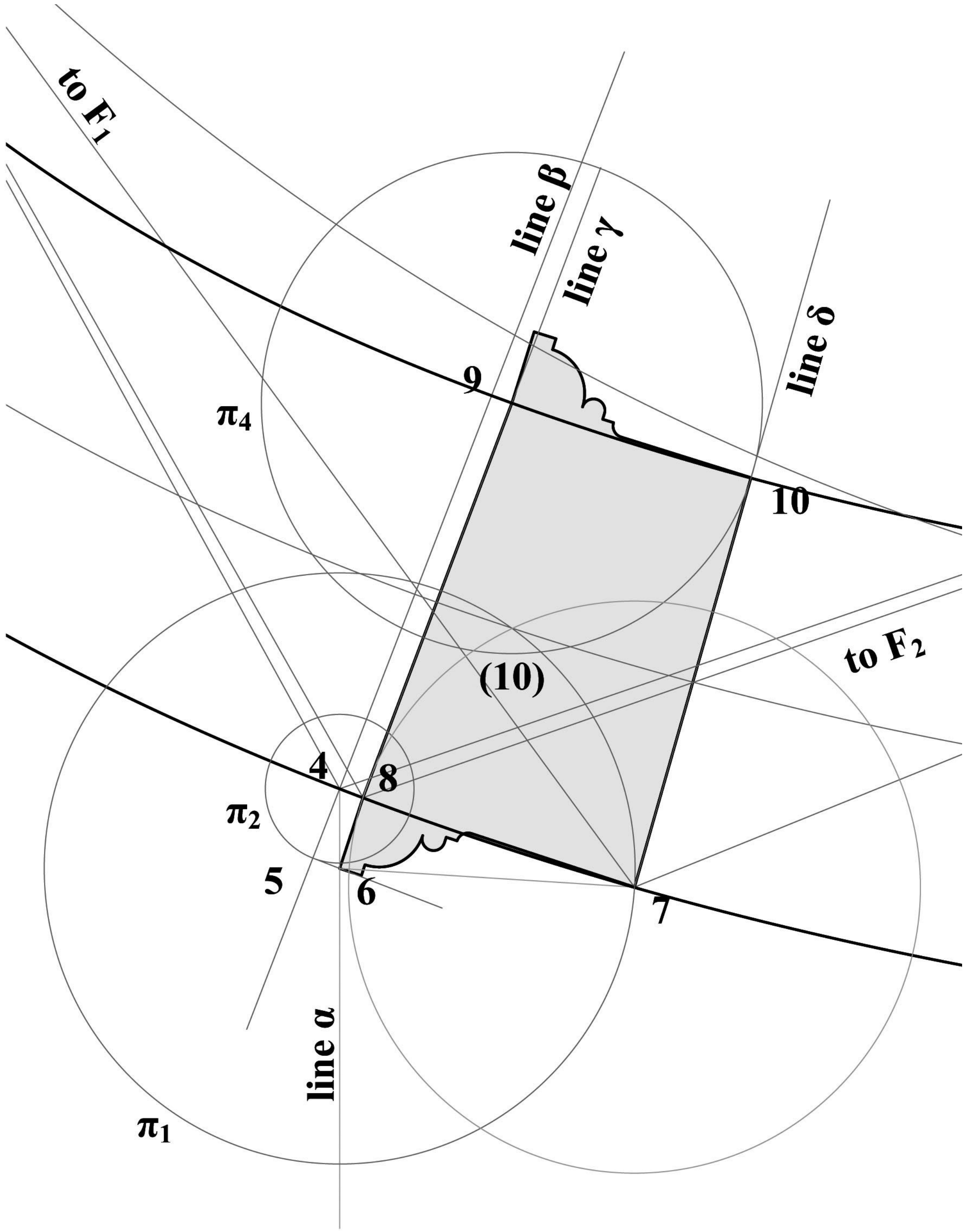


Figure 133. Geometric construction for the elliptical chapels archways.
Drawing by the author.

the arch section will happen moving point *1* to point *6*. Centered on *6* with span π_1 to gain *7* (which corresponds to *2*); likewise, Center on *7* with span π_3 to gain *8* (corresponding to *3*) on the chapel's outer ellipse.

Having set up the arch molding facing the side bay, it is possible to do the same for their counterparts facing the inside of the chapel too. Connect *7* and *8* to the foci F1 and F2 and draw the respective bisector lines gaining the points *9* (on *line γ*) and *10* (on *line δ*). As visible, the arch profile facing the inside of the chapel is shorter than the other one. Such volumetric reduction will be contained by the fascia at the bottom of the arch. Move a mirrored copy of the arch profile having point *3* coincident to point *9*.[24] Centered on *9* with span *9-10* draw the circle π_4 intersecting the temporary section from *9* on *(10)*. Rotate *(10)* along π_4 until reaching the inner profile of the chapel at *10*. Cut the section on line δ completing the arch profile.

To define its three-dimensional layout, the arch needs to be extruded along a convex plane corresponding to the chapel geometry in plan **[figure 134]**. The volume is composed according to stereotomic rules. However, because of the digital nature of this application, the number of elements segmenting the arch is reduced in number. While in real life the arch may be realized following the direction here provided, its segmentation will depend, among other factors, by the size of the available stone.

The main reference for controlling the extrusion of the arch is its main edges, this is to say the points *7, 8, 9, 10*. Connecting these points to their counterpart on the other side of the arch provides the main generatrices which are projected on the convex plane of the chapel (which may be extruded from the plan itself). The procedure here described

24 The mirroring of the section is justified by the different orientation of the arch when facing the chapel.

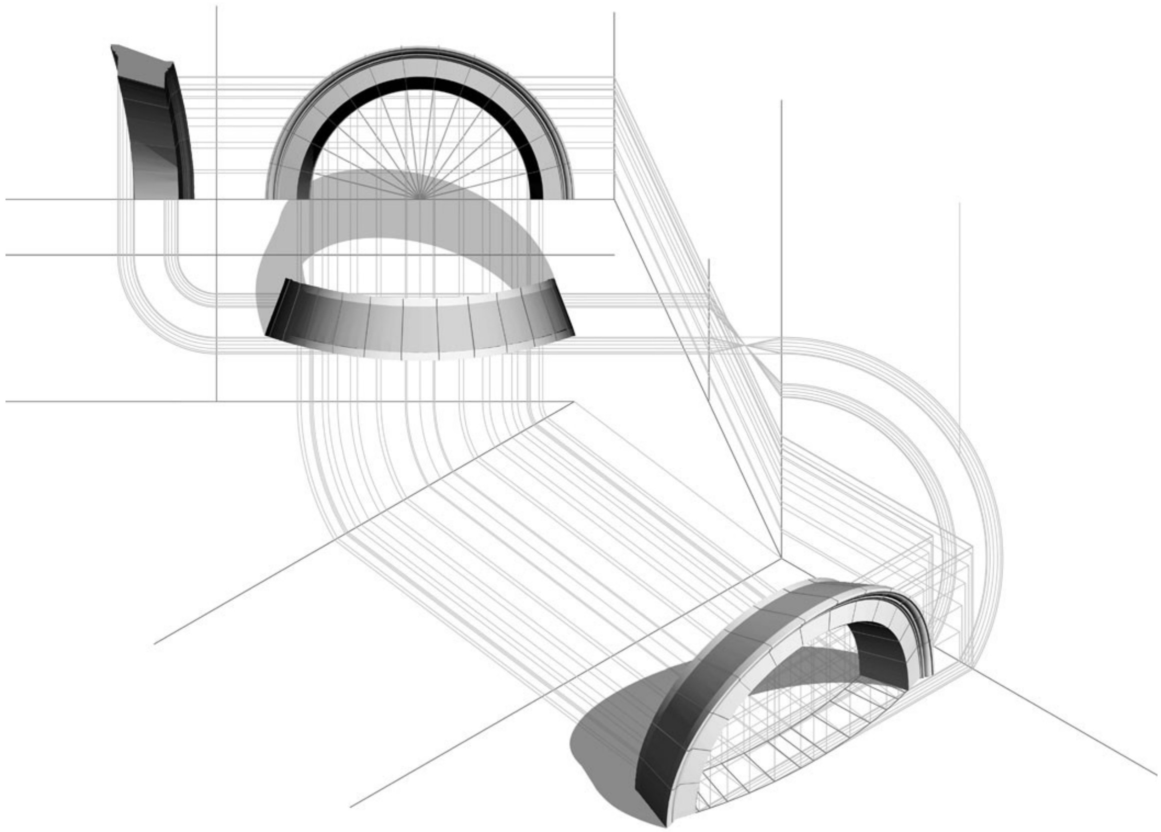


Figure 134. Composition of the elliptical chapels archways.
Drawing by the author.

is for one of these arches only, the one from point *7*. The other three, in fact, will follow a similar construction.

As visible from the engraving, beside its movement in plan, the arch preserves its semicircular profile in elevation. Here, the arch can be segmented in a variable number of parts. The more the elements segmenting the arch, the more accurate will be its final profile. In the present application, it was decided to divide the arch in thirteen parts. It is, in fact, desirable to segment an arch in an odd number of parts in order to avoid a joint in correspondence of its keystone. It is however suggested to add an additional point at the keystone just for control purposes. In this way, it is guaranteed that the arch will preserve its actual height after the extrusion.[25] Additionally, introducing a control point on the keystone provides an accurate reference for cutting the arch in half. Mirroring the missing portion of the element will guarantee its symmetry.

After dividing the arch in elevation, its segmentation points need to be projected on its curvilinear profile in plan. The easiest way to proceed it to generate a 3D-line following the arch outline in elevation. It is not required for such a line to maintain the actual curvature of the arch but its segmentation only. It purpose, in fact, is only to provide three-dimensional references for the arch extrusion. The same procedure may be followed for the other arches from *8*, *9*, and *10* [references relate **to figure 133**]. The actual extrusion was done in two separate solids at first: one for each of the two arches facing the side bay and the chapel.[26] The two volumes were later joined by Boolean operations using as reference the arch passing through *10*. During the creation of the three-dimensional arch, in fact, only the edge guiding the extrusion (from *7*) preserves its

25 Extrusions, in fact, connect reference points by interpolation. While this process is fairly accurate while working on a straight plane, it needs to be controlled when working on along a curvilinear surface.

26 Extrusions maybe realized by any CAD software.

correct geometry. The other edges, instead, (*8, 9,* or *10*) need to be manually corrected using as references their own 3D-lines. Additional imprecisions which may appear after joining the two main volumes may be later corrected, optimizing the vertexes composing the solid.

4.3.6 The domes in the elliptical chapels

The graphic information Guarini left about Sainte-Anne does not show how the volumes inside the elliptical chapels would be solved. Based on their layout in plan, however, is seems plausible to hypothesize the chapels would have been covered by domes. The simple volumes of an elliptical dome, however, are subjected to different cuts when appearing in the first two levels of the church. At the first level, the dome is deformed on one side by the bended arch facing the side bay. At the second level, instead, its volume is partially cut by the side bay vault.

At the first floor, the springer plane of the dome is the same one used for the arch accessing the chapel. Inside the chapel itself, the tip of the dome is located along the plane passing from the top of the triglyphs in the secondary order. In this way, the fascia above the frieze and the whole cornice of the secondary order provide enough thickness to constitute the slab for the second level. Using these references, it is possible to build a first model for the dome. Part of this model, however, will have be deformed to accommodate the bended arch accessing the chapel. Because this arch shows a constant thickness in elevation, it means it is free from eventual deformation from the elliptical chapel behind it. In the opposite case, in fact, its thickness would have changed while moving from springer to keystone. As a result, it will be the elliptical dome that deforms according to the arch profile.

The construction focuses first on the dome half that stays undeformed (this is to say, the one in contact with the church peripheral walls) **[figure 135]**. In order to maintain continuity to the arch model already realized (points from A to G), whose geometry defines part of the dome, its segmentation is used in the dome too. Since the dome will be realized by horizontal sections, the points between F and G may be eliminated because of its proximity to G itself: it would have not add sensible information to the dome. From the points from A to G, draw in front view horizontal lines until reaching the dome profile[27] thus gaining the points from *1* to *7* in both front and side view. Project these points in plan on their respective dome axes (longitudinal axis for the points in front view; transversal for the ones in the side view). Pointing in plan into the center of the ellipse at the base of the dome it is possible to draw contour lines for each on points of the longitudinal and traversal axes.

The remaining contour lines may be obtained dividing the rest of the dome in additional segments. In order to preserve a spacing similar to the one already used, the remaining portion of the dome is radially divided in six more parts using the very same center of the arch, AG. The eccentricity of the ellipse individuating the dome profile in front view, in fact, is very close to a half circle. Therefore, the use of radial lines provides a segmentation almost as constant as on a circumference. The new points resulting from such division go from *8* to *13*. They may be projected in the side view and then moved in

27 Both longitudinal and transversal sections of the dome may be already drawn since the plan profile of the solid and its tip measure are already known.

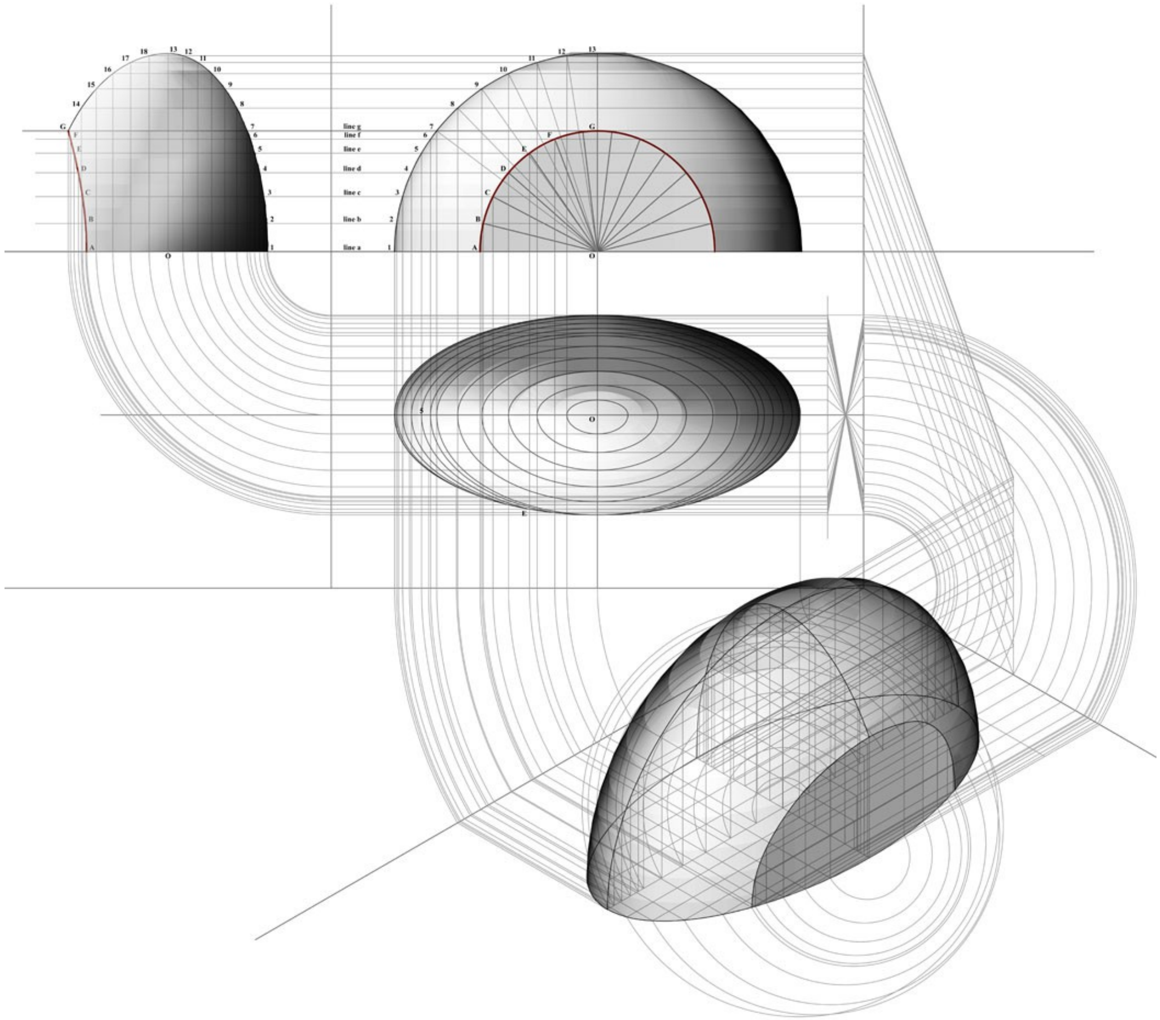


Figure 135. Dome in the elliptical chapels.
Drawing by the author.

plan to find the missing contour lines.

More complex than the previous solid, the second half of the elliptical dome needs to merge with the bended arch accessing the chapels. Moving down from its keystone, this dome half is composed by contour lines whose eccentricity vary to absorb the volume of the bended arches. The lower portion of this half dome follows the points from A to G. Project these points in plan on the outer profile of the dome and draw the contour lines passing from them and their correspondent points on the dome longitudinal axis. For example, focus on point E. Located on *line e*, this point belongs to the contour lines from *5*. Project in plan both *5* and E and, centering on O, draw the ellipse passing through them.[28]The same method may be repeated for the other points over the arch AG.

To construct the upper portion of the dome, the analysis needs to move to the side view (section along the transversal axis). Centered on O, draw the ellipse by *13* and *G* which show the profile of the dome along its transversal axis. Extend the lines from *8* to *12* until intersecting the new curve, thus obtaining the points *14* through *18*. Project these points in plan along the minor axes of the dome and, centering on O, connect them to their correspondent points on the longitudinal axis. Match these curves to the ones individuated on the other half of the dome, completing the information required to create an accurate three-dimensional solid of the dome. Such a solid may be created with any CAD software by a simple mesh connecting the contour lines.

28 Such ellipses may be drawn using the construction for an ellipse by center and two points not belonging to the axes of the curve.

4.4 Tier I – The World of Humankind (The Celestial Path)

Away from the horizontal and vertical directions of the longitudinal and transversal axes, the Celestial Path crosses diagonally along the indoor spaces of the church. Anchored on the main pillars and their corresponding protrusions on the peripheral walls, this new path wraps the church figure ground with curvilinear vaults and domes. Along such surfaces, diagonal ribs underline the new geometric setting. When reaching the central bay, the compositional fulcrum of the church, the first level orientation overlaps he second level, giving birth to a pendentive. Due to its polymorphic surfaces, the whole composition evolves into a circumference, the symbol of perfection; its geometry will shape the upper levels of Sainte-Anne-la-Royale.

Because of its composition, the second level is mainly occupied by vaults and domes with plain profiles. Sporadic exceptions to this rule appear in the arches framing the central bays and in the pedestals linking the vaults to the first level architectural order. A new architectural order appears only in the elliptical chapels and side bay windows.

4.4.1 The vaults pedestal

As the link between the architectural orders in the first level pillars and the vaults above them, the pedestals have the purpose of elevating the apparent vaults level. Their nature and architectural details are not perceivable from the section engraving. However, since the cornice below them had Corinthian roots and the gallery above is Doric, the pedestals, as middle elements, have been referenced to the Ionic order. Because of their reduced height, the pedestals would have been mostly hidden from view by the overhanging of the main order cornice. Consequently it is here chosen to avoid excessive decoration and reference them to the first Ionic order from *Architettura Civile*[29] **[figure 136]**. The composition of its elements adapts the proportion in Guarini's essay to the graphic information in Sainte-Anne's engraving [see **figures 124** at page 228, **129** at page 247, **131** at page 254].

Element	Dimension in section	Distance from shaft
Plinth	6½ p	3¾ p
Kyma	2 p	1¼ p ~ 3¼ p
Tondino	1 p	2 p
Base dimensions	*9½ parts*	*3¼ p*
List	1 p	1 p
Aphophis	1 p	0 ~ 1 p
Shaft	1 M, 6½ p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Shaft dimensions	*1 M, 10½ p*	*1 p*
Ovolo	2 p	3 p
List	1 p	3½ p
Fascia	2 p	4½ p
List	1 p	5 p
Capital dimensions	*6 p*	*5 p*
Pedestal Total dimensions	***3 M, 2p***	***5 p***

Table 22: Proportions of the vault pedestals

29 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), Plate 2-III number 21.

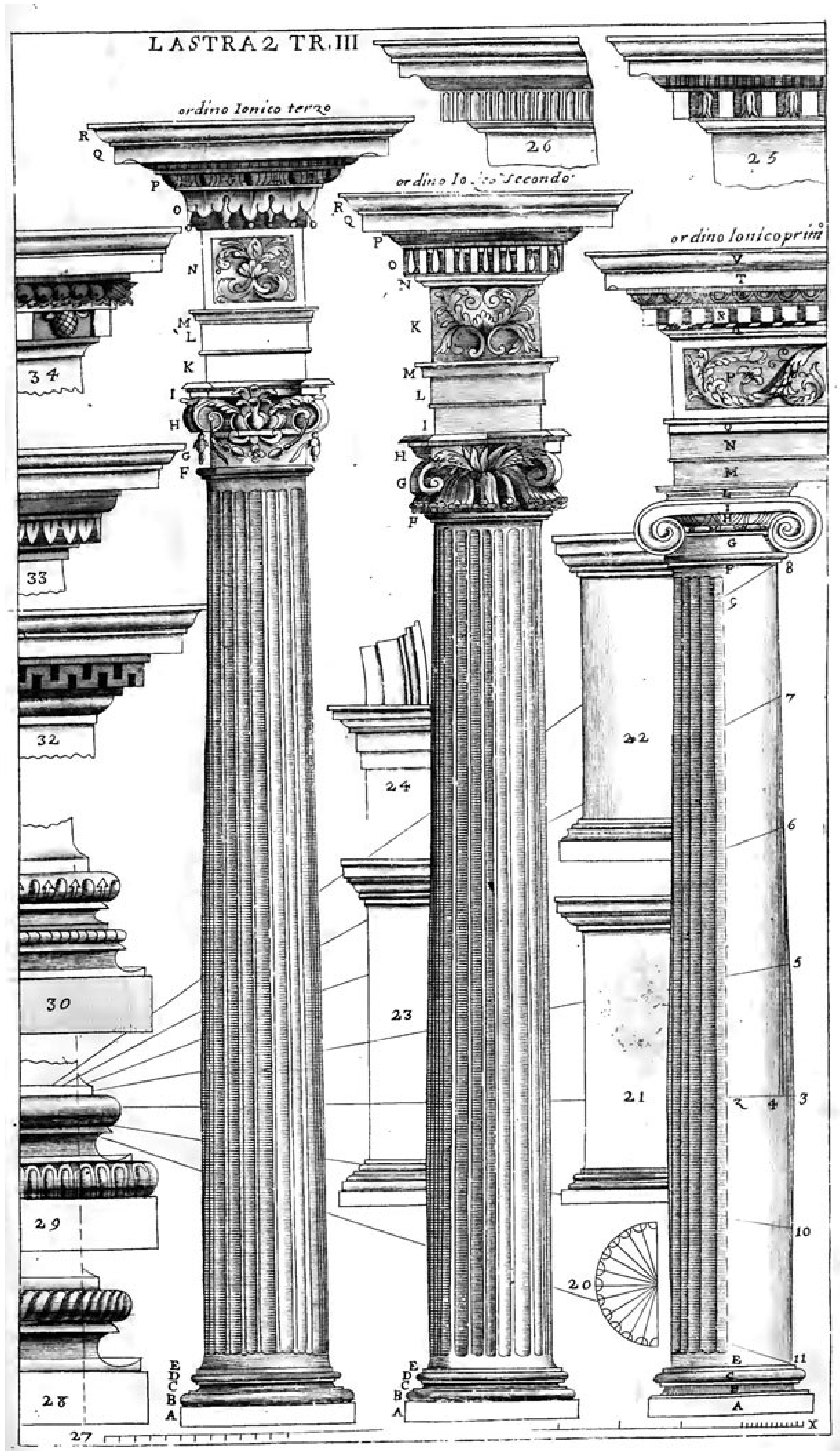


Figure 136. Reference for the vault pedestal from Architettura Civile.
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 2-III

Above the pedestals, the ribs framing the vaults preserve the same width of the main order pilaster strips. When in the central bays, the ribs are no more directed in plan orthogonally to the pillars but bend sideways while their profile is embellished by molding reminiscent of Ionic and Corinthian architraves.

4.4.2 The arches framing the central bay

According to the engravings, a line divides the arches in the central bay in at least two fasciae. Such a composition may indeed suggest a division similar to an Ionic architrave. Since *Architettura Civile* does not provide additional information on such elements, their missing details are hypothesized based on Guarini's still-existing projects. Among them, San Lorenzo in Turin seems to provide enough references for such arches. In that project, in fact, the arches framing the central bay show a division in two fasciae. Additional moldings further enrich the arches together with carvings in their intradoses. The only difference between the arches in San Lorenzo and the ones in Sainte-Anne regards their spacial setting. The straight path above which they develop in Paris instead bends around the central bay in Turin.

The overall proportion for reconstructing these details along Sainte-Anne central bay arches comes again from the main architectural order. The arches, like the ribs framing the vaults in the church, are in direct relationship to the length of the main order pilaster strips. Their module is mainly used to proportion the moldings in between the two main fasciae, while these last elements concentrate eventual out-of-module measures dictated by the variable intersection between arches and side bay vaults **[figure 137]**.

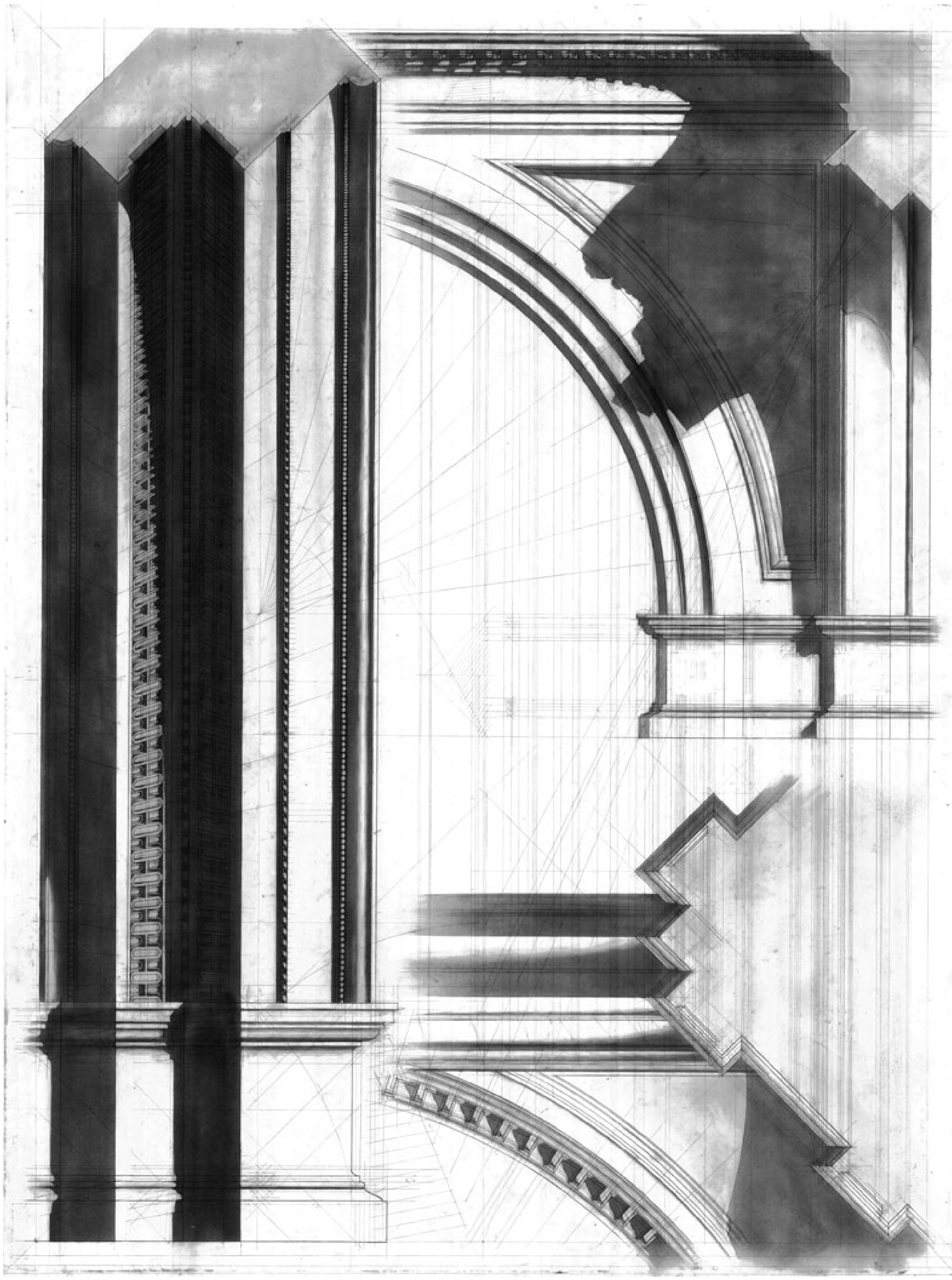


Figure 137. The pendentive in the central bay.
Drawing by the author.

Based on San Lorenzo and the proportions of Ionic architraves, the arches facing the central bay are composed as follows:

Element	Dimension in section	Distance from shaft
Fascia I	6 p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	1¼ p
Fascia II	10½ p	1¼ p
Apophis	½ p	1¼ p ~ 1¾ p
List	½ p	1¾ p
Tondino	1 p	2½ p
Ovolo	2½ p	4½ p
List	1 p	5 p
Arches dimensions	*2 M*	*5 p*

Table 23: Proportions of the arches framing the central bay

Besides visual alteration from the engraving due to the further details added into the arches, it must be remembered that in the engraving the arches do not appear in real size but reduced by half. In plan, they are tilted by forty-five degrees from the vertical plan onto which the section has been cut. The orientation of the arches directs their lower fascia towards the longitudinal/transversal axis of the church so that at the keystone the top moldings will sustain the independent entablature.

At the side of the facades facing the central bay, the complete body of these arches wraps the pillar's corner in the transition from central to side bays. These additional portions of the arches, however, are subjected to the irregular geometry of the pillars thus evading exact modular measures. Also in these cases geometric irregularities are concentrated in the fasciae only while continuity in the composition is maintained by the constant proportions of the moldings. Based on the surface available, the arches facing the side bays show one fascia only. In these cases, the composition of the arches happens from top to bottom. In this way the top moldings have been properly put in place while the rest of the arch surface constitutes a fascia.

According to these directions, two different arch/architrave settings are put in place in Sainte-Anne-la-Royale: one facing the side bays along he transversal axis, and a second one facing the side bays on the longitudinal axis. Their setting depends on the corner transitions in the pillar while moving from the central to the correspondent side bay.

On the transversal axis, the transition between central and side bays is composed by four sides perpendicular to one another **[figure 138]**:

(a) the architrave/arch facing the central bays;

(b-1) the side portion of the arch (which corresponds to the pilaster strip side facing the central bay);

(b-2) the side portion of the arch (corresponding this time to the pilaster strip side facing the transversal side bay);

Among (b-1) and (b-2), only the first segment holds a molded profile because of its belonging to the central bay. Segment (b-2), in fact, is present in plan only. The pillar

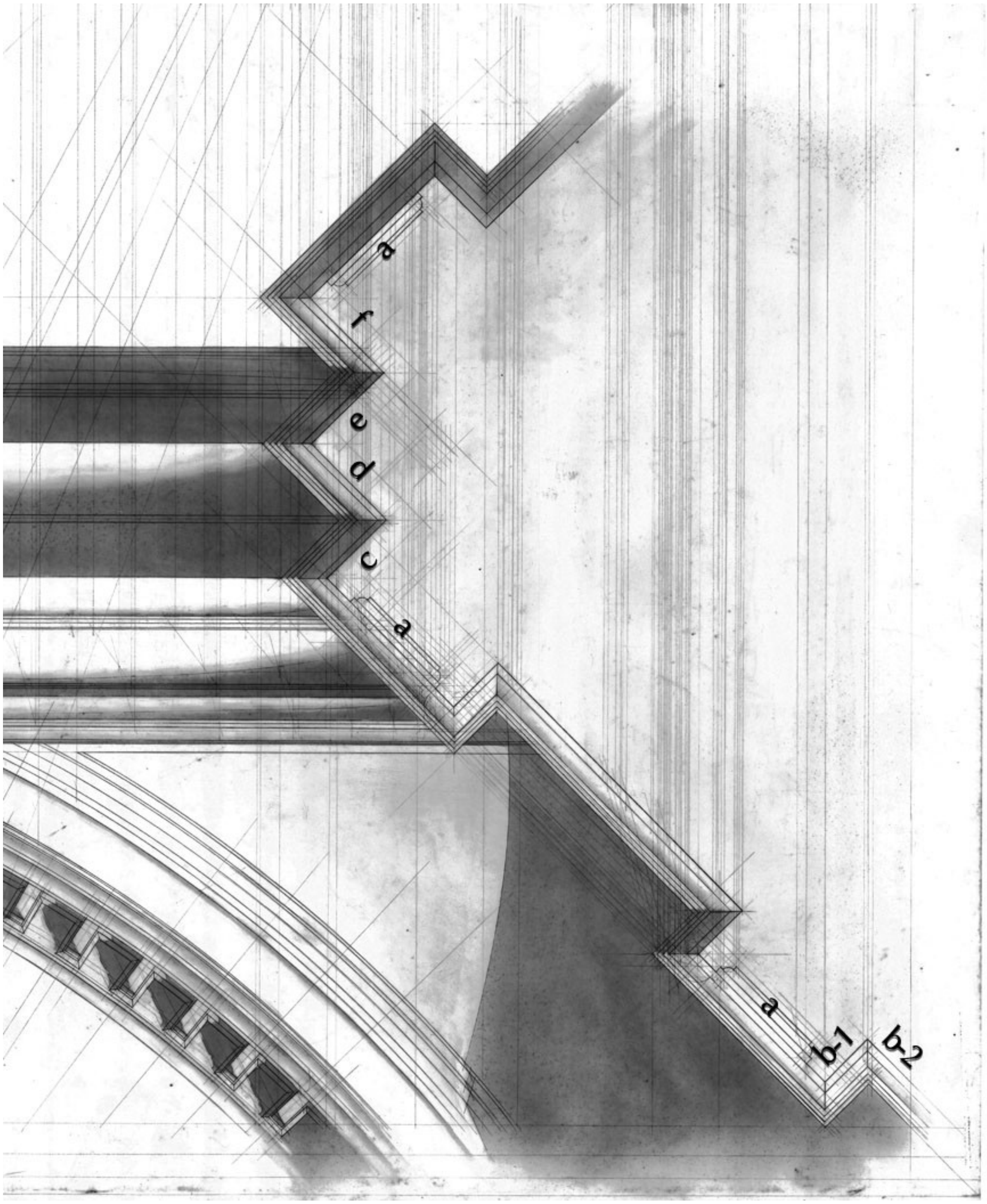


Figure 138. Composition of the aches framing the central bay.
Drawing by the author.

to which (b-2) belongs sustains one of the side bay ribs which move in plan orthogonally to its correspondent pilaster strip. Because of this, the side (b-1) becomes the actual visible edge of the side bay. At its top, the segment (b-1) will be directly connected to part of the side bay vault. The correspondent joint needs to be highlighted in order to avoid a weak connection where the side bay merges into the transitional arch. The detail of the join references the molding in the main arch/architrave while taking in consideration the reduced surface of (b-1) when compared to the main arch (a). The moldings are put in place starting from the joint between (b-1) and (b-2), thus leaving to the fascia at the bottom the task of absorbing the eventual irregularities of the pillar.

Element	**Dimension in section**	**Distance from shaft**
Fascia I	6¼ p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	1¼ p
Arch dimensions	*8¼ p*	*1¼ p*

Table 24: Composition of the arch between central bay and transversal axis

Along the longitudinal axis, the corresponding transition increases its complexity. This time, the corner is composed of six different segments. Still perpendicular one another, these sides can be mapped in the following way [see **figure 138**]:

(a) – (c) – (d) – (e) – (f) – (a)

where (a) still represents the length of a pilaster strip. In this new configuration, the segments from (c) to (f) constitute the intrados of the arch perceivable from the central bay. A comparison with the node on the transversal axis suggests the pairing:

(b-1) = (e)

(b-2) = (f)

Like (b-2), segment (f) corresponds to the pilaster strip side facing the longitudinal side bays. As part of the rib framing the side bays, its profile will stay plain while molding will be applied on (e). In between (a) and (e), the two segments (c) and (d) create a carving inside the arch intrados. Following this idea, these two surfaces are treated similarly to the arch intradoses in San Lorenzo: geometric carvings expose the "inner core" of the arch. The composition of these carvings is inspired by San Lorenzo, whose patterns are adapted to the variable proportions of the segments (c) and (d) in Sainte-Anne:

Segment (c) = 1 M

Segment (d) = 1 M, 2 p

The arrangement of the carvings are analyzed on segment (c) first, then adapted to the elongated measure of segment (d). The following table contains the proportions used in segment (c) starting from the edge between (c) and (d). Here a tondino smoothes the transition between the two segments similarly to the configuration used in San Lorenzo. As usual, the inevitable out-of-module measures are concentrated in the fasciae.

Element	Dimension in section	Depth of the carving
Tondino	½ p (half diameter)	Protrude of ¾ p
Fascia	2½ p	-
Carving	7 p	1¼ p
Fascia	2½ p	-
Total dimensions	*1 M*	*1¼ p*

Table 25: Composition of Segment (c)

Element	Dimension in section	Depth of the carving
Tondino	½ p (half diameter)	Protrude of ¾ p
Fascia I	2½ p	-
Fascia II	1 p	½ p
Carving	7 p	1¼ p
Fascia II	1 p	½ p
Fascia I	2½ p	-
Total dimensions	*1 M, 2 p*	

Table 26: Composition of Segment (d)

The *tondino* listed in both tables is located in the traditional place between the two segments (c) and (d). While its total diameter equal to one part of the main order module, only half of this element intervenes in each segment. Its center lays at the junction between segments (c) and (d). Additionally, because of its position, three quarters of its diameter are exposed from the arch behind it.

Finally, segment (e) shows a sequence of moldings similar to (b-1). The extended surface of (e) gives the chance to introduce further moldings than in (b-1) providing a profile closer to the main one used on segment (a). The moldings are put in place starting from the top, this is to say, the junction between (e) and (f).

Element	Dimension in section	Distance from shaft
Fascia I	4 p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	1¼ p
Fascia II	5½ p	1¼ p
Apophis	½ p	1¼ p ~ 1¾ p
List	½ p	1¾ p
Tondino	1 p	2½ p
Ovolo	2½ p	4½ p
List	1 p	5 p
Total dimensions	*1 M, 5 p*	*5 p*

Table 27: Composition of Segment (e)

4.4.3 The central bay pendentives

The irregular octagon individuating the layout of the central bay is linked to the circle in the gallery above by a polymorphic volume, transitioning the diagonal straight line between the pilaster strip of the main pillars into a quarter circle. The pendentive is framed by four edges; their geometry will set up the guidelines for solving the volume.

Bottom edge (on a horizontal plane):

a straight segment diagonally oriented, contained by two adjacent pilaster strips in the central bays;

Side edges (on two vertical planes, orthogonal to one another):

the arches framing the central bay (which share the same radii);

Top edge (on a horizontal plane):

the circle inscribed into the central bay.

Because of its symmetry on both longitudinal and transversal axes, the pendentive may be divided into four equal portions. Only one of them will be analyzed, of course. Each piece is composed by a spheroidic volume built through horizontal sections. The geometric and stereotomic analyses will provide the main guide lines to determine the volume. However, in order to avoid excessive construction lines, the number of horizontal sections cutting the pendentive is here limited to eight.[30]

Draw in plan a quarter of the central bay, whose center will be located on O **[figure 139]**. From this reference the edges listed above will be represented by the following elements:

Bottom edge: segment *1-11*

Side edges: segment *1-9* and segment *11-19*

Top edge: quarter circle *9-19*

The segments *1-9* and *11-19* are shown in plan as segments but, in reality, they host half the arches connecting central and side bays. Using additional planes, it is

30 The pendentive in the physical model accompanying the research, instead, is cut by 40 planes in order to increase the definition of the volume.

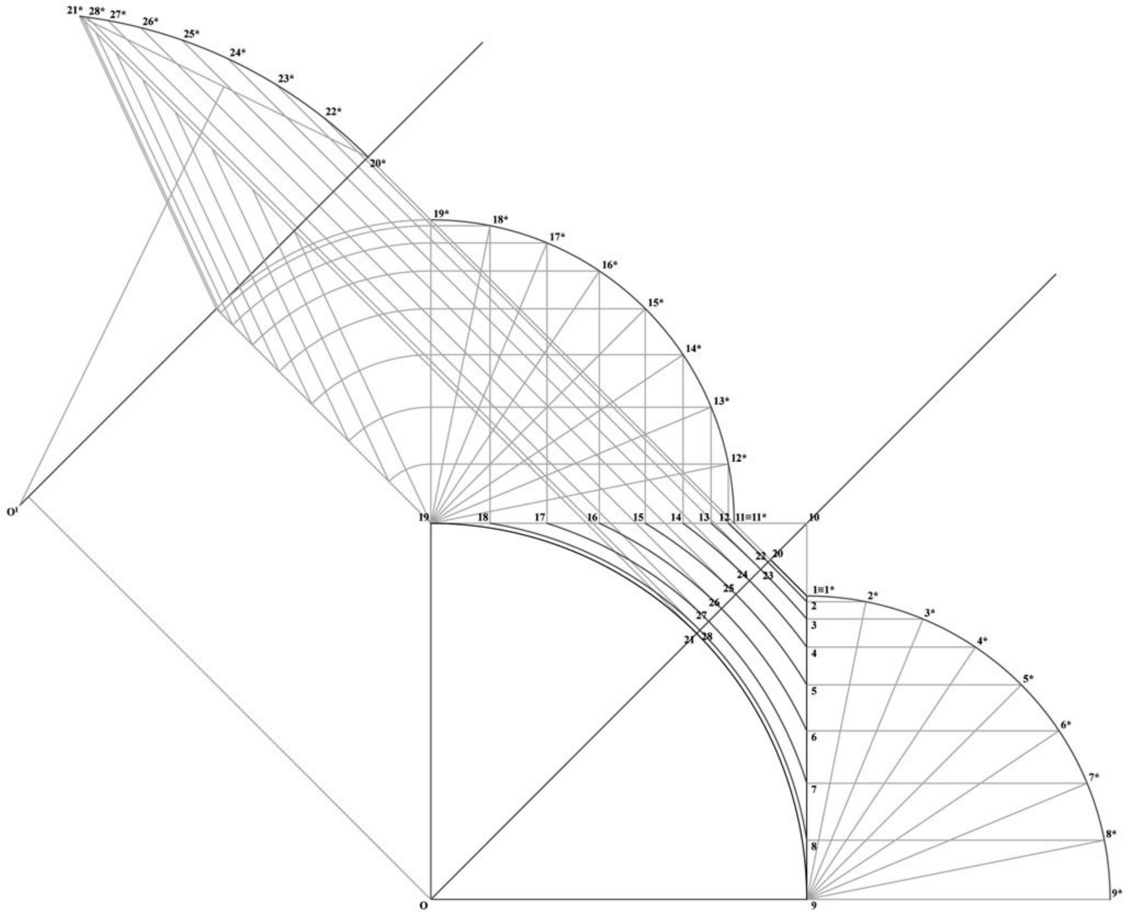


Figure 139. Geometric construction for the central bay pendentive.
Drawing by the author.

possible to draw the actual profile of these arches, thus finding the arches *1*-9** and *11*-19**. So far, these are the only vertical elements known in the pendentive. Therefore, they will provide references for selecting the horizontal planes through which the pendentive will be realized. Divide *1*-9** in an equal number of parts (eight in the example) gaining the points *2** through *8**. Project these points in plan, finding the points from *1* to *8*. The very same procedure may be repeated for the arch *11*-19** whose segmentation may be projected in plan to locate the points from *12* to *18*. Since the arches *1-9* and *11-19* share the same radius and are segmented in the same number of parts, their correspondent points will belong to the same horizontal planes (*2* and *12*, *3* and *13*, and so on).

Each pair of points will be linked by a curve. Circular in nature, these sections of the pendentive will move progressively from O (center of the bay) to an improper point. Such movement will happen on the axis of the pendentive, a forty-five degree line. In this way, while moving away from O, the circles will progressively increase their diameter, approximating to a straight line until their center will become an improper point. However, in order to determine the profiles of these circles it is required to find a third point for each horizontal plane slicing the pendentive. A third vertical plane passing from the pendentive axis is therefore introduced (O-*10*). The information already used so far provide the measure and location for both top and bottom points of the pendentive (points *20** and *21**). Because of the spheroidic nature of a pendentive, these two points will be part of a circle centered on the springer plane of the pendentive. Draw a segment connecting *20** and *21**. The axis of this segment will intersect the horizontal plane from *20** (springer of the pendentive) in O^{I}.[31] Center on O^{I} drawing the circle through *20*-21**

31 Note that O^{I} is not aligned with the projection of point O. The misalignment does not represent an error in the construction of the pendentive but it relates to the composition of the bay itself.

which will be sliced in the points from *22** to *28** by the horizontal planes chosen previously. Project these points back in plan and link them to their coplanar points, thus gaining enough information to draw one circle for each chosen plane. As expected, the circles will have their center moving progressively distant from O until degenerating into a straight line *1-11* **[figure 140]**.

4.4.4 The pendentive carvings

The engraving clearly shows some type of decoration on the pendentive surface. However, it is not clear whether such additions would have been carved (like in the Chapel of the Holy Shroud) or painted (like in San Lorenzo). Since the building was realized in Paris, it may be argued such moldings would have been carved, thus fitting French stereotomic principles. *Architettura Civile* does not provide suggestions for a possible molding sequence in the pendentive; while the solution in the Chapel of the Holy Shroud mentioned above does not fit the theme in Sainte-Anne. A possible reference, instead, was identified in the Church of Immaculate Conception in Turin.[32] Realized in 1673, the church was not directly designed by Guarini although the influence of his style pervades the whole building. According to some historians, in fact, the building might have been a re-interpretation of one of Guarini's lost projects: Santa Maria Ettinga in Prague.[33] Following this direction, the moldings in Sainte-Anne's pendentive are composed and proportioned according to the table below:

32 Giuseppe Dardanello, Susan Klaiber, Henry A. Millon, *Guarino Guarini* (Turin: Umberto Allemandi & C., 2006), p. 88-93 (figures 90, 91, 93, 94, 95, 96).

33 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), Plates 19, 20, 21. Giuseppe Dardanello, Susan Klaiber, Henry A. Millon, *Guarino Guarini* (Turin: Umberto Allemandi & C., 2006), p. 90 (figure 92), p. 93 (figure 97), p. 94 (figure 98).

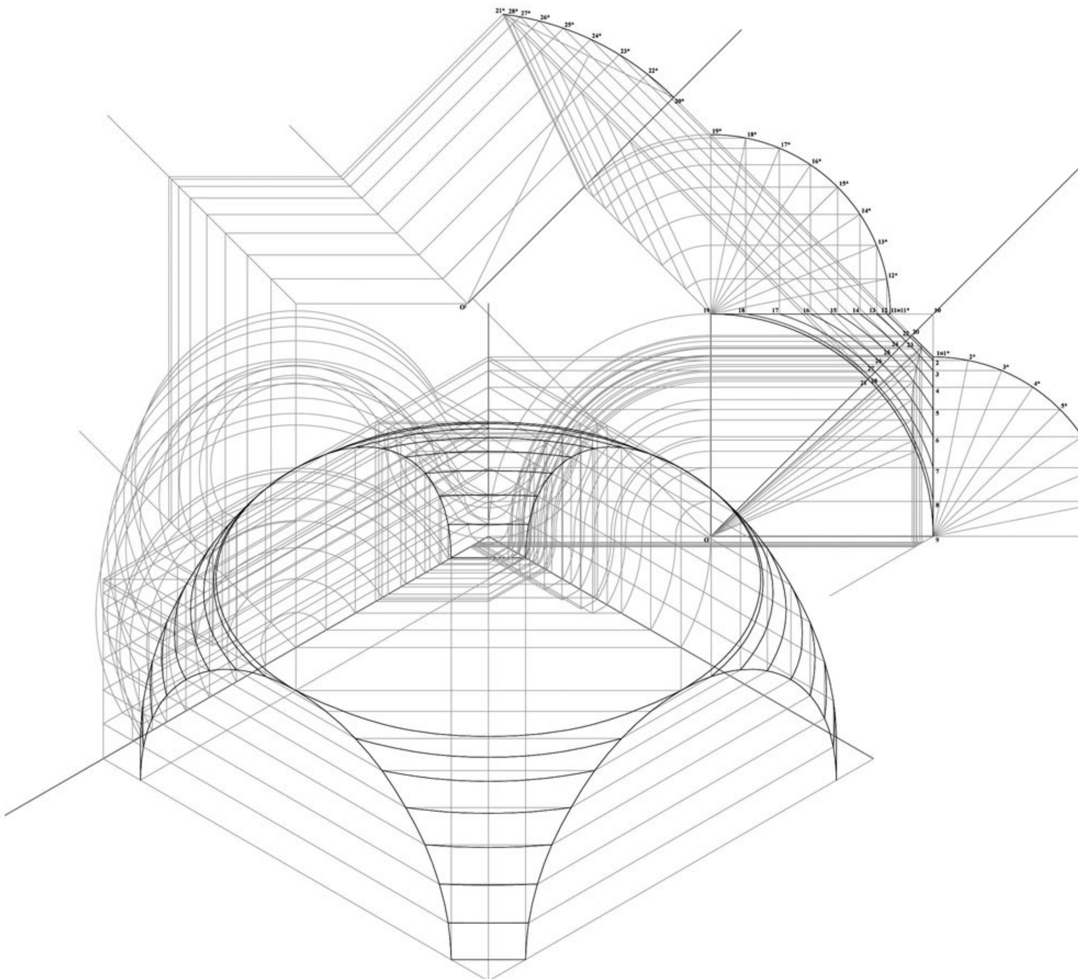


Figure 140. Complete layout for the central bay pendentive.
Drawing by the author.

Element	Dimension in section	Depth of the carving
List	1 p	½ p
Fascia	1½ p	- ½ p
Tondino	1 p	- 1p
List	1 p	- 1¼ p
(back surface)	-	- 1¾ p
Carvings dimensions	*4½ p*	*½ + (- 4½) p*

Table 28: Proportions of the carvings in the pendentives

The references for the depth of the carving are related to the surface of the pendentive. Therefore, the carvings acquire a positive or negative measure for their depth when they respectively overhang or under-hang the pendentive surface.

4.4.5 The pendentive entablature

Sustained by the four arches framing the central bay of Sainte-Anne-la-Royale, the pendentive entablature is an example of the free-standing elements described in *Architettura Civile*. There is not a clear indication of the order to which the entablature might belong. From the engraving, the entablature appears divided in three main parts: an architrave composed by two fasciae and a top molding, a plain frieze, and a cornice with a molding (maybe an *ovolo*) but not visible dentils or brackets. Such sparse details are completed by comparing the entablature to its corresponding element in San Lorenzo. Similarities and discordances between the two examples offer clues about the possible layout for the entablature in Sainte-Anne [see **figure 137** at page 274].

The division of the architrave in two fasciae points towards Ionic roots for both projects. In Turin the fasciae are topped by a molding (a list for the bottom fascia; an *ovolo* for the top one). Such details refer to Ionic entablatures in *Architettura Civile* and are adapted to the proportions in Sainte-Anne's engraving. The module used for the entablature is still the one form the main architectural order. The arches sustaining the pendentive entablature, in fact, preserve the length of the main order thus implying its same modular division.

Element	**Dimension in section**	**Distance from the back wall**
Fascia I	3 p	-
List	½ p	½ p
Tondino	1 p	1 p
Fascia II	4 p	1 p
List	½ p	1½ p
Ovolo	2 p	3½ p
List	½ p	4 p
Architrave dimensions	*11 ½ p*	*4 p*

Table 29: Architrave in the pendentive entablature

Above the architrave, the frieze in Sainte-Anne departs from the one in Turin. While the project in Paris shows a plain frieze, the one in San Lorenzo is composed by short sculpted pilaster strips whose pattern is followed by the brackets in the cornice above. Away from the opulent decoration in Turin, the frieze in Sainte-Anne is left undecorated, composed by a *cavetto* and a reversed *kyma* in line with Ionic entablatures in *Architettura Civile*.

Element	Dimension in section	Distance from the architrave
Cavetto	9½ p	0 ~ 1½ p
List	1 p	1½ p
Reversed kyma	2 p	4 p
Frieze dimensions	*1 M, ½ p*	*4 p*

Table 30: Frieze in the pendentive entablature

Following the Ionic roots in the Architrave and Frieze, the molding in the cornice that is identified at first as an *ovolo* might instead be dentils. The vertical spacing in Sainte-Anne's engraving, however, suggests instead proportions compatible with brackets more than with dentils. In *Architettura Civile*, in fact, the entablature number 35 in Plate VI shows a possible precedent for such hybrid Ionic-Corinthian order which is adapted to Sainte-Anne's proportions. The transition between frieze and cornice is smoothed by adding an *ovolo* (as in Guarini's Ionic orders) while, at the top of the cornice, the *kyma* is increased in size to match the dimensions of the brackets below it (as visible from the engraving).

Element	Dimension in section	Distance from the architrave
List	1 p	4½ p
Ovolo	2 p	4½ p ~ 6½ p
List	½ p	7 p
Fascia with brackets	2½ p	7 p
Fascia	2½ p	1 M, ½ p
List	½ p	1 M, 1 p
Kyma	2½ p	1 M, 1 p ~ 1 M, 4 p

List	½ p	1 M, 4 p
Cornice dimensions	*1 M*	*1 M, 4 p*

Table 31: Cornice in the pendentive entablature

The design of the brackets follows the directions in *Architettura Civile*, Plate V, number 30. The brackets are analyzed, reconstructed, and then resized to match the proportions of the fascia behind them.

4.4.6 The side bay vaults

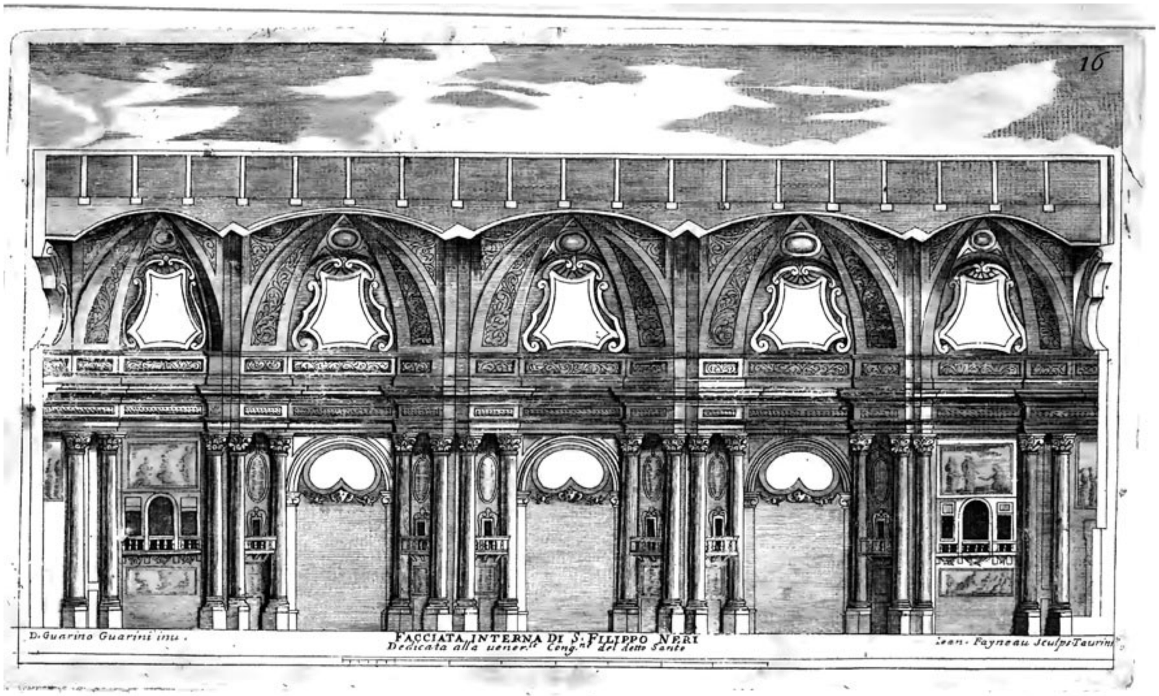
Following the layout of the ground level, the vaults covering Sainte-Anne's side bays develop above an irregular octagon. Their structural elements are plain ribs aligned to the main order pilaster strips. Their intersection is unconventionally solved by having rib A joining rib C and rib D joins rib B. Complex for its composition, the vault setting in Sainte-Anne-la-Royale is a recurrent theme in Guarini's churches. The evolution of this theme, however, does not always match a chronological appearance of these vaults. The most mature version of these vaults happens in Sainte-Anne-la-Royale. According to the illustrations in *Architettura Civile*, Guarini planned at least two more buildings with vaults compatible to the ones in Sainte-Anne, although none of them survived:

San Filippo Neri (Turin – 1660)

Santa Maria di Ettinga (Prague – 1679)

Both projects show a linear, one-nave plan whose octagonal bays provide the illusion of a space dilated beyond the physical boundaries of the main pillars. The visual effect is strengthen by the vaulted roof—whose sinuous profile provides unity to the main volumes—and by diagonal pillars, introducing vanishing lines to increase the depth perception while approaching the altar.

In San Filippo Neri **[figure 141]**, the linear edges of the octagonal bays provide a prototype for Sainte-Anne-la-Royale. Elongated on the transversal axes of the church, these bays concentrate their structural elements along the diagonal sides of the polygon only. Differently from Sainte-Anne, the main pillars do not constitute a solid mass but are void inside, carved by clerical spaces accessible from a secondary route hidden from view. From the main nave, the structural function of the pillar is highlighted by the two columns sustaining an entablature. At its top, the vault assumes a three-dimensional setting more complex than the one shown in plan. Here, the projections of the vault suggest a pavilion setting which, instead, is maintained only above the diagonal pillars. Along the longitudinal and transversal axes the vault is composed by portions of a cross vault (*nails*). The intersection of these eight volumes is obtained by simple lines converging towards the compositional fulcrum of the vault. The ribs framing Sainte-Anne's vault are still not present in San Filippo Neri. Here, the whole surface of the vault above the pillars become a structural element whose edges are framed by plain fasciae. Additionally, the vaulted structure is perceivable from inside the church only. The whole building, in fact, is covered by a pointed roof whose continuity is not broken even by lanterns. The only light sources for the main bay of the church are the windows opened in the vault along the bay's transversal axes.



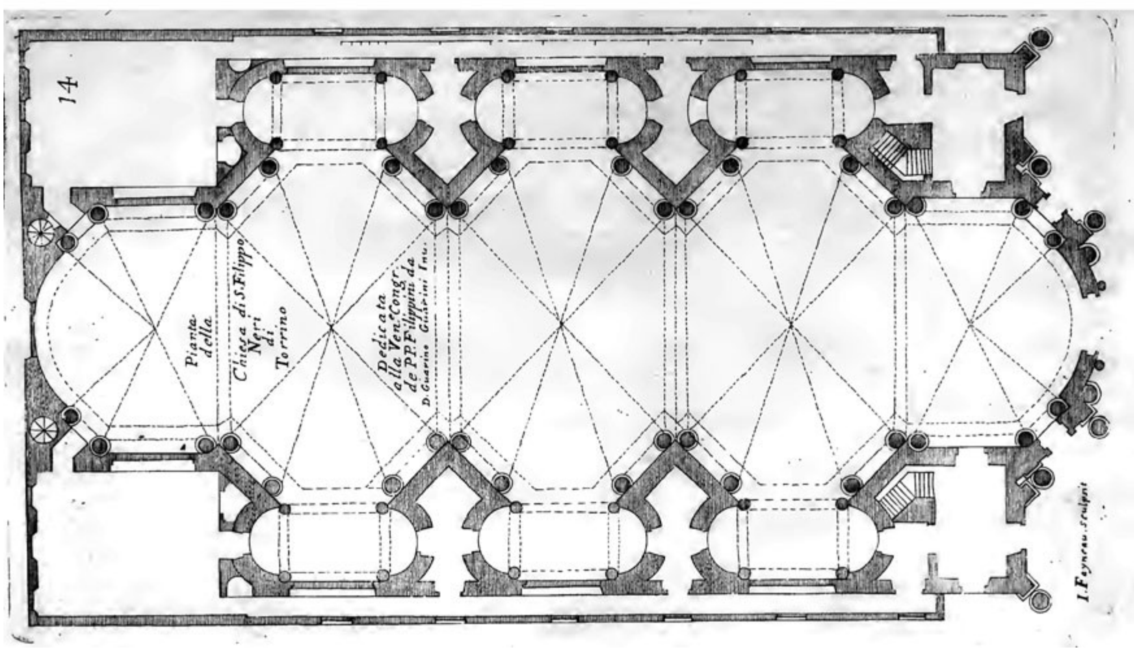


Figure 141. Project for San Filippo Neri in Turin by Guarino Guarini
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plates 14, 16

Similarly to San Filippo Neri, also Santa Maria Ettinga **[figure 142]** was developed as one-nave church. The side bays are still present, although they now intrude and merge into the main bays. Along the three bays of the church, only the middle bay preserves an octagonal setting. Almost identical to the one seen in Sainte-Anne, the octagonal bends into a convex profile in front of the side bays, whose elliptical geometry is now compressed into a lens-shape. Like in Sainte-Anne, the vault is framed by structural ribs aligned in plan to the main architectural order. The intersection of the ribs creates at the top of the vault an opening in the shape of an irregular hexagon. At its top, a lantern illuminates the indoor spaces of the church together with windows that open at the side of the vaults, similar to San Filippo Neri. Like in this last project, also in Prague the voluptuous profiles of the vaults are not perceivable from the outside. They are hidden by a pointed roof which this time is crossed by three lanterns: one for each bay. Cylindric in volume, the side bay lanterns follow the elliptical geometry of their bays, whose size is smaller than the middle bay. Such reduction allows an increase in the surface of the side bays which then gain an elliptical profile like in Sainte-Anne. As in San Filippo Neri, these chapels connect to a hidden route carved inside the main pillars. Circular rooms suggest the presence of spiral stairs leading to the middle bay's niches (located on a level higher than the main one in the church) or directly to the roof. The one-nave setting, in fact, does not suggest the presence of a second level (or not even its necessity for that matter).

4.4.7 The side bay vaults along the transversal axis

The section engraving in *Architettura Civile* shows only partial information about

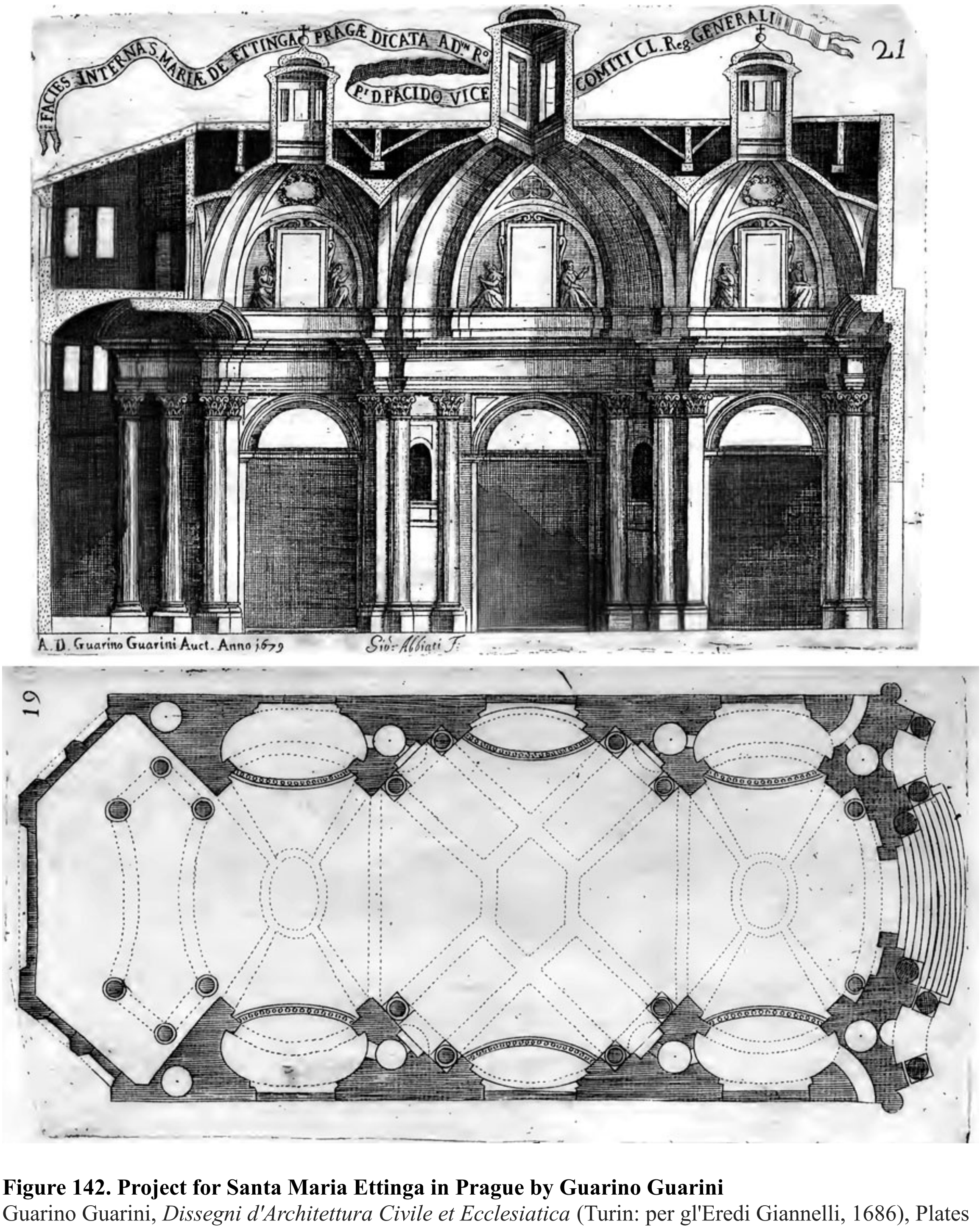


Figure 142. Project for Santa Maria Ettinga in Prague by Guarino Guarini
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plates 19, 21

these vaults.[34] Beside the alternation of spindles (in correspondence of the main pillars) and nails (on the longitudinal and transversal axes) complexity of the vault is found in its ribs. According to the engraving, the ribs framing the vault lay on the same plan when intersecting. Because of this, their intersection does not create a fold line (like in similar examples like in Cordoba's Mosque vaults **[figure 143]**) but shows a curved, smooth surface. So far, only Mario Passanti attempted to geometrically analyze these vaults offering a quarter circle profile to their longer ribs.[35] Beside his hypothesis, however, no additional information about the geometry and volume of the ribs is found.

The only way in which the two perpendicular ribs in Sainte-Anne may join in a smooth curved surface while moving along a quarter circle path is through a warping of their section. Among the four ribs in each half of a side bay, each setting is followed by the ribs 01 and 02. The other two ribs (03 and 04), instead, join the height of 01 and 02 following an elliptical path **[figure 144]**. In between these ribs, the vault is segmented is several pieces, each with its own geometry:

- half pavilion vault in between the couples 01-03 and 02-04;
- a barrel vault between the ribs 01 and 02;
- a link between the arch framing the central bay, a straight line at the top of the vault and the curved profile of ribs 03 and 04 facing the transversal axis of the church;

34 Along the longitudinal axis the vaults preserve the same geometric properties analyzed along the transversal axis. The different plan setting (more expanded than on the transversal axis), however, implies the necessity to create a completely new model for the longitudinal vault. Omitted in this research, this construction follows the exact same directions provided for its transversal counterpart.

35 Mario Passanti, *Nel Magico Mondo di Guarino Guarini* (Turin: Toso, 1963), pp. 76-81

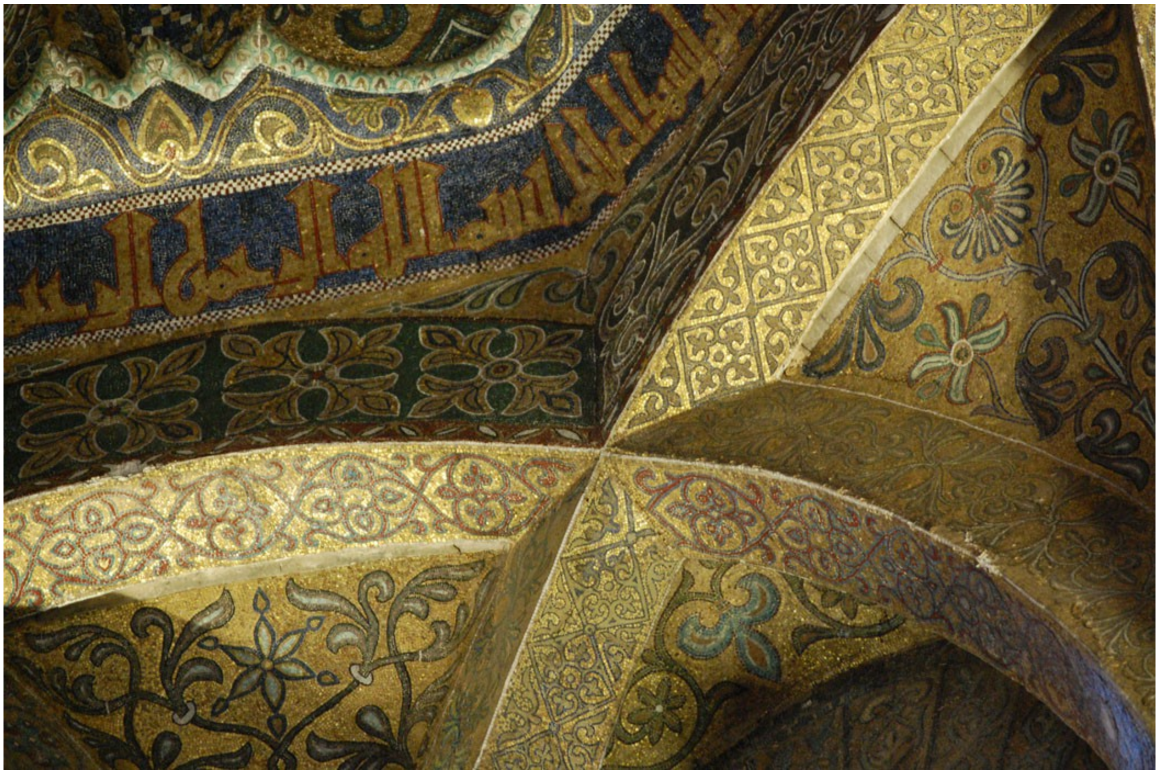


Figure 143. Fold lines at the intersection of the ribs in the mirhab's vault from Cordoba's mosque.
© Manuel de Corselas, *Mezquita de Córdoba. Bóveda de la macsura (detalle)*. 2011. Available from: http://commons.wikimedia.org/wiki/File:Cordoba_Mosque_06.jpg

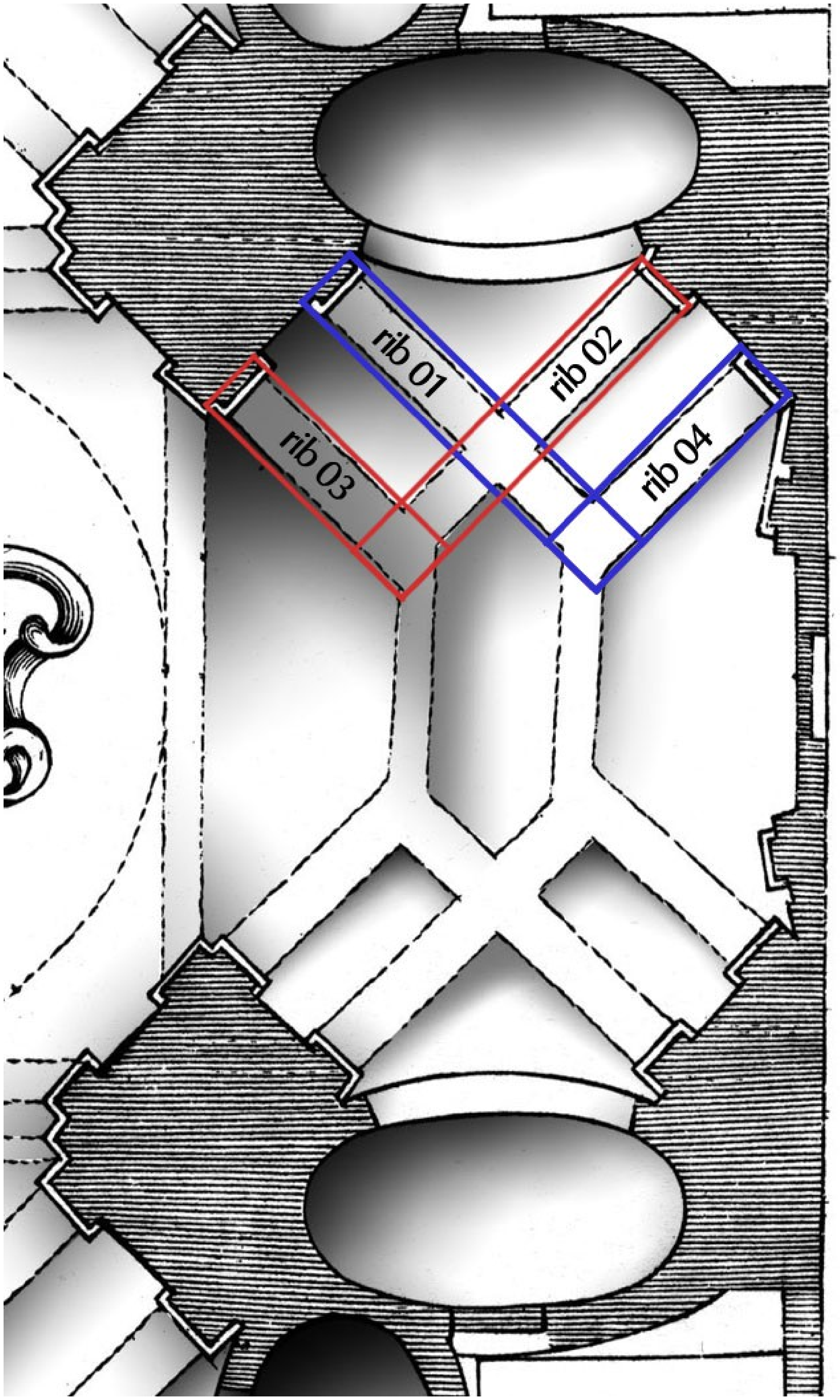


Figure 144. Plan of the vault above the eastern side bay of Sainte-Anne-la-Royale.
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate 9 . Additions by the author.

This configuration is used in the side bay vaults on both longitudinal and transversal axes. The overall proportions of the vaults, however, change in relation to the different areas occupied by the bays on the two axes. On the longitudinal one, the intersecting ribs still preserve a quarter circle profile. However, because of their increased length, the lantern over the vault reaches a height higher than the ones in the transversal axes. This situation creates a minimal alteration to the main elevation (in which the lantern above the entrance bay is not rendered). In addition, it makes sense from a compositional point of view: it increases the height of the vaults onto the longitudinal axis, thus providing visual emphasis to the church's main route.

However, in section the increased height of the longitudinal vaults create structural issues in correspondence to the gallery whose pathway passes through the vaults. To avoid this incompatibility, two solutions might have been possible. A first solution suggests a reduction in height of the longitudinal vaults matching the transversal ones; as a consequence, the geometry of the longitudinal ribs has to be modified from a quarter circle to a quarter ellipse. A second solution might raise up the height of the gallery, avoiding the overlap between its circular pathway and the longitudinal vaults.

The first solution is not convincing though. Altering the profile of the longitudinal ribs only to meet the height of their transversal counterpart sounds more like a cheap compromise than an actual compositional choice. Additionally, that solution would have devalued the role of the longitudinal axis as main route in Sainte-Anne.

The second solution, instead, sounds more reasonable. Increasing the height of the gallery indeed causes a gap in the building which has to be filled by adding another volume in the building. At the same time, however, this choice maintains unaltered the original structure in the church while preserving with minimal alteration both section and elevation. While historical accounts mention a partial realization of the lower levels, Guarini's gallery was never built. From this point of view, it is not surprising finding imprecisions or even mistakes in the original engravings. Some of these issues might have been fixed and solved later. The mismatching information between section and elevation can be read in a similar way, like the missing lantern at the top of the entrance bay in the section illustrating the main facade. Omitting this lantern might have been a graphic choice aiming to avoid excessive information; or, indeed, a sentient choice for avoiding to show its incompatibility with the gallery's height mentioned above.

4.4.8 Geometry of the side bay along the transversal axis

The basic configuration of the vaults along the transversal axis shows two pairs of symmetric arches **[figure 145]**:

Rib 01: A-B-J-I	symmetric to	Rib 02: E-F-M-N
Rib 03: C-D-M-L	symmetric to	Rib 04: G-H-J-K

As already mentioned, Passanti attributes to Ribs 01 and 02 a quarter circle profile. The two elements intersect one another at roughly 2/3 of their length creating a seamless junction. This can only be accomplished by warping both the ribs. To achieve such results, the information in plan has to be matched to two vertical planes: one from O^I-H^I (vertical plane 1, referred to as PV1) and one from O^I-D^I (vertical plane 2, referred as to PV2).

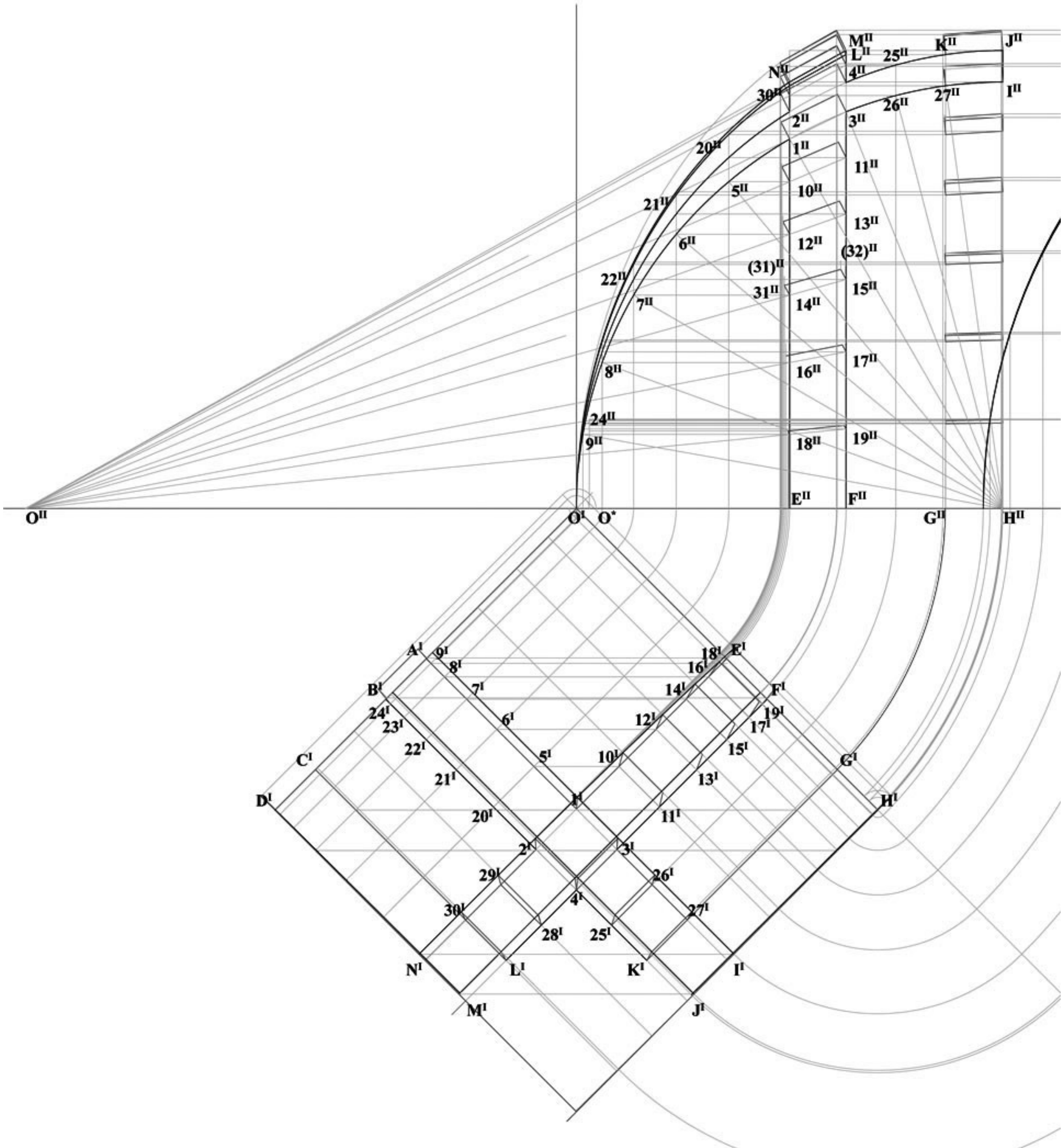


Figure 145. Geometric construction for the eastern side bay vault – Plan and PV1.
Drawing by the author.

Project H^{I} on PV1 gaining H^{II}. Centering on H^{II} with span O^{I}-H^{II} individuate the arch O^{I}-I^{II}. Its profile is the same used by the arches A-I and E-N. This last arch, however, appears in PV1 as a line only. The intersection between the two main ribs happens in plan onto the points 1^{I}, 2^{I}, 3^{I}, 4^{I}. Among them, only 1 and 3 can be projected in PV1 over O^{I}-I^{II}. Because the ribs are constrained by symmetry along the axis from O^{I}-1^{I}-4^{I}, point 2^{I} will be symmetric to 3^{I} . Therefore, on PV1, it is possible to locate 2^{II} on the same measure of 3^{II}. From the plan, it is known that point 2^{I} is connected by a curve to B^{I} and J^{I}. However, while on PV1 point B^{II} is coincident to O^{I}, the point J^{II} can not be located. Because of the rib warping, J^{II} will be higher than I^{II} but it is still not possible to attribute it an exact location. But, the profile O^{I}-J^{II} will still be a curve and, more precisely, an ellipse. Since the center is known (H^{I}), the edge of one of its axis (O^{I}), and one of its points (2^{II}) of this ellipse, it is possible to draw its profile[36] thus finding the correct location of J^{II}. Project 4^{II} on O^{I}-J^{II} completing in PV1 the layout of the ribs A-B-J-I (visible in elevation by curved profiles) and E-F-M-N (rendered in front view as straight lines). In order to distribute the amount of warping in these two ribs, work E-F-M-N on PV1; the results found may be projected on the other rib A-B-J-I due to their symmetry. Draw the line passing from 1^{II} and 3^{II} intersecting the ground line (horizontal lines from O^{I}) into O^{II}. This projection center will link on the rib E-F-M-N the points standing between the edges E^{II}-N^{II} and F^{II}-M^{II}. As verification, draw the lines by 2^{II}-4^{II} and N^{II}-M^{II}; both of them converge into O^{II}.

Having found the distribution of the warping in the first two ribs, it is now possible to segment them. This will divide O^{I}-1^{II} in 6 equal parts (points from 5^{II} to 9^{II})[37]

36 Check the appendix for the construction of an ellipse by one axis and one point not belonging to the axes.

37 The radial division of the segment is done keeping H^{II}, the center for the arch O^{II}-I^{II}, as a projection

and *3*^{II}-I^{II} in 3 parts (points *26*^{II} and *27*^{II}).[38] Since the construction for any of these points will follow the same patterns, it will be analyzed for one point only, *7*^{II}. This point belongs to O^{I}-I^{II} which, for symmetry, shares its properties with E^{II}-N^{II}. Project *7*^{II} horizontally on E^{II}-N^{II} gaining point *14*^{II}. Connect *14*^{II} to O^{II} individuating on F^{II}-M^{II} point *15*^{II}, the warped pairing of *14*^{II}. To verify the pairing between points *14*^{II} and *15*^{II}, project *15*^{II} back onto O^{I}-J^{II} by a horizontal line and find *22*^{II}, which has to be vertically aligned to *7*^{II}. The whole arch O^{I}-J^{II}, in fact, is an elliptical deformation of the quarter circle O^{I}-I^{I}; both these arches share the same radius O^{I}-H^{II} (which in O^{I}-J^{II} constitutes half of the curve minor axis).

Also the other two ribs in the vault (C-D-M-L and G-H-J-K) are warped; although their deformation is less perceivable than the ribs described above. Both ribs C-D-M-L and G-H-J-K follow an elliptical profile because of their position in plan. Although on PV1 the geometry is perceivable for C-D-M-L only (curves O^{I}-*30*^{II}-L^{II} and curve O^{I}-N^{II}-M^{II}). The method to find reference points on these two new ribs is exactly the same used above. Therefore, point *7* will be used again as reference point. On PV1, extend the vertical line from *7*^{II} and *22*^{II} intersecting the curves O^{I}-*30*^{II}-L^{II} and O^{I}-N^{II}-M^{II}. Project these intersection points horizontally until their corresponding ribs (G^{II}-K^{II} and H^{II}-J^{II}).

Alternatively, it is possible to use the vanishing point method already described above for the previous two ribs. The only downside in applying this method to the two peripheral ribs is the position of their vanishing point—quite distant from the actual

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point.

38 In this case, point *27*^{II} is located on the intersection between A^{I}-I^{I} and G^{I}-K^{I}. Point 26^{II}, instead, is obtained by dividing the arch *3*^{II}-*27*^{II} into two equal parts. The resulting bisector line showing the position of point 26^{II} starts from H^{II}, the center of the arch O^{II}-I^{II}.

working area. Draw a line connecting 27^{II} to I^{II} and extend it until reaching the ground line in O^{III}. All the points on the vault peripheral ribs C-D-M-L and G-H-J-K will be linked in their warping by this vanishing point.

At last, the construction of the ribs is completed by adding thickness to their sections until reaching the surface of the vault behind them. However, finding this additional information requires introducing a second vertical plane PV2, orthogonal to PV1 **[figure 147]**. The points *7* and *14* will be taken as references for the following construction. On PV2, centering on O^{III} draw the arch O^{I}-N^{III} (a quarter circle symmetric to O^{I}-N^{II}). From N^{III} draw a vertical segment as long as the ribs' thickness (which can be obtained by the church's plan) thus gaining point N^{*}. Apply the same measure N^{III}-N^{*} from O^{I}, finding point O^{*}. Connect N^{*} and O^{*} by an arch with center on O^{II} representing on PV2 the thickness of the edge F-M in the rib E-F-M-N. Repeat the same construction from M^{III} thus finding the arch O^{*}-M^{*}, a quarter ellipse. At this point move 14^{II} and 15^{II} to PV2, individuating the points 14^{III} and 15^{III}.

To find the thickness of the rib in correspondence of 14^{III} connect this point to O^{III} and extend this line individuating 31^{III} on O^{*}-N^{*}. Likewise, the rib thickness from 15^{III} will be individuated by the point 32^{III}. However, in this case, 15^{III} belongs to an ellipse, making it impossible to use a vanishing point to find its correspondent point 32^{III}. Since 14^{III} and 15^{III} are vertically aligned, such properties will be also preserved by 31^{III} and 32^{III} (which are indeed linked to 14^{III} and 15^{III}). Therefore, draw a vertical line from 31^{III} and intersect it to the line from 15^{III} parallel to 14^{III}-31^{III} thus finding point 32^{III}.

The section 14^{III}-15^{III}-31^{III}-32^{III} graphically describes the amount of rib warping.

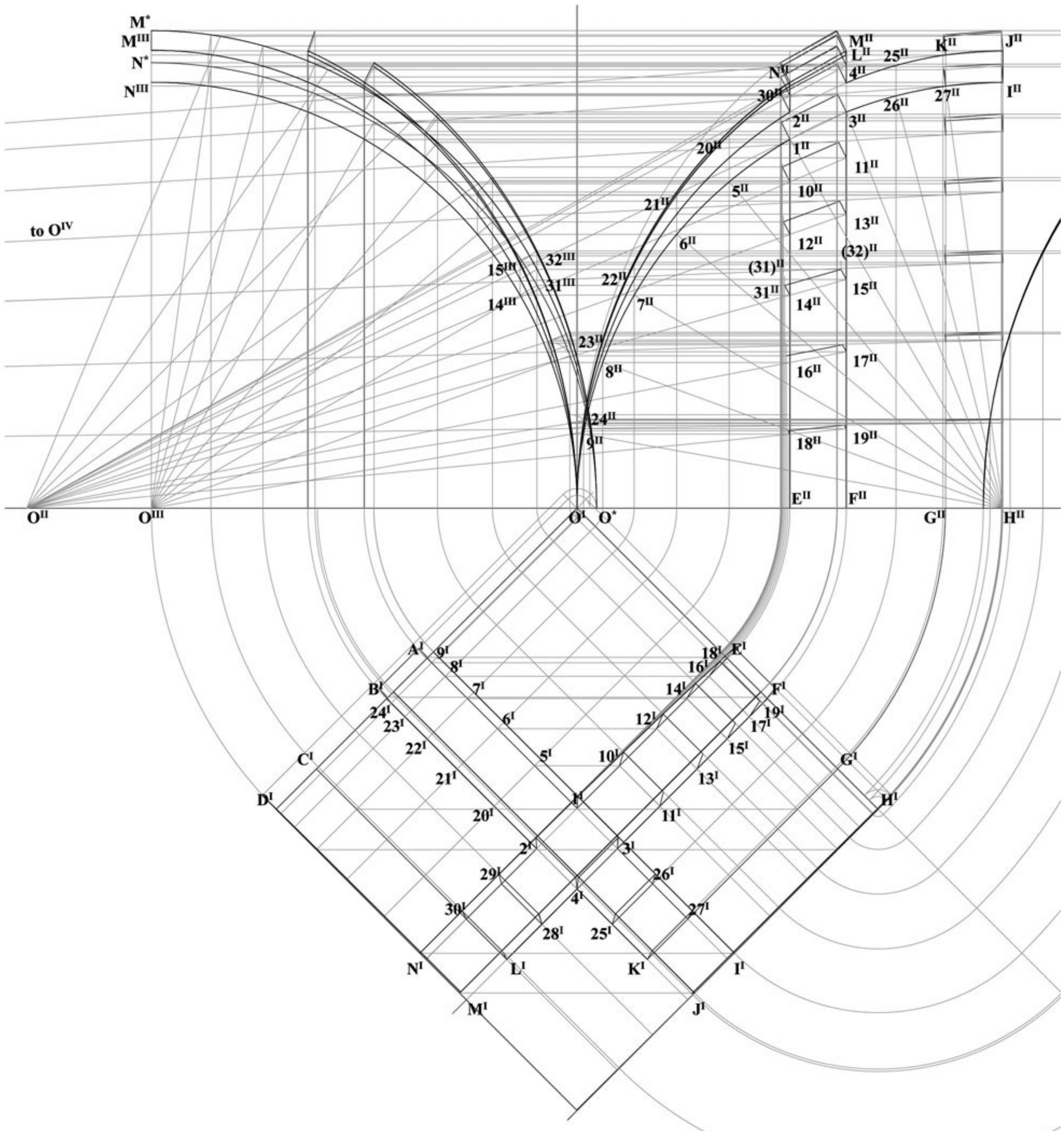

Figure 146. Geometric construction for the eastern side bay vault – PV2.
Drawing by the author.

However, there is still not enough information to project *31*^{III} and *32*^{III} onto both PV1 and plan. In order to find such missing information, move on PV1 and draw on *14*^{II}-*15*^{II} a rectangle with minor sides equal to the measure of the rib thickness gained from the church's plan (which has been already used in N^{III}-N^{*}, M^{III}-M^{*}, and O^{I}-O^{*}). This rectangle shows, undeformed, the rib section from *14*^{II}-*15*^{II} individuating the points (*31*)^{II} and (*32*)^{II}. To move these two last points into PV1, draw a vertical line from both of them until intersecting their corresponding projection from PV2 thus individuating the points *31*^{II} and *32*^{II}.

To complete the three-dimensional model for the rib, the same construction needs to be repeated for the other points in which the ribs are segmented. Finally, it is suggested to add eventual control points in correspondence of any mutual intersections or major points of the ribs in order to ensure precision in the final model **[figures 147, 148]**.

4.4.9 The gore vault towards the central bay

This portion of the side bay vault develops above a trapezoidal plan A-B-C-D. Its edges are composed by the following elements **[figure 149]**:

- AB: the arch framing the central bay;
- BC: the rib of the side bay vault;[39]
- CD: the straight line at the top of the vault;
- DA: the circular profile on the vault transversal axis;

39 Note that the segment BC is not a straight line in plan, but slightly curved. The segment, in fact, corresponds to the top edge of the side rib in the vault. Because of their settings, all the ribs in the vault are warped, and thus rendered in plan by curves.

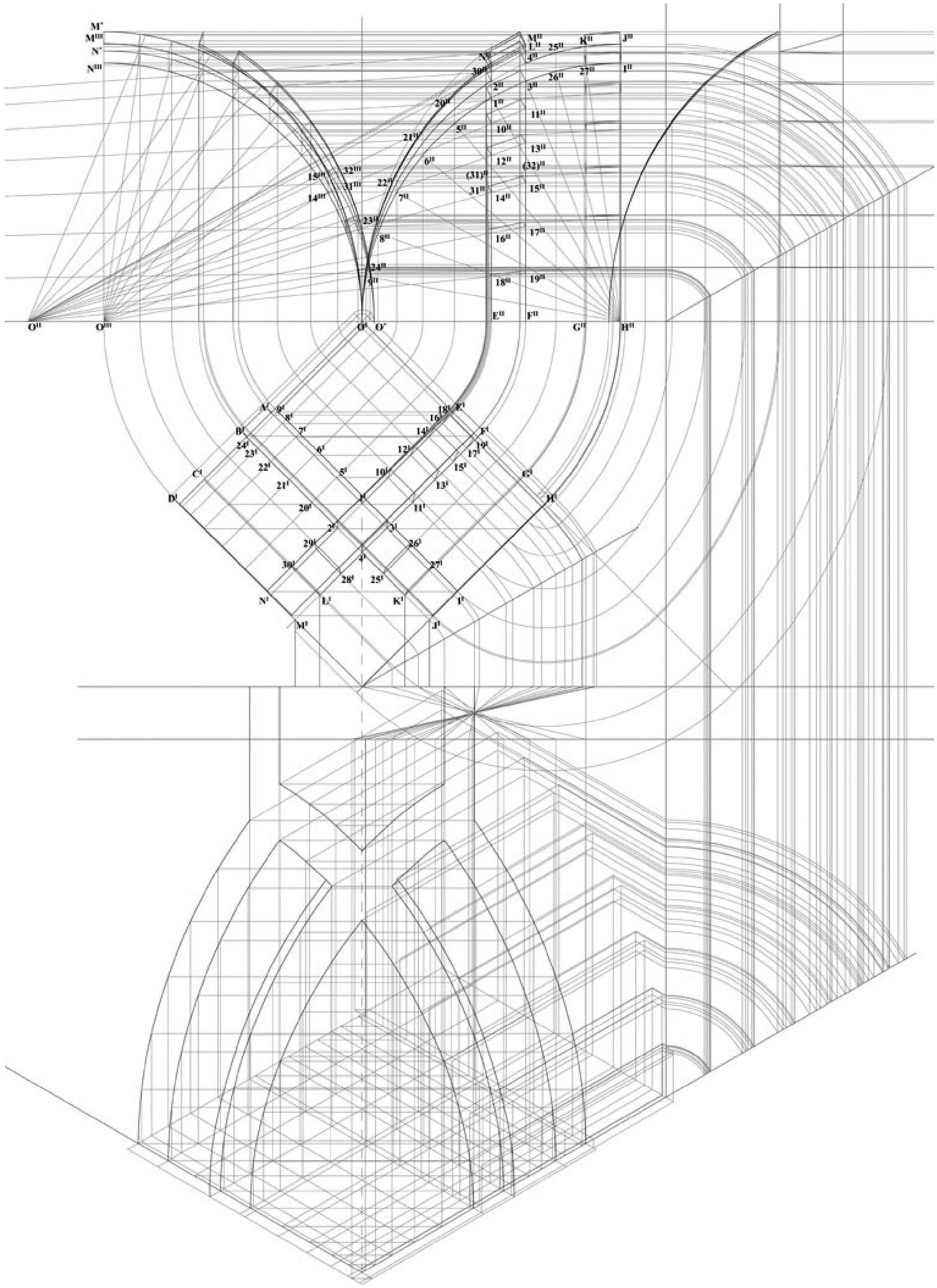

Figure 147. Geometric construction for the eastern side bay vault with axonometric view of the ribs. Drawing by the author.

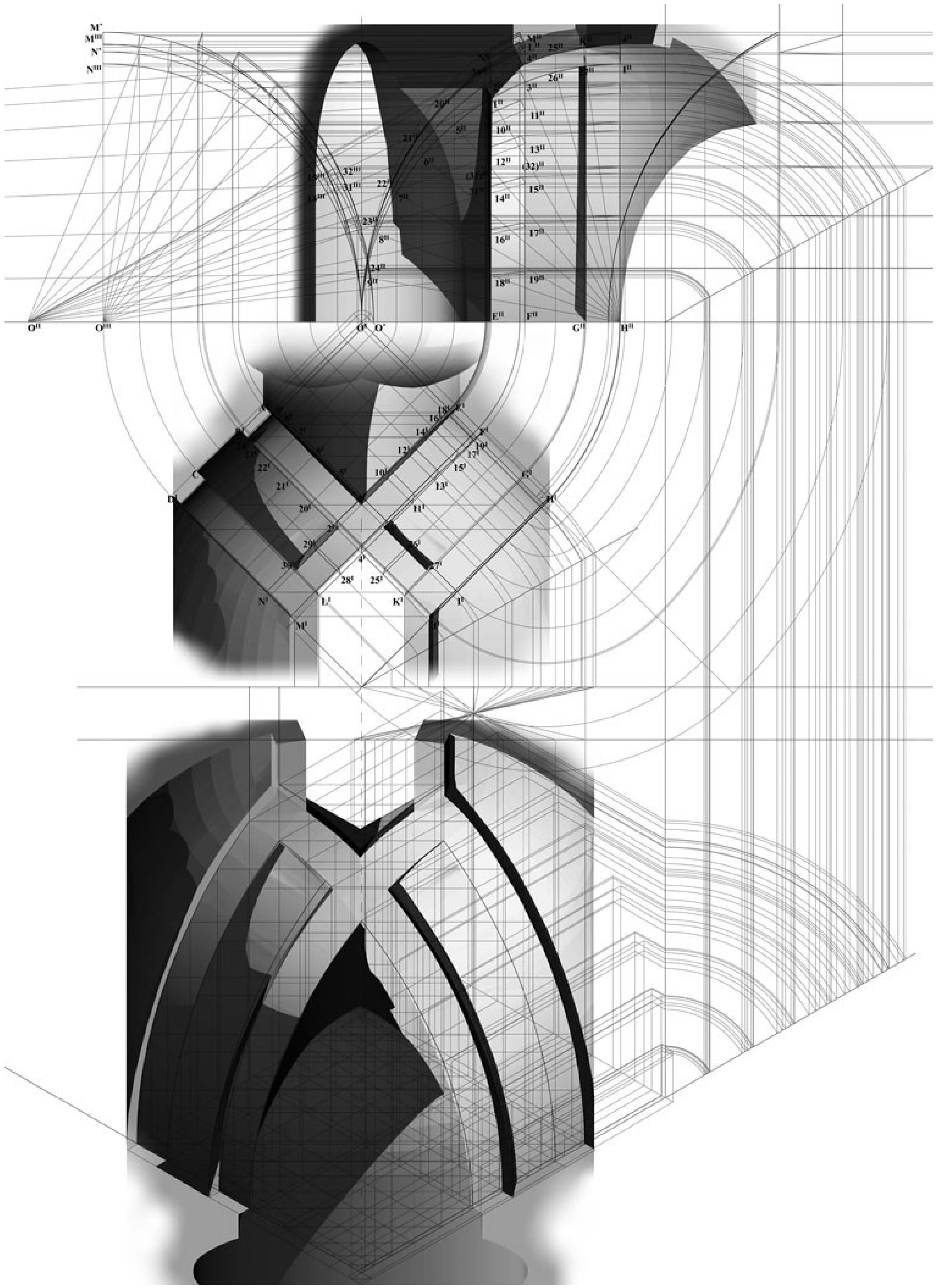

Figure 148. Complete geometric construction for the eastern side bay vault.
Drawing by the author.

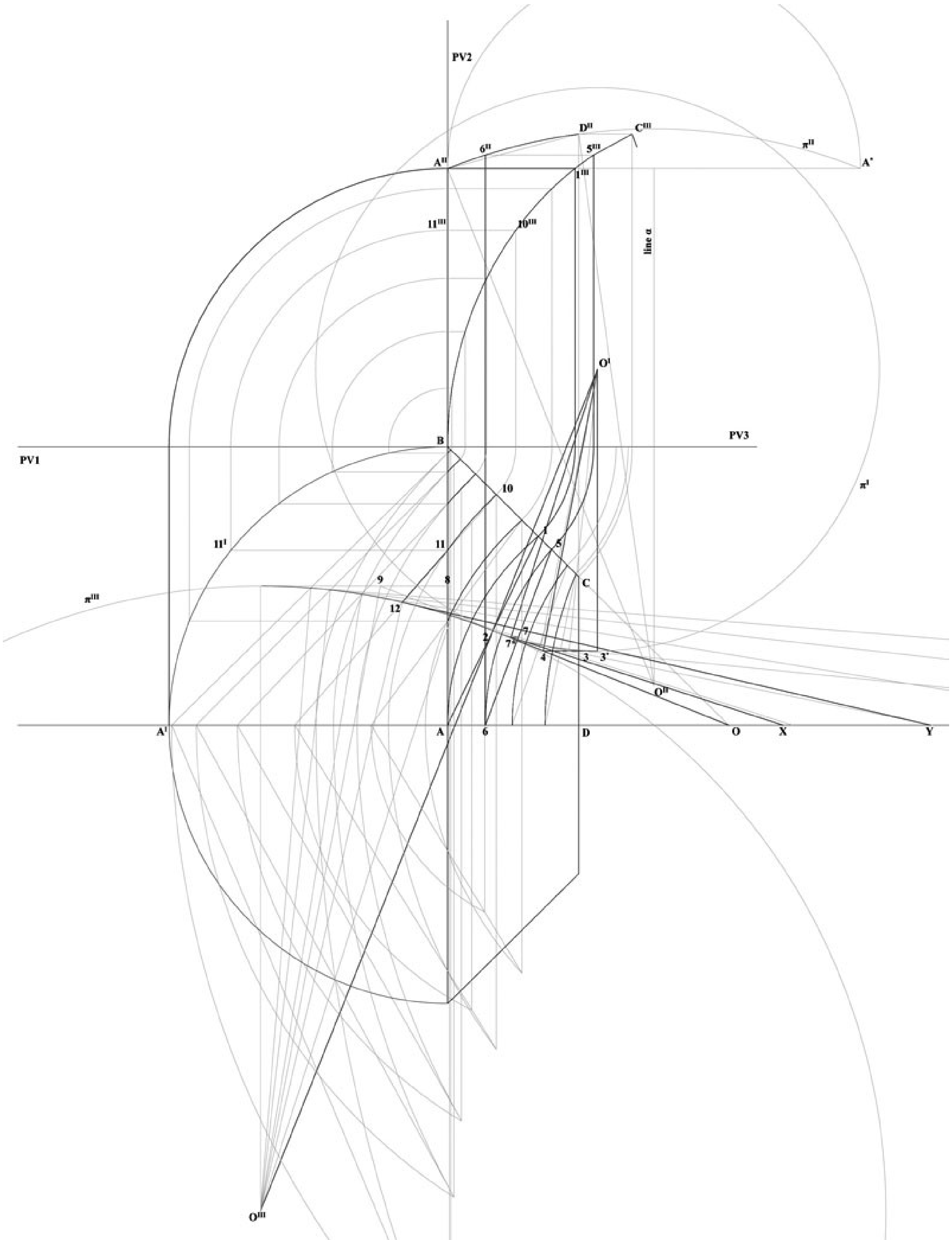

Figure 149. Geometric construction of the gore vault in the eastern side bay.
Drawing by the author.

As for the other volumes in the church, this gore vault is built by horizontal sections progressively transforming ellipses into the straight lines on CD. The geometric construction providing these horizontal sections uses two methods. A first method (ellipses by center and two points) when dealing with the arch framing the central bay. A second method (ellipses by one point and one axis) when moving above the arch keystone. Because of its symmetry along the transversal axis, only half of the trapezoidal gore vault is analyzed here.

The construction of the vault A-B-C-D will use three additional planes, each related to one side of the volume. The arch on AB will be rendered in the plan PV1; the rib profile on BC will be rendered on PV2; the partial circle on AD will be rendered on PV3 (partially overlapping PV2). Side CD is just a straight line so it does not require its own projection plane. As already mentioned above, the horizontal sections in the vault will have an elliptical profile transforming into a straight line while approaching CD. This is to say, the center of these ellipses will progressively move away from the vault until becoming an improper point degenerating the ellipses into the straight line CD. This analysis starts with point A, the keystone of the arch framing the central bay. To gain its correspondent point on BC, project A onto PV1 obtaining its measure (point A^{I}) and, from here, project it onto PV3 finding point 1^{III} on the rib profile. Move back 1^{III} in plan individuating point *1*. The points A and *1* will be connected by an ellipse whose center is located at O, the intersection between the extension of BC and the vault's transversal axis. Knowing its center O, its half axis OA and point *1* (not belonging to OA) it is possible to draw the first ellipse describing the gore vault.

Draw the segment A-*1* and connect its middle point (*2*) to O. Move on CD, individuating its middle point (*3*). In order to transform the ellipse A-*1* into a the straight line CD, point O needs to become an improper point; this is to say, the line *2*-O needs to rotate until assuming a horizontal position in *3*. From this last point, draw a horizontal line until intersecting *2*-O in point *4*. Draw a line from *2* perpendicular to *2*-O and intersect it to the line from *4* bisecting the angle *2*-*4*-*3* individuating point O^{I}. The circle π^{I} with center O^{I} and passing by 2 will also be tangent to *2*-O and *4*-*3* (on the point *3**). Its tangent line along the arch *2*-*3** will describe the progressive transformation of point O into an improper point.

The vault profile on AD must be identified before continuing with the gore vault construction. Both points A and D can be projected on PV2; their quote is provided by the corresponding rib projection on PV3. The curve connecting them, instead, may be drawn referencing the vault's longitudinal axis (line α) from which it is possible to mirror point A^{II} obtaining A^{*} (located on the opposite side of the vault). The desired vault profile on A^{II}-D^{II} is represented by the circle passing from these two points and A^{*}. Its center O^{II} belongs to line α.

At this point, it is possible to obtain the upper part of the vault. As reference point, point 5^{III} is used, corresponding to one of the joints of the rib on BC. Project 5^{III} in plan, individuating point *5*. Its corresponding point on A^{II}-D^{II} is 6^{II} (which shares the same measure of 5^{III}). Project 6^{II} in plan and draw the segment *5*-*6*. From its middle point (*7*), draw a vertical line until intersecting π^{I} at 7^{*}. This last point, tangent to π^{I}, will provide on the transversal axis the center for the ellipse passing through the points *5* and *6* (point X).

Finding the horizontal sections for the lower portion of the vault requires using a different construction. This time, in fact, the points through which the ellipse will pass by are individuated by the rib on BC and the arch on AB. None of the points on these two elements belong to one of the vault's vertical axis. Therefore, the ellipse linking them will have to use the construction by two points and the curve center. In order to get this last reference, the movement of the ellipse centers will again be taken in consideration. In point B, the horizontal sections cutting the vault are reduced to one point only. Since there are no other references for describing an ellipse, point B represents another reference where the curves describing the vault degenerate. Similarly to CD, the ellipse passing from B will have an improper point at its center.

On A-B, individuate the middle point *8* and from here draw a horizontal line until intersecting the extension of *2-0* at *9*. Draw the bisector line between *9-8* and *9-2* intersecting the extension of *2*-O^{I} at O^{III}. Using this last point as center, draw the circle π^{III} passing through *2* and tangent to both *9-8* and *9-2*. The intersections between the lines tangent to π^{III} and the vault transversal axis will individuate the centers of the ellipses in the lower portion of the gore vault.

As an example on how to proceed, consider one of the reference points in the rib, 10^{III}, and its corresponding point on the central bay arch, 11^{III}. Project both these points in plan to find *10* and *11*, through which an ellipse will pass. Before drawing the ellipse, finding its center is required. Draw the line from *10-11* intersecting π^{III} at *12*. From here, draw a line tangent to π^{III}, which will intersect the vault transversal axis at Y, the center of the ellipse, by *10* and *11*. At this point, the ellipse may be drawn using the construction in the appendix (ellipse by center and two point not belonging to its main axes).

4.4.10 The vault in between two adjacent ribs

This portion of the vault is quite simple to solve. It may be considered as a spindle, a portion of a pavilion vault connecting two of the main ribs. Since the profiles of these two elements are already determined, creating the vault requires connecting the correspondent points on these two ribs. The vault will follow the warping of the ribs, thus increasing the complexity of a traditional pavilion vault. Additionally, because of their geometry, the ribs will show a different segmentation; one of the ribs will be divided in eight parts while the other in seven. Therefore, the top element in the vault will not follow a quadrilateral but a triangular one [see **figures 145**, **146**, **147**, **148**].

4.4.11 The barrel vault connecting the ribs and its intersection with the dome in the elliptical chapel

This last portion of the vault inherits most of its elements from the ribs. The rib portions taken in consideration are the ones facing the elliptical chapels on the longitudinal axis of the vault. As for the other portions of the vault, the rib projections in plan are not rendered by straight lines but by curves due to their spacial warping.

Because of the vault symmetry along its longitudinal axis, only half of the volume is analyzed for the present construction **[figure 150]**. The points from A^I to G^I correspond to the segmentation used to construct the rib. The only exception is point G^I whose actual position is slightly moved in order to indicate the intersection between the two orthogonal ribs.[40] Together with the plan, two additional vertical planes are used to individuate the

40 In the rib construction, in fact, the point which would have corresponded to G is extremely close to the

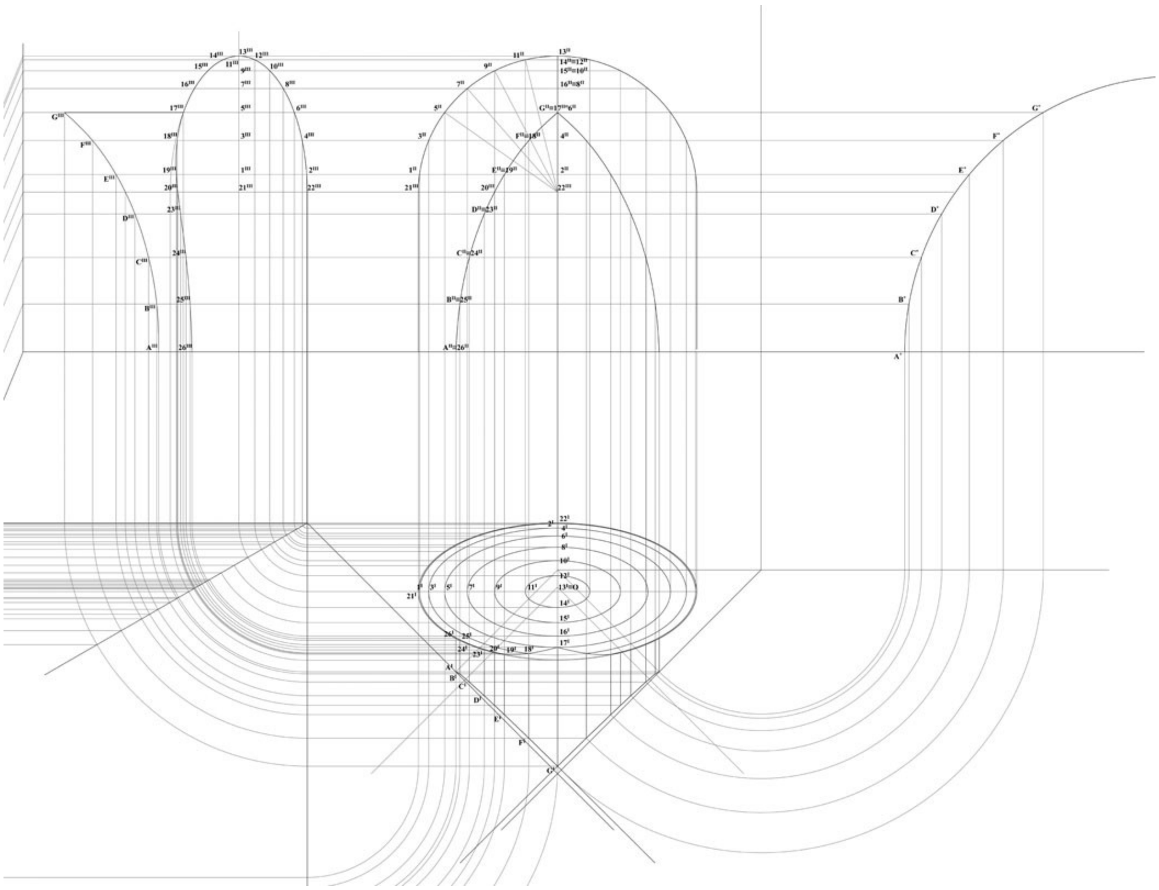

Figure 150. Geometric construction for the barrel vault in between ribs 01 and 02.
Drawing by the author.

ribs' intersection. Introducing the intersection as a control point would have created confusion in the construction process because of its vicinity to the original segmentation used in the rib. At the same time, only an excessive magnification of the drawings would have been able to show the minimal distance between the two points. Thus, it was decided to move point G to the intersection itself. In this new setting, the exact position of point G is obtained intersecting the parabolic plan of the rib with the axis of the vault. Likewise, the very same point may be obtained mirroring the same parabolic profile along the longitudinal vault axis.

layout of the barrel vault and its intersection with the elliptical dome behind it. In these views, the ribs and the domes may be drawn using the information already provided above. The volume of the dome, together with its section along the major and minor axes, refers to the undeformed portion of its correspondent volume on the first floor (this is to say, the half dome facing the church's peripheral walls). Its alignment with the side bay vaults locates the intrados of the dome keystone to the highest point in the vault. Because of the different height of the side bay vaults between the church transversal and longitudinal axes, on the latter ones the elliptical domes will increase their height. The present construction takes in consideration the vault layout on the church transversal axis.

In the front elevation, draw a horizontal line from each point between A^{II} and G^{II}. Among them, the lines from $E,^{II}$ $F,^{II}$ and G^{II} intersect the dome in the elliptical chapel individuating the points *1*, *3*, and *5* on the dome longitudinal axis and *2*, *4*, and *6* on the transversal one. As visible from the side view, the dome grows taller than the barrel vault. Because of this, additional points must be taken on the dome. To assign these additional points, divide the dome section in front view into four parts using 22^{II} as a projection center.[41] These new points go from *7* to *13* on the longitudinal axis, with *13* located at the top of the dome itself. Their counterparts on the transversal axis, instead, are labeled from *14* to *17*.

Starting from *17*, the barrel vault intersects the dome by a profile matching its own in the front elevation. In the side elevation and plan, instead, the arch creates a curve by the variable profile. The position of these intersection points may be obtained by

41 Formally the dome section in the front view follows an elliptical profile instead a circular one. However, because of the reduced eccentricity of the curve, it is possible to divide using radii from its center.

slicing the dome with horizontal planes.

For example, consider the plane from 3^{II}-F^{II}-4^{II}. In plan, center on O and draw the ellipse passing through 3^{I} and 4^{I} intersecting the vertical line from F^{I} at 18^{I}. Project this point in the side elevation individuating 18^{III}. Proceed in the same way for the other horizontal planes passing from A^{II}, B^{II}, C^{II}, D^{II}, and E^{II}, thus obtaining the curved profile caused by the intersection between the barrel vault and the elliptical dome.

Some control points (*20*, *21*, *22*) are introduced in the construction in correspondence to the dome's springer. From them, an additional horizontal plane is introduced in the construction in order to precisely map the point where the curvature of the elliptical dome starts **[figure 151]**.

*   *   *

Few additional elements are present in the second level of Sainte-Anne-la-Royale (the Celestial Path): the windows in the elliptical chapels, and their variation on the transversal axis of the church. While these elements are part of the composition, they play mostly a decorative role. Therefore, they will be analyzed later on together with other similar elements in *Chapter 6: Fioriture*.

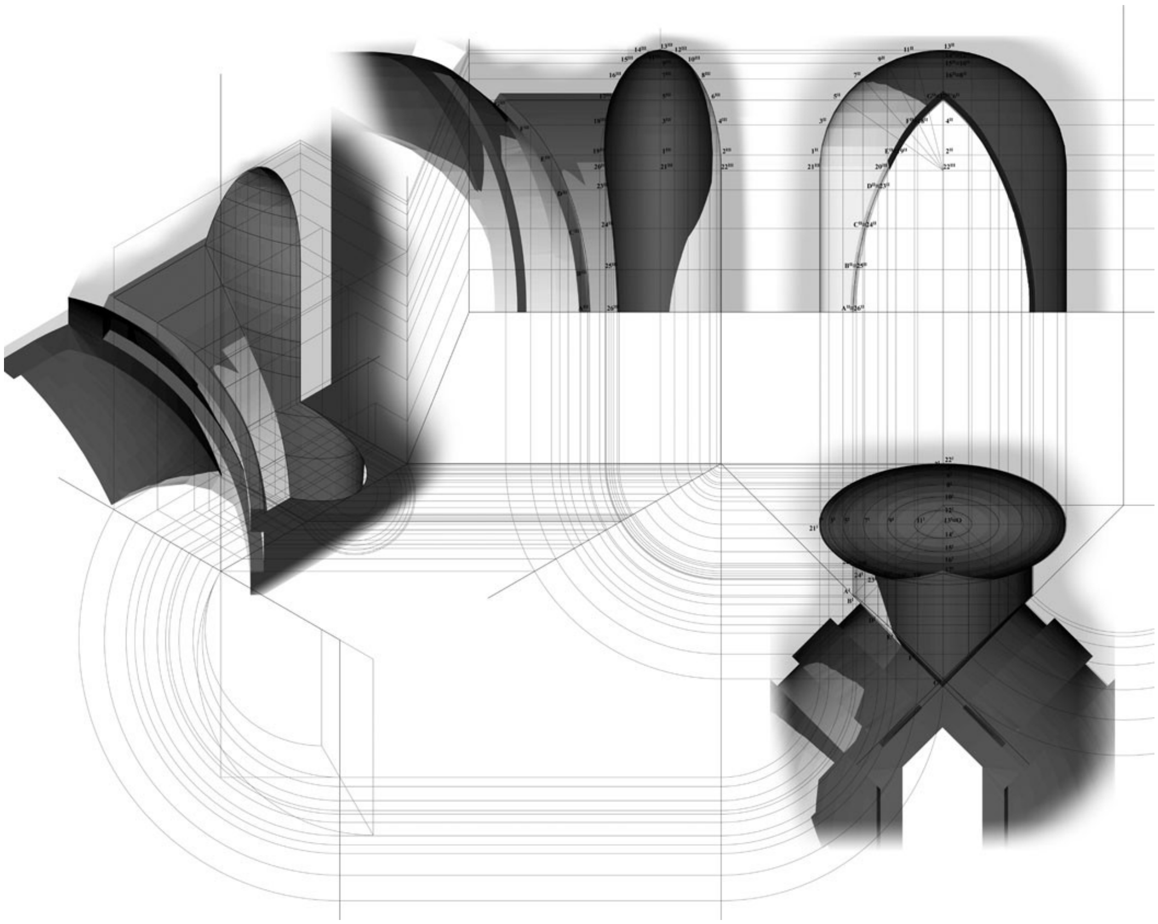

Figure 151. Complete geometric construction for the barrel vault in between ribs 01 and 02. Drawing by the author.

Figure 152. Natural light from the first to levels of Sainte-Anne-la-Royale in Paris.
Picture by the 3d printed model by the author.

Figure 153. Detail of the elliptical chapels in Sainte-Anne-la-Royale in Paris.
Picture by the 3d printed model by the author.

Figure 154. View of the elliptical chapels in the entrance bay of Sainte-Anne-la-Royale in Paris. Picture by the 3d printed model by the author.

Figure 155. Detail of the elliptical chapels in the entrance bay of Sainte-Anne-la-Royale in Paris. Picture by the 3d printed model by the author.

4.5 The link between second level (the Celestial Path) and third level (the Sidereal Emptiness)

According to Guarini's engravings, the joint between the pendentive and the gallery does not create compositional issues. The original engravings, however only show partial information in the transversal section of the building. When moving on the longitudinal axis, in fact, the side bays increase their heights, exceeding their counterparts on the transversal axis. In this configuration, the gallery level is misplaced; its component passes through the surface of the longitudinal vaults, thus implying the introduction of an additional volume between pendentive and gallery. This new element, a pedestal, elevates the gallery level while, at the same, aims to avoid extensive modifications in the building. Because of the perspective in the building, the visibility of this addition is almost entirely hidden from an observer standing at the bottom of the central bay by the overhang from the pendentive's entablature.

The composition of this pedestal follows the directions Guarini provided in *Architettura Civile* for the first Doric Order, in accordance to the nature of the architectural order used in the gallery above. The only elements in the pedestal with altered proportions are its plinth and shaft, which are resized to properly fit the raised height of the longitudinal side bays. The out-of-module measures are concentrated in the plinth.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	~ 9½ p	2 p
Fascia	2 p	1 p
List	1 p	½ p
Apophis	½ p	½ p ~ 0
Shaft	1 M	-
Reversed Kyma	2 p	½ p ~ 1½ p
List	1 p	2 p
Pedestal dimensions	*2 M, 4 p*	*2 p*

Table 32: Composition of the pedestal between pendentive and gallery

4.6 Tier II – The Sidereal Emptiness

Upon reaching the gallery level, the geometry defining the church changes. Aiming for the perfection of divine creation, the church is now organized around a circumference. The orthogonal routes along which the first two level in the church were arranged are now fused together into eight arches that open in the central bay. Formally not accessible, Sainte-Anne's gallery embodies a space between Heaven and Earth: a Sidereal Emptiness between two plains of existence where the soul may ponder about its past and future actions. The act of ascension is accompanied by the loss of material needs. The intricacies and decorations of Corinthian and Ionic orders are left behind. While still not entirely revealed, the fabric of the universe becomes now visible; its pure volumes gently highlighted by smooth Doric profiles.

The new essence of the gallery translates into a new modular system. Still divided in twelve parts, the new module is smaller in size than the one ruling the levels below. Corresponding to eight and half part of the previous module, this new proportional system unifies the upper levels of the church. Additionally, the architectural orders and details in these levels follow one reference only: the first Doric order in *Architettura Civile*. Differences in proportions from the directions in *Architettura Civile*, however, are still perceivable.

At the bottom of the gallery, a Doric pedestal has the double function of providing a basement for the columns framing the gallery while hosting a railing between them. Slightly shorter in size, the pedestal seems to adjust itself to the spindles in the railing. The alteration of the original proportions are contained in its shaft. Its top and bottom moldings, in fact, are extended around the gallery containing the railing **[figure 156]**.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	3½ p	2 p
List	1½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	4 M, 5 p	-
Reversed Kyma	4 p	½ p ~ 3 p
List	2 p	4 p
Pedestal dimensions	*5 M, 3 p*	*4 p*

Table 33: Pedestal of the gallery main order

Similarly to the pedestals, the main order shafts are also shortened. Their top diameters are reduced by 4 parts from their bottom measure while the tapering follows a hyperbolic line. A graphic construction for such profile is described by Guarini in *Architettura Civile*

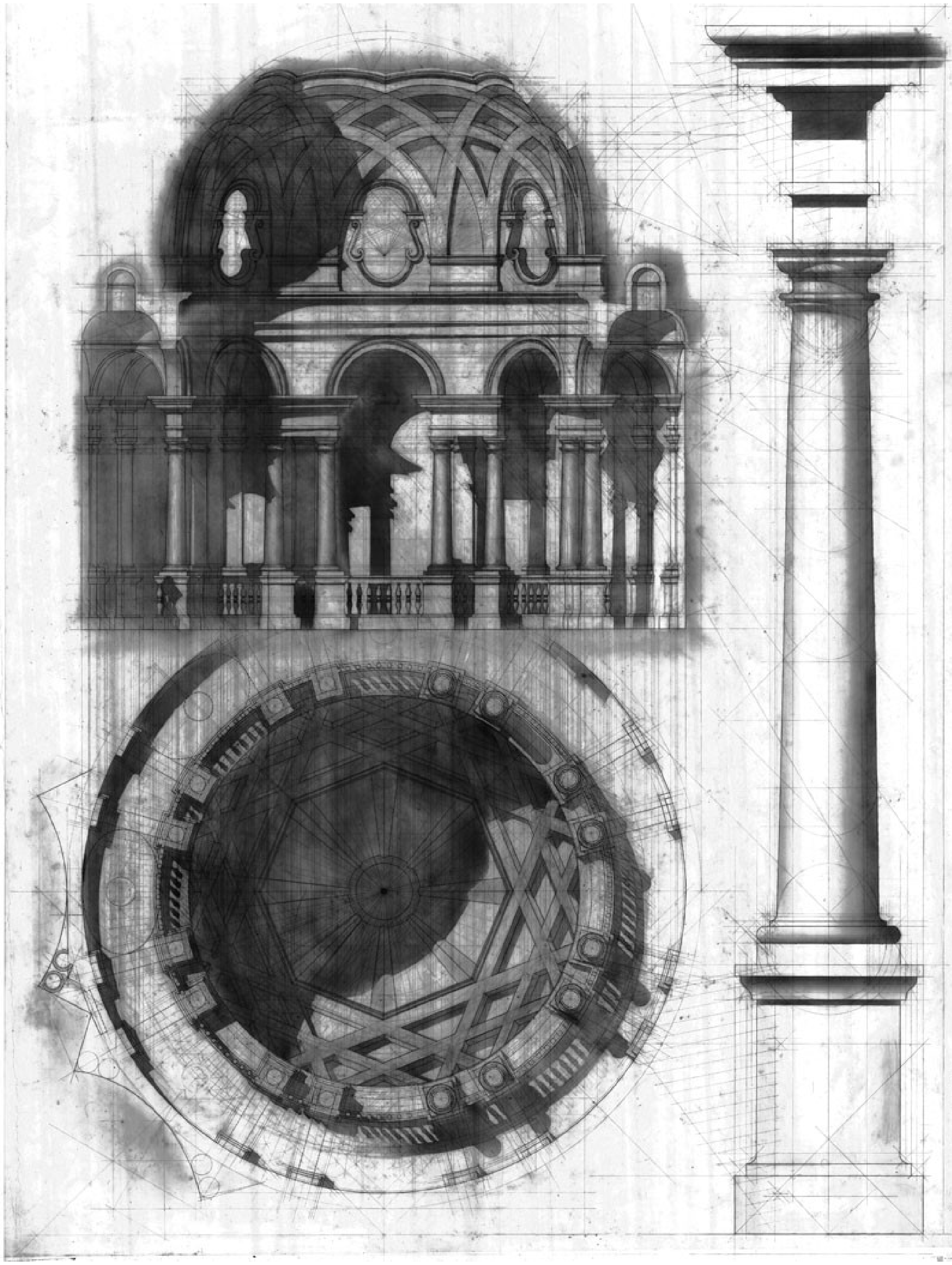

Figure 156. Analysis of the gallery at the third level of Sainte-Anne-la-Royale.
Drawing by the author.

while its mathematical and geometrical demonstrations are provided in a second publication by the Theatine priest, the *Applied Euclides.*[42] Because of the tapering, the profiles above and below the column shaft are not vertically aligned but follow the shaft reduction. This is to say, the set of moldings at the top of the shaft will be recessed by two parts when compared to the bottom moldings.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	4 p	4 p
Tore	3 p	4 p
Base dimensions	*7 p*	*4 p*
List	1 p	1½ p
Apophis	1½ p	1½ p ~ 0
Shaft	13 M, 6½ p	- (the next measures are recessed by 2 parts by the tapering)
Apophis	1 p	1 p
List	1 p	1 p
Shaft dimensions	*13 M, 11 p*	*1½ p*
Tondino	1 p	2½ p
Apophis	½ p	½ p ~ 0
Necking	2½ p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Ovolo (Echinus)	2 p	2½ p
Cavetto (Abacus)	2 p	3 p ~ 4 p
List	1 p	4 p
Capital dimensions	*10 p*	*4 p*

42 Written in latin only, the book has never been translated in any other language, becoming slowly forgotten. Its contents, however, still provide at the present day an incredible and extremely valuable source of knowledge.

Main Order dimensions	***15 M, 4 p***	***4 p***

Table 34: Gallery main order

The entablature is adapted to the one in *Architettura Civile*. In the engraving, in fact, the order shows an excessively compressed entablature while its main elements (Architrave, Frieze, Cornice) have matching proportions. Because of this, it is here decided to restore the entablature according to the directions in *Architettura Civile*. The overall gallery, in fact, shows (beside columns and pedestals shafts) elongated proportions acquiring an appropriate setting when perceived from the bottom of the central bay in perspective.

Element	**Dimension in section**	**Distance from the shaft**
Fascia	8 p	-
List	2 p	2 p
Architrave dimensions	*10 p*	*2 p*
Fascia (Frieze)	1 M	-
Reversed Kyma	3 p	1 p ~ 3 p
Frieze dimensions	*1 M, 3 p*	*3 p*
Fascia	2 p	4 p
Drip Molding	3 p	10 p
List	1 p	10 p
Tondino	2 p	1 M
Ovolo	3 p	11 p ~ 1 M, 2 p
Cornice dimensions	*11 p*	*1 M, 2 p*
Entablature dimensions	***3 M***	***1 M, 2 p***

Table 35: Gallery main entablature

The entablature does not run constantly along the circular profile of the gallery but is broken in eight circular segments, linking two adjacent columns. In between each segment, an arch creates an opening in the gallery while following the cylindrical volume of the central bay. Their plain profiles in the engravings are here re-worked according an appropriate molding sequence suggested by Guarini in *Architettura Civile*.[43] The overall size of an arch matches the diameter of the column below them. This measure also provides an adequate measure for their diameter.

Element	**Dimension in section**	**Distance from the shaft**
Fascia	1 M, 2 p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	1¼ p
Ovolo	3 p	¾ p ~ 3¾ p
List	1 p	4¼ p
Arches dimensions	***1 M, 8 p***	***4¼ p***

Table 36: Arches above the gallery main order

At the top of the arches keystone an additional entablature closes the gallery, wrapping around its entire diameter. Still following the Doric roots of the gallery, this entablature repeats the elements and proportions in the entablature at the top of the gallery columns below. The only visual difference between the two identical elements is their different setting. Where the lower entablature breaks along the gallery columns, the upper one is perceived a constant and unique element. Because of this, its proportions are not repeated

43 Guarino Guarini, *Architettura Civile* (Turin: Appresso G. Mairesse all'insegna di Santa Teresa di Gesù, 1737), Plate 1-III number 23

here.

4.6.1 The gallery ceiling

Behind the arches framing the gallery, the simplicity of Doric orders leave space to a complex structure away from human proportions. Keeping almost a ratio of 1:4 between plan and section the gallery is proportioned in perspective for an observer standing at the bottom of the central bay. The railing in the gallery, for example, arrives roughly to a person' shoulder standing in the gallery. Likewise, the windows open in the peripheral wall are located on a height much higher than a standard person. Only when moving the vanishing point at the first level of the central bay do these elements acquire recognizable proportions. The railing appears shorter than in section while the windows behind them seems to be properly located for human height.

Such proportions might also be the reason why Guarini did not include staircases accessing the gallery level. The original project from Valperga, for example, showed circular staircases carved in the volume of the main pillars which disappear in Guarini's plan. However, the main issue is not the presence or not of a way to access the upper levels of the church but, instead, how these stairs would have been included into the project. Carving staircases into the pillars' mass would have created several issues in Guarini's project. The gallery, in fact, is not directly aligned with the pillars. Any staircases would have to compensate for this misalignment, introducing an additional volume altering the outdoor layout of the gallery. Otherwise, the stairs should have been divided in two portions: a first one carved into the pillars, and a second one bending towards the gallery while moving along the inner surface of the pendentive. If the first solution does not appear reliable for the excessive alterations caused in the main elevation, the second ones appear structurally dangerous. It would have further increased the already challenging balance of superimposed vaults and domes in the church. Maybe this is another why Guarini chose to omit the staircases in his drawings. They might also have been a detail to solve later in construction. When the gallery was never realized, the staircases become an overlooked detail.

Behind the apparent simplicity of a Doric order, the gallery shows a highly complex ceiling composition. Each column in the gallery is linked by an arch to the peripheral wall behind them. When the columns are joined by an entablature, the arches behind the host a radial barrel vault. In correspondence of the arches, instead, an elliptical dome sustains a cylindrical lantern. The composition of these domes, however, does not follow conventional rules. The original rectangle on which the bay is proportioned, is projected on a circular sector thus becoming a trapezoid with curvilinear bases. Each of its four sides hosts arches which, paired in couples, share the same keystone. The two arches on the diagonal sides correspond to the radial arches already mentioned above. The ones on the two curvilinear bases, instead, move up their keystone. Its height is determined by the arch on the minor base—the very same arch framing the gallery surface. Therefore, the arch on the major base assumes an elliptical layout in order to adapt its increased diameter to the measure of its paired companion on the minor base.

Linked together by four pendentives, the two sets of keystones are crowned by a sinusoidal pendentive at whose top sits an elliptical dome. Beside the intense spacial deformations to which both domes and pendentives are subjected, their final volumes maintain a simple, almost pristine nature. Their realization, however, hides a monstrous geometric construction filled with reference points to preserve curvilinear profiles into a deformed environment.

4.6.2 Geometry of the elliptical domes

4.6.2.1 Part I – Determining the ellipses in the deformed environment

The gallery's trapezoidal bay A-B-C-D can be obtained directly from the building plan. Inside this curvilinear trapezoid will be inscribed an ellipse whose geometry is deformed according to the radial nature of the gallery. In addition, the trapezoid sides admit two projection centers. The center for the circular segments A-D and B-C is located in O^{I}, where the gallery center is located too **[figure 157]**. The intersection of the two sides A-B and C-D, instead, happens at O^{II}. The reason for this difference relates to the radial arches connecting the gallery columns to the peripheral wall. Regardless of the radial nature of the gallery, these arches preserve a rectangular body. Therefore, their axis only is projected towards the center of the composition while their sides in plan are parallel to the axis itself, thus moving the sides A-B and B-C from their alignment with O^{I} to O^{II}.

Before working on the ellipse, the construction requires putting in place the keystone of the arches at the perimeter of the trapezoid, introducing three projection planes. Project the circular segment A-D onto the straight line A-D and, choosing its middle point, draw the half circle ADE where E is the measure for the keystones of both the arches on A-D and B-C. To draw this very last arch B-C, project E on the plane at the

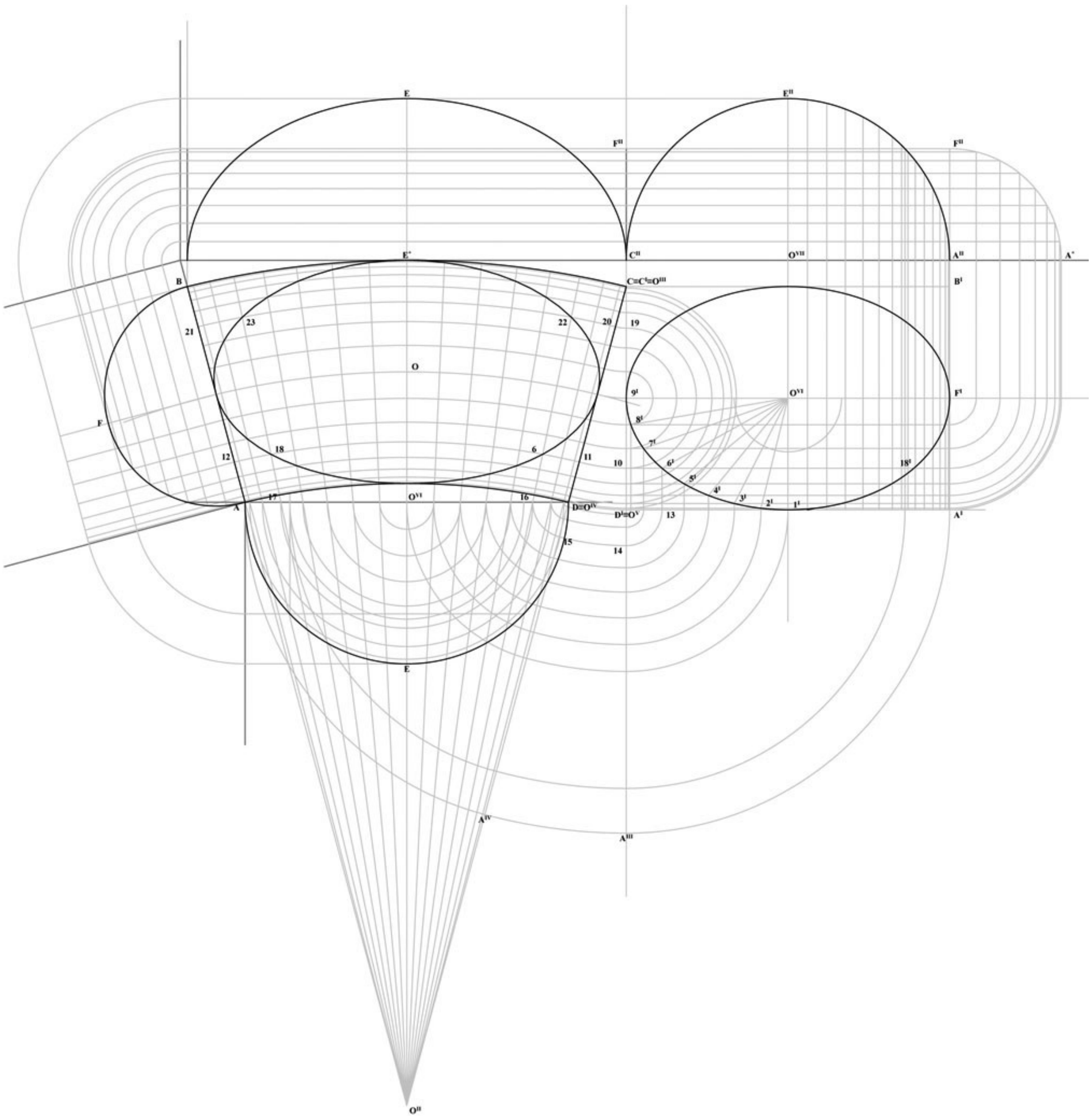

Figure 157. Geometric construction for the domes in Sainte-Anne-la-Royale's gallery - Part I.
Drawing by the author.

top and draw the ellipse with center E^* (the projection of E on the segment B-C) and passing through B, E, and C. The resulting elliptical arch represents a stretched version of the arch AED. At last, on the additional plane related to A-B, draw a half circle with diameter AB whose keystone is located at F. Because of the symmetry between A-B and C-D, F individuates the keystone for C-D too.

These references will provide the springer plan at whose top the ellipse is put in place.

The several deformations to which the ellipse is subjected require shaping its construction into an un-deformed setting first. This information is then moved into the curvilinear trapezoid. At first, the trapezoid A-B-C-D is to be projected onto a new reference system where it is not deformed thus appearing as a rectangle. Point O^{III} (corresponding to C) is used as a projection center moving the circular segment of the trapezoid along the vertical line C^I-D^I.[44] As visible, the construction in the un-deformed environment appears mirrored when compared to the one in the deformed environment.

From C^I and D^I draw two lines perpendicular to C^I-D^I where A^I and B^I will be located. In order to do this, move onto the horizontal line from D^I a segment corresponding to A-D. Otherwise, intersect A-B and C-D individuating O^{II}. Centering on D, move A onto D-O^{II} (A^{IV}) and, using O^{III} and center, move A^{IV} onto O^{III}-D^I (A^{III}). Finally, locate O^V (coincident with D^I), individuating A^I. Point B^I can be simply obtained as the intersection between the line from C^I perpendicular to C^I-D^I and the one from A^I perpendicular to A^I-D^I.

44 Point C^I is coincident to O^{III} and C itself.

Find the center of the rectangle A^{I}-B^{I}-C^{I}-D^{I} (as intersection of its diagonals) individuating point O^{VI}, the center of the ellipse inscribed in the rectangle.[45] Because of its symmetry, it is possible to work on a quarter of the ellipse only and then project the results on the other portions of the curve. Each quarter of the ellipse will be divided in eight parts. The amount of segmentation is not relevant; although, higher the segmentation of the curve more precise will be the final result. Take in consideration one quarter of the ellipse and divide it into eight parts (points from 1^{I} to 9^{I}). Each of these points will use the same procedure which, therefore, may be described one time only for point 6^{I}. Project 6^{I} onto C^{I}-D^{I} (*10*) and, centered on O^{III}, project it onto C-D (*11*). From *11*, draw an arch with center O^{I} intersecting AB at *12* and individuating the curve where point *6* will lay. Move back in the un-deformed environment and project 6^{I} onto C^{I}-D^{I} (point *13*) and move it according to each appropriate projection center: O^{V} (point *14*), O^{III} (point *15*), and O^{IV} (point *16*). Connect *16* to O^{II} until intersecting the arch *11-12* at *6*. The other points on the ellipse corresponding to *6* may be easily obtained. Project *16* from O^{VI}, the middle point of the segment A-D, gaining point *17* (symmetric to *16*) and connect it to O^{II} obtaining point *18* on the arch *11-12*, symmetric to *6* according to the minor axis of the deformed ellipse. Likewise, in the un-deformed environment, use 9^{I} as projection center (*9* is the middle point of the segment C^{I}-D^{I}) moving *10* onto *19*. This very last point must be projected on C-D using O^{III} (point *20*) and then O^{I} (point *21*) individuating the arch *21-22*. This arch intersects the line O^{II}-*16* at *22* and the line O^{II}-*17* at *23*. Both points *22* and *23* belong to the ellipse and are symmetric to *6* and *18* according to the major axis of the ellipse.

The other points of the ellipse will follow the very same procedure. The curve

45 The minor and major axes of the ellipse are located on the middle points of the rectangle sides.

connecting them will provide the profile of the ellipse in the deformed environment.

4.6.2.2 Part II – Setting up the springer plane

The plane containing the dome springer passes through the four keystones of the arches framing the bay. In the un-deformed environment, this plane is cylindrical in shape while, when moved to the deformed environment, it degenerates into an irregular cone. As for the ellipse below, also the springer plane needs to be constructed in an un-deformed environment first before shaping it into the deformed one **[figure 158]**.

Project F and E onto the un-deformed environment obtaining F^{II} and E^{II}. [46] The profile of the cylindric plane for the dome springer is defined by the elliptic arch with center O^{VII} (the middle point of the the segment C^{II}-D^{II}) and passing through F^{II} and E^{II}. Project above this curve the points 1^{I} to 9^{I}. Their projections will provide the springer plane measure for each of the points in which the ellipse is segmented. Move these measures back into the deformed environment, determining a front view of the curvilinear pendentive.

4.6.2.3 Part III – The elliptical pendentives

At the bottom of the dome, four pendentives link the arches in the trapezoid to the sinusoidal pendentive **[figure 159]**. Because of the different measures of the keystones of two adjacent arches in the trapezoid, the pendentives may be divided into two main portions: a first portion below the lower keystone (arches A^{I}-B^{I} and C^{I}-D^{I}), and a second

46 The point F^{II} has two projections: one on C^{II}-D^{II} and a second one on A^{II}-B^{II}. In order to avoid the introduction of additional labels, the same label of F^{II} is maintained for both points.

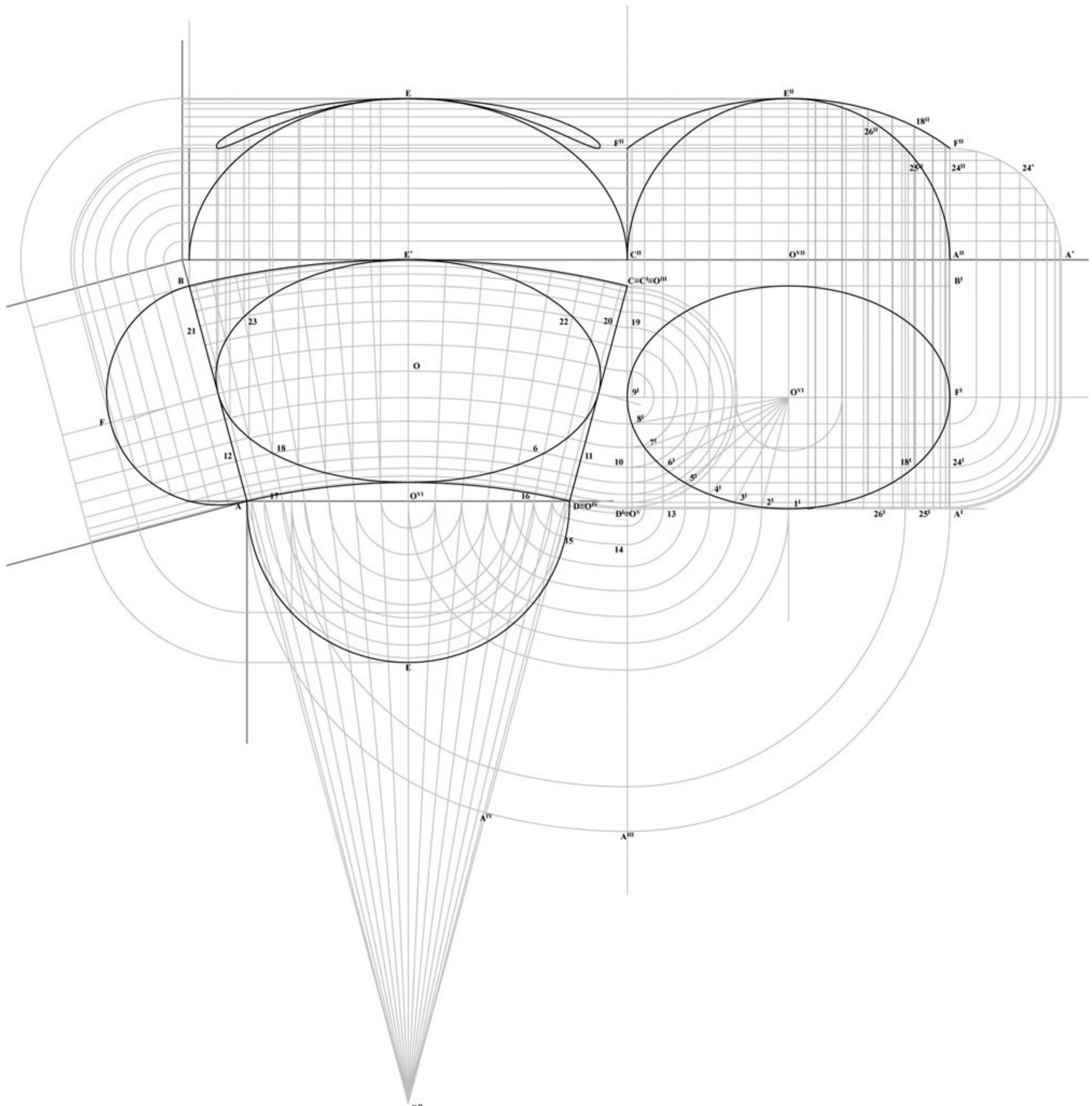

Figure 158. Geometric construction for the domes in Sainte-Anne-la-Royale's gallery - Part II. Drawing by the author.

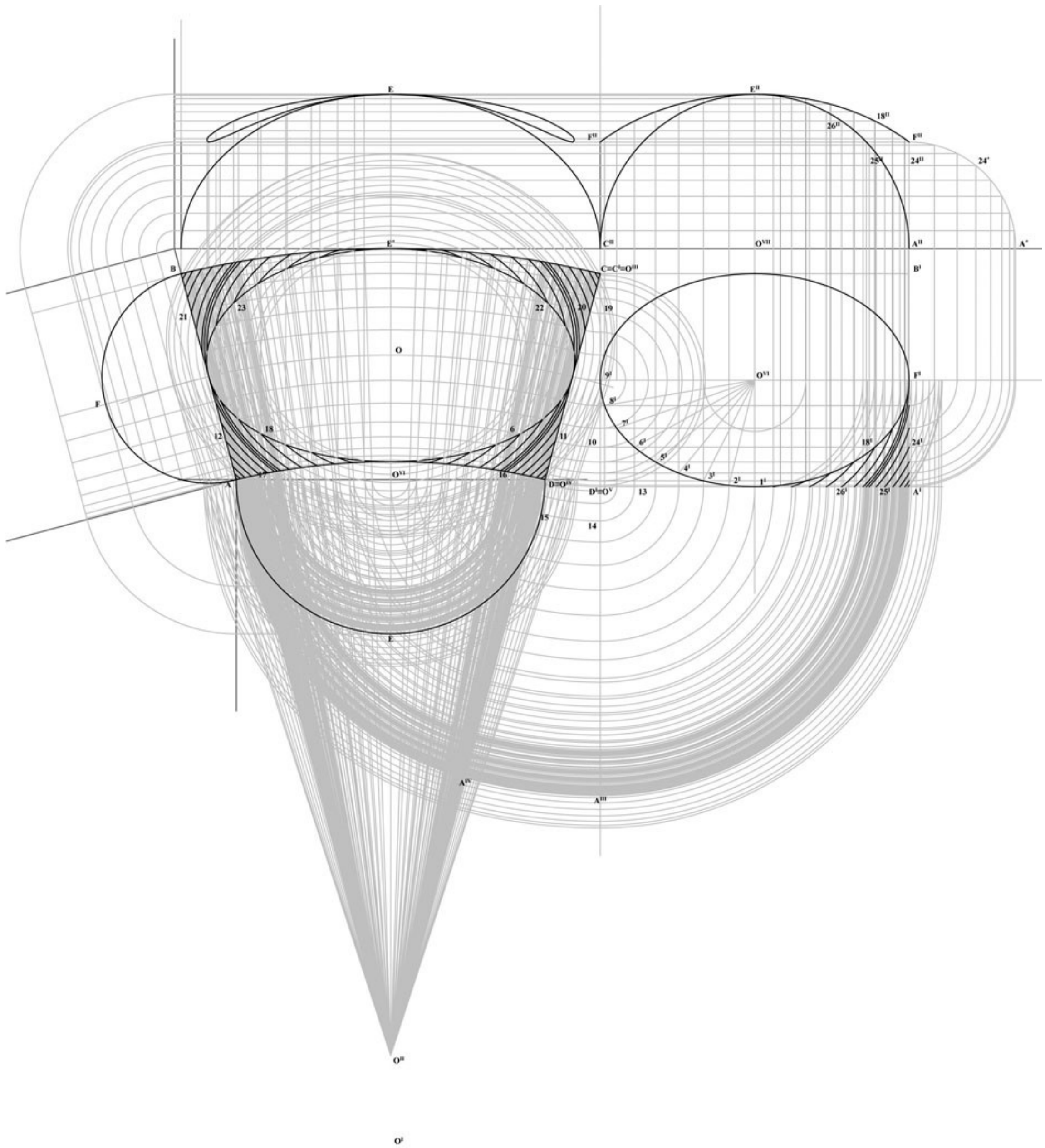

Figure 159. Geometric construction for the domes in Sainte-Anne-la-Royale's gallery - Part III.
Drawing by the author.

portion reaching the next keystone (arches A^{I}-D^{I} and B^{I}-C^{I}).

Point *24*^{I} will be used as a reference to show how to construct the lower portion of the pendentive. Since 24^{I} belongs to the arch A^{I}-B^{I}, it needs to be projected on an additional plane before being located in the front view. Centering on A^{II} with span A^{II}-F^{II} draw the arch F^{II}-A^{*}, a projection of half the arch A^{I}-B^{I}. To project onto it point *24*^{II}, move back to the plan. Using F^{I} as a projection center, move *24* onto the line F^{I}-O^{VI} and from here move it in elevation until intersecting the arch F^{II}-A^{*} at *24**. Project *24** on A^{II}-F^{II} obtaining the desired point *24*^{II}. Extend the horizontal line from *24**-*24*^{II} until intersecting the arch A^{II}-E^{II}, gaining *25*^{II} and project it in plan on A^{I}-D^{I}. The curve linking *24*^{I} and *25*^{I} will individuate the section of the pendentive. Additionally, this curve will be part of a circumference with center O^{VI} (which is also the center of the ellipse inscribed in the trapezoid). To verify this geometry, it is possible to use the construction of an ellipse by a center and two points not belonging to the axes. Its result will be the same circumference drawn above.

The same construction needs to be repeated for the other points in which the ellipse has been divided.

The second portion of the pendentive follows a similar procedure. This time the points of the pendentive may be projected directly onto the elliptical arch E^{II}-F^{II} without introducing a further projection plane like previously described. Point *18*^{I} will used to describe how to construct this second portion of the pendentive. Project *18*^{I} on the vertical plane above obtaining *18*^{II}. From here, a horizontal line will individuate the cut plane passing through *18*, intersecting the arch A^{II}-E^{II} at *26*^{II}. Project this last point onto A^{I}-D^{I} individuating *26*^{I} and draw the curve with center O^{VII} and passing through *26*^{I} and *18*^{I}. As already happened in the previous construction (the lower part of the pendentive), this curve is a circumference.

Use the same method to draw additional sections of the pendentive corresponding to the number of points in which the springer is divided.

Having completed the construction of the dome by its horizontal cut planes in the un-deformed environment, it is possible to move this information onto the deformed one. In this procedure, however, each curve previously identified will be deformed, losing its geometric nature. Because of this, each curve needs to be further segmented into a number of points. Their projection onto the deformed environment will provide a reference for drawing the required curves. In order to avoid an excessive use of points and construction lines in the drawing, it is here chosen to segment these curves in the un-deformed environment according to the horizontal and vertical lines connecting the points from 1^{I} to 9^{I}. The overall process is not described here since it involves just projections using the same method adopted for moving the un-deformed ellipse onto the deformed environment.

4.6.2.4 Part IV – The elliptical dome

The profile of the dome is represented in section by the elliptical arch through F^{II} and G^{II} **[figure 160]**. Its profile, however, is interrupted by cylindric lanterns whose internal radius in plan may be taken directly from the geometric analysis of the church

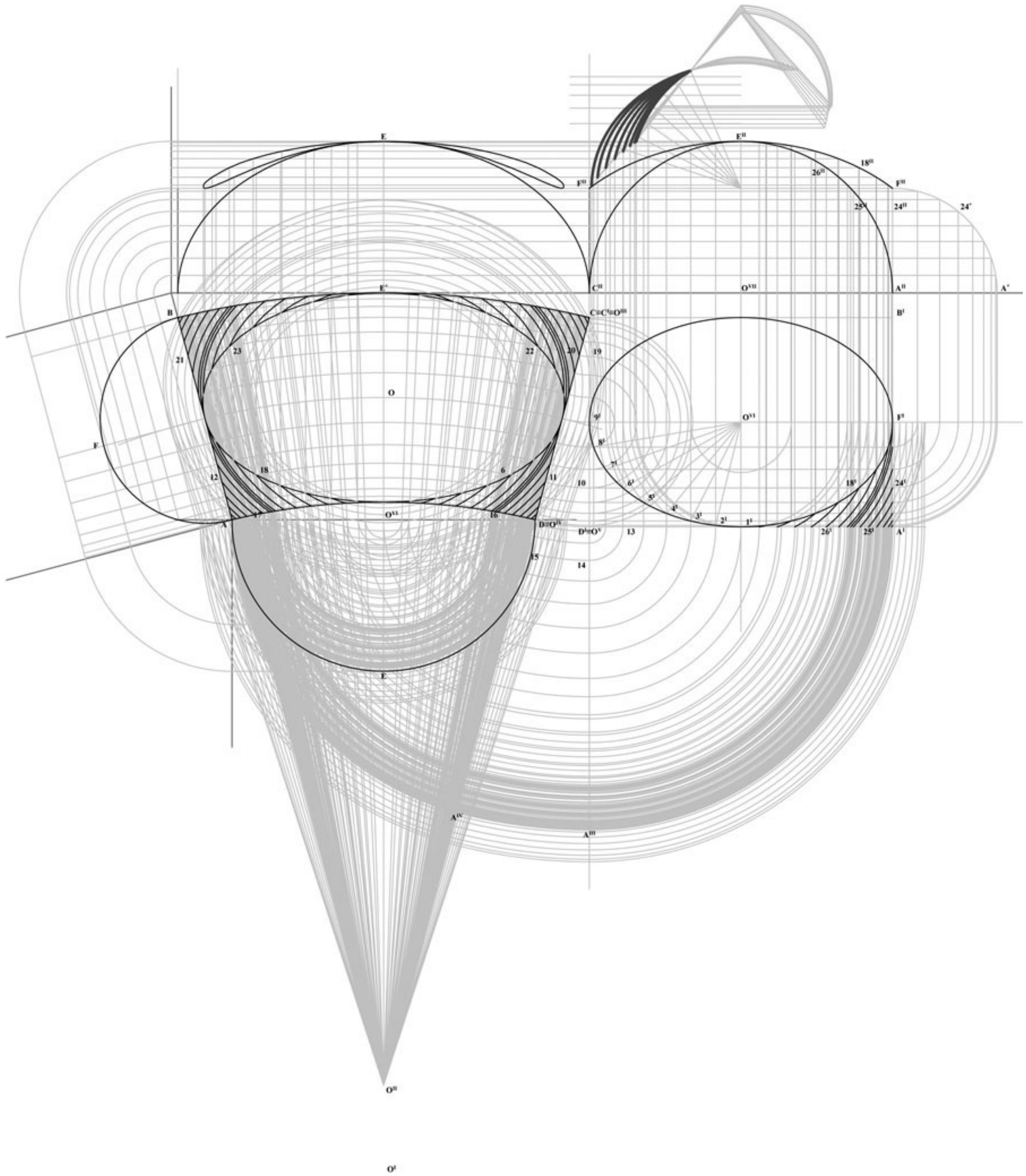

Figure 160. Geometric construction for the domes in Sainte-Anne-la-Royale's gallery - Part IV. Drawing by the author.

plan (the circle with center O^{VII} and radius O^{VII}-H^{I}). While moving along the sinusoidal pendentive, each of the radial planes slicing the elliptical dome will have a unique profile. In the undeformed environment, these radial planes are centered on O^{VI}, each passing through the points 1^{I} to 9^{I}.

For example, take in consideration the radius 6^{I}-27^{I}. Because of its location in plan, this radius needs to be rotated in order to be represented in front view. Centering on O^{VI}, rotate 6^{I} on O^{VI}-9^{I} individuating point (6^{I}) and project it onto the vertical plane along the horizontal line from 6^{II} thus individuating (6^{II}).[47] Using O^{VIII} as the center, draw the ellipse through (6^{II}) and 27^{II} individuating the correspondent profile of the dome in the selected section plane.

The same construction has to be repeated for all the other points in which the ellipse has been segmented. It is suggested to divide the dome into two portions using as a reference the horizontal plane passing from the keystone of the arches on D-A and B-C —this is to say the line (*1*)-1^{II}. The lower portion of the dome will be drawn using cut planes by the points in the springer plane. The upper portion, instead, will be divided into a set number of parts (six in the picture) along the major axis of the dome itself. In both cases, each point found on the vertical plane will be projected in plan onto O^{VI}-9^{I} and then rotated on its proper radius using O^{VI} as rotation center.

After obtaining all these references, their points may be projected into the deformed environment as already described above. However, when moved into the deformed environment, the radii in plan transform from straight lines into curves. Because of this, all the points segmenting each radius need to be individually projected,

47 Repeating the same process is not required for 27^{I}. This point, in fact, belongs to the circle with radius O^{VI}-H^{I} and thus, its rotation from O^{VI} will coincide with H^{I} itself (in plan) and H^{II} in elevation.

Figure 161. Section of the gallery in Sainte-Anne-la-Royale in Paris.
Picture by the 3d printed model by the author.

Figure 162. View of the gallery from the bottom of the central bay.
Picture by the 3d printed model by the author.

Figure 163. The gallery in Sainte-Anne-la-Royale in Paris.
Picture by the 3d printed model by the author.

Figure 164. Detail of the gallery ceiling.
Picture by the 3d printed model by the author.

Figure 165. Detail of the gallery.
Picture by the 3d printed model by the author.

increasing exponentially the amount of construction lines. The final result, however, will provide an accurate representation of the dome.

4.7 Tier III - The Edge of the World

Composed by a net of interlaced arches described along a spheric surface, the first dome in Sainte-Anne-la-Royale lacks a proper architectural order. At its bottom, however, a pedestal inherits the Doric nature of the gallery below it. A comparison with doric pedestals in *Architettura Civile*, in fact, shows similarities with the second and third Doric order, both sharing the same pedestal. Beside the usual alterations in the plinth and shaft length, the pedestal in the engraving shows an additional molding at its top, a fascia. Typical of Ionic orders, this molding is preserved in the present reconstruction in order to strengthen the separation between pedestal and structural ribs. The overall proportions are still related to the gallery module. The ribs, in fact, preserve the same width of the columns in the gallery (more precisely, their top diameter) [see **figure 156** at page 324].

Element	**Dimension in section**	**Distance from the shaft**
Plinth	9 p	3 p
Tondino	1½ p	2½ p
List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft	1 M, 5½ p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Tondino	2 p	2½ p
Reversed Kyma	3 p	2½ p ~ 4½ p

List	1 p	5 p
Fascia	3 p	6 p
List	2 p	7 p
Pedestal dimensions	*3 M, 7 p*	*7 p*

Table 37: Pedestal for the interlaced ribbed dome

At the top of the first dome **[figure 166]**, the sides of the octagonal hole in the center show a profile decorated with moldings. While there is no surviving information about the nature of these profiles, their relationship to the interlaced ribbed dome suggests the use of a Doric set of moldings. The bent arches in the gallery provide a reference for these new profiles **[figure 167]**.

Element	Dimension in section	Distance from the back wall
Fascia	9½ p	-
Apophis	½ p	½ p
List	½ p	½ p
Tondino	1 p	1¼ p
Ovolo	2 p	2¾ p
List	1 p	3¼ p
Entablature dimensions	*1 M, 1½ p*	*3¼ p*

Tier 38: Entablature of the octagon crowning the ribbed dome

4.7.1 Roots for interlaced ribbed domes

The technical bases that Guarini apparently used give physical shape to ideas from Islamic traditions: a dome framed by interlaced arches. Such a structure is lighter than a

Figure 166. View of the interlaced ribbed dome.
Picture by the 3d printed model by the author.

Figure 167. The two domes in Sainte-Anne-la-Royale.
Picture by the 3d printed model by the author.

normal dome while conferring a higher static stability. The Islamic examples typically use these structures as blind domes or as a shell pierced by small openings. Guarini, instead, uses interlaced domes to open windows among their ribs, bringing more light inside the volume. However, because of the secular friction between the Roman church and the Islamic world, a declared use of "infidel" ideas for a holy building would have been more than heretical. As already mentioned, Guarini never declares the origin of his domes; moreover, in his *Architettura Civile*, he declares that those structures are an invention of his own.[48]

It was Otto Shubert who, while analyzing the Baroque architecture in Spain in 1908, suggested for the first time Islamic architecture as a possible source for Guarini's domes.[49] Other hypotheses about this connection came some years later by scholars[50] who suggested Guarini travelled in the Iberian Peninsula based on a project he realized in Lisbon: Santa Maria della Divina Providenca (which was destroyed by an earthquake in 1755). The journey is connected with a period of two years (from 1660 to 1662) in the life of the Theatine architect about which there is no documentation. Moreover, the dedication of Guarini's *Placita Philosophica* to Francisco de Mello Torres, Portuguese ambassador in French and England courts, suggested Francisco as a guide during this

48 In the same way, Guarini (who was also an astronomer) declared to not believe in the Heliocentric theory by Galileo Galilei, probably to keep distance from the heretical theory that bought Galilei more than one time in front of the Inquisition Tribunal.

49 Otto Schubert, *Geschichte des Barok in Spanien* (Esslingen: Paul Neff Verlag, 1908), p. 176.

50 Joaquín Bérchez and Fernando Marías, "Guarini and le Spagne d'Europa e d'America," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 494-513; Meek, H. A., *Guarino Guarini and his architecture* (New Haven: Yale University Press, 1988), pp. 12-17.

supposed journey.[51] On this track, Adolfo Floresa[52] and other historians[53] suggested possible Spanish buildings that may have inspired Guarini.

Another group of scholars, instead, suggest an indirect connection of the Theatine priest with Spain.[54] Discarding the idea of Guarini traveling in Spain, they hypothesized knowledge coming from books, essays, and other informal sources (like travel accounts) to justify the similarities between Guarini's architecture and Arabo-Hispanic examples. Among the evidence for this hypothesis there are connections with the artist Juan Andres

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51 H. A. Meek, *Guarino Guarini and his architecture* (New Haven: Yale University Press, 1988), p. 13; Paulo Varela Gomez, "Guarini in Portogallo," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 515-523; Enrico Guidoni, "Modelli Guariniani," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), II, p. 237 where Guidoni hypothesizes a supposed travel in Portugal between the 1656 and 1659.

52 Adolfo Florensa, "Guarini ed il mondo Islamico," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 637-665.

53 Otto Shubert, *Geschichte des Barok in Spanien* (Esslingen: Paul Neff Verlag, 1908), p. 176; Sigfried Giedion, *Space, time and architecture: the growth of a new tradition* (Cambridge, MA: Harvard University Press, 1941), pp. 121-126; Giulio Carlo Argan, "La tecnica del Guarini," in *Guarino Guarini e l'internazionalità del Barocco,* ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 35-46; Pierre Charperntrat, *Living Architecture: Baroque – Italy and Central Europe* (Fribourg: Office du Livre, 1967), p. 99; Enrico Guidoni, "Modelli Guariniani," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), II, pp. 229-282; Anthony Blunt, *Baroque and Rococo – architecture & decoration* (New York: Harper & Row Publishers, 1978), pp. 64-69; Rudolph Wittkower, "Introduzione al Guarini," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), I, pp. 20-32; Marian Moffett, *A world history of architecture* (London: Lawrence King Publishing Ltd., 2003), pp. 370-372; Joaquín Bérchez and Fernando Marías, "Guarini and le Spagne d'Europa e d'America," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 494-513; Eugenio Battisti, "Schemata del Guarini," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), II, pp. 107-178; Oleg Grabar, *Islamic Visual Culture, 1100-1800: constructing the study of Islamic art* (Burlington: Ashgate Publishing Company, 2006), II, p. 385; Susan Klaiber, "La formazione di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 22-27.

54 Paolo Verzone, "La struttura delle cupole in Guarino Guarini," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA. VV. (Turin: Accademia delle Scienze, 1970), I, pp. 401-413; H. A. Meek, *Guarino Guarini and his architecture* (New Haven: Yale University Press, 1988); Hanno-Walter Kruft, *A history of architectural theory: from Vitruvius to the present* (New York: Princeton Architectural Press, 1994), p. 105; Cristina Maritano, "«Antichità Romane,» edifici moderni e «Gottici esempi» in *Architettura Civile*," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 106-115; Andrew Morrogh, "Aclune fonti per le cupole del Guarini," In *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 50-57; Marco Rosario Nobile, "Guarini e la Sicilia," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 486-493; Paulo Verala Gomez, "Guarini and Portugal," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 515-523.

Ricci (with may have introduced Guarini to the Salomonic order)[55] and with the architect Juan Caramuel de Lobkowitz (who criticized by Guarini for his excessive use of "oblique architecture," a type of architecture based on visual and geometric deformations of volumes).[56] This supposed connection may have happened while Guarini was in Messina (Sicily). In fact, during its history, the Italian island has been subjected to Islamic domination by the Almoravids (similar to some portions of Spain) who maintained for a long time a connection with Madrid. Morrogh suggests that Islamic buildings in Messina (also secondary buildings like hamam), may still have existed at the time of Guarini's sojourn to the island.[57]

Other possible scenarios explored by scholars, locate inspiration for Guarini's domes back in Italy. Possible precedents are suggested in a few buildings in the North of Italy (like Borromoni's Magi Chapel in the College of Propaganda Fide, which was used also by the Theatine order)[58] and some vernacular examples (like Sant' Evasio in Casale Monferrato). From studies in 2006, it is also suggested that some sketches by Leonardo da Vinci depicting vaults with interlaced arches gave inspiration to Guarini; however, like for the Islamic precedents, there is no proof of Guarini coming into contact with them

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55 Andrew Morrogh, "Alcune fonti per le cupole di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 50-57.

56 Cristina Maritano, "«Antichità Romane,» edifici moderni e «Gottici esempi» in *Architettura Civile*," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 106-115; Joaquín Bérchez and Fernando Marías, "Guarini and le Spagne d'Europa e d'America," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 494-513.

57 Andrew Morrogh, "Alcune fonti per le cupole di Guarini," in *Guarino Guarini*, ed. Giuseppe Dardanello, Susan Klaiber, Henry Millon (Turin: Umberto Allemandi & C., 2006), pp. 50-57.

58 Willian V. Hudon, *Theatine Spirituality* (Mahwah, NJ: Paulist Press, 1996), p. 28.
Several historians suggest this building may have been the inspiration for the dome in Sainte-Anne-la-Royale. I have included a list of most of them in the chart accompanying the precedent paper related to the analysis of the critique on Guarini from 1665 to the present time.

(which were stored in Milan).

4.7.2 Cordoba: a possible precursor for Guarini's domes

The expansion of the Islamic empire slowly spread out from the middle-east touching the Mediterranean shores of North Africa and southern Spain. According to the historical accounts, the domains in the Iberian peninsula gave birth to the kingdom of al-Andalus, the farthest European borders of the empire. Mainly focused on farming production, the headquarters of al-Andalus were originally located in Seville—which was the original capital of the kingdom—and in Toledo, the second main center. The city of Cordoba, which already existed before the arrival of the Muslims in 711 CE,[59] gain importance only from 716. During the Umayyad emirate,[60] in fact, the Governor al-Hurrin ibn al-Thaqafi (716-719) transferred the capital of al-Andalus from Seville to Cordoba transforming the city into a center for trade and commerce. Later in time, between 747 and 756, the conflicts between Umayyad and Abbasid dynasties in the Islamic homeland created an ascending role for the city of Cordoba. While escaping from the massacre of his own family in Syria, Abd ar-Rahamn I found refuge in al-Andalus. Here he gained the title of *amir* of the remaining Umayyad dynasty[61] and tansformed the kingdom from a province of the Abbasid empire into an independent state (even if al-Andalus continued to pay homage to the Abbasid caliphs in the homeland of the empire.)[62] As capital of the new born state, Cordoba started gathering and increasing

59 The July-August of 711 Cordoba was occupied by the manumitted slave Mughith al-Rumi, deputy of Tariq idn Ziyad [Josef W. Meri and Jere L. Cacharach, *Medieval Islamic Civilization* (New York: Routledge, 2006), p. 175];

60 *Ibid*. 175

61 Amelia Helena Silowski, *Islamic ideology and ritual: architectural and spatial manifestations* (New York: UMI, 2007), p. 35

62 Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96

administrative, military, religious, and cultural activities of the kingdom.[63]

A Roman city by foundation, Cordoba's (or Qurtuba) urban setting was already altered in the past by Visigoths; however, even at the time of the Islamic domination, the original Roman implant was still ruling the city thanks to a bridge over the river Guadalquivir (Wadi al-kabir) and a fortification wall surrounding the original settlement. Interestingly, the new cultural directions introduced by the Islamic domination did not erase these previous traces (like it happened in Jerusalem, for example); rather, al-Andalus promoted a cultural integration, giving birth to an original, if not unique, coexistence of Islamic, Roman, and Visigoth roots. Architectonically, the most interesting extent of this cultural mingling are the double-tiered arcades in Cordoba's mosque, probably inspired by the Roman aqueducts in Merida.[64] In Cordoba's mosque, the execution of these arcades alternates brick and stone voissoirs. According to some scholars, this architectural choice relates to Umayyad examples in Syria[65] (the Great Mosque in Damascus) and Israel (the Dome of the Rock in Jerusalem).[66] A different hypotheses for the roots of alternating materials in the arches of Cordoba's mosque, instead, suggest a reference to local traditions (a later Roman style[67] or to Visigoth traditions[68]) which might have spread out in the Iberian peninsula prior the Arab conquest. According to this second hypothesis, a similar prevalence of local heritage

63 *Ibid*. 175
64 Amelia Helena Silowski, *Islamic ideology and ritual: architectural and spatial manifestations* (New York: UMI, 2007), p. 35
65 Gurlu Necipogulu, *Muquarnas, an annual on the visual culture of the Islamic world: 1996* (Leiben: E. J. Brill, 1996), p. 80
66 Amelia Helena Silowski, *Islamic ideology and ritual: architectural and spatial manifestations* (New York: UMI, 2007), p. 35
67 *Ibid.*, p. 35
68 Alejandro Lapunzina, *Architecture of Spain* (Westport: Greenwood Press, 2005), p. 83

above traditional Islamic forms may also explain the absence of pointed arches in Cordoba's mosque (an architectural feature universally employed in the Islamic homeland).[69]

The original structure in Cordoba's mosque was realized in 785 under the caliph Abd al-Rahman[70] and it was expanded multiple times in an attempt to make this building the religious center of al-Andalus.[71]

Mixed roots of religious tolerance are the most interesting feature of Cordoba's mosque. According to several sources, the first congregational mosque in Cordoba was the Visighotic cathedral of Saint Vincent, which was shared with the local Christian population.[72] While not a common event, analogous examples of shared buildings were already documented in the Islamic world.[73] However, beside a religious tolerance towards Christians and Jews, Cordoba's Muslim community used inscriptions on the exterior of the mosque as territorial marks sacralizing the site to the Muslim faith.[74] Moreover, when later in time the cathedrals were entirely purchased by Muslims, the site was purified and consecrated as an Islamic sanctuary[75] through the realization of a completely new

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69 James Fergusson, *A history of architecture in all countries* (London: John Murray, 1987), II, p. 400

70 Josef W. Meri and Jere L. Cacharach, *Medieval Islamic Civilization* (New York: Routledge, 2006), p.175; Spencer Baynes, *Encyclopædia Britannica,* (Edinburgh: Adam and Charles Black, 1878), XVI, p. 864

71 Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96

72 Janina M. Safran, *The second Umayyad Caliphate: the articulation of caliphal legitimacy in al-Andalus* (Cambridga, MA: Harvard University Press, 2000), p. 61, 182; Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96; see also Alejandro Lapunzina, *Architecture of Spain* (Westport: Greenwood Press, 2005), p. 81. Lapunzina indicates Abdullah ibn-Falad as architect for the first Cordoba's mosque, which was realized under Adb-al-Rahman.

73 Gurlu Necipogulu, *Muquarnas, an annual on the visual culture of the Islamic world: 1996* (Leiben: E. J. Brill, 1996), p. 84. Necipogulu cites Christian churches in Damascus which, under Abu Ubayda al Khalid, were sheared by both Christians and Islamic faithfuls.

74 Janina M. Safran, *The second Umayyad Caliphate: the articulation of caliphal legitimacy in al-Andalus* (Cambridga, MA: Harvard University Press, 2000), p. 61

75 Gurlu Necipogulu, *Muquarnas, an annual on the visual culture of the Islamic world: 1996* (Leiben: E.

building. The serial plan of this new mosque (which was enlarged in several occasions) mixes the implants of traditional hypostyle halls to elements unusual for religious buildings, like double arcades resting on columns. In the homeland, the Great Mosque in Damascus already used a similar solutions with two story columns; however, in Cordoba, the double arcades do not rest over walls like in Damascus but are free standing elements. As a result, the space in Cordoba's mosque becomes free of structural boundaries (the walls), offering the illusion of a never ending forest of pillars. To give strength to the composition, the double tiers of arches framing the space of the mosque create two different outlines. The arcades in the upper level preserve a typical round profile; the arcades in the lower level, instead, develop over a horseshoe-shaped arch suggesting a naturalistic reference to palm leaves.[76] Like the already mentioned alternation of brick and stone voissoirs, the use of horseshoe-shaped arches can be traced back to ancient traditions present in the Spanish architectonic language before the Arabic conquest.[77] Beside the precedent in Damascus, the compositional choice of double arcades in Cordoba seems to follow a functional path more than a stylistic one. The columns used in the mosque, in fact, were not originally realized for this building but came from Roman ruins in the area (mainly from Merida). Due to their disparate origins (like the forum and private houses), the columns did not share dimensions and proportions. Moreover, since they were too short for creating a large hypostyle hall, the example of Damascus suggests the creation of a superstructure overlapping the main.[78] From this point of view, the

J. Brill, 1996), p. 84

76 Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96

77 Deborah K. Dietsch, *Architecture for dummies* (Hoboken, Wiley Publishing, Inc., 2002)

78 Richard Ettinghauser and Oleg Grabar, *Islamic art and architecture 650-1250* (New Haven and London: Yale University Press, 1987), p. 132. The two authors specify that the choice of using columns from existing buildings comes by the incapability of Spanish builders to provide monumental columns characteristic of Syria.

alternation of red bricks and white stone may be considered a visual device showing the coexistence of the two structures.[79]

Among the several additions and extensions to the mosque, the feature most relevant to this research is the *maqsura* realized by al-Hakam II in 961.[80] A structure with screen like walls (usually in wood or metal), a *maqsura* has the purpose of screening its occupant from the other worshippers but, at the same time, allowing him to see and participate to the ritual.[81] Liturgically, this element does not imply any significant role; insted, it is a visible exaltation of the ruler's rank. From this point of view, its volume raises above the rest of the building due to a raised gabled transept (in the outside) and domes (in the inside).[82]

Because of its meaning and composition, a *maqsura* is a typology mainly used in Umayyad palaces. Its origins, in fact, are usually connected to princely ceremonies; here a maqsura is a domed room framed by arches leading to the throne room.[83] Its presence in Cordoba's mosque may be again traced back to some unconventional features in the Great

79 *Ibid.*, p. 132.

80 Amelia Helena Silowski, *Islamic ideology and ritual: architectural and spatial manifestations* (New York: UMI, 2007), p. 39; Alejandro Lapunzina, *Architecture of Spain* (Westport: Greenwood Press, 2005), p. 83. Together with the *maqsura*, Hakan II added also twelve additional bays, and a double *quibla* wall.

81 Robert Hillenbrand, *Islamic architecture: form, function, and meaning* (New York: Columbia University Press, 1994), p. 49

82 *Ibid.*, p. 49. The transept, especially, never attained any great popularity since its form could not be imposed on all kinds of mosque. Moreover, a transept implies a roofing system that extend parallel to the qibla instead perpendicular to it. The use of transepts in mosques introduces a secondary axis emphasizing the main axis ending in the mirhab. For this purpose, the roofing system of this element gained an extra height towering above the whole mosque. According to Hillenbrand, the mosque which first used this typology was the Great Mosque of Damascus.

83 *Ibid.*, p. 49. This second hypothesis relates to a visible exaltation of the ruler's rank. A processional entry of the caliph or sultan in the mosque for the friday *salat* was, in fact, a long-established tradition in the medieval Islamic world. From this point of view, elements like the raised gablets, domes over the maqsura, and a dome above the mirhab (like in Cordoba) would have created a architectonic scenario proper to such pomp and circumstance. Later in time, during al'Hakam II's caliphate, the lobed arches were included in Cordoba's mosque during its extension works (962-966).

Mosque of Damascus (which merged with a Syrian church).[84] However, since during the caliphate period, Cordoba's mosque represented a daily reminder of Umayyad rule, the mosque itself represented a symbol of success, faith and dynastic inheritance.[85] When compared with the other bays in the mosque, the *maqsura* shows elaborated five-foil interlaced arches overlapped on the double arcades in the rest of the building.[86] While their main purpose is to enhance a seven sided *mirhab*,[87] these additional arcades gain also a structural meaning: to counter the greater lateral thrust of the stone vaults topping the three bays in the *maqsura*.[88] The compositional choice of shaping these additional arcades as lobed arches becomes a device for camouflaging the required supports.[89] Following the same intent, the dome in the central bay of the *maqsura* and the vaults in

84 *Ibid.*, p. 49. According to Hillenbrand the Great Mosque of Damascus is the first religious building where a maqsura is used. The original church in Damascus might have work as centerpiece for the mosque, which inherited the original Christian implant. A similar deliberate reformulation of foreign components fits the typical taste of Umayyad architecture.

85 Janina M. Safran, *The second Umayyad Caliphate: the articulation of caliphal legitimacy in al-Andalus* (Cambridga, MA: Harvard University Press, 2000), p. 61

86 Alejandro Lapunzina, *Architecture of Spain* (Westport: Greenwood Press, 2005), p. 83

87 Richard Ettinghauser and Oleg Grabar, *Islamic art and architecture 650-1250* (New Haven and London: Yale University Press, 1987), p. 83. Like the *maqsura*, also the *mirhab* in Cordoba had an unusual geometry. Its original effect must have been either that of a darkened opening into another world or, if a light was put into it, of a beacon for the faithful. The numerous inscriptions in it (almost entirely Qur'anic), refers to royal rights and ritual obligations. Perhaps, under the influence of the surrounding Christian world the *mirhab* acquired a precise liturgical, ceremonial, and religious meaning usually absent elsewhere in the Muslim world. Sustaining this hypothesis there are unusual rites which were performed in the mosque, like the carrying in procession a copy of the Qur'an. These liturgical innovations may also explain the horseshoe shape within rectangular frames used for gates (like San Esteban, one of the main gates into the mosque, 855). Similar formal ensembles, not always charged with meaning, are characteristic of most western Islamic architecture.

88 Alejandro Lapunzina, *Architecture of Spain* (Westport: Greenwood Press, 2005), p. 83

89 Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96. The ability of mixing decorative and structural elements is typical of Andalusian architecture. Moreover, the use of lobed arches to reach these structural and decorative purposes may be traced back to Umayyad architecture and, in particular, to the Khirbat al-Mafjar palace complex in Jericho. Here the use of lobed arches might have been inspired by natural shapes like shells. The first appearance of this architectonic elements in Spanish architecture happened in the Madinat al-Zahram (three miles northeast of Cordoba). This palatine fortress was built for administrative uses becoming later the residence of the different governors of Cordoba. A different source for the poly-lobed arches is instead suggested by Grabar and Ettinghausen. The two scholars, in fact, connect this shape to the decorative niches of certain Abbasid buildings (palace of al-Ashir in Samarra, and the mosque of Ibn Tulun), even if their hypotheses are still not confirmed. [Richard Ettinghauser and Grabar Oleg, *Islamic art and architecture 650-1250* (New Haven and London: Yale University Press, 1987), p. 135]

the two side bays are framed by interlaced ribs[90] concentrating the strengths in specific points in the composition: at the bases of the arches and in their intersections. The resulting structure transforms a traditional heavy dome into a light shell.

The dome in the central bay of the *maqsura* (located in front of the *mirhab*) works on an octagonal base. The interlaced ribs framing the dome individuate two squares intersecting one another. Beside the structural advantages of a similar structure, the visual effect of this specific composition generates the illusion of a surface shorter than a traditional hemispherical dome. In fact, the geometry resulting from the intersection of the ribs shares dimensions close to the one of the figure at the base of the dome itself. To avoid a flattened effect, the total hight of the shell has been enhanced in Cordoba by paired columns at the base of the ribs. The visual effect created by these columns suggests an elongated composition in which the volume containing the columns appears as a drum. At the top of the composition, the octagonal opening framed by the interlaced ribs opens the view towards a second dome. While hemispherical in shape, the perfect geometry of this element is hidden by a carved poly-lobed flower (whose main petals align to the vertexes of the octagon at its base).

The two vaults in the side bays of the *maqsura*, show a variation in the composition of the ribs. This time, each side of the polygon is directly connected to the opposite one, so each rib skips two vertexes of the octagon before reaching its next support (while in the dome in the central bay of the *maqsura* each vertex of the two squares skips one vertex of the octagon only). As a consequence, the octagon at the

90 Ali Wijdan, *The Arab contribution to Islamic art* (Cairo: The American University in Cairo Press, 1999), p. 96

intersection of the ribs looks smaller in dimension than the one at the base of the vault.

An analysis of the volumetric concatenations in the *maqsura*, shows that the several geometries involved in the composition are polygons only. The hemispherical dome at the top of the central bay hides its hemispherical nature by a carved poly-lobed flower. In the same way, the intrados of the ribbed arches in the three bays of the *maqsura* do not bend above an hemispheric structure (as will happen in Guarini's architecture) but preserve a traditional horizontal axis. At their intersections, in fact, the arches do not merge one another but show an intersection line as result of the different planes of their axis. However, the main consequence of the absence of circles from the plan of the mosque, becomes visible in the transition from the main level and the dome and vaults in the *maqsura*.

In the first level, the hypostyle implant of the mosque develops through squared bays (or, more precisely, slightly rectangular bays). Each bay has two columns on the transversal axis (located at the corners with no support in the middle) and three on the longitudinal axis (a third column divides the bay in two parts). In the *maqsura*, this scheme varies: one side of the bay is now occupied by the qibla wall (with two pilaster strips at the corner of each bay) while the three standing sides are divided in two portions by three columns (only the central bay of *maqsura* is framed by four columns in front of the *mirhab*). However, at the connection between prayer hall and *maqsura* the supports on the longitudinal axis are paired columns. The presence of paired columns creates compositional issues in the *maqsura*, where the center of the vaults does not align to the middle supports.

Above the arches in the *maqsura*, this first level is closed by a straight frieze following the squarish perimeter of the bay. The second level, instead, works on an octagonal shape which, however, does not maintain a direct relationship with the architectonic volume below it. The vertexes of the octagon in the second level show a correspondence with the supports below on the side opposite to the qibla only. In the same way, the different division of the bays in the first level (two portions) and the framing of the octagon in the second level of the same bays (three portions) with different lengths between the central one and the two on the sides) creates a mismatching between vertexes of the octagons and keystones of the arches in the first level.

Similar problems appear in the transition between the square at the first level and the octagon at the second one; the diagonal sides of the octagon fly over the corners of the squared bays. Since each side of the octagon hosts an arch, this compositional imperfection is partially hidden by muqarnas which create a transition from the right angle of the squared bay to the round arch of the octagon. However, the partially flying supports of the arches in the diagonal sides of octagon break the continuity of the structure, which looks sliced into two overlapping and independent volumes.

Similar solutions are visible in the other two vaults of the mosque: the dome in Villaviciosa chapel[91] and the one in the Royal chapel. In both these structures the geometric reference is no more an octagon, but the square of the bay itself. Each side of the square is divided into four portions providing a better connection with the interlaced arches than in the *maqsura*, even if the final result is still not quite perfect. The squared geometry used in the two vaults provides new routes for interlaced ribs: perpendicularly

91 Henri Terrasse, *L'art Hispano-Mauresque des origines au XIIIe siècle* (Paris: G. Van Oest, 1932), pp. 139-40.

from side to side, and diagonally. Like for the *maqsura*, the polygon resulting form the intersection of the ribs matches the one at the base of the vault—which, in the case of two chapels is a square. The irregularity of the volumes at the corner of the square are hidden by *muqarnas* and, in Villaviciosa only, by a suggestive alternation of light and shadow provided by windows at the base of the vault; these elements create the illusion of a floating vault.[92]

While original in shape, the rough details in the domes and vaults realized in Cordoba suggest their experimental nature. It seems that their builders were not fully aware about the structural possibilities of interlaced ribs which might have permitted vaults lighter than usual. Likewise, the Islamic western architecture does not deeply explore similar solutions.[93] Also outside Islamic borders, it is difficult to trace similar innovations of traditional forms; structural elements by truncated lines broken up into smaller units[94] appear sporadically in Armenian churches,[95] and to certain features of Sasanian and later Iranian dome construction.[96] Almost one thousand years later, western Christian architecture shows examples of interlaced structures in the works of Guarino Guarini and of his followers (mainly Bernardo Vittone and Filippo Juvarra),

Few scholars attempted to trace back the origins of these construction methods, whose origins were searched for in the Islamic homeland. In fact, it is unlikely to

92 While both the vaults in the Royal chapel and Villaviciosa show windows at their base, the windows in the latter are now partially closed until the impost of the arches.
93 Richard Ettinghauser and Grabar Oleg, *Islamic art and architecture 650-1250* (New Haven and London: Yale University Press, 1987), p. 137
94 *Ibid.*, p. 134
95 Auguste Choisy, *Historie de l'architecture* (Paris: Bibliothèque de l'Image, 1899), pp. 11, 22-23
96 Andre Godard, *Voûtes Iraniennes*, (Haarlem: 1949)

hypothesize that Spanish builders might have transformed oriental decorative shapes into forms of construction since, in most instances, the evolution runs in the opposite direction.[97] In fact, while the arches and vaults in Cordoba might have been local Spanish developments inspired by the double tiers of arches (in the mosque from 784),[98] their origins have to be traced back to the link between construction and decoration in Islamic architecture.[99] In the Islamic homeland, in fact, domes are usually ornamental details, a carpentry framing covered with stucco or mastic.[100] In Spanish traditions, instead, domes reflect Roman traditions being properly constructed and constituting the actual roofs of the buildings. The case of Spanish-Arabic architecture falls in between these two opposites; while vaulting did not get particular attention, this mixed architecture focused mainly on fanciful and gorgeous decorations more than on technical executions with durable materials.[101]

Following the example of Cordoba's vaults and domes, the architecture in the Iberian peninsula blossomed with variations and further explorations of structures with interlaced ribs in both Christian and Muslim buildings. While difficult to trace back the real origins of these structures, Florensa and Gomez Moreno suggest some possible precedents in Iran.[102] Among the five hundred domes in the Great Friday Mosque in Isfahan, three at least show interlaced ribs on squared bays. Realized in the XIIth century, these Iranian structures belong to a later time frame than the vaults in Cordoba. However,

97 Richard Ettinghauser and Oleg Grabar, *Islamic art and architecture 650-1250* (New Haven and London: Yale University Press, 1987), p. 137
98 *Ibid.*, p. 137
99 *Ibid.*, p. 137
100 James Fergusson, *A history of architecture in all countries* (London: John Murray, 1987), II, p. 402
101 *Ibid.*, p. 402
102 Adolfo Florensa, "Guarini ed il Mondo Islamico," in *Guarino Guarini e l'internazionalità del Barocco*, ed. AA.VV. (Turin: Accademia delle Scienze, 1970), pp. 645-646; Manuel Gomez Moreno, "El arte árabe español hasta los almohades, arte mozárabe," in *Ars Hispaniae,* ed. AA.VV. (Madrid: Editorial Plus-Ultra, 1951), III

the two scholars suggest these Iranian models might have been inspired by precedents lost in time.

4.7.3 Geometry of the interlaced ribbed dome in Sainte-Anne-la-Royale

The dome in Sainte-Anne-la-Royale may be schematized as half of a sphere. The rendition of this generative volume, however, is completely reinvented; its surface is fragmented by a net of intersecting ribs organized according to the setting of the gallery's columns below. The proportion of the ribs, in fact, corresponds to the measure of these columns' upper diameter. Sixteen in total, the ribs are paired in eight couples similarly to the gallery columns. Each couple constitutes a single structural element which, cut along a spheric surface, assumes a conical intrados with a correspondent tilted section. The overall volume of the ribs is not difficult to obtain; it is essentially an extrusion along a semicircular path. However, because of their plan setting, each rib couple intersects one another creating a total of forty joints in the dome, which may be organized in the four types of stereotomic nodes:

Stereotomic node 01: the intersection between the base of one major and one minor rib (sixteen nodes in total);

Stereotomic node 02: the intersection between two adjacent minor ribs (eight nodes)

Stereotomic node 03: the intersection between two adjacent major ribs (eight nodes)

Stereotomic node 04: the intersection between two adjacent major ribs and a single minor rib (eight nodes)

Each node will be individually analyzed. The procedure may be entirely solved in plan and then projected in elevation to provide a complete set of information. The projection on a vertical plane, is not described since it is a simple matter of projecting each edge in the node on its appropriate reference arch. Each set of nodes, in fact, will share constant measures throughout the dome regardless of their position or the vertical plane chosen.

Instead of a conventional plan organizing the view from top to bottom, the dome is here approached by a reversed plan.

4.7.3.1 Stereotomic node 01: The merging springer between major and minor ribs

The first stereotomic node corresponds to the base shared by the major rib A-F and the minor rib A-N **[figure 168]**. Both the arches start in plan from A (1^{I}-2^{I}-3^{I}-4^{I}) departing orthogonally from each other along the spheroidal volume of the dome. The main joint between these two ribs can be obtained directly in plan by the intersections of their correspondent edges; point 5^{I} (intersection between A-N edge from 2^{I} and A-E edge from 3^{I}) and point 6^{I} (intersection between A-N edge from 1^{I} and A-E edge from 4^{I}). These two points are the reference from which the ribs will be segmented. Such cuts will be realized according to radial planes whose position is calculated in relation to each rib

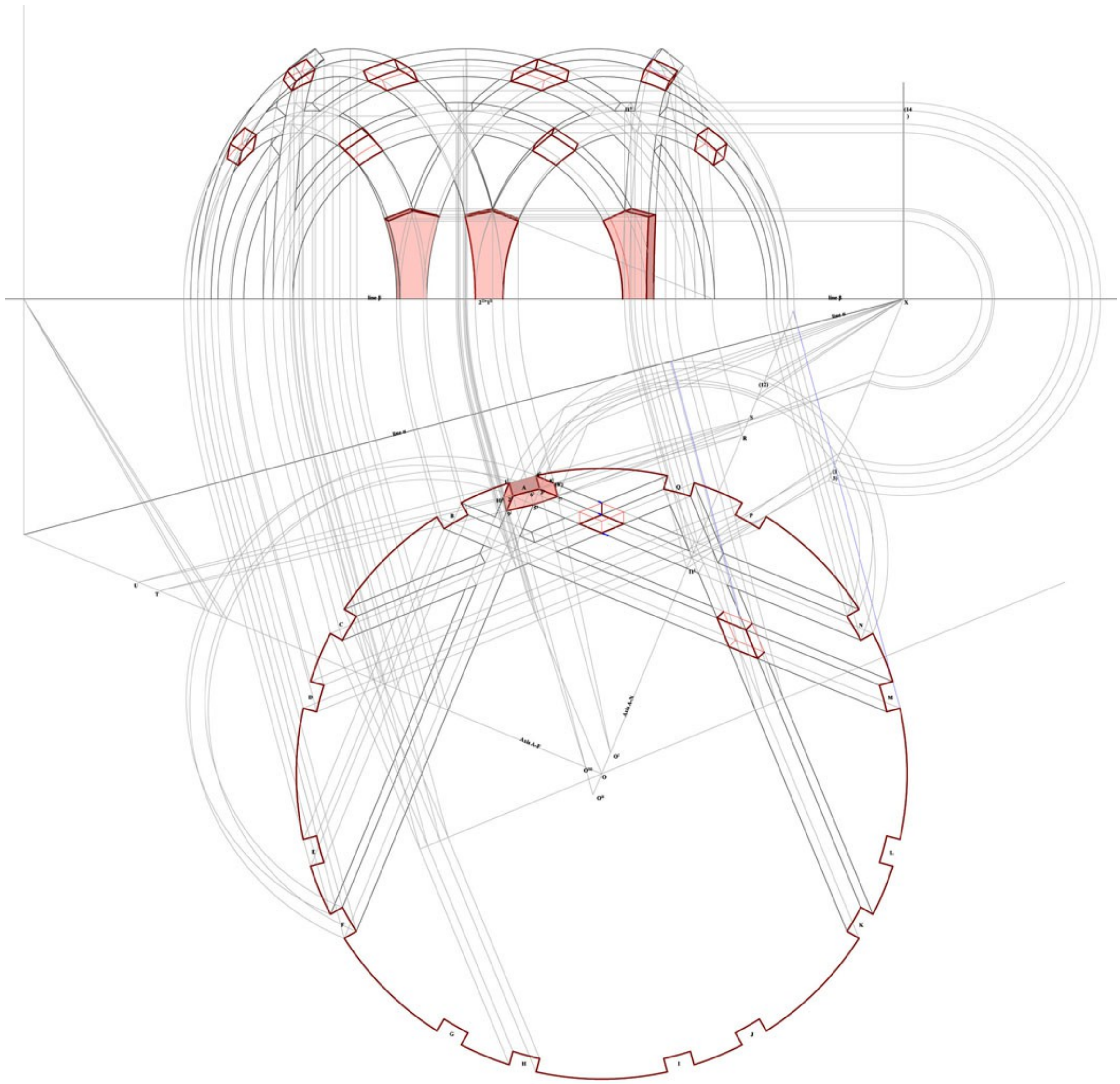

Figure 168. Stereotomic Node 1.
Drawing by the author.

in the dome. For example, rib A-N will be taken in consideration. The surface contained between the edges 2^{I}-3^{I} rotates along the spheric volume of the dome until reaching its symmetric segment in N. Along this path, the line 2^{I}-3^{I} changes progressively its inclination, ending up directed towards O, the center of the dome, when reaching the axis of A-N until assuming in N a setting mirrored to the starting one. To control 2^{I}-3^{I} during its path, extend 2^{I}-3^{I} until intersecting A-N axis in R. The sheaf of lines passing from R and contained between A and N describes the movement of 2^{I}-3^{I} along the dome.

The same method can be used for the rib face 1^{I}-4^{I}. This time, the projection center is located at S, the intersection between 1^{I}-4^{I} and the A-N axis. The other two sides of the rib (3^{I}-4^{I} and 1^{I}-2^{I}), instead, will admit their projection center at O^{I} and O^{II} respectively.

Using this information, the mapping of the stereotomic node may be completed. This first node, however, is cut differently from the other ones. The joint line between major (A-F) and minor (A-N) arches is directed towards O (the center of the composition) but not towards any of the center points (R, S, O^{II}, and O^{III}) individuated. Rather than an error or an imprecision, this situation happens because both the arches have have different radii and cover different spans. As a result, the line through 5^{I}-6^{I} generates an anomalous reference for the arch implying that the lines from the four centers will not be able to individuate a closed quadrangle from these two points. For example, connect 5^{I} to R individuating 7^{I} and project this last point from O^{I} individuating point (*8*). When connected to S, (*8*) does not converge on 6^{I}. Such irregularity, however, may be easily circumvented to obtain an accurate cut of the rib.

Connect 5^{I} to R cutting the arched profile in 7^{I} and, likewise, connect 6^{I} to S, gaining 8^{I}. The quadrangle thus obtained (5^{I}-6^{I}-7^{I}-8^{I}) will belong to the same plane although its shape will not match the section of the arch (individuated by the rectangle 1^{I}-2^{I}-3^{I}-4^{I}). Repeat the same process and corresponding adaptation for the arch A-F. This time, point 5^{I} will be connected to T (point 9^{I}) while 6^{I} will connect to U (point 10^{I}) completing the springers for both arches.

The projection of the node on a vertical plane is done orienting the said plane parallel to both segments 1^{I}-4^{I} and 2^{I}-3^{I}. The references used for the projections are *line α* and *line β.* Together with their intersection point X, these three elements are used to move the tilted references in plan onto a front view horizontally oriented. The height of the ribs edges are provided by the plan itself. For example, consider segment 2^{I}-11^{I}. Centering on 11^{I} (which is located on the A-N axis), draw the arch from 2^{I} intersecting A-N axis at (*12*). The segments 11^{I}-2^{I} and 11^{I}-(*12*) have the same measure, of course.[103] Connect (*12*) to X and from 11^{I} draw a copy of the segment replicating its length and inclination, thus obtaining point (*13*). Connect (*13*) to X and, centering on X itself, rotate (*13*) until reaching (*14*) in the line from X perpendicular to *line β.* The horizontal line from (*14*) represents in elevation the point where 11^{II} (the keystone for the edge by point 2^{I} in the rib A-N) will be located. This reference will be valid for all the other arches in the dome with span equal to A-N.

103 Both 2^{I} and 12^{I} are on the same circumference with center 11^{I}

4.7.3.2 Stereotomic node 2: Intersection between two minor ribs

As for the previous node, also the present one may be entirely solved in plan and then projected in elevation **[figure 169]**. The intersection in the present node happens between the ribs A-N and C-Q which, in plan, is represented by the surfaces 14^{I}-15^{I}-16^{I}-17^{I} (facing the dome center) and 18^{I}-19^{I}-20^{I}-21^{I} (in contact with the back wall). As for the previous node, the defined surfaces are the references from which the ribs needs to be cut according to their projection centers. Point 14^{I} will provide an example on how to proceed. Project 14^{I} from V (projection center for the edge in C-Q containing the point 14^{I}) obtaining point 22^{I}; likewise, project 18^{I} from W individuating 18^{I}. Repeat the same procedure for the very same points 14^{I} and 18^{I} using, this time, the projection center from A-N, thus individuating the points 26^{I} and 27^{I} respectively. In the same way, the points 16^{I} and 20^{I} need to be projected according to their centers on A-N (points 24^{I} and 25^{I}) and C-Q (points 28^{I} and 29^{I}).

The final volume will fit both ribs A-N and C-Q and it may be projected in elevation. The only construction required in the procedure is the one described in node 1 about the individuation of the keystones for each arch in the rib edges. At last, using a vertical plane parallel to the rib orientation in plan will show the curvature of the arches segments composing the rib.

4.7.3.3 Stereotomic node 3: Intersection between two major ribs

The construction follows the same guidelines used for the node above. The only difference regards the actual shape and volume of the final node. The intersection

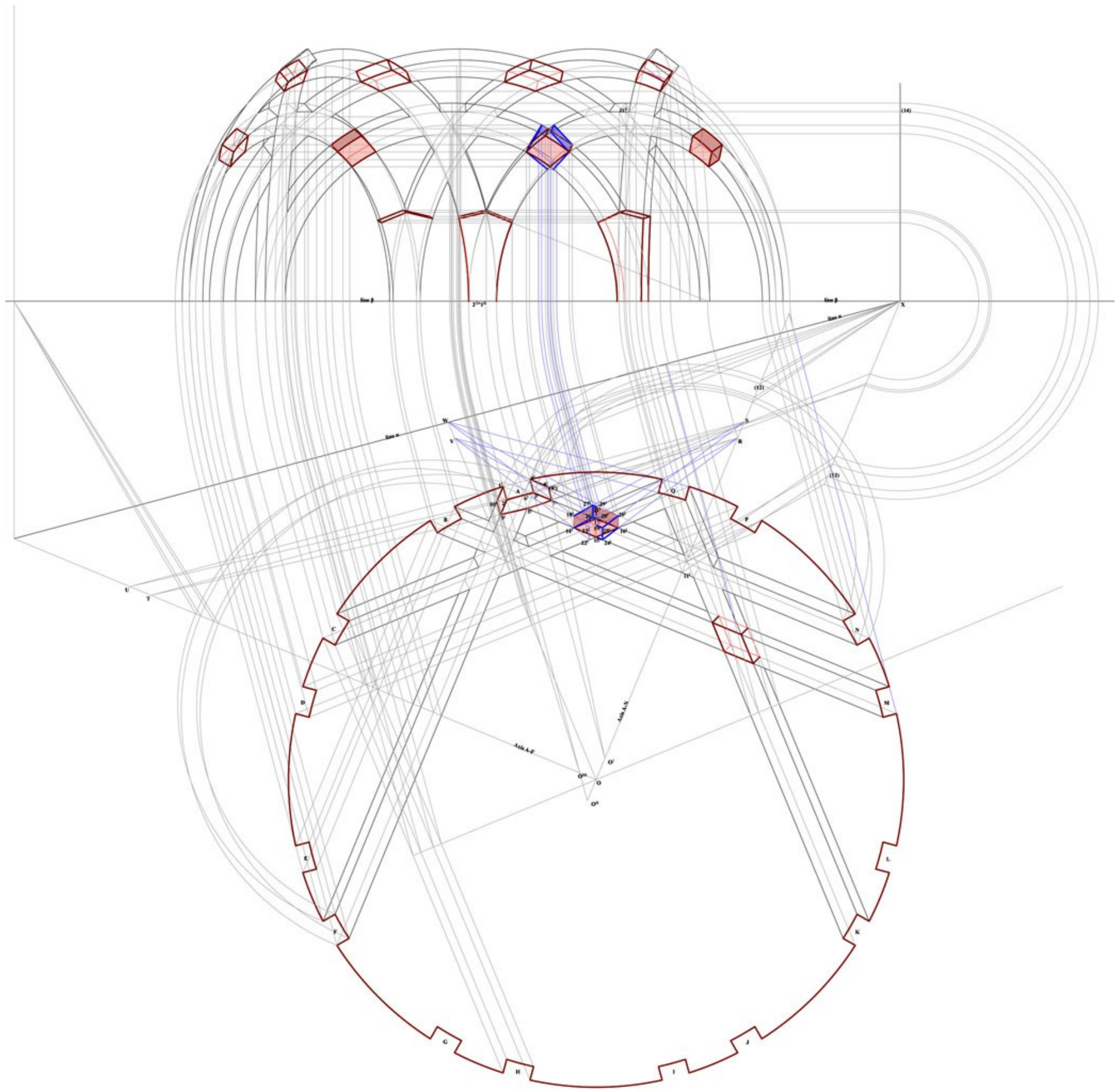

Figure 169. Stereotomic Node 2.
Drawing by the author.

between two major ribs, in fact, create a volume compatible in shape to the one found for the minor ribs. The only difference between these two nodes is their volume, bigger in node 3 than in node 2. The procedure to individuate node 3 is exactly the same already described for node 2. After individuating the surfaces of the node in plan, its vertexes need to be joined to their correspondent projection points obtaining a representation of the final node. Also in this case, a front view of the rib will provide the amount of curvature for the arched segments composing the node **[figure 170]**.

4.7.3.4 Stereotomic node 04: Intersection between two major ribs and one major one

This last node intersects the major ribs A-F and B-M with the minor rib C-Q. In order to avoid an excessive overlap of reference points and construction lines, the node is analyzed on a clean plan. The vertical planes, instead, are chosen to better fit node 4. For the present analysis, three vertical planes are used:

- vertical plane 01: parallel to the minor rib C-Q (frontal view of the node);
- vertical plane 02: parallel to the major rib B-M (skew view of the node);
- vertical/section plane 03: passing from the axis of the node and aligned to the center O.

As in the previous examples, the vertical planes have been set up on a horizontal reference in order to calculate one time only the point of the node vertexes. Projections from plan to these vertical planes used appropriate rotation points. Again, most of the construction can be realized in plan **[figure 171]**.

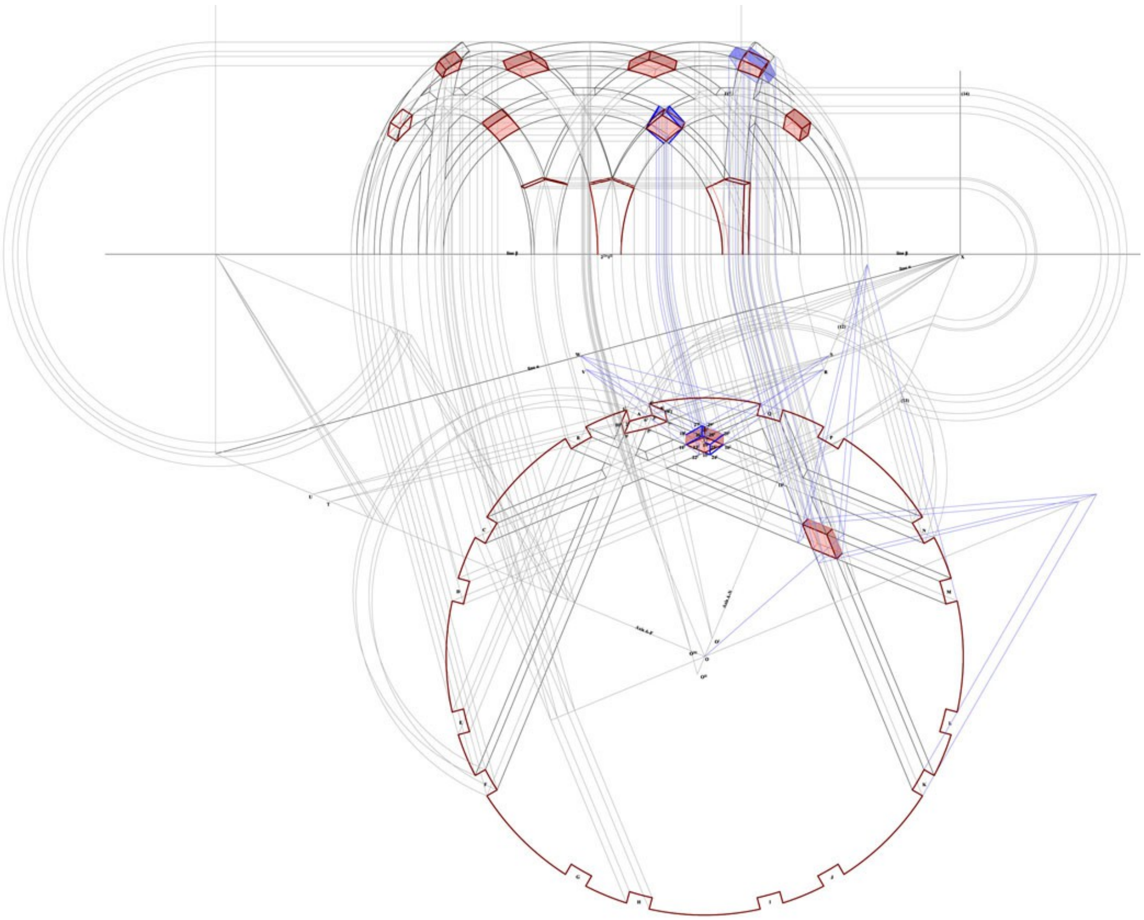

Figure 170. Stereotomic Node 3.
Drawing by the author.

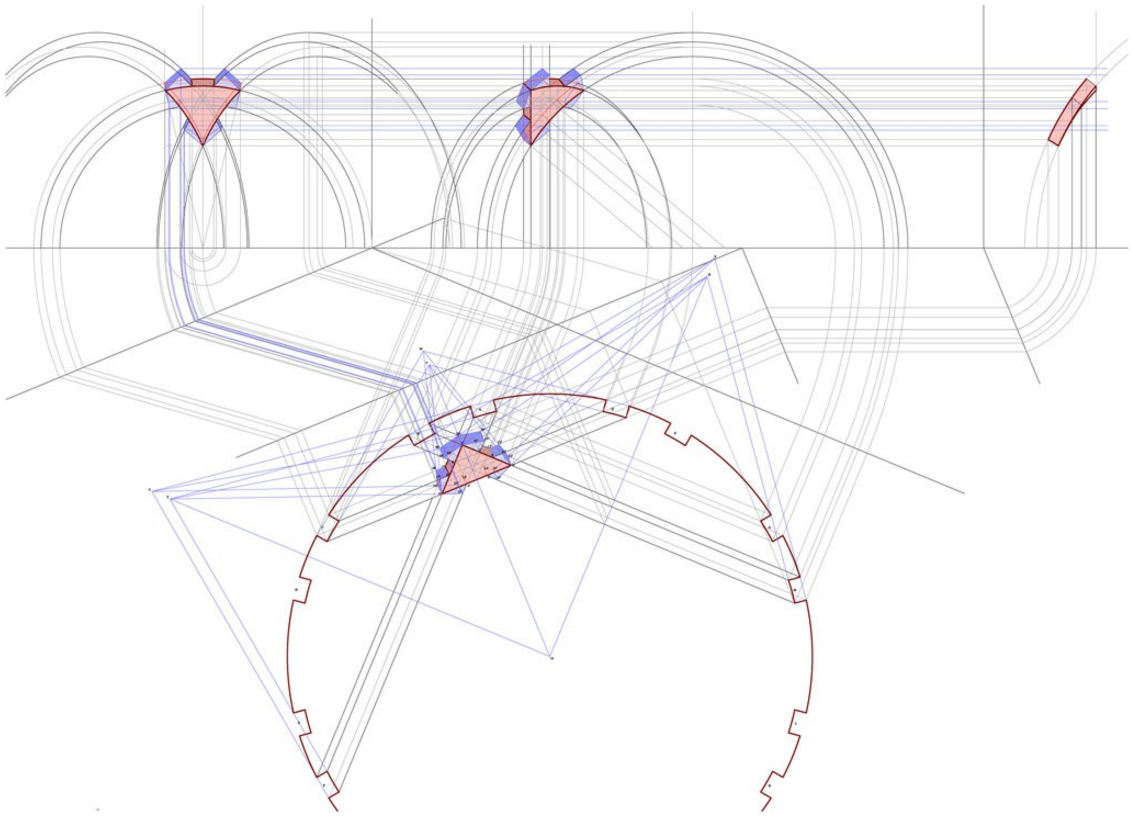

Figure 171. Stereotomic Node 4.
Drawing by the author.

The main surfaces composing the node are two spheric triangles: the first one contains the points from 1^{I} to 9^{I} while the second one from 10^{I} to 18^{I}. The paired vertexes of these spheric triangles (1^{I} and 10^{I}, 4^{I} and 13^{I}, and 7^{I} and 16^{I}) need to be projected towards their respective projection points in order to obtain a radial segmentation of the node. For example, point 1^{I} will be linked to R (point 29^{I}) and T (point 19^{I}), while point 10^{I} will be linked to S (point 30^{I}) and U (point 20^{I}). Proceed in the same way for the other vertexes, directing them towards their own projection points. The resulting node may be projected in elevation where, in front view, it will be possible to individuate the curvature of the segmented arches composing the node edges. Additionally, moving the node in elevation helps in maintaining an error-free construction.

4.8 Tier IV – The Empyreal Void

The octagonal profile individuated at the top of the interlaced ribbed dome becomes the springer of a new structure: a pavilion vault **[figure 172]**. Enhancing the levitational tension in the church, the vault follows a raised arch profile. For the first time in the building the vault volume is not altered between indoor and outdoor profiles. Both show the curvature of the vault. With the exception of structural ribs in the joints between two adjacent vault spindles, no architectural orders appear in the vault. At its bottom, a set of windows illuminate the church. Only their light, however, is perceivable by an observer. Because of their size and location, in fact, the windows can not be seen from

Figure 172. The two domes in Sainte-Anne-la-Royale.
Picture by the 3d printed model by the author.

inside the church thus providing the illusion of a vault floating at the top of the interlaced ribbed dome. If this last element was interpreted as an armillary sphere representing the edge of the world, the floating vault represents the void surrounding the universe.

4.8.1 Geometry of the pavilion vault

The pavilion vault and the lantern above it are the results of a single concept structured upon an equilateral triangle. Reminiscent of the Holy Triad, this theme will be later re-invented by Guarini into the Chapel of the Holy Shroud.

The proportions of the triangle on which the last two levels are structured come from the octagon at the top of the interlaced ribbed dome **[figure 173]**. The diameter of the circle circumscribed to this polygon identifies the measure for the triangle sides (segment *1-2*). To complete the triangle, center on *1* with span *1-2* and draw the quarter circle π_1. Repeat the same procedure for point *2* individuating point *3* (the top vertex of the triangle) in the intersection between the two circles. Both pavilion vault and lantern will be inscribed inside this triangle.

Individuate the middle point of the segment *1-2* (point *4*); using it as the center, draw the circle passing through *1* and *2* (π_2) intersecting *3-4* at point *5*. Centering in the middle point of the segment *3-5* (point *6*), draw the circle passing through *3* and *5* (π_3). Divide the segment *3-4* (the height of the starting triangle *1-2-3*) into its golden section, individuating *line α*, which intersects π_3 at *7* and *8*. The ellipse with center *4* and passing through *1-7-8-2* individuates the raised profile of the pavilion vault.

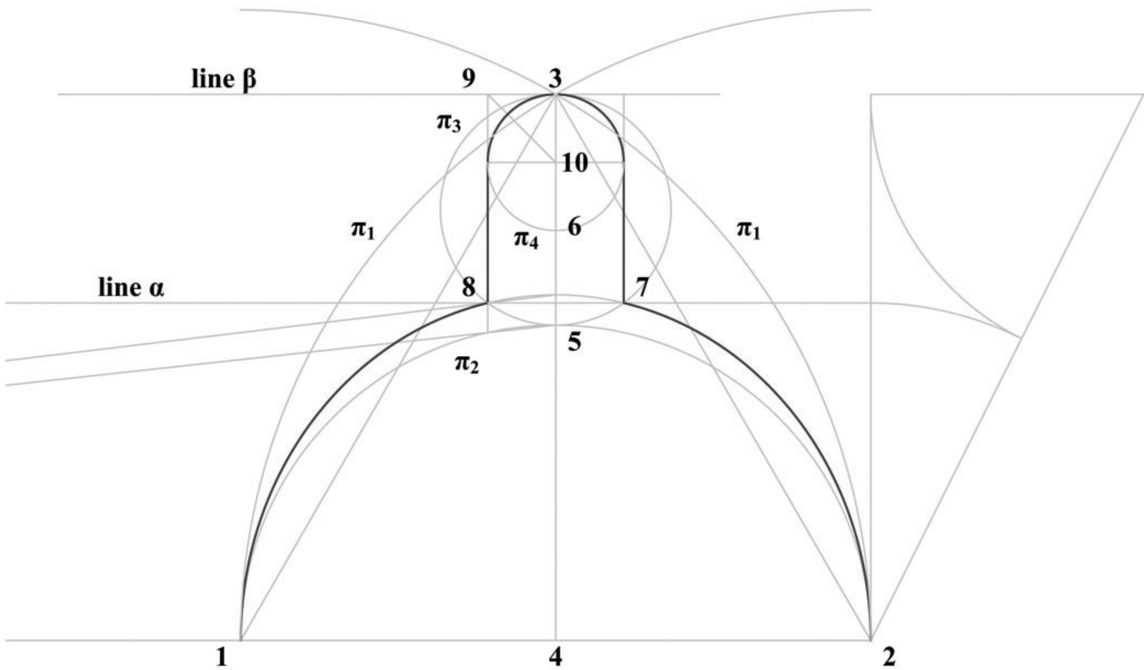

Figure 173. Geometric construction for the section of the pavilion dome and lantern at the top of Sainte-Anne-la-Royale.
Drawing by the author.

4.9 Tier V – The Light of Truth

The last element completing the building, the lantern still preserves the polygonal profile of the vault below it. In each of its sides, a rectangular window is framed by a simple molding. At its very top, a hemispherical dome completes the indoor volumes of the church. On the outside, the dome is hidden by a spiral pinnacle stretched towards the sky above **[figure 174]**.

4.9.1 Geometry of the lantern

The construction of the lantern completes the previous analysis of the pavilion vault. In the same reference drawings, draw a horizontal line passing through point *3* (*line β*) and intersect it with a vertical line from *8* individuating point *9*. From point *9*, draw a diagonal line intersecting *3-4* at *10*. Centering on this very last point, draw a circle with span *10-3* (π_4). Its upper half indicates the profile of the hemispherical dome closing both the lantern and the whole church.

Like for the pavilion vault below it, also the lantern does not show any architectural order. Its inaccessible location at the very top of the building, in fact, does not require excessive decorations but only elements creating shadows; their visual impact would have avoided an eventual flattening of these inaccessible volumes. At the bottom and top of the lantern, the transition with adjacent volumes is marked by a simple cornice. Barely visible from the original engraving, this element is here interpreted as a

Figure 174. View of the top lantern.
Picture by the 3d printed model by the author.

simple combination of two moldings: a cavetto and a fascia. Their proportions are still based on the gallery module.

Element	**Dimension in section**	**Distance from the profile below**
Fascia I	3 p	1 p
Apophis	1 p	1 p ~ 2 p
List	1 p	2 p
Fascia II	4 p	3 p
List	1 p	4 p
Cornice dimensions	***10 p***	***4 p***

Table 39: Cornice in the top lantern

Chapter 05: The main elevation

The mismatched details in the original engravings of Sainte-Anne-la-Royale imply an analysis of this church moving from its core towards the main elevation. Without a doubt, the main elevation of Sainte-Anne played a strategic compositional role. It needed to adapt to a pre-existing urban setting while, at the same time, sticking out from its urban background. Re-interpreting Valperga's elevation, Guarini connects Sainte-Anne with the adjacent buildings. The surfaces of the church, however, are not parallel to the street but bend concavely around the profile of the entrance bay, which protrudes convexly onto the sidewalk. Underlining these contrasting profiles, paired columns are radially disposed, introducing a theme understandable only when looking at the building as a whole. While approaching the church, in fact, an observer may perceive just the first two levels of the church. It is only when moving to the opposite shore of the Siene that the upper levels finally appear. Recessed at the top of the central bay, the celestial temple levitates at the top of the adjacent buildings. Its circular plan translates in elevation by opposing the convex cylindrical walls of the gallery to concave entablatures sustained by paired columns, thus explaining the theme used in the two lower levels. Likewise, the reduction of the second level facade with two oversized sculpted leaves directs the view towards the skies above. The celestial temple progressively reduces its volume upward until reaching the spiral pinnacle at the top of the composition **[figure 175]**.

In order to reconstruct such complex volumes, their nature has to be fully understood first. However, starting the analysis from the outside skin of the church would

Figure 175. Bird's eye view of Sainte-Anne-la-Royale's main elevation.
Picture of the 3d printed model by the author.

have been reductive. The incongruent details between the original engravings must be fully accounted for to recognize the inner volumes of Sainte-Anne. Beside its complexity, the main elevation has two-dimensional qualities when compared to the inner volumes. Where these last elements work in a three-dimensional setting, allowing the building to stand, the outside layers might have been applied above the main structure. Additionally, several elements in the church appear not to be rendered in the elevation engraving, mainly the lanterns and roofs at the top of the second level vaults. As for example, the lanterns on the side bay vaults appear on the transversal axis only while missing at the top of the entrance bay. It may be argued that this last lantern might have been hidden by the railing closing the second level of the church. However, as already mentioned before, the vaults on the longitudinal axis are much taller than their counterparts on the transversal axis. For the same reason, also the roof at the top of the elliptical chapels would have appeared in the main elevation.

As for compositional inconsistencies between plan and elevation, the main entrance clearly shows different solutions. In plan, the entrance gate is framed by one column for each main and secondary order. In elevation, however, the secondary order shows paired columns in the first level. At the second level, instead, the main order is now composed by paired columns; the added column aligned to one from the secondary order below, which is compositionally inconceivable. The present reconstruction attempts to correct this. The final results show few differences; however, the goal of this reconstruction was not just to build Sainte-Anne-la-Royale but to analyze and understand Guarini's project—intervening only when it was required. In the case of the entrance gate columns mentioned above, the first and second level are partially altered in order to provide a better vertical relationship between these two levels. A second column is introduced in the main order at the first level, thus promoting a radial setting similarly to the one in the gallery above. As a consequence, the overall number of columns is increased to eight in the first level: four for both main and secondary order.

Some other minor details have been introduced. The niches in both first and second level now protrude from the wall. To enhance their three-dimensional qualities, they now show a curvature opposite to the one of the wall hosting them. At the second level, the sculpted leaves closing the sides are strengthened by introducing a second leaf inside them. Smaller in size than the first one, this additional volume preserves a similar geometry of its companion while increasing the visual impact and three-dimensional qualities of the elevation.

5.1 The first level of the main elevation

The first two levels of Sainte-Anne's main elevation host two architectural orders **[figure 176]**. The main order in both first and second level show Corinthian roots. Their capitals are composed by two tiers of acanthus leaves from which *caulicoli* spring diagonally. The only difference in between these two main orders, beside the difference length of their shafts, is their entablature composition. As visible from the details included in the original engravings, at the first level the main order preserves a

Figure 176. The first two levels in Sainte-Anne-la-Royale's main elevation.
Picture of the 3d printed model by the author.

Corinthian elements. At the second level, instead, the entablature transforms into a hybrid between Doric and Ionic orders.

In the first level, a secondary order accompanies the main one. Its Doric origins are clearly identifiable from the *triglyphs* in the frieze. However, as happens inside the church, the overall proportions of the secondary order are altered and adapted to fit the main order. The entablature of the secondary order, in fact, occupies a space corresponding to the height of the main order capitals. Because of this, both orders share the same module which, however, is proportioned on the main order inside the church. The reason for this choice is due to the strong relationship between inside and outside layouts. Doors, niches, and windows need to keep constant proportions in both indoor and outdoor settings. Since these elements have been already been proportioned on the main indoor order, its module provided a valid reference from the main elevation too. A side effect of this choice reflects in the mismatching between the module measure and the column base diameter. However, since none of the columns or pilaster strips in the building have heights following the directions in Architettura Civile, the choice above has a negligible impact.

5.1.1 The main architectural order

The Corinthian nature of the main architectural order **[figure 177]** is confirmed by a cornice detail in the elevation engraving. Besides a traditional set of moldings, Guarini opens up his creativity in the floral design of the cornice brackets. Carved in the shape of lilacs, the brackets are spaced by *rosettae* smaller than usual. In the original engraving, only one rosetta takes place between two adjacent brackets. However, according to the

Figure 177. Detail of the main architectural order from the first level of the main elevation.
Picture of the 3d printed model by the author.

actual proportions of the cornice, that solution would have cause the brackets to be too close one another, altering the pattern contained in the engraving detail. Because of this, it is chosen to introduce a second rosetta in between two brackets, restoring an appropriate spacing of these elements.

As for the architectural orders used indoor, the engraving does not provide compete information about the main architectural order. While the profiles of the missing moldings are provided by *Architettura Civile*, their spacing is adapted to the engraving proportions. Finally, it needs to be taken in consideration that the measure of the outdoor orders is lower then the indoor level of the church. The height of the six steps elevating the building from the street level is given by the elevation engraving. The position of the architectural orders, instead, is obtained by aligning the bottom *apophis* in their shafts to the indoor level of the church.

Element	**Dimension in section**	**Distance from the shaft**
First Plinth	-	7 p
Second Plinth	-	5 p
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 p ~ 1½ p
Smoothed list	½ p	2 p ~ ½ p
Tore	2 p	2½ p
Base dimensions	*7 p*	*5 p*

Table 40: Base of the main order in the first level elevation

The plinth is divided in two portions (indicated as First and Second Plinth). Both these elements are not assigned a modular height but adapt to the steps in the main elevation. Their proportions are obtained composing the base from top to bottom. As already mentioned, the bottom apophis in the main order shaft is aligned to the indoor level of the church. Staring from this point, the base of the column is reconstructed, individuating the measure for the second plinth's top surface, then following the church steps. The protrusion of the plinth from the convex steps is visible from the original engraving too.

The shaft does not present any compositional irregularities. Its tapering, however, has been altered. The usual decrease by four parts from the base diameter is extended to the top of the second level columns. According to the engraving, in fact, the main order columns in the second level (which are vertically aligned to the ones in the first level) appear squatter then usual. A traditional reduction of their base diameter (which corresponds to the top diameter of the first level main order columns) created slender elements not fitting the overall engraving proportions. Instead, considering the columns in both levels as one unique element offered a solution fitting the graphic in the elevation engraving. As a consequence, the tapering in each these columns starts from the bottom diameter at the first level and finishes at the top one of the second level columns. Therefore, each individual column has an unconventional tapering measure.

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	17 M, 8 p	0
Apophis	1 p	1 p ~ 0
List	½ p	1 p

Shaft dimensions	*17 M, 11 p*	*1 p*

Table 41: Shaft of the main order in the first level elevation

As usual, the distances from the shaft are affected by the tapering. Therefore, the measures in the last two entries are not vertically aligned to the first two in the table but are recessed by the tapering.

The capital is developed adapting Corinthian standards to the engraving proportions. The final result produced a capital shorter than usual. Its irregularities mainly affect the lower tier of leaves, which are partially compressed.

Element	Dimension in section	Distance from the shaft
Tondino	1 p	1½ p
Capital	1 M, 10½ p	-
Cavetto	2 p	1½ p ~ 2½ p
List	1 p	2½ p
Ovolo	2 p	2½ p ~ 4½ p
Capital dimensions	*2 M, 4½ p*	*4½ p*

Table 42: Capital of the main order in the first level elevation

Above the capital, the entablature of the main order follows the movement of the main elevation. When passing over the top of the main entrance gate, however, the architrave abandons the main order entablature to join the secondary one into a convex profile, opposite the rest of the main entablature. The resulting surface between architrave and frieze is occupied in the engraving by a sculptural element crowning the area at the top of the entrance gate.

The overall composition of the main architectural order follows the directions of the second Corinthian type in *Architettura Civile*. The resemblance is preserved in the frieze section too, which develops along a convex profile instead of a traditional one. At its top, the harsh junction with a *tondino* shown in *Architettura Civile* has been smoothed by substituting the molding with a *cavetto* topped by a list. Finally, the cornice follows the directions of the detail provided by Guarini at the bottom of the elevation engraving. The introduction of two blossoms in between the floral brackets (which was already mentioned above), suggested the arrangement of these sculptural elements for the corner solution. Here, formed into a triangular shape, three of the blossoms in between the brackets are grouped together. Continuity in the drip molding is guaranteed by preserving constant proportions for the blossoms while a specialization of the corner is highlighted by the different arrangement of the very same sculpted elements. Because of their sculptural nature, the brackets and the blossoms are not listed in the tables below where, instead, only the actual surfaces where these sculptural elements are applied appear.

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	3 p	-
Tondino	½ p	½ p
Fascia II	4 p	¾ p
Reversed Kyma	1 p	1½ p
Fascia III	5 p	2 p
List	½ p	2½ p
Tondino	1 p	3 p
Reversed Kyma	3 p	5¼ p
List	1 p	5¾ p

Architrave dimensions	*1 M, 7 p*	*5¾ p*
Convex Frieze	1 M, 4 p	-
Cavetto	2½ p	2½ p
List	1 p	2½ p
Frieze dimensions	*1 M, 7½ p*	*2½ p*
Reversed Kyma	3½ p	3 p ~ 5½ p
List	½ p	6 p
Tondino	1 p	7 p
Ovolo	2½ p	6½ p ~ 9 p
Brackets (back surface)	3 p	7 p
Fascia	2½ p	13 p
List	½ p	13½ p
Kyma	3 p	16 p
List	1 p	16 p
Cornice dimensions	*1 M, 5½ p*	*16 p*
Entablature dimensions	**4 M, 8 p**	**16 p**

Table 43: Entablature of the main order in the first level elevation

5.1.2 The secondary architectural order

The secondary order in the main elevation is compositionally framed and proportionally connected to the main architectural order. A frieze with triglyphs indicates a Doric nature for this order resembling the Second Doric order in *Architettura Civile*. Contaminations with other architectural orders and alterations of the overall proportions appear as usual in the secondary order. The base, for example, does not follow Doric roots but matches the Corinthian base of the main order in both dimensions and composition. Likewise, the capitals of the secondary order show elongated proportions visually aligned to the framing of the main access gate.

Alterations to the elevation settings in terms of number of columns between main and secondary order (which were already mentioned) implied a reduction of the Doric columns' diameters in order to fit all of them. At the same time, reducing their diameter was required in order to avoid excessive protrusion from their entablature, which might have covered the main order capitals. Therefore, the columns' shafts for the secondary order appear rather elongated, measuring seventeen modules (while the tallest among Guarini's Doric orders mentions a twelve module shaft). A partial justification for such result also takes in consideration the hybrid nature of the secondary order. Beside the above mentioned Corinthian base, the entablature shows Ionic inserts: its architrave, in fact, is divided into two fasciae against the single plain surface of Doric orders. At last, the distance and spacing of the secondary columns takes in consideration the frieze's rhythm alternating *triglyphs* and *metopes*.

The matching bases between main and secondary order implies the latter preserves the same proportions and height of the main order. As a consequence, the plinth appears extremely short; it stops when reaching the fourth step in the main elevation. Beside the free standing columns at the side of the main entrance gate, the secondary order appears also in pilaster strips running behind the main order columns. In this case, the pilaster strip bases merge directly to the main order bases. Similarly, the shafts of the two elements fuse together without, however, following a uniform rule along the elevation.

Element	Dimension in section	Distance from the shaft
Plinth	-	
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 p ~ 1½ p
Smoothed List	½ p	2 p ~ ½ p
Tore	2 p	2½ p
Base dimensions	*7 p*	*5 p*
List	½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	17 M, 2½ p	-
Apophis	1 p	0 ~ 1 p
List	½ p	1 p
Shaft dimensions	*17 M, 5½ p*	*1 p*
Neckling	7 p	-
Apophis	1 p	0 ~ 1 p
Tondino	1 p	1½ p
Ovolo	2 p	1 p ~ 3 p
Cavetto	2 p	3½ p ~ 4½ p
List	1 p	4½ p
Capital dimensions	*1 M, 2 p*	*4½ p*

Table 44: Column of the secondary order in the first level elevation

The entablature of the secondary order combines an Ionic architrave to a Doric frieze. Because of its location below the main order, the secondary entablature misses a cornice while, when moving to the top of the main entrance gate, its convex profile is accompanied by the main order architrave. The composition of the secondary entablature is partially rendered in a detail from the elevation engraving. *Triglyphs* and *metopes* are developed according to the detail. The triglyphs are composed by two incisions only while following a layout which in *Architettural Civile* develops into a wavy section. At their bottom, a set of *guttae* (drops) complete the triglyphs according to Greek Doric orders. The metopes, instead, show a flower connected by ruffles to the triglyphs' top. The other elements in the detail refer to the entablature at the second level, as visible from the top cornice, missing in the first level. The overall proportions of the entablature are altered to cover a surface corresponding to the height of the main order capitals, as visible from the elevation engraving.

The final layout for the entablature mixes elements from the Secondary Doric order with two other details in *Architettura Civile* (number 28 and 29 in Plate VI) [see **figure 130** at page 251**]** which are not described in the original text.

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	3 p	-
Fascia II	4 p	½ p
Tenia	2 p	1½ p
Architrave dimensions	*9 p*	*1½ p*

Table 45: Architrave of the secondary order of the first level elevation

The *tenia* in the table above follows the profile of the *triglyphs* protruding to the side. In correspondence of such protrusion, six cone trunk *guttae* cover the architrave top *fascia* for a height of two parts.

Element	Dimension in section	Distance from the shaft
Metope	1 M, 4½ p	-
List I	2 p	1½ p
List II	1 p	½ p
Frieze dimensions	*1 M, 7½ p*	*1½ p*

Table 46: Frieze of the secondary order of the first level elevation

5.2 The second level of the main elevation

When moving to the second level, the main elevation experiences a volumetric reduction. The walls at the far side of the first level—behind which opens a quadrangular courtyard—disappear at he second level. In their place, two oversized sculpted leaves guide the eye towards the volume of the entrance bay, whose setting is similar to the one at the first level. At the top of the main entrance gate, a serliana type window occupies the center of the facade. The window geometry conforms to the similar openings in the transversal axis of the church; its decoration, however, is updated to match the opulent theme in the main elevation. At the side of the windows, above the first level secondary doors, arched niches repeat the pattern already seen in the level below **[figure 178]**.

The transition between first and second level happens through a strong horizontal element: a thick pedestal whose height matches the top portions of the first level entablature (frieze and cornice). A sense of verticality, however, is preserved by the main architectural order whose columns are aligned to the ones in the level below. The tapering of the columns (which has been already discussed above) together with their reduced

Figure 178. Detail of the sculpted leaves at the second level of the main elevation.
Picture of the 3d printed model by the author.

height create a forced perspective according to which the elevation appears taller than its actual measure.

5.2.1 The main architectural order at the second level

Because of the column composition between first and second level, both orders preserve similar properties. Flutes, which were added in the first level columns, are maintained at the second level too. Likewise, the Corinthian capitals from the first level are resized to accommodate the reduced diameter of the columns at the second level, as visible from the engraving. The entablature, instead, follows different directions from the Corinthian ones from the first level and mixes Ionic influences to Doric elements. The solution is partially rendered in a detail accompanying the elevation engraving—although the drawing mixes together second level main order and first level secondary order **[figure 179]**.

The second level pedestal corresponds to a similar element found inside the church below the side bay vaults. When appearing in the main elevation, however, the pedestal shows an increased amount of details matching the intricate decorative patterns in the main elevation. The reference for this element is identified by the First Ionic Order in Architettura Civile while its proportions are related to the first level module. The pedestal, in fact, is an extension of the first level entablature.

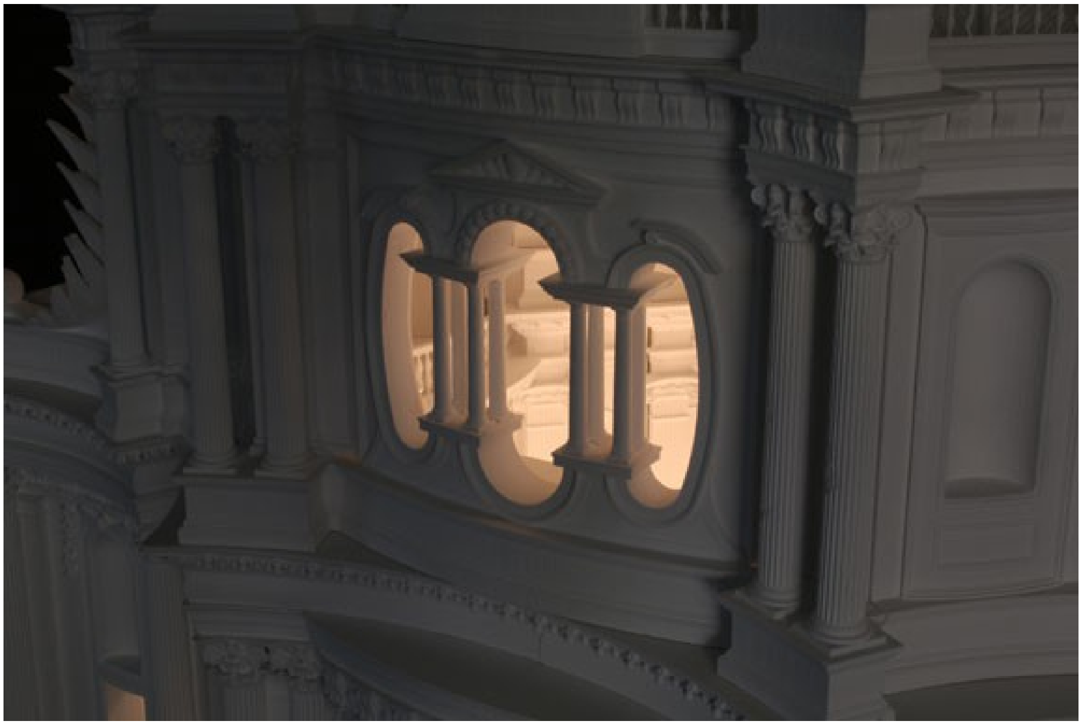

Figure 179. Detail of the central bay at the second level of the main elevation.
Picture of the 3d printed model by the author.

Element	Dimension in section	Distance from the shaft
Plinth	8 p	3¾ p
Reversed Kyma	2 p	3¼ p ~ 1¼ p
Tondino	1 p	1¾ p
List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft	1 M, 3 p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Ovolo	2 p	1 p ~ 3 p
List	1 p	3½ p
Fascia	2 p	4½ p
List	1 p	5 p
Pedestal dimensions	*3 M*	*5 p*

Table 47: Pedestal of the main order in the second level elevation

Beside a compositional similarity to the first level main order, the columns at the second level experience a modular reduction due to the tapering starting at the first level. Their shafts are reduced too, providing a new set of proportions for the overall order.

Element	Dimension in section	Distance from the shaft
Plinth	-	
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 p ~ 1½ p
Smoothed List	½ p	2 p ~ ½ p
Tore	2 p	2½ p
Base dimensions	*7 p*	*5 p*
List	½ p	1 p

Apophis	1 p	1 p ~ 0
Shaft	15 M, (~) 2¼ p	-
Apophis	1 p	0 ~ 1 p
List	½ p	1 p
Shaft dimensions	*15 M, 5¼ p*	*1 p*

Tondino	1 p	1½ p
Capital	1 M, 10½ p	-
Cavetto	2 p	1½ p ~ 2½ p
List	1 p	2½ p
Ovolo	2 p	2½ p ~ 4½ p
Capital dimensions	*2 M, 4½ p*	*4½ p*

Table 48: Column of the main order in the second level elevation

The entablature of the main architectural order at the second level appears compatible to the one described in the First Ionic Order in *Architettura Civile*. Its dentils and cornice, in fact, are almost identical to the ones in the elevation detail except for the list at the top of the cornice, thicker in the detail than it is in the plate of the First Ionic Order. The architrave, which is not rendered in detail, is divided into two *fasciae*, as typical of Guarini's Ionic orders. The frieze, however, introduces *triglyphs* and *metopes* as in Doric orders. Differently from the detail, the *metopes* at the second level lose sculptural details and show a plain surface. Likewise, the *guttae* below the *triglyphs* disappear. Becasue of this omission, the profile of the *tenia* at the top of the architrave is rendered by a *cavetto* profile according to Ionic Orders (the presence of *guttae*, in fact, would have required for the *tenia* a list instead of a *cavetto*).

Element	Dimension in section	Distance from the shaft
Fascia I	5 p	-
Tondino	½ p	½ p
Fascia II	5½ p	1 p
Cavetto	2 p	1½ p ~ 3 p
List	1 p	3 p
Architrave dimensions	*1 M, 2 p*	*3 p*
Fascia with Metope and Triglyphs	1 M, 4 p	-
Reversed Kyma	2 p	½ p ~ 1½ p
List	1 p	2 p
Frieze dimensions	*1 M, 7 p*	*2 p*
Dentils	4½ p	5 p
List	½ p	5½ p
Ovolo	2 p	7½ p
List	½ p	8 p
Drip Molding	3 p	1 M, 1 p
List	½ p	1 M, 1½ p
Reversed Kyma	3 p	1 M, 2 p ~1 M, 4½ p
List	1 p	1 M, 5½ p
Cornice dimensions	*1 M, 3 p*	*1 M, 5½ p*
Entablature total dimensions	**4 M**	**1 M, 5½ p**

Table 49: Entablature of the main order of the second level elevation

5.2.2. The secondary order in the second level

The transition between the main order Corinthian columns and the wall behind them is not mediated by any element in the original engraving. However, it is doubtful that a similar solution would really take place at the second level. The compositional similarities between first and second level suggest also for the latter the presence of a secondary order—although, much less visible than the one at the first level. Since the surface at the top of the arched niches at the second level is clearly free from decorative patterns, a secondary order would have appeared mainly in the shape of pilaster strips behind the main order columns (like happens at the first level). In this case, the pilaster strips extend until reaching the main order capitals. The height of these last elements host the secondary order entablature. Differently from the one at the first level, the secondary entablature does not run below the main order, but appears only at the top of the pilaster strips. Such reduced surface implies a consequent reduction of its decorative patterns; triglyphs and metope are omitted since the entablature moldings are extensively covered by the main order capitals.

The nature of the order is maintained, consistent to its first level counterpart: a Second Type Doric order with an Ionic architrave divided in two *fasciae*. Also the proportions of the moldings in the entablature are preserved, although they have been scaled down to match the module of the main order at the second level. As already mentioned, only the shafts are reduced in length, matching the height of the second level in the original engraving.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	-	
Tore	2½ p	5 p
List	½ p	3 p
Scotia	1½ p	3 p ~ 1½ p
Smoothed List	½ p	2 p ~ ½ p
Tore	2 p	2½ p
Base dimensions	*7 p*	*5 p*

List	½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	14 M, 2¼ p	-
Apophis	1 p	0 ~ 1 p
List	½ p	1 p
Shaft dimensions	*14 M, 5¼ p*	*1 p*
Neckling	7 p	-
Apophis	1 p	0 ~ 1 p
Tondino	1 p	1½ p
Ovolo	2 p	1 p ~ 3 p
Cavetto	2 p	3½ p ~ 4½ p
List	1 p	4½ p
Capital dimensions	*1 M, 2 p*	*4½ p*
Column total dimensions	**16 M, 2¼ p**	**5 p**

Table 50: Column of the secondary order in the second level elevation

Element	Dimension in section	Distance from the shaft
Fascia I	3 p	-
Fascia II	4 p	½ p
Tenia	2 p	1½ p
Architrave dimensions	*9 p*	*1½ p*
Metope	1 M, 4½ p	-
List I	2 p	1½ p
List II	1 p	½ p
Frieze dimensions	*1 M, 7½ p*	*1½ p*
Entablature total dimensions	**2 M, 4½ p**	**1½ p**

Table 51: Entablature of the secondary order in the second level elevation

5.2.3 The railing at the top of the second level

The first two levels of Sainte-Anne's main elevation are closed by a pedestal compositionally identical to the one between first and second level. At the top of the main order columns and serliana window at the second level, the pedestal shows a traditional shaft. When not aligned to these elements, instead, the pedestal shaft is substituted by a railing. The spindles composing the railing are shaped similarly to the one used indoors at the top of the elliptical chapels—their proportions scaled to match the elevation pedestal (which appears shorter than the indoor railing).

Element	**Dimension in section**	**Distance from the shaft**
Plinth	8 p	3¾ p
Reversed Kyma	2 p	3¼ p ~ 1¼ p
Tondino	1 p	1¾ p
List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft / Railing	1 M, 3 p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Ovolo	2 p	1 p ~ 3 p
List	1 p	3½ p
Fascia	2 p	4½ p
List	1 p	5 p
Railing dimensions	*3 M*	*5 p*

Table 52: Railing at the top of second level elevation

5.3 The third level

The circular gallery at the top of the central bay is rendered in elevation by a voluptuous contrast between concave and convex profiles **[figure 180]**. Pedestal, columns, and entablature, in fact, are arranged along an octagonal perimeter whose side bends concavely. Behind them the main walls of the gallery maintain a cylindrical nature, thus showing a convex curvature. The contrast between these surfaces connects the third level of the church to the rhythm already established in the elevation of the first two levels. Approaching each edge of the concave octagon, a set of paired columns moves away form the gallery's main wall. Only the outermost of these columns is freestanding; the other one emerges from the convex surface behind it. In between two set of columns, the gallery hosts alternatively a window and a niche. In correspondence with the indoor elliptical domes in the gallery, the elevation hosts a rectangular window. The areas behind the radial barrel vaults, instead, host in elevation a rectangular niche—its proportions matching the windows. According to the elevation engraving, the gallery elevation hosts windows only. This solution, confuted in the section engraving, would not be possible by the actual gallery setting. The distance between two indoor pilaster strips in correspondence of a radial barrel vault does not provide enough space for a window proportioned like in the engraving. Confining all the windows in the gallery to such a tight space would have altered the balance of the whole third level. Additionally, because of their position, the window lintels would have broken into the vault springers creating an uncontrolled and unpleasant composition in the indoor spaces. Because of this, it is

Figure 180. The elevation of the upper levels of Sainte-Anne-la-Royale.
Picture of the 3d printed model by the author.

here decided to modify the elevation by alternating windows to niches thus preserving the rhythm and appearance of the original elevation.

As for the nature of the architectural order in the third level elevation, the elevation engraving show a hybrid setting, in line with the rest of the building. Columns have smooth shafts; a feature used mainly for Doric orders in Architettura Civile. The capitals are decorated in the same fashion of the two levels below, appearing Corinthian in nature. The entablature shows an architrave divided in two fasciae like for Ionic orders, like the rest of the entablature too. The only missing elements confirming such Ionic roots are the dentils. However, it is possible they might have been omitted in the engraving, covered by the shadow of the drip molding above them. Additionally, Plate II from Architetura Civile shows the possibility of a First Ionic Order with a smoothed shaft. Likewise, the very same plate and the following one document several variations for Ionic capitals with Corinthian like features (as it appears in Plate III, number 24 and 25).[1]

Because of this, the architectural order in the third level of the elevation, is here identified as Ionic. In this way the different height of such orders starting from the same point (as visible form the section engraving) makes more sense; the outdoor order (Ionic) taller than the indoor one (Doric). At the same time, the use of an Ionic order for the third level elevation provides a coherent transition for the elevation. The Corinthian order in the first level becomes a Corinthian/Ionic hybrid in the second level; an Ionic order in the third; Doric from the fourth level and above.

1 The very same capitals are used as reference for the architectural order in the side bay windows (see chapter 6).

The top surface of the pedestal sustaining the Ionic order in the third level elevation is aligned to its Doric counterpart in the indoor gallery. The rest of the outdoor pedestal, instead, shows a variable measure around the gallery dictated by the different heights of the side bay roof. Around the gallery, the outdoor Ionic pedestal reaches its maximum length in correspondence to the church transversal axis; its minimum on the longitudinal axis **[figure 181]**. Such differences in measures are contained in the pedestal plinth, avoiding an excessive deformation of the pedestal proportions. In the table below, the plinth proportions refer to its minimal height on the church transversal axis.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	3 p	4 p
Reversed Kyma	2 p	3½ p ~ 1½ p
Tondino	1 p	2 p
List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft	2 M, 11 p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Ovolo	2 p	1 p ~ 3 p
List	1 p	3½ p
Fascia	2 p	4½ p
List	1 p	5 p
Pedestal dimensions	*4 M, 3 p*	*5 p*

Table 53: Pedestal of the third level elevation

As usual, the length of the column shaft does not conform to the directions in Architettura Civile. The actual shaft measure is obtained by setting up base and capital first, then filling the space in between them. The quote for both base and capital, in fact, may be

Figure 181. Details of the roofs at the junction with the gallery.
Picture of the 3d printed model by the author.

easily obtained by overlapping on both section and elevation engraving a grid based on the gallery module.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	3½ p	4 p
List	½ p	3½ p
Scotia	2 p	3½ p ~ 2 p
Smoothed List	½ p	3 p
Tondino	2 p	1 p
Base dimensions	*8½ p*	*4 p*
List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft	18 M, 5 p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Shaft dimensions	*18 M, 9 p*	*1 p*
Necking	7 p	-
Apophis	½ p	0 ~ ½ p
Tondino	1 p	1 p
Voluptes	3 p	-
Echinus	3 1/3 p	1½ p
Abacus	2½ p	2½ p
Capital dimensions	*1 M, 5 1/3 p*	*2½ p*
Column total dimensions	**20 M, 10 5/6 p**	**4 p**

Table 54: Column in the third level elevation

The capital is rendered according to the directions provided by Guarini in Architettura Civile (Plate III, numbers 24 and 25) **[figure 182]**.

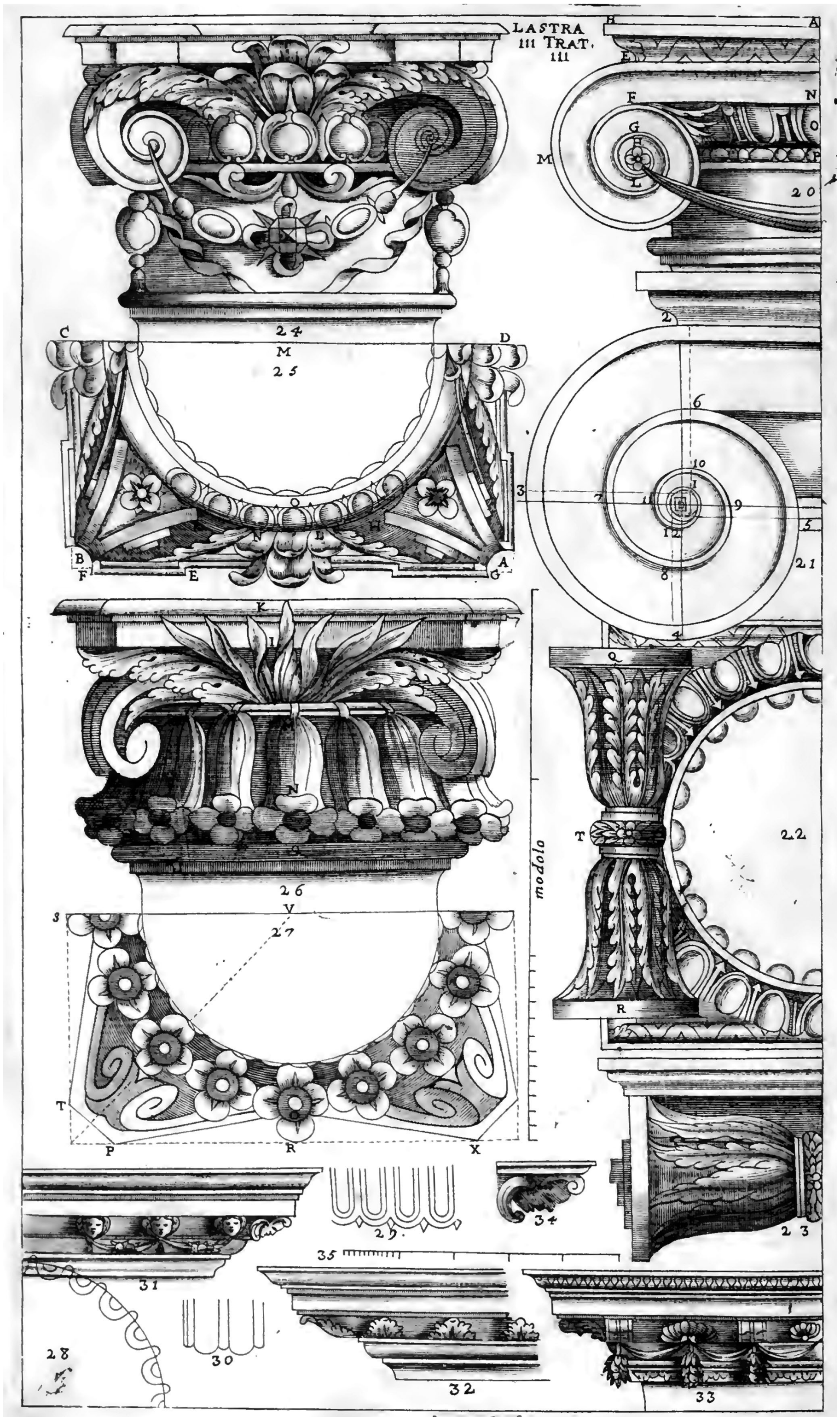

Figure 182. Ionic details from Architettura Civile.
Guarino Guarini, *Dissegni d'Architettura Civile et Ecclesiatica* (Turin: per gl'Eredi Giannelli, 1686), Plate III-III.

The entablature does not present any unusual elements or alterations when compared to the First Ionic Order described and illustrated in Architettura Civile.

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	5 p	-
Tondino	½ p	¾ p
Fascia II	5½ p	1 p
Cavetto	2 p	2 p ~ 3 p
List	1 p	3 p
Architrave dimensions	*1 M, 2 p*	*3 p*
Freize	1 M, 3 p	-
Reversed Kyma	2 p	½ p ~ 1½ p
Frieze dimensions	*1 M, 5 p*	*1½ p*
Dentils	5 p	2 p ~ 5 p
List	½ p	5½ p
Ovolo	2 p	5½ p ~ 7½ p
Fascia	1½ p	8 p
Drip Molding	3 p	14 p
List	½ p	14½ p
Kyma	3 p	14½ p ~ 18 p
List	1 p	18 p
Cornice dimensions	*1 M, 4½ p*	*18 p*
Entablature total dimensions	**3 M, 11½ p**	**18 p**

Table 55: Entablature in the third level elevation

At the very top of the entablature, a conical roof covers the indoor radial gallery and domes. The junction between roof and entablature is realized by adding a second set of moldings to provide a finishing line for the roof while avoiding its merging with the entablature top surface. Not present in the original engraving, these additional moldings do not alter the appearance of the building; they are perceivable in a front elevation only while hidden in a realistic perspective setting. For its positioning, the molding is set back from the main order cornice below; its fascia aligned to both architrave and frieze from the main order.

Element	**Dimension in section**	**Distance from the shaft**
Pedestal	2 p	½ p
Fascia	3 p	-
List	½ p	½ p
Kyma	3 p	½ p ~ 4 p
List	1 p	4 p
Cornice dimensions	*9 ½ p*	*4 p*

Table 56: Additional cornice in the third level elevation

5.3 The forth level

The spheric volume of the interlaced ribbed dome remains perceivable from the inside of Sainte-Anne-la-Royale only. In elevation, the structure assumes a cylindric volume whose walls maintain the same rhythm of the gallery below. Because of the reduced surface, a single pilaster strip takes the place of the gallery paired columns. In between them, eight harp-shaped windows bring light directly into the dome. Aligned to their counterparts into the gallery below, the indoor and outdoor profiles of the fourth level windows do not entirely match **[figure 183]**. The reversed arch at their bottom, visible from the inside of the church, disappears in elevation giving to a straight frame

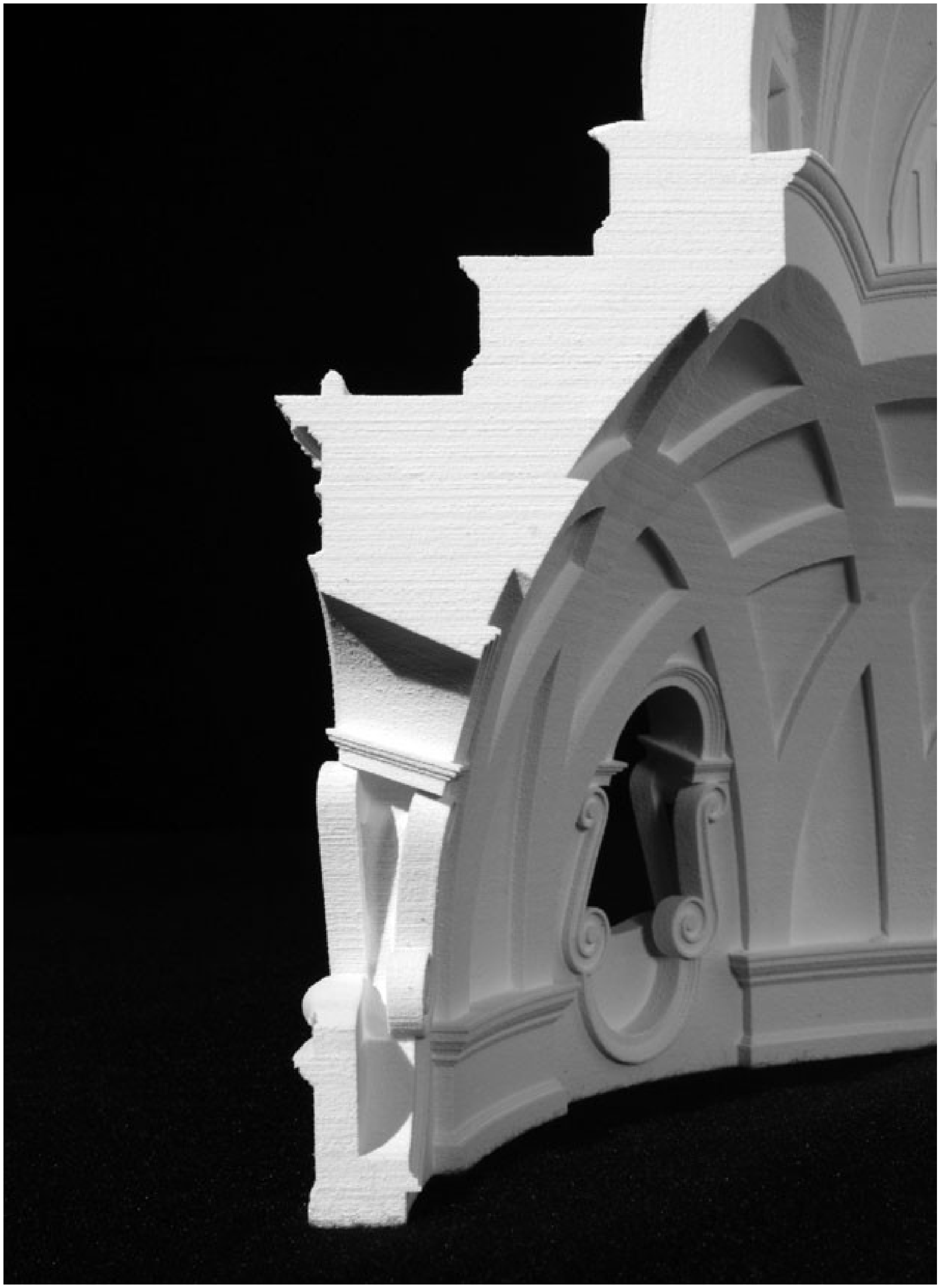

Figure 183. Section detail of the gallery windows.
Picture of the 3d printed model by the author.

sculpted in the shape of a scroll. The mismatching profiles would have been visible from the inside the church only (where the windows covers an area wider than in elevation). However, for perspective reasons, only the top arch in these windows is perceivable from the bottom of the central bay. Moving back into the main elevation, in between two harp-shaped windows, a rectangular niche preserves the syncopated rhythm from the gallery below.

The other elements composing the fourth level are rendered in the elevation engraving with smooth undecorated surfaces. Together with the details in the pilaster strips, such details appear referencing a First Doric Order in Architettura Civile. Although, as usual, variations and alterations appear to be applied to that reference. Both architrave and frieze appear joined in the engraving while occupying the very same space of the pilaster strips capitals. The impossibility of such a solution may be interpreted as an imprecision due to the reduced scale of the engraving. At the same time, it needs to be remembered that these levels of the church were never realized. From this point of view, errors and imprecisions in the engravings may be interpreted as rendition of ideas not fully developed. In the present reconstruction, the entablature of the fourth level Doric order is properly rendered, re-introducing a distinction between architrave and frieze. At the same time, the capitals are moved to their proper position below the entablature. A visual similarity to the elevation engraving is obtained extending the molding below the capital on the cylindrical wall of the level; its horizontal mark passing above harp-shaped windows.

The transition between fourth level and the gallery below uses a pedestal.

Compared to the direction in Architettura Civile, the pedestal shaft is shortened to match the height of the gallery lanterns.[2] Due to the Doric nature of the main order in the forth level, the pedestal should have been developed according to it. However, the setting of molding lines rendered in the engraving does not match any of the three Doric pedestals, resembling instead a First type Ionic one. It may be argued that using an Ionic pedestal below a Doric order would have been compositionally wrong. However, hybrid combinations appear in almost all of the architectural orders in Sainte-Anne-la-Royale thus justifying the eventual mismatching.

The proportions suggested in Architettura Civile for these Ionic pedestals is adapted to the corresponding element used indoor at the bottom of the ribbed dome. Both plinth and top surface of the outdoor pedestal have been aligned to the corresponding elements in the indoor one. The junction with the conic roof of the gallery below, instead, is obtained by adding a second plinth in the outdoor pedestal—its profile extruded until reaching the roof below. The eventual clash between gallery lanterns and pedestal due to their extreme vicinity is prevented by substituting two moldings in the pedestal base (a kyma and a tondino) with a less overhanging fascia.

The overall proportions for the order in the fourth floor are still based on the gallery module.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	7 p	2½ p
Fascia (instead of Kyma and Tondino)	3½ p	1¾ p
List	1½ p	1 p

2 In the original engraving, the top surface of the pedestal is imprecisely rendered as an inclined line; its left side on a height taller than the right one.

Apophis	1 p	1 p ~ 0
Shaft	2 M, 4 p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Ovolo	2½ p	3½ p
Fascia	1 p	4 p
Drip Molding	2½ p	5½ p
List	1 p	6 p
Pedestal dimensions	*4 M, 2 p*	*6 p*

Plinth	4 p	4 p
Tore	3 p	4 p
Base dimensions	*7 p*	*4 p*

List	1 p	1 p
Apophis	1 p	1 p ~ 0
Shaft	12 M, 3 p	-
Apophis	1 p	1 p
List	1 p	1 p
Shaft dimensions	*12 M, 7 p*	*1 p*

Tondino	1 p	2½ p
Apophis	½ p	½ p ~ 0
Necking	1½ p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Ovolo (Echinus)	2 p	2½ p
Fascia (Abacus)	2 p	3 p ~ 4 p
List	1 p	4 p
Capital dimensions	*8 p*	*4 p*

Column and pedestal dimensions	**18 M**	**4 p**

Table 57: Pedestal and Column in the fourth level elevation

Element	Dimension in section	Distance from the shaft
Fascia	6 p	-
Apophis	2 p	0 ~ 2 p
List	2 p	2 p
Architrave dimensions	*10 p*	*2 p*
Fascia	1 M	-
Reversed Kyma	3 p	1 p ~ 3 p
Frieze dimensions	*1 M, 3 p*	*3 p*
Fascia	1 p	4 p
Drip Molding	3 p	10 p
List	1 p	10 p
Tondino	2 p	1 M
Ovolo	3 p	11 p ~ 1 M, 2 p
Cornice dimensions	*10 p*	*1 M, 2 p*
Entablature dimensions	**2 M, 1p**	**1 M, 2 p**

Table 58: Entablature in the fourth level elevation

At the top of the entablature, the fourth level is closed by a railing. Compositionally similar to the indoor railing at the top of the elliptical chapels, these elements are now resized adapting to the proportions of the Doric order below.

Element	Dimension in section	Distance from the spindle axis
Plinth	4 p	2¾ p
Fascia	1 p	2 p
Apophis	1 p	2 p ~ 1½ p
Spindle	1 M, 11 p	1 p
Cavetto	1½ p	1½ ~ 2 p
List	½ p	2 p

Reversed Kyma	2½ p	2½ p ~ 4 p
List	1 p	4½ p
Railing dimensions	*2 M, 10½ p*	*4½ p*

Table 59: Railing in the fourth level elevation

Behind the railing, the transition between fourth and fifth level is rendered in the elevation engraving by a single pedestal. In reality, however, two pedestals would have been put in place: the first one hidden by the above mentioned railing. In the section engraving the double pedestals would have been visible. However, the area where the first pedestal would have been put in place is instead void. Its correspondent wall in contact with the interlaced ribbed dome is rendered without thickness. In the present reconstruction, the first pedestal is restored. Its proportions, together with the ones of the second pedestal above it, are identical to the railing closing the fourth level. The two elements are detailed according to the proportions of the pedestal already used in the fourth floor: a First Ionic Order. This time, however, it is not necessary to alter the base moldings since no spacial issues occur.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	7 p	4 p
Kyma	3 p	3½ p ~ 1½ p
Tondino	½ p	2 p
List	1½ p	1 p
Apophis	1 p	1 p ~ 0
Shaft	1 M, ½ p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p

Ovolo	2½ p	3½ p
Fascia	1 p	4 p
Drip Molding	2½ p	5½ p
List	1 p	6 p
Pedestal dimensions	*2 M, 10½ p*	*6 p*

Table 60: Pedestal at the top of the fourth level elevation

5.4 The fifth level

Closing element in the church, the fifth level does not contain any architectural order. The windows in the top lantern, in fact, are simply framed by a set of moldings without using columns or pilaster strips. Likewise, the lantern has no proper pedestal or entablature; but just simple moldings highlighting its top and bottom edges. The main element composing the fifth level of Sainte-Anne-la-Royale is a spiral pinnacle. Stretching the church towards the skies above, the pinnacle is analyzed together with other details in the church in the next chapter.

Chapter 06: Fioriture

While the elements analyzed in the previous chapters constitute the main body of the Sainte-Anne-la-Royale, several additions and details flourish on the church surfaces. These elements are still proportioned according to the main modules in the building. Their role, however, is mostly decorative although not necessary sculptural in nature. Similarly to *fioriture*—complex embellishments frequently used in baroque music to enhance melodies—secondary elements augment Sainte-Anne-la-Royale's architecture. They are not essential to the building definition although their presence completes the composition, saturating volumes and surfaces with niches, lanterns, and windows. When reaching the main elevation, the sober indoor profiles acquire sensible sculptural details, mainly located in the first two levels.

6.1 Niches

At the first level in Sainte-Anne-la-Royale, the original engraving shows two niches located in between the main pilaster strips: a first niche shaped like an archway and, at its top, a second niche elliptical in shape [see **figures 124, 129, 131**]. After superimposing the section with a modular grid based on the main architectural order, it was possible to provide a clear reference for the niches' locations:

Section	**Dimension in modules**	**Total height**
From floor to main bracket	6 M, 9 p	24 M
From main bracket to niche base	2 M, 7 p	

(surface at the top of the modlings)	
Arched niche height (carving without moldings)	7 M
Distance between arched niche and elliptical niche (distance of the carvings without moldings)	2 M, 2 p
Elliptical niche height (carving without moldings)	3 M , ½ p (aligned to the main order shaft top apophis)
Distance between elliptical niche and main order entablature	2 M, 5½ p

Table 61: References for the niches between two adjacent pilaster strips

The information above relates to the vertical displacement of these elements only. Horizontal proportions, in fact, can not be directly obtained from the section. Here the main pillars are skewed because of the their diagonal plan setting. However, the niche from the section engraving provides hints about the overall proportions of the niches. Apparently the moldings framing the lower niches are almost in contact with the pilaster strips at their side. While the distance between two pilaster strips vary on the three sides of the main pillars, the niches preserve their overall proportions; which means the niches have to properly fit the pillar side with the shortest distance between two adjacent pilaster strips (this is to say, the one facing the transversal side bays). On the other two pillar sides, the same niches will be aligned to the pilaster strips' mid-axis.

The nature of the moldings framing these niches can not be identified from Sainte-Anne's engravings. Likewise, Architettura Civile does not provide enough information about it. However, other buildings realized by Guarini show solutions compatible to the ones in Sainte-Anne and, therefore, provide general directions for molding profiles in the niches. The moldings for the arched niches in between the indoor pilaster strips is referenced to the ones adorning the windows in Palazzo Carignano. In Sainte-Anne-la-Royale, in fact, the niches are located on a height away from human access. Occupied by life-sized sculptures, these niches represent actual windows for their marble hosts more than traditional carvings in the walls. At their base, a sculpted bracket indicates the protrusion from the pillar surface behind. The statues would be invited into the church indoor space, fading the boundary between architecture and sculpture. The resulting dynamic narrative would have gripped the observer's attention, understating the heavy proportions of the diagonal main pillars.

The elliptical niches, instead, seem to play a purely decorative role. From the original engraving, it appears these niches would have been left empty. Interestingly, there is also no trace of moldings framing them, although this unusual absence may be considered an oversight in the engraving. Because of their height, in fact, these niches would have become scarcely perceivable if deprived of a molded profile. It may be argued the ellipses in the engraving might have represented elliptical paintings instead. However, their proportions (almost 1.50x0.80 meters) and location (almost 9.52 meters above ground) would make them invisible. As elliptical niches, instead, they might have provided shadows, filling the void in between the arches' niches and the pillar entablature above. In order to restore their appearance, the elliptical niches are referenced to similar elements Guarini created for the Chapel of Holy Shroud in Turin. The walls of the corridor connecting the chapel to Turin's duomo, host several elliptical niches similar to the ones in Sainte-Anne. The opulent rococo framing around the niches in Turin has not replicated, of course. Only the moldings adorning the immediate boundaries of these niches was taken in consideration—a simple set of moldings joining the concave carving of the niche to a convex tondino extruded along an elliptical path.

6.1.1 The arched niche

As already mentioned above, the niche is repeated with constant proportions around the main pillar. The variable geometric setting of the pillar, however, requires analyzing the niche when contained by the pilaster strips with the lesser distance in the pillar. In this configuration, it is unlikely the niche moldings would have been directly in touch with the pilaster strips shafts. The niche base, in fact, extends beyond the actual opening of the niche, thus becoming the main reference for setting the whole element in place. The thickness of the niche base is modified from its appearance in the engraving; there the base appears thin and fragile, almost unable to sustain the weight of the marble statue and out of proportions from the massive bracket below it. Because of this, an additional molding (a fascia) is introduced.

Referenced to the widows in Palazzo Carignano, the niche moldings are described in the table below proceeding from the inner core of the niche towards the outside; their proportions are expressed according to the module of the main architectural order in the first indoor level.

Element	**Dimension in section**	**Distance from the wall**
Cavetto with apophis	2½ p	-
List I	½ p	1 p
List II	1 p	1½ p
Frame dimensions	*4 p*	*1½ p*

Table 62: Frame of the indoor arched niche

The moldings in the niche base, instead, are described proceeding as usual from bottom to top. The measures in section, however are not referenced to the surface of the wall behind but to the second list (list II) framing the niche profile. The base, in fact, extrudes along a curvilinear path making it impossible to express the distance of its moldings from the wall behind. Therefore the alignment is provided using a front elevation where the base cavetto has been aligned to the outermost list (list II) framing the niche.

Element	**Dimension in section**	**Distance from the fascia above**
Fascia	3 p	-
Cavetto	2½ p	1 p
List I	½ p	2 p
List II	1 p	2½ p
Base dimensions	*4 p*	*2½ p*

Table 63: Bracket at the base of the arched niche

The geometry of the niche base is not provided from the original engravings although its shape may be discerned. The carvings of the arched niches would have probably been semicircular in plan, as suggested by their elevation profile. The presence of brackets below the niche base indicate an overhang for this element. Its geometry might have completed the semicircular geometry in the niche carving while increasing the shelf size to contain the moldings around the niche edges **[figure 184]**.

The section of the niche is represented by the circle π_1 with center O and diameter

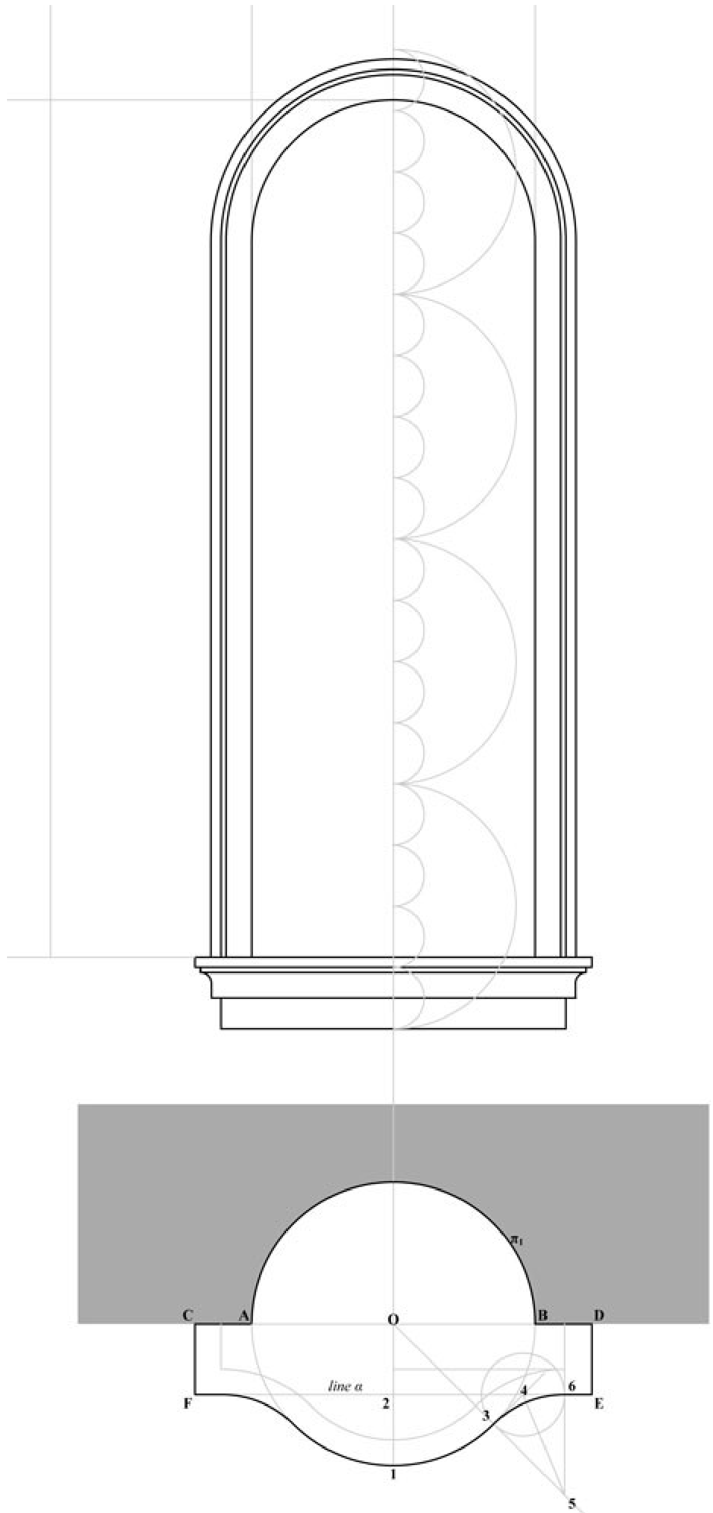

Figure 184. Geometric construction for the arched niche.
Drawing by the author.

AB. A horizontal line from AB individuates the surface of the pillar hosting the niche. For the overhanging profile of the niche base, instead, draw the vertical radius *O-1*. Let *2* be the middle point of the radius and, from this point, draw another horizontal line (*line α*). From O, draw a diagonal line intersecting intersecting π_1 at *3*. From this last point, the curvature of π_1 needs to be linked to *line α*. To do this, draw from *3* a line perpendicular to *O-3* until intersecting *line α* at *4*. From here, draw the bisector line between *3-4* and line *α* intersecting *O-3* in *5*. Centering on 5, draw a circle with radius *5-3* (π_2) which intersects *line α* at *6*. The final distance *6*-E is gained directly by the proportions of the moldings in the niche base (see table above).

The final profile *1-3-4-6*-E-D individuates half of the niche base geometry.

The bracket sustaining the niche base is not well defined in the section. This element appears to be composed by four main elements:

- a main portion in the center with a vague S shape;
- a small element below the previous one;
- two arched-like elements hanging from both sides of the main portion and connected to the niche base above.

Such details suggest two possibilities:

1. An S-shaped bracket with a smaller bracket at the bottom and two wreaths at both sides;
2. A bracket in the shape of an Atlante (this is to say, a half-bust sustaining the niche base with the head (main element) and arms

(side arched-like elements);

The first option seems more likely the correct one. Brackets with S shapes were commonly used in architecture already from the Renaissance. In that hypothesis, the smaller element below the main bracket may be interpreted as a smaller C-shaped bracket. Similarly, the elements hanging from the sides might have been sculpted laurels moving from the main bracket eye to a joint at the bottom of the niche base (maybe in the shape of rosettae). However, because of their hanging quality, it is questionable these laurels might have been realized in stone; their proportions and weight would have easily damaged them.

The detailing of the bracket is realized alternating concave and convex profiles, as typical for such elements. Likewise, the whole element has been framed by two lists. Again the overall proportions are realized according to the main order module at the first level of the church; each of the elements in the bracket (lists, concave and convex profiles) measuring one part. From the engraving, instead, the whole bracket is a height of one module.

The additional small bracket below the main one, is realized with a C-shape in order to mediate the junction between wall and S-shape bracket. The detailing of this second bracket is differentiated by the one in the main element. It would have been unlikely that two adjoining elements with different sizes would have preserved the same profile, even if resized. A new sequence of moldings is thus introduced looking at

Renaissance brackets (mainly from Michelangelo's Laurentian Library):

- a concave profile;
- a convex profile (bigger than the previous one);
- a *rocchetto* (on the bracket axis);
- a convex profile;
- a concave profile.

Each of the elements above is proportioned by dividing the parts composing the main module.

6.1.2 The elliptical niche

Located between the arched niche and the main order entablature, these elliptical niches are detailed according to similar elements appearing in Guarini's Palazzo Carignano in Turin **[figure 185]**. In that project, Guarini framed the niched with a tondino surrounded by an elaborate decoration reminiscent of rococo mirrors. Such opulence is not considered for Sainte-Anne. In its place, the sober inner surfaces of Sainte-Anne suggested the introduction of two simple moldings framing the niche's edge: a cavetto and a list. As for the arched niche, the reference for this molding combination is suggested by the window frames in Palazzo Carignano.

In section, it is hypothesized the elliptical niche preserves its curvilinear nature. Dividing the ellipse in facade by its major axis provides the profile used to carve the pillar hosting the niche. In order to conform the elliptical niche to its companion below,

Figure 185. Elliptical niches in Palazzo Carignago.
© Pino Dell'Aquila, *Prospetto della rampa meridionale dello scalone di Palazzo Carignano (1679-1692)*. Available from: Giuseppe Dardanello, Susan Klaiber, Henry Millon, *Guarino Guarini* (Turin: Umberto Allemando & C., 2006), fig. 194.

additional depth is added to the carving by extruding the profile of the niche in facade.

6.1.3 *The niches in main elevation*

The arched niches between the indoor pilaster strips appear again in the main elevation too, although altered by a different compositional setting. The surface containing the niches bends with a curvature opposite the facade wall at whose junction a molded frame appears.

At the first floor of the main elevation the surface containing the niches hosts secondary doors at its bottom. Rectangular in shape, these doors are framed by the very same set of moldings used in the niches above them. The convex volume containing both doors and niches extend for the whole height of the first level, coming in touch with the secondary entablature above. The profiles and proportions of the molded frames is developed using the indoor arched niches as references **[figure 186]**.

Element	**Dimension in section**	**Overhanging from the wall**
List I	1 p	1 p
List II	1 p	2 p
Tondino	2 p	2¾ p
List III	1 p	3¼ p
Frame dimensions	*5 p*	*3¼ p*

Table 64: Frame of the niches at the first level of the main elevation

The very same molding sequence is also used around the profile of both arched niches and secondary doors below them. The proportions and positions of both niches and doors is obtained by the analysis of the elevation engraving. The keystone of the niche arch is

Figure 186. Niche at the first level of the main elevation.
Picture of the 3d printed model by the author.

aligned to the top of shaft of the secondary pilaster strips. The secondary doors, instead, show a volumetric reduction while moving from the main elevation to the indoor spaces. This solution, perceivable in the courtyard doors of the elevation engraving, has been applied also to the church's secondary doors (which in the engraving are skewed). Both courtyard and secondary doors, in fact, show the very same setting and detailing, suggesting all their features would have been preserved.

When moving to the indoor spaces of the church, the combination of arched niche and secondary door causes a variation in the bracket sustaining the arched niche base. The door, in fact, does not provide enough space for a whole S-shaped bracket. Therefore, the element is reduced in volume preserving its top spiral only. In this way it is possible to preserve visual continuity with the other identical elements enclosing the entrance bay.

As already mentioned, at the very far sides of the main elevation, the niche/door pattern appears again. This time, however, each side door accesses a squared courtyard whose the only purpose was to provide light to the elliptical chapels while connecting the church to pre-existing buildings. While sharing the same level of the church indoor spaces (taller than the street level), both doors and courtyards show no traces of steps accessing them. Likewise, these squared open spaces are not even accessible from the inside the church itself. Such unreachability is expressed by the layout of the convex volume hosting both niche and door open; its bottom edge overhangs above an empty space.

At the junction with the secondary entablature, the profile of the volume hosting door and niches at the first floor of the main elevation is enriched by sculpted details. An angel face with two side wings guides the profile of the niche arch, while, at the sides, a wreath of six flowers hides the junction between the niche's convex volume and concave back wall. When reaching the main entrance gate, a theme variation adapts itself to a double framed main door. The outer frame, aligned in plan to the plinths of the secondary columns extends in elevation until the top shafts of the very same order in a pattern similar to the niches. At its top, an angel face with side wings appears again although this time the lower portions of the wings are free-standing. At its side, flower wreaths fill the rest of the lintel connecting the angel wings to the capitals of the secondary order. Below this outer frame, a second one carves deeper into the wall. Still aligned to the elements in the elevation architectural orders, this second frame is also surrounded by flowers and wreaths. While these details do not appear in the original engraving, they are here added to better adapt the church's main entrance to the overall composition of the first level. Without them, in fact, the main gate appears much less appealing than side doors and courtyard accesses.

6.1.4 The niches at the second level of the main elevation

Niches carved into a convex volume appear at the second level of the main elevation too. This time, however, the niches appear only in correspondence to the entrance bay. The walls closing the side courtyards, in fact, transform into oversized sculpted leaves, reducing the elevation width **[figure 187]**. Details and alignments of both niches and volumes hosting them are almost identical to their counterparts at the first level. The secondary doors at the first level disappear at the second level; their

Figure 187. Niches at the first two levels of the main elevation.
Picture of the 3d printed model by the author.

proportions compress into rectangular plates. No more in contact with the entablature, the top edge of the niche's convex volume now develops its own entablature. Aligned to it, a molding frames the adjacent surface at the top of the main entrance gate. The composition of the niche's entablature is developed referencing the corresponding element at the top of the church windows (which are analyzed further below):

Element	**Dimension in section**	**Overhanging from the wall**
Fascia I	1 p	-
Fascia II	1½ p	½ p
List	½	1 p
Ovolo	1½ p	1 p ~ 2½ p
List	½ p	3 p
Fascia III	1½ p	3½ p
List	½ p	4 p
Kyma	1½ p	4 p ~ 5½ p
List	½ p	5½ p
Entablature dimensions	*9 p*	*5½ p*

Table 65: Entablature of the niches in the second level of the main elevation

6.2 Windows

6.2.1 Windows at the first level of the elliptical chapels

At the first level of the elliptical chapel, sunlight radiates towards the indoor volumes by curvilinear windows opened in the far end of the chapels themselves. Physically distant from the archways accessing the chapels, the windows are compositionally linked to them. The connection, however, is perceivable in elevation/section only where the top surface of the window appears following the layout of the archway (virtually) above.

The linkage between archway and window implies using the first one to obtain a geometric interpretation of the latter **[figure 188]**. Let O be the center of the mentioned archway. The circle passing through *1* represents the outer edge of the arch while the circle through *2* is the lower edge of the same arch. From O, draw a vertical line intersecting the arch from *2* at point *3*. Centering on 3, draw the circle π_1 tangent to the arch from *1* and intersecting O-*3* at *4*. Using as radius the span O-*4*, draw the circle π_2 with center O. Divide the ninety degree angle *1*-O-*4* into three equal parts individuating *line r* (inclined by thirty degrees on O-*1*) and *line s* (inclined by sixty degrees on the same reference). *Line r* intersects π_2 at *5* and O-*1* at *6*. Centering on *5* and *6* with span equal to the segment *5-6*, individuate point *7* on *line r* (the figure *5-6-7* is an equilateral triangle). Centering on *7*, draw the circle passing through *5* and *6* (π_3) and intersecting *line r* at point *8*. Likewise, centering again on *7*, draw π_4 passing by the middle point of *5-6* (point *9*). The circle π_5 with center *8* and radius *8-9* indicates the thickness of the molding framing the window. Draw a vertical line from 8 until intersecting π_5 at *10* and, from here, draw a horizontal line (*line t*) individuating part of the inner window edge. Move back onto point *8* and draw this time a line perpendicular to *r* and intersecting *t* at *11*. Extend line t until O-*3*, individuating point *12* and, from it, draw a copy of the circle π_5 individuating point *13* on O-*3* itself. The horizontal line from *13* (*line u*) individuates part of the outer window edge. The very same line intersects *5-6* at *14*. At last, to complete the

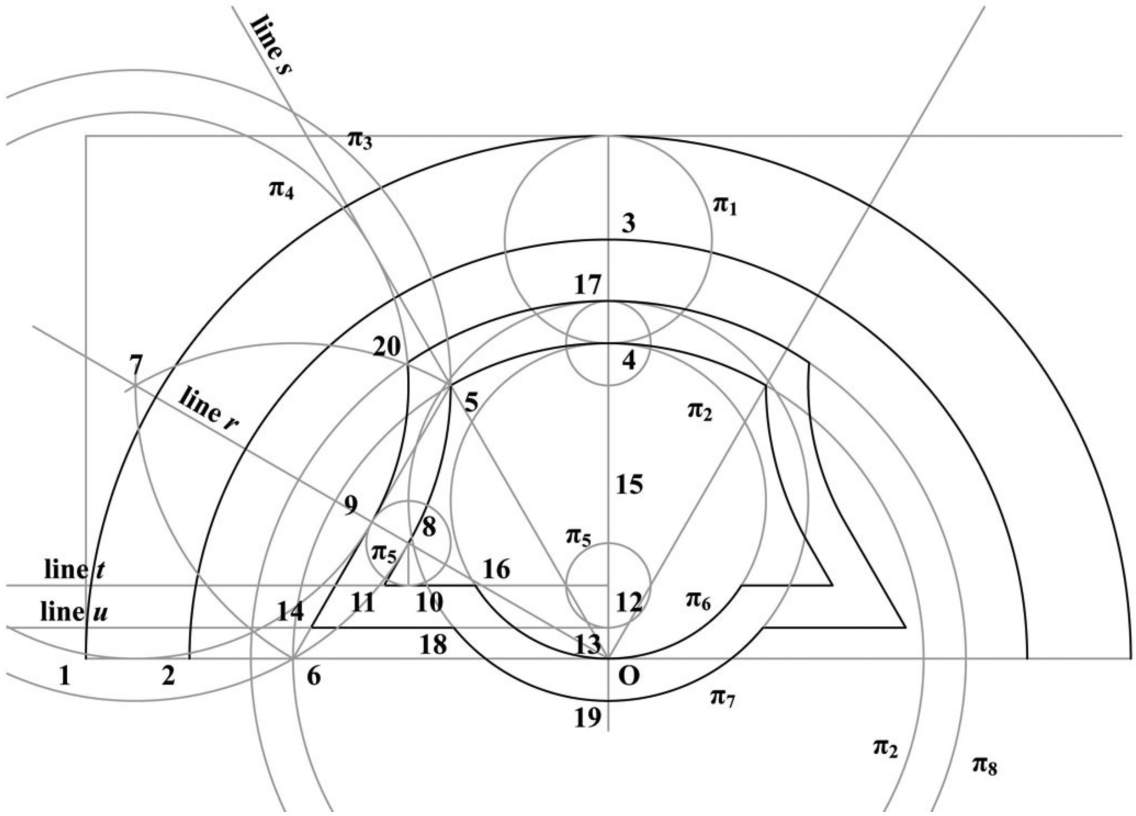

Figure 188. Geometric construction for the windows at the first level of the elliptical chapels. Drawing by the author.

lower profile of the window frame, draw from the O-*4* middle point (*15*) the circle π_6 with radius *15-4* individuating *16* on *t*. The profile *4-5-8-11-10-16*-O individuates the inner edge of the window.

To complete the outer edge for the same window frame, draw a copy of π_5 using point *4* as center thus individuating *17* on O-*3*. Centering on 15, draw π_7 passing through *17* and intersecting *line u* at *18*, O-*3* at *19*, and π_4 at *20*. The profile *17-20-9-14-18-19* individuates the outer edge of the window frame. At its top, the curve from *17* to *20* hosts and additional entablature extending until the arch *2-3* (lower edge of the archway accessing the elliptical chapels).

The section engraving provides information about the nature of the moldings in the window frame. From the inside out, a *cavetto* (composed as usual by *fascia*, *apophis*, list) and an *ovolo* wrap around the window. The *ovolo*, however, preserve its traditional profile only at the top of the window (where an entablature completes the window frame); in the rest of the frame, the *ovolo* alters its profile becoming a sort of oversized *tondino* while preserving its constant decorative pattern.

Element	**Dimension in section**	**Overhanging from the wall**
Fascia	2 p	1 p
Apophis	1 p	1 p ~ 2 p
List	1 p	2 p
Ovolo	3 p (in the back, it goes down of 1/8 p	2½ p
Frame dimensions	*7 p*	*2½ p*

Table 66: Frame for the windows in the elliptic chapels at the first level

In the upper part of the window, additional moldings appear at the top of the window frame composing an entablature. In front elevation, this element appears to link the window to the arch accessing the chapel itself; although, the two elements are placed in plan at the opposite edges of the chapel. The original section engraving, where the windows appear, does not provide enough information for identifying the moldings in the entablature. Therefore, they are obtained form the analysis of the order appearing in the chapel at the second level of the church. As a result, a *kyma* is added to the window frame, preceded and followed by a list. In the table below, the moldings in the window entablature are joined to the ones in the window frame; their combination, in fact, creates a single element visible only from the altered profile of the ovolo mentioned in the analysis of the window frame above.

Element	**Dimension in section**	**Overhanging from the wall**
Fascia	2 p	1 p
Apophis	1 p	1 p ~ 2 p
List	1 p	2 p
Ovolo	3 p	2½ p
List	1 p	3 p
Kyma	3 p	3 p ~ 5 p
List	1 p	5 p
Entablature dimensions	*1 M*	*5 p*

Table 67: Entablature for the windows in the elliptical chapels at the first level

A compositional issue involves the windows in the elliptical chapels: according to the plan, two adjacent chapels fuse their elevation into one another. In the original engraving, the window chapels are not affected by this volumetric merging; along the transversal axis of the church, the windows appear to end just before the junction with the ones on the longitudinal axis. By analyzing and re-drawing the church plan, however, it is found to be inaccurate. The longitudinal chapel walls partially overlap the transversal windows. Resizing or moving the chapel window would have compromised Guarini's original project. Therefore, the curvature of the exterior chapel walls was altered when in proximity of their junction and in correspondence of the windows only. These elements, in fact, occupy a reduced surface in elevation—which is not directly perceivable by an observer (the windows open in secluded courtyards in the main elevation while, in the back, they would have faced private areas accessible to the congregation only).

6.2.2 Windows at the second level of the elliptical chapels

At the second level of the church, the elliptical chapels host a new window pattern based on a *serliana* **[figure 189]**. This traditional motif is composed by a central arched window accompanied at both sides by two additional rectangular openings; their lintel aligns to the springer of the arch of the main window. Under Guarini's creative genius, the serliana window in the chapel bends along the curvilinear surfaces of the church. Its presence in the composition is highlighted by a plinth, protruding from the chapel walls. At its top, the two columns generating the window's three partitions are doubled in number, appearing in correspondence of both indoor and outdoor profiles. Their distribution in plan between these two profiles is not identical; the columns, like all the other surfaces cutting through the wall thickness, are radially projected from the center

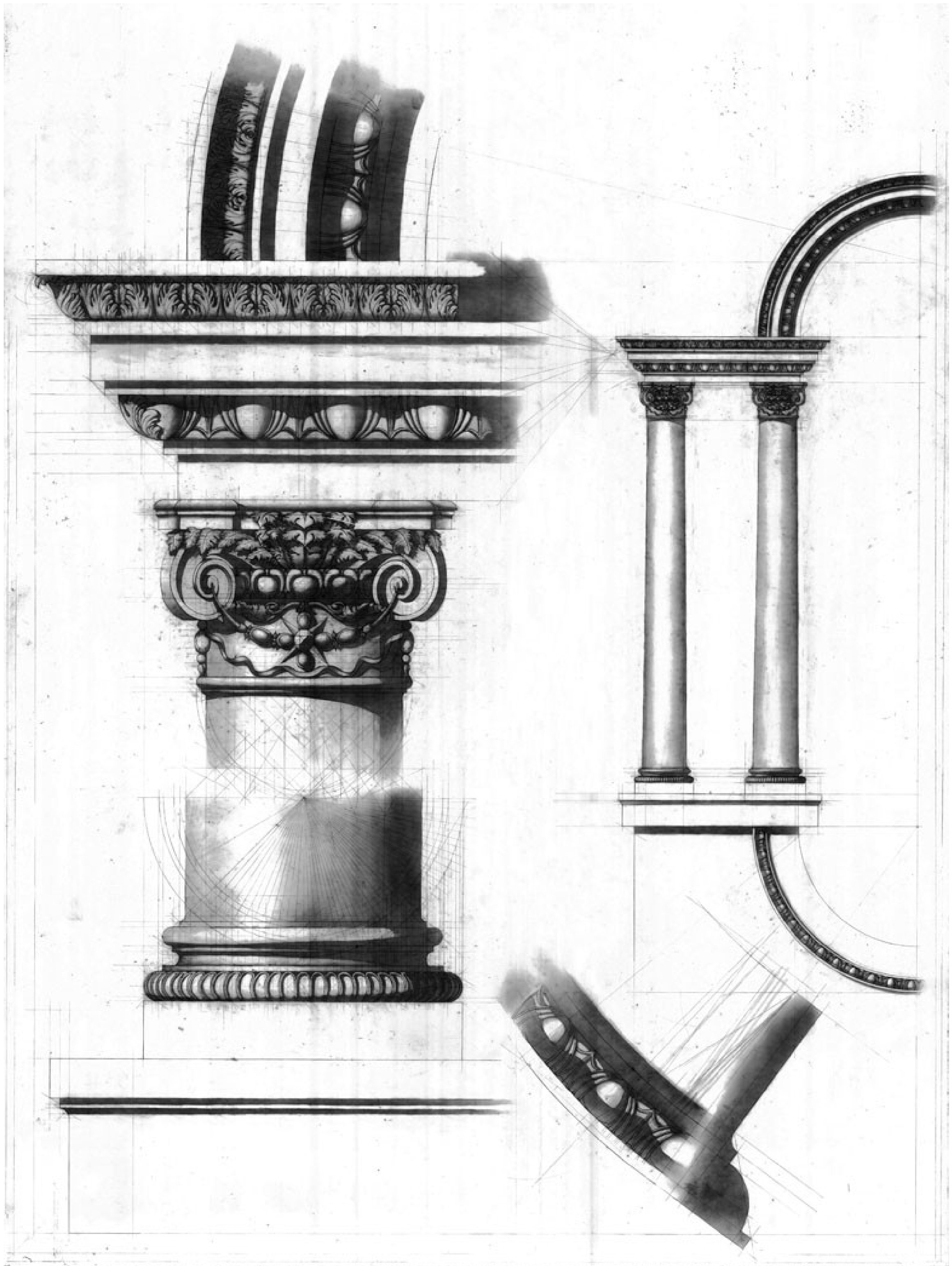

Figure 189. Analysis of the architectural order and composition in the serliana window at the second level of the elliptical chapels.
Drawing by the author.

(in plan) of the elliptical chapel. The columns are then radially displaced while the arch above them assumes a conical section while bent in plan according to the chapel profile. Interestingly, the arched window at the serliana center does have not a traditional straight window-sill. It mirrors the serliana arch above, creating a reversed arch; its keystone is at the bottom. The two arches, however, do not share similar moldings.

The overall details for the window can not be entirely perceived by the original engravings of Sainte-Anne-la-Royale. The missing information is supplied by the church of San Lorenzo in Turin, where Guarini used a similar serliana window. In Sainte-Anne, in fact, the lower portion of the serliana windows appear extremely stylized. The reversed arch in the central window is rendered as a simple wall cut; its profile is deprived of any molding. Likewise, the columns separating the three openings are in direct contact with the wall below them. When moving to the end of the church transversal axis, a variation of the chapel *serliana* window appears (one is erroneously rendered in the original section engraving at the second level of the central bay). Here the missing details mentioned above are finally rendered; the lower profile of the window is bordered by molded frame. Though the element is still not convincing (it moves without distinction from the reversed arch to the area below the columns) it provides direction for detailing the lower portion of the *serliana* windows in the elliptical chapels. Similarly to the *serliana*'s top arch (whose thickness corresponds to the top diameter of the column shafts), the reversed arch at the bottom of the same window is proportioned accordingly to the bottom diameter of the very same columns. The mediation between column base and reversed arch is obtained by introducing a pedestal, compatible in both proportions and details to the reversed arch (they are rendered as one element only in the windows at the end of the church's transversal axis).

The details for the architectural order in the *serilana* windows can not come from Sainte-Anne's engravings. Therefore, these details are supplied by the similar elements Guarini used in San Lorenzo in Turin. The opulent details in Turin's project are preserved as much as possible in Sainte-Anne's windows. Eventual variations are supplied by compatible solutions from *Architettura Civile*. The overall order in the windows, however, does not show a specific nature but a combination of different elements. The entablature appears as a combination of simple moldings (*fascia, ovolo, kyma*) not referencing any specific architectural order. The capitals are changed from the ones in San Lorenzo. Their Corinthian nature does not match the rough profiles in Sainte-Anne's engraving which appears instead closer to a variation of Ionic capitals contained in *Architettura Civile* (Plate III, number 24 and 25). In accordance to the capitals' Ionic nature, the Attic column bases in San Lorenzo are detailed referencing Plate II, 29 from *Architettura Civile* (an Attic base with sculpted lower *tore*). The overall proportions use a module based on the diameter of the *serliana* columns in the *serliana*.

Element	**Dimension in section**	**Distance from the shaft**
Plinth	4 p	4 p
Tore	3 p	4 p
List	½ p	2 p
Scotia	1½ p	2 p ~ 1 p
List	½ p	1 p
Tore	2 p	2 p
Base dimensions	*11½ p*	*4 p*

Table 68: Base for the serliana windows in the elliptical chapels at the second level

Regardless of the nature of the capitals (Ionic in Sainte-Anne, Corinthian in San Lorenzo), the columns shaft's show a smooth profile. As for the other architectural orders, the distances from the shaft in the table below take in consideration the reduction of the columns diameter caused by the tapering.

Element	**Dimension in section**	**Distance from the shaft**
List	½ p	½ p
Apophis	½ p	½ p ~ 0
Shaft	14 M, 2 p	-
Apophis	½ p	0 ~ ½ p
List	½ p	½ p
Column dimensions	*14 M, 4 p*	*½ p*

Table 69: Shaft for the serliana windows in the elliptical chapels at the second level

The capital (as shown in Architettura Civile) is composed by four diagonal volutes above a collarino, an element typical of Tuscan/Doric orders (the same solution was already encountered in the main architectural order of Sainte-Anne-la-Royale, whose collarino was carved by seven flutes). Smooth, like the column shaft, the collarino hosts several decorative patterns, some of them hanging from the volutes themselves. The overall geometry of the capital is realized following the direction provided by Guarini himself in Architettura Civile. An imprecision, however, was found in the notes of the Theatine regarding the ovolo sustaining the volutes. The space where this molding is supposed to be located does not provide enough space for a typical quarter circle profile. In order to avoid altering the capital composition, it is here chosen to deform the profile of this molding into a quarter ellipse.

Element	Dimension in section	Distance from the shaft
Tondino	1 p	½ p
Collarino	7 p	-
Apophis	½ p	0 ~ ½ p
List	½ p	1 p
Ovolo	3 p	1 p ~ 2 p
Volutes	4 p	5 p
Cavetto (Fascia)	1 p	5 p
Cavetto (Apophis)	½ p	5 p ~ 5¼ p
Cavetto (List)	½ p	5½ p
(Cavetto) Smoothed List	1 p	5½ p ~ 4½ p
Capital dimensions	*1 M, 7 p*	*5½ p*

Table 70: Capital for the serliana windows in the elliptical chapels at the second level

Column dimensions	**16 M, 10½ p**	**5½ p**

Table 71: Total dimensions for the serliana windows

The entablature references San Lorenzo only; *Architettura Civile*, in fact, does not show any trace of a solution similar to the one used in Turin or rendered in Sainte-Anne. The overall proportions are provided by combining the entablature in San Lorenzo to the module used in the *serliana* windows.

Element	Dimension in section	Distance from the shaft
Fascia I	4½ p	-
List	1½ p	1½ p

Ovolo	4½ p	6 p
List	1½ p	7½ p
Fascia II	4½ p	1 M
List	1½ p	1 M, 1½ p
Kyma	4½ p	1 M, 6 p
List	1½ p	1 M, 7½ p
Entablature dimensions	*2 M*	*1 M, 7½ p*

Table 72: Entablature for the serliana windows in the elliptical chapels at the second level

This entablature appears not just at the top of the rectangular side windows in the *serliana*, but also bends along the arch at the top of the central opening. For the reversed arch at the bottom of the window, instead, a less-decorated profile is used. This arch, in fact, is in contact with the bases of the window columns, whose decorations are simpler than the ones in the order entablature. The nature and proportions of the moldings in this lower arch are therefore developed referencing the arches that mark the transition between central and side bays.

Element	Dimension in section	Distance from the shaft
Fascia	1 M, 3¾ p	-
Apophis	1½ p	0 ~ 1½ p
List	1½ p	1½ p
Ovolo	4½ p	6 p
List	1½ p	7½ p
Frame dimensions	*2 M, ¾ p*	*7½ p*

Table 73: Molding framing the reversed arches in the serliana windows at the second level of the elliptical chapels at the second level

The joint between the reversed arch and the columns bases in the *serliana* is home to a pedestal, thus providing a composition similar to the one at the top of the same *serliana* (capital-entablature-arch). More than a pedestal, however, it would be more accurately described as a set of moldings mediating the transition between columns and reversed arch. The composition of this intermediate element references the moldings in the reversed arch while its total height preserves the balance in the section engraving; its top surface is aligned to the springer plane of the side bay vaults' pedestal. As a consequence, the first fascia in this intermediate element develops an out-of-module measure, absorbing the different proportions of the pedestal vault module.

Element	**Dimension in section**	**Distance from the shaft**
Fascia I	~ 11½ p	-
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Fascia II	4 p	2 p
Pedestal dimensions	*~ 1 M, 5½ p*	*2 p*

Table 74: Pedestals between reversed arch and serliana columns in the elliptical chapels at the second level

Finally, the intersection between two adjacent elliptical chapels creates irregularities for the *serliana* windows, as already mentioned for the windows at the first level of the very same chapels. In the case of the *serliana*, however, the merging chapels involves a surface much lager than the first floor. In that case, the curvature of the outdoor chapel wall is altered, obtaining a profile no longer parallel to its indoor geometry **[figure 190]**. In this way, the whole *serliana* on the transversal axis may have direct access to the sunlight. However, the rectangular portions of the *serliana* close to the merging chapel obtains only indirect light while showing in front elevation the curved

Figure 190. Detail of the junction between two elliptical chapels at the second level of Sainte-Anne-la-Royale.
Picture of the 3d printed model by the author.

wall of the adjoining chapel (although the wall does not obstruct the window).

6.2.3 Variation in the serliana windows at the end of the transversal axis and in the entrance bay

At the end of the transversal axis, the *serliana* window in the elliptical chapels appears again. Due to an increased surface, corresponding to the semicircle of the arches framing the central bay, the *serliana* evolves. At the side of the rectangular openings, at the side of the main window in the previous configuration, two new windows appear. Their elliptical geometry is interrupted only in correspondence with the paired columns in the *serliana*. The new profile, in fact, extends above the columns' entablature and below their pedestals, similar to the reflected arches in the main central opening **[figure 191]**.

The elliptical profiles of these new elements is discovered by linking three circles. Two of them, at the top and bottom of the window, sharing the same radius equal to half the radius of the main opening at the *serliana* center. The middle point of the segment connecting the centers of these two circles individuate the center of the third curve closing the ellipse. However, in order to provide an elliptical profile to the window, each ellipse will host the center of its third circle on the window at the opposite side of the *serliana*. This is to say, the center of the third circle completing the right elliptical window will be on the axis of the left window. In the same way, the center of the third circle completing the window at the left will be located on the axis of the right window.

As the main window at the center of the *serliana*, the elliptical side windows are also framed by a set of moldings. Their profile and composition is kept compatible with the one used in the reversed arch in the previous *serliana*. The arch at the top of the main

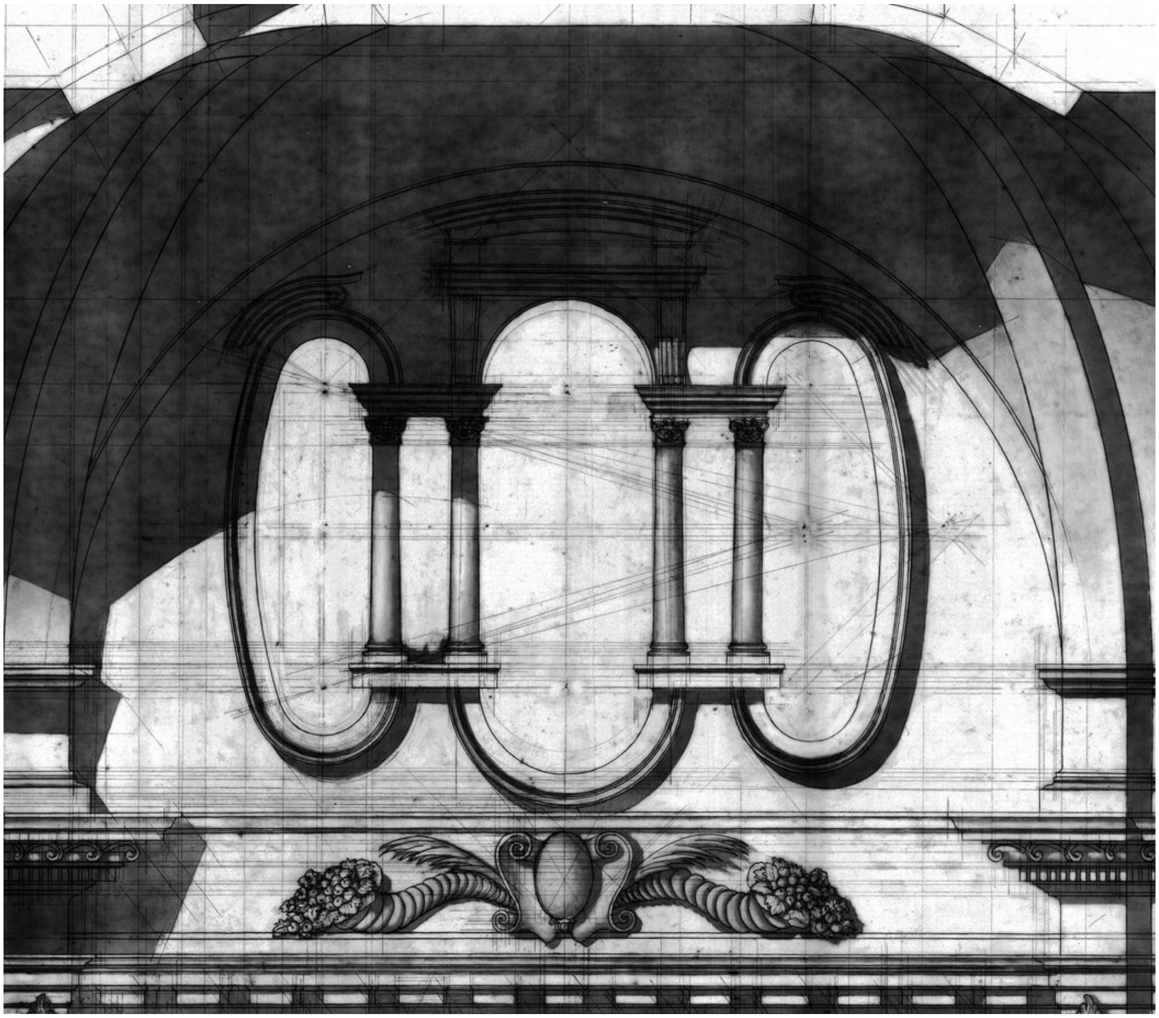

Figure 191. Serliana window in the side bays from Sainte-Anne's transept.
Drawing by the author.

opening, instead, loses the entablature seen in the elliptical chapels, being substituted by a single list. At its sides, two brackets (aligned with the columns' axes) sustain an arched pediment matching the curvature of the vault above it. The layout of the brackets, not detailed in the original engraving, appears to be compatible with the ones rendered in Plate XI, 26 of *Architettura Civile*. The moldings in the pediment, instead, preserve the same setting and proportions of the entablature at the top of the *serliana* columns (which was also the same one adopted in the now missing arched entablature of the main window).

The straight and curved profiles of the pediment are no longer in contact with one another, as rendered in the original engraving. The resulting void space is thus filled by introducing a *cavetto*, whose profile recalls Ionic friezes (since two brackets already appear below the pediment). The composition of this new molding follows the proportions in the table below. The module is still related to the half diameter of the *serliana* columns.

Element	**Dimension in section**	**Distance from the shaft**
Fascia	10¼ p	-
Apophis	4½ p	4½ p
List I	1½ p	4½ p
List II	2¼ p	6 p
Total dimensions	*1 M, 6½ p*	*6 p*

Table 75: Moldings introduced between straight and curved pediments

6.3.4 Further variations in the serliana motif in Sainte-Anne's main elevation.

At the top of the main entrance, in elevation, the longitudinal axis is closed by a *serliana* window whose configuration matches the one at the end of the transversal axis. In line with the opulent decorative patterns in the main elevation, the *serliana* is adorned with a sculptural enhancement compared to its indoor counterpart. The key differences concentrate at the top of the main arched window. The single list framing the window arch from the inside becomes in main elevation part of a thicker frame composed by a fascia decorated with rosary beads. At its top, a triangular pediment is joined to the elliptical side windows by a curvilinear cornice.

Following the convex profile of the facade, the outer *serliana* bends its profile towards the center of the entrance bay. As a consequence, all its elements increase their size while moving from the inside the church towards the outdoor space, thus increasing the depth perception (as it does in the *serliana*s in the elliptical chapels) [see **figure 179** on page 399].

At the side of the main elevation, the *serliana*s in the elliptical chapels timidly peek out towards the outdoor space. Partially hidden by the sculpted leaves linking first and second level of the main elevation, these secondary *serliana*s show an elevation much simpler than the window above the main entrance gate. From the elevation engraving, the *serliana* profile is excessively simplified. The columns creating the window tripartition are rendered as pilaster strips while the bent profile of the chapel (which is rendered in plan) is omitted. For the present reconstruction, the columns in the *serliana* are preserved; while two pilaster strips are introduced. One of them is maintained at the far end of the elevation while a second one is moved at the joint shown in plan between straight wall and chapel curvature. According to the elevation engraving, these pilaster strips have a smoother shaft and sustain an entablature divided in three main portions (probably architrave, frieze, and cornice). According to Architettura Civile, such undecorated, almost spare details are compatible with the First Doric Order.

It must be noted that there is an imprecision in the elevation engraving: the elliptical chapels at the second level are rendered shorter than they really are. As a consequence, the entablature identified above as First Doric Order appears below the Ionic one closing the second level of the entrance bay. In the present reconstruction, instead, the correct height of the chapel walls is restored. Therefore, the Doric entablature at their top reaches the same level of the Ionic one in the front facade (providing a uniform height for the roofs). Because of the new alignment between the two entablatures, the Doric one is proportioned according to the Ionic one (from which the Doric order will also obtain its generative module). In addition, the detailing of this Doric order is developed according to the secondary order in the main elevation, which shows an architrave divided in two fasciae like for Ionic orders. The rest of the surfaces, instead, are appointed simply as visible in the elevation engraving. The other elements in this order used for the chapel elevation, instead, preserve their original Doric nature. Below the pilaster strips, a pedestal is introduced to avoid an excessive length for the main vertical supports. At the same time, the pedestal is used to provide a visual solid base to the level while enhancing the design of the *serliana*. Since the pedestal sustains the columns in the *serliana*, its proportions adapt to these elements (which are based on a module different form the pedestal) thus introducing an out-of-module measure contained in the pedestal shaft.

Element	Dimension in section	Distance from the wall
Plinth	10½ p	11 p
List	1½ p	10 p
Apophis	1 p	10 p ~ 9 p
Shaft	2 M, 4½ p	9 p
Reversed Kyma	4 p	9½ p ~ 12 p
List	2 p	13 p
Pedestal dimensions[1]	*3 M, 10½ p*	*13 p*
Plinth	4 p	9 p
Tore	3 p	9 p ~ 6½ p
Base dimensions	*7 p*	*9 p*
List	1 p	6½ p
Apophis	½ p	6½ p ~ 5 p
Shaft	14 M, 10¾ p	5 p
Apophis	½ p	5 p ~ 6 p
List	1 p	6 p
Shaft dimensions	*15 M, 1¾ p*	*6 p*
Tondino	1 p	7½ p
Apophis	½ p	5½ p ~ 5 p
Necking	2½ p	5 p
Apophis	½ p	5 p ~ 5½ p
List	½ p	5½ p
Ovolo	2 p	7½ p
Capital dimensions	*7 p*	*7½ p*
Pilaster Strip dimensions	**16 M, 3¾ p**	**7½ p**

Table 76: Pilaster strips of the main elevation Doric order corresponding to the second level of the elliptical chapels

1 The distances from the back wall are provided according to a section on the pilaster strip. Therefore, the pedestal measures provided in the table relate to the protrusion the pedestal has when sustaining a pilaster strip. When in direct contact with the back wall, instead, the distance of the pedestal moldings from the back wall has to be subtracted by 5 parts (which represent the distance of the pilaster strip shaft from the back wall).

Element	Dimension in section	Distance from the wall
Fascia I	5 p	5 p
Tondino	½ p	5½ p
Fascia II	5½ p	6 p
Cavetto	2 p	6½ p ~ 8 p
List	1 p	8 p
Architrave dimensions	*1 M, 2 p*	*8 p*
Fascia	1 M, 4 p	5 p
Reversed Kyma	2 p	5½ p ~ 6½ p
Frieze dimensions	*1 M, 6 p*	*6½ p*
Fascia I	3 p	7 p
Fascia II	2 p	10 p
List	½ p	10½ p
Ovolo	2 p	1 M, ½ p
Fascia	½ p	1 M, 1 p
Drip Molding	3 p	1 M, 6 p
List	½ p	1 M, 6½ p
Kyma	3 p	1 M, 7 p ~ 1 M, 9½ p
List	1 p	1 M, 10½ p
Cornice dimensions	*1 M, 3½ p*	*1 M, 10½ p*
Entablature dimensions	**3 M, 11½ p**	**1 M, 10½ p**

Table 77: Entablature of the main elevation Doric order corresponding to the second level of the elliptical chapels

Doric Order total dimensions	**24 M, 1¾ p**	**1 M, 10½ p**

Table 78: Dimensions of the main elevation Doric order corresponding to the second level of the elliptical chapels

From the elevation engraving, it appears that the surface corresponding to the elliptical chapels is decorated by frames similar to the fourth level (the interlaced ribbed dome). However, the pattern of these frames on the chapels walls is not entirely clear; the details are essential and the areas is mostly covered by the sculpted leaves. Because of this, the frames from the fourth level are applied to the chapels using the *serliana* components as axial references. The two main areas containing the frames are in correspondence to the *serliana* columns; and the second, to the top of the *serliana* entablature. The middle line used as reference edge between these two frames is the top edge of the *serliana* entablature. The details in the frame, are the same already used in the elevation of the fourth level.

Element	**Dimension in section**	**Distance from the wall**
Apophis	1 p	0 ~ 1 p
List	1 p	1 p
Tondino	2 p	1 ~ (-1¼ p) with center at (-½ p)
List	1 p	(-) 1¼ p
Apophis	1 p	(-) 1 ¼ ~ (-) 2¼ p
Frame dimensions	*6 p*	*1 p (protrusion)* *2 ¼ (carving)*

Table 79: Frame around the elliptical chapels in main elevation

6.3 Lanterns

6.3.1 The lanterns above the side bay vaults

At the center of the side bay vaults, the ribs individuate an irregular hexagon. The intersection between this extruded geometry and the vault surface generates the lanterns at the top of the side bays. The resulting surface may be described as an ellipsoid. Perceivable on the church roofs, it appears again in the vault at the top of the lantern and in the roofs covering it. Even the squared windows and the moldings framing the lantern are affected by this movement, obtaining a skewed profile **[figure 192]**.

As for most of the details in Sainte-Anne, the original engravings provide basic information about the lanterns. Their unconventional volumes, however, are not an invention Guarini applied to Sainte-Anne only; it will be repeated in later buildings too—although none of them were actually realized or survived to us. Overall, the lanterns show plain surfaces and simple moldings fitting the simplicity of Guarini's Doric orders. Their location in the project, in fact, made these elements not directly perceivable from both inside the church nor in elevation, making it unnecessary the use of elaborate profiles or decorative patterns saturating their surfaces.

The biggest compositional issue caused by the lanterns is their relationship with the adjacent gallery. According to Guarini's plan for Sainte-Anne, the outdoor borders of the lanterns are extremely close to the star-shaped profile of the gallery. In order to avoid a direct contact between these two volumes, the thicknesses of the lantern walls (which are indicated by Guarini in the section engraving only) are accordingly proportioned. When necessary, some of the moldings framing the top and bottom surfaces of the lantern walls are slightly altered, reducing their depth.

Another issue caused by the lanterns has been the analysis and composition of the roof system. While connecting the star-shaped gallery to the polygonal profiles, the roofs

Figure 192. The lantern at the top of the side bays.
Picture of the 3d printed model by the author.

bend along the surfaces of the side vaults. In Sainte-Anne's section engraving, Guarini provided an idea on how the roofs along the transversal axis of the church would have been solved. Here, however, the side bay lanterns reach a height lower than the gallery base. On the longitudinal axis, instead, the increased size of the vaults pushes the lanterns above the gallery base, altering the curvature of the roofs (and the consequent flow of rain water above them). Mixing together inclined planes and curved surfaces it is possible to provide a coherent layout of the roofs.

6.3.2 The architectural layout of the side bay vaults lanterns

As already mentioned, the engravings do not show traces of architectural features in the lanterns. However, a sequence of moldings would have framed at least their lower and upper edges—not just for visual purposes, but also to keep the lanterns in line with the rest of the building. Likewise, the windows opened in the lantern walls would have had at least a minimal set of moldings in their frames. The absence of columns or pilaster strips on the lantern surfaces suggest a layout similar to a pedestal, thus introducing a minimal amount of details. The details for this element is taken by the pedestal in the adjacent gallery, proportioned according to the First Ionic Order (likewise for the module proportioning the element in both its indoor and outdoor profiles). The only modification in the order is introduced at the lantern top. There, the combination *ovolo/fascia* suggested in *Architettura Civile* is substituted by a kyma/fascia similarly to the drip molding closing the top entablature of First Ionic Orders. The length of the referenced drip molding, however, is preserved since it would have clashed against the gallery pedestal **[figure 193]**.

Figure 193. Section of the side bay lantern.
Picture of the 3d printed model by the author.

	Element	Dimension in section	Distance from the wall
Side Bays Lantern Base (outdoor)	Plinth	3 p	4 p
	Kyma	2 p	3½ p ~ 1½ p
	Tondino	1 p	2 p
Side Bays Lantern Shaft (outdoor)	List	1 p	1 p
	Apophis	1 p	1 p ~ 0
	Shaft	4 M, 6½ p	-
	Apophis	2 p	0 ~ 2 p
	List	1½ p	2 p
Side Bays Lantern Cornice (outdoor)	Fascia	3½ p	2¾ p
	List	½ p	3½ p
	Kyma	4 p	3½ p ~ 7¾ p
	List	½ p	7¾ p
Outdoor Lantern dimensions		**6 M, 2½ p**	**7¾ p**

Table 80: Outdoor layout for the side bay vaults lanterns

The windows in the lantern walls open not in the middle of the lantern height, but close to the top surface of the lantern (2 modules and 9½ parts from the bottom lantern surface; this is to say at 2 modules and 3½ parts of the shaft). Due to this choice, the lower portion of the lanterns suggest an illusion of solidity (the moldings at the bottom of the lantern occupy a space shorter than the ones at the top). At the same time, this positioning of the windows subjects the lantern to a forced perspective when perceived from inside the church, providing the illusion of a taller volume.

Moving to the indoor profiles of the lantern, the moldings in the element are modified. In this new configuration, the transition between vault ribs and lantern is marked by an additional set of moldings. At the same time, the profile crowning the lanterns is lowered in height to host the top vault. The lantern's outdoor profiles, in fact, absorb not just the thickness of the lantern vault but also the roof at its top. Such different purposes are addressed by restoring the molding used for the lantern (First Ionic Order pedestal) according to the directions in Architettura Civile. Therefore, the indoor top surface of the lantern shows the combination ovolo/fascia. The solution used on the outside (kyma/fascia), has been instead used to separate the vault ribs from the lantern.

Element		**Dimension in section**	**Distance from the wall**
Fascia		7½ p	-
Apophis		2 p	0 ~ 2 p
List		1½ p	2 p
Fascia		3½ p	2¾ p
List		½ p	3½ p
Kyma		4 p	3½ p ~ 7¾ p
List		½ p	7¾ p
Cornice dimensions		*1 M, 7½ p*	*7¾ p*
Side Bays Lantern Base (indoor)	Plinth	3 p	4 p
	Kyma	2 p	3½ p ~ 1½ p
	Tondino	1 p	2 p
Side Bays Lantern Shaft (indoor)	List	1 p	1 p
	Apophis	1 p	1 p ~ 0
	Shaft	4 M, 2 p	-
	Apophis	1 p	0 ~ 1 p
	List	1 p	1 p
Side Bays Lantern Cornice (indoor)	Ovolo	2 p	1 p ~ 3 p
	Fascia	1 p	3½ p
	Drip Molding	2 p	4½ p
	List	1 p	5 p
Indoor Lantern dimensions		*5 M, 7 p*	*7¾ p*

Table 81: Indoor dimensions for the side bay vault lanterns

The windows in the lantern are shaped according to the geometry visible from the engraving; their simple frame is detailed by a minimum set of moldings. Their purpose is mainly to cast shadows in the lantern, enhancing the three-dimensional properties of the element. The profiles below are used for both the indoor and outdoor layout of the windows.

Element	**Dimension in section**	**Distance from the wall**
Fascia	4¼ p	-
Apophis	¾ p	0 ~ ½ p
List	½ p	½ p
Tondino	1 p	1 p
Fascia	1 p	1¼ p
List	½ p	1¾ p
Recessed List	½ p	-
Frame dimensions	*8 p*	*1¾ p*

Table 82: Window frame for the side bay vault lanterns

The recessed list mentioned in the table above indicates the inner portion of the window, where the actual window frame would have been located.

6.3.3 The gallery lanterns

At the top of the elliptical domes in the gallery, cylindrical lanterns closed by a hemispherical dome illuminate the circular gallery corridor by four elliptical windows **[figure 194]**. Similar to the elements at the top of the side bay vaults, also the gallery

Figure 194. Gallery lantern.
Picture of the 3d printed model by the author.

lanterns show a smooth profile deprived of decorative patterns. Moldings appear only in correspondence to the lantern's main joints, where a simple profile (composed by a list and a cavetto) mark the transition between adjacent compositional elements. When closing the lanterns, two additional moldings (a fascia and a list) complete the lantern profile, providing the idea of a closing entablature.

The proportions of the lanterns are obtained using the same module in the gallery (which remains constant for all the upper levels in the church).

Element	**Dimension in section**	**Distance from the wall**
Lantern body	3 M, 6 p	-
List	1 p	½ p
Cavetto	3 p	1 p ~ 2 p
List	1 p	2 p
Fascia	3½ p	2½ p
List	1½ p	3 p
Gallery Lantern outdoor layout	*4 M, 4 p*	*3 p*

Table 83: Outdoor layout for the gallery lanterns

Because of the conic roof covering the gallery, the inside and outside layouts of the gallery lanterns do not lay on the same plane. The inside setting is even more simple than the outside one. It is composed by repeating the very same set of moldings at the bottom and top of the lantern volume. The connection between inner and outer profiles is marked indoors by the lower edge of the list at the bottom of the lantern.

Element	Dimension in section	Distance from the wall
List	1 p	½ p
Cavetto	3½ p	1 p ~ 2 p
List	1½ p	2 p
Inside lantern molding set	*5 p*	*2 p*

Table 84: Indoor layout for the gallery lanterns

6.4 The top spiral pinnacle

Stretching the church towards the skies above, a spiral pinnacle completes the composition. At its top, a sphere, symbolizing perfection, sustains a greek cross, the mark of eternal devotion. Spiraling around the church axis, the pinnacle constantly changes its section. This metamorphic evolution is structured onto a sixteen-side polygon, a geometry linked to the octagonal figures constantly appearing in the church. Each of the polygon sides hosts a *tondino*. In between two adjacent *tondini*, a semicircular section carves the pinnacle volume in a fashion similar to a flute. While moving up towards the sky, the pinnacle section rotates; the *tondini* and flutes in each section, however, remain projected towards the church axis, being subjected to constant deformations—their size varying in proportion to the distance form the church axis.

To graphically describe such movement of the pinnacle section **[figure 195]**, both starting and finishing circles in the pinnacle are divided in sixteen parts (points from *1* to

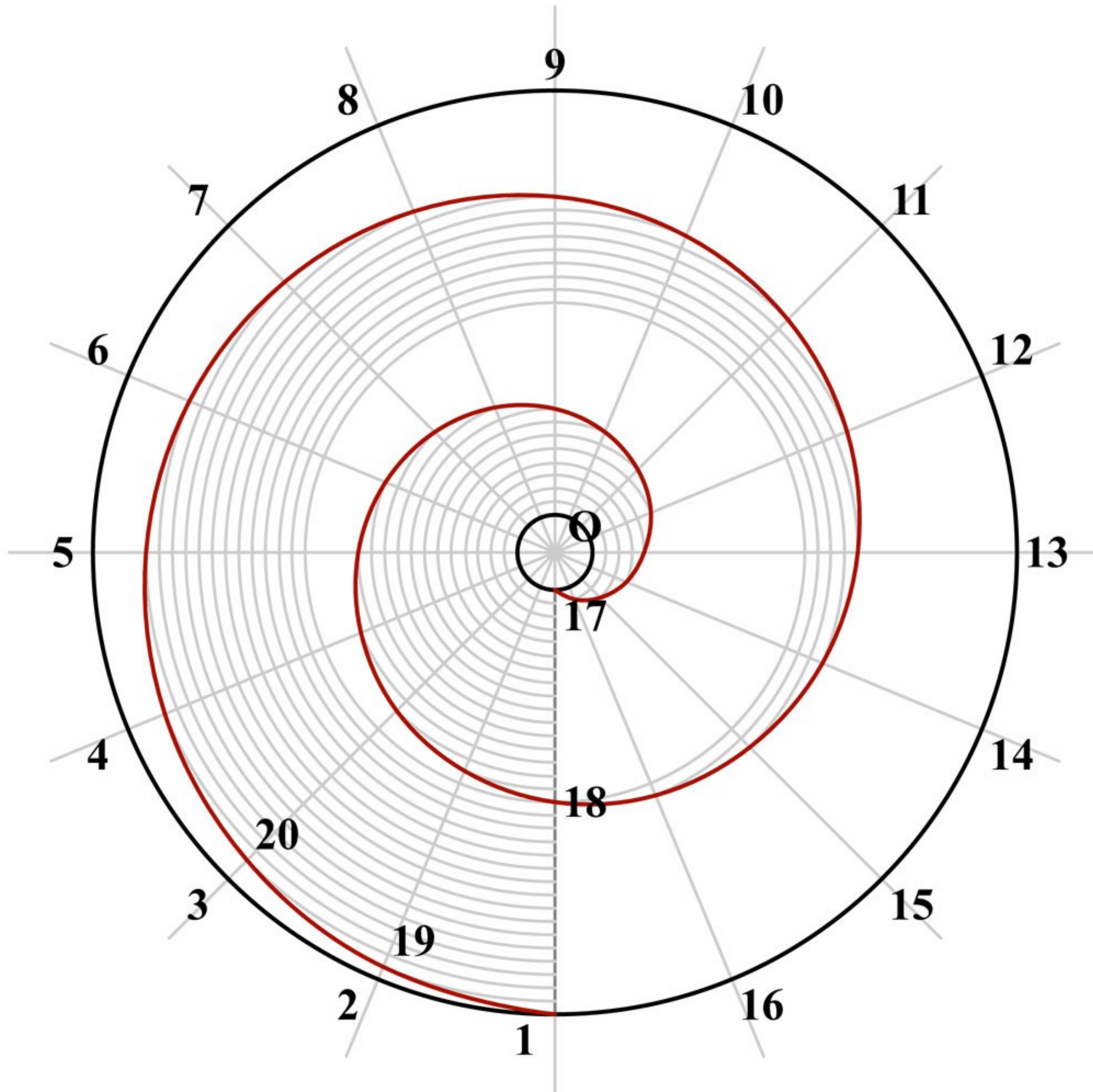

Figure 195. Geometric construction for the top spiral pinnacle.
Drawing by the author.

16). The vertical line from point *1* shows where the spiral will start while point *17* on the circle at the pinnacle top shows where the spiral will finish. In its route from *1* to *17*, the spiral needs to wrap on itself two times. At the end of its first loop, the spiral will reach *18*, the middle point of the vertical line *1-17*. To draw the spiral, divide both segments *1-18* and *18-17* in sixteen parts (since the geometry used for the pinnacle is based on a sixteen sided polygon). Using O as center, each of the sixteen points in both the segments will be moved along its corresponding axis. For example, starting from point *1*, point *a* will be moved onto O-*2* individuating point A; *b* will be moved onto O-3 individuating B; and so on. The points A, B, … etcetera, show the path followed by the spiral.

After completing the spiral in plan, it is possible to move on a vertical plane where the pinnacle will be sliced by horizontal sections. Each section needs to be individually calculated. Because of the deformation the church axis causes to the pinnacle, each section will have a unique layout. The number of planes slicing the pinnacle is connected to the number of points used to draw the spiral (32). The first 16 planes will describe the pinnacle section along the first loop of the spiral while the following 16 planes will be related to the second loop of the same figure.

The first section passes from point *1* **[figures 196, 197]**. The line joining *1* to the pinnacle axis *O* intersects the top circle in the pinnacle at point *17*. Centered on *17*, draw a the circle passing through *1*, individuating the profile of the pinnacle. The sixteen axes from *O* will divide the circle centered on *17* into sixteen arcs. Each of them will host a *tondino* at its center and a half flute at its side. The proportions of the both flutes and *tondini* remain constant throughout the section while their measure is resized according to the variable length of the arcs.

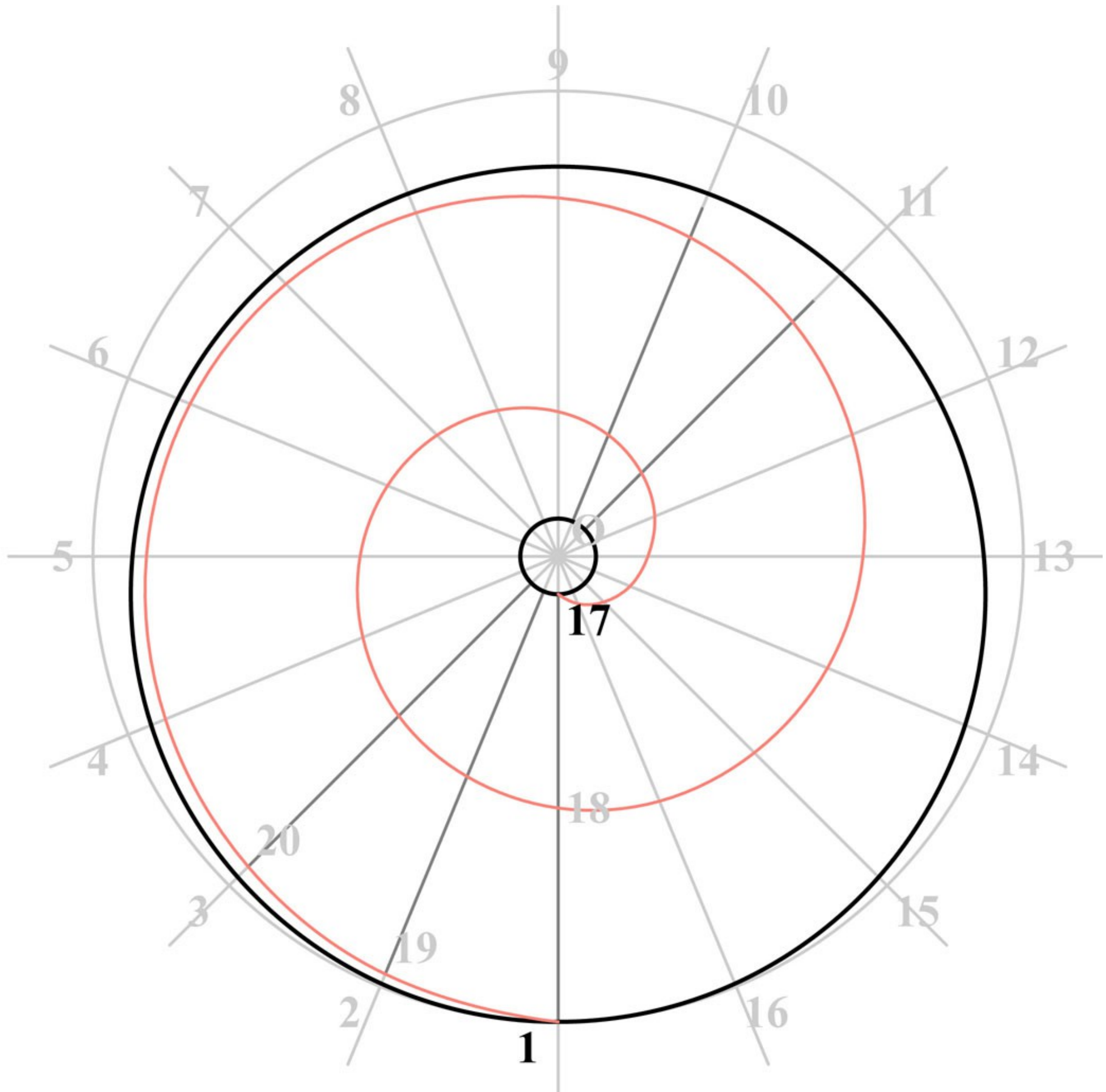

Figure 196. Geometric construction for the first section of the spiral pinnacle.
Drawing by the author.

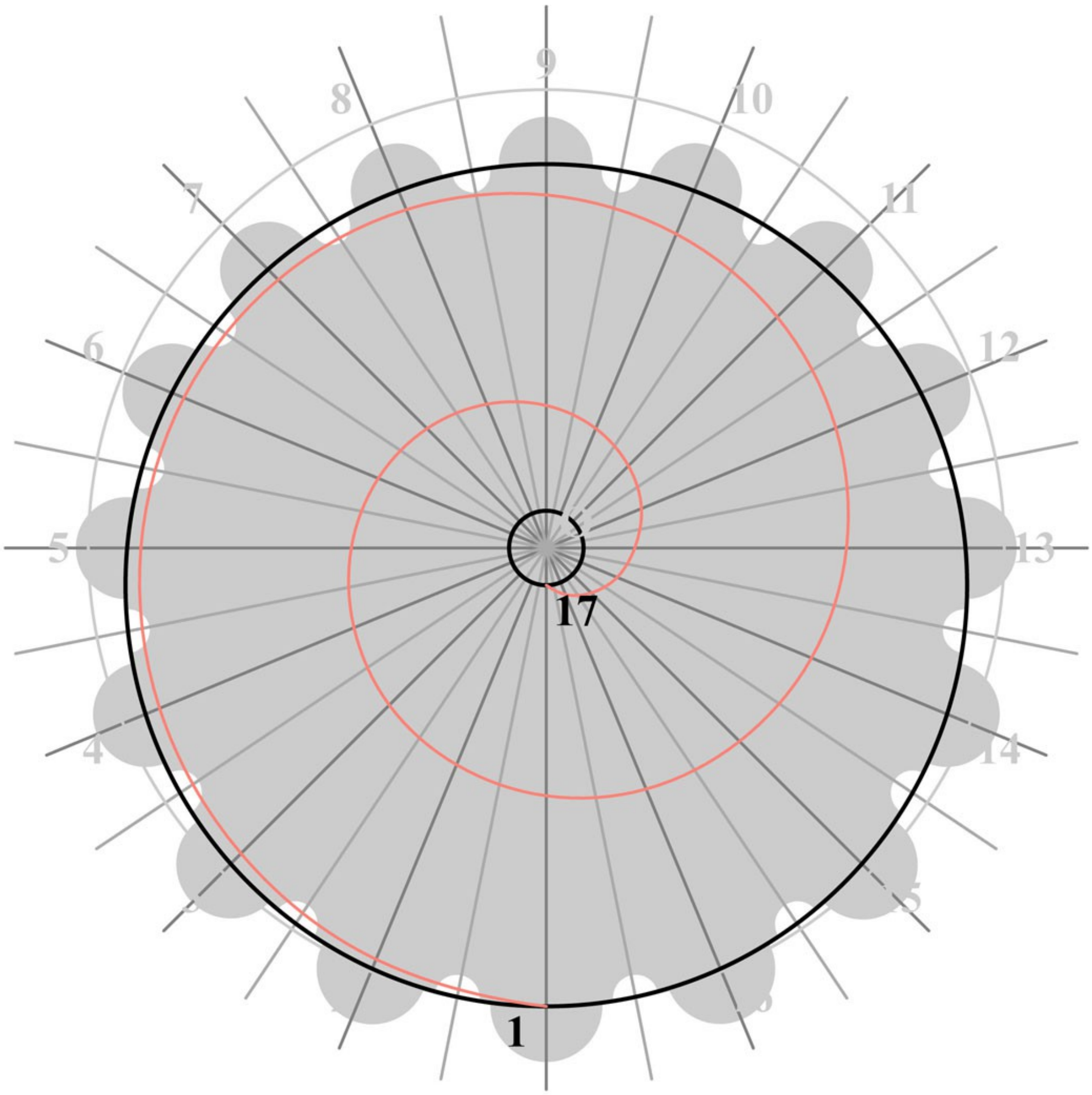

Figure 197. Profile for the first section of the spiral pinnacle.
Drawing by the author.

The next section will work in a similar way. This time, the axis *O-2* intersects the top pinnacle circle at *19*, from which it is possible to draw the circle passing through A. Using the pinnacle axes, the circle will be divided in uneven arcs on which the tondino and flutes above will be resized **[figures 198, 199]**.

The same procedure needs to be repeated for the other horizontal planes sectioning the pinnacle, thus completing the reconstruction of Sainte-Anne-la-Royale **figure 200]**.

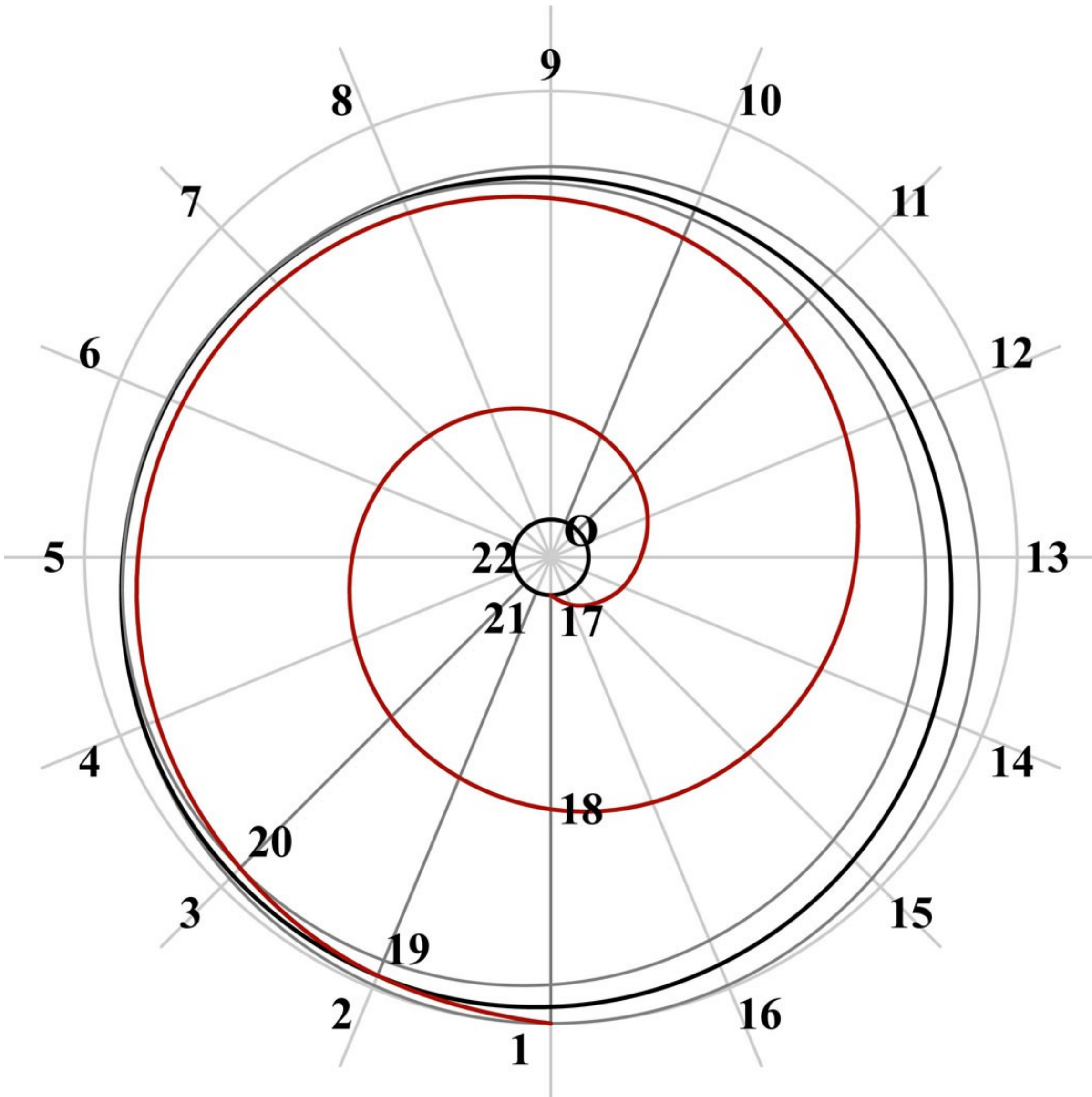

Figure 198. Geometric construction for the second section of the spiral pinnacle.
Drawing by the author.

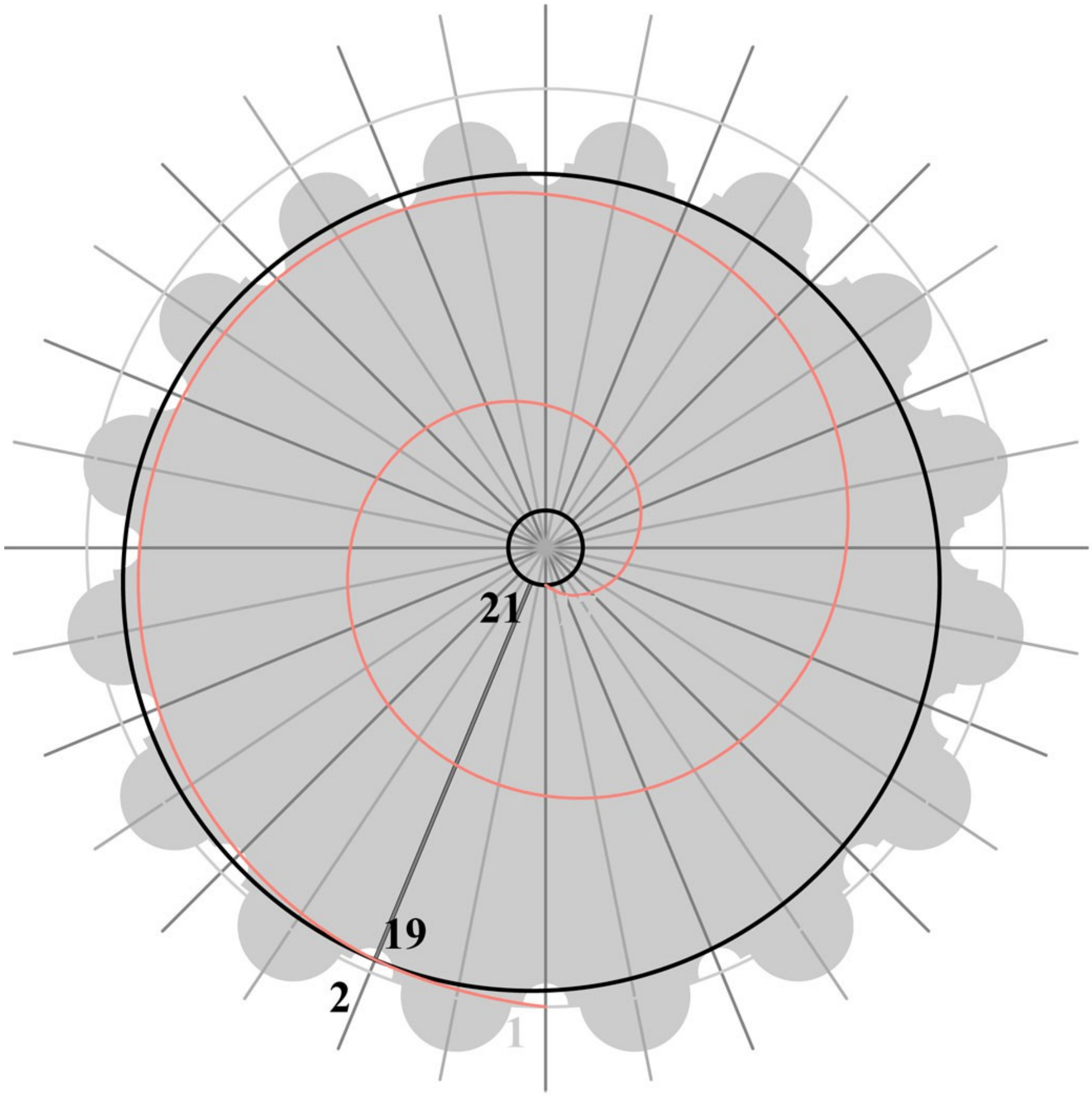

Figure 199. Profile for the second section of the spiral pinnacle.
Drawing by the author.

Figure 200. Overview of the model with indoor illumination.
Picture of the 3d printed model by the author.

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APPENDIX A:
Geometric Construction for and Ellipse by One Point and One Axis

By using a cad software, this type of construction is immediate although not necessarily accurate. In order to draw ellipses in a CAD software it is usually required to provide the intersection between major and minor axis of the ellipse, main reference for the curve. The following step requires the length for both axes.

However, when one axis only is known, it is possible to draw an ellipse by just defining one additional point of the curve not belonging to the known axis, of course. When, instead, two points only of the ellipse are known (not laying on the major or minor axes of the curve) together with the curve center (this is to say the intersection of its main axes), CAD softwares may found difficulties in providing an adequate profile for the curve.

In order to avoid these issues and still be able to draw an ellipse knowing one axis and one point not belonging to it (or to the axis perpendicular to it, for that matter), it has been here provided a simple method taking in consideration the relationship between ellipses and circles. An ellipse, in fact, may be considered as a skewed circle. In a three-dimensional setting, this means having a circle rotating along one of its diameters. During such rotation, the circle will progressively transform into an ellipse until degenerating in a straight line (when the rotation reaches 90 degrees from the starting position).

According to this interpretation, it is always possible to re-conduct any ellipse to its original circular profile thus identifying the minor axis of the curve (subjected to deformation by the rotation of the circle).

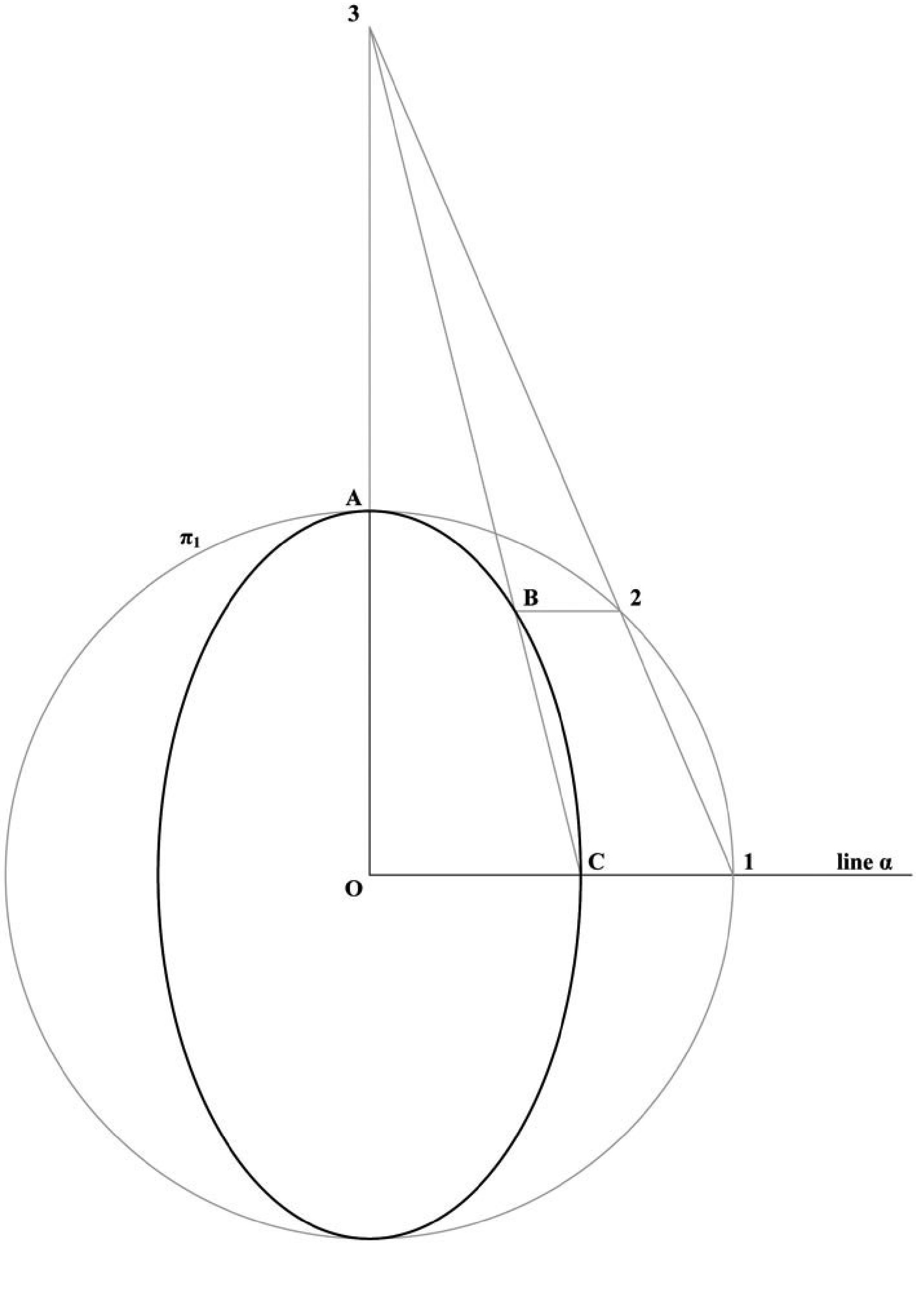

Figure A.1: Geometric construction for an ellipse by one point and one axis

Draw the segment *O-A* **[figure A.1]** representing the major axis of the ellipse we want to draw (*O-A* may also be the minor axis; the construction will work either way requiring only to be rotated by 90 degrees from the chosen reference). Select a random point *B* not belonging to *O-A* from which the curve will pass to. From *O* draw a line perpendicular to *O-A* (*line α*) on which the other main axis of the ellipse will be located. Point in *O* with radius *O-A* identifying the circle π_1, which intersects *line α* in *1*. Using a line parallel to *α*, project *B* on π^1 individuating point *2*. Draw a line passing by *1* and *2*, which intersects *O-A* extension in *3*.

Suppose that the circle π_1 will rotate around *O-A*. In this case, also the line by *1-2* will be subjected to the same rotation around *O-A*, keeping point *3* stationary. During this movement, both points *1* and *2* will always be connected to a line passing from 3. Because of this, when point *2* reaches the position of point *B,* it is just required to draw the line *3-B* in order to find *C*, edge of the ellipse axis orthogonal to *OA and* corresponding to point *1*. Having identified the position of point *C*, it is possible to draw the unique ellipse with axis *O-A* and passing by point *B*.

APPENDIX B:
Geometric Construction for and Ellipse by its Center and Two Points Not Belonging to the Curve Main Axes

In this second case, to draw the ellipse it is required to figure out where the edge of one of its axes will be located. Draw thee random points **[figure B.1]**:

- *O*, center of the ellipse;
- two points, *A* and *B* from which the curve will pass by.

Since *A* and *B* will be on the ellipse profile, the line connecting the two points has not to pass by *O*. Draw from *O* two perpendicular lines (*line α* and *line β*) over which the two axes of the ellipse will be located (although it is still not possible to establish the locations of their edges). From the previous appendix, it has been shown the relationship linking a circle to an ellipse. However, while in that case the searched ellipse was passing by one point only, this time the curve will pass by two points, *A* and *B*. Because of this, it will be established a new relationship between ellipse and circle based on *A-B* middle point, *1*.

Take in consideration a quarter circle and cut it by a chord (points *a* and *b*) **[figure B.2]**. Extend such chord to one of the edges of the quarter circle (point *c*). Centering in *d*, middle point of *o-c,* draw the circle with diameter *o-c*. Its intersection on *a-b* will happen in *e*, middle point of the chord *a-b*. Such property will always be valid in any quarter circle regardless from its radius of from the length and position of the chosen chord. This relationship will be used to draw the searched ellipse.

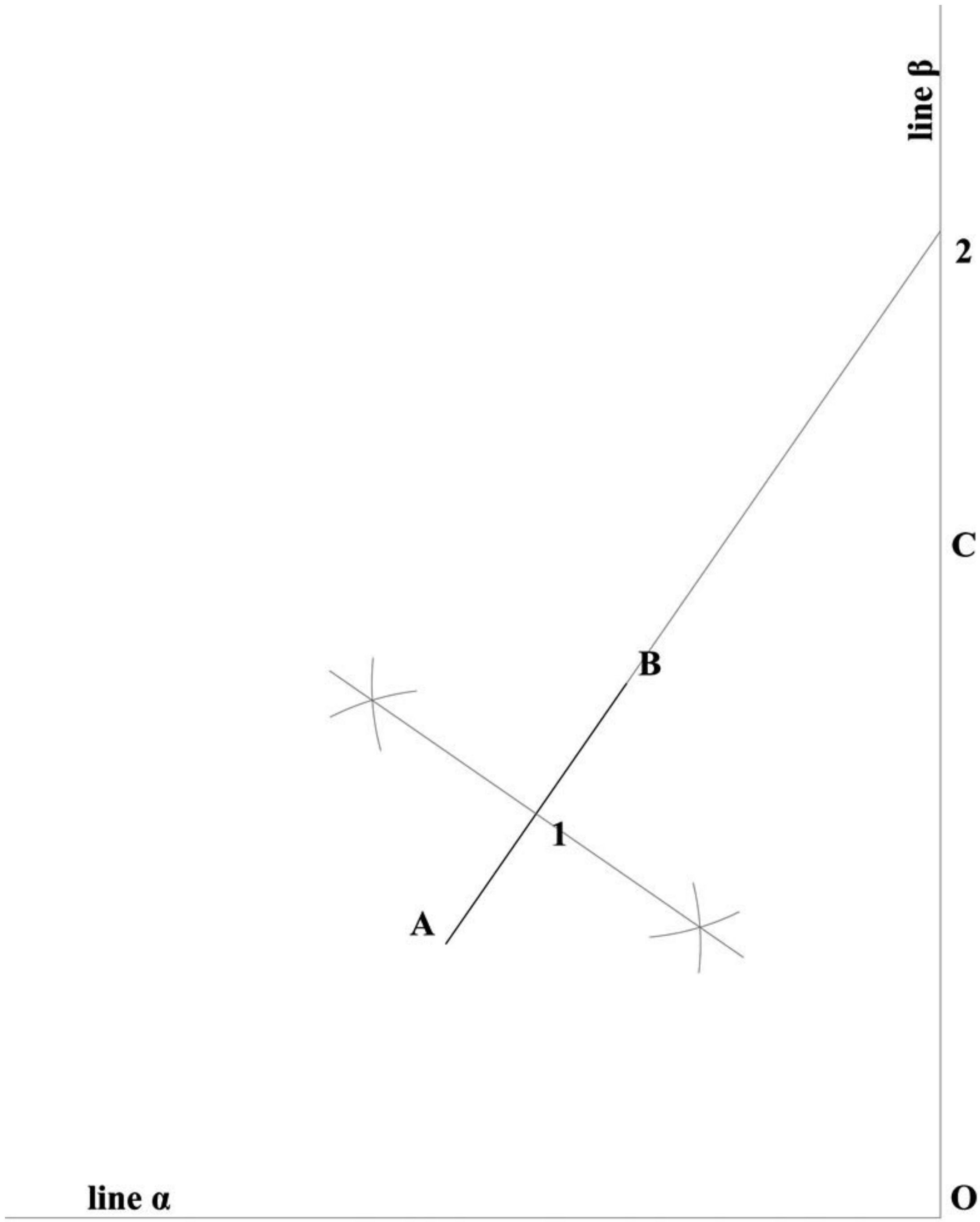

Figure B.1

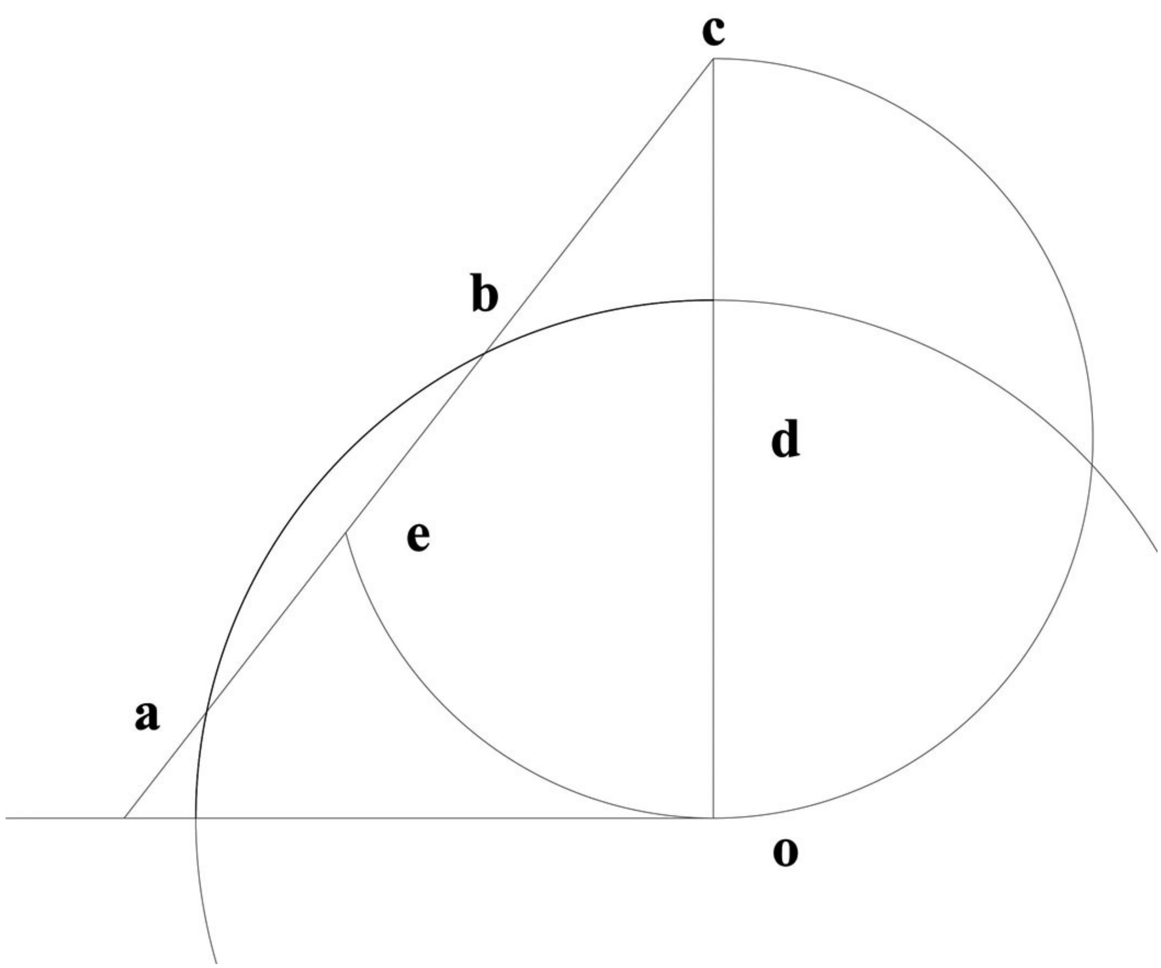

Figure B.2

Individuate the middle point of the segment *A-B* (point *1*) **[figure B.3]** and extend the *A-B* until intersecting *line β* in *2*. Center in *3*, middle point of *O-2*, and draw π_1, a circle with radius *3-2.* From *1*, draw *line γ* parallel to *α* and intersecting π_1 in *4*. Connect *4* to *2* individuating line and, using projection lines parallel to *line γ*, move both *A* and *B* on the line *2-4* thus individuating the points *5* and *6* respectively. Because of the above mentioned property in a quarter circle, both points *5* and *6* will belong to the same circle centered in *O*. Additionally, because of the relationship between ellipse and circle established in Appendix A, point *C* (intersection between π_2 and *line β)* will individuate the edge of one main axis of the searched ellipse.

Having located *C*, the searched ellipse can be drawn using the method in Appendix A using as additional reference any of the two points *A* or *B*.

The construction is still valid in case point 2 would have been on *line α* (instead of *line β* like in the example). In this case, *line γ* will have to be parallel to *β*, of course; while the whole construction will have to be accordingly rotated by 90 degrees.

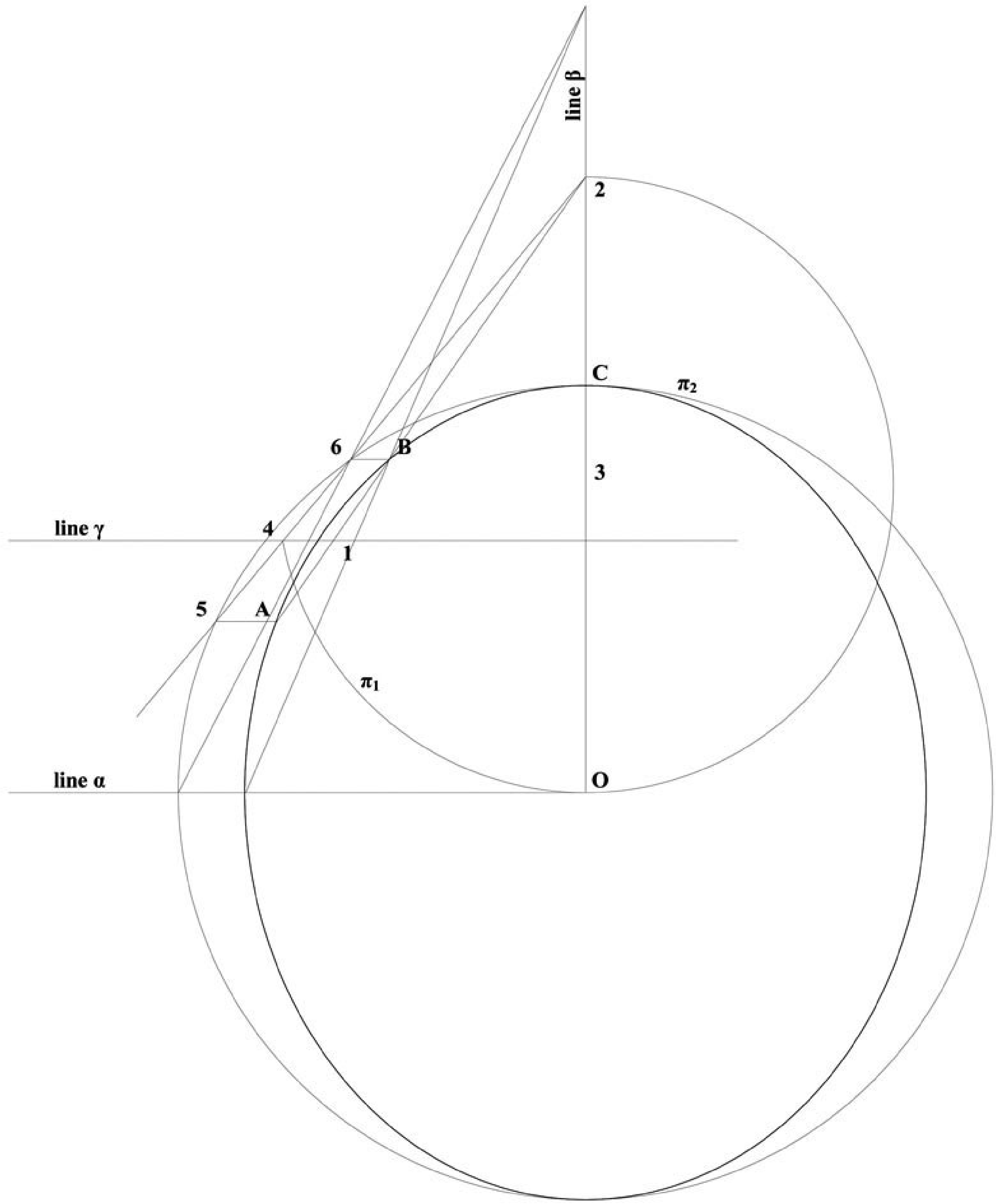

Figure B.3

CURRICULUM VITAE

Giuseppe Mazzone

Place of birth: Bari, Italy

Education:

Architecture Professional License:
Bari (Italy), June 2007
(valid in Italy and Europe)

B.A and M.A.,
Polytechnic of Bari (Bari,Italy), February 2006

Certificate/Diploma:
International Workshop for the access of archaeological sites
Castellammare di Stabia (Naples, Italy)
Theme: Herculaneum Archaeological Site

Dissertation Title:

Geometry of Faith – A Stereotomic Reconstruction of Sainte-Anne-la-Royale in Paris

Awards:

Chicago ICAA 2014 Acanthus Award in the category "Student Works"
Theme: "Sainte-Anne-la-Royale (Paris, 1662)"
http://classicistchicago.org/acanthus-awards.php

Professional Experience:

Adjunct Professor (with Graduate Assistant contract)
UWM School of Architecture and Urban Planning, Milwaukee (WI)
Fall 2010-Fall 2014
Courses taught:

- *ARCH190: Seeing and Analyzing Space* (Fall 2011/2012/2013/2014)
- *ARCH190: Creating Spatial Organization* (Spring 2012/2013/2014)

Both courses have been offered at UWM School of Architecture and Urban Planning. As new courses offered at UWM-SARUP, I was in charged to write their own syllabi.

ARCH190: Seeing and Analyzing Space
The course focuses on reading and analyzing buildings. Students's attention is moved towards uses and junctions among structural elements. Selected buildings in history of architecture bring students attention at:

- evolution of materials and structures in architecture;
- different approaches to three-dimensional spaces;

Class lectures are accompanied by two practical applications. The first assignment analyses the elevation of an informal building (chosen in Milwaukee area); the second assignment analyzes the structure of historical domes and vaults through a set of sketches and a physical model.

ARCH190: Creating Spatial Organization

The course aims to provide students simple methods to properly represent their own ideas and projects. Information in class come in the form of tutorials showing students how to use increase their graphic and modeling skills. The main assignment in the course focuses on a large scale model; in 2012 we worked with a forced perspective; in 2013 we realized a cross vault; in 2014 we realized a ribbed dome on pentagonal base. The model realized in 2013 and 2014 were executed in cardboard having each piece in the structure calculated according to French stereotomic principles.

- *ARCH390-790: Handmade Applications of Descriptive Geometry*
  Fall 2010/Spring 2011

The course focuses on the application of descriptive geometry principles. A set of twelve assignments guide students from simple projections to the use of multiple projection planes, axonometric views, perspectives, shadows (in both bi-dimensional and three-dimensional environments). All the assignments are realized during class time. As final assignments, students will work on two projects:

- analysis of an assigned classic architecture detail (according to Giacomo Barozzo da Vignola);
- analysis of a classic building.

All the applications requires hand-made drawings in graphite. The assignments are realized on paper (class assignments) and mylar (final assignments).

Graduate Assistant for Architectural Design Studios
UWM School of Architecture and Urban Planning, Milwaukee (WI)
Fall 2008-Spring 2010

ARCH410: Architectural Design I (Fall 2008 & Fall 2009);
ARCH648: Chandigarh Studio (Spring 2009);
ARCH420: Architectural Design II (Spring 2010);

Visualization and Representation Specialist
Polytechnic of Bari – School of Architecture (Bari, Italy)
Spring 2006-Spring 2008

My main task was taking care of the graphic works in school's publications; when required, both handmade and CAD drawings have been corrected and/or reworked.

Lectures:

"Visualization + Representation"
UW-Milwaukee, School of Architecture and Urban Planning
February 2010

"Stone in Architecture"
UW-Milwaukee, School of Architecture and Urban Planning
April 2012, April 2014

Publications:

Article mentioning my PhD dissertation
Jack Wolf, "Architectural Reconstructions by 3D Printing"
in *MasterGraphics Weblog*, posted April 2, 2014
(http://www.mastergraphics.com/wordpress/2014/2698/);

Drawings and illustrations
"The Hues of Paradise – Examining Color Design in the Islamic Garden"
in Sheila Blair & Jonathan Bloom (eds.) *Color in Islamic Art and Culture*
Cambridge: Yale University Press, 2011

Giuseppe Mazzone, Attilio Petruccioli, Calogero Montalbano
Recupero delle acque piovane per uso domestico nell'area mediterranea [Sustainable Architecture in the Mediterranean area: storage systems for rain water]
Bari: ICAR, 2009

Attilio Petruccioli
After Amnesia: Learning from the Islamic Mediterranean Urban Fabric
Bari: ICAR, 2007
(alterations and corrections on drawings by other authors)

Attilio Petruccioli, Christian Richters
Fathpur Sikri: la capitale dell'Impero Moghul, la meraviglia di Akbar [Fathpur Sikri: the capital of Moghul's Empire – Akbar's wonder]
Milan: Electa, 2007
(selected CAD drawings in the publication)

Fabio Galeandro
“La Ceramica a Tenda: Origini ed Evoluzione”
[Origins and Evolution of Tent's Motif Pottery]
in *Taras – Archaeological Review*, xvii, 2 (1998)