Use of Parametric Tools in the 3D Reconstruction of the Cloister of the Church of San Filippo Neri in Turin

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Abstract

In 1714, Filippo Juvarra outlined a series of design proposals for the Congregation of the Order of San Filippo Neri, whose church, built at the turn of the century, had recently collapsed. This first series culminated in 1717, with a design that historians would come to refer to as Fondazione Nuova.
In all iterations of the Church of San Filippo Neri, the disposition of the complex, and thus the relative position and overall dimensions of the cloister, remained unaltered, even though its formal characteristics underwent drastic changes. By combining the observable characteristics of the cloister today and the scant information that can be obtained from the Fondazione Nuova drawing series, it is possible to hypothesize the configuration of the cloister at the time of the project.
This paper describes the process of reconstruction of the cloister through the use of parametric tools, by focusing on the 'variations on a theme' nature of its design and the relations between variables and fixed constraints.

Keywords
Filippo Juvarra, Congregation of the Oratory of San Filippo Neri, Turin, parametric modeling, 3D modeling.

3D model of the *Fondazione Nuova*, by the author.

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Introduction

Over the closing months of 1714, immediately after arriving in Turin, Filippo Juvarra (Messina 1678-Madrid 1736), newly-made First Architect of newly-made King Vittorio Amedeo II of Savoy, started working on the project for the newly-collapsed Church of San Filippo Neri in Turin [1]. Over the next three years, he developed the project into three central 'Ideas', each allowing for a variety of alternatives. The three ideas were the double-symmetry church with the dome in the middle (Idea A, 1715, compatible with the late-17th century church), the Jesuit counterreformation church (Idea B, 1715) and the double-cross church. which bore more than a passing resemblance to Rainaldi's S. Maria in Campitelli (Idea C, 1716-1717). The *Fondazione Nuova* (fig. 1), a 1717 design that elaborated on Idea C, won the Congregation's support, and remained the operative design of the church until at least 1727 [2]. Construction of the main church never began, however, and in 1732 Juvarra presented the Congregation with the new, dome-less design, that informed the construction of the church over the following century-and-a-half.

Volume 22 of section *Riserva 59* at the Biblioteca Nazionale di Torino [3] contains all technical drawings Juvarra's atelier drafted on the subject of this church. These drawings include an exploration of the three ideas, the *Fondazione Nuova*, and finally copies of the eight designs proposed for the original church, built at the turn of the century in the 1675 expansion of Turin towards river Po [4]. Of these early solutions, *foglio 5r* was long since identified as the definitive design of the original church, based on the similarities it shared with the remnants visible in Juvarra's design [Comoli, Mandracci 1967, pp. 32-33; Pommer 2003, pp. 63-64]. The *Fondazione Nuova*, however, appeared in print in 1758 [Baroni di Tavigliano 1758], owing to the efforts of Juvarra's collaborator Giovanni Pietro Baroni di Tavigliano (born Ignazio Agliaudi) [5]. The drawings from volume 22 were copied (with minor adjustments) and integrated with details of auxiliary structures, to then be published under the title *Modello della Chiesa di S. Filippo per li PP. Dell'Oratorio di Torino, inventato, e disegnato, dall'abate, e cavaliere D. Filippo Iuvara, Primo Architetto di S. M. Dato in luce dal Conte Giampier Baroni di Tavigliano, e dal medesimo consecrato A.S.S.R.M. Carlo Emanuele Re di Sardegna* (henceforth *Modello*).

One of the most important contributions to the history of the cloister is Pommer's sorting of the expenditures between church and convent [Pommer 2003, *Appendice* VIII, p. 165]: it appears that 1723-1732 [6] saw a complete halt in the construction of the church, paired with significant activity in the construction of the convent (1725-1737), and specifically of the left wing of the cloister, which, however, was to be completed only in 1740 [Comoli Mandracci 1967, p. 93]. This means that construction of the cloister began at a time when the *Fondazione Nuova* design was still in effect.

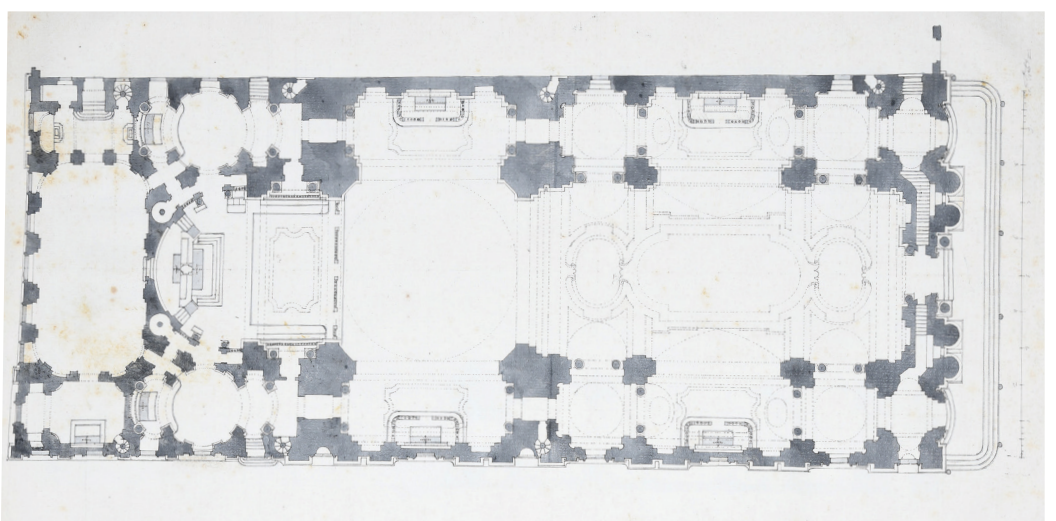

Fig. 1. Filippo Juvarra's atelier, Plan of the *Fondazione Nuova*, 1717. BNTO Ris. 59/22 f16. Ministero della Cultura. Biblioteca Nazionale Universitaria di Torino, divieto di riproduzione.

Source material

Representations of the cloister are few and far between; more generally, the body of drawings that Juvarra's atelier produced on San Filippo appears largely unconcerned with the question of connecting the church to the convent. That being said, the cloister does appear in f3 and f5 (fig. 2), Juvarra atelier copies of, respectively, Guarini's proposal and the definitive plan of the original church. In f5, the cloister is divided into 11 equally-spaced spans, coming to a hard stop as they reach the convent to the north. The openings into the side of the church bear no correlation to the articulation of the cloister.

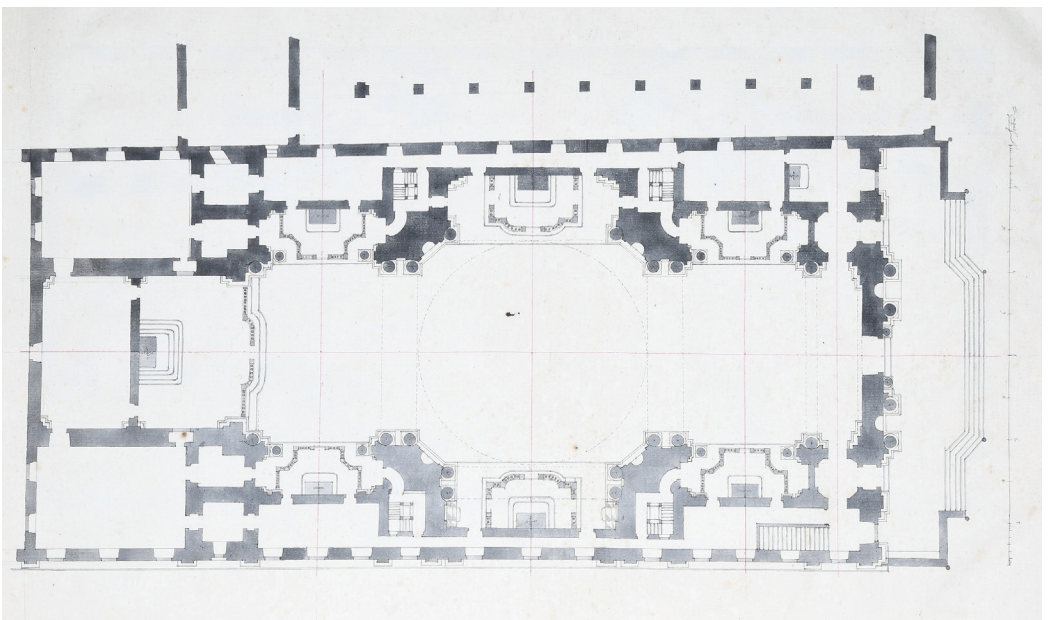

Fig. 2. Filippo Juvarra's atelier, Copy of the plan of the old church, [1714-1717]. BNTO Ris. 59/22 f5. Ministero della Cultura. Biblioteca Nazionale Universitaria di Torino, divieto di riproduzione.

Of the drawings pertaining to Juvarra's own designs, only the *Fondazione Nuova* series extends to those parts of the convent that come directly in contact with the church, which ought to constitute further proof of the operative nature of the *Fondazione Nuova*, compared to the speculative exercise of the Three Ideas. The drawings from which we can glean information on the cloister are f27 of Vol. 22 (figure XIII of *Modello*) and n.17 of the San Filippo series at the Museo Civico di Arte Antica di Torino (figure XIV of *Modello*) [7]. Drawing f27 (fig. 3) comprises a plan and longitudinal section, and drawing n.17 (fig. 4) a series of cross sections, of the quarters located to the back of the chancel. Unlike f5, both drawings show the sequence of cross-vaulted bays that run flush to the church continuing into the northern wing of the convent, spanning the entire length of the complex. The bays all span the same length, shorter than their f5 counterparts, and the pillars that uphold them emerge as pilasters from the wall towards the convent, and only as capitals from the church flank. They are generated by a polycentric curve (*C1*; see fig. 7) defining a long barrel vault, perpendicularly intersected by webs that originate from another polycentric curve (*C2*; see fig. 8) as well. The minor axis of C2 is equal to the distance from the spring line of the vaults to the intersection between the two types of arc that make up C1.
This determines a raised profile for the webs of the vault, resulting in a series of cross vaults that appear raised in the transversal direction and cross-like along the length. Aside from the basic caution not to get caught in one of the pillars, section n. 17 shows that (at least in the area of the sacristy) the openings into the church's body are com-

pletely independent from the bays. What's more, the windows in this portion of the design show no reverence for the vaults of the cloister, and thus end up bisected.
The two systems are therefore entirely unconnected, with no concern for practicality. This is at least partly explained by the necessity that the cloister wings be aligned with the convent (to which they belonged on a conceptual level), which had remained largely unaffected by the collapse of the church: n. 17 shows a series of clever workarounds designed to bridge the gap between the levels of the church and those of the convent.
Between the *Fondazione Nuova* and today lie the 1730-1732 design phase, construction, and the centuries that have since elapsed. The current structure, surveyed by local practice De.Arch in 2021, displays significant departures from the portion shown in the *Fondazione Nuova*, while retaining enough similarities to be used as a starting point to try and envision what the rest may have looked like. The situation is complicated by the fact that neither De.Arch nor I were allowed to inspect the northern wing of the convent,

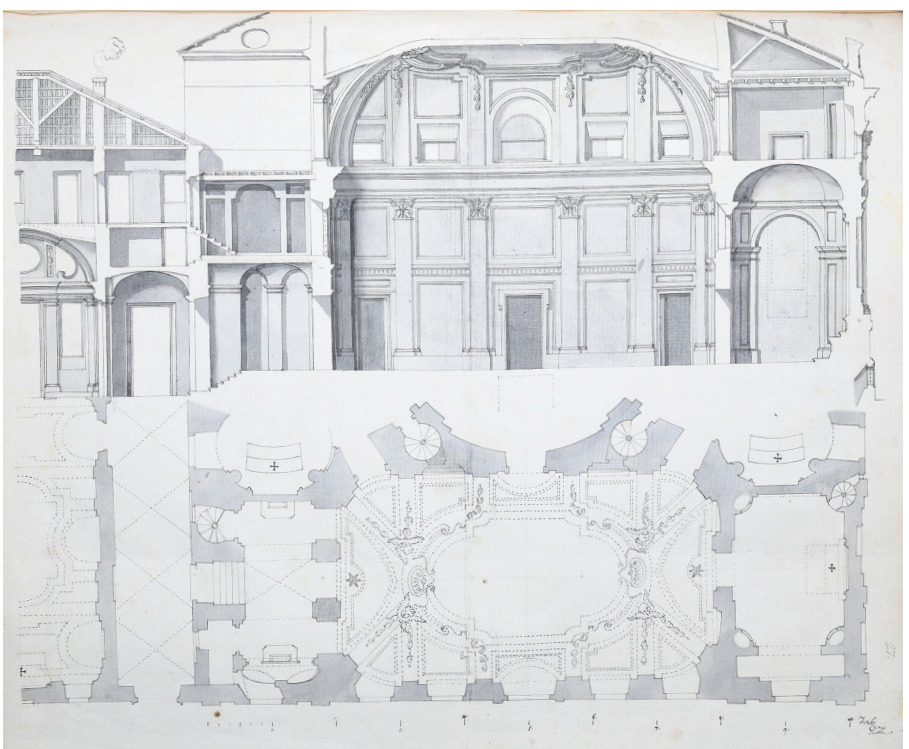

Fig. 3. Filippo Juvarra's atelier, *Fondazione Nuova* Sacristies, 1717. BNTO Ris. 59/22 f27. Ministero della Cultura. Biblioteca Nazionale Universitaria di Torino, divieto di riproduzione.

Fig. 4. Filippo Juvarra's atelier. Cross sections of the *Fondazione Nuova* Sacristies, 1717. Museo Civico di Arte Antica di Torino, Disegni Sciolti, Filippini n 17, detail. In [Pommer, 1967/2003, fig. 260]. Courtesy of Fondazione Torino Musei.

the only portion depicted in Juvarra's project, and thus could not use it as a control. What can be observed, however, gives plenty of information.
The basic principle regulating the creation of the vaults remains the same (polycentric barrel vault intersected by webs with a raised profile; see fig. 6), and the same can be said for the position of the vault relative to the shafts and for the profile of the capitals. The width of the bays remains nearly identical (7:4 feet [8]), whereas the length appears greater and no longer uniform: the five central spans [9] of the cloister determine a B-c-A-c-B climax, in contrast to the wider D span that characterizes the overall rhythm (fig. 5). Since this area is not indicated in the *Fondazione Nuova* drawings, it is impossible say for a certainty that this was always the preferred solution.
The visible portion of the western wing of the cloister displays a series of elements routinely employed by Juvarra when characterizing more utilitarian or subordinate structures: the succession of polycentric cross vaults, and profile of the capitals (both of which can be found in the drawings); as well as the elision of the sharp angle (here displayed in the pillars),

Fig. 5. Church of San Filippo Neri in Turin, cloister, 2023 (photo by the author).

Fig. 6. Church of San Filippo Neri in Turin, cloister vaults, 2023 (photo by the author).

and the framework of the windows of the first floor of the cloister traced in a dashed line by bricks in relief [10].

Parametric rendition of the cloister

The cloister constituted a peripheral portion of the model of the *Fondazione Nuova*, which I built in *Rhinoceros* as part of my PhD Thesis on the subject of Juvarra's unbuilt projects (2024). Therefore, the built cloister, and its present configuration, were necessary as a starting point to try and envision what they may have looked like had the *Fondazione Nuova* been built.
I soon realized that it presented characteristics that made it ideal for parametric reconstruction: the spans varied but at the same time presented clear constraints, in the form of the longitudinal barrel vault and the height of the crown of the archways towards the courtyard, which needed to remain the same even as the other characteristics of the bays and archways varied. It is possible to identify four distinct stages in the parametric rendition of the bays of the cloister:
1. the starting point for the reconstruction of the cloister was tracing *C1*. Adjusting the profile in n27 to the total width of the survey (7:4 feet), the minor axis becomes 2:6 feet. The compass holes for tracing the two smaller circles are clearly visible in the drawing, which places their radius at 2:2 feet. By interpolating this measurement with

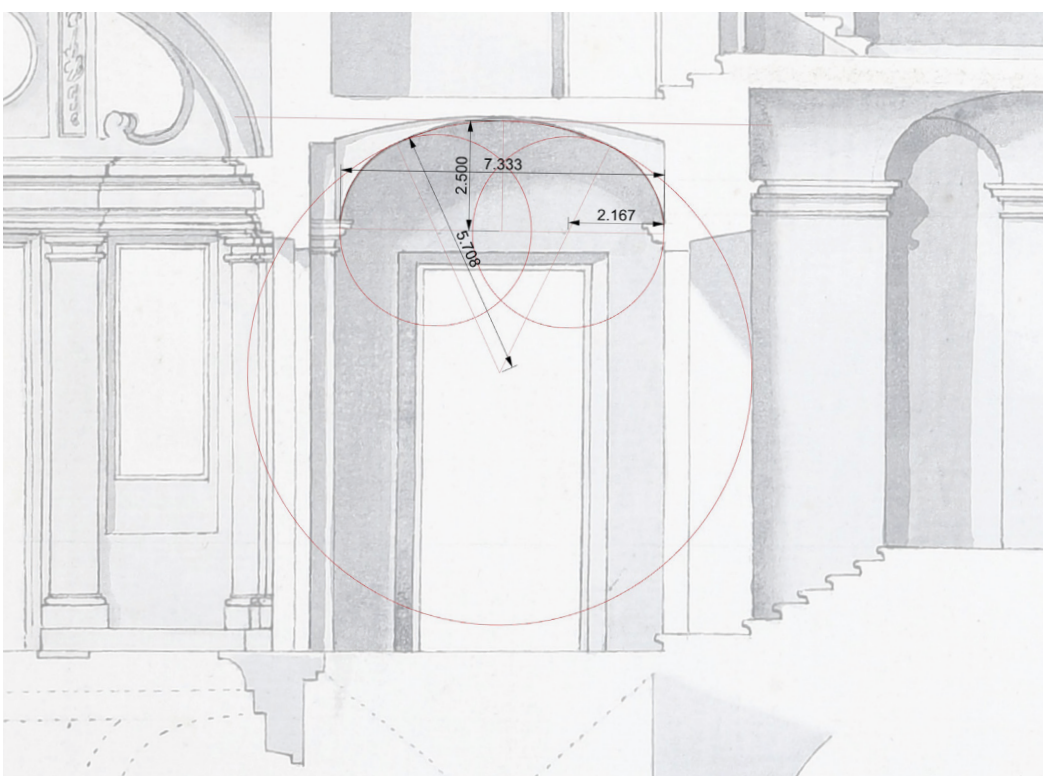

Fig. 7. Curve *C1* over figure 3 (drawing by the author).

the length of the minor axis we obtain the measurements for the smaller circle, 5:8:6 feet. This is the measurement of the entire barrel vault running flush to the side of the church (fig. 7);
2. however, I soon realized that partitioning the portico into individual bays would lend itself better to the use of parametric tools. The curve *C1* was transposed into *Grasshopper* and extruded for the length of a random bay (*S1x*). I then proceeded to use the two given constraints for the creation of *C2x* (the width of the bay and the height of

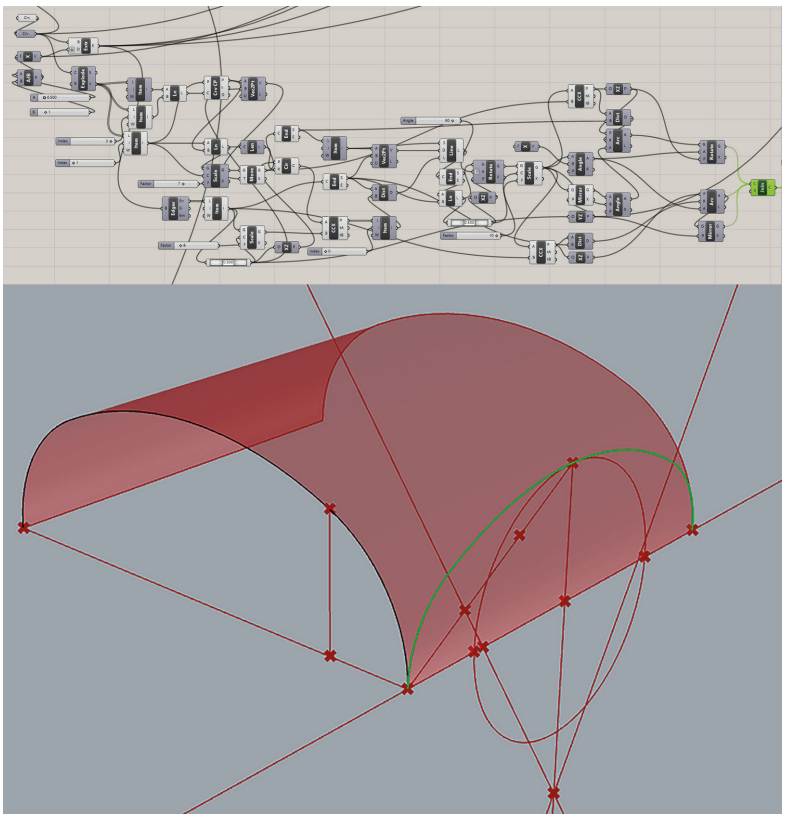

Fig. 8. Curve *C2x*,
(drawing by the author).

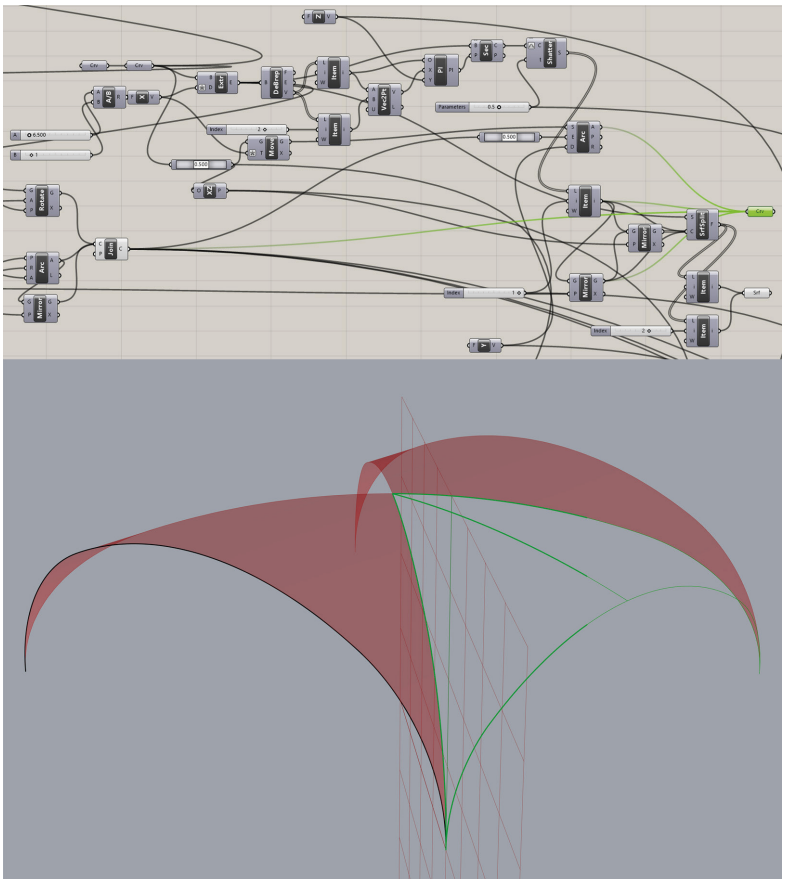

Fig. 9. Curves *C1*-*C2x* vault
(drawing by the author).

the junction between the two circles that made up *C1*, respectively the major and minor axis of the *C2x* oval) to compose a sequence that would enable me to obtain each *C2x* curve simply by altering the length of the major axis (fig. 8);
3. following that, I proceeded to cut *S1x* with vertical planes belonging to the diagonals of the bay, and use the resulting curves, along with *C2x* the arc A spanning the distance between the center of the vault and the midpoint of *C2x* (therefore an arc with a fixed span and radius, but whose position is mobile according to the length of the bay) to create in *Rhinoceros* the webs intersecting *S1* (fig. 9);
4. Grasshopper was also employed to mold the archway towards the cloister for each bay, by offsetting inwards, moving outwards, offsetting outwards, and moving inwards *C2x,* joining these offsets to one another into surfaces, and subsequently joining the surfaces together. Lastly, by creating vertical lines starting from the ends of *C2x* and

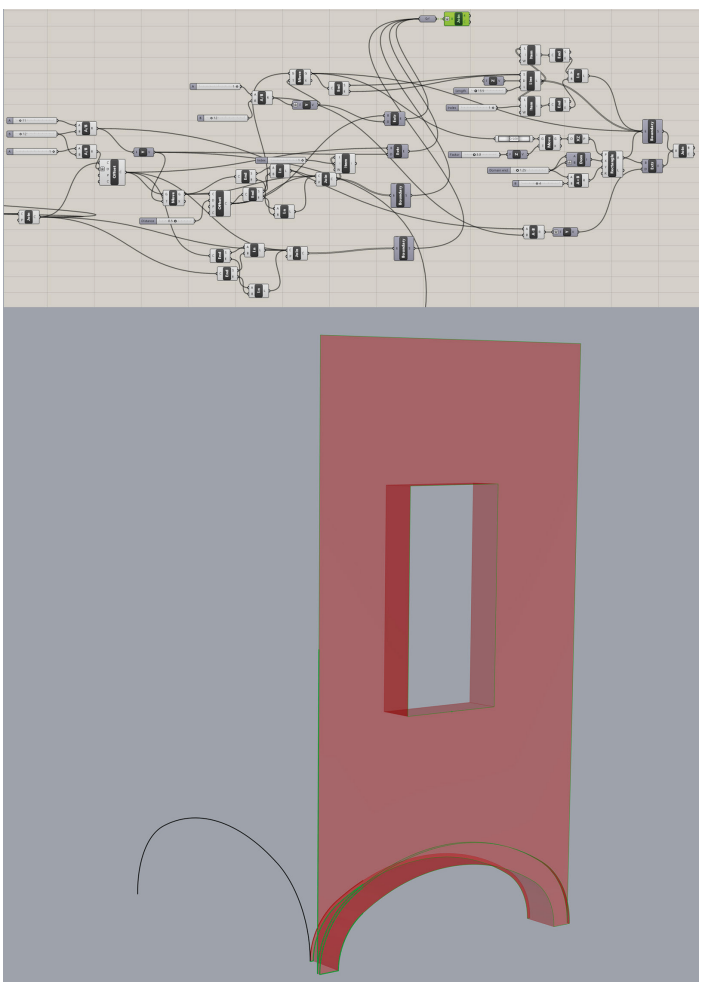

Fig. 10. Curve *C2x* archway and wall (drawing by the author).

tracing a horizontal one to their ends, placing a rectangle above the middle that shared the measurements of the windows commonly found in the building, and generating a surface between the two figures, it was possible to recreate the tract of wall above each archway (fig. 10).
This way it was possible to generate the vaults, archways, and tracts of wall corresponding to each type of bay by simply altering the width of the span. This method was employed to produce six variations on the 7:4 feet span of the north-south wing of the cloister, plus the perpendicular wings (that, being wider, employed generative curve *C3* for the barrel

Fig. 11. 3D model of the *Fondazione Nuova* (model by the author).

vault). In the succession of vaults characterized by *S1* there was however an exception in the form of the bricked-in span (*c*), which was simply too narrow (at 3:7 feet) for the polycentric *C2* to exist in that span, and therefore was made into a semicircular arc and substituted for stage 2 (since this span follows a completely different scheme, the remaining stages do not apply).

Notes

[1] On the timeline of the events surrounding design and construction of the church, see Chevalley 1942; Pommer 2003; Comoli Mandracci 1967; Di Macco 1995; Bonetti 2012. See also De Matteis 2024, chapters 2-4. The most comprehensive account of the funding and construction process remains that of Chevalley, with Di Macco making the most significant integrations.

[2] In 1727, the altar, which previously occupied the center of the chancel, was moved against the back wall (see Di Macco, 1995). ACOT, Memorie dei padri della Congregazione, Padre Gio. Domenico Perardi, Biografia, Anonimo, in Di Macco 1995, note 43: "[*i quadri*] e che col tempo dovessero servire alle cappelle della navata della chiesa da compiersi con forme i dissegni dell'Abbate Primo Architetto di S. M. più volte nominato". The wording here seems to refer to a concrete design, and since Juvarra would not start working on the new project until 1730, the *Fondazione Nuova* is the only one the text could be pointing towards.

[3] BNTO Ris. 59/22; 59/22add. Isolated technical drawings can also be found in BNTO Ris. 59/1; 59/17; 59/19; 59/20 Sketches of the designs for San Filippo in Juvarra's own hand can be found at Museo Civico di Arte Antica di Torino, vol. I-II. Moreover, the MCT also holds a series of five original technical drawings of the built project (Disegni Sciolti, Filippini n13-17), permanently loaned from the Congregation archive.

[4] On the urban renovation of Turin in the Early Modern Age, see Comoli Mandracci 1983; Pollak 1991. On the ties between the Congregation of the Order of San Filippo Neri in Turin and the court, see Di Macco 1995; Silvestrini 2009.

[5] On Tavigliano's apprenticeship with Juvarra, see Cattaneo 2021. On Tavigliano's role in the preservation of Juvarra's drawings, see Giaccaria 2001; Dardanello 2011.

[6] According to the documents in Pommer [1967] 2003, *Appendice* VIII, it appears that construction works on the church pre-1723 mostly had to do with demolishing the unserviceable structures of the old church and clearing the debris; re-housing the burials to make room for the enlargement of the foundations that Juvarra's project would require; and of course the provisional church (built 1720-1722). Related expenditures: wooden model of the *Fondazione Nuova* (1718), paintings to be placed inside the church. So it seems that in 1717-1723 nothing of the *Fondazione Nuova* was actually built aboveground.
[8] Museo Civico d'Arte Antica di Torino, Disegni Sciolti, Filippini n17. Interestingly, however, only two of the three sections in n.17 were copied into Tavigliano's publication, leaving out precisely the one depicting the cloister.

[9] The Piedmontese unit was the *trabucco*, 3.086 m. A *trabucco* was made up of six *piedi* (*piede*=foot), 0.514 m; a *piede* was equal to 12 *once*; an *oncia* to 12 points.

[10] Originally the archways in this area were open towards the cloister, but they were bricked up in the 19th century Chevalley 1942; whereas the structure above them was raised by two floors (Comoli Mandracci 1967).

[11] Also found in the façades of the Military Quarters.

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