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# Borromini's Plans for Sant'Ivo alla Sapienza

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The most accessible, primary source materials supplying the raw data upon which architectural history is based often include original verbal accounts and written documents. The project as built and drawn is also consulted, but even when drawings and images are traceable to primary sources, visual artifacts do not always receive an equally detailed analysis. Careful consideration of the architect's original graphic documents, especially in comparison with the salient characteristics of built projects, when paired with a critical assessment of type, audience, and use, can yield significant new information. Drawings are devices of communication in a dynamic process, and like verbal language they are tools of conversation and persuasion that must be considered in the context of the speaker's goals and the persons to whom they are addressed. In graphic as in written material, one must assess the style and question the veracity of the information being offered.

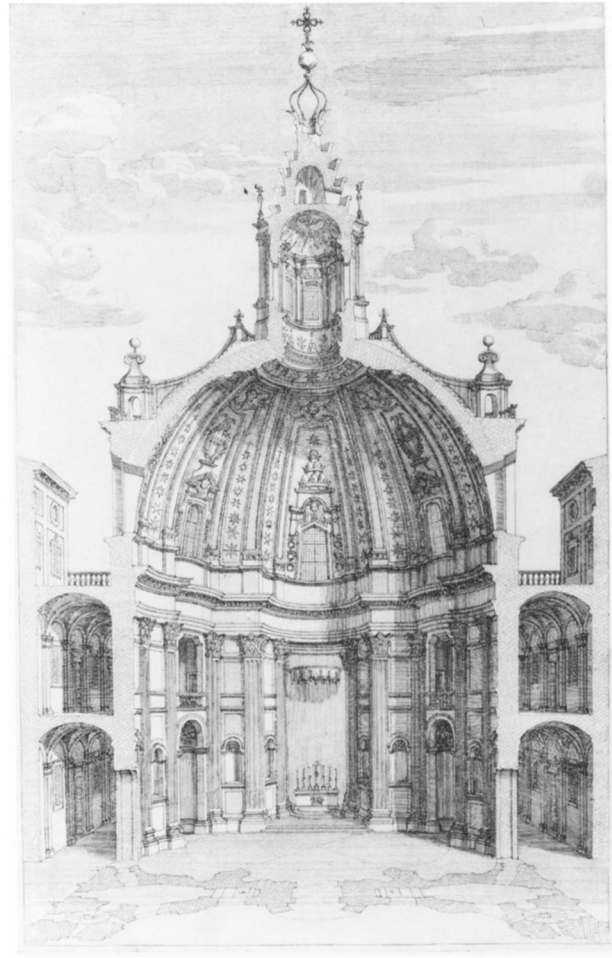
Drawings tend to follow the architectural design process in a relatively straightforward, linear fashion, proceeding from an initial set of generalized or diagrammatic, small-scale proposals of great variety, to drawings with more consistency, larger scale, and greater detail. Later, a summary of the project for publication often returns to the techniques of the earliest design period, and includes simplifications or revisions that the architect chooses for new reasons and different audiences. A particular architectural drawing can therefore be categorized by type, which

usually accords with its chronological position in the design sequence. Graphic characteristics that determine this typological categorization include the drawing's scale, the amount and kind of included information, the style and level of accuracy, and the significance and features of its details. Each drawing type—including preliminary design drawings, design development, and construction document drawings—can be identified by particular characteristics that are fairly constant and relate to the drawing's primary purpose as a document of exploration, clarification, or execution.<sup>1</sup> Any drawing may also be considered in terms of its persuasive use with a particular audience, which always includes the architect but usually extends to a variety of others. When any of the documents produced by the architect is shared with an outside audience, whether friend, client, or posterity, the drawing will develop observable characteristics of presentation.

While any architectural project, and the work of any architect, might be considered in these terms, Francesco Borromini's designs for Sant'Ivo, the Baroque church within Rome's Sapienza Palace (Figures 1, 2), provide an especially fertile opportunity. The paucity of significant written statements by Borromini and his contemporaries leaves the graphic documents as the most direct, personal account of the Sapienza's story.<sup>2</sup> Furthermore, the graphic material requires both a chronological and a typological approach, given the complex and unresolved history of Sant'Ivo and Borromini's drawings and the lack of agreement about doc-



**Figure 1** Francesco Borromini, Sant'Ivo alla Sapienza, Rome, 1643–1660; view from courtyard, looking east. Photograph by Elizabeth Meredith Dowling Lowe

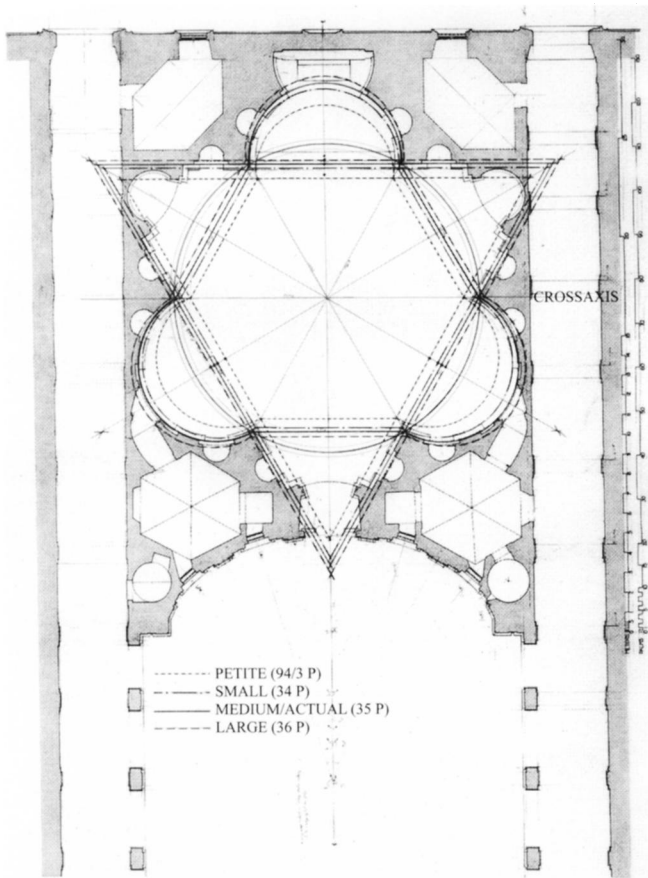


**Figure 2** Domenico Barrière, Sant'Ivo, cutaway interior perspective section with plan, 1659/60 engraving

umentary evidence and historical interpretations. Closer analysis of the drawings' graphic details supplies new information and resolves chronological questions during two crucial periods of Sant'Ivo's design history under Borromini. During the early period (1635–1640), precise graphic analysis works alone because the graphic evidence is quite limited and mostly of the same design-development type. In contrast, during the design's late period (1658–1660), Borromini's extant drawings vary among several different types, so an analysis of their purposes and audiences in their chronological context becomes a key issue in understanding discrepancies among the drawings and between the drawings and the building. The findings are summarized in two charts (see Figures 25, 26).

For the church at the Sapienza, the most important drawings are the plans made by Borromini or created under his auspices. Despite the church's intensely three-dimen-

sional character and the building's sectional transformations from ground to sky, plan conditions dominate the project. The design's vertical and horizontal axes, and the relationships between interior and exterior, are crucial conditions that the plans succinctly convey. The plans contain the most important pragmatic data for the church's site and structure, and depict the temporal experience of the building's sequential spatial unfolding as well as its conceptual geometric logic and its iconographic symbolism. Borromini used his plan drawings to control all of these conditions at Sant'Ivo, so it is not surprising that past analyses of Borromini's design almost invariably have been based upon interpreting the plan.<sup>3</sup> Usually focused upon the interior ground floor plan geometry, these analyses rightly have connected the plan with the building's core meaning, with its tectonic form and spatial character, and with Borromini's creative process and architectural intentions. No consensus has been

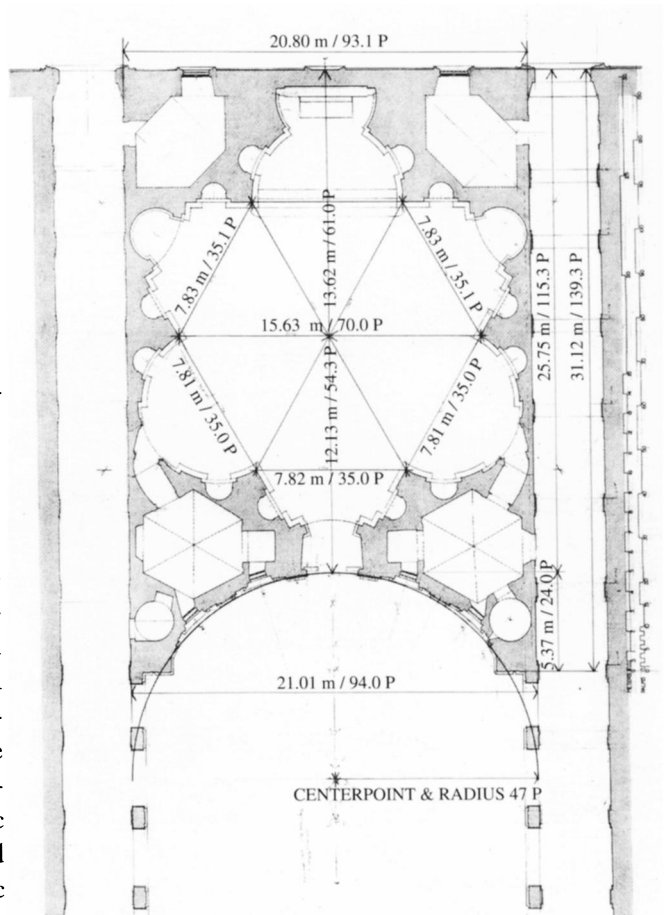


**Figure 3** Comparison of Borromini's four plan sizes: petite (94/3 palms), small (34 palms), medium/actual (35 palms), and large (36 palms). This and all other diagrams by author with James Black unless otherwise noted.

reached, however, regarding the accurate description of Sant'Ivo's plan, and two primary, contradictory proposals are current: a hexagon, most recently and fully supported by John Beldon Scott; and a single large triangle, plus apses minus angles, proposed by Joseph Connors.<sup>4</sup> This crucial disagreement continues not only because important differences exist in contemporary accounts and perceptual readings of the building, but also because crucial dimensional and geometric inconsistencies exist among Borromini's plan drawings and the church as built. A comparison of Borromini's plans in Figure 3 makes clear the parameters of the problem. As his exquisitely precise drafting techniques confirm, he deliberately drew plans of four different, specific sizes, which can be described as petite, small, medium, and large. In addition to the size change, the plans' geometric constructions are variable. The larger plans are based on determining the site's cross axis and the center point for a circle and hexagon first, while the petite plans use the

dimension of a triangle that fits the site's width. Analysis and interpretation of Borromini's reasons for these two very different approaches reveal his ideas about Sant'Ivo's form and symbolic meaning.

To establish an immutable template against which each of Borromini's plans may be judged, an accurate, detailed plan of the existing building is required, with dimensions in the Roman palm scale used by Borromini (Figure 4).<sup>5</sup> Based on my recent measurements of the existing church and parts of the Sapienza palace, this new plan demonstrates that the primary interior dimensions of the built church are exquisitely accurate: across the main space they range only from 69.90 to 70.01 palms, while the dimensions for the hexagon's sides range from 34.96 to 35.05 palms.<sup>6</sup> These measurements leave no doubt that the body of the church, as built to Borromini's design in the years 1643 to 1645, was based on a series of interrelated geometric figures sharing a common dimension of 35 Roman palms, illustrated in Figure 5: a circle of radius 35 palms, a hexagon with sides of 35 palms; added lobes with



**Figure 4** Sant'Ivo, measured, as-built ground floor plan, 1999. Drawing by Daniel Piselli and author



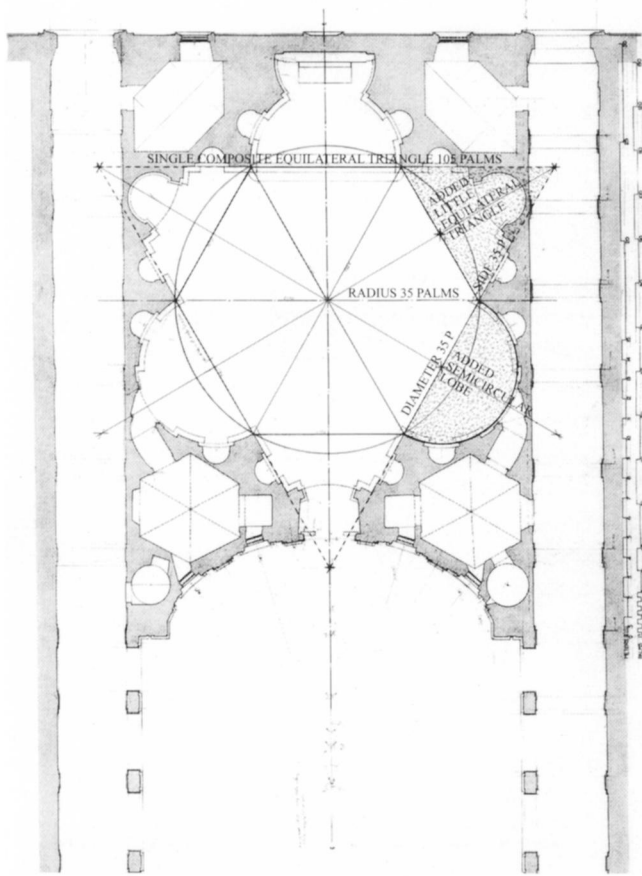


Figure 5 Sant'Ivo, as-built plan showing basic geometries of 35 palms

35-palm diameters whose centerpoints (in the two lobes adjacent to the main entry) lie precisely on the hexagon's sides, added little equilateral triangles with sides of 35 palms, giving a single composite equilateral triangle with sides of 105 palms (35 palms times 3).

The precision of Borromini's simple 35-palm geometric strategy for the church plan is remarkable in a design that fits with exquisite delicacy within the predetermined boundaries established by the site's prior development. The papal institution that would become the University of Rome was originally founded in 1303 as the Studium Urbis, but it was not until 1432 that property was purchased for its future home in the irregular city block between Piazza Navona and the Pantheon (Figure 6).<sup>7</sup> The school's facilities were gradually expanded through purchases and renovations, modifications and additions to the earlier structures, and over time the definitive physical form of the Sapienza complex emerged. The basic palace strategy, for a single interior courtyard surrounded by two levels of arcaded porticoes, had been firmly established before Giacomo della Porta became the architect of the complex, but it was his proposal of 1581 that created the Sapienza's definitive *parti* (Figure 7 and Appendix 10): a symmetrical, three-story, U-shaped palace surrounding the two-story arcaded courtyard; a main entry centered on the west façade; planned dual secondary

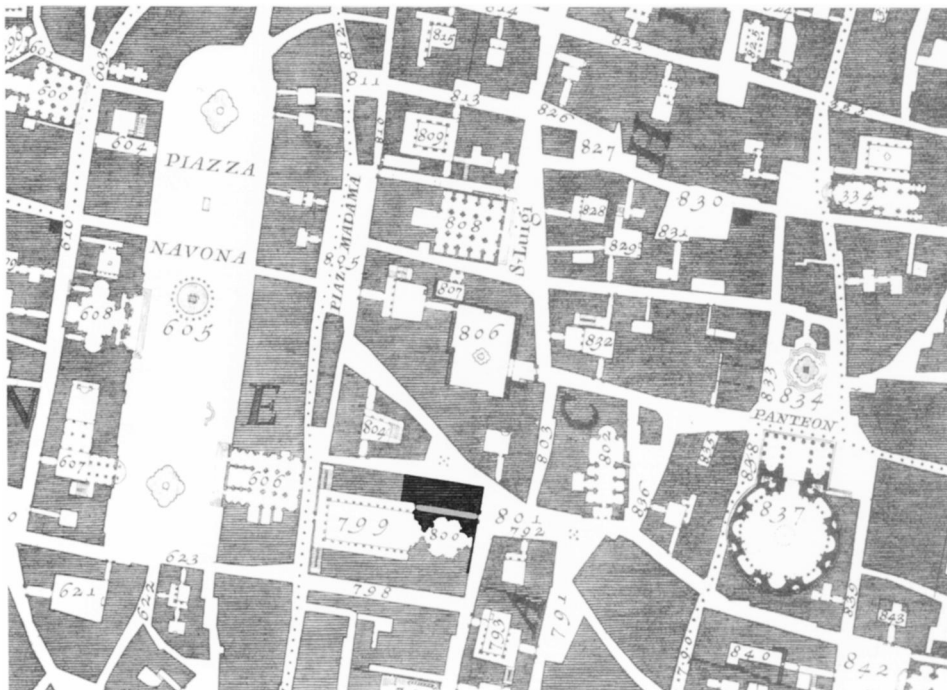
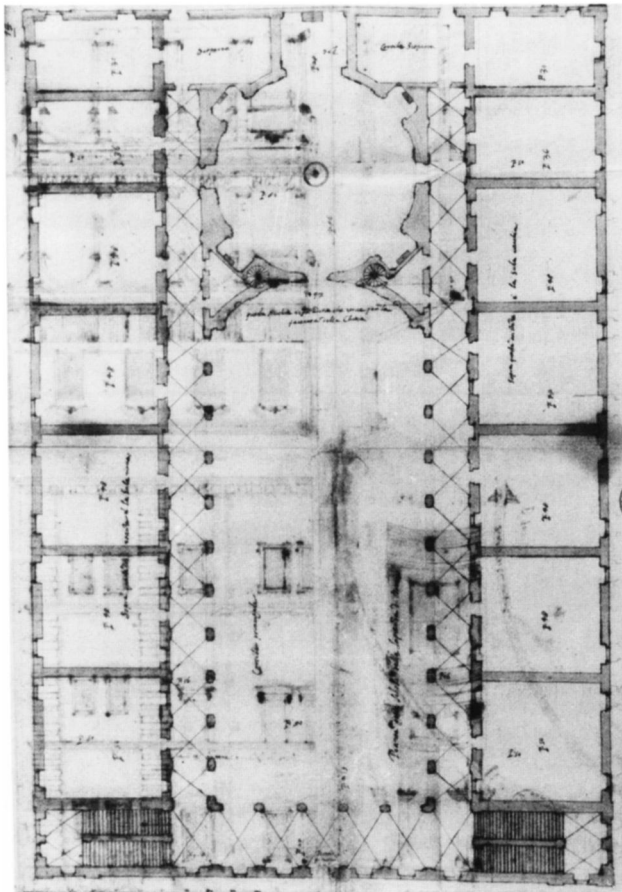
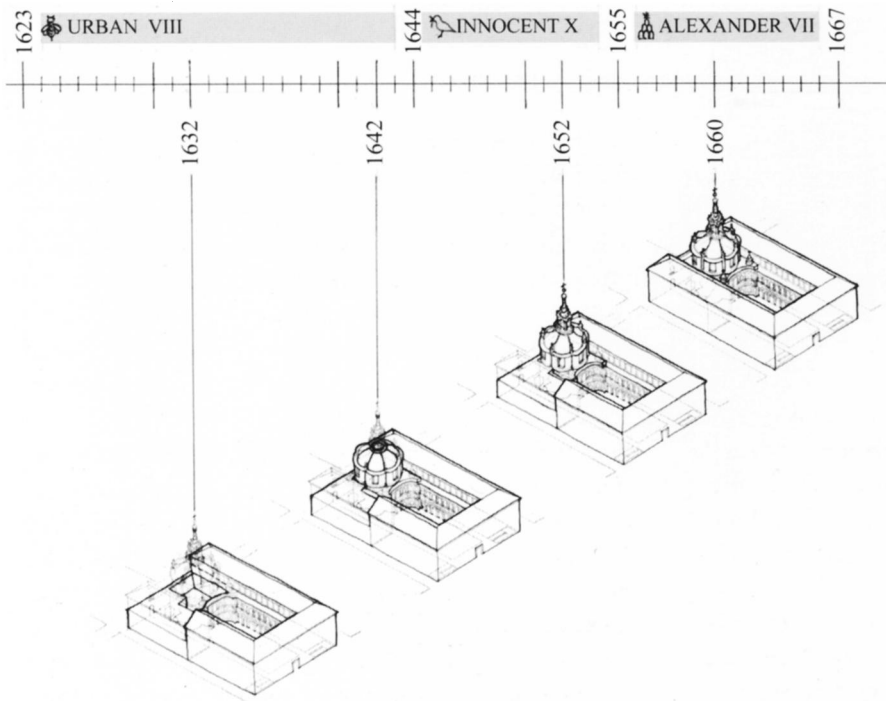


Figure 6 Map of Rome, Nolli, 1742, detail of area between Piazza Navona and Pantheon (north at top). Key: Palazzo della Sapienza, 799; Sant'Ivo, 800; Piazza Sant'Eustachio, 801; older structures remaining from 1645–1659, hatched area



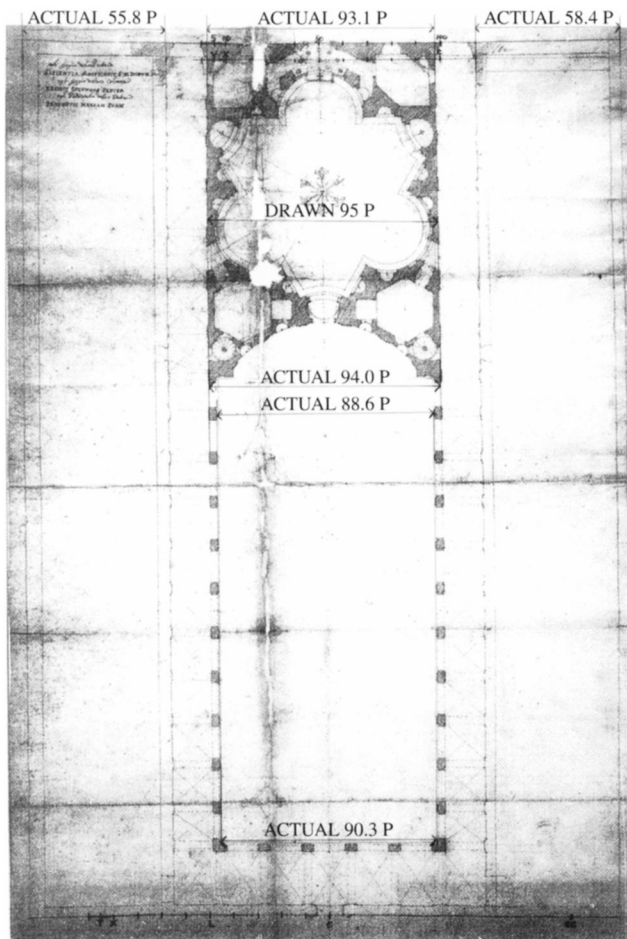
**Figure 7** Giacomo della Porta's design, Palazzo della Sapienza, drawing from model of 1581

entries from the eastern rear façade toward Piazza Sant' Eustachio; and a centralized church behind a curved exedra on the eastern end of the courtyard.<sup>8</sup> Of this, most of the palace's south wing and two-thirds of the north wing, the west entry façade, most of the courtyard loggias, and the exedra were built under della Porta between 1578 and his death in 1602. Borromini's tenure at the Sapienza, from his appointment as the institution's architect in 1632 until his death in 1667, stretched out over three successive pontificates (Figure 8). When Borromini was appointed by Pope Urban VIII Barberini, the church as well as the eastern third of the palace's north wing, the corridors leading toward Piazza Sant'Eustachio, and most of the east façade were still incomplete. During Borromini's thirty-five years as architect, design and construction of these building parts were dependent on sporadic infusions of papal interest and funds, and proceeded in a series of bursts of significant activity divided by long periods of inaction. Of those active times, Borromini was engaged in designing the church, drawing and redrawing the church's plan, during just two short periods: first, when the church design was seriously pursued between 1635 and 1640; and later, between 1658 and 1660 when the church and palace were both completed.

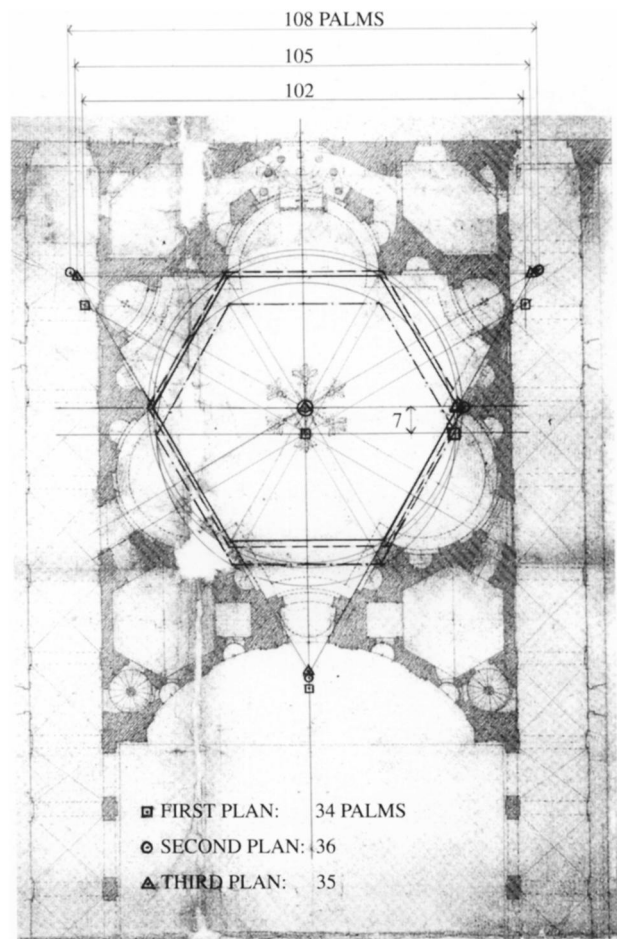


**Figure 8** Sant'Ivo, design and construction periods and patrons, 1632–1660





**Figure 9** Borromini, Archives plan, 1635–1640, comparison with actual site conditions



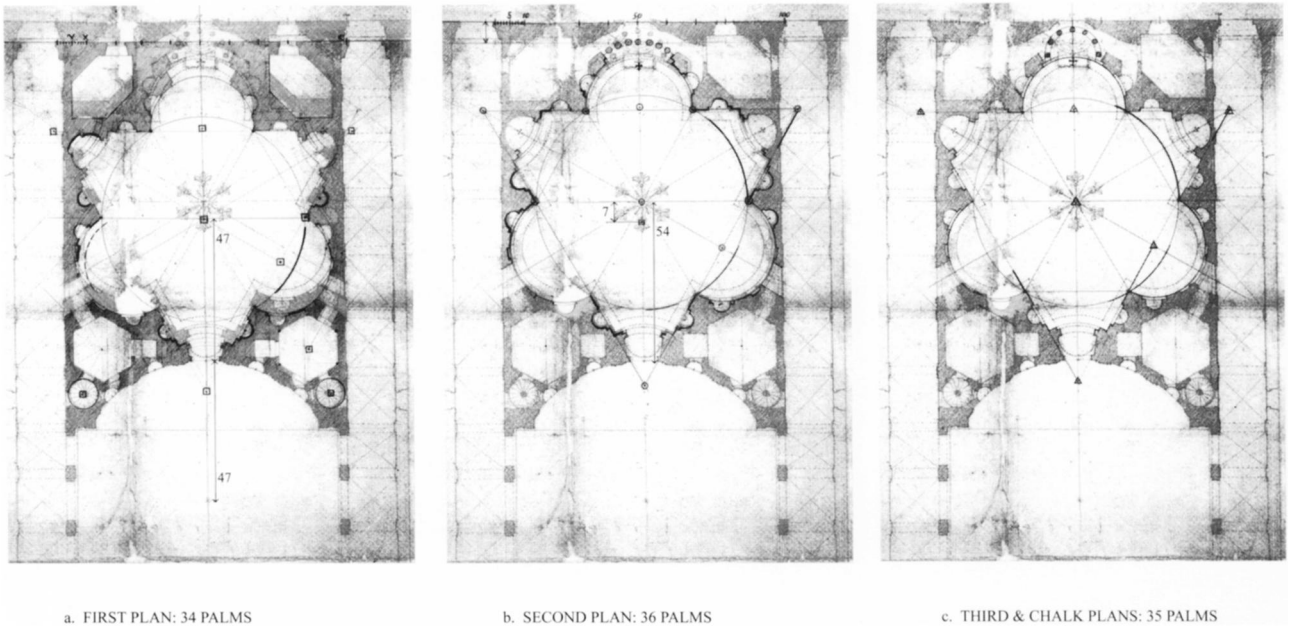
**Figure 10** Borromini, detail of Archives plan, comparison of first, second, and third schemes

### The Early Period: 1635–1640

Almost nothing is known about why and precisely when the decision was made to replace della Porta's design except what can be deduced from examining the earliest drawings, especially the famous plan from the State Archives in Rome (Figure 9 and Appendix 1).<sup>9</sup> On it, the palace plan was drawn first, merely as the background setting for Borromini's earliest known church design.<sup>10</sup> In its role as the diagrammatic context for the church design, the palace plan does not depict certain actual site irregularities, such as the narrowing of the courtyard and south portico from west to east, and the complexity of the exedra's arc, which Borromini has approximated with a single radial curve of 47 palms, exactly half the courtyard's width.<sup>11</sup> The unequal widths of the north and south palace wings, on the other hand, did merit inclusion.<sup>12</sup> Scrutiny of the church plan itself discloses four distinct layers and three different plans.

The first three plans, drawn in graphite, were each partially erased, with the third plan drawn again in red chalk. Figure 10 reconstructs the basic geometries and dimensions for each of the plans on the basis of incised guidelines, partially erased pencil marks, and compass-point holes. These marks are definitive evidence of Borromini's own geometric methods, so they are emphasized in the analytical comparison of plan geometries, dimensions, and center-point locations in Figure 11.

The first and most completely erased plan (Figure 11a), some of whose features were previously identified by Connors, is the smallest and is based on a circle with radius of 34 palms.<sup>13</sup> In this plan, Borromini positioned the church's center point 47 palms from the entry door by just repeating the exedra's drawn radius. This scheme has a geometric and dimensional simplicity that suggests it is Borromini's first drawing to scale: that is, after the initial conceptual free-



Figures 11a, b, c Borromini, Archives plan, first, second, and third schemes with construction marks highlighted

hand sketches, Borromini here was fitting the previously determined figure of the church plan into the space available, but laying it out very meticulously with compass and straightedge. He also copied the original graphic scale from the sheet's bottom edge, drawing a new, shorter scale at the top of the sheet conveniently adjacent to the church plan. This first plan already includes every major element of the final, built scheme: six primary pilasters on the hexagon's points, three semicircular lobes and three triangular areas with niches added to the hexagon's alternate sides, and four hexagonal sacristies in the four corners of the remaining site area. The second Archives plan (Figure 11b), identified here for the first time, is based on the largest 36-palm dimension. However, because the palace's east wall was incorrectly located in the base plan, the center point has been moved 7 palms eastward along the center line of the palace, to its final position 54 palms from the entry door.<sup>14</sup> Now recognizing this error, Borromini corrected it, moving the wall 7 palms east. Simultaneously, he added a new, third graphic scale on that repositioned line, marked with Arabic numerals rather than the Roman ones he had used earlier. The erased apse design using seven columns arrayed on a wide circumference, parallel to the 36-palm lobe, belongs to this stage of the design, after the east wall correction added depth to the site.<sup>15</sup> The third, definitive Archives plan utilizes the same center point as the larger second plan, but it is based on a middle-sized 35-palm circle and hexagon (Fig-

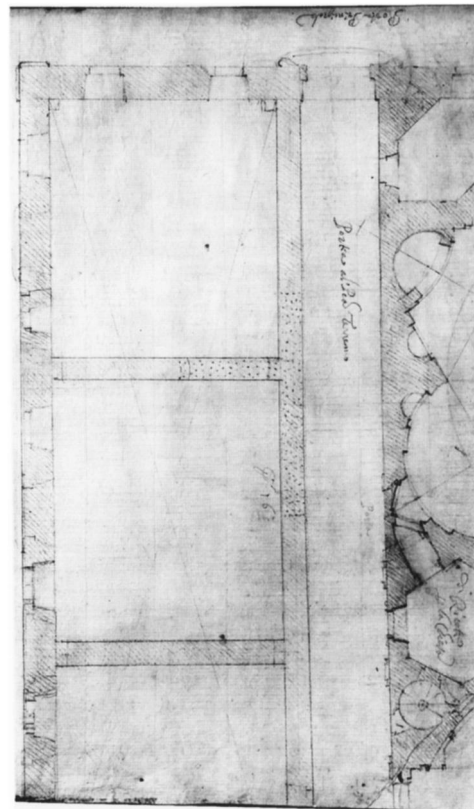


Figure 12 Borromini and assistant, Albertina 501, partial ground floor plan drawing, 1635–1640, spring 1659, and summer 1660

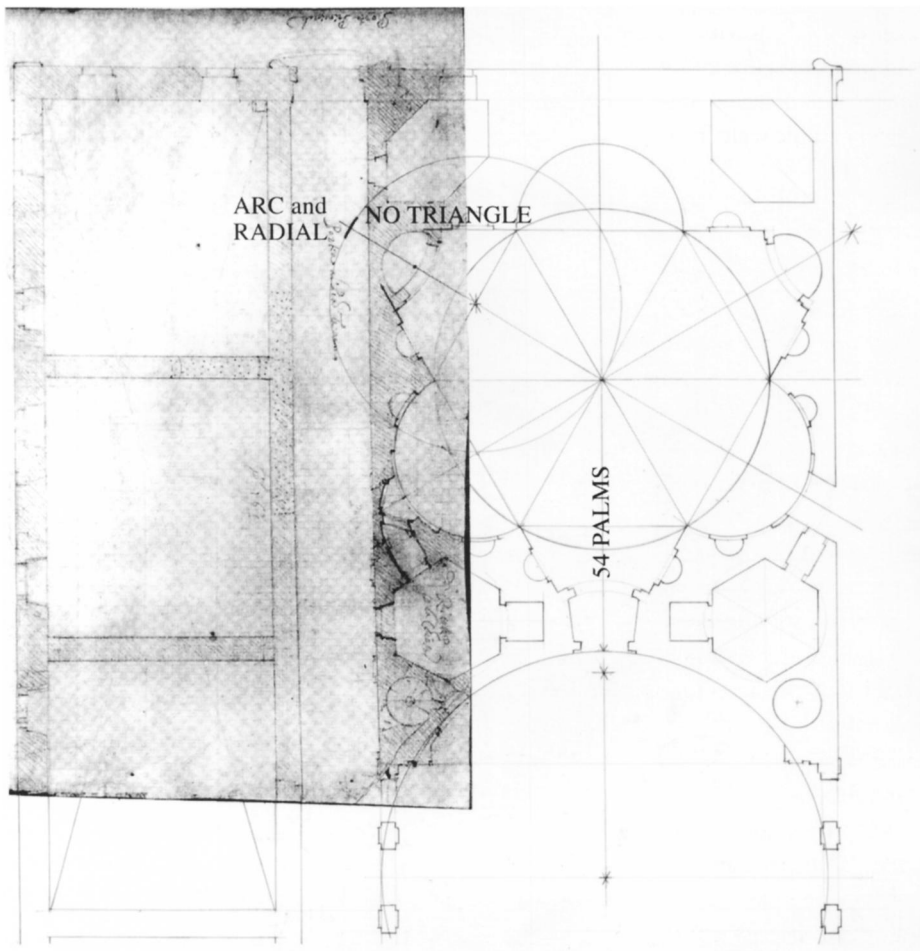


ure 11c). Borromini, in finalizing the dimensions and geometry of the plan, also modified the altar area slightly, tightening the radius of the seven columns. The graphic details, but not the architecture, of this third plan were slightly revised when it was redrawn in red chalk. Since this fourth version is a presentation document, and not a design-development drawing, its new features and importance will be considered later.

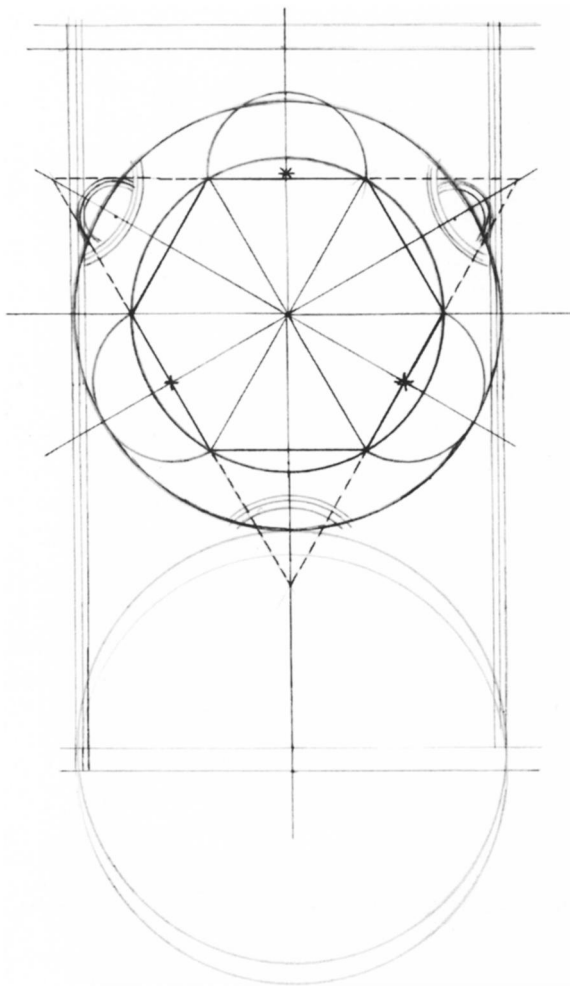
Until now, the Archives sheet has been thought to be the only extant document from the 1640 era. However, an unpublished plan, Albertina 501 (Figures 12, 13 and Appendix 3), showing part of the church and the ground floor of the palace's north wing, also originally dates from that time. Albertina 501 is the remaining fragment of a larger drawing, and it exactly matches the Archives sheet in scale. Incomplete lines on the bottom and right side indicate that the original drawing continued in both of those directions, and the right edge also coincides exactly with the fold line of the Archives sheet. Due to its 34-palm radius, generalized palace details, and superseded door and window locations,

Albertina 501 is specifically related to the earliest phase of the Archives sheet. Like the second Archives plan, however, the locations of the east façade wall and the position for the church's center point have both been moved to their correct positions. Therefore, Albertina 501 can be placed developmentally and chronologically after the first but before the second Archives plan.

Having established the sequence of Borromini's early designs—first Archives plan, Albertina 501 plan, and second and third Archives plans—his actions can be followed. Borromini first drafted the 34-palm plan on the Archives base sheet, relative to the palace's incorrect site edges. Next, realizing that the site was deeper, Borromini used a new, corrected palace plan in Albertina 501, and moved the center point of the church, while retaining the 34-palm radius. Then, going back to the Archives sheet and correcting that site plan and the church center point, he tested a larger plan with a 36-palm radius in an effort to increase the size and proportionate height of the central space. However, he almost immediately realized that this scheme brought the



**Figure 13** Borromini, Albertina 501, reconstruction with construction marks highlighted



**Figure 14** Geometric diagram of Borromini's church plan, as developed 1635–1640, and as built, 1643–1645; radius of 34, 35, or 36 palms

church's lobes too close to the porticoes and that it was structurally too daring. So in the next plan, he settled upon the median size of 35 palms. Except for changes in the altar area, and the inevitable lack of precision in a drawing at this small scale, the third plan records the church as built to an astonishingly accurate degree. The church *is* built with the 35-palm dimension; its center point *is* 54 palms from the entry door; the two lobes next to the entry door *are* constructed using the 17.5-palm radii centered on the hexagon's edge; and the apse lobe *is* slightly stilted.

Comparison of Borromini's four designs with the built conditions also reveals a consistency in fundamental geometry (illustrated in Figure 14) that does not coincide with traditional Sant'Ivo lore.<sup>16</sup> Borromini's earliest designs uti-

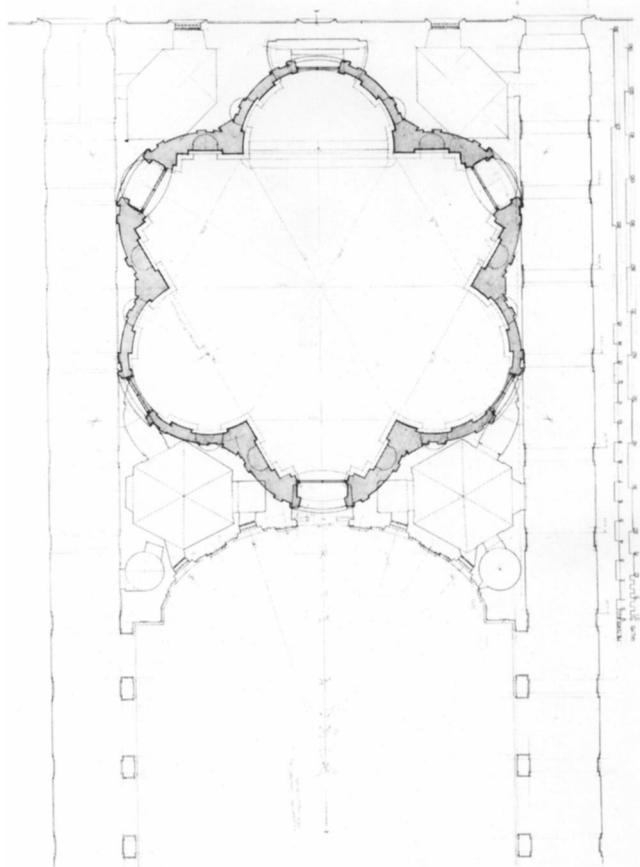
lize an initial cross axis, center point, circle and inscribed hexagon, and a simple whole-number radius in Roman palms calculated to the pilasters' points. That whole number always is the diameter of the three semicircular lobes on the hexagon's alternating sides, and the two flanking lobes have their center points exactly on the hexagon's edge, while the altar lobe does not. In contrast, the three alternating triangular areas have convex wall segments, cutting off the triangles' points, whose controlling radius changes in length for each scheme and does not equal the radius used for the semicircular lobes.<sup>17</sup> When the hexagon's size changed, the curved elements at the triangle's points were simply made deeper or more shallow, larger or smaller, from one design to the next.<sup>18</sup>

On the other hand, a slight but significant modification in geometric strategy shows that Borromini's ideas about the church's form did evolve during this period. Here the evidence of the Albertina plan is crucial in determining Borromini's earliest geometric *parti*, because in that drawing the drafted guidelines were not erased, as they were on the Archives sheet. As Figure 13 highlights, the position of the compass-point hole out in the north corridor in the Albertina 501 plan is established by an arc, still visible, swung from the edge of the hexagon along the radial line. The compass point's position clearly occupies a location generated from the initial circle and hexagon, and it is being used only to create the convex inward curve of the added triangular area. Albertina 501 does not contain a single large triangle whose compass point out in the corridor preceded the hexagon. However, in both of the later (second and third) Archives plans, Borromini *did* extend the lines of the hexagon's sides to create the small triangles added on to the central hexagon, which in turn creates a composite figure of a single triangle (Figures 11b, 11c). In the two later schemes, that triangle, with its points hovering beyond the site's actual boundaries, *has* achieved a certain subtle presence, but only as a secondary figure. Along with the switch to using the Albertina sheet, the addition of this large triangle and the other primary changes that occur between the first Archives plan and the second and third plans signal a new direction midway through the design sequence.

The design modifications suggest the intrusion of outside forces into what thus far has been treated as Borromini's self-directed monologue. Certainly, control over the commission and its design and resultant fabric did not rest unilaterally in Borromini's hands. The daily and detailed governance of the university's pragmatic affairs and its Sapienza facilities was administered by papal appointees to a directing board, the Collegio degli Avvocati Consistoriali. This committee of approximately twelve lawyers often

played significant intermediary and advisory roles in design decisions, as is attested in contemporary documents.<sup>19</sup> It is reasonable to assume that the Consistorial Advocates, and perhaps Urban VIII, were asked to react to the first design on the Archives sheet. While that drawing was out of Borromini's hands, he continued to develop the project on the Albertina sheet. When the Archives sheet came back, with the clients' approval but also with additional iconographic suggestions and requests for small pragmatic changes, Borromini erased the first plan, transferring the corrected center point and rear-wall data from the Albertina sheet. He then proceeded to the detailed and time-consuming design modifications that are contained in the last two, very similar Archives plans, which differ significantly only in their size, and which both now contained the secondary, composite triangle and the seven-columned apse. The question for Borromini had become one of determining the precise dimensions and details of a scheme, not the invention of its major form or ideas. Finally, he presented the design to the clients again in its red chalk presentation format. The Archives sheet was retained thereafter by the university, which explains its continuing survival, as well as its lack of subsequent revisions: it stood as the university's official document for Borromini's project and predates the building's actual construction.<sup>20</sup>

The sequential manipulations in the earliest plans are understandable already as rational, accurate responses to the site boundaries, where the 94-palm width between the north and south porticoes sets one of the crucial limitations on the plan's interior dimensions. However, the full story of the design's development must also include the exterior dimensions of the hexagonal dome and drum above, especially in relation to structural requirements. Previous analyses have depended primarily on the Archives sheet's ground level plan, which makes the building appear to be a spatial void carved from a solid, with a continuous, undulating wall surface. But when the upper-level plan as built in 1643–1645 is re-created in Figure 15, the church looks much more like a buttressed, hexagonal frame structure whose six primary piers simultaneously trap, squeeze, and support a thin, shell-like dome.<sup>21</sup> The structural and conceptual importance of the six piers is verified by the original construction records, which specifically describe the church foundations built in 1643 as a series of six, irregular L- or V-shaped pieces forming the church's six angles, with the two pieces on the cross axis built first (Figure 16). The completion of the ninth foundation section created “the sixth angle of the Church, in order to make the hexagonal form.”<sup>22</sup> The church was not designed to act structurally as an equally loaded, bearing-wall building. The six primary



**Figure 15** Reconstruction of upper-level plan and Barberini drum as built, 1644/45

piers, buttressed by diverse building elements appropriately positioned along the hexagon's six radial axes, extend upward three-dimensionally to the dome's oculus as thickened ribs, while the relatively thin wall areas in between are freely pierced as desired. Figure 17 illustrates the design as it was built in the 1640s, when the interior wall at piano nobile level was considerably more perforated and the structure's frame was more apparent, inside and out.<sup>23</sup> Because the piers are the primary structural elements, Borromini made the unusual and otherwise puzzling decision to base the geometry and dimensions of his plans on the piers' pilaster surfaces rather than on the wall surfaces between and behind them. This interior dimension takes precedence over the exterior dimensions because it is also crucial for figuring the dome's span, for setting out the building dimensions on the site, and for regulating the interior elevations, which had to be treated more rigorously than the drum's exterior dimensions. Borromini's point-loaded strategy had numerous advantages. It brought the major weight of the six-lobed dome down to a set of bearing areas on the



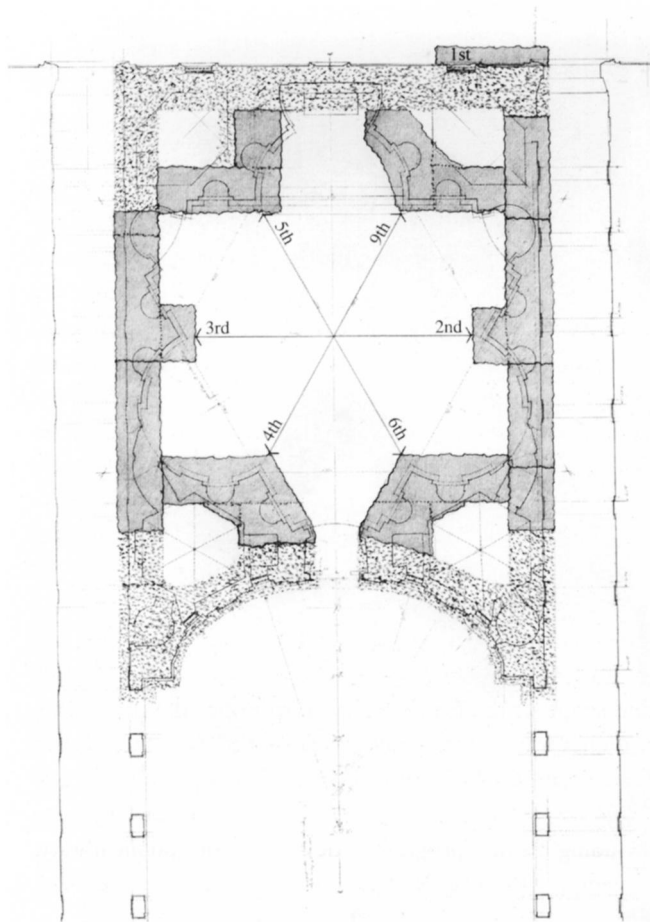


Figure 16 Foundation plan of six piers as built, spring 1643

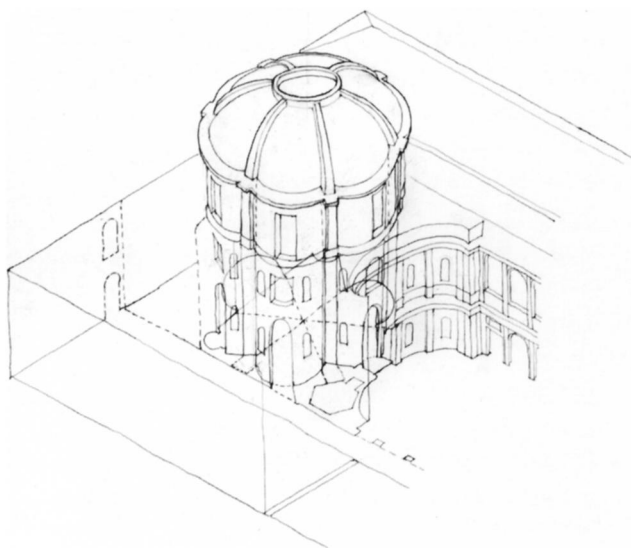


Figure 17 Isometric of structure and interior, drum, and roof as built, 1643-1645

ground that fell comfortably within the constricted available site, while up above it allowed Borromini to increase the size and visual impact of the dome by pushing the thinner membrane walls outward to their absolute maximums. The precise reconstruction of the upper-level plan of 1645 (see Figure 15) verifies that the outer surfaces of the dome's lobes extended exactly to the portico walls on either side, so that none of their weight rested on the loggia vaulting below.<sup>24</sup> By decreasing the thickness of the dome's shell in the curved lobes to its absolute feasible minimum, Borromini could also limit the wall thickness in the three triangular lobes.<sup>25</sup>

The importance of attracting the eye to the upper exterior form of the church can scarcely be overemphasized. As all of those involved in the new design would have known, it was the church's drum and lantern that would become the most important image of the Sapienza in the pope's city. In the building records, the drum and roof are described as the "six-petaled rose," stressing the symmetrical appearance of the drum's exterior form and its emblematic character.<sup>26</sup> This six-part division of the upper, outside surfaces must have driven the initial conception of the building and the plan. Borromini's perspective sketch, underscoring his attention to that form before 1652, depicts the drum and ribbed dome, lantern and spiral, as they would appear from the courtyard (Figure 18 and Appendix 6). As the sketch shows, before the imminent design and construction of the *porticelli* (the arched "gates" above the drum pilasters) and the roof's countercurving buttress ribs, the six divisions of the drum continued more prominently and directly up to the still open oculus.

The church was a structural shell, complete only up to the main entablature inside, when Urban VIII died on 29 July 1644, but his appointees, the Consistorial Advocates, oversaw the completion of the Barberini drum and dome up to the lantern opening. That construction was completed by 1645 in accordance with Borromini's original design, but the church was uninhabitable since it lacked a lantern, windows, and final finishes.<sup>27</sup> The new pope, Innocent X Pamphili, who like Urban VIII was more concerned with imprinting his image on the skyline than on creating a usable interior, financed the lantern and spiral, which were built between March 1652 and May 1653. Borromini made no new ground plans for the main structure during Innocent's reign, because the "tempietto" did not seem to call for changes in the church below.<sup>28</sup> Its additional weight precipitated cracking in the dome beneath it, however, even though the *porticelli* and thicker ribs were added, as was an iron chain at the drum's base.<sup>29</sup> The problem apparently was exacerbated by the still unfinished porticoes and hexagonal



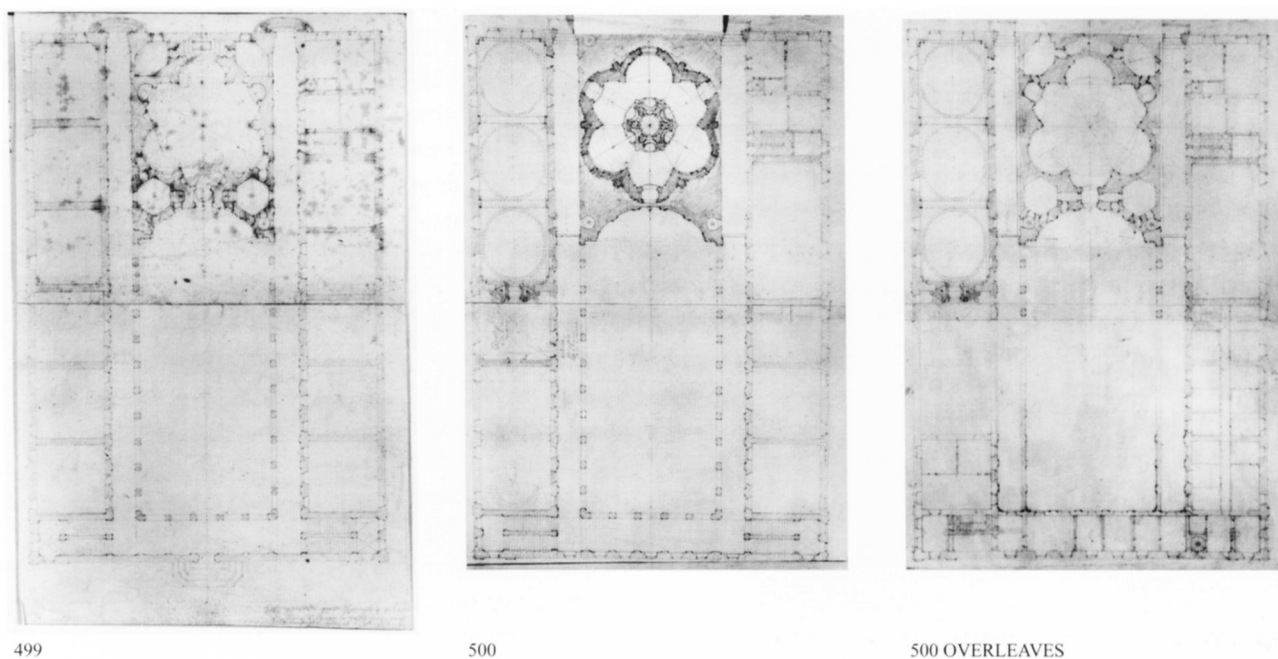
**Figure 18** Borromini, detail of Albertina 518v, perspective sketch of the church, 1652

rooms on the north, and although six foundation pieces below the planned portico were completed in summer 1653, by 1655 nothing more had been accomplished.<sup>30</sup> In that same year, Innocent X died and Flavio Chigi was elected, as Pope Alexander VII, but it was not until 1658 that decisive action was taken that would create a flurry of new drawings and new construction.

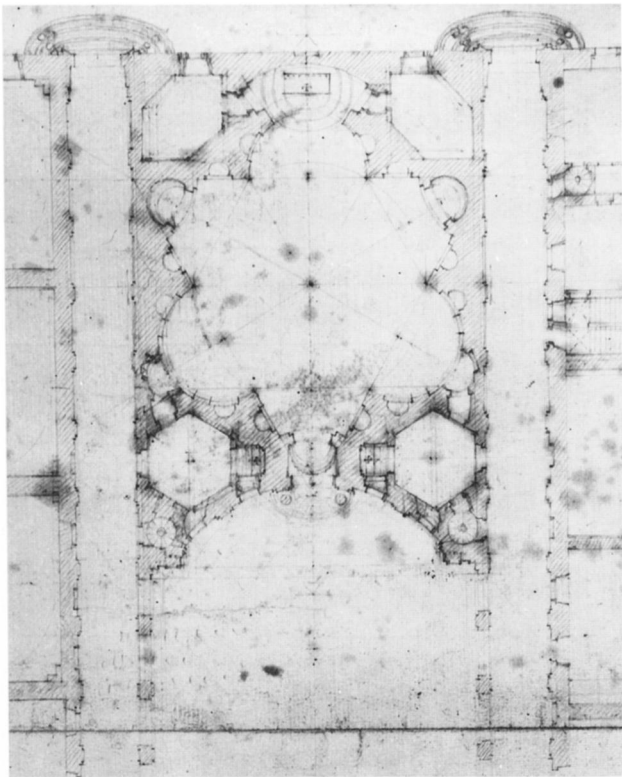
### The Late Period: 1658–1660

The graphic and documentary evidence from the years from 1658 to 1660 has not received the close, careful attention of the earlier active periods, but it has crucial implications for understanding Borromini's uses of drawings and his changing ideas about the church.<sup>31</sup> The interpretation of the various and extensive graphic documents datable to this period is difficult, even when limited to the plan conditions, because the chronology of the documents and the construction history is extremely complicated. Many of the drawings have been modified or reused, resulting in several layers, and each drawing often served more than one audience and function. Here, only a basic chronology and description of the drawings and documents will be given.<sup>32</sup>

The smallest and earliest plans, begun in November 1658, are the Albertina set 499 and 500 and the later 500 overleaves, showing the three successive floor levels of the church and palace (Figure 19 and Appendix 2, a-c).<sup>33</sup> Only the two full sheets were drawn initially, to explain the ideas and scope of the proposed work to Pope Alexander. In a presentation to Alexander, made by the Advocates Carlo Cartari and Carlo Emanuele Vizzani, an appeal was made for sufficient funds to complete the palace's north wing, now including the new programmatic element of a public library, as well as the completion of the north portico, the east



**Figure 19** Borromini, Albertina 499 set (499, 500, and 500 overleaves), plan drawings of first, second, and third levels, 1658, modifications 1659 and 1660



**Figure 20** Borromini, *Albertina 499*, detail of church, ground floor plan, 1658, modified 1660

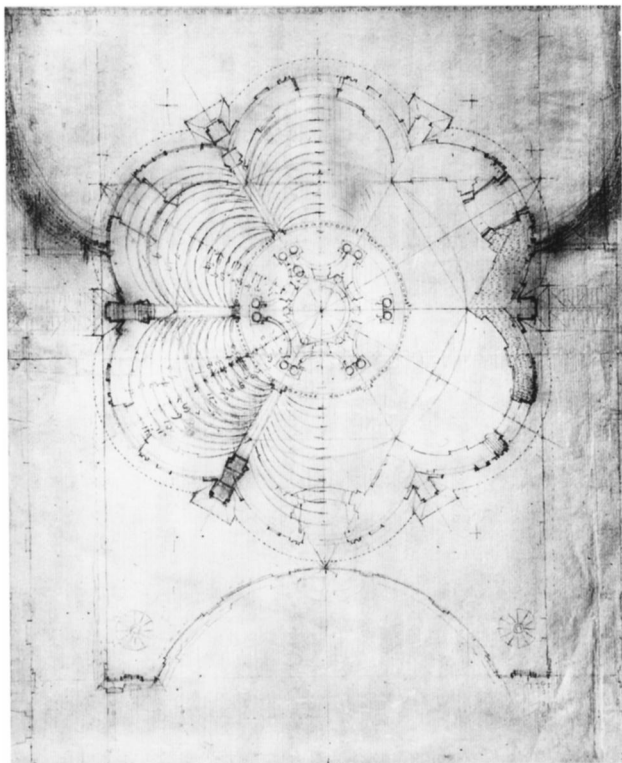
façade and entry on Piazza Sant'Eustachio, plus the church and its hexagonal spaces on the north side.<sup>34</sup> These changes would have several salutary results: the smelly, rowdy businesses still surrounding the church to the north and east would be removed, and Alexander's generosity to the struggling papal university would be advertised on an urban scale.<sup>35</sup> The drawings *Albertina 499* and *500* depict the two lower levels of the entire palace and supplement the large wooden half model of the Sapienza, "built excellently many years ago," that was moved from the Sapienza to the Quirinal Palace so that the pope would have it continuously before his eyes and in his thoughts.<sup>36</sup>

The many changes to the church's ground floor plan on *Albertina 499* (detail, Figure 20) confirm that here Borromini worked out for the first time the false, impossibly petite, 94-palm plan based on a triangle. He first drew a shrunken but accurate version of the built plan. Then he manipulated certain plan elements until a visually satisfying amount of hatched wall space and reasonable wall thicknesses remained. For example, he twice enlarged the niches at the triangle's points; he stilted the church's two lobes adjacent to the main entry by moving their center points

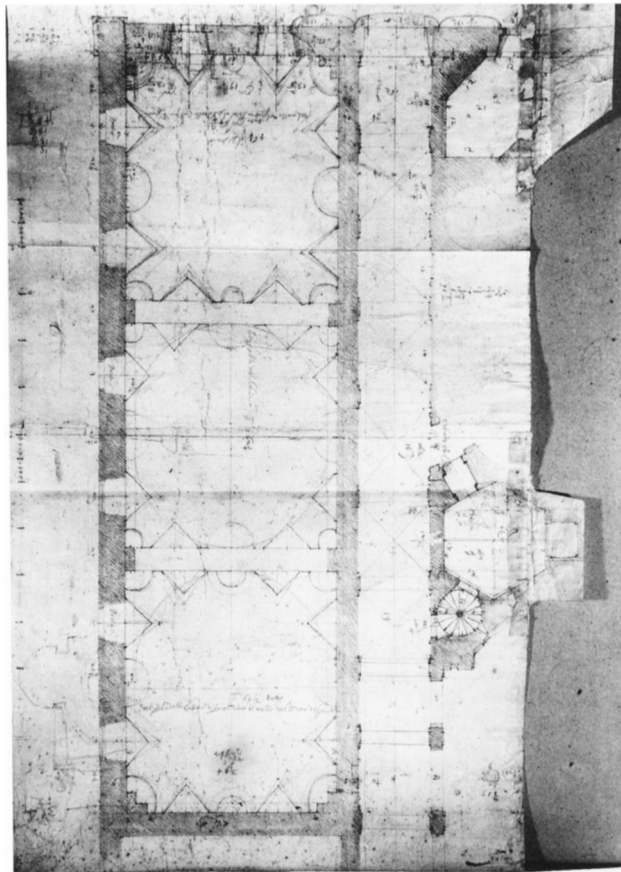
off the triangle's sides; and he changed the sizes and positions of the four hexagonal sacristies in relation to the portico walls. The *Albertina 500* matching plan was drawn next, and initially showed the piano nobile plans of both the church and palace, including the main library plan.<sup>37</sup> Alexander approved the entire project on 24 December and authorized the initial sum of 10,000 scudi on 31 January 1659.<sup>38</sup> Papal involvement, usually channeled through Cartari or Vizzani because of Alexander's personal discomfort with Borromini, would remain high during the next twenty-two months, and building progress was swift and coherent. Demolition began 31 March 1659, and by late October of the same year certain changes to the church interior were made, and the hexagonal rooms, the north porticoes, and the library were structurally complete in all essentials excepting the library's oval vaults, which would be finished in January of 1660.<sup>39</sup> Changes to the church interior, including the walling-in of the twelve niches on the piano nobile level and the opening of the additional two choir lofts to match the one over the church's main door, were made by this time. The east elevation, known from Borromini's drawing published by Maurizio Fagiolo (Appendix 7), had to be revised during the winter when Alexander objected because the first scheme would have blocked the view of the drum's new Chigi decorations.<sup>40</sup> The pope complained about it in his diary on 28 January: "M. Vizzani [sent away] with the drawing for the back of the Sapienza changed again by Borromini . . . afterward, a headache."<sup>41</sup> In May 1660, the stuccowork was being completed, although final details and last-minute changes were still being considered by Borromini, discussed with Cartari, and brought to the pope when necessary.<sup>42</sup>

By the late summer of 1659, Borromini already had revised and updated *Albertina 500*, so that with *Albertina 499* the two plans could serve a second purpose: to guide the engraver Domenico Barrière in creating a set of plates for a planned publication on the Sapienza church and palace.<sup>43</sup> On *Albertina 500*, Borromini drew over the church's piano nobile plan, substituting the church's drum-level plan and then adding the lantern plan, too. These changes resulted in the darker hatching and incompatibilities on the main *Albertina 500* sheet, so that now it combined the piano nobile plan of the palace and library with the upper-level church plans. Borromini then added a small flap over the church only, re-creating the church's piano nobile plan in a clean copy, and a larger, half sheet flap at the bottom to accommodate his design for the proposed lodgings on the uppermost floor in the palace's western half. At the bottom of the ground floor plan, his note to Barrière proposes, "From the 3 plans of this we will make 4 in





**Figure 21** Borromini, Albertina 509, plan drawing, 1659/60

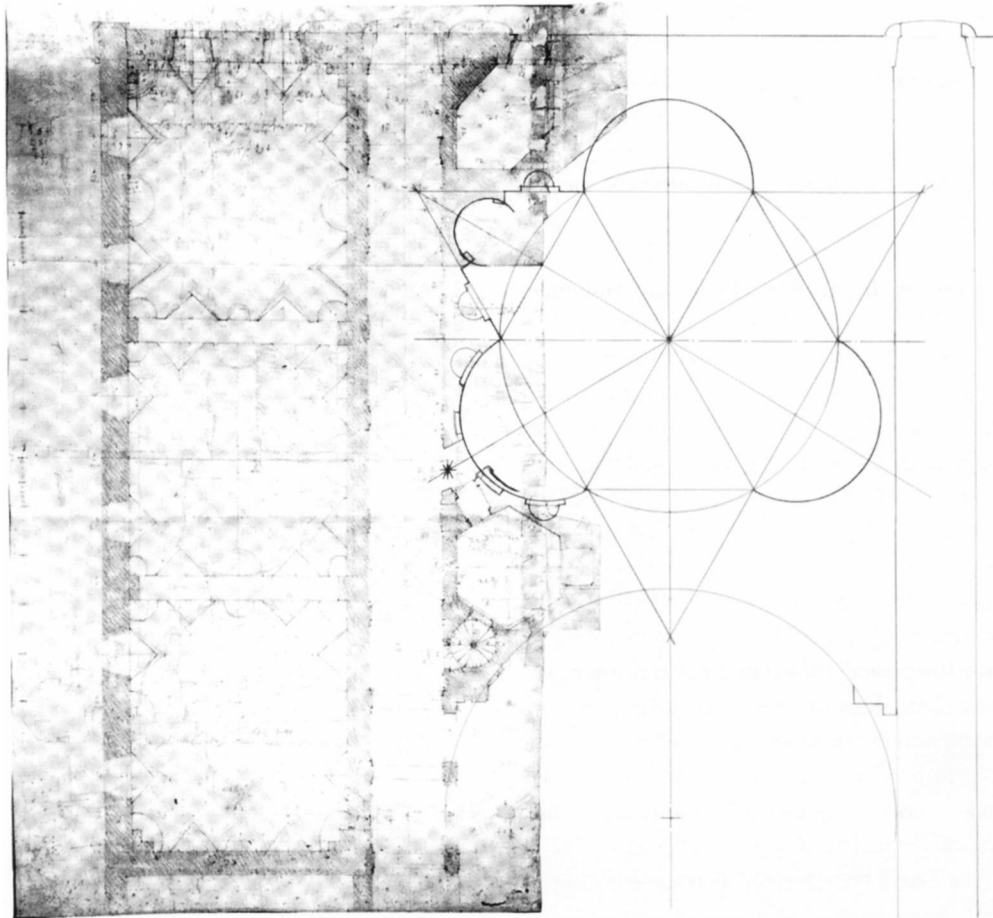


**Figure 22** Borromini, Albertina 502, partial ground floor plan drawing, spring/summer 1659

Nov[ember 1659] increasing the third plan more so that it matches well with the Carta Reale.”<sup>44</sup> The “third plan”—by which Borromini means the third-level plan of the church as redrawn on Albertina 500 to show the drum and lantern—will be increased in scale so that it will fill the same-sized sheet of paper as that used for the smaller-scale plans of the entire Sapienza palace.<sup>45</sup> This fourth drawing is in fact Albertina 509 (Figure 21 and Appendix 5), Borromini’s famous split plan of Sant’Ivo’s drum, roof, and lantern, which is a perfect larger copy of the altered Albertina 500 church plan.<sup>46</sup> Details of the drawing, which are inconsistent with in situ conditions, are purely the result of Borromini’s deliberate shrinking of the plan and adding the palace plan last.<sup>47</sup> For example, using the composite triangle with the dimension of 94 palms required the painstaking falsification of the geometry and dimensions for elements that already had been built: the roof steps are drawn narrower, the pilasters at the drum’s exterior angles and the *porticelli* above them are pushed outward far beyond their actual locations, and the drum’s exterior surface has been drawn a second time to visually increase the wall’s

thickness. The publication project was never completed as planned, but copies of three prints based on the 499 set and on Albertina 509, dating to the fall and winter of 1659/60 as pulled from Barrière’s original plates, have survived.<sup>48</sup> One of these—the cutaway interior perspective (see Figure 2 and Appendix 9)—thus provides another plan image directly supervised by Borromini.

In 1659 and 1660, Borromini again used Albertina 501 (see Figure 12 and Appendix 3), the sheet from 1638 with the 34-palm hexagonal church plan, but now it was only a fragment. As such, it focused on the palace’s north wing, and Borromini’s additions and changes to the drawing were made so that he and the clients could consider pragmatic questions, such as changing the angled passageways into the church from the porticoes.<sup>49</sup> Another partial plan, Albertina 502 (Figures 22, 23 and Appendix 4), is a complex design-development drawing of the ground floor exactly twice the scale of Albertina 501, still being modified to determine similar practical issues and to verify the final design for the workmen. Its many precise written dimensions and specific details connect the sheet to the months of construction



**Figure 23** Borromini, Albertaina 502, reconstruction with construction marks highlighted

between April and June 1659 when the foundations, walls, and vaulting of these rooms were built.<sup>50</sup> In Albertaina 502, Borromini deliberately did not draw the entire church interior; instead, only carefully selected lines and plan parts were drawn, and then some were modified to increase wall thicknesses. The last drawing from this period is the very large pavement drawing, with two possible designs on the top and bottom halves of the sheet (Figure 24 and Appendix 8).<sup>51</sup> It was to be shown to the pope on 3 November 1660, just eleven days before the dedication ceremonies of the church.<sup>52</sup> To focus on the paving design, Borromini included none of the subsidiary spaces of the church, and he cut the plan at floor height to depict the dimensions of the pilaster bases, using a somewhat simplified geometry for them. Despite these slight anomalies, the drawing includes enough information to reconstruct the interior church plan at eye height and to locate the exedra and the east wall precisely, demonstrating that the pavement drawing also is essentially accurate to the 35-palm built conditions.

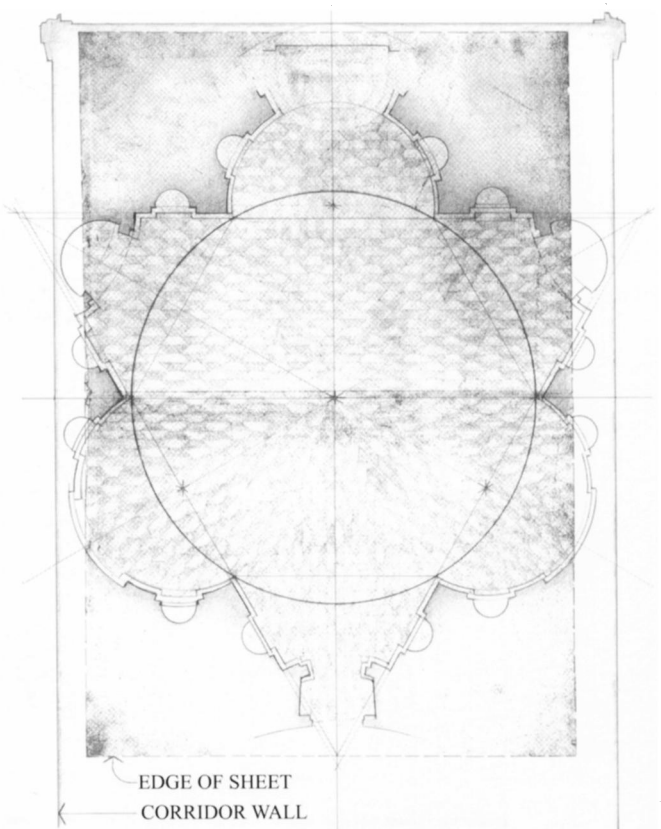
### Comparisons by Chronology and Typology

Two charts compare all of the drawings so that Borromini's actions and their motivations can be seen. In the first chart, Figure 25, the drawings are arranged chronologically by the dates of their original construction as well as their subsequent revisions and reuse. The drawings are divided into the two relevant time periods—early and late—and each plan is categorized by size as petite, small, medium/actual, or large. As we have seen, in Borromini's two sheets from the early period, all the early designs except for the red chalk Archives version were made for a single primary purpose: as preliminary designs for Borromini's own use. Since there are no major changes of audience or type, the drawings' chronology coincides directly with Borromini's changing design ideas, and the earliest designs were definitively rejected for the final 35-palm scheme that was built. In contrast to the early period, however, the chronological charting of the drawings for the late period does not result in an

order that is readily coherent. Apparently arbitrarily, during the two years between November 1658 and November 1660, Borromini developed the shrunken, false plans, but he also drew some accurate new plans while sometimes reusing the inaccurate older plan, Albertina 501. For the the late period, chronology alone is an insufficient means to explain the variations among the plans.

The second chart, Figure 26, arranges the plans by type. Now, differences due to use, client, and audience become visible, and both the early and late drawings fall into clear groupings. All of Borromini's design drawings made primarily for himself are in the top half of the chart, in either the first or second group of audience and purpose, and they show the church at either its real 35-palm size or its initial but rejected 34- and 36-palm sizes. Borromini always used accurate, "truthful" plans when he was speaking to himself as a designer, trying to work out new design options or modifications based on actual conditions. However, there is an interesting nuance in the group of accurate drawings from the late period, shown in the chart's top right quadrant. Because these drawings had a secondary use, for client presentations, none of them was displayed to the pope or the Consistorial Advocates *except* in camouflaged form. Albertina 501 reappears merely as a practical background for consideration of pragmatic changes, so the size of the 34-palm plan should have been treated as irrelevant. Nevertheless, the sheet's mutilated condition suggests that Borromini took the extra precaution of cutting off most of the church plan to obscure its size (which is very close to the actual conditions) and focus attention elsewhere. Albertina 502, the other partial plan, also omits most of the church through a combination of judicious cropping and clearly intentional omissions that leave glaring blankness where the plan should be. The pavement plan manipulates the depiction of the wall locations and the edges of the church interior, so that in this drawing, too, the church plan's dimensions cannot be judged without elaborate, very precise overdrafting.

In sum, Borromini went to great lengths in these late years to obscure the church's dimensions in the accurate drawings that were presented to the pope and his advisers. One reason certainly was that continuing structural problems made Borromini eager to hide the evidence of the church's thin walls and minimal bearing capacity. In 1652, the cupola's cracks had not been stabilized despite the installation of the iron reinforcing chain around the base of the drum.<sup>53</sup> By 1655, the cracks had become a matter of such extreme concern to the Consistorial Advocates that they delivered a formal letter to Borromini, calling on him to accept responsibility for the church's potential design flaws.

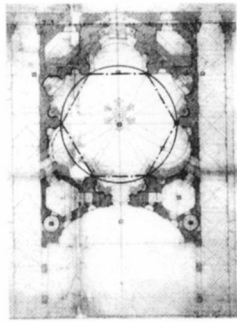


**Figure 24** Borromini, pavement plan, design drawing with reconstructed conditions, October 1660

Borromini could not know whether or to what extent the church's daring structural scheme (rather than other contributing factors) was causing the fabric's movement, but he reacted to the situation in three different ways. He drew attention first to problems that were clearly neither his fault nor under his control. In his letter of reply to the Advocates, he specifically agreed to guarantee the dome's structural integrity for fifteen years only on condition that the Advocates see to the completion of the palace's north porticoes, whose incomplete state might be contributing to the cracks.<sup>54</sup> And during on-site discussions with Cartari, he emphasized the danger of movement in the original structure due to variations in the groundwater level when the new foundations were built.<sup>55</sup> Later, Borromini made significant changes to the actual building when serious construction activity began again in 1659. The records confirm that he increased and reinforced the church's structural mass by filling in earlier floor and wall openings below the entablature specifically for structural reasons.<sup>56</sup> Because of these potentially devastating problems, Borromini went further and also worked actively to put false, shrunken plans in front

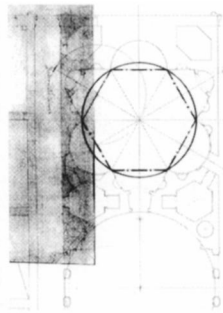


EARLY PERIOD  
1635–1640



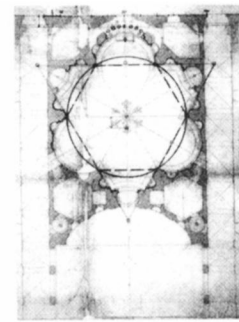
Archives First Scheme

Design  
Small = 34 palms



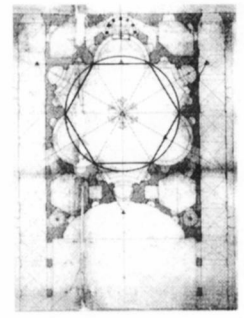
Albertina 501

Design  
Small = 34 palms



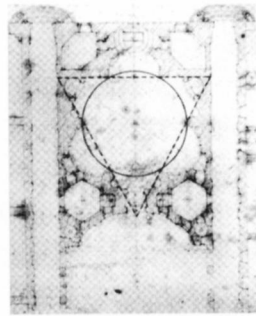
Archives Second Scheme

Design  
Large = 36 palms

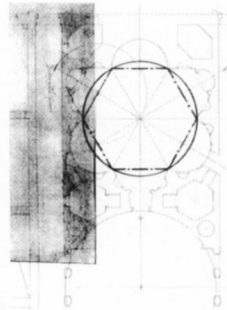


Archives Third Scheme and  
Red Chalk Layer  
Presentation  
Actual/Medium = 35 palms

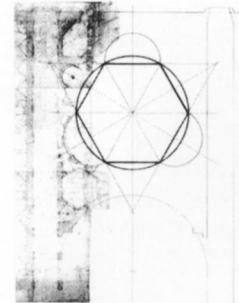
LATE PERIOD  
1658–1660



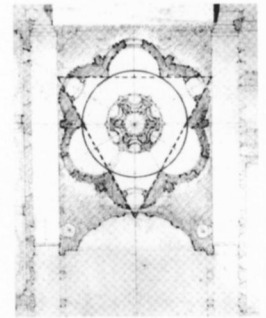
Albertina 499 and 500  
November 1658  
Presentation  
Petite = 94/3 palms



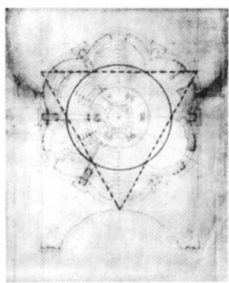
Albertina 501 revised  
Early Spring 1659  
Design and Presentation  
Small = 34 palms



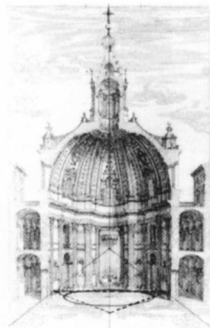
Albertina 502  
Spring 1659  
Design and Construction  
Actual/Medium = 35 palms



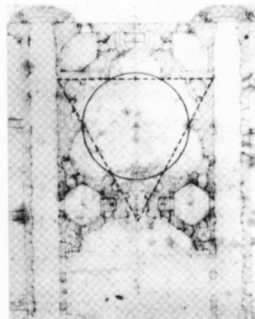
Albertina 500 revised and  
500 overleaves  
Late Summer 1659  
Publication  
Petite = 94/3 palms



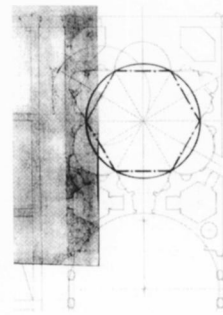
Albertina 509  
Fall/Winter 1659  
Publication and Presentation  
Petite = 94/3 palms



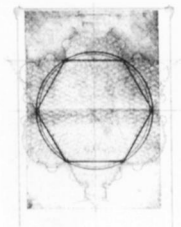
Barrière Perspective  
Winter 1659–1660  
Publication Engraving  
Petite = 94/3 palms



Albertina 499 revised  
Spring 1660  
Presentation  
Petite = 94/3 palms



Albertina 501 revised  
Summer 1660  
Design and Presentation  
Small = 34 palms



Pavement Drawing  
Fall 1660  
Design and Presentation  
Actual/Medium = 35 palms

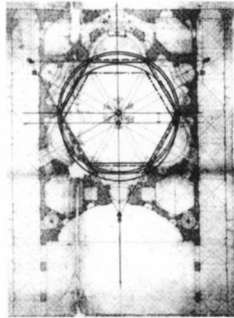
**Figure 25** Chart no. 1: Chronology of drawings with dates, primary uses, and four plan sizes

PURPOSES and AUDIENCES

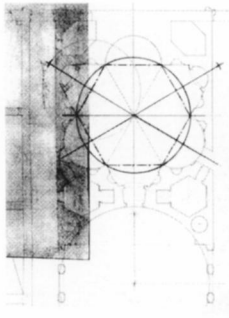
EARLY PERIOD: 1635–1640  
Pope Urban VIII (Barberini)

Group 1:  
Design Development,  
Construction Document,  
& Presentation Drawing

Borromini,  
Workmen,  
Pope and Papal Advisers

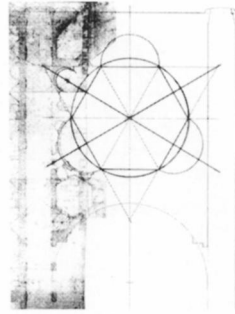


Archives Schemes  
Between 1635–1640  
Small, Large, and Medium

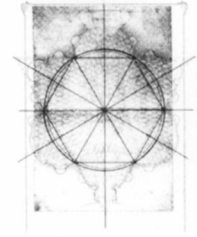


Albertina 501 (entire sheet)  
Originally between 1635–1640  
Small = 34 palms

LATE PERIOD: 1658–1660  
Pope Alexander V (Chigi)



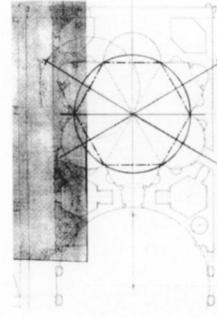
Albertina 502  
Spring 1659  
Actual/Medium = 35 palms



Pavement Drawing  
Fall 1660  
Actual/Medium = 35 palms

Group 2:  
Preliminary Design,  
Design Development,  
& Presentation Drawing

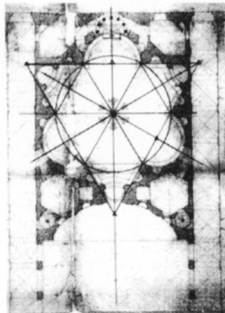
Borromini,  
Pope and Papal Advisers



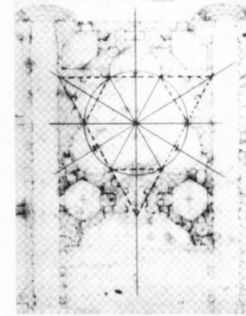
Albertina 501 (cut down)  
Early Spring 1659, Summer 1660  
Small = 34 palms

Group 3:  
Presentation,  
& Publication Drawing

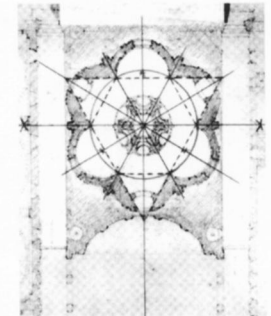
Pope and Papal Advisers,  
Barrière



Archives Red Chalk Layer  
Between 1638–1640  
Actual/Medium = 35 palms



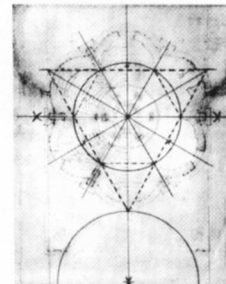
Albertina 499 and 500  
November 1658  
Petite = 94/3 palms



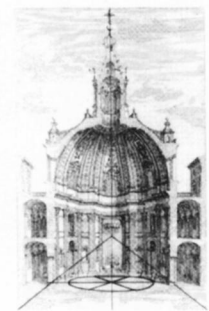
Albertina 500 (revised)  
Late Summer 1659  
Petite = 94/3 palms

Group 4:  
Publication,  
& Presentation

Architectural Critics,  
Posterity, Barrière,  
Pope and Papal Advisers



Albertina 509  
Fall/Winter 1659  
Petite = 94/3 palms



Barrière Interior Perspective  
Winter 1659–1660  
Petite = 94/3 palms

**Figure 26** Chart no. 2: Typology of drawings with dates and four plan sizes, showing primary geometric construction

of Alexander and the Consistorial Advocates. The real building's daringly thin walls and point loads, which are immediately apparent in accurate, complete plans, surely would have alarmed the clients, including Alexander, who had the interest and ability to read architectural drawings.<sup>57</sup> The presentation sheets Albertina 499 and 500 vividly displayed the newly created petite plans that made the church look as if continuous, thick structural walls safely and solidly supported it.

The new triangular geometry of the late drawings was also extremely significant in 1658. The original scheme for the church, which even in the first Archives plan had indeed referred to the House of Wisdom expressed via the Barberini hexagon, was presented to Urban VIII before 1640 in the red chalk version. In that rendering, Borromini emphasized the plan's symbolism, by adding the biblical inscription and altar instructions that specifically refer to the apse design.<sup>58</sup> He simultaneously erased his graphite construction guidelines (the circle, hexagon, and triangular extensions) while adding visual stress to the radial lines. The plan's outward, radial expansion from the center point was further emphasized, and made explicitly iconographic, by the addition of the radiant Barberini sun and six bees.<sup>59</sup> All the parties involved at the time seem to have seized upon the symbolic opportunity that this plan presented, if their statements made in hindsight are taken at face value.<sup>60</sup> In the guidebook to Rome penned by Borromini's personal friend and supporter Fioravanti Martinelli between 1660 and 1663, the Sapienza's history furnishes a written confirmation of that drawing.<sup>61</sup> Borromini annotated the unpublished manuscript, and the project's description draws attention to design elements that Borromini valued. The difficulties with the tightness, narrowness, and small scale of the church site are stressed more than once, as is Borromini's ingeniousness in creating an unusually large, grand space. The related but distinct issue of the site's crookedness, it is proclaimed, inspired Borromini, who turned an irregular, out-of-square condition to his advantage, so that the unusual "angled" plan is presented as a brilliant and necessary invention. Even in the 1660s Borromini did not object to Martinelli's description: "The church is based on the pontifical impresa of the Barberini Bee, which . . . forms a hexagonal figure." Martinelli reinforces the importance of the hexagon by immediately continuing, "counted among the most perfect by the architectural authors, [\*] and as was certainly required by the angular site."<sup>62</sup> Borromini himself added a note in the margin [\*here], giving another reason for the hexagon's appropriateness as his choice: "whence the compass is called a 'sesto,' since with a single fixed opening it embraces its diameter [radius], repeated six times in its

circumference."<sup>63</sup> Two other contemporary sources also describe the plan as hexagonal.<sup>64</sup> In contrast to these explicit written statements, no equivalent contemporaneous material supports an initial triangular *parti*.

The deliberate replacement of those initial hexagonal schemes with the geometry of the single triangle from 1658 on occurs only in the presentation drawings (see Figure 26, bottom right). The geometric change is linked directly to the change in papal patronage, and the first exaggerated triangles of Albertina 499 and 500 were used as a means of relaying to Alexander and his advisers that the building's latent Trinitarian symbolism, and connections with Chigi motifs, could be enhanced and the Barberini hexagon suppressed.<sup>65</sup> In 1658, Borromini's proposed physical changes to the church, besides alleviating the structural problems, met the new programmatic and iconographic demands of the client. Actual changes to the interior elevations, especially opening the two choir lofts to match the earlier condition above the main door, had the significant effect of emphasizing a tripartite spatial reading of the interior, and the new stuccowork completely eliminated the overt Barberini symbols from the final decorative program, inside and out.

### Borromini's Design Procedures

The magnitude of the change to the new geometry can be appreciated by comparing the inherent distinctions between a Sant'Ivo plan based on a hexagon versus one based on an equilateral triangle. The church site determines the choice of an axially symmetrical plan, but not the exact position of the geometric figure along the axis. In the hexagonal plan, the choice of the figure's center point and cross axis has to be made first. Then, the circle's radius is chosen and drawn, and the six hexagonal divisions equal to the circle's radius are marked by putting the compass point sequentially on each of the two points of the cross axis and swinging arcs to either side, above and below. This creates the hexagon's other four points on the circle's perimeter, and this exact sequence was followed when the building's foundations were laid out. To complete the church plan, the radial lines from the center point to the hexagon's points and sides are added, so that the three semicircular lobes and the three small triangles can be added alternately. The final step in the construction cuts off the triangles' points. Except for that final step, all of these operations move outward from the center. In distinct contrast, to generate Sant'Ivo's plan from a single triangle, the construction must move inward and begin with the triangle's point at the entry door, with its other two points determined by the immutable dimension set by the width of the site. Then the triangle's sides are bisected, and the radial



lines are drawn inward from the edges to derive the center point of the entire figure as a last step, in a procedure that creates the circle and hexagon merely as checks for accuracy.<sup>66</sup> In this geometric process, the location of the plan's center is unimportant, while in the church it is paramount. The triangle's position and size can never vary, theoretically, while in fact the ability to modify the figure's position and dimensions was crucial to the development of the design. The advantages of the hexagon over the single triangle are not just conceptual, however. In a plan drawing, beginning with the center point and circle provides a substantial advantage in accuracy, compared to drawing a single triangle first and then dividing its legs. And although the single triangle can be very forcefully apparent in a drafted plan, it would never have any practical utility to the workmen on site laying out the foundations and walls at full scale. Borromini's own plans consistently exhibit characteristic signs of the geometric sequence that establishes the center of the circle and the hexagon first, not only in the early plans, but in the later triangular ones as well.<sup>67</sup> Borromini preferred the original and more precise hexagonal construction, even when he was constructing the triangular plans. The hexagonal divisions and their coincidence with the circle, versus the inequalities among the lengths of the triangle's sides, makes the central construction certain. Other conditions typical of the centralized construction exist in several late drawings: radials run outward through rather than inward from the single triangle's points, and arcs are drafted to establish the hexagon's perpendicular cross axis.

Although geometric rigor was an essential component of the church's design, Borromini did not treat geometry in isolation from dimension, nor did he start with one while ignoring the other. Instead, he worked with their reciprocal nature, utilizing simple round numbers in a geometric scheme. This was Borromini's normative design process: he would begin with simple geometric figures and whole-number dimensions, which were chosen in relation to real scale and site restrictions, and then continue to develop the plan through highly precise and never arbitrary modifications of individual dimensions, in a series of delicate manipulations.<sup>68</sup> In Sant'Ivo's design development, represented by the Archives drawing, the precision of the geometric figure already was manipulated to the nearest palm. As design continued, these whole-number conditions sometimes were actually constructed in the primary centralized spaces—for example, in the 35-palm church interior and the 12- and 13-palm hexagonal sacristies. Albertina 502, which records conditions just prior to construction, shows other situations where simple dimensions and pure geometric figures became irrelevant. In the corridor and the rooms below the

library, Borromini only used whole numbers for standardized, repetitive elements such as the 3-palm pilasters, and for practical, unseen dimensions such as the 3-palm wall thickness. Total, overall dimensions in large spaces tend to be the result of an accumulation of small measurements manipulated to the  $\frac{1}{2}$  palm. In both cases, Borromini's ultimate goal is to achieve visual consistency, and that goal may or may not coincide with the retention of the ideal geometry and whole numbers of the initial, preliminary design. Cumulatively, Borromini's sophisticated and necessary choices resulted in an actual plan whose logic in visual, geometric, and numerical terms is not readily apparent.

So, did Borromini create the triangular plans because, while not literally true, they conveyed aspects of the underlying spatial logic of Sant'Ivo? After all, the church does fit both literally and perceptually between the north and south wings of the palace; it does not challenge or invade the flanking corridors spatially, as the accurate plan seems to imply.<sup>69</sup> Sant'Ivo's interior has often been described using verbs of motion, particularly relative to the walls' positions, but the movement and struggle reside more accurately in the description of Borromini's activities as he manipulated his pencil and compass to draft the plan. This is not equivalent to ascribing an active, anthropomorphic condition to the architectural elements themselves; Sant'Ivo has a calmness to it that is not comparable to the sensibility of motion conveyed by some Mannerist or late Baroque spaces, for example. Similarly, while the apparently overgrown, capricious actual plan, with its geometric armature, seems arbitrary in relation to the dimensions and geometry of the irregular palace context, the false plans clearly demonstrate that the church plan was generated in response to the pre-existing site conditions. In reality, the built plan is the masterful and better solution, but it does not appear so in plan. In this context, Borromini's false plans can be understood as didactically useful. Yet the triangular plans are false because they are a direct attempt to obscure the structural problems in the building, and to portray the design as more simple than in fact it was. Here Borromini was not just tidying up some minor discrepancy between his intentions and an unfortunate awkwardness imposed by fate, so that the basic clarity of the project would become more accessible.

One may sympathize with the reasons for Borromini's tactics in creating the false documents. In 1658, to win Alexander's support for the project, Borromini needed to present a highly rational proposal that could easily be explained. The pope's personal antipathy toward Borromini, his predisposition to suspect Borromini's competence due to difficulties with other architectural commissions, and his preference for Borromini's rival Bernini were firmly estab-

lished and widely known.<sup>70</sup> The 499 and 500 drawings provided the perfect visual media to support the presentation of the entire project for the church, library, and east façade. Their very small scale, and their lack of both written dimension and graphic scales, focused attention on the whole, while allowing the simple rationality and new symbolism of the triangular church plan to be appreciated. One year later, creating visual materials that made the church plan's geometric rationalism comprehensible to an even wider audience had become important to Borromini, and the characteristics of the 499 and 500 drawings were also ideal for that new task. The revised 499 set, with Albertina 509, would yield a publication forcefully demonstrating the geometric rationalism of Sant'Ivo's plan, despite the difficult, preexisting site conditions. The proposed publication would constitute Borromini's response to his many detractors in the public arena of Roman architectural discourse, and it would satisfy the wish that his nephew Bernardo described: "to have the magnitude of his knowledge seen."<sup>71</sup> Borromini's final version of the building, drawn in 1659/60 for that audience, is represented in the Barrière engravings, where the message of Borromini's rationalism could be conveyed through a medium that allowed and even encouraged some specific design "changes." The style and limited information in the intended engraved plans and perspective views accentuate Sant'Ivo's form idea, encouraging a simplified, geometric reading of the plan and emphasizing the perceptual image of the total composition. Even the balancing of the plan and section in Barrière's interior cutaway perspective only had to be visually convincing, which it is, rather than dimensionally accurate, which it is not.<sup>72</sup> By 1660, Barrière's perspective plan has changed again: it includes the circle and the six primary radial lines, but it does not include either the hexagon or the triangle (see Figures 2, 26). In that drawing, which conveys his ultimate and most public message, Borromini chose to emphasize the church's centrality and its radial but still clearly six-part character. For a host of reasons, he now wanted to show Sant'Ivo not as it was actually built, and not as he had hoped it would be built, but rather as he wished it to be perceived by the book-buying, educated architectural elite in 1660.

The clarification of the chronology and interrelationships of the Borromini drawings provides a clear outline of Borromini's changing ideas. His initial design from the late 1630s for a centralized church had its genesis in a hexagonal geometry connected with Urban VIII and wisdom

iconography, and its dimensions were taken from the existing site, especially della Porta's exedra. The expansion of the hexagonal frame with added lobes was generated by the importance of the dome and the six segments on the drum's exterior. The elaboration of alternately added triangular areas addressed the frontal requirements inside, at ground level. Borromini developed and built the church in 1643–1645 based on the largest feasible design with the maximum usable floor space. He modified the design to achieve clarity in the section, proportions, and details, so that the visitor's experience of the actual building, its larger size and its bulk and height relative to its surroundings, would be as he wished and as it exists today. The church's formal logic is magnificent: the primary, unifying vertical axis controls the simultaneously centralized and frontal properties of the hexagonal armature and the processional, directional axis that dominates at ground level; and the tension between exterior and interior forms is emphasized by experiencing the outside sequentially from top to bottom, but the interior from below to above. The experience of Sant'Ivo, unfolding through the visitor's apprehension of form in real time and without the benefit of a plan drawing in hand, creates the power of Borromini's design.

The evidence given priority in ascertaining Borromini's intentions has been the building itself and the written and drawn material directly connected to him during his lifetime. The picture that emerges indicates that Borromini's actions were highly coherent and rational, and grounded in the pragmatic issues of constructing architecture: analyzing and utilizing preexisting site conditions; drawing precise forms and testing ideas with diverse clients; considering structure, materiality, and perceptual effects; controlling the political situation and the project's image. Usually, his decisions were made while considering several of those issues simultaneously. Borromini's multivalent design strategy obviously also included factors that this article has not examined, either because they have already been addressed elsewhere, or the evidence seems less definitive. Inclusion of information about the roles played by other architectural projects or precedents, secondary symbols, and cultural conditions or individuals besides those mentioned here, would color but cannot change the story told by Borromini's plans. Perhaps, while less intriguing in some ways, knowing the more practical reasons for some of Borromini's decisions will further his goal: to have us appreciate the brilliance of his solution to an extraordinarily difficult design problem.

## APPENDIX OF GRAPHIC DOCUMENTS

All drawings are graphite unless otherwise noted. Measurements of sheet sizes are given in millimeters for the bottom and the right edges, with east at the top, unless otherwise noted.

1. Archives plan (filed as ASR Università v. 198, n. 122, but located separately, Archivio di Stato di Roma). Graphite, with final church plan in red chalk. Ground plan of palace and church. Borromini. General palace plan and first church plan, 1635 or later; second and third, and red chalk church plans, between 1638 and 1640. Sheet: 476 x 698. Three graphic scales: first scale at lower left, in Roman numerals, 100 palms = 183 mm (1:122.1); second scale at upper center along incorrect east wall, in Roman numerals, 100 palms = 184 mm (1:121.4); third scale at upper center along corrected east wall, in Arabic numerals, 100 palms = 184 mm (1:121.4). Text: *nel fregio della Porta / SAPIENTIA AEDIFICAVIT SIBI DOMVM Prov. C. 9 / nel fregio delle 7 colonne / EXCEDIT COLVMNAS SEPTEM / nel Piedistallo della statua / PROPOSUIT MENSAM SVAM.*

2. Albertina 499 set: 499, 500, and 500 overleaves

a. Albertina 499 (It. AZ 499, Albertina, Vienna). Ground level plan of palace and church. Borromini, 1658, modified 1660. Sheet: 269 x 408 mm. No graphic scale, but 100 palms = approx. 102.5 mm (1:218). Text: At bottom right: *Delle 3 piante di questo si farano 4 nel nov[embr]e / che viene a crescere la terza pianta più per / accompagnane bene a la Carta Reale. In the north loggia: questa e s[baglia?], because the loggia's width is not drawn correctly.*

b. Albertina 500 (It. AZ 500, Albertina, Vienna). Plan of piano nobile of palace, with drum and tempietto plans of church. Borromini, 1658, modified 1659. Sheet: 269 x 374.5. No graphic scale, but 100 palms = approx. 102.5 mm (1:218). Text: Originally none. Text added in summer 1659, referring to freehand design changes in the library areas: at the curved seating: *Teatro*; in the loggia: *entrata* (twice, erased), and *entrata principale per libreria e sala dottori*; in the proposed antechamber: *Ricetto per Libreria e Sala delle Dottore.*

c. Albertina 500 overleaves (It. AZ 500, Albertina, Vienna). Small sheet: plan of piano nobile of church. Large sheet: third level of palace. Borromini, 1659. Sheet, small: 101 x 155, large: 269 x 173. No graphic scales, but 100 palms = approx. 102.5 mm (1:218). Text: none.

3. Albertina 501 (It. AZ 500, Albertina, Vienna). Fragment of ground floor plan of palace and church. Borromini and assistant, 1635–1640, 1659, 1660. Sheet: 174.5 x 293 mm. No graphic scale, but 100 palms = approx. 181.2 mm (1:123). Text: Written in 1630s on original complete drawing: in hexagonal sacristy: *[?]a di Ricetto p[er] la Chiesa; in*

portico: *Porta* (erased); in second rectangular room: *P[al]mi 165*. Written darker, in 1659 or 1660: in portico: *Portico al Pian Terreno*; at east door: *Porta Principale*.

4. Albertina 502 (It. AZ 502, Albertina, Vienna). Partial ground plan of palace and church. Borromini, 1659. Sheet: 410 x 679 (top edge 476), with two added flaps. Graphic scale: 100 palms = 362.5 mm (1:61.5). Text: At angled passage: *entrata alla Chiesa*; across first eastern rectangular room: *46¼ il vano; tutto P[al]mi 54¾ del mezzo del portico al filo della cortina di fuori*; in central room: *longhezza della libreria P[al]mi 162¼*; across third room: *P[al]mi 65½ tutto del filo della cortina di fuori sino al mezzo del vano del portico*. Also many individual and added sums of dimensions, for center-line dimensions of windows, portico bay dimensions, wall thicknesses, widths of windows or rooms, wall lengths, and diameter of spiral stairs, most as constructed.

5. Albertina 509 (It. AZ 509, Albertina, Vienna). Plan of drum, roofing, and tempietto of the church. Borromini, 1659/60. Sheet: 295 x 357. No graphic scale, but 100 palms = approx. 218 mm (1:103). Text: None except for numbers marking each roof step.

6. Albertina 518 (It. AZ 518 verso, Albertina, Vienna). Perspective sketch of church from courtyard, with sketch of column capital. Borromini, before 1652, when construction of the lantern, *porticelli*, and roof buttresses began. Sheet: 463 x 323. Not to scale. On recto: Column capitals for the inside and outside of Sant'Agnese in Piazza Navona. Heinrich Thelen, *70 disegni di Francesco Borromini dalle collezioni dell'Albertina di Vienna* (Rome, 1958), 23, item 52, who dates it 1654. Their sizes but not their exact details match the capitals as built, according to Martin Raspe, whom I thank for sharing his expertise on this question. See also Raspe, "Borromini und Sant'Agnese in Piazza Navona," *Romisches Jahrbuch der Bibliotheca Hertziana* 31 (Munich, 1996): 315–368.

7. East elevation. Published by Maurizio Fagiolo, "La Sapienza di Borromini: un progetto per il Palazzo dell'Università; l'emblematica / la natura / la struttura significante," *Storia dell'Arte* 38/40 (1980): 343–351, fig. 1. Not illustrated. Façade design for Piazza Sant'Eustachio. Borromini, late summer 1659, fall–winter 1659/60. Sheet (from Fagiolo): 335 x 485. Graphic scale depicts 100 palms = approx. 194 mm (1:115).

8. Pavement drawing (Codex Chigiano, P.VII-9, 95v–96r, Vatican Library, Rome). Ground plan of church interior with two paving designs. Borromini, October 1660. Sheet: 527 x 768. No graphic scale, but 100 palms = approx. 651.5 mm (1:34.3).

9. Section with interior perspective (*Popish Ceremonies*, vol. 2, King's Library, 134 g. 11, fol. 15; British Library, Lon-



don). Barrière, 1660. Lined edges: 265 x 422. No graphic scale, but section dimensions of 100 palms = approx. 194 mm (1:115). The scale exactly matches the Fagiolo east façade drawing.

Republished with minor changes as Tavola VIII by Sebastiano Giannini, 1720. Changes to Barrière's plate include addition of shading, particularly on the left side of church interior and in the dome; decrease in width from 275 to 265 mm. 10. Della Porta designs (Collezione Campori, gamma I.1.50 – Piante e disegni, c. 14 r–v, Biblioteca Estense Universitaria, Modena). Ink and ink wash. Plan (verso), with section and elevation details of church and palace (recto). Drawings 1597, after the 1581–1585 model by Giacomo della Porta. Plan side, sheet: 438 x 569. Graphic scale at bottom, 100 palms = 146 mm (1:153).

11. Giannini engraving, Tavola X (*Opera . . . del Cavaliere Borromini . . . La chiesa . . . e fabrica della Sapienza di Roma*, ed. Sebastiano Giannini, Rome, 1720). Not illustrated. Ground floor plan called "according to the first idea, and design" of Borromini. Lined edges: 312 x 426. No graphic scale, but 100 palms = approx. 219 mm (1:102). Text: *Tavola X. Contiene la Pianta intiera di tutta la sopradetta Chiesa secondo la prima Idea, e Disegno del detto Cavalier Boromino.*

## Notes

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1. In Renaissance and Baroque Italy, a drawing's scale was established in general terms by its use, and in specific terms by the size of the sheet of paper available for the drawing. Standardized reductions, such as 1:100, were not used, so drawings of the same scale are usually directly related. Christof Thoenes, "Zur Frage des Mastabs in Architekturzeichnungen der Renaissance," *Studien zur Kunstlerzeichnung: Klaus Schwager zum 65. Geburtstag* (Stuttgart, 1990), 38–55; see also Elisabeth Kieven, "Romische Architekturzeichnungen des Barock," in Kieven, ed., *Von Bernini bis Piranesi* (Stuttgart, 1993), 11–21; and Joseph Connors, "Die Revolution des Graphits," in Kieven, 33–40.

2. Primary material includes the original *misura e stima* documents in the Archivio di Stato di Roma: Università, vol.115, fol. 6r–54v, for 1643–1655; ASR Univ. 115, 289r–412v, for 1659–1661; Marcello Del Piazzo, *Ragguagli*

*borrominiani: mostra documentaria* (Rome, 1968); Fioravanti Martinelli, *Roma ornata dall'architettura, pittura e scoltura* (MS, Rome, 1660–1663) in Cesare D'Onofrio, ed., *Roma nel Seicento* (Florence, 1969). More recent materials include: John Beldon Scott, "S. Ivo alla Sapienza and Borromini's Symbolic Language," *JSAH* 41 (December 1982): 294–317; Joseph Connors, "S. Ivo alla Sapienza: The First Three Minutes," *JSAH* 55 (March 1996): 38–57; and "Borromini's S. Ivo alla Sapienza: the spiral," *Burlington Magazine* 138 (October 1996): 668–682; and a comprehensive building history in Elisabetta Cirielli and Alessandra Marino, "Il complesso della Sapienza: lettura critica dei documenti d'archivio e loro riscontro sul manufatto ai fini della conservazione," thesis, Università degli Studi di Roma, Facoltà di Architettura, 2 vols. (1981–1982), published in drastically condensed form as "Il complesso della Sapienza: le fasi del cantiere, gli interventi successivi al Borromini, le manutenzioni," *Ricerchi di Storia dell'Arte* 20 (1983): 39–64.

3. The long-favored but no longer tenable view that the plan was based on two overlapping triangles, or Star of David, was expressed by Leonardo Benevolo, "Il tema geometrico di S. Ivo alla Sapienza," *Quaderni dell'Istituto di Storia dell'Architettura* 3 (1953): 1–14. As first noted by Leo Steinberg, *Borromini's San Carlo Alle Quattro Fontane: A Study in Multiple Form and Architectural Symbolism* (New York and London, 1977), 379 and n. 42, none of Borromini's drawings contain a second overlapping triangle; that construction was published and gained currency only in 1720, when it appeared in Sebastiano Giannini, ed., *Opera . . . del Cavaliere Borromini . . . La chiesa . . . e fabrica della Sapienza di Roma* (Rome, 1720), engraving of the "as built" plan, located at Tavola 46. See also Scott, "S. Ivo," 299 and n. 26, and Connors, "First Three Minutes," 50 and nn. 67–71.

4. Scott, "S. Ivo," 298–302 and fig. 8; George Hersey, *The Monumental Impulse: Architecture's Biological Roots* (Cambridge, Mass., 1999), 64. The supporters of the single triangle include Connors, "First Three Minutes," 38–57; Kieven, ed., *Von Bernini bis Piranesi*, Kat. 12, 67–69, and Kat. 15, 74–75; and Steinberg, *Borromini's San Carlo*, 374–396, with a synopsis of earlier authors' views. Paolo Portoghesi, "Il Palazzo della Sapienza," *L'Archivio di Stato di Roma: I Tesori degli Archivi* (Florence, 1992), 189–243, sees both conditions in a starry hexagon; see also Portoghesi, *Francesco Borromini*, 2nd ed. (Milan, 1984), 151–164; and Benevolo, "Tema geometrico," 1–14.

5. Benevolo, "Tema geometrico," fig. 21, provides an accurate but incomplete interior plan with a graphic metric scale. Portoghesi's very beautiful drawings in *Francesco Borromini* (1984) and "Palazzo" (1992) are not reliable dimensionally.

6. The work was supported by grants from the College of Architecture, the Vice-Chancellor, and the Vice-President for Research and Graduate Studies, University of Kentucky. Special thanks are due to Raffaele Trotta and Franco Mincinese, and to student assistants Daniel Piselli and Anthony Rawe. The measured drawing was constructed at a metric scale of 1:50, subsequently converted to *palmi romani*, with 1 palm = 0.2234 meters = 8.795 inches.

7. Heinrich Thelen, "Der Palazzo della Sapienza in Rom," in *Miscellanea Bibliothecae Hertzianae zu Ehren von Leo Bruhns, Franz Graf Wolff Metternich, Ludwig Schudt* (Munich, 1961), 285–307; Anna Bedon, *Il Palazzo della Sapienza di Roma* (Roma, 1991), especially 19–21; Michael Kiene, "Der Palazzo della Sapienza—Zur Italienischen Universitätsarchitektur des 15. und 16. Jahrhunderts," *Romisches Jahrbuch für Kunstgeschichte* 23/24 (1988): 220–271; Fiorenza Rangoni, *S. Ivo all Sapienza e lo "Studium Urbis"*, *Le Chiese di Roma Illustrate*, new ser. 24 (1989), 17–45.

8. The drawings were first identified by Jack Wasserman, "Giacomo della Porta's Church for the Sapienza in Rome and Other Matters relating to the Palace," *Art Bulletin* 46 (December 1964): 501–515. See also Kiene, "Palazzo della Sapienza," 251–260; Connors, "First Three Minutes," 40–44, figs. 7, 8 and nn. 10, 11.

9. The 1635–1640 dates for the Archives sheet are based on my interpretation of evidence in Connors, “First Three Minutes” (41–46 and n. 15), for Borromini’s use of Roman and Arabic scales between those dates, and red chalk techniques between 1638 and 1640. The first, conceptual sketches could have been earlier. A 1632 date for the Archives sheet, but without new data, is proposed by Robert Stalla, “L’opera architettonica di Francesco Borromini nel contesto politico, culturale e storico del Seicento romano,” Richard Bösel and Christoph Frommel, eds., *Borromini e l’universo barocco* (Milan, 1999), 23–33. Connors, “First Three Minutes,” 53 n. 9, gives a complete bibliography.
10. Connors, “First Three Minutes,” 42, describes the pinholes proving that the palace plan was copied from [or to?] another sheet.
11. For the actual measurements, see Figures 4, 5, and 9.
12. The central solid wall between the windows in the north wing is 2.58 palms narrower than that wall section in the older south wing.
13. Connors, “First Three Minutes,” 41–46, figs. 9, 10.
14. The origin of this mistake was due to inaccurate preliminary measurements on the site, or using information from an inaccurate earlier plan. The built dimensions shown in Figure 4 confirm that the corrected east wall location on the Archives sheet is off by less than one palm. The rear edge of the property continued the palace’s earlier southeast corner (Bedon, *Palazzo*, 64–70, 76; Cirielli and Marino, “Complesso della Sapienza” [1983], 40 and fig. 2). The rest of the east façade, completed by Borromini in 1659/60, reused and rehabilitated the preexisting walls and foundations (ASR Univ. 115, 21r, 289r–v, 296r–297v, and 347v).
15. Connors, “First Three Minutes,” 46 and fig. 9, incorrectly assigned this apse design to either the first or the third scheme.
16. The traditional but incorrect diagram (Anthony Blunt, *Borromini* [London, 1979], frontispiece and fig. 83) is from Benevolo, “Tema geometrico,” 3, fig. 5, who cites the argument of A. E. Brinckmann, *Baukunst des 17 und 18 Jahrhunderts in den romanischen Ländern* (Berlin, 1915), 65. The geometric proposal is doubly flawed: neither the two triangles nor the equality of the six circles is accurate. Other recent geometric analyses: Portoghesi, “Palazzo della Sapienza,” figs. I–V; Connors, “First Three Minutes,” figs. 9–11; Raspe, *Das Architektursystem Borrominis* (Munich, 1994), 97–98 and fig. 48, 105 and fig. 49; Scott, “S. Ivo,” fig. 8; Steinberg, *Borromini’s San Carlo*, 379–380; Benevolo, “Tema geometrico,” fig. 21.
17. The interior elevation’s dimensions in those areas are determined by the requirement for the repetitious narrow wall segments between the pilasters to match. The wider central segments in the three curved versus the three triangular lobes therefore cannot be of equal width.
18. As one example, the radii for the large statue niches, built as 12.53 palms, and their center-point locations, were continually adjusted as the design developed.
19. Particularly the writings of Carlo Cartari (1614–1697), lawyer, papal adviser, and key member of the Collegio from 1642 (A. Petrucci, “Carlo Cartari,” *Dizionario biografico degli Italiani* [Rome, 1960–], XX: 783–786).
20. The anticipated start of construction in spring 1642 was delayed until January 1643 (Del Piazzo, *Ragguagli*, 133).
21. The *misura e stima* refers to the interior vault as a six-part pavilion: “e cominciano a voltare con il suo sesto per formare il padiglione della volta . . .” (ASR Univ. 115, 11v). Observations by other authors point in this direction: Benevolo, “Tema geometrico,” 7, on the visual impact of the six reentrant pilasters; Connors, “First Three Minutes,” 47–48, emphasizing the dome’s unique enlargement beyond the hexagon’s points.
22. “A di 24 d[et]to [marzo 1643] segue il nono pezzo di fond[amen]to a man dritta del altare maggiore lon rag.to P[al]mi 16 1/2 fon P[al]mi 27 1/4 g.o P[al]mi 10[.] seguita il braccio congiunto insieme che forma il sesto angolo della Chiesa p[er] esser di forma esagona . . .” (ASR Univ. 115, 8v, entry 19). The twelve foundation pieces which were built under and beside the church between January and May 1643 as shown shaded in my reconstruction are based on the dimensions and locations described in ASR Univ. 115, 6v–9r, entries 1–27. The dotted foundations are earlier or later.
23. On the mezzanine level, a series of twelve niches matched the ones at ground level, and large windows were centered above the angled passages in the two lobes next to the main entrance (ASR Univ. 115, 359v–360r, and Cirielli and Marino, “Complesso della Sapienza” [1983], 42 and figs. 6, 7).
24. The Barberini drum’s stucco, ASR Univ. 115, 31r–v; for the original appearance of the drum’s exterior, in the 1652 engraving by J. van Meurs, and a perspective drawing of 1653–1655 attributed to Barrière, see Joseph Connors, “Spiral,” figs. 52, 43.
25. ASR Univ. 115, 25v, entry 194: curved lobes’ thickness at windowsill was a mere 2 palms, the arch above the window, 4 palms; the respective thicknesses in the triangular lobes were 6 and 8 palms. In comparison, Sant’ Agnese’s drum of c. 1655, with an equivalent interior span of 75 palms, has a thickness of 8 palms all around, plus buttressing elements beyond that (Albertina It. AZ 60).
26. “Segue il Lavori del Tamburo, . . . la muraglia p[er] di fuori è formata con sei semicircoli a guisa d’una rosa di sei foglie” (ASR Univ. 115, 403r). Kieven, ed., *Von Bernini bis Piranesi*, 74, attributes this poetic description directly to Borromini.
27. Del Piazzo, *Ragguagli*, 133, 233; ASR Univ. 115, 27v–28r, item 149. For the dome’s “extraordinary” design and construction requirements, and the repeated rebuilding that Borromini demanded, see Connors, “Spiral,” 670.
28. The 1650s history and drawings are fully published by Connors, “Spiral,” 668–682.
29. *Ibid.*, 671, 675.
30. ASR Univ. 115, 45r–46v, items 301–311.
31. Most of the drawings from the 1658–1660 period are in the Graphische Sammlung Albertina files, It. AZ 499 through 529. Some are mentioned but not evaluated by Elisabeth Kieven, *Von Bernini bis Piranesi*, Kat. 12, n. 7. Preliminary findings in Smyth-Pinney, “Borromini’s S. Ivo: Perception and Plans,” *ARRIS* 5 (1994): 38–55, relied on inaccurate evidence to date some of those drawings.
32. The complete and detailed sequence of events, and a complete drawing appendix, is forthcoming in another publication.
33. Selected references for the 499 set: Joseph Connors, *Borromini and the Roman Oratory, Style and Society* (New York, Cambridge, Mass., and London, 1980), cat. 90 (266–269); Connors, “First Three Minutes,” 38–39 and n. 8; Connors, “Sebastiano Giannini: ‘Opus Architectonicum,’” in Bruno Contardi and Giovanna Curcio, eds., *In Urbe Architectus: modelli, disegni, misure: La professione dell’architetto in Roma 1680–1750* (Rome, 1991), 204–213; Kiene, “Palazzo della Sapienza,” 260–262, figs. 39, 40, and 41; Kieven, ed., *Von Bernini bis Piranesi*, Kat. 12, 67–69; Smyth-Pinney, “Perception and Plans,” 46–55; Heinrich Thelen, *70 disegni di Francesco Borromini dalle collezioni dell’Albertina di Vienna: 19 novembre 1958–6 gennaio 1959* (Rome, 1958), 17–18, items 30 and 31, and Tav. IV.
34. P.J.A.N. Rietbergen, “Papal Patronage and Propaganda: Pope Alexander VII (1655–1667), the Biblioteca Alessandrina, and the Sapienza Complex,” *Nederlands Instituut te Rome, Mededelingen van het N.I.* 47 (1987): 157–177.
35. Martinelli, in D’Onofrio, ed., *Roma*, 217. For the competition with the Collegio Romano, see Maria Rosa Di Simone, *La “Sapienza” Romana nel Settecento: Organizzazione Universitaria e Insegnamento del Diritto, Studi e Fonti per la Storia dell’Università di Roma* (Rome, 1980), 1: 15–61, 100–101, 289–292.
36. “Monsignore fece trasportare del salone della Sapienza nella galleria di Monte Cavallo un gran modello di legno lavorato egregiamente molti anni

sono nel quale si esprimea la metà della fabrica del medesimo studio" (Del Piazzo, *Ragguagli*, 138). This model portrayed half of the "studio" (the palace and church) split along the east-west line of symmetry, probably showing the palazzo's north wing (Bedon, *Palazzo*, 54, 74–75). The original model, completed for della Porta in 1583 (ibid. and Appendix 10) and depicted in the Modena drawings, could have been modified twice by Borromini: first in 1635–1640, to show his own church design, and perhaps again in 1658 to show the new library.

37. The earliest pencil marks on Albertina 500 are just barely visible, where Borromini drew the church's piano nobile plan with the original corridors of the 1640s leading to windows in the two lobes flanking the main entry, before they were closed off in 1659.

38. Richard Krautheimer and Roger Jones, "The Diary of Alexander VII: Notes on Art, Artists, and Buildings," *Romisches Jahrbuch für Kunstgeschichte* 15 (1975): 209, entries 260, 273; Cartari's diary entry on the same event is in Del Piazzo, *Ragguagli*, 225.

39. Specifics of the construction of 1659/60 (ASR Univ. 115): 1659 foundations, 289r–292v; ground floor rooms, 296r–304; ground floor and piano nobile loggia, and third level *loggia scoperta*, 327r–332r; hexagonal rooms, 333r–349v; library walls and vaults, 309r–325r; the closing of the twelve upper niches, 359–360r and 365r; the two added *coretti*, 362r–363v; closing the two ground floor angled passages from the porticoes into the church, 365r–369r. Also Del Piazzo, *Ragguagli*, 226, 136, 227.

40. The changes required demolition and rebuilding of some 1643–1645 vaults and other details (ASR Univ. 115, 352r–v, and 349; 21v and 14r–v, and 362r–v).

41. "e da noi M. Vizzani col disegno del tergo della Sapienza mutato di nuovo dal Boromino, ci segue il martellino di capo" (Krautheimer and Jones, "Diary," 213, entry 385).

42. On the Chigi era stucco, ASR Cartari-Febei v. 78, 204–206, 211r; ASR Univ. 115, 359r; and Del Piazzo, *Ragguagli*, 226, 227. On design changes, Del Piazzo, *Ragguagli*, 227–228.

43. See n. 48 below.

44. "Delle 3 piante di questo si farano 4 nel nov[embr]e / che viene a crescere la terza pianta più per / accompagnane bene a la Carta Reale."

45. *Carta Reale* seems to be a shortened form of *carta imperiale*, the standard-size high-quality paper by Fabriano, measuring 54 x 78 cm. Cut in quarters, this yields four sheets of 270 x 390 mm, which accords well with the sheet sizes of Albertina 499 (269 x 408 mm), Albertina 500 (269 x 374.5), and Albertina 509 (295 x 357), as well as with Barrière's prints. My thanks to John Scott and Elisabeth Kieven who both helped me with this issue.

46. For other opinions, see Connors, "Spiral," 674, 682; Steinberg, "Borromini's San Carlo," 379–381.

47. Inaccurate palace dimensions, fitted around the church plan, include the exedra's curve drawn with a radius of only 41 palms, the east wall location too far back, and the incorrect total site depth. The sketchy, curved *mezza-luna* walls were added during the winter of 1659/60.

48. *Popish Ceremonies*, vol. 2, King's Library, 134 g. 11, fol. 13, 14, 15, British Library; identified by Connors, "Sebastiano Giannini," 204–213. The written account of the Borromini/Barrière engravings is given by Borromini's nephew Bernardo in a manuscript of his uncle's life (full transcription in Connors, *Oratory*, Doc. 26, 157–161). Four, not five, engraved plates were made by Barrière: the perspective of the Piazza Sant'Eustachio (east) façade, the perspective view from the courtyard, the cutaway section/interior perspective, and a "geometrical plan." With revisions, the first three plates were reprinted in Sebastiano Giannini, *Opera*, Plates V, VI, and VIII, respectively; Plate III, showing the palace's west façade, has no connection to Barrière. An original print of the "geometrical plan" from Barrière's plate has not yet been found. It is not clear whether that plate survived and was mod-

ified later to create the plan published as Plate X by Giannini, which certainly relies on original source material from the 1660 period, and is directly related by scale and details to Albertina 509, with other details consistent with Albertina 499 and Barrière's plan in perspective. I especially thank Martin Raspe for sharing his insights into these topics. See also Antony Griffiths, "The Print Collection of Cassiano dal Pozzo," *Print Quarterly* 6, no. 1 (March 1989): 3–10; Connors, "First Three Minutes," 53 n. 8, and idem, "Spiral," 675 n. 8, on Giannini's Tav. III.

49. That passageway connecting the church and portico directly was drawn on the original plan and partially built on the north during the 1643 campaign (ASR Univ. 115, 13v). It was changed in 1660 to a "twin door" scheme, drawn freehand in Albertina 501 approximately as it would soon be built, and the word *porta* has been erased. Access also was changed between the portico, spiral stair, and hexagonal sacristy.

50. Where the written dimensions have been compared to the building, they match precisely. For example, the center lines of the windows along the north wall are accurate to within 0.2 palms. The triple arcs at the great entry door from Piazza Sant'Eustachio also exactly match the first design phase of the east elevation study, where Borromini had fashioned giant Chigi mountains to surround the portals (see Appendix 7).

51. Leonardo Benevolo, "Il problema dei pavimenti borrominiani in bianco e nero," *Quaderni dell'Istituto di Storia dell'Architettura* 13 (1956): 1–19, figs. 11–15; Paolo Portoghesi, *Borromini nella cultura europea* (Rome, 1964), 49–54, 197 and figs. VI, XXIV, XXV, 47.

52. Del Piazzo, *Ragguagli*, 137.

53. Connors, "Spiral," 671, recounts the extreme difficulties with fashioning the chain to Borromini's exacting specifications. The problem was excruciating because the chain had to draw the ribs inward without crushing the fragile lobes. The largest crack in the dome and wall, to the altar's left, still exists and is continuously monitored with electric gauges.

54. ASR Univ. 198, 133, 135 for the two original letters; also Del Piazzo, *Ragguagli*, 151.

55. Del Piazzo, *Ragguagli*, 226; ASR Univ. 115, 289–292.

56. Closing the upper-level niches and redesigning the apse were specifically connected to the structural problems (ASR Univ. 115, 350r, 359v, 351v).

57. In June 1660, for example, the pope noted that he had given back a drawing of the Sapienza that had been left with him (Krautheimer and Jones, "Diary," 213, entry 409).

58. Numerous articles have commented on the text, with divergent interpretations given by Scott, "S. Ivo," 301–302; Connors, "First Three Minutes," 46; and Portoghesi, "Palazzo," 208–210. The altar design suffered significant modifications, both during Borromini's lifetime and beyond (Cirielli and Marino, "Complesso della Sapienza," [1983], 42–50).

59. Scott, "S. Ivo," 299; and Portoghesi, "Il Palazzo," 207.

60. Scott, "S. Ivo," 298–302, explores the connection between the hexagon as a geometric figure, which is one condition, and the bee's honeycomb and body shape, which is another, all in the context of Urban VIII's court and the sensibilities of the 1640 period. Connors, "First Three Minutes," 49–52, considers the bee shape a "non-source" for Borromini's architectural invention, accepting it only as "important in the rhetoric, both visual and verbal, surrounding the commission." I agree with Connors that the body shape of the bee is an unlikely initiator for the plan in Borromini's mind. However, for Borromini to take on the six-part hexagonal geometry both as an architectural challenge and a reference to the patron would be in sympathy with the record.

61. Martinelli, in D'Onofrio, ed., *Roma nel Seicento*, 202–220.

62. "Si fondo nell'impresa ponteficia dell'Ape Barberina, la quale con l'apertura delle quattro ali, e con testa e corpo forma una figura essagona, annoverata tra le più perfette dall'autori d'architettura, e tale a punto



richiedeva l'accantonato sito" (ibid., 217).

63. Connors, "First Three Minutes," 50. Borromini took this description almost verbatim from Sebastiano Serlio, *The Five Books of Architecture*, book 1, chap. 1, fol. 2 (Dover reprint of English ed., 1611 [N.Y., 1982], n.p.).

64. Carlo Cartari's letter, 1669: ". . . in the church building, which was begun in the time of Urban VIII, and therefore is *quasi* in the shape of a bee" (Del Piazzo, *Ragguagli*, 228); also Padre Francesco Macedo's description, 1661, quoted by Martinelli, in D'Onofrio, ed., *Roma nel Seicento*, 217: "unusual architecture, imitating the shape of a flying bee" (Scott's translation, "S. Ivo," 298 and n. 17.)

65. Martin Raspe, "Borromini e la cultura antiquaria," in Bösel and Frommel, eds., *Borromini e l'universo barocco*, 83–93, identifies several other potential sources and reasons for triangles.

66. Smyth-Pinney, "Perception and Plans," 52, figs. 19 and 20.

67. In the 499 set, even though the plan is derived, conceptually, from the single triangle, in practice the circle's center point was set first, so the triangle's point that should touch the front door is "off." Albertina 509 is completely unique geometrically: the composite triangle may have been drawn first, and the palace plan certainly was worked in afterward, which explains why the triangle's three points touch the front door and corridor walls perfectly.

68. Raspe, *Das Architektursystem Borrominis*, 97–100, examines several different Borromini projects and comes to this same conclusion, adding the caveat that only comparisons between the original drawings and highly accurate, modern measured drawings of the actual structures (generally nonexistent) would provide incontrovertible evidence.

69. Kieven, ed., *Von Bernini bis Piranesi*, Kat. 12, 67–68.

70. Joseph Connors, "Francesco Borromini: la vita (1599–1667), in Bösel and Frommel, eds., *Borromini e l'universo barocco*, 7–33.

71. "per fare vedere il molto del suo sapere" (Connors, *Oratory*, 160, Doc. 26). In one example of contemporary criticism, Giovanni Mola describes both the campanile at Sant'Andrea delle Fratte and the Sapienza's lantern as "*bizzarro*" (*Breve racconto delle miglior opere d'Architettura, Scultura et Pittura fatte in Roma . . . descritto da Giov. Battista Mola l'anno 1663*, transcribed by Karl Noehles, *Quellen und Schriften zur Bildenden Kunst*, 1 [Berlin, 1966], 215). Alexander's statement that Borromini's architecture was "gothic" was reported by Cartari in March 1660 (Del Piazzo, *Ragguagli*, 136). See also Blunt, *Borromini*, 211–222.

72. The actual interior dimensions, from my preliminary measurements: top of cornice, 75 palms, exactly matching the *misura e stima* dimensions (ASR Univ. 115, 28v–29r, and 361v); from cornice to interior lantern/dome edge, 66 palms. The engraved section reduces the dome's height at the cut line by almost 20 palms.

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Figures 8, 17. After Paolo Portoghesi's isometric rendering, in *Borromini* (1984), 160

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Figures 12, 18–22. Graphische Sammlung Albertina, Vienna

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