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Original

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(Article begins on next page)

Rectangular Ratios in the Design of Villas from Serlio's Manuscript for Book VII of Architecture

Introduction (*Roberta Spallone, Marco Vitali*)

The *magioni per fare alla villa fuori delle città* (country houses), as they are called in the table of contents of Serlio's Vienna Manuscript, preserved in Vienna's Österreichische Nationalbibliothek as Codex Cod. Ser. n. 2649 (Serlio n.d. [Vienna Manuscript]), are private country houses, also known as villas. Other Renaissance treatise writers, such as Francesco di Giorgio Martini (*Trattato di architettura civile e militare*, about 1470), dealt with this kind of domestic architecture, but it was only with Sebastiano Serlio (*Book VII* on Architecture, published posthumously in 1575) and Andrea Palladio (*I quattro libri dell'architettura*, 1570) that this typology assumed significant importance.

Interest in the design of villas developed in a period permeated by Renaissance research on proportions in architecture, which included Leon Battista Alberti (*De re aedificatoria*, about 1450) among the initiators. Serlio and Palladio's villas have plan layouts accurately studied from this point-of-view. The first refers to 24 models of villas of his invention, and the second mainly to buildings designed by him. While Palladio's drawings (not only from the treatise) and buildings have been the focus of several well-known studies, Serlio's models have been less studied, particularly the use of proportional ratios as a design criterion. The compositional diagrams of some of the Serlian villas were reconstructed by Marco Rosci (1966a), who compared them with those of Rudolf Wittkower (1949) relative to the Palladian villas, identifying convergences and differences.

The object of the present research is to recognize the application of the seven rectangular ratios described by Serlio in Book I on Geometry (1545) in the designs of the 24 villas presented in the Vienna Manuscript preparatory to Book VII on Architecture. These ratios, of which Serlio foresees the use in the proportioning of rooms, correspond in part to the seven room shapes described by Palladio (1570). The Vienna manuscript provides both textual and graphic descriptions of Serlio's villas, which can form the basis of graphic analyses and examinations regarding criteria for composition and distribution of the Serlian designs, identifying the simple geometries that give shape to the individual room plans and their relationship with the geometric shape that outlines the general plan. Basing ourselves on the work of earlier architectural historians, here we examine the possible links between the works by Serlio and Palladio, considering that the two architects were a generation apart (Serlio being 33 years older than Palladio), and that they could have met in Vicenza before Serlio's departure for Fontainebleau.

The Vienna Manuscript as a Basis for the Realization of Book VII (*Roberta Spallone*)

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3 Serlio's Book VII was published posthumously (1575) by Jacopo Strada in Frankfurt. The text of this
4 first edition was in both Italian and a Latin translation. The manuscript of the book, discovered in
5 1919 by Julius Schlosser in the Kunsthistorisches Museum in Vienna (Dinsmoor 1942: 80), contains
6 original drawings and transcribed texts. It consists of 152 parchment folios. The texts (written on
7 twenty-nine folios) precede the ink drawings (realized on 123 plates). At the front of the book, there
8 is one single autograph sheet by Serlio, which synthesizes the book's contents.
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12 In the preface to Book IV, first published in 1537, Sebastiano Serlio (1475-1554 or 1555) announced
13 Book VII. However, even if Book VII had been foreseen from the beginning of the draft of the
14 treatise, to reconstruct its elaboration process was rather difficult for the historians. This aspect is
15 relevant for the developments of the present study, as the possible influences that the models of
16 Serlian villas could have had on the designs of Palladian villas depend on when the elaboration of
17 these drawings begins and on the hypothetical encounter between the two masters. Indeed, some
18 scholars consider it likely that a meeting took place in 1539 (Rosci 1966a; Frommel 2008) when
19 Serlio went to Vicenza to build a temporary theatre at Palazzo da Porto. Palladio might have seen the
20 preparatory drawings for the book on this occasion or elsewhere (Frommel 2008: 68). This supports
21 the hypothesis that when Sebastiano Serlio left Venice for France, in the spring of 1541, most of the
22 drawings for Books VI and VII were already prepared (Frommel 1998: 349-369).
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28 Tancredi Carunchio highlights other elements in support of an Italian origin for Book VII, precisely
29 with regard to the drawings of the 24 villas that are featured as "Italian" villas, except the final villa,
30 with attics "in a French way" (Carunchio 1994: 252). Regarding the finishing of the work, Sabine
31 Frommel said that Serlio worked on the manuscript until the end of his stay in Lyon, since the drawing
32 of a portal is dated 9 March 1552. This date perhaps indicates the definitive conclusion of the book.
33 On May 19, 1552, he wrote to his patron François de Dinteville that he had completed the texts
34 (Frommel 1998: 358). Finally, in a letter by Strada, it is written that in 1553 he had the wood tables
35 drawn by Serlio himself for the illustrations of Book VII (which, therefore, represent the final version)
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54 A further issue concerns the existence of a second version drawn up in anticipation of publication,
55 which got lost. Therefore, the Vienna Manuscript should be considered the first version (Dinsmoor
56 1942; Carunchio 1989: 203).
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Lastly, in relation to the decision by Strada to publish the volume in 1575, Dirk Jansen thought that it is probable that Strada was motivated to finally print Book VII because of the publication, in 1570, of the *Quattro libri dell'architettura* by Andrea Palladio (Jansen 1989: 212). A confirmation of this hypothesis could come indirectly from the way in which the volume, originally designed as a “book of accidents”, was filled by Serlio himself with new materials and, in particular, by the initial addition of 24 inventions of villas that had not found a place in the linear and progressive structure of Book VI. In fact, these are designs that, despite the various shape options (mostly variations on a centralized theme), are impressive because of the homogeneity of clients that they presume (Beltramini 2008: 187).

Drawing techniques in the Vienna Manuscript (*Roberta Spallone*)

The Vienna Manuscript was written on parchment sheets measuring 31.4 × 21.3 cm. The scale drawings of the manuscript are in orthographic projections on single plates, according to the plans of the ground floor and the front elevations, except in four cases (Villas IX, XIV, XV, and XVIII), where the model is presented across two plates, including the back elevation and a section. Moreover, Serlio organized some single plates to contain also the rear elevations, or the sections, or portions of them. The projective method is consistent with the recommendations of the 1519 “Letter to Leo X” by Raphael and Baldassare Castiglione (Hart and Hicks 2006) and is admirably consistent with the variations of the planimetric schemes that allow Serlio to multiply his examples (Fiore 1994: XXV-XXVI).

The layout of the different projections seems to depend on a precise graphic choice by Serlio: to use the entire extension of the sheet, starting from the general shape of the plan (including the garden), and always placed in the lower part of the sheet. The drawings in each plate are in projective correlation and the same scale, except three (Villas X, XI, and XII), where the lateral development of the garden appears only in the plan, leading to an enlargement of the elevation. Given that the unit of measurement is the Vicentine foot, equal to about 35.7 cm, it follows that each model has been drawn at a different scale: ranging from a scale of about 1:100 up to about 1:460, depending on the dimension of the plan. A graphic scale, designed by Serlio generally along the vertical axis of symmetry, allows the transportation of the measurements, with the aid of the compass.

Although historians have observed several differences between the Vienna Manuscript and Book VII as published (Schlosser 2001; Dinsmoor 1942; Rosenfeld 1974; Carunchio 1976), in the case of the

1 plans of the 24 villas, the differences mainly concern the text, which, as acknowledged, was carefully
2 rewritten (Jansen 1989: 213).
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4 **Rectangular ratios between geometry and architecture** (*Roberta Spallone*) 5

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7 At the end of the Book I on Geometry, Serlio deals with the seven rectangular ratios that the architect
8 “can use for different things” (Serlio 1545: 20, our trans.). He defines the square as “the most perfect
9 shape” (Serlio 1545: 20, our trans.), in a pragmatic conception of geometry, which uses the simplest
10 shapes as the base of the most complex ones (Lorber 1989: 115). The figures that derive from the
11 square correspond in part to Palladian proportions and harmonic proportions.
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18 In Serlio’s book, a progressive series of rectangles, with ratios between the sides of 4:5, 3:4, $1:\sqrt{2}$,
19 2:3, 3:5, 1:2, follows the square (1:1). Regarding the 1:2 ratio, Serlio establishes links with
20 architecture and, in particular, with the ratios in the plan of the rooms. Thus he specifies that “in the
21 good things of Antiquity there is no shape found that exceeds the double, except the entrance, the
22 lodge... but in vestibules, halls, rooms, and other habitable spaces this ratio is not used by the experts,
23 because it is not suitable” (Serlio 1545: 21, our trans.). Palladio also includes seven “most beautiful
24 and proportionate types of rooms” (Palladio 1570: 52, our trans.), six of which have the same ratios
25 between the sides indicated by Serlio, while the rectangular one (4:5) is absent and is replaced by the
26 circular plan.
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36 The harmonic ratios (1:2, 2:3, and 3:4) characterizes three of the seven figures indicated by Serlio. In
37 light of the results of the analysis presented in this paper, we cannot share the opinion of Lorber who,
38 writing about Serlio’s Book I, affirmed that the issue of musical proportions remained the reference
39 of the theoreticians and certainly not a relevant element in the practices of designing and building
40 (Lorber 1989: 115). The absence of the rectangle obtained with the golden section of the side was
41 also observed; this construction, a canonical in the study of proportions, was considered an
42 idealization of the real design practices (Lorber 1989: 115).
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50 **Working methodology** (*Roberta Spallone*) 51

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53 The analysis of the villa plans is focused on the geometric proportion and distributive-functional
54 aspect. Working on the plans means also constantly comparing elevation and sections, which reveal
55 and confirm symmetries, rhythm, and layouts of the façades.
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1 Describing the villas, Serlio establishes the measurements of the plans sides for most of the rooms,
2 each of which is identified by a letter, avoiding repetitions through the reference to the symmetries
3 and leaving out the measurements of a few smaller rooms for service and distribution. Serlio's
4 measurements refer to the clear dimensions of the rooms, while the overall measurements of the
5 villa's boundary and the thickness of the walls are not defined. The areas considered in the present
6 work are those to which Serlio attributed a value. Only in a few cases do we attribute dimensions to
7 the rooms by reading them directly from the drawings. This was done when there was a lack of one
8 of the two sides measurements or when it was possible to obtain the measurements by observing the
9 alignments of the rooms. The measures integrated in this way are written between parentheses.
10 Moreover, we found that the errors, probably due to the transcription, are very few. We have corrected
11 them by measuring the dimensions from the drawings and writing the exact measurements between
12 square brackets. To justify the lack of a metric definition of some areas, Serlio states that "of many
13 particular measures I do not speak because it would be long to describe everything, but the diligent
14 architect will find what is missing with the compass in hand" (Serlio n.d. [Vienna Manuscript]: fol.
15 7, our trans.).

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28 The first part of the graphic analysis concerns the definition of the proportional-geometric features of
29 each villa. After having scaled the plans in feet of Vicenza, the analysis turned to the search for the
30 shape and the ratio between the sides of the villa's boundary, also determining the overall area. Then,
31 symmetries and anti-symmetries, overall and between the rooms, were identified. Finally, areas
32 responding to rectangular ratios according to Serlio's description in Book I have been identified,
33 indicated by shading in different colours.

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41 Only the exact ratios were considered, which is unlike the procedure of Rosci, who, observing the
42 need for Serlio to insert the wall thickness, proposed approximations, for example, 13×20 as 2:3
43 (Rosci 1966a: 61). Only the ratio $1:\sqrt{2}$, which contains an irrational number, has been approximated
44 to the ratios that are closer to it, such as 7×10 , and 10×14 , as the canonical approximations during
45 the Renaissance (March 1998: 65-66).

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51 Comparative plates (Figs. 1, 2, 3, 4) have been created as a result of the analysis of all of the villas.
52 The use of the different colours allows us to observe recurrences and relationships between the figures
53 present in the single model, between different models, and in the complex of the 24 villas. These
54 elements, together with the relationship between the figure that outlines the villa's boundary and the
55 figures that shape the rooms, suggest the compositive criteria used by Serlio.

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The functional-distributive analysis is complementary to the proportional-geometric analysis, which can be superimposed to it as a layer. This analysis led to the diagrammatic representation of each plan, which was inspired by the study drawings of the Palladian villas made by Wittkower before 1944 (Benelli 2008: 49-53) and by the graphics standards established by Cavallari Murat for the representation of the historical urban fabric (Politecnico di Torino 1968).

For each villa, only those areas intended for residential purposes were considered, thus excluding the gardens, the small pavilions not connected to the body of the residence, and the external staircases, and instead included the entrance lodges and the internal lodges. The wall thicknesses were represented as a wireframe with a medium line, the openings in the façades and the internal passages through their axis, traced with a thick line, having different lengths to distinguish them. The stairs, which constitute the vertical distribution systems, have been drawn in their overall development, and an arrow identifies the main entrance of the villa. This representation allows us to appreciate the distribution paths, as well as the alignments between doors and windows, which can generate enfilade, façade divisions, and rhythms.

Table 1 Proportional-geometric and functional-distributive features of the 24 villas. Abbreviations, R: rectangular; SQ: square; L: longitudinal; T: transverse; D: diagonal; A: antisymmetry

The comparative plate, unlike the famous Wittkower plate depicting 11 Palladio villas (Wittkower 1949: 65), presents the diagrams of the villas reproduced at the same scale, thereby facilitating comparison between the models, even from the dimensional point-of-view (Figs. 5, 6, 7, 8).

A synoptic table flanks the two previous graphic analyses, which presents the architectural typology, the shape and size of the plot, the presence of symmetries with respect to the general shape of the building and to the layout of the rooms, the number of rooms on the ground floor and the percentage of which responds to rectangular ratios, the percentage of areas in rectangular ratios with respect to the total area (Wassell 1999), the number of rooms referred to each rectangular ratio, the ratio prevailing in each villa, and the value of the scale reduction (Table 1).

The Designs of 24 Villas from Serlio's Vienna Manuscript: A Comparative Analysis (*Roberta Spallone*)

The comparative analysis of the 24 models does not highlight an explicit sequence between them, such as the recurrence and the variation on morphological and compositive themes guided by geometric features (symmetries and antisymmetries, proportional ratios between the sides of the

1 figures that shape the rooms, modular grids). Serlio describes the general shape of the building, but
2 never refers to the figures in which it is inscribed. However, in light of the analysis carried out; it is
3 believed that they are of significant importance in the shape genesis of the plans.
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6 The 24 villas always have an axis of longitudinal symmetry, coinciding with the entrance system to
7 the building, which rules their overall shape. In most cases (14 out of 24), the axis of longitudinal
8 symmetry is orthogonally intersected by an axis of transverse symmetry, giving rise to centralized
9 shapes, on the main hall or the inner courtyard. In one case, that of Villa XIII, in addition to the two
10 main axes, there are two more rotated by 45°, on which there is a diagonal cross plan. The relationship
11 between the exclusively longitudinal axiality and the shape of the building is reflected in the choice
12 of rectangular block plans (Villas I and XI), horseshoe-shaped (Villas VI and XVI), H-shaped with
13 asymmetries (Villas IX and XXII), and C-shaped (Villas XIX, XX, and XXIV). Instead, in the cases
14 of double axiality, the shape of the building ranges between the square block plan (Villa II), cross
15 (Villas III, XVIII, and XXI), X-shaped (Villas IV and VII), courtyard (Villas V, XII, XIV, XV, and
16 XVII), and H-shaped (Villas VIII, X and XXIII).
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27 If the examples of villas are analyzed by grouping them according to the typology to which they
28 belong and following their sequence in the manuscript, they can, in general, be read as an evolution
29 of the shape, from the simple to the complex, and a search for possible solutions to the arising
30 distribution problems. However, we cannot be certain that, with the first example, Serlio wants to
31 propose an archetypal shape for the considered typology and that its variants follow: an example is
32 the development of the courtyard villas, which start from a shape with remarkable peculiarities, and
33 then return to a simpler type. The features of the block-, courtyard-, horseshoe-, C-, H-, cross-, and
34 X-shaped villas can, therefore, be examined, considering all of those characterized by different
35 symmetry relationships.
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45 ***Recurrences and variations on the typologic theme (Roberta Spallone)*** 46 47

48 The block villas (I, II, and XI) show a growing dimensional development. Villas I and II, having a
49 large main hall as their central organising element, propose a rectangular and square plan; Villa II,
50 which has a surface of 3.5-times that of Villa I, is divided into several rooms and has two front and
51 rear lodge diaphragms, which interrupt the two façade planes. Villa XI proposes, along the front and
52 back façades, setbacks of the central part, with an entrance lodge. This entails the indentation of the
53 main hall around which the rest is organised. The courtyard villas (V, XII, XIV, XV, XVII, and XXI)
54 are catalogued starting from Villa V. It is outlined by a large square, which presents large breaks in
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correspondence with the two symmetry axes and an isolated pavilion in the center. Villas XII and XIV develop new internal courtyard shapes, respectively circular and oval. This does not influence the shape of the rooms on the courtyard, which simply appear as residual spaces and perform ancillary functions. Villas XV and XVII seem to refer to the more usual courtyard schemes, having a square boundary and a concentric square courtyard, the main hall placed at the center of one of the sides, and, in Villa XVII, an internal lodge on all four sides. Villa XXI is organized on an octagonal courtyard, surrounded by corridors that distribute the rooms of the individual arms of the cross.

The horseshoe-shaped villas (VI and XVI) show a maturation of the compositive language thanks to which the semicircular curve of the façade, in the second case, is repeated in the rear façade and generates an original and axial main hall.

The C-shaped villas (XIX, XX, and XXIV) have some similarities (both XIX and XX have two short side wings, front and rear, respectively). Villa XIX, exceptionally, has no main hall, and the entrance is through a lodge, whereas Villa XX has a decentralized main hall, like Villa XXIV that presents a remarkable development of the wings that form a real open courtyard, with a sequence of rooms.

The H-shaped villas (VIII, IX, X, XXII, and XXIII) present a series of variations starting from the model of Villa VIII, characterized by a circular, centrally-located main hall, flanked by the two symmetrical wings parallel to the longitudinal axis. In Villa IX, the plan undergoes a 90° rotation: the central body develops along the longitudinal axis that houses the main hall, and the two wings form the front and rear façades. Villa X, which is similar in its size to Villa VIII, also has a centralized square hall, with four expansions along the sides. Villas XXII and XXIII show a loss of centrality of the main hall. In the latter case, the connecting body between the wings is considerably developed and the general contour figure, which in the previous cases was a square, becomes rectangular.

The cross-shaped villas (III, XVIII, and XXI) show a progressive complexity of the compositive theme. Villa III presents a square, centrally-located main hall, from which the rooms are developed in a telescope-like manner. Villa XVIII has the largest central hall, from which the four arms branch off, expanding into the terminal parts. Villa XXI is based on an octagonal centrally-located courtyard that superimposes the radial system on the axial system.

The X-shaped villas (IV and VII) show the need to consider spaces for connecting the different rooms. Villas IV and VII, inscribed in a square, consist of four square corner blocks connected to a central square block, used as the main hall. The connection between the blocks occurs, in the first case, using lodges along the sides of the central block that create alternative passages for the connection between

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the rooms. In the second, due to the intersection between the corner blocks and the central block, the main hall becomes the distribution center of the building.

Villa XIII, a unique case of the diagonal cross shape, can be considered as the result of shape researches on the cross-shaped villas and the X-shaped villas. The large octagonal courtyard and the two squares rotated by 45° that circumscribe the overall shape drive a radial composition that creates some difficulty in reconciling the general plan with the shapes and sizes of the individual rooms.

Relationships between the rooms and proportional ratios (Roberta Spallone)

While general symmetry relationships are present in all 24 villas, those among the rooms are less frequent, as these must respond to functional and distributive needs that do not always allow the symmetry of the rooms in relation to an axis. Twelve villas present symmetry relationships between the shapes of the rooms, not necessarily coinciding with those that rule the general shape. In one case (Villa III) Serlio experiments with anti-symmetry of the rooms around the central nucleus that generate a “swirling” effect in the plan. In Villas VII and VIII there are attempts of antisymmetric composition not completely successful.

Most of the rooms (about 57%) to which Serlio attributes dimensions have sides corresponding to one of the rectangular ratios, as documented in Table 1. The 1:1 ratio, which accounts for approximately 61% of the total of rooms in rectangular ratio, is the most applied ratio. The other ratios vary between about 3% and 9% of the total, for rooms in ratio $1:\sqrt{2}$ and 3:4 respectively. The 3:5 ratio, which Serlio describes as “a very beautiful ratio” (Villa XVII), is present in about 6% of the cases.

Regarding the proportional ratio prevailing within each villa, it can be observed that despite the clear prevalence of the square rooms, in some villas, Serlio adopts mainly another ratio. In Villa IX, the 4:5 ratio prevails, 3:4 in Villas IV and XXI, $1:\sqrt{2}$ in Villa XVIII, 2:3 in Villa VI and XXII (Figs. 1, 2, 3, 4).

Fig. 1 Comparative plate of proportional-geometric features, Villas I-VI. Drawings: Roberta Spallone

Fig. 2 Comparative plate of proportional-geometric features, Villas VII-XII. Drawings: Roberta Spallone

Fig. 3 Comparative plate of proportional-geometric features, Villas XIII-XVIII. Drawings: Roberta Spallone

Fig. 4 Comparative plate of proportional-geometric features, Villas XIX-XXIV. Drawings: Roberta Spallone

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As said in the methodological notes, in the present work we have chosen to consider only the exact ratios and the canonical approximations of the ratio $1: \sqrt{2}$. Instead, if Rosci's remarks about Serlio's Book VI, reasonably applicable to the Vienna Manuscript, had been taken into account, the number of rooms in rectangular ratio would have significantly expanded. Indeed, Rosci believes that it is clear and demonstrable that Serlio proposes his dimensions based on precise proportional ratios. He also explains that the dimensioning in Palladio's projects conventionally omits the thickness of the walls, so the dimensions of the building are obtained from the exact sum of the dimensions of the rooms, while in Serlio's projects they refer to the measurements of the internal perimeter of the rooms: the small differences with respect to perfect ratios can be explained precisely with the presence of even small "variables" of wall thicknesses. Therefore, in his analysis Rosci highlights Serlio's design intentions, beyond the objectively observable metric values.

The survey we carried out concerning the rectangular ratios present in the villas' rooms cannot deny that there are numerous rooms whose "imperfect" ratios are the result of Serlio's adjustments due to the need to consider the thickness of the walls. However, the variability and consistency of these thicknesses, often equal to three feet, and more rarely to four feet, would have given a certain degree of uncertainty to our analysis, which in this phase of the research seems to us prudent to avoid.

Geometric hypotheses on the compositive method (Roberta Spallone)

In some cases, Serlio emphasizes the character of the invention of his villas. Thus, describing Villa XIII, which is certainly one of the most original, Serlio states that "this house is very different than those I have ever seen" (Serlio n.d. [Vienna Manuscript]: fol. 4r, our trans.). As stated above, to highlight the underlying compositive criteria, the relationship between the boundary of the villa and the shape of the building can be investigated. In the majority of cases (17 out of 24), the boundary is a square. Moreover, in the case of Villa XXIV, a measure given in the text does not correspond to that in the drawing: this seems to reveal a first thought regarding a square outline. In another case, the outline responds to rectangular ratios, 3:5 for Villa VI.

The recurring reference to the large contour square suggests a compositive method *ad quadratum*, according to which the overall shape is divided through a modular grid, within which solids and voids of the building are juxtaposed. In the subdivision, a 3×3 matrix prevails, which in some cases could be considered regular (Villas III, IV, and XVIII), in others it presents a wider central module, identical on both sides (Villas II, VII, VIII, X, XI, XII, XVII, and XXI), while in others it still diversifies the two central modules (Villas IX and XXII).

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The partition of the large square also takes on 4×4 and 5×5 matrices (Villas XV and V). Also, in the horseshoe-shaped Villa XVI, the outline is a square. In this case, the 3×2 grid gives rise to a portion occupied entirely by the hall hemicycle and another by two wings. Finally, the square that surrounds Villa XIII, a diagonal cross rotated by 45° gives rise to the octagon that guides the arrangement of the four arms which, in turn, influence the size of the octagonal internal courtyard.

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Villa XIV has a large internal oval court. A 3×3 grid, with the central module of greater spans that rule the lengths of the oval axes, defines the entire composition. For the remaining seven cases (Villas I, VI, XIV, XIX, XX, XXIII, and XXIV), in which the regulatory figure is a rectangle, this seems to be valid for both the compositive criteria of a geometric kind and the additive logic underlying the compositive method of Serlio, as highlighted by historians (Carunchio 1989: 206; Kühbacher 1990: 169).

In Villas XIX and XX, the compositive scheme seems to be ruled (with some approximation), in the first case by the partial overlapping of two equal squares which shape the vestibule, and in the second by two equal squares whose distance generates the vestibule's space. In Villas XXIII and XXIV, the additive-type composition is manifested in the sequential arrangement of the rooms (Figs. 5, 6, 7, 8).

Fig. 5 Comparative plate of functional-distributive features, Villas I-VI. Drawings: Marco Vitali

Fig. 6 Comparative plate of functional-distributive features, Villas VII-XII. Drawings: Marco Vitali

Fig. 7 Comparative plate of functional-distributive features, Villas XIII-XVIII. Drawings: Marco Vitali

Fig. 8 Comparative plate of functional-distributive features, Villas XIX-XXIV. Drawings: Marco Vitali

The main hall as a regulating element of the composition (Marco Vitali)

Other interesting considerations can be made on the relationships between the position of the main hall and the general structure of the villas. In 13 of the 24 villas, the main hall is on the entrance axis of the complex, assuming in 9 villas a central position, in the other four a position translated in relation to the center. When it assumes a central position it clearly declares its dominant role of distribution: only in the case of Villa I, it assumes a central position even on a rectangular scheme.

In many cases of centrality of the main hall it always assumes a square shape (Villas III, IV, VII, and XVIII), or in rare cases oval (Villa I), octagon (Villa II), circular (Villa VIII), or square with expansion in the four main directions (Villa X). The main hall, therefore, sets the dimensions of the

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central field of the compositional grid, of ratio 1:1 and produces symmetrical fields along the two longitudinal and transverse axes of the grid. In just one case, that of the Villa IX, while maintaining a central position, it takes the shape of the double square, generating a compositional grid with modules of different ratios along the two axes.

When the main hall is translated along the entrance axis, it defines the width of the subdivision modules in plan along that axis, and occupies a central position with respect to the back façade of the building (Villas XI, XIV, XV). Only in the case of Villa XVI, the compositional grid of which can be assumed to be 3×2 , does the main hemicycle-shaped hall occupy the three modules of the back façade. In contrast, it takes a position along the transversal axis in Villas XII, XVII, XXII and XXIII, assuming an elongated shape, and in only one case using rectangular ratios (ratio 2:3 in Villa XXIII). In these villas, the translation of the main hall position can be justified by the presence of an internal courtyard (Villas XII, XVII) or by the H-shaped configuration, in which the center is occupied by a lodge (Villa XXII, where the central body is extremely thin) or by a vestibule (Villa XXIII). A separate mention must be made for Villa XIII, in which the general organization depends on a courtyard and the main hall is placed on one of the arms of the diagonal cross, according to one of the diagonal axes. In the remaining villas (V, VI, XX, and XXIV) the main hall, always elongated, is placed in a corner position (V and VI) or in a decentralized position on the back façade of the building (XX and XXIV).

An anomaly is instead represented by Villa XIX, which does not include a main hall. Serlio himself, in the textual description of the villa, reports: “From the right side there is a little hall C... This villa has no main hall, but as it is designed as a summer villa, the terrace and the lodge will take the place of it, according to the position of the sun” (Serlio n.d. [Vienna Manuscript]: fol. 6v, our trans.).

It is also possible to make an analysis in relation to the rooms of entrance to the main hall following the path of access to the villa. In only four villas (I, VII, VIII, and X) can the main hall be directly reached without going through any other room. In Villa V, the main hall can be reached directly from the internal garden: this is because of the particular shape of the courtyard, that is opened along the longitudinal and transverse axis.

In Villas IV, XI, and XXII, the main hall has direct access from a lodge. In all other cases, the main hall is reached by differently composed and increasingly complex systems: from a simple vestibule (VI, IX, XX, XXIII, and XXIV), which in one case is reduced to a small-sized corridor (XVI), to a system of lodge and vestibule (II, XVIII, and XXI) or vestibule and lodge (XVII), or vestibule and

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2 internal courtyard (XII, XIII, and XIV), double lodge and courtyard (XV), and finally a system
3 composed of a vestibule and a little hall (III).

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5 ***Proportioning criteria and dimensions of the rooms (Marco Vitali)***
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8 Another theme of interest is related to the shape and size of the rooms in relation to the intended use.
9 Starting from the entry spaces and those that distribute the main hall, it is easy to notice how normally
10 they are proportioned with recurring criteria. The lodges always present an elongated shape that
11 never assumes rectangular ratio. The vestibules, when present (in 15 villas out of 24), are mainly
12 elongated: in Villas VI, XII, XIV, XVII, XIX, and XX they present the 1:2 ratio, in two cases, doubled
13 along the secondary façade (XII, XVII); in Villa II it has a 2:3 ratio; in Villa XIII it has a $1:\sqrt{2}$ ratio;
14 in Villas IX, XIII, and XXIV a square ratio (1:1). In the remaining cases, the vestibules have
15 dimensions that do not follow any of Serlio's preferred rectangles from Book I on Geometry.
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24 Anterooms and little halls are present in 12 out of 24 villas, and mainly have a prevalent sizing with
25 rectangular ratio of 3:4 (V and XXI) or very close to it (VI and XIII), sometimes with a square ratio
26 (III, XXIII and XXIV).
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31 The bedrooms, present in large numbers in every villa, deserve a more general discourse: in great
32 prevalence they are proportioned on the square shape, which presents, also in relation to the size of
33 the villas, modules of 16×16 feet (I), 20×20 (XI and XIX), 21×21 (II and III), or 22×22 (IV and
34 VIII) and, in the vast majority of cases 24×24 feet (V, VI, X, XII, XIII, XIV, XVI, XVII, XX, XXII,
35 XXIII, and XXIV); only in exceptional cases do they reach larger dimensions, as in the case of Villa
36 XIV (25×25 feet) or in Villa VII, in which the 25×25 module is associated with the circular and
37 octagonal shapes, or in the case of the Villa XXIII, with a truly impressive size, reaching up to $30 \times$
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49 ***Case studies (Marco Vitali)***
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52 Following the comparative analysis of the 24 villas, a detailed analysis of some case studies, critically
53 selected as representative sample of the whole series, was organized. Villas of different shapes and
54 sizes have been chosen: block-, cross-, horseshoe-, and H-shaped, ranging from the smallest (Villa I,
55 about 2000 square feet) to the largest (Villas XIII and XXIII, about 12000 square feet).
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59 The selected cases testify to how the rectangular ratios are used differently for the proportioning of
60 the rooms in relation to the logic of composition: the composition of the general figure with modules,
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as much as possible, respecting rectangular ratios (Villas VI and XXIII), the prevailing use of a certain rectangular ratio for the definition of almost all the rooms (such as the square module in Villas III and X), and a freer proportioning of the rooms in relation to certain difficulties of composition. Losses of the proportional criterion often occur:

- when, in the presence of general symmetries, parts of the building are organized in sequences of differently shaped rooms, where the wall thickness plays a fundamental role (Villas VI, XIII, XXIII and XXIV);
- when the subdivision of the plan in rooms it is necessary because of distribution requirements (Villas II and III);
- when the rooms due to their function assume a particularly elongated configuration, as in the case of lodges or in the expansions of a room (as in Villas II and X);
- when residual spaces with particular shapes and/or ratios have to be divided (Villas VI and XIII).

Lastly, it should be noted that the choice of cases also considered the analyses carried out by other scholars, which relate the individual villas by Serlio with the subsequent production by the young Palladio. Beyond some similarities related to the general principles of composition, such as the raising of the ground floor of at least five feet, or a clear symmetry in the layout of the façades (Rosci 1966a: 34), there are some precise reverberations of the Serlian models in Palladio's work:

- as in Villa II, connected by Frommel with a design for a villa (RIBA VIII, 13r) which is a variation of the Odeon Cornaro of Falconetto in Padua (Frommel 2008: 68), and connected by Rosci with a drawing (RIBA XVII, 1) for Villa Pisani in Bagnolo, which is a prelude to the final version of the Villa Rotonda (Rosci 1966b: 131);
- as in the case of Villa VI, which Frommel compares to another drawing by Palladio for Villa Pisani (RIBA XVII, 17) in relation to the organization of the entrance with an exedra and a circular stair (Frommel 2008: 68).

In order to facilitate the reading of individual cases, we present Table 2, which provides, for each villa, some information regarding the size of the villa in relation to the area of the lot on which it sits, when possible, and the indication of the dimensions of the rooms, grouped by homogeneity of intended use: vestibules (V) and lodges (L), main halls (H), halls and antechambers (h), bedrooms (R), service rooms (r), and dressing rooms (dr). The intention is to show, through some numerical data, the characteristic aspects of each villa.

Table 2 Dimensional and functional features of the case studies

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3 ***Villa I***
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6 The reading of the general structure of the building would suggest an additive composition of rooms:
7 they are organized into two mirror-like apartments connected by the central space of the main hall,
8 oval in shape with niches “in which there will be benches to sit on” (Serlio n.d. [Vienna Manuscript]:
9 fol. 1r, our trans.). The composition logic emphasizes the axuality with respect to the entrance
10 direction, also highlighted by the organization of the access stairs. As already highlighted in the
11 general part, the bedrooms follow the most common logic of proportioning: they have a square
12 dimension and stand on a minimum size, given the small overall dimensions of the system (Fig. 9).
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20 **Fig. 9** Sebastiano Serlio, Villa I. Graphic overlay of the proportional-geometric and functional-distributive
21 analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 32v, reproduced by
22 permission; graphic overlay: Marco Vitali
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26 ***Villa II***
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29 The plate represents a building of medium size (about 7000 square feet). It seems quite evident how
30 the composition of the building arises from the subdivision of a base square. It is possible to
31 hypothesize that the organization of the plan in a 3×3 grid follows the criterion of subdividing the
32 sides of the square into 1, $\sqrt{2}$, and 1 modules.
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38 The scheme proposes the octagonal main hall (30×30 feet) with niches in a central position, to
39 occupy the largest field of the base grid, emphasizing a double longitudinal and transversal axuality.
40 The angular fields of the grid are occupied by square bedrooms of average size, while the axial fields
41 of the perimeter, characterized in our hypothesis by a ratio of $1:\sqrt{2}$, are divided into rooms that differ
42 as follows:
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48 - on the entrance axis, two lodges of elongated ratio are located – conferring particular strength
49 on the longitudinal axis – and rooms linked to the ceremonial entry and reception (vestibule
50 2:3 and accessory rooms 3:4);
51
52 - on the transversal axis, there are two further vestibules (very elongated), two rooms serving
53 the corner rooms, small dressing rooms, and spiral staircases. The rooms (apart from the
54 square dressing rooms) do not follow a codified ratio: rather they seem to respond, within the
55 limits of the space dedicated to them, to functional needs (Fig. 10).
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Fig. 10 Sebastiano Serlio, Villa II. Graphic overlay of the proportional-geometric and functional-distributive analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 33, reproduced by permission; graphic overlay: Marco Vitali

Villa III

The built area (about 6500 square feet) is organized “in the form of a cross” (Serlio n.d. [Vienna Manuscript]: fol. 1r, our trans.). The general organization is a grid of nine fields, defined in their dimensions by the central field on which sits the main hall, which is the largest room in the whole villa (40 × 40 feet), occupying 25% of its built surface. The translation along the diagonals of the central square, with a partial overlap to the central field, defines the space occupied by the gardens, as is evident from the layout of the flowerbeds.

Almost all the rooms of the entire villa are designed on the square module, used for the main hall and the halls on the longitudinal axis, while the bedrooms and the service rooms are on the transverse axis. The other rooms (vestibules with adjoining rooms and dressing rooms) are dimensioned without reference to the rectangular ratios to fill, with the staircases, the areas of the cross left free by the square modules. The general organization follows an anti-symmetric setting; the balance between the axes is only partially offset by the presence, along the entrance axis, of the stairs connecting to the gardens (Fig. 11).

Fig. 11 Sebastiano Serlio, Villa III. Graphic overlay of the proportional-geometric and functional-distributive analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 34v, reproduced by permission; graphic overlay: Marco Vitali

Villa VI

The organization of Villa VI deserves special mention. As Serlio states, “its main façade will have partly the shape of a theater” (Serlio n.d. [Vienna Manuscript]: fol. 2r, our trans.). The plan is of medium size (about 6000 square feet) and includes rooms mainly defined by rectangular ratios, which seem to be juxtaposed to fill the rectangular outline of 3:5 ratio.

The layout of the villa is symmetrically configured with respect to the entrance axis, on which a vestibule (1:2) is placed: this symmetry is broken by the main hall on the right side, which does not correspond to the coupled hall on the left. The bedrooms (of medium size), the service rooms, the dressing rooms, and the staircases along the wings of the building are in symmetry. In the spaces

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2 within the hemicycle of the garden, a small vestibule with a dressing room, a chapel, and two
3 staircases, disrupt the symmetry of the composition (Fig. 12).

4 **Fig. 12.** Sebastiano Serlio, Villa VI. Graphic overlay of the proportional-geometric and functional-
5 distributive analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 37,
6 reproduced by permission; graphic overlay: Marco Vitali
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10 *Villa X*

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12 The plan of the villa of medium size (about 7000 square feet) comes from the subdivision of the
13 square: the central field of larger dimensions is occupied by the central hall (48 × 48 feet), which
14 occupies almost 30% of the plan. In the corner fields are placed the square bedrooms of the four
15 apartments into which the complex is sub-divided. The central fields on the sides of the figure can be
16 assimilated into four modules of 3:5 ratio, which are attached on the expansions of the central hall,
17 generating small recesses in the façade: the two modules positioned along the entrance axis are
18 intended for a garden, underlining the longitudinal axial organization, while those positioned along
19 the transverse axis host pairs of square service rooms (Fig. 13).
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30 **Fig. 13.** Sebastiano Serlio, Villa X. Graphic overlay of the proportional-geometric and functional-distributive
31 analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 42v, reproduced by
32 permission; graphic overlay: Marco Vitali
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36 *Villa XIII*

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38 Villa XIII is one of the largest examples (about 12000 square feet), important for the complexity of
39 its geometric and distributive composition. The scheme of the plan can be read from the square shape
40 that defines the space of the garden, which, rotated 45° around its center, defines the dimension of
41 the building's arms, articulated around a large octagonal courtyard (80 feet in diameter). The structure
42 develops with an almost complete symmetry relative to the longitudinal and transversal axes and the
43 diagonal axes: this symmetry is only partially weakened by the different configuration of the
44 connections between the different arms of the building. The entrance axis is emphasized by the
45 staircase bodies connecting with the garden.
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55 The composition of the rooms seems to show, in each of the fields that form arms and courtyard ring,
56 alternative distribution solutions, as Serlio explicitly suggests in the descriptions of Villa XII (Serlio
57 n.d. [Vienna Manuscript]: fol. 4r): this would justify the differences in the depth of the courtyard ring,
58 the positioning, often alternating, of staircases, and the different solutions for the organization of the
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2 apartments. The rectangular ratios, as already underlined, find little use here, perhaps because of the
3 difficulties also constituted by the complex articulation of the plan.

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5 The arms of the cross are proportioned by building four diagonal modules with a rectangular ratio
6 (1:2), which define the positions of the other rooms:
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- 10 - the two arms facing the entrance house two apartments, each consisting of a bedroom and
11 service areas (in one case with rooms defined by the repetition of the 24×24 square module,
12 in the other by differently sized rooms, including a staircase).
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- 15 - the two arms facing the back façade of the villa hold, on one side, the main hall, almost
16 corresponding to the rectangle of ratio 1:2, and on the other side, a hall with service rooms
17 and a staircase.
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22 The connecting curtains between the arms, of different depths, house:
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- 25 - in the direction of the entrance, aligned with the two accesses to the garden, a vestibule, and
26 accessory compartments;
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- 28 - in the transversal direction, on one side a small room, and on the other a room with relative
29 accessory compartments and staircases (Fig. 14).
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34 **Fig. 14.** Sebastiano Serlio, Villa XIII. Graphic overlay of the proportional-geometric and functional-
35 distributive analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 45,
36 reproduced by permission; graphic overlay: Marco Vitali
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38 39 *Villa XXIII*

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43 Villa XXIII is presented in a plate that shows the building, of considerable size (about 12700 square
44 feet), inside a very large garden, characterized by corner pavilions. The general composition is
45 governed by an additive logic, organized with respect to the two longitudinal and transversal axes.
46
47 On the longitudinal axis is placed the vestibule to which the main hall is linked on one side, which
48 approaches the ratio 1:2, and on the other side an antechamber and a large square room (30×30 feet).
49
50 At the end of the sequence, there are two symmetrical rooms in rectangular ratio 4:5 (24×30 feet).
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52 In the wings that make up the arms of the H-shaped configuration, there are four apartments, each
53 consisting of a square room (24×24 feet), a dressing room, and a staircase (Fig. 15).
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Fig. 15. Sebastiano Serlio, Villa XXIII. Graphic overlay of the proportional-geometric and functional-distributive analyses. Image: Vienna, Österreichische Nationalbibliothek, Cod. Ser. n. 2649, fol. 58v, reproduced by permission; graphic overlay: Marco Vitali

Conclusion (*Roberta Spallone, Marco Vitali*)

The graphical analysis and the comparison between the drawings of the 24 villa models by Serlio has highlighted the relationships between geometry, proportional relationships, and architecture present in the composition of the plans, which had until now been unexplored. Notwithstanding the fact that the drawings present Serlio's inventions and are not designs destined to be built, they reveal:

- The relationships between the geometric characteristics of symmetry with respect to one or two axes and the morphological types of plans;
- The presence of symmetries and anti-symmetries in the placement of the rooms;
- Compositional recurrences and variations on the theme for the different types in relation to geometric transformations, rotations, translations, and expansions;
- The wide application of rectangular ratios in the dimensioning of the rooms;
- The application of the compositional method *ad quadratum*, based on which the outline figure is subdivided by a modular grid that governs the arrangement of buildings and gardens;
- The importance of the main hall as a centralizing and regulating figure of the entire composition;
- The use of different rectangular ratios depending on the functions of the rooms and the prevalence of some measures in each type of room.

A development of the present research foresees the study of the relationships between the proportions of the lengths and widths of the rooms and their heights, also verifying the morphological and constructive compatibility of the proposed roofing systems. In this sense, three-dimensional digital models of synthesis could facilitate the spatial recomposition of the 24 villas, providing an understanding of the paths and the use of the rooms. Further ideas could arise from a widespread comparison, including graphic analyses, of the drawings in Book VII and, above all, with the models of private houses drawn in the two manuscripts of Book VI. Moreover, the possible links between the works of Serlio and Palladio, including a strict comparison between Serlio's and Palladio's plans, should be the subject of future work.

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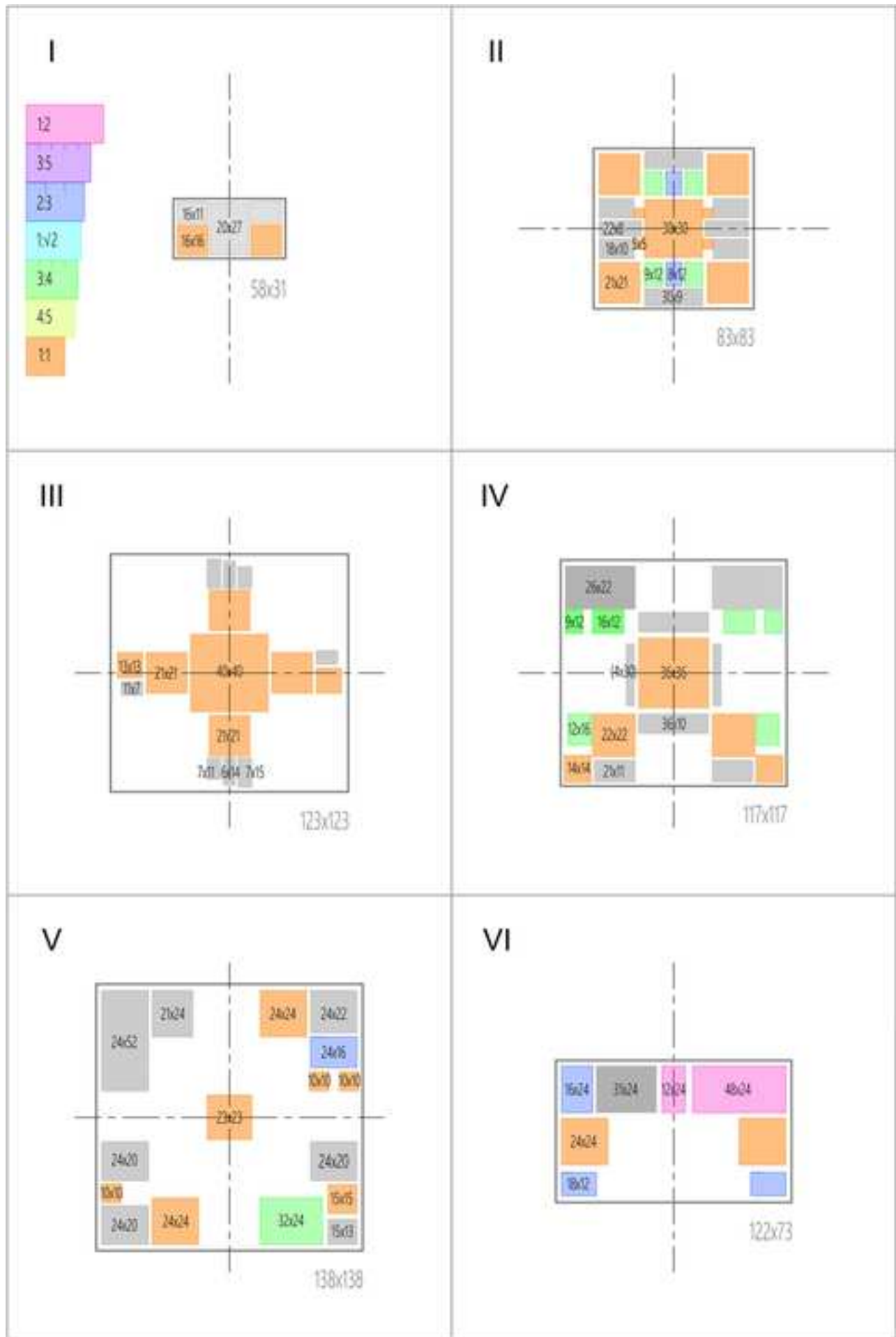
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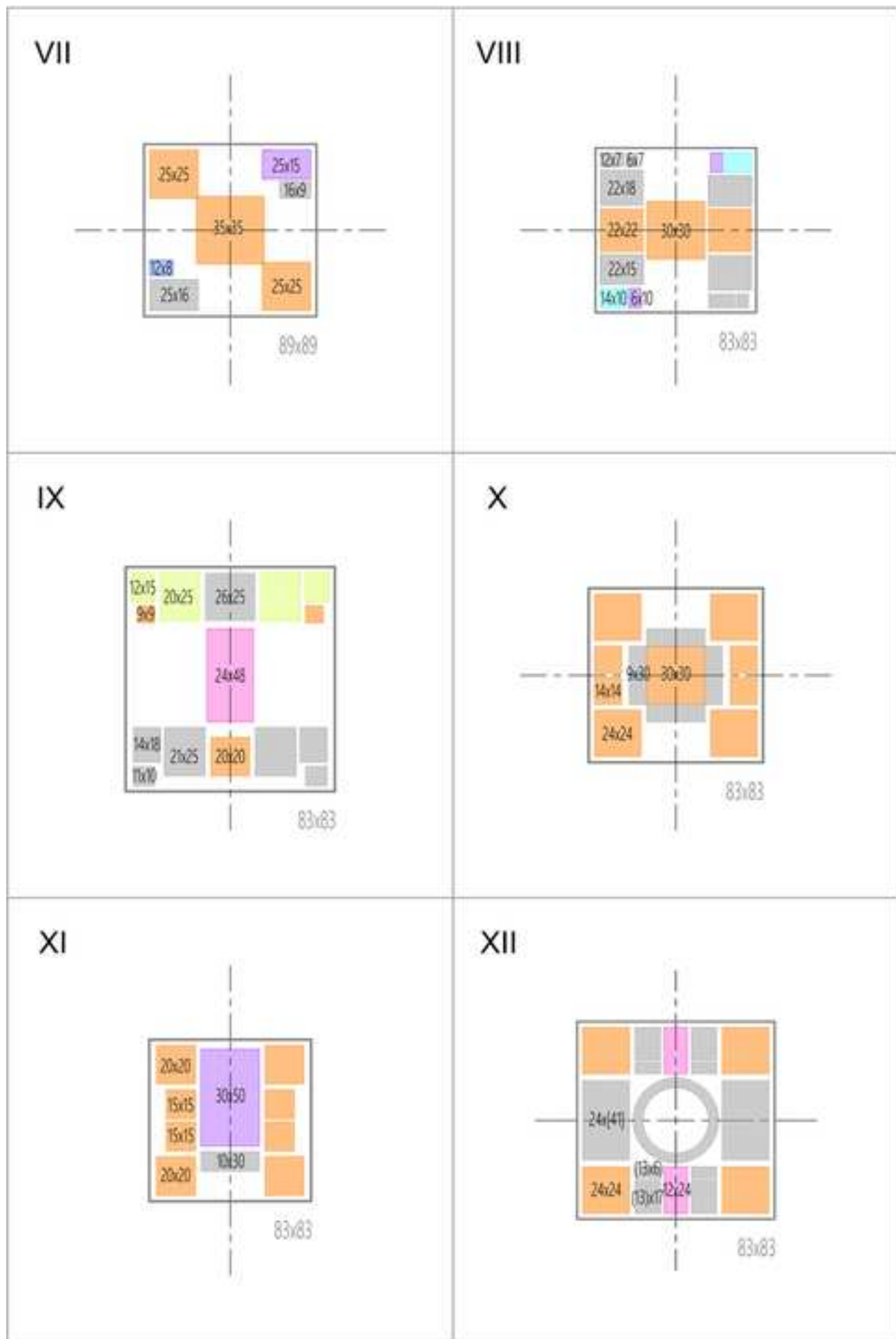
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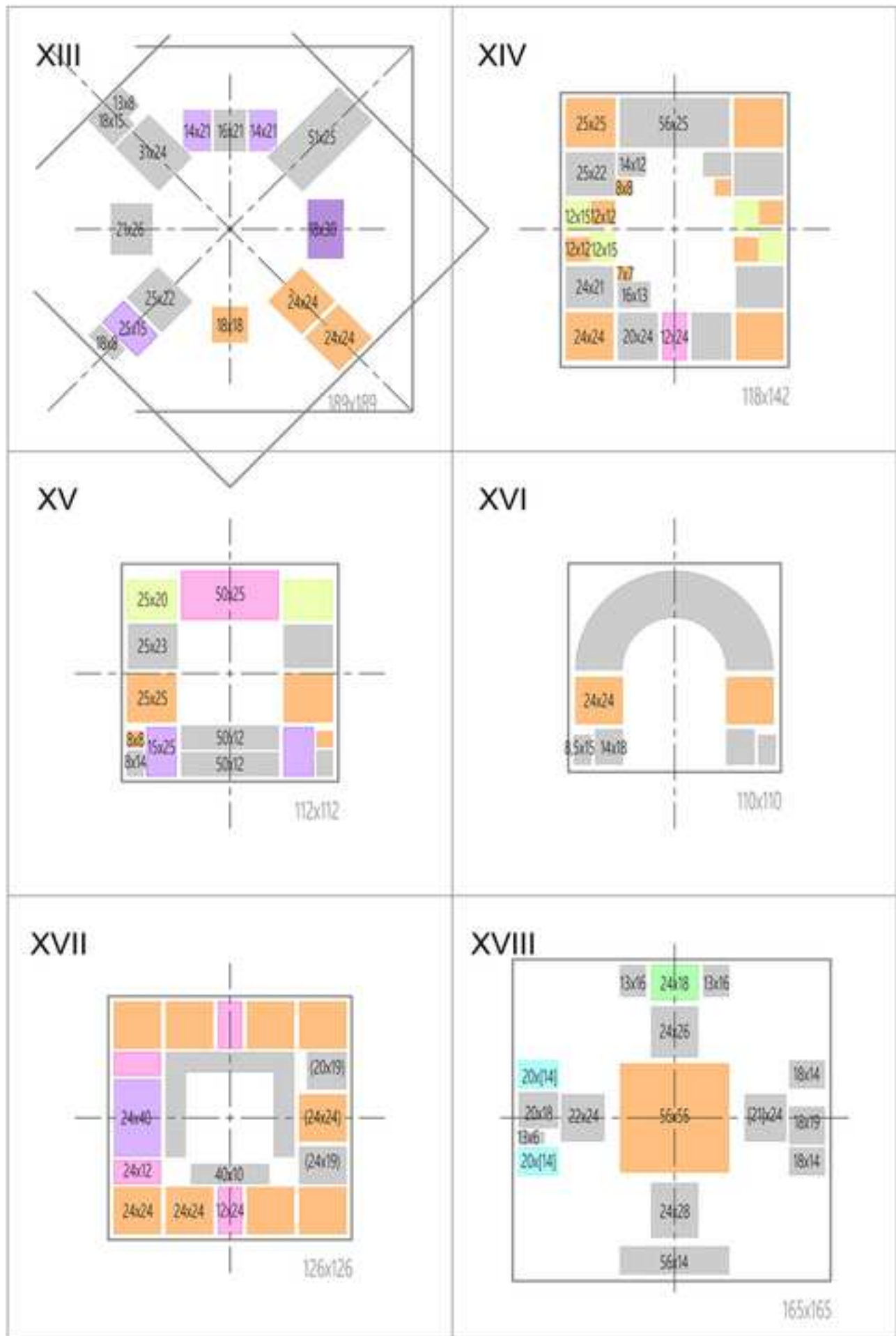
villa n.	typology	building boundary	plot area (feet)	shape symmetry	rooms symmetry	rectangular ground floor rooms	rooms in rectangular proportions (%)								main proportional ratio	areas in rectangular proportions (%)	drawing scale ratio
								1:1	4:5	3:4	1:√2	2:3	3:5	1:2			
I	block	R (none)	58x31	L	L	5	40%	2	0	0	0	0	0	0	1:1	36%	≈1:102
II	block	SQ	83x83	L - T	L - T	23	65%	9	0	4	0	2	0	0	1:1	68%	≈1:143
III	cross	SQ	123x123	L - T	A (L - T)	15	47%	7	0	0	0	0	0	0	1:1	84%	≈1:223
IV	X shape	SQ	117x117	L - T	L	19	58%	5	0	6	0	0	0	0	3:4	59%	≈1:188
V	courtyard	SQ	138x138	L - T	none	16	56%	7	0	1	0	1	0	0	1:1	46%	≈1:324
VI	horseshoe-shaped	R (3:5)	122x73	L	none	8	88%	2	0	0	0	3	0	2	2:3	83%	≈1:210
VII	X shape	SQ	89x89	L - T	none	7	71%	3	0	0	0	1	1	0	1:1	84%	≈1:154
VIII	H shape	SQ	83x83	L - T	none	15	47%	3	0	0	2	0	2	0	1:1	57%	≈1:238
IX	H shape	SQ	83x83	L	L	15	53%	3	4	0	0	0	0	1	4:5	56%	≈1:181
X	H shape	SQ	83x83	L - T - D	L - T	13	69%	9	0	0	0	0	0	0	1:1	79%	≈1:157
XI	block	SQ	83x83	L	L	10	90%	8	0	0	0	0	1	0	1:1	93%	≈1:201
XII	courtyard	SQ	83x83	L - T	L - T	16	38%	4	0	0	0	0	0	2	1:1	48%	≈1:232
XIII	diagonal cross	SQ	189x189	L - T	none	15	47%	3	0	0	0	2	2	0	1:1	43%	≈1:351
XIV	courtyard	R (none)	118x142	L - T	none	26	62%	11	4	0	0	0	0	1	1:1	43%	≈1:238
XV	courtyard	SQ	112x112	L - T	L	15	60%	4	2	0	0	0	2	1	1:1	63%	≈1:250
XVI	horseshoe-shaped	SQ	110x110	L	L	6	33%	2	0	0	0	0	0	0	1:1	60%	≈1:210
XVII	courtyard	SQ	126x126	L - T	T	17	82%	9	0	0	0	0	1	4	1:1	86%	≈1:330
XVIII	cross	SQ	165x165	L - T	none	16	25%	1	0	1	2	0	0	0	1:√2	46%	≈1:293
XIX	U shape	R (none)	110x67	L	L	10	50%	2	0	0	0	0	2	1	-	40%	≈1:197
XX	U shape	R (none)	130x59	L	none	8	63%	4	0	0	0	0	0	1	1:1	56%	≈1:210
XXI	cross	SQ	167x167	L - T	none	19	47%	2	1	4	0	2	0	0	3:4	57%	≈1:308
XXII	H shape	SQ	109x109	L	none	11	55%	2	0	1	0	3	0	0	2:3	63%	≈1:166
XXIII	H shape	R (none)	217x124	L - T	T	10	90%	6	2	0	1	0	0	0	1:1	76%	≈1:463
XXIV	U shape	R (none)	185x166	L	none	15	47%	6	1	0	0	0	0	0	1:1	33%	≈1:325
TOT	/	/	/	/	/	330	/	114	14	17	5	14	11	13	/	/	/

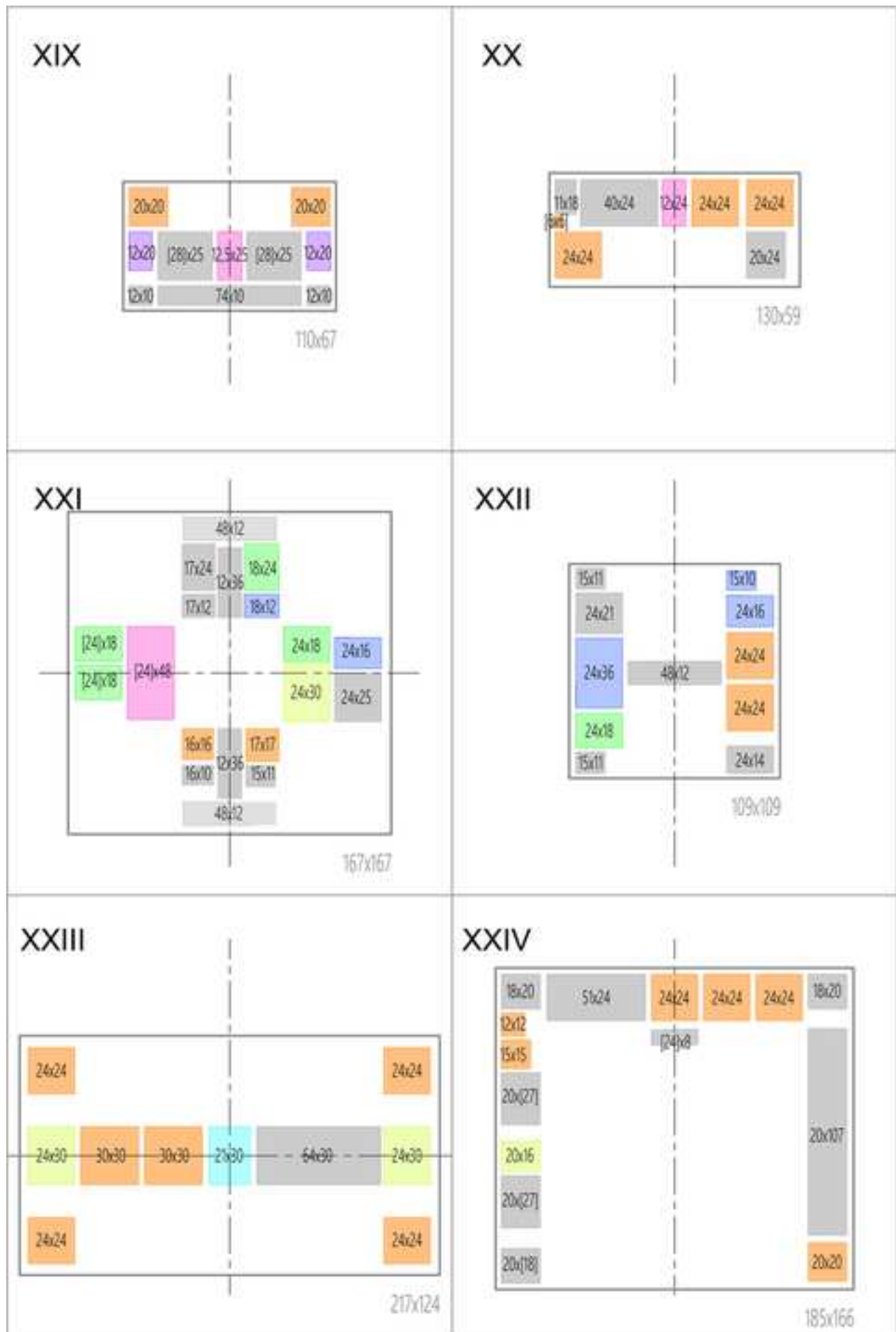
	type of room	letter on the plate	dimensions (feet)	proportional ratio	area (square feet)	% of built area	
I built area: ≈1950 square feet	H	A	20 x 27	none	540	28 %	
	R	B ₁ -	16 x 16	1:1	512	26 %	
	r	C ₁ -	16 x 11	none	352	18 %	
II built area: ≈8900 square feet	L	A ₁ -	30 x 9	none	540	8 %	
					540	8 %	L tot
	V	B ₂ -	8 x 12	2:3	192	3 %	
	V	D ₁ -	22 x 8	none	352	5 %	
					544	8 %	V tot
	H	C	30 x 30	1:1	900	13 %	
					900	13 %	H+h tot
	R	E ₁ -	21 x 21	1:1	1764	26 %	
					1764	26 %	R tot
	r	F ₁ -	18 x 10	none	720	10 %	
	dr	G ₁ -	9 x 12	3:4	432	6 %	
dr	-	5 x 5	1:1	100	1 %		
				1252	18 %	r+dr tot	
III built area: ≈4400 square feet	V	A, H	6 x 14	none	168	3 %	
					168	3 %	V tot
	H	C	40 x 40	1:1	1600	25 %	
	h	B, G	21 x 21	1:1	882	14 %	
					2482	39 %	H+h tot
	R	D ₁ -	21 x 21	1:1	882	14 %	
					882	14 %	R tot
	r	F, K ₁ -	7 x 11	none	308	5 %	
	r	-	7 x 15	none	210	3 %	
	r	E ₁ -	13 x 13	1:1	338	5 %	
				856	13 %	r+dr tot	
VI built area: ≈5600 square feet	V	D	12 x 24	1:2	288	5 %	
					288	5 %	V tot
	H	G	48 x 24	1:2	1152	19 %	
	h	E	31 x 24	none	744	13 %	
					1896	32 %	H+h tot
	R	B, H	24 x 24	1:1	1152	19 %	
	R	F	16 x 24	2:3	384	6 %	
				1536	26 %	R tot	
r	C, I	18 x 12	2:3	432	7 %		
				816	7 %	r+dr tot	
X built area: ≈7000 square feet	H	B	30 x 30	1:1	900	13 %	
		C (expansions)	9 x 30	none	1080	15 %	
					1980	28 %	H tot
	R	D, F ₁ -	24 x 24	1:1	2304	33 %	
				2304	33 %	R tot	
r	E, G ₁ -	14 x 14	none	784	11 %		
				784	11 %	r tot	

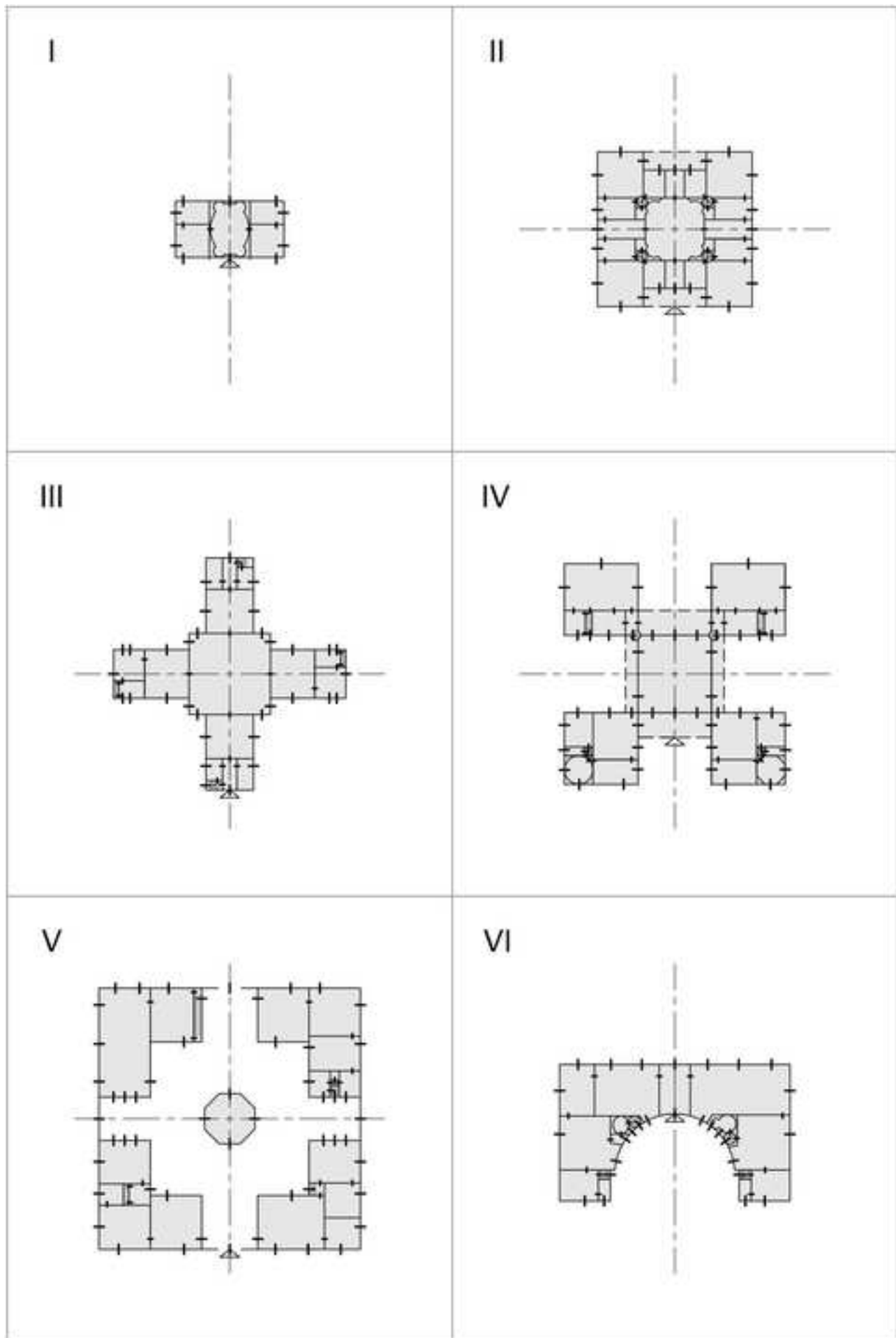
	type of room	letter on the plate	dimensions (feet)	proportional ratio	area (square feet)	% of built area	
XIII built area: ≈11800 square feet	V	A	18 x 18	1:1	324	3 %	
	V	M	16 x 21	none	336	3 %	
					660	6 %	V tot
	H	P	51 x 25	none	1275	11 %	
	h	I	24 x 31	none	744	6 %	
	h	Q	18 x 30	3:5	540	5 %	
					2559	22 %	H+h tot
	R	C	25 x 22	none	550	5 %	
	R	F	21 x 26	none	546	5 %	
	R	R	24 x 24	1:1	576	5 %	
					1672	14 %	R tot
	r	D	25 x 15	3:5	375	3 %	
	r	K	18 x 15	none	270	2 %	
	r	N, O	14 x 21	none	588	5 %	
	r	S	24 x 24	1:1	576	5 %	
	dr	G, H, +, +	? x ?	?	?	? %	
	dr	E	18 x 8	none	144	1 %	
dr	L	13 x 8	none	104	1 %		
				2057	17 %	r+dr tot	
XXIII built area: ≈12700 square feet	v	E	21 x 30	1:√2	630	5 %	
					630	5 %	V tot
	H	I	64 x 30	none	1920	15 %	
	h	F	30 x 30	1:1	900	7 %	
					2820	22 %	H+h tot
	R	C, C, M, O	24 x 24	1:1	2304	18 %	
	R	G	30 x 30	1:1	900	7 %	
					3204	25 %	R tot
	R	K	30 x 24	4:5	720	6 %	
	r	H	30 x 24	4:5	720	6 %	
dr	D, O, N, P	? x ?	?	?	? %		
				1440	11 %	r+dr tot	

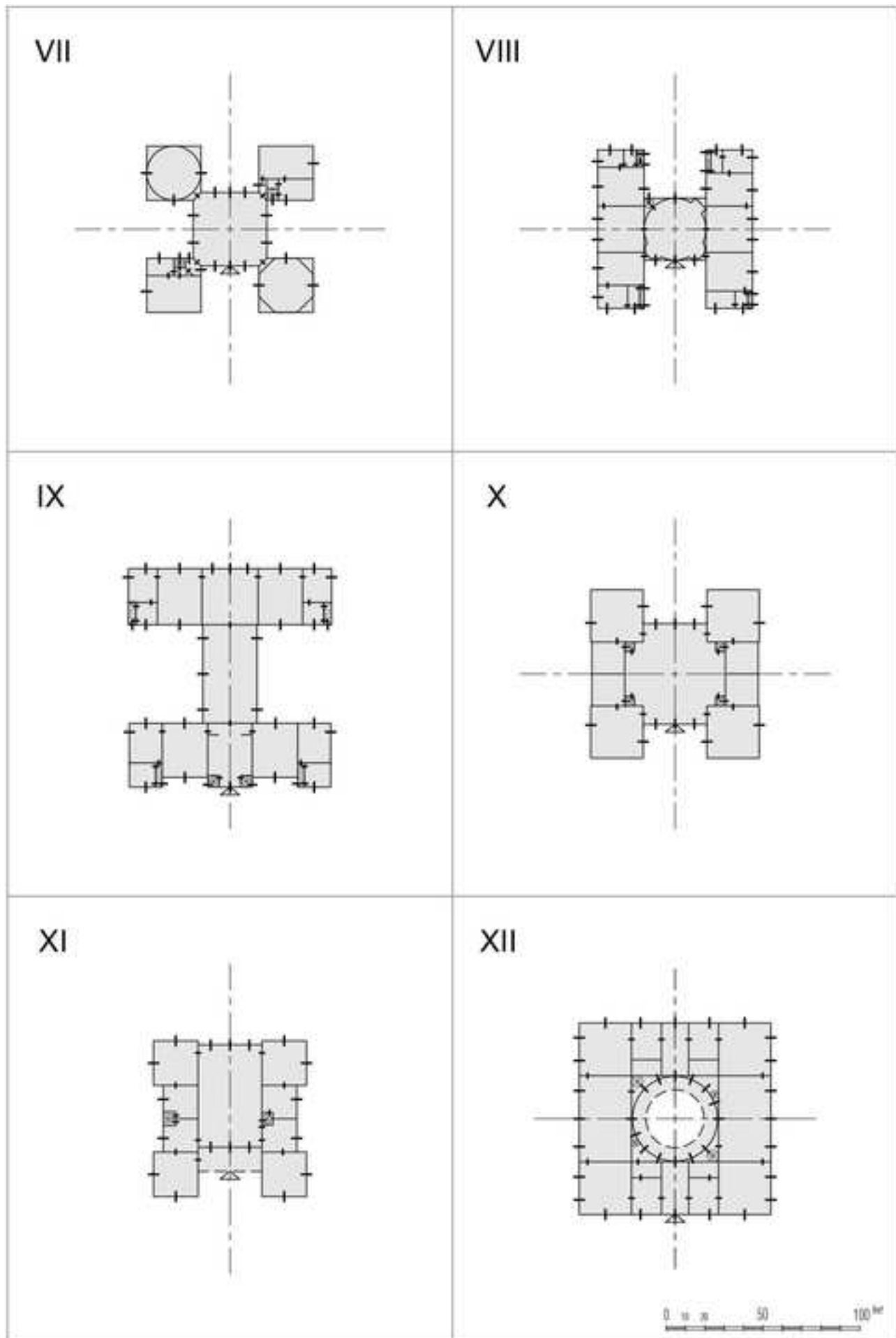


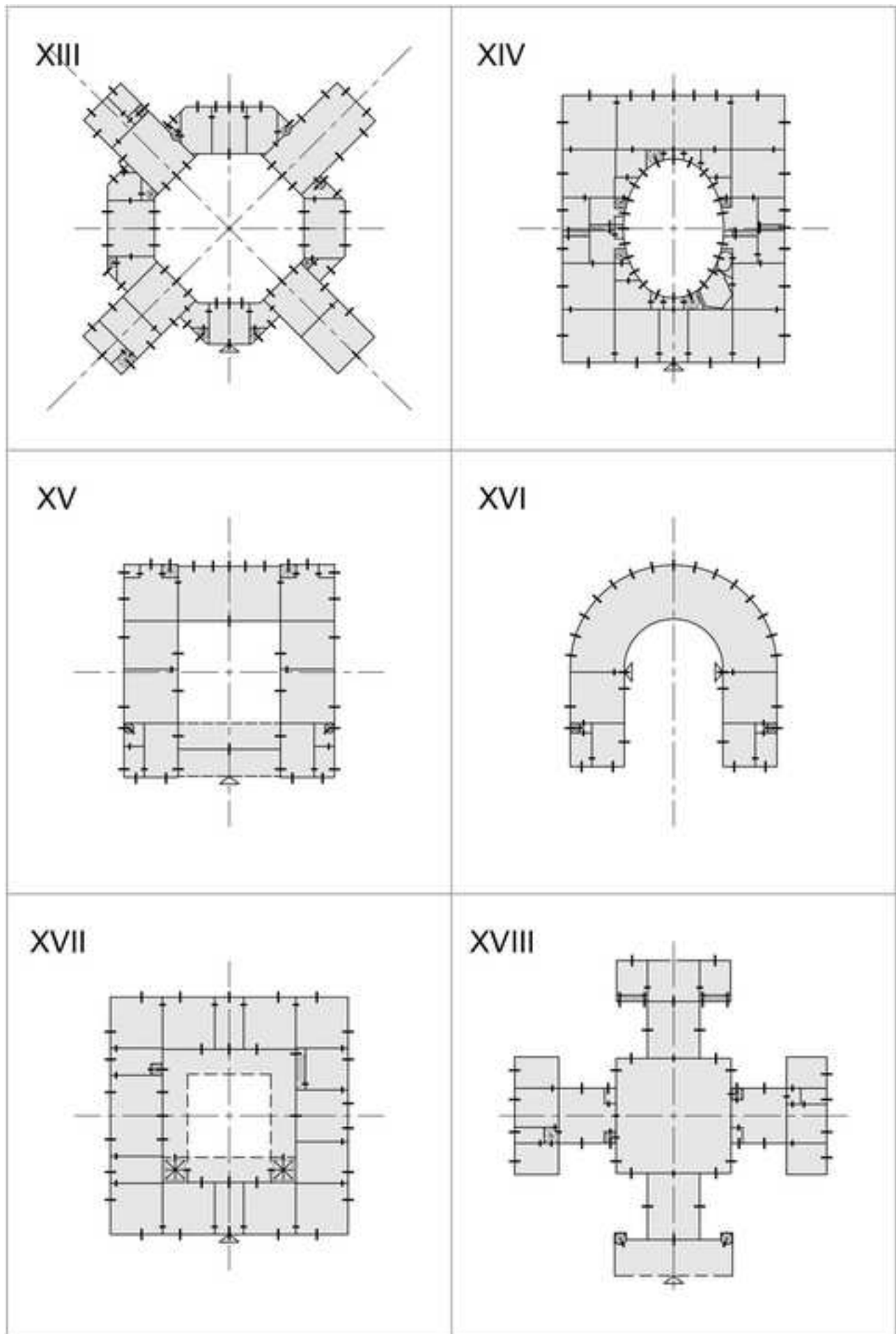


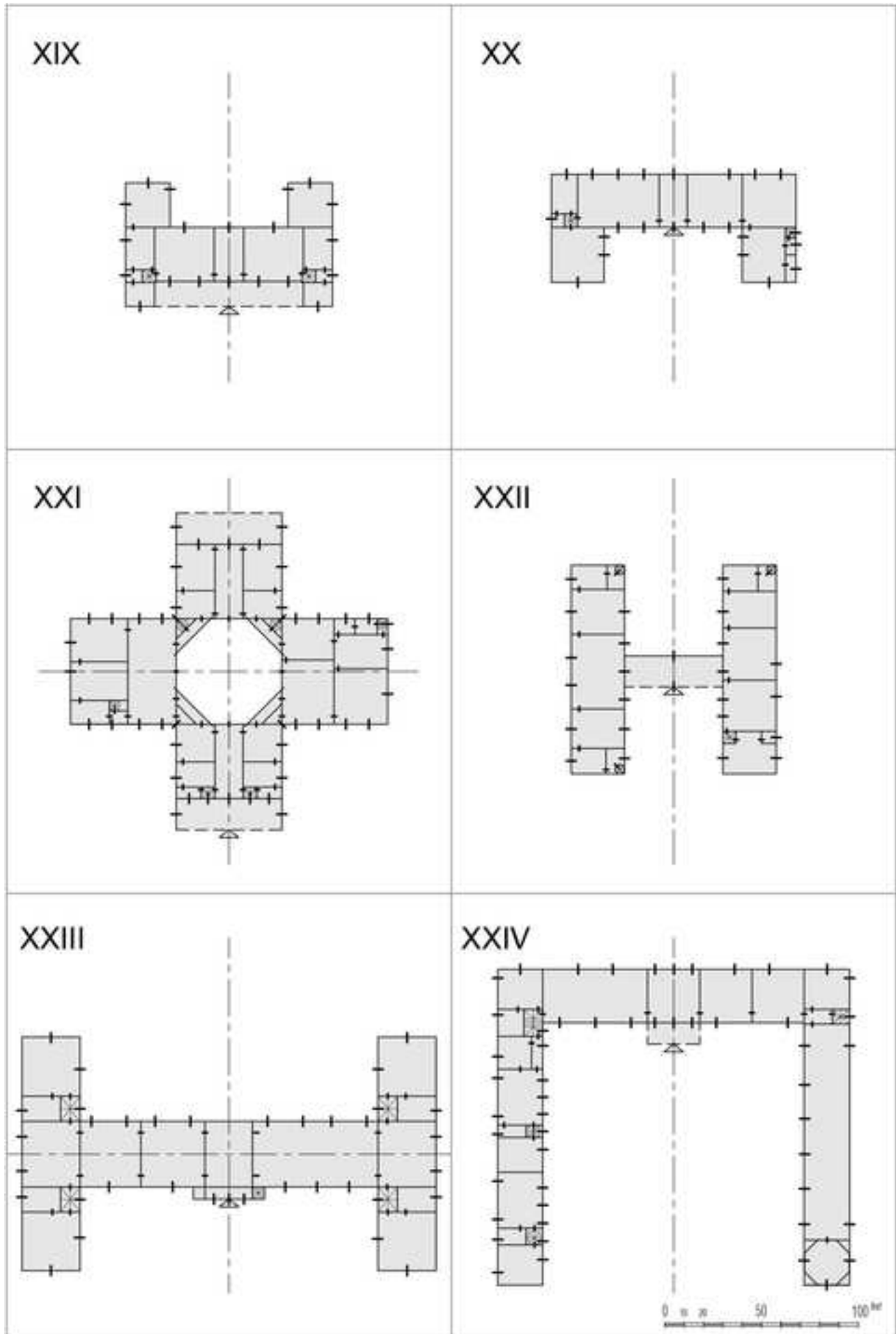


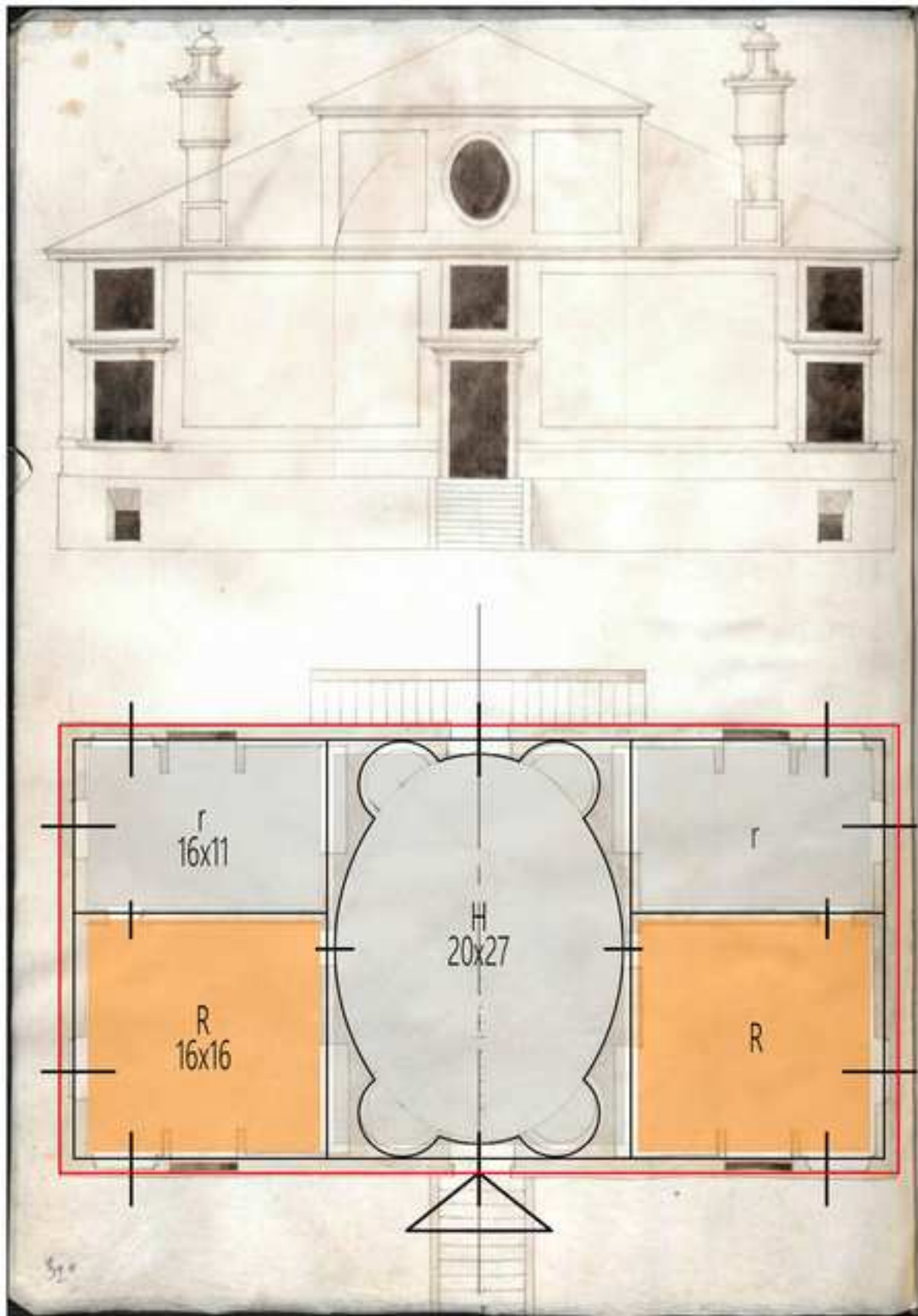








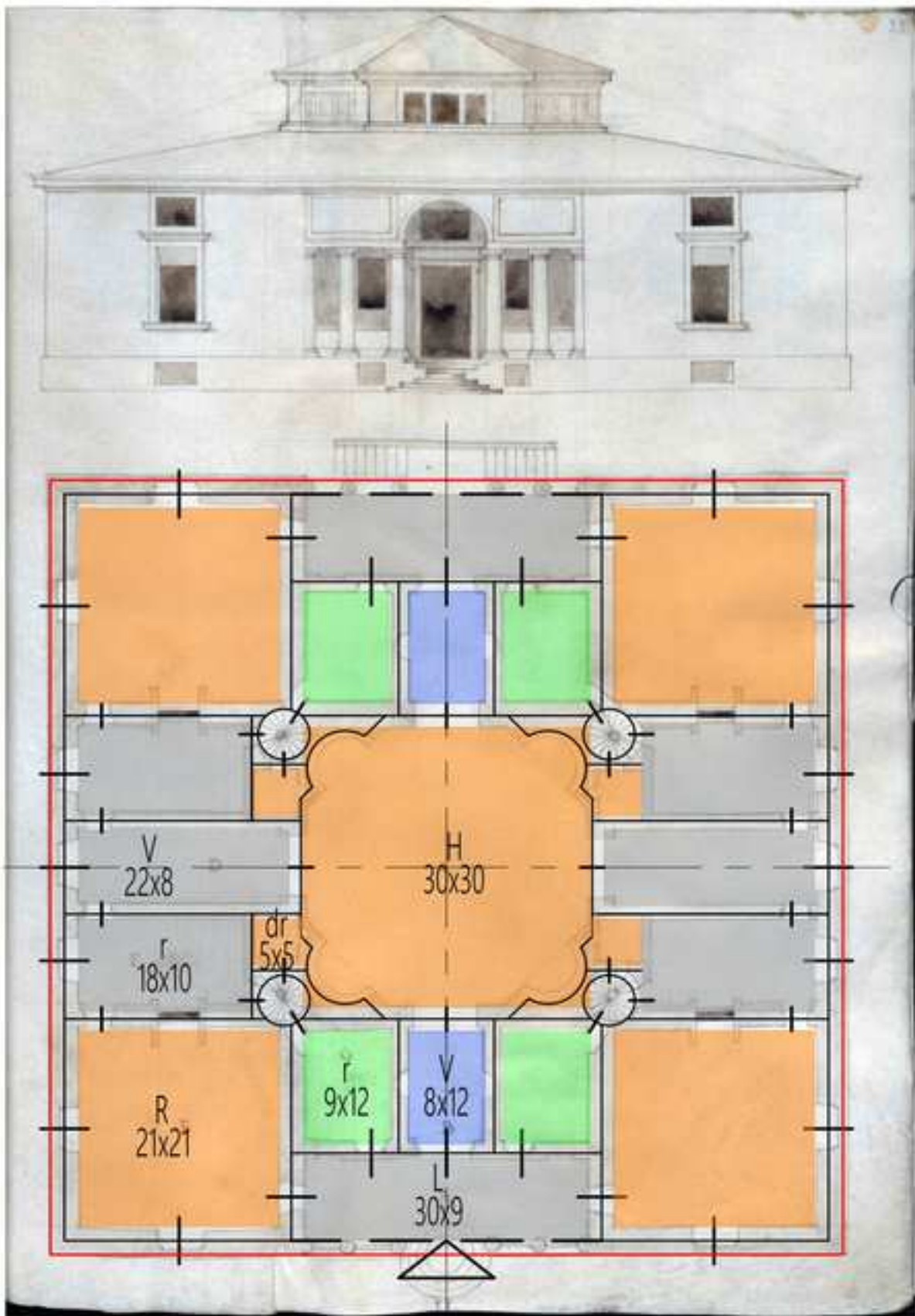




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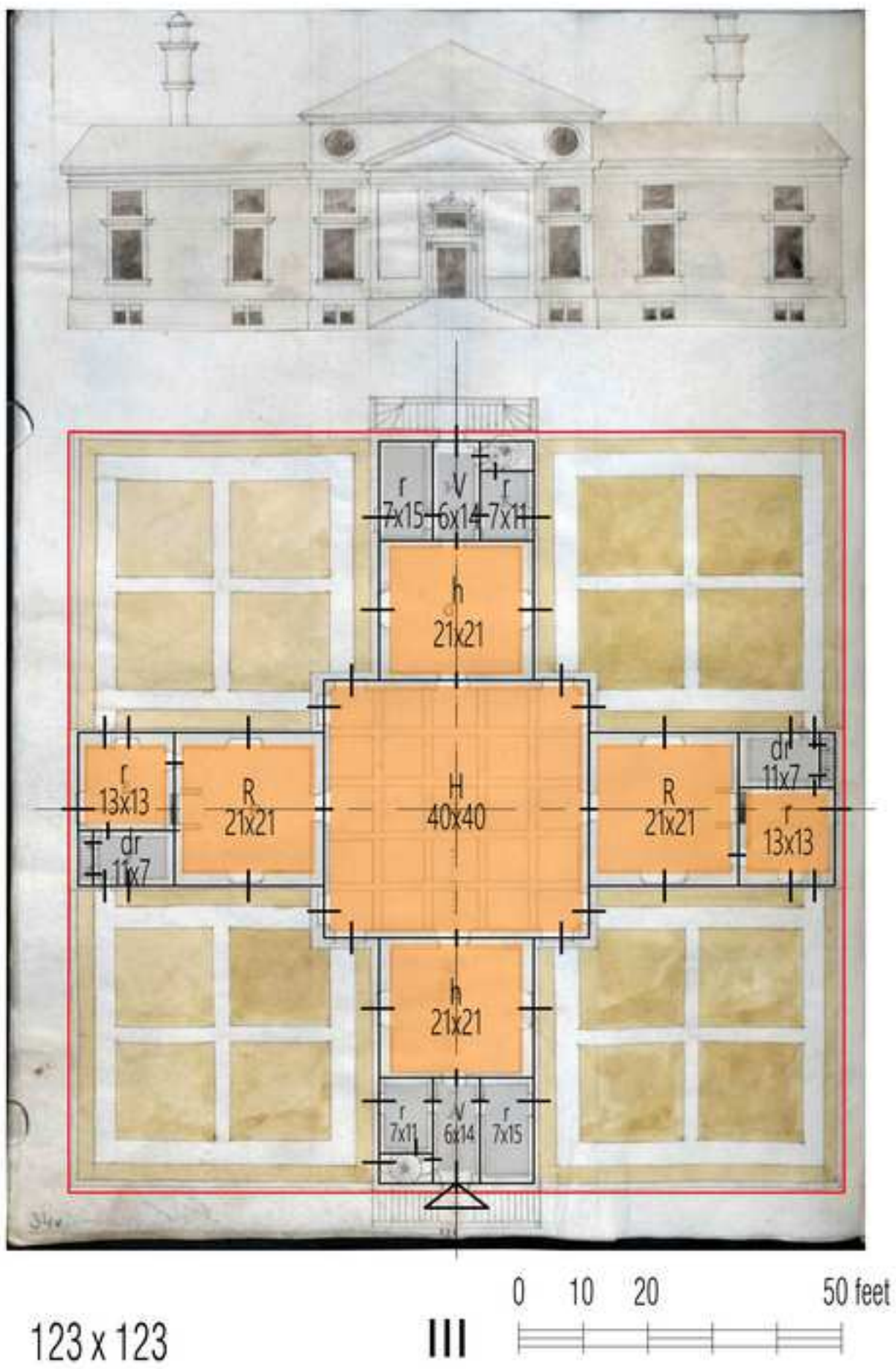


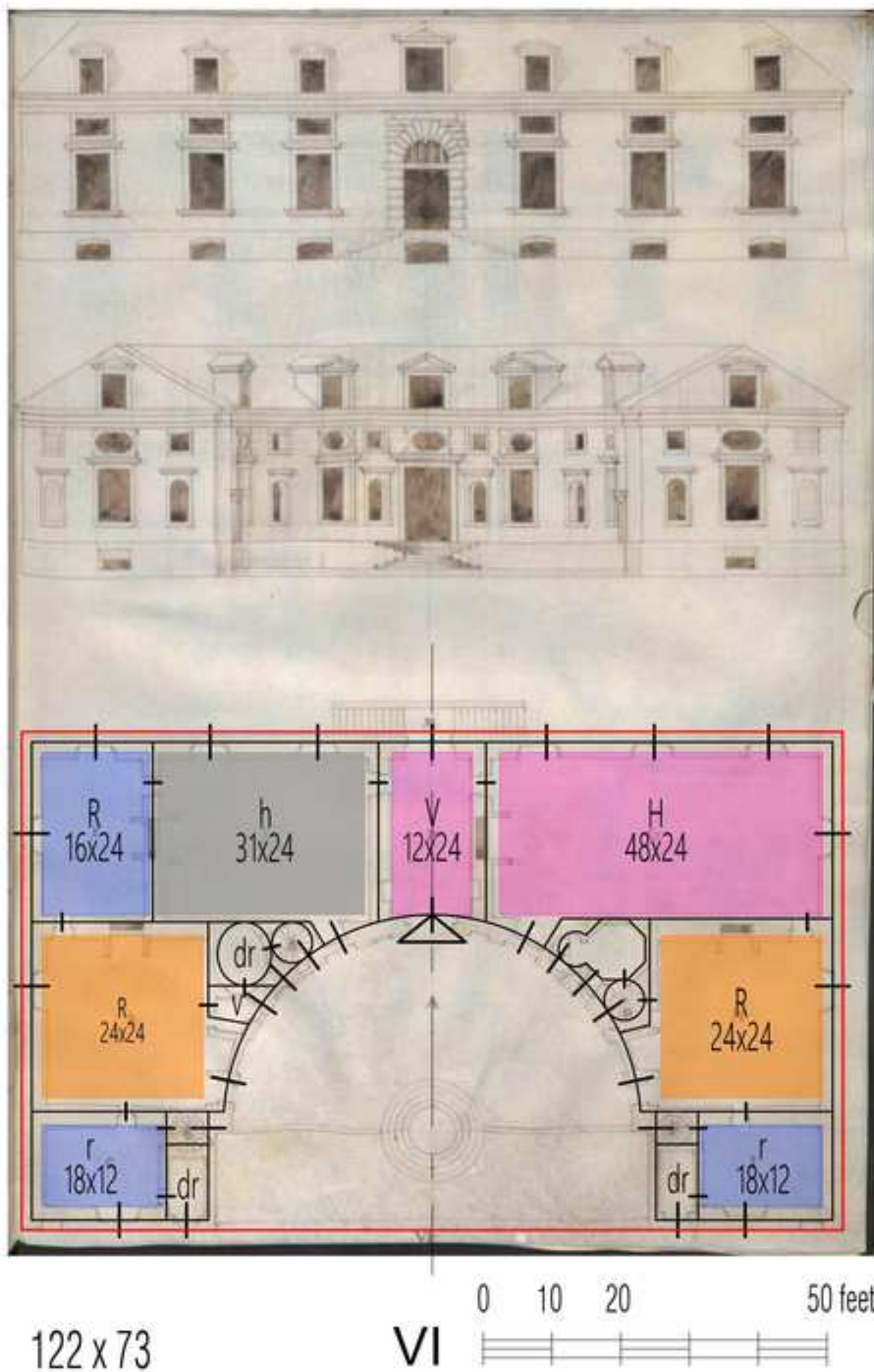


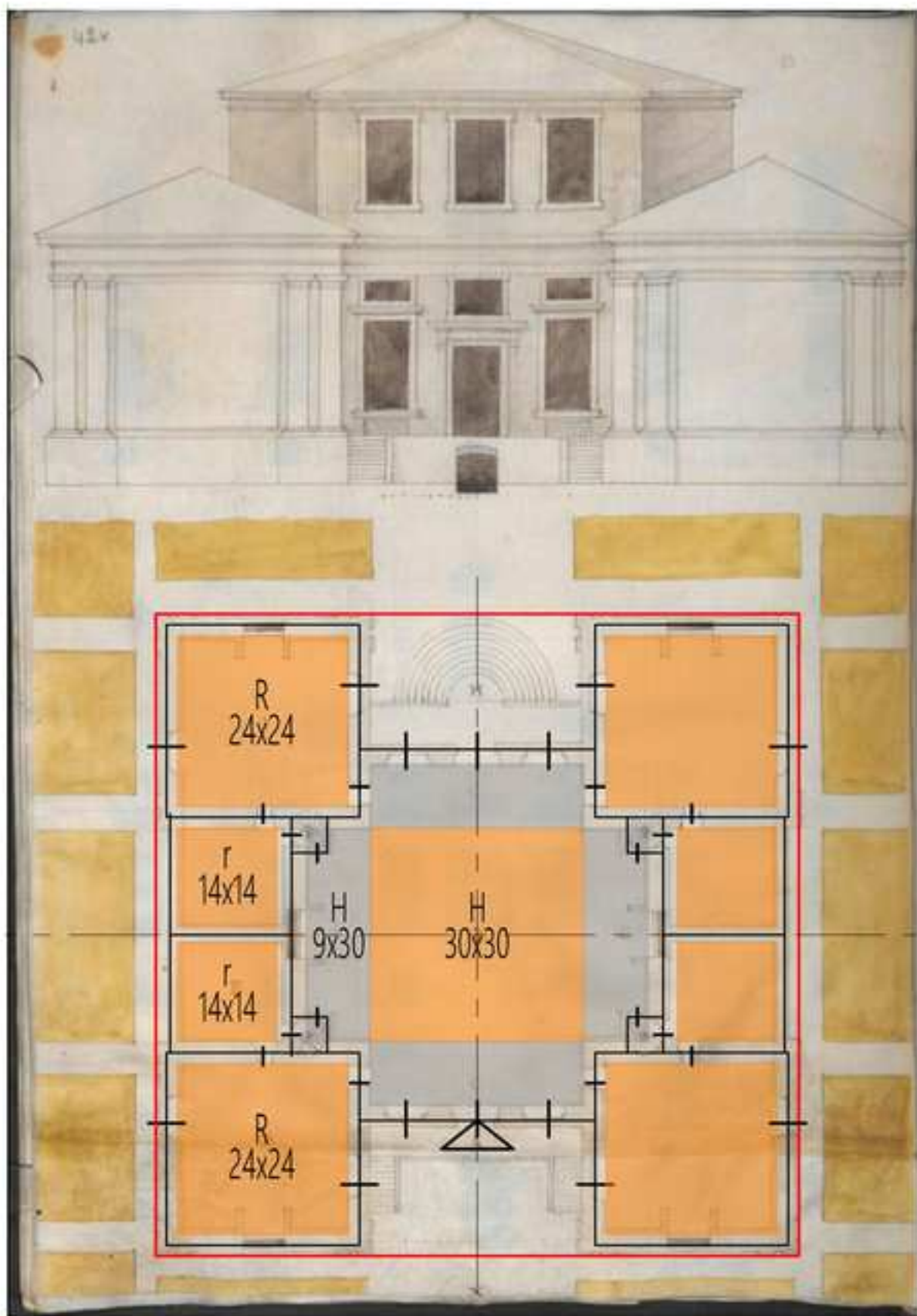
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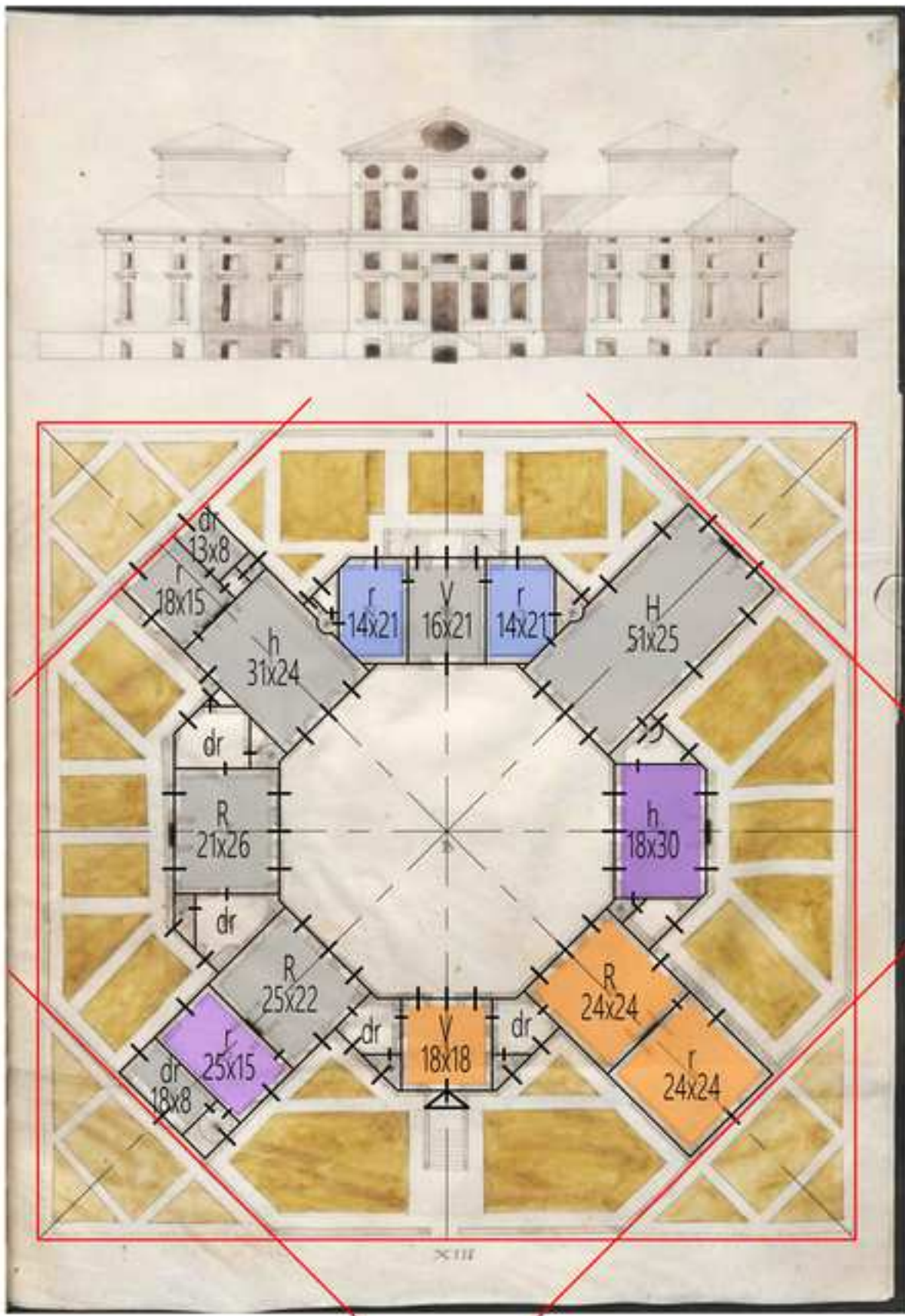






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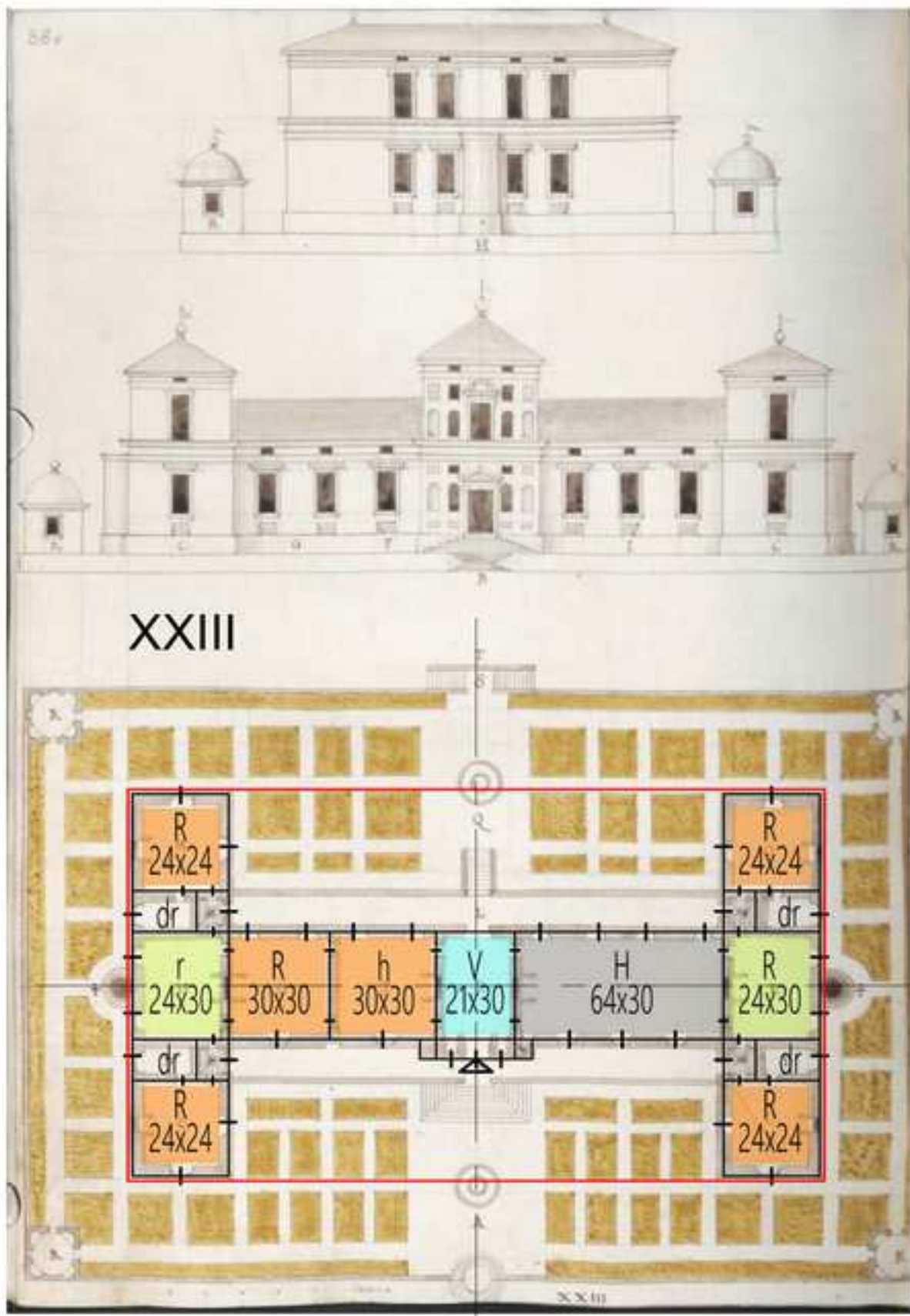




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XIII





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XXIII

