



Partitioning Sites for Invention in Serlio's and Palladio's Palazzi

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Abstract

Throughout history, diagrammatic drawing formed a *modus operandi* for generating architectural typologies, creating spatial hierarchies, codifying ratio and proportion while defining the shape grammar of the edifice. Despite the prominence of the diagram in architectural design, no account of designing irregular sites during the Renaissance exists, nor how diagrams partition space. This paper's computer-aided graphical analysis elucidates how to design irregular sites by reading principles of partitioning in the treatises of Serlio and Palladio. Through the numeric lexicons of Serlio, Palladio and Bertotti Scamozzi, this paper uncovers the ways the transformative power of the diagram codifies irregular typologies while ordering its spatial hierarchies. The cases of Serlio's and Palladio's geometrical reckoning illuminate a commonplace working method for partitioning Renaissance palazzi where the heuristic diagram visually uncovers the architect's idea by combining context, site, and function that result in architectural inventions.

Keywords Renaissance Architecture · Generative Diagrams · Sebastiano Serlio · Andrea Palladio · Geometry

Introduction

Generative diagrams form an inherent part of the history of architectural design. For example, Villard de Honnecourt's album of sketches (c.1225-35) depict architecture in a diagrammatic, rather than technical way, whereas Matthes Roriczer's *quadratura* (c1486) relied on the diagram for designing Gothic structures (Carpo 2001: 31; Bork 2011: 26). For perpetuating Renaissance designs, few have been more successful than Serlio and Palladio. Serlio's *Primo libro* discusses and visualises how the computation of lines collates architectural compositions, creating design diagrams (Serlio 1545: 22v). Through the aid of

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print, Serlio communicated geometric schemes that acted as heuristic devices for the reader to sequentially compute processes to draw, redraw and design architecture (Carpo 2001: 36). Palladio continued such diagrammatic approaches in *I quattro libri*, where his three proportionalities—the arithmetic, geometric and harmonic—form his best known (Palladio 1570: I.54; Wittkower 1967: 109). Since Palladio rarely used these means in his architectural design (Branko 2004: 70–71), these proportionalities underline their theoretic significance to design architectural space. Further, Serlio and Palladio formulated design rules for architecture whereby the manipulation of lines stipulated architectural conception following Renaissance customs (Hersey 1976: 84). The respective architects used such mathematical measurements and proportional systems to design mostly rectangular and symmetrical typologies (March 1998: 186; Spallone and Vitali 2019: 296) while theorising columnar applications from practice or vice versa (Hemsoll 2015: 33). The scholarship acknowledges the importance of mathematics in the designs of both architects but scrutinising the ways urban typologies and irregular sites were used remains necessary.

Architectural prints, unlike their built counterparts, are not susceptible to deformation or construction inaccuracies and therefore represent “pure” proportional models. Yet, deviations appear in the architectural depictions resulting from the effect of scale and the inexactitudes stemming from drawing processes and xylograph printing (Mols 2019). Moreover, Serlio and Palladio understood the capacity of geometric models to reckon slightly diverging plans of the Pantheon, displaying different levels of accuracy (Fletcher 2019: 343). Thus, the analytical drawings in this inquiry form a reliable point of departure since their geometries compute graphic knowledge that acts as mathematical proof of the drawing process.

By analysing one case of Serlio, and two of Palladio, this paper demonstrates a *modus operandi* for designing irregular sites. Serlio’s *Settimo libro* that appeared in Frankfurt explains architectural design procedures, including for irregular sites in urban contexts (Serlio 1575: 128–55). The still existing manuscript of the *Settimo libro*, dating to 1542 (Rosenfeld 1978: 41), describes an irregular plan for a palazzo and unveils the room ratios while construing planimetric divisions according to spatial functions (Serlio 1575: 148). Similar to Serlio, Palladio’s *Quattro libri* contains multiple irregular plans, including a plan for a Venetian palazzo that explains its room divisions (Puppi 1975: 89; Beltramini and Burns 2008: 196). However, plans appearing in Renaissance printed books often idealised the architectural design, regularising them more than built works (Hemsoll 2015: 1). Thus, a third case elucidates how such methods apply within practice. Palladio built numerous irregular edifices including the unfinished Palazzo Thiene (1542–58) or the Palazzo Barbarano (1568–69) (Beltramini and Burns 2008: 40, 210). Nonetheless, their partial designs, lack of scale or off-grid irregular plans make them unsuitable for a proportional analysis. Unfinished, the Palazzo Valmarana, built in Vicenza by the noblewoman Isabella Nogarola Valmarana (Puppi 1975: 369; Beltramini and Burns 2008: 196), shows regularised internal divisions and still occupies an irregular site. Bertotti’s survey drawings of the palazzo exhibit reliable proportions on which to impose a proportional analysis, forming the basis of many similar studies (Howard and Longair 1982: 129; Hemsoll 2015: 4).

These cases form the ideal basis to understand how modes of diagrammatic drawings correspond to the principle of partition (*partitio/compartitio*). These examples also illuminate how Renaissance architects designed irregular urban sites and their spatial hierarchies through geometric reckoning. Reinterpreting the diagram as a generative representation rather than a deductive formal analysis help unveil a potential design method of Renaissance palazzi. Despite the authority partitioning takes in the history of design, little is known about their drawing processes and how such diagrams formed a *modus operandi* for architects. Through reading Serlio's and Palladio's famed treatises and the principle of partition, we can relate Euclidean theorems to designs of the architects, unveiling critical insight into the formation of their plans.

Methodology

This paper comparatively analyses design methods in the works of Serlio and Palladio that exhibit a configurative study for architecturally morphing geometric grids. The history of diagrammatic-geometric analyses of architecture stems from Rudolf Wittkower and Colin Rowe (Wittkower 1967; Rowe 1976), that Marco Rosci expanded to investigate Serlio's architectural typologies (Rosci 1966: 61). Their works reduced architectural compositions to a geometric scheme to understand design and its humanist value. As a result, the oversimplification of diagrammatic analyses led to investigations of measured proportions and actual architectural geometries of Serlio, refining Rosci's prior analyses (Rosenfeld 1978), or the study of musical proportions in the work of Palladio (Howard and Longair 1982). Ever since, the geometric inquiries and spatial contributions of architecture investigated real measurable ratios imposed on architectural plans seen in the work of Lionel March (March 1998). Next, Roberta Spallone and Marco Vitali established what may count as the most current state of comparative geometrical research in Renaissance typologies which the present paper applies (Spallone and Vitali 2019).

The analysis of the Palazzi focuses on the geometric methods of partitioning urban designs of Serlio and Palladio. Throughout his works, Serlio textually described his ratios, but despite the ratio being numerically measurable, it does not need to correspond to the building's actual measurements. However, Serlio provides a scalebar near all his plans, while mentioning different units of measure, and used feet for the descriptions of *Il settimo libro* (Serlio 1996: 458). Due to the contentious quality of the prints of the seventh book, the Vienna MS is used as the basis for this investigation (Dinsmoor 1942: 83; Rosenfeld 1978: 501, 408). In contrast, Palladio visually depicts the ratios he used on his plans using Vicentine feet (Hemsoll 2015: 54n153). Bertotti published measured plans, contrasting to Palladio's idealised *I quattro libri* and offers a more reliable basis for comparison even though his interpretation of the Vicentine foot (35.7 cm) diverges from that of Palladio (34.7 cm) (Howard and Longair 1982: 129). As such, we can rely on the accuracy of the ratios measured in the respective Palazzi of Serlio, Palladio and Bertotti's survey. For the comparison, we visualised the measurements in Vicentine feet that ensure a reliably scaled juxtaposition of the analytical plans. A CAD retracing of the

plans allows for better comparison while providing a unified graphic representation and follows established procedures for measured drawings (Chitham 1980). The vectoral base of CAD also grants a better extraction of measurements that Serlio and Palladio did not mention or depict.

The plans act as an underlay to investigate the underlying grid used for the design conception of the palace typologies based on Euclid's theorems that may have been employed. This will be measured by imposing axial division for the plot, irrespective of the wall thicknesses (Rosci 1966: 61), as it provides diagrams for the architects' inventions that allow design flexibility. The diagrammatic schemes visualise comparative plans and respect established architectural drawing conventions.

Partitioning of Sites

The history of design procedures raises many questions, partially relies on speculation, and remains open to interpretation. Nevertheless, architects usually start by scrutinising the urban context and site restrictions. Alberti first defined partitioning (*partitio*) in *De re aedificatoria*, forming part of the material elements of architecture alongside locality, area, walls, roofs and openings (Alberti 1541: I.2,9; Alberti 1988: 7, 23; Williams 2019: 288). Alberti mentions that “[com] partitioning is the process of dividing up the site into yet smaller pieces” and that smaller divisions consolidate a larger interconnected unit “joined together like members of the whole body” (Alberti 1541: I.2; Alberti 1988: 8). As apparent, partition regulates architectural invention—or the design—that integrates all building components according to “utility, dignity and delight” (Alberti 1541: I.2,9; Alberti 1988: 7, 23).

Dubbed compartment by Krautheimer and van Eck, partitioning formed part of the structure of the building to harmoniously organise architectural ornaments (Krautheimer 1963: 42–52; van Eck 1998: 280). While technical in nature, partitioning contains a theoretical narrative to create a higher order of architecture. As such, partitioning regulates architectural ratios and proportions to unify arrangement and measure (Payne 1999: 80–81). While seemingly the instigator of the term, Alberti does not elaborate on how the architect partitions a building and only gives brief definitions. Thus, Serlio's and Palladio's respective treatises may illuminate the methods of partitioning sites stemming from Alberti.

Going beyond Alberti's theoretic foundations, Serlio's *Il primo libro*, dealing with geometry, gives one of the first illustrated accounts on dividing architectural sites mentioning (Fig. 1);

The architect could encounter a shape of different, unequal sides—whether land or any other substance—which has to be reduced to a rectangular form, or rather to a perfect square. (Serlio 1545: I.6v; Serlio 1996: 13)

Serlio recommends the subdivision of irregular sites by reducing them to their rectangular origin, depending on the site's boundaries. With this interpretation, Serlio perpetuated the Pythagorean idea, common in the Renaissance, that interpreted a building as a cube with the rectangle as its planimetric equal (Hersey

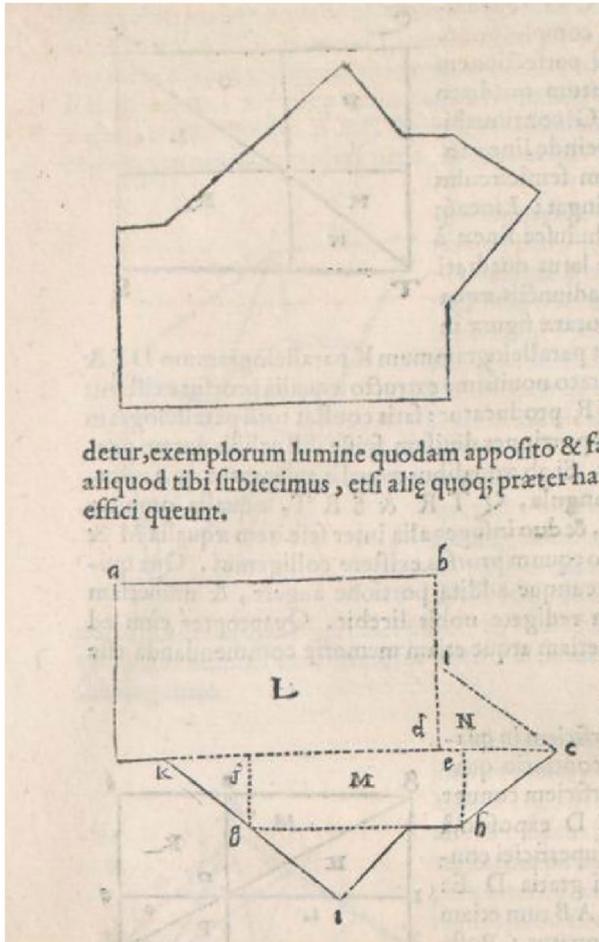


Fig. 1 Method of reducing shapes to rectangles, Sebastiano Serlio, *De Architectura*, (Venice: Francesco de Franciscis & Johannes Crugher, 1569), 8. ETH-Bibliothek. Doi: <https://doi.org/10.3931/e-rara-12168>

1976: 51). More interestingly, the description immediately follows Serlio's description of doubling squares and circles (Serlio 1545: I.5v-6r) that represent two proportionalities of the harmonic mean ($h = \frac{2wl}{w+l}$) and the geometric mean ($h = \sqrt{wl}$) (Padovan 1999: 233). Later, Palladio would equally use these in spatial design and add the arithmetic mean $h = \left(\frac{w+l}{2}\right)$, a mean not found in Serlio's writings (Wittkower 1967: 107). Moreover, Serlio recommended spatial arrangements according to rectangular ratios (Spallone and Vitali 2019: 296) as derived from subsequent pages in his first book (Serlio 1545: I.21r). The initial hint at site division and its reduction to a rectangular base unveil the basis of Serlio's plausible design procedure.

In the *Sesto libro*, on the plan of the now lost Hôtel de Grand Ferrare, Serlio mentioned “Taking the partition (*compartitio*) and commodities of this house and adding some elements of beauty, I shall form the house of an Illustrious Prince,” (Serlio Munich Ms, 14v), the latter being Ippolito II d’Este Cardinal of Ferrara (Frommel 2003: 27–28). Serlio immediately commences to “set out” the plan of the house, meaning that the partition referred to the division of the architectural design and the commodity to its use. Moreover, Serlio mentioned partition on numerous occasions, including for the arrangement of the orders in the *Regole Generali* (Serlio 1537: IV.150v,154v), and in the *Settimo libro* for a design of “a habitation on a noble site in the city” (Serlio 1575: VII.60). On this habitation, Serlio explains that “the figure shown is the plan of the upper floor over the above plan. It is thus founded on the same walls but the partition to the front above the shop is altered” (Serlio 2001: 228). Here, Serlio directly refers to the partitioning for dividing the planimetric layout of the rooms underlining its value in the design process. Moreover, Serlio did not use the term partition sparsely, but incorporated it throughout all his books, signifying its theoretical importance for combining commodity and utility.

Like Serlio, Palladio took the precepts of Alberti’s principle of partitioning, moulding them to serve his own theory. Palladio’s *Quattro libri* mentions partitioning for the division of buildings and sites, stating;

First, I will discuss buildings in the city and then well-chosen and convenient sites required for buildings in the country and how they are partitioned (*compartire*) (Palladio 1570: I, 6; Palladio 2002: 6).

In this description, Palladio proclaims that site division in the city requires partitioning. In later chapters, he even devotes a chapter “On partitioning (*compartimento*) of streets in a city” and “On the partitioning (*compartimento*) of temples” (Palladio 1570: III.8; IV.9; Palladio 2002: 166, 219). Beyond the practical (*commodità*) need for sectioning urban sites through partitioning, Palladio also mentions the importance of site division for creating beautiful arrangements (Palladio 1570: III, 8; Palladio 2002: 166). The partitioning of a site creates smaller parts of an urban layout or an architectural composition that regulate the decorum—the suitability—of a building in which “the parts should be so arranged that they match the whole and each other, and the appropriate decoration applied” (Palladio 1570: II, 3; Palladio 2002: 77). Like Alberti and Serlio, Palladio uses partitioning to divide and arrange a site by correlating the parts as a unified whole, as commonplace at the time (Wassel 2015: 112). Similarly, the correlation of beauty and ordering through partitioning underlines the theoretic narrative of partition during the Renaissance (Payne 1999: 80; van Eck 1998: 286, 293). Thus, partitioning did not only constitute regulatory principles of design but also correlated to the theory of decorum and beauty for designing judicious architecture (Payne 1999: 81). However relevant the theoretical framing of partition proves, none of the Renaissance authors provide a clear method on how to lay out a Renaissance plan, which the three subsequent cases will explore.

Serlio's Design for a Palazzo

Serlio starts his *Settimo libro* by stating that “I would discuss situations, being, various unusual forms of sites, restorations of old buildings, and the utilisation of elements which have been reused” (Serlio 1575: VII.1; Serlio 2001: 169). Dealing with unusually shaped sites, *Il settimo libro* unriddles Serlio's *modus operandi* for site partitioning. Previously, the importance of Serlio's partitioning was outlined but does not elaborate on how it methodically procreates architectural form (Koehler 2020). In his designs for typologies and rooms, Serlio constantly places the square at the centre, deeming it the most perfect according to Renaissance customs (Hersey 1976: 53; Spallone and Vitali 2019: 296). Serlio even mentions the regularisation and division of sites to the “ideal” square basis stating; “I shall then discuss many different types and unusual shapes of sites, and how to design any house quadrate” (Serlio 1575: VII.1; Serlio 2001: 169). Serlio's partitioning of sites assembles square-derived rectangular shapes (Hersey 1976: 53–54), resonating with Renaissance systems to correlate geometric proportions for whole buildings (Scholfield 1958: 39).

Il settimo libro contains seven “propositions” on irregular sites, but only the sixth proposition hints at Serlio's design procedures for geometrically reckoning irregular sites (Serlio 1575: VII.149). In these propositions, Serlio explains positioning the door at the centre of the main façade, with a passage projecting perpendicularly into the site (Serlio 1575: VII.128, 136, 148). On the design for a palazzo of the sixth proposition Serlio is very clear; “I will always want to put the door in the middle, and pull the passage to square the road, and then end up where he wants” (Serlio 1575: VII, 148; Serlio 2001: 302). Unlike the other propositions, Serlio elucidates the sequence of apartments, halls, rooms and courtyards. While illuminating their ratio and measure, we can only guess how Serlio envisioned its partitioning. Nevertheless, in *Il primo libro*, Serlio explains how to reduce a shape of unequal sides to a rectangle, or preferably, a square (Serlio 1545: I.6v);

You should first draw as large a square or rectangle [as possible], with all corners being right angles, that the figure can contain. Other rectangular forms with right angles can then be extracted from the remainder, also with right angles, it will be good. If impossible, extract as many triangles as possible (Serlio 1545: I.6v; Serlio 1996: 13).

Serlio explains that all unequal forms, thus including irregular sites, can be reduced to their quadrangular or triangular basis. The unison of *ad quadratum* ($\sqrt{1}:\sqrt{2}$) and *ad triangulum* ($\sqrt{3}:\sqrt{4}$) represented the divine and thus beautiful, making such numeric series common in the Renaissance (March 1998: 105, 215). As such, Serlio's application of quadrature or triangulation shows his interest in unifying and ordering plans, relating to Alberti's combination of beauty and ornament. In the example given, Serlio mentions to “extend the upper, the middle and the bottom lines” of the site's perimeter, where the architect can “draw a diagonal line” from the corners and “drop a vertical line to the bottom line” at the intersection (Serlio 1545: I.7v; Serlio 1996: 14). While not explicitly mentioned in

Il settimo libro, the procedure described in *Il primo libro* resembles the propositions for partitioning irregular sites. Serlio's procedure mimics some of Euclid's much older propositions, such as propositions V in Book II;

If a straight line be divided into two equal parts and also into two unequal parts, the rectangle contained by the unequal parts, together with the square of the line between the points of the section, is equal to the square of half that line (Euclid 2017: II.V, 58).

When looking at Euclid's geometric proof of the proposition we see the division of the form through squaring the rectangle and reckoning through diagonals. Serlio even quotes Euclid's aforementioned proposition, albeit in his own words; "As Euclid states, if from equal parts we remove equal parts, the remaining parts will be equal" (Serlio 1545: I.5v; Serlio 1996: 12). Euclid's connection to Serlio is not unknown (Serlio 1996: 431n27), but its usage for partitioning sites remained hitherto overlooked. The duplication of the cube and square inherently resonates with Renaissance architectural conception (Hersey 1976: 53) while echoing Serlio's intent to reduce all sites to their square origin. Moreover, since Euclidean arithmetic and reckoning geometric means through diagonals was commonplace, as seen in the work of Barbaro and Palladio (March 1998: 11), we can convincingly assume that Serlio used such principles for partitioning sites. Serlio even commends "the mean will not be criticised" (Serlio 1575: VII.126), referring to the mean of two extremities in design, which appears right before his "propositions" for designing irregular sites.

Most architectural designs seem to stem from Renaissance denominations—that the shape of ratios—that regulate Renaissance designs (Williams 2019: 276–279). The principle of denomination, just like Serlio's, reduces the site into squares and rectangles, making it suitable for architectural conception. Yet, Serlio did not fix the thickness of the walls as these "are to be thicker or thinner depending on the material from which they are made" referring to brick, marble or stone (Serlio Munich ms: VI.55v; Serlio 2001: 114) or rely on the wishes of the patron (Serlio 1540: III.122v; Serlio 1996: 242). As such, due to the variability of wall thickness in Serlio's design, we cannot consider its measurement for determining a plausible method for partitioning irregular sites.

When scrutinising Serlio's plan for the sixth proposition, a sequence of drawn schemes unveils a potential method for partitioning sites (Fig. 2). The planimetric diagram shows the original plan and the plausible sequential partitioning process in different colours. According to his recommendations, Serlio placed the door centrally and projected the central line to the end of the site, creating a regulating visual axis (Fig. 2n1). Serlio's mention of creating rectangles based on the extremities of the site (Serlio 1545: 6v) also corresponds with the figures, seemingly forming the first subdivision of the site (Fig. 2n2). Next, the drawn diagonals connect the extremities of the site's perimeter. When projecting a line at the intersection between the diagonal and the central axis, we find an overlapping position of the resulting line and Serlio's walls (Fig. 2n3-4). Next, these lines create a new sequence of extremities on which the same procedure can repeat itself, namely drawing diagonals between the extremities and projecting horizontal and vertical lines at the

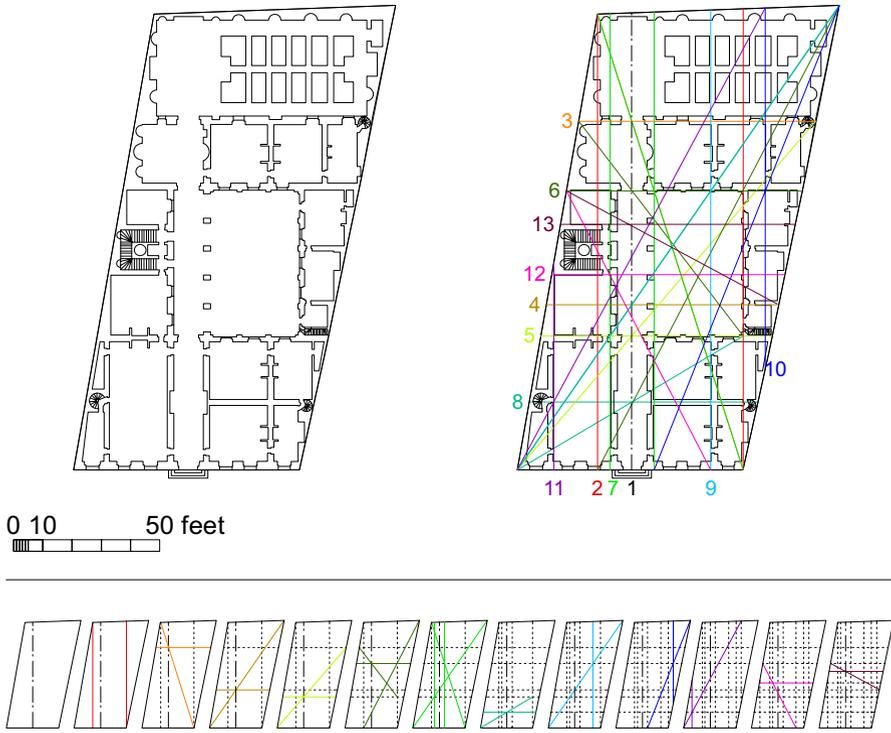


Fig. 2 Planimetric Study of Serlio's Irregular Palazzo. Image by author

intersection, first with the central axis (Fig. 2n.3–6,8,13), and subsequently at the nexus of the prior gridlines (Fig. 2n.6,7,9–12).

The repetition of this procedure results in the site's overall grid, whereas the deletion of some of the gridlines delineates Serlio's plan. The partitioning of irregular plots starts from the subscribed perimeter—the site itself—and, due to their morphology, copy the same geometric procedures over and over until the desired plan results. In contrast, Serlio's regularised plans describe the overall architectural morphology and room dimensions (Spallone and Vitali 2019: 302), but not the circumscribed figure of the design itself. Thus, Serlio's *modus operandi* repetitively computes the irregular site by drawing diagonals that may constitute an algorithmic design method. Carpo already related Renaissance treatises, including Serlio's, to "combinatory" functioning in typographic and standardised architectural representation (Carpo 2001: 54). Yet, Serlio's principles for partitioning irregular sites seem to fit that algorithmic context well. His method of site division allowed design flexibility rather than computing only one correct result, thus forming a site for architectural invention.

Palladio's Design for a Palazzo in Contrada di San Samuele, Venice

Stylistically distinct from either Serlio and Alberti, the analysis of Palladio's palazzo shows similarities in the methods for partitioning irregular sites (Puppi 1975: 290). Palladio's *I quattro libri* deals with domestic plans and touches upon partitioning of rooms (*compartimento*) in the book's introduction to produce suitable (*commodo*) and appropriate (*qualità*) buildings (Palladio 1570: II.3; Palladio 2002: 77). Palladio's partitioning to create beautiful and appropriate buildings (Hersey 1976: 113–14), mimics Alberti's approach linking *partitio* to ornament and beauty (Alberti 1545; van Eck 1998: 280). At the same time, Palladio mentions that the distribution or partition of rooms (referring to the verb *compartire*) must correspond to one another and thus create "a suitable distribution of its members, making the whole beautiful and graceful" (Palladio 1570: II.4; Palladio 2002: 78). He resumes:

In cities, our neighbours' walls, the streets, or public squares nearly always predetermine certain boundaries over which the architect cannot trespass, he must abide by the constraints of the sites (Palladio 1570: II.4; Palladio 2002: 78).

Here, Palladio mentions that urban sites have perimetrical constraints that presumably include asymmetrical plots. The last chapter of the second book, entitled "on some projects for different sites," contains two designs for irregular sites (Palladio 1570: II.71; Palladio 2002: 149; Puppi 1975: 290). Palladio explains it is not always possible to build on open land, thus deciding "that it would not be irrelevant to our purpose to add the designs included above" (Palladio 1570: II.71; Palladio 2002: 149). The design pertains to an irregular site, described as:

The awkwardness of their sites and the method I used in fitting the rooms and other places into them so that they would relate to each other well in terms of location and proportion will (I believe) make these designs very useful (Palladio 1570: II.71; Palladio 2002: 149).

First, Palladio's statement mentions the partitioning or "fitting" of rooms in relation to one another, so they correspond in position and proportion. Second, the passage explains such distribution of rooms relates to the "awkwardness of sites" implying a correlation between the perimeter of irregular sites and their partitioning. Third, Palladio discloses that he used a "method" for the partitioning of the irregular sites, resulting in the "location" of rooms. Therefore, we know Palladio relied on a method for partitioning irregular plots. Unlike Serlio's rectangular preference, Palladio thought of architecture in the third dimension, naming the cube the noblest shape (Hersey 1976: 160). During the Renaissance, the cube counted as the three-dimensional projection of the two-dimensional square (Hersey 1976: 19; March 1998: 67). As such, Serlio's squaring of sites correlates well with Palladio's design rhetoric, even though Palladio's method remains obscure.

While the plan depicted by Palladio near the description of the site division shows an irregular shape, the irregularity of the site only pertains to the upper part of the house near the courtyard, loggia and secondary rooms (Palladio 1570:

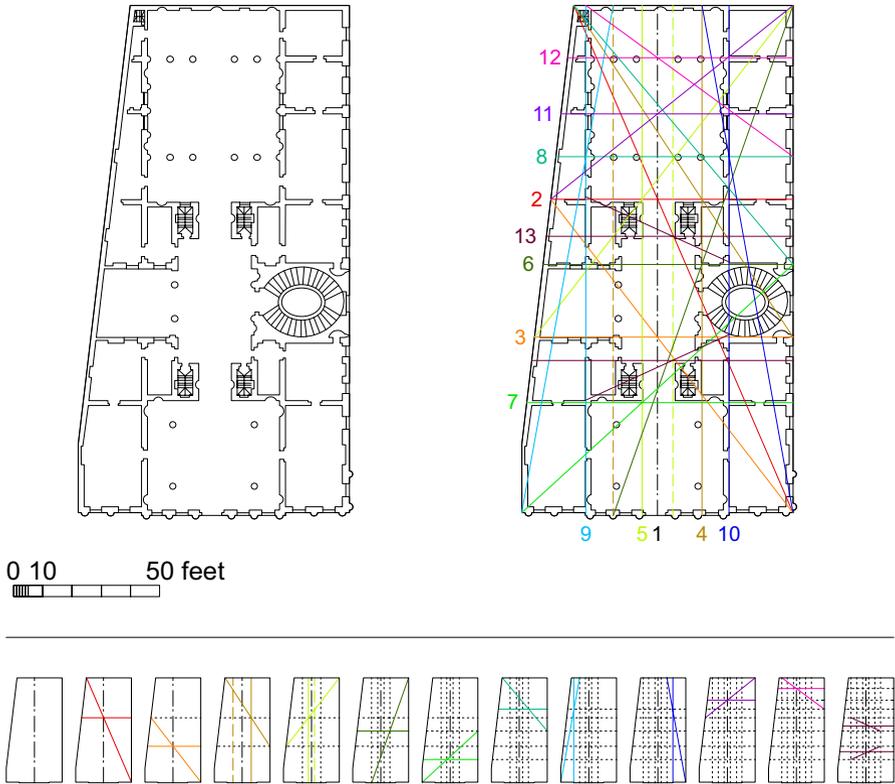


Fig. 3 Planimetric Study of Palladio's Irregular Palazzo. Image by author

II.71; Palladio 2002, 149). The main body of the palazzo contains a perfectly symmetrical shape and room distribution, preventing it from being an ideal case to analyse Palladio's method for partitioning irregular sites. Alternatively, the second design that appears in this chapter of *I quattro libri*, depicts the unexecuted Palazzo in Contrada di San Samuele (1553) (Palladio 1570: II.71; Puppi 1975: 289–90) (Fig. 3). While mostly symmetrical and regular in plan, the Venetian palace does show an irregular perimeter with its inclination almost stretching the entire length of one of the sides. Moreover, *ad quadratum* ($\sqrt{1}:\sqrt{2}$) dimensions trace to Palladio's ceiling design for the palazzo (March 1998: 223–24). The ceiling plan exhibits rational convergents of $\sqrt{2}$, or the ratios stemming from the doubling of the square, based on Euclidean theorems, just like Serlio (Euclid 2017: II.V, 58). Beyond the ceiling, Palladio regularly used the ratio $1:\sqrt{2}$, underpinning the significance of Euclidean principles in Palladio's oeuvre (Wassel 2015: 114). Due to the mentioned method of partitioning, the irregularity of its site, and the square basis of its plan, Palladio's Venetian palace forms the ideal case to impose a similar method of partitioning an irregular site as used by Serlio.

When looking at the plan of the Venetian Palace, a congruous procedure for dividing irregular sites like the one employed by Serlio surfaces. Like Serlio, Palladio thought the room ratio important and imposed an axial symmetry in his domestic designs (Padovan 1999: 234; Wassel 2015: 113, 117). Indeed, when looking at the plan, the main door appears centrally on the façade, out of which a central axis develops, ending in an atrium (Fig. 3n1.) By drawing a diagonal and projecting a line at the intersection with the central axis, the first partition of the site emerges (Fig. 3n2). As such, Palladio forged the boundary between the “front” and the “back” house creating a hierarchy of apartments as he did for other Palazzi (Wittkower 1967: 78). No other lines appear that culminate from the intersection of the diagonals of the extremities of the site’s perimeter and the central axis. However, when the recently drawn line creates a new horizontal extremity, the same procedure can numerously be scaled and copied, generating additional vertical projections (Fig. 3n3-5). Based on these vertical lines, a longitudinal diagonal creates a variation of the same *modus operandi* (Fig. 3n6). The remaining figures form similar variations of the horizontal and vertical connections of the perimeters, repeating the system over and over, leading to the preferred site partition, resulting in Palladio’s plan (Fig. 3n7-13).

Serlio and Palladio seemingly used similar methods for subdividing irregular sites that both stem from Albertian theory. Due to the interrelation of these methods and the inconclusive and indirect connection between the architect-authors, we can assume that such methods of site partitioning stem from fifteenth-century design practices and still influenced architectural design up to the later sixteenth century.

Palladio’s Palazzo Valmarana by Bertotti

The exposure of a commonplace design method for partitioning sites in the cases of Serlio and Palladio contains one significant challenge. Namely, Serlio’s built legacy remains limited whereas Palladio idealised the designs depicted in *I quattro libri* (Puppi 1975: 370).¹ Thus, looking into an irregular site of a built example by Palladio proves the method in practice which a pattern book or theory cannot. The Palazzo Valmarana, one such example, forms part of the well-esteemed realisations of Palladio’s Vicentine palazzi. As such, numerous studies of the Palazzo exist but primarily describe its façade rather than the plan (Wittkower 1967: 84–85; Ackerman 2002: 250; Beltrami and Burns 2008: 198–99;). Built by the noblewoman Isabella Nogarola Valmarana from 1566 to 1582 on a dense pre-existing site (Puppi 1975: 369), the palazzo’s shape stems from its urban context, making it ideal for discerning partitioning.

Palladio’s *I quattro libri* presented theoretical models of ideal architecture, including that of the Palazzo Valmarana (Puppi 1975: 370; Hemsoll 2015: 1, 4). Thus, the treatise only exhibits a model rather than the built morphology. Due to site limitations, Palladio could not develop his plan orthogonally nor

¹ Many thanks to Professor Roberta Spallone for making this suggestion.

symmetrically (Beltramini and Burns 2008: 198) and adjusted the typology to the site's irregular boundary (Puppi 1975: 370). Yet, the complexities of the plot mean that reconstructing the palazzo's original perimeter proves futile (Puppi 1975: 371). In 2008, Simone Baldassini provided a surveyed ground floor plan, specifying the most updated plan of the extant edifice (Beltramini and Burns 2008: 196). Nevertheless, the plan's limited size and geometry outlive its use, imposing the need to rely on alternative surveys. Moreover, Baldassini's plan does not reflect the numerous alterations the palazzo underwent throughout the centuries, including the bombardments of 1945 (Puppi 1975: 371). Thus, the survey by Bertotti - published in *Le fabbriche e i disegni di Andrea Palladio* - forms a fitting case to study Palladio's *modus operandi*. Bertotti's plan reconciles the measures of the site with the idealised design of Palladio, yielding the most optimised blueprint for the Palazzo Valmarana (Bertotti 1786: I.49–52). Bertotti explains that “of this design, which is reserved in the plan, I only produce that portion, which has been completed” (Bertotti 1786: I.49). This statement signifies the reliability of the measurements of Valmarana's design as generally endorsed by scholars (Hemsoll 2015: 4). Bertotti commences:

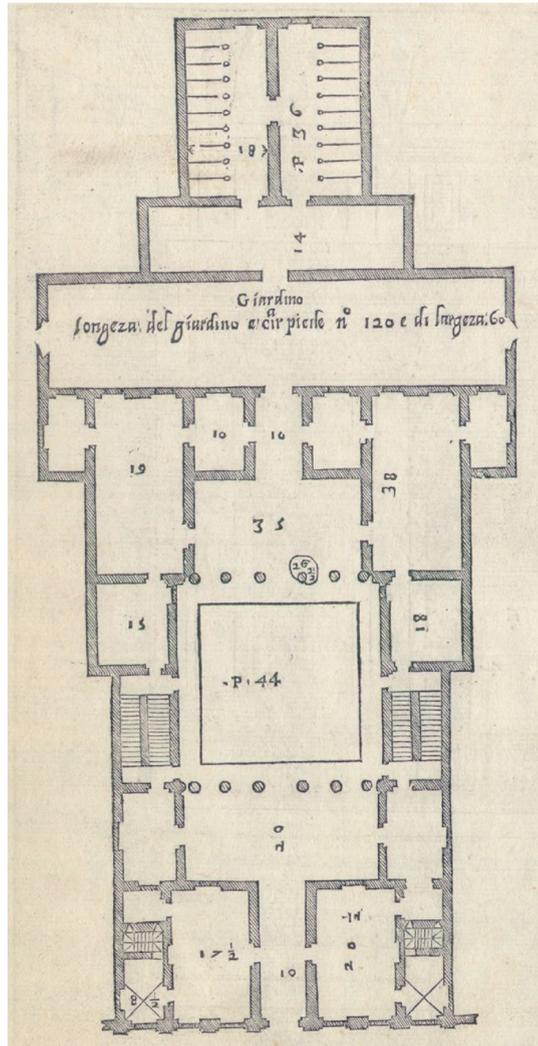
But before moving on to describe it [the palazzo] methodically, let me point out a trait of masterful fabrication practised by our Author in overcoming an obstacle encountered in erecting the main scheme (Bertotti 1786: I.49).

The statement appears in the first paragraph of the “Fabbrica Valmarana,” outlining the importance of the site's irregularity as an “obstacle” that Palladio had to solve. Bertotti thought the scheme's perimeter so crucial to understanding the design, that he explained its formation before mentioning the room layout, the façade and the ornament. Yet despite its perimetrical obstacle Bertotti still praises the design:

if it were entirely accomplished, this design would be magnificent, commodious in its grandiose extension, its regular partitions [*comparto*], and its most elegant ornaments (Bertotti 1786: I.51–52).

Beyond its commodity and elegant ornaments, Bertotti notes the regularised partitions in the plan. Yet, before understanding the site partitioning, we must acknowledge the differences between Palladio's plan published in *I quattro libri* and Bertotti's *Le fabbriche*. The lack of inclined surfaces in Palladio's “theoretical model” stands in stark contrast to Bertotti's “as built” survey (Figs. 4 and 5). The haphazard shapes and inclined walls mostly appear at the bottom part of the palazzo, comprising the realised part of the building. The upper part displays a unified harmony but still exhibits differences. For example, Palladio's plan seems diminished in width in respect to Bertotti's but the contrast is most noticeable in the second courtyard or “*giardino*” that almost takes the shape of an elongated alley in *I quattro libri* while illustrating a full-fledged and well-proportioned courtyard in *Le fabbriche* (Palladio 1570: II.16; Bertotti 1786: pl.xx). Seemingly, Bertotti's measures provide more reliability than Palladio, who mentions that “the garden, which one finds in the front of the stables, is much larger than indicated on the plan,

Fig. 4 Palladio's plan of the Palazzo Valmanara, Palladio, Andrea. *I quattro libri dell'architettura*. (Venice: Domenico de Franceschi. 1570), II.16. ETH-Bibliothek. Doi: <https://doi.org/10.3931/e-rara-363>



but has been made so small because otherwise the page would not have been large enough” (Palladio 1570: II.16; Palladio 2002: 92). Thus, the complex and extensive geometries presented by Bertotti forms a better case to understand the principle of partitioning in practice.

Like Alberti and Palladio, Bertotti remains obscure when discussing the Palazzo Valmarana’s grid and method of partitioning. Yet, when discerning the plan, the central axis around which the design develops stands out (Fig. 5n1), as expected from Palladio (Padovan 1999: 234; Wassel 2015: 113, 117). The former examples of irregular sites presented by Serlio and Palladio depict irregular yet simple polygons.

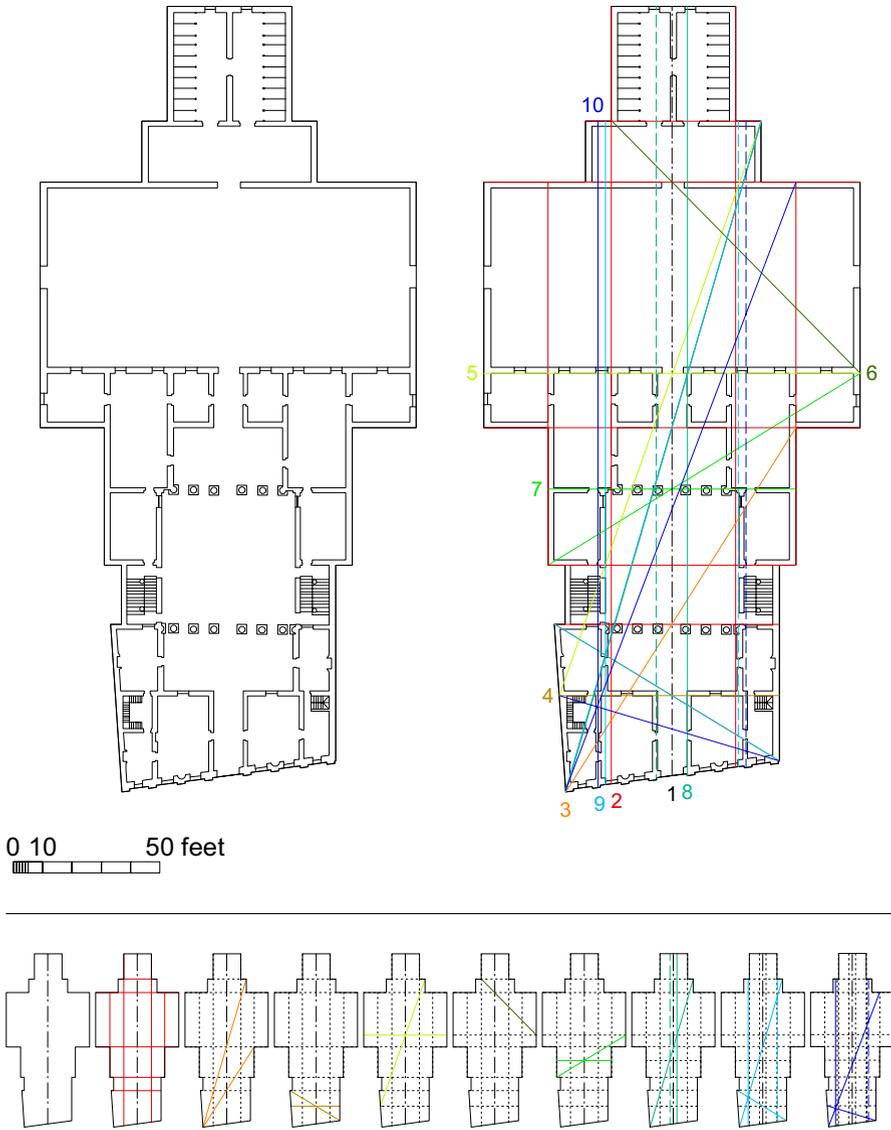


Fig. 5 Planimetric Study of Palladio's Irregular Palazzo. Image by author

The Palazzo Valmarana contains more recessions and progressions in the site's perimeter, resulting in complex geometries. According to the prescribed Euclidean recommendations, the knowing architect can reduce the site's complex perimeter to square or rectangular shapes (Serlio 1545: 6v). When projecting lines from the

angles of Palazzo Valmarana's boundary (Fig. 5n2), a grid results and shows a variation to the design method as described by Serlio.

The procedure for partitioning the rooms of the Palazzo Valmarana corresponds to the prior examples of Serlio and Palladio, where the diagonals of the extremities create new gridlines by intersecting with the central axis (Fig. 5n3-7). Like the prior precedent for Palladio's Venetian palace, the gridlines compute a "front" and "back" house based on the models of the ancients (Wittkower 1967: 78; Puppi 1975: 371). Secondary divisions culminate from the nexus between the perimeters and the grid, but not the central axis, thus creating a second layer of partitioning (Fig. 5n8-10). Moreover, the greater complexity of the palazzo's morphology allows for multiple diagonals to converge with the same gridline to create a new one, making its principle of partitioning even more believable (Fig. 5n3,9,10). From these partitions, the overall grid and plan come forth. Thus, the analysis of Bertotti's plan presents a plausible method of partitioning an irregular site of a built example of Palladio. The investigation shows that the principle of partitioning did not limit itself to the theoretical descriptions in the treatises of Alberti, Serlio and Palladio. Rather, the planimetric survey indicates a flexible and practical design method for laying out irregular plans.

Conclusions

To conclude, diagrammatically analysing the irregular sites of Serlio, Palladio and Bertotti's measured survey of Palladio unveils a potential method explaining how Renaissance architects could have partitioned irregular sites. While Renaissance treatises contain overabundant rules on architectural ratios and proportionalities, the partitioning of sites remained hitherto largely obscure and unnoticed. Through *partitio*, Serlio and Palladio divided an architectural whole into smaller parts via a heuristic unified system (Serlio, Munich ms: 14v; Palladio 1570: II.3). As such, both Serlio and Palladio followed Alberti's idea of *partitio* that divided all the architectural members while equally joining the parts as a whole to accommodate commodity and beauty (Alberti 1541: I.2; Payne 1999: 80).

The cases of Serlio and Palladio show a generative *modus operandi* whereby its success partially lies in its flexibility to generate innumerable diagrams. Seemingly, Serlio and Palladio reduced irregular sites to a squared figure, applying the Euclidean theorem of equals and applying a strict set of seven room ratios, even though the latter requires further scrutiny (Hersey 1976: 53; Wittkower 1967: 108). Depending on the diagonal division, the partitioning of irregular sites can repeatedly compute different shapes, creating a plethora of possible partitions. The difference between Serlio's and Palladio's respective plans strengthens this claim. First, Serlio's plan displays a level of clarity and simplicity in the computation of its grid, whereas Palladio's plan makes use of a denser and much more complex grid. In contrast, Serlio's plan adopts unified room ratios that appear in a more complex composition than the simple and balanced one of Palladio (Rosci 1966: 34; Spallone and Vitali 2019: 303-08). As a result, this paper fathoms a deeper understanding of the design agency of partitioning in three cases of some of the most influential early modern

architects. The revaluation of the heuristic *modus operandi* of *partitio* provides a plausible explanation to how Renaissance architects may have divided sites for their inventions, altering the place *partitio* takes in the history of architectural design.

Rather than an end, this study provides a stepping stone to apprehending the theories and practices of Renaissance partitioning and it must still scrutinise the application of room ratios, spatial hierarchies and the partitioning of façades and ornaments. The combination of beauty and commodity, theory and practice make the principle of partitioning a prime part of Renaissance architectural conception. The beautification of irregular sites through repeating the same design procedures resembles a principle of algorithmic design. As it were, creating design infinitudes that lead to an infinite variation of the same function determined by the site's perimeters (Carpo 2011: 40). Thus, the partitioning of irregular sites constitutes a combinatory design method, becoming highly topical in today's digital society, making the Renaissance relevant once more.

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