CONFERENCE PAPER

Florentine Streetscapes and their Role in Revisiting Palazzo Rucellai's Urban façade Hypotheses

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Abstract

The *facciata* double meaning as façade and outer appearance embodies the Italian city-state's political, cultural, and social values that Leon Battista Alberti outlined in his famed *De re aedificatoria libri decem* (1485). This concept lies at the heart of Florence's urban fabric: one of the early cradles of Renaissance architecture that originated from the artistic expenditure of prosperous families including, the Medici, Strozzi, and Rucellai. In this context, the Palazzo Rucellai (c.1446-66) marks an important historical moment in history as its façade, with its three superimposed orders and well-proportioned urban composition, was the first of its kind in Renaissance Florence. However, the palazzo's unfinished façade sparked a debate regarding its finished appearance which the paper revisits by positioning a 3D digital twin onto the façade's historic urban context and by applying through Space Syntax to explore its relationship to the urban fabric.

Keywords Space Syntax · Public Space · Leon Battista Alberti · Palazzo Rucellai · Urban Renaissance History

Introduction

The *facciata* double meaning as façade and outer appearance embodies the Italian city-state's political, cultural, and social values that Leon Battista Alberti outlined in his famed *De re aedificatoria libri decem* (1485). This concept lies at the heart of Florence's urban fabric: one of the early cradles of Renaissance architecture that originated from the artistic expenditure of prosperous families including, the Medici, Strozzi, and Rucellai. In this context, the Palazzo Rucellai (c.1446-66) marks an important moment in history as its façade, with its three superimposed orders and

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well-proportioned urban composition, was the first of its kind in Renaissance Florence. However, the palazzo's unfinished façade sparked a debate regarding its finished appearance which the paper revisits by positioning a 3D digital twin onto the façade's historic urban context and by applying Space Syntax to explore its relationship to the urban fabric.

Background and Methodology

Giovanni Rucellai (1403-81) commissioned his palazzo at the time of Firenze's seigneurial shift to the *de facto* rulership of the Medici family. Unlike Michelozzo's contemporary Palazzo Medici Riccardi (1444-84), Palazzo Rucellai did not comprise a grand new scheme but a piecemeal house extension where the unfinished façade shows Rucellai's intention to extend the palazzo. Additionally, by purchasing and demolishing neighbouring plots, he created a small square and loggia, presumably based on Alberti's designs (Borsi 1986: 51). Although scholars extensively scrutinised the palazzo's building phases and proposed multiple hypotheses on the image of the 'finished' façade, all overlooked Palazzo Rucellai's inseparable intertwinement with Florence's urban fabric (Hersey 1976:173; Naredi-Rainer 1982: 168).

For revisiting Palazzo Rucellai's façade hypotheses in relation to the Florentine streetscape the paper imposes a comparative study of Alberti's *Della tranquillità dell'animo* and *De re aedificatoria* (Alberti 1485; Alberti Palatino ms). The following Space Syntax study of Palazzo Rucellai's direct urban environs explores its spatial configuration to uncover urban hierarchies and further test the façade hypotheses via a Visibility Graph (VGA, Turner et al. 2001) and Angular Segment Analysis (ASA, Turner 2007). A contextual immersive reading of these spatial hierarchies requires a photo-realistic digital twin of the palazzo, the loggia, and the *De Rucellai* square, which this research generates via close-range photogrammetry (Luhmann et al. 2020) through the Structure-from-Motion (SfM) and Multi-View-Stereo (MVS) processing of 279 2D images in Agisoft Metashape (Fig. 1). The output digital twin consists of
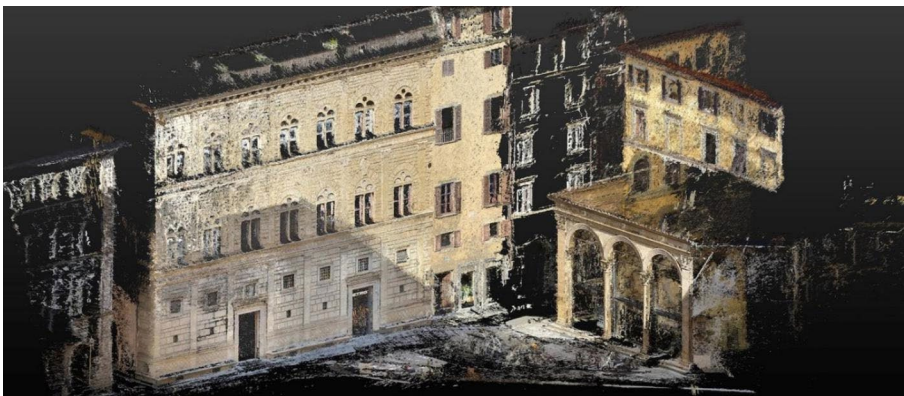

Fig. 1 3D Digital reconstruction of the Palazzo, Loggia, and Piazza represented in CloudCompare. Image: C. Pezzica and N. Mols 2023

345 million raw data points and 235 million points after the 3D point cloud cleaning. Scaling the 3D model output using the Florentine *braccia* (58.3 cm), as the unit of measurement, then allows for sufficient geographic and architectural accuracy, and mathematical clarity to scrutinise the façade hypotheses (Naredi-Rainer 1982: 170). The digital twin of Palazzo Rucellai's façade forms the virtual and visual space for reconstructing the façade hypotheses while the isovist-based (Benedikt 1979) VGA analysis investigates the façade hypotheses considering how they visually relate with its urban-level context. Aspects of metric precision were not central to this research, making image-based survey techniques favourable over range-based ones. Besides relaxing data collection requirements, this facilitated the examination of qualitative morphological, visual, and spatial aspects in relationship to the palazzo's façade. A 2D configurational study is performed in view of the quasi-planarity of the analysed space and the focus of this research on façade elements located at eye level, particularly the entrance doors.

Urban Hypotheses

The map of Florence (c.1470) shows that the city *intra muros* consisted of a well-developed urban layout with a limited provision of open plots (Fig. 2) (Goy 2002). Therefore, Florence's present-day urban grid presumably assumes the same form as in the Quattrocento. Yet, the urban context and location of Palazzo Rucellai raises questions. Giovanni's purchase of the neighbouring plot of land for 1,000 florins - the price of an average Florentine palazzo - indicates that he could afford a regularised palazzo anywhere in Florence, but he chose to remain in his ancestral house. The palazzo's location was, however, economically most desirable, positioned in the centre of the wool trade quarter, where most of the Rucellai operated: right in the middle of Via della Vigna Nuova, connected to Piazza Goldoni as a former entry point for the wool trade and to Piazza della Repubblica, the former Mercato Vecchio, the Arte della Lana, and the Loggia del Mercato Nuovo (Fig. 3).

Fig. 2 Map with a view of Florence. Attr. Francesco Rosselli. Copy of the lost original c.1470. Tempera on canvas. 578×1,316 mm. Image: Museo di Firenze, Florence. M01-085

Fig. 3 Normalised Angular Choice core (15% highest NACH Rn values) in OSMnx 'Firenze walk' network and VGA Integration, Connectivity, Clustering and Control indices in the 'Rucellai trade' district. The colour-coded maps show Palazzo Rucellai's central location between a former junction for the wool production (Piazza Carlo Goldoni) and the old market (Piazza della Repubblica) and its neighbourhood-level hierarchies. Image: C. Pezzica 2023

The ASA shows Palazzo Rucellai's location in relation to the distribution of local (Radius 800 m) and global (Radius n) centrality levels in the Florentine pedestrian path network. The ASA therefore reveals the relative importance of the location at different scales for to- and through- movement flow potential to assess its spatial attractiveness as a hub for the Rucellai's commercial activity. The VGA then offers an overview of 2D configurational variations in the public open spaces surrounding the palazzo, and particularly in the Piazza De Rucellai with its Loggia, in terms of neighbourhood-level spatial permeability and architectural-level visibility properties. The analysis captures the distribution of selected isovist-based metrics relevant to investigate urban square's hierarchies (Cutini 2003), among which *Visual Integration, Connectivity, Clustering Coefficient, Visual Control and Through Vision*, and resorts to punctual public life observations to confirm the qualitative interpretation of the VGA results. The combination and overlapping of these layers enable the integration of urban perspectives and human experience to re-assess the façade composition while offering useful digital scenes for discussing and testing the façade hypotheses.

Façade Hypotheses

Alberti's *De re aedifcatoria*, *De cifris*, and *Della tranquilità dell'animo* all explore mathematics' merit either in architecture or for the virtue (*virtù*) of the mind. Similarly, Alberti owned Euclid's *Elements* with his annotated copy still held at the Biblioteca Marciana. Thus, by applying Euclidean theorems, a geometrical survey visualises the correlation between the palazzo and loggia that the literature had previously described as intemperate, unruly and without any mutual correlation. From this analysis a new order and harmonious relationship emerges, seemingly adhering to a pre-conceived mathematical logic that adapts to the morphological constraints and spatial characteristics of the piazza, as underscored by the Space Syntax analysis. The theorem reckons the triangle's geometrical centre by connecting the midpoint of one of the triangle's sides with the opposing vertex. Imposed on Palazzo Rucellai, the axis that connects the lowermost vertex (A) with the opposite line's midpoint (B) extends to the position of one of the main doors of the palazzo (Fig. 4). When projecting a perpendicular line from the triangle's geometrical centre (a) to the palazzo's façade it ends near the second door from the right (C). While such a construct could be entirely coincidental, when drawing a second triangle comprising the face of the loggia and the inner perimeter of the piazza, a similar sequential procedure emerges. The projection of a line culminating from the geometrical centre of this second triangle (b) perpendicular to the façade ends near the end of the seventh bay (D), where the current unfinished façade terminates. Hypothetically, the other axis of the inner triangle leads to the end of the adjacent building's façade (between the 9th and 11th bay), corresponding to the boundary of what could have been the eleventh bay (E). As such, the seemingly underlying mathematical principles underpin the necessity to revise the façade hypotheses of Palazzo Rucellai, aided by a configurational analysis of the square and its surrounding spaces.

Based on the VGA and the digital twin, inspecting the three main façade hypotheses in their urban context questions their reliability and visual relationship with the piazza (Fig. 5). Scholars mostly consider the eight-bay hypothesis as the most credible, as it constitutes the simplest solution to the finishing of the façade. However, this paper argues that its discordance with Albertian theory, that outlined the need of even numbers of legs (the pilasters) in façades, and the discrepancies in its urban composition make it a highly unlikely and disputable case. The unfinished façade shows Giovanni's intent of expanding his palazzo by adding the adjacent plot, but the full width of the plot would conform to a nine-bay façade, which may seem the most convincing hypothesis. Nonetheless, its asymmetrically positioned doors question the purity of the design according to Alberti's principles, which the eleven-bay façade would resolve, calling for further exploration.

Conclusion

By reading Alberti's ruleset concerning palazzi designs and placing the digital twin of Palazzo Rucellai in its urban context, the systematic analysis of the façade's composition together with its urban configuration help formulate and test hypotheses for the
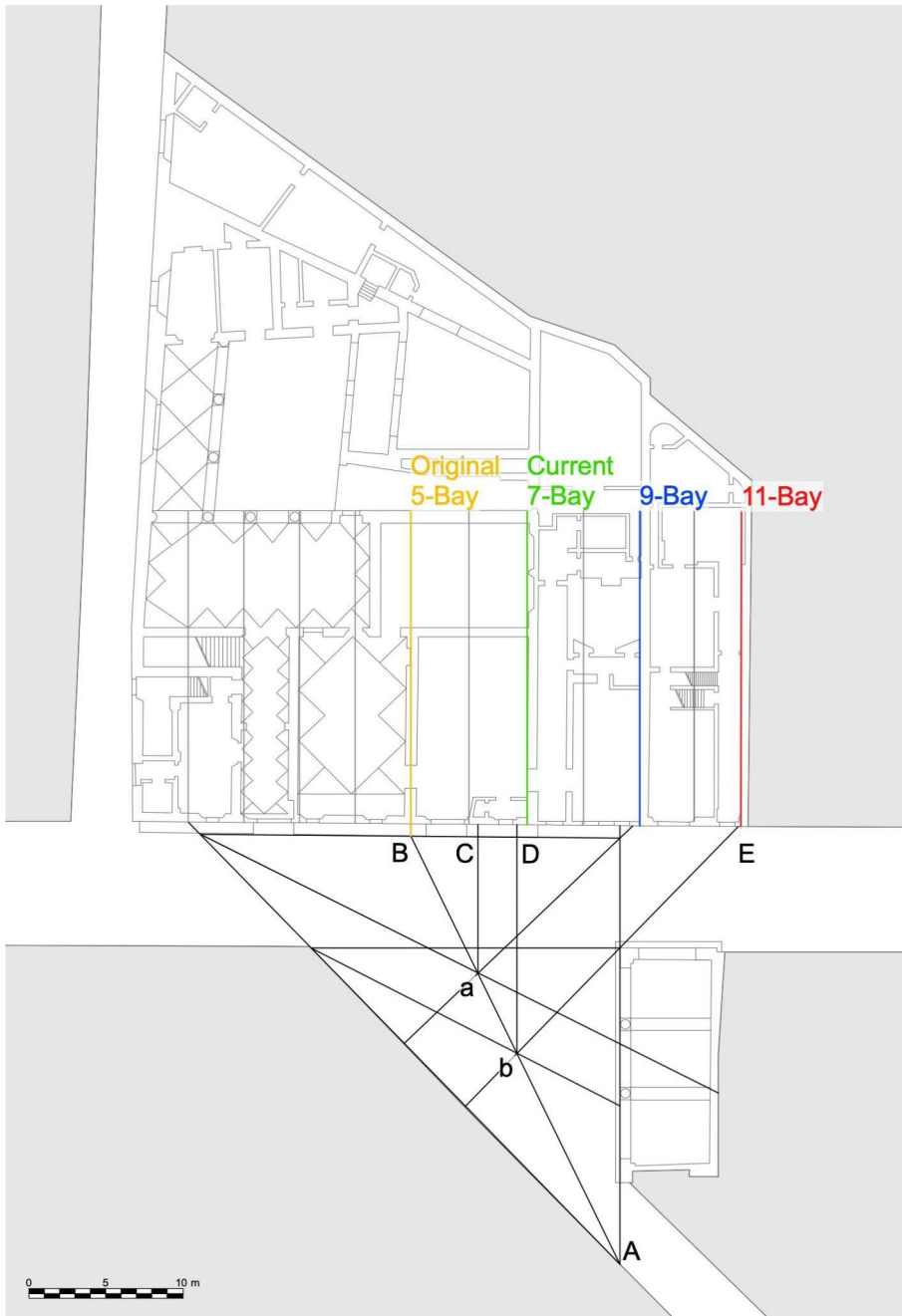
Fig. 4 Palazzo Rucellai's Euclidean Theorem and Hypothetical Façade endings. Image: N. Mols based on Preyer 1977

Fig. 5 Palazzo Rucellai's Façade Hypotheses. Left: eight-bay façade. Middle: nine-bay façade. Right: eleven-bay façade. Image: N. Mols and C. Pezzica based on the 3D digital reconstruction of Palazzo Rucellai 2022

envisioned design. Alberti codified architectural principles that substantiated power in grandeur and expressed civil morale and authority in the transformative urban context of Quattrocento Firenze. The Space Syntax analysis and digital twinning of Piazza and Palazzo Rucellai help unveil these qualities, providing insights into how Renaissance spectators perceived the Rucellai façade from its urban context. Last, by positing different possibilities for Rucellai's envisioned final façade according to Albertian rules, the paper highlights that Alberti's pivotal work marked a transition in palazzi inventions that shaped Renaissance *disegno*.

Declarations

Conflict of Interest The authors declare no conflict of interest.

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Nick M. L. Mols is a Lecturer in Architecture at the Welsh School of Architecture, Cardiff University. Nick's research bridges established historical and innovative digital methods to investigate European and Eurasian architecture in its historiographical, cultural, and scientific context from 1500 to 1750. He focuses on early modern architectural history, digital art history, and proportional theory to unveil how past technological advancements and architecture influence the present-day digital turn and algorithmic thinking in design.

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