Trachtenberg, M 2014 To Build Proportions in Time, or Tie Knots in Space? A Reassessment of the Renaissance Turn in Architectural Proportions. *Architectural Histories,* 2(1): 13, pp.1-8, DOI: http://dx.doi.org/10.5334/ah.bp

RESEARCH ARTICLE

To Build Proportions in Time, or Tie Knots in Space? A Reassessment of the Renaissance Turn in Architectural Proportions

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Since Alberti, and most critically since Wittkower's *Architectural Principles*, architectural theory has tended to construe 'proportions' in plenary, static terms. The dimension of time and change that relentlessly affects all human endeavor is not accommodated by the celebrated Albertian ideal of immutable design perfection, so perfect in all respects that once attained 'nothing can be added, taken away, or altered, but for the worse'. This article, drawing on the author's recent book, *Building-in-Time from Giotto to Alberti and Modern Oblivion* (Yale, 2010), outlines the antithetical, dynamic proportional methodology of the pre-Albertian architectural regime. Its point of departure was the author's concept of durational aesthetics, according to which perfected architectural form is produced by a process of incessant revision. What distinguished this process from related ancient or neo-antique doctrines was above all its dynamic modality and participation in the fluid orientation and processes of 'building-in-time'.

Introduction

In this paper I intended to treat the ideas on proportion of my recent book, *Building-in-Time* (Trachtenberg 2010). But in the writing I was detoured to another relevant topic for the conference that prompted this paper, Rudolf Wittkower's idea of 'proportions in perspective' in Brunelleschi.[1] I realized it needed to be part of the revisionist critique that I will offer. As a result, this will be a two-part paper. First, I will show that Wittkower did not prove his case about Brunelleschi and probably was altogether wrong, a useful point considering that Wittkower's reading is still widely accepted. Then I will discuss the proposal of my book concerning durational proportions, which are an aspect of what I term *durational aesthetics*, a model that incorporated time and change and allowed for the flexible shaping and reshaping of proportions through time. This system ran counter to another aspect of Wittkowerian doctrine, regarding the anti-temporal aesthetic model that was first promoted by Alberti, who sought to evacuate time from all architectural production, including the management of proportions.

Wittkower's 'proportion in perspective'

In the mid-twentieth century, just after World War II, a nexus of ideas took shape in architecture culture regarding proportions, the hot new topic celebrated by the 1951 Milan conference that the 2011 Leiden conference on proportion revisited. Among historians, the central agent was Wittkower, plenary speaker in Milan, chosen because of his powerful book of 1949 projecting an ideal humanist world of Renaissance architectural principles (Wittkower 1949). Joining him but on the architects' side was the other star of the Milan conference, Le Corbusier, with his alluring although cumbersome 'Modulor'. This proportional model was broached in 1943, published in 1948, and followed by 'Modulor 2' in 1955. It became widely diffused as a modern pseudo-humanist icon echoing Leonardo's redaction of Vitruvian man (**Fig. 1**).[2]

For Le Corbusier, Wittkower and their adherents, Leonardo da Vinci's seductive drawing encapsulated a Renaissance ideology that was at once anthropocentric, -morphic, and -metric. Obviously it also was highly gendered. It concretized a fixed human scale of measure and proportions, derived at once from nature and from antiquity, which were closely associated models in the Renaissance imaginary. Leonardo's image encapsulated the authority of antiquity, the proportional doctrine of its surviving voice, Vitruvius, and the glamour of its rebirth.

In the Renaissance, as Wittkower and others explained, Vitruvianism had been articulated in the widely influential, neo-antique proportional doctrines of contemporary theorists such as Palladio and Vignola, who advocated fixed canons of proportions both for the orders and in general regarding dimensional relationships in architecture. The first among these figures was Alberti, founder of Renaissance and modern Vitruvianism. Although Alberti rejected the Vitruvian anthropomorphism of proportions promoted by Leonardo and most Renaissance theorists, he adopted Vitruvian organicism. Most importantly, he was the first modern to advocate a model of fixed sets of proportions for various architectural schemes, which he spelled out in elaborate detail.

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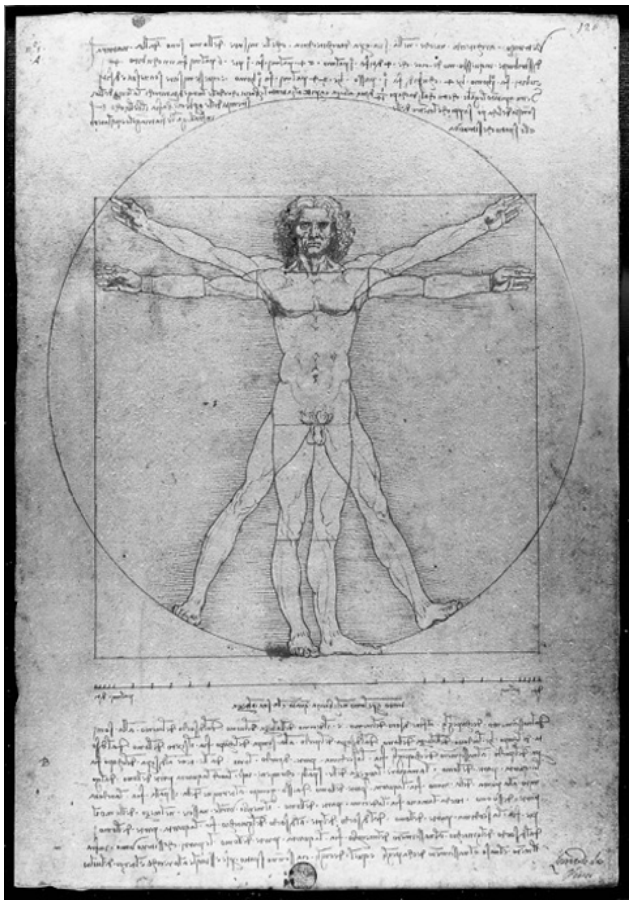

Fig. 1: Vitruvian man, Leonardo da Vinci, 1487 (Venice, Accademia).

Fig. 2: San Lorenzo, nave, built after 1442.

Fig. 3: Santa Croce (begun 1294).

Alberti's program was a pivotal datum in the post-war fascination with Renaissance proportions, and we will return to him. Yet before Alberti, of course, stood Brunelleschi. Although he left no theoretical writings, he was not only the founder of Renaissance architecture, but simultaneously the inventor of Renaissance perspective. In the theoretically heated climate of the post World War II years, a connection between Brunelleschi's two endeavors was an intersection waiting to happen. Again, this convergence was led by Wittkower, in the publication to which I earlier alluded, a 1953 article in the *Journal of the Warburg and Courtauld Institutes*, of which he was a founding editor. Its title, 'Brunelleschi and Proportion in Perspective,' was an irresistible combination of terms (Wittkower 1953). Moreover, Wittkower's article had reinforcement. Its first lines assert origins in an article of 1946 in the same journal by the noted Giulio Carlo Argan, 'The Architecture of Brunelleschi and the Origins of Perspective Theory', which sought to connect the two aspects of Brunelleschi's career, architecture and perspective, that had always been treated separately (Argan 1946).

Wittkower, in a proto-Baxandallian move, explicitly took the next step, famously claiming (in a footnote) that 'Brunelleschi would have liked seeing his buildings in photographs' — that is, in veristic perspective renderings (Wittkower 1953: 289 n. 5). As he put it,

> Brunelleschi's invention of linear perspective set the seal to the Renaissance conviction that the observing eye perceives metrical order and harmony throughout space. If one is keyed up to the metrical discipline of buildings like S. Lorenzo [**Fig. 2**] or S. Spirito and tries to see as if through a screen the lines retreating towards the vanishing point and the quickening rhythm of the transversals, it is possible to evoke visual reactions similar to those which Renaissance people must have experienced. [...] the difference between architecture and painting becomes one of artistic medium rather than of kind. (Wittkower 1953: 289)

Unfortunately, this seductive reading is undermined by a number of problems not addressed by Wittkower. First, the idea that Brunelleschi's perspective and his architectural interiors share a common 'period eye' is diluted by the simple fact that the proportional-perspectival effect described by Wittkower is to varying degrees shared by most columnar, arcaded basilicas. Far from having the period- or author-specificity that Wittkower posits, the 'proportion in perspective' effect is to a great extent shared by the early Christian basilicas of Rome, not to mention their medieval successors, including the churches of Lucca, Pisa, and Florence itself. The effect is also seen directly in buildings historically more proximate to Brunelleschi, in interiors such as Santa Croce, which was built as a perspectival theatre inhabited by a measured proportioning of space, piers, wall features, and arcading (**Fig. 3**).[3] In other words, to the degree that 'proportion in

Fig. 4: Masaccio, Plate of Nativity, 1427–28 (Berlin).

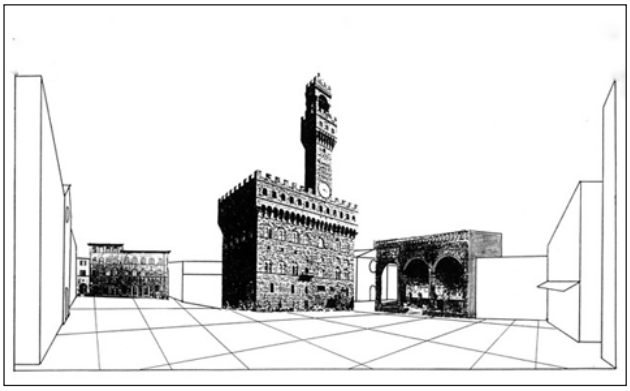

Fig. 5: Brunelleschi, panel of Piazza della Signoria, c. 1425.

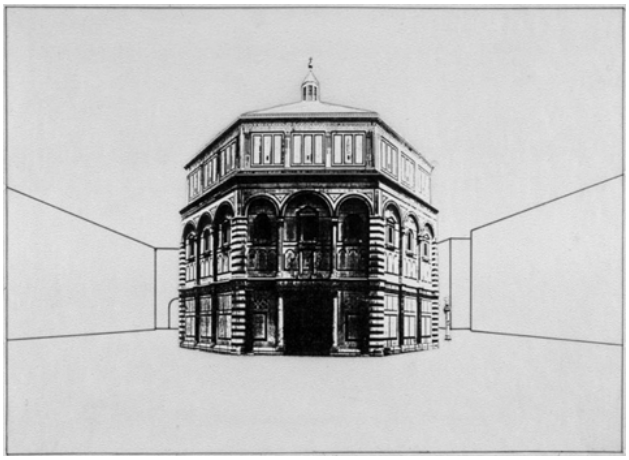

Fig. 6: Brunelleschi, Baptistery panel, c. 1425.

perspective' is a legitimate interpretive concept, it is not limited to Brunelleschi or the *quattrocento*. It does not in itself uniquely define his architecture but at most would situate it in an older architectural discourse.

A second set of problems regarding Wittkower's hypothesis involves the other side of the equation, Brunelleschi's invention of Renaissance perspective around 1425. Wittkower does not illustrate reconstructions of Brunelleschi's lost panels, nor does he mention them in the text except for single references to 'famous panels' and 'experiments'. His only illustrations, apart from some geometrical diagrams, are of Brunelleschi's two basilicas, a detail of the late *quattrocento* Urbino perspective panel, and Bramante's illusionistic choir at San Satiro.

Given this lacuna, if one were to read Wittkower's article without knowing the subjects of Brunelleschi's panels, one would probably imagine them to depict interiors of existing basilicas or other spaces with receding arcades, as seems to be inferred. But this was not what he painted. Alternatively, it might be imagined that Brunelleschi's panels resembled contemporary paintings done under the influence of his demonstrations, including well known works of Fra Angelico, Masaccio, Masolino, and others (e.g., **Fig. 4**). Or it might be speculated that Brunelleschi perhaps elected to depict his own new architectural creations as projects, or some unbuilt scheme, a vision of his new-ancient perspectivally proportioned architecture. Such conjectures would all be wrong.

Armed only with the material presented in Wittkower's article, the reader probably would never guess the actual subjects of Brunelleschi's two panels. Rather than representing arcaded interior spaces, they depicted two spatially unitary *trecento* piazzas and their monuments, in one case the entire Piazza della Signoria, in the other the Baptistery at the center of the Piazza del Duomo (**Figs. 5**, **6**). The latter, to be sure, showed the Baptistery's blind-arcaded sides in visible recession, yet this was far from producing the dominant proportional-perspectival matrix effect that Wittkower describes.

Thus, the evidence of Brunelleschi's actual pictorial-perspectival practice does not sustain Wittkower's speculation that the architect self-consciously imagined or configured his own buildings in any modality of 'proportion in perspective'. The perspectival modality of his demonstration panels does not align with his architectural interiors, certainly not in the ways that Wittkower conjectured. A more credible scenario, in historical context, is — as often imagined — that it was Alberti who transformed Brunelleschi's rational perspectival invention into a method by which 'proportion in perspective' might actually accommodate architectural planning and figuration, real or imaginary, of the *modular kind* studied by Wittkower, especially one involving a pavement grid (**Figs. 7**, **8**). In this light, the Wittkower thesis, without supportive evidence to the contrary, appears to have been an unfounded and fruitless distraction with respect to understanding either Brunelleschi's work or the origins of Renaissance perspective and related issues of proportional practice.

Durational proportions

These observations lead to my second topic regarding the role of temporality in proportion theory, a question that hinges on Alberti rather than Brunelleschi, the latter of whom basically was traditional in his proportioning of design (which employed a combination of square-schematism, rotational figuration, simple Pythagorean ratios, and other common proportional devices, albeit

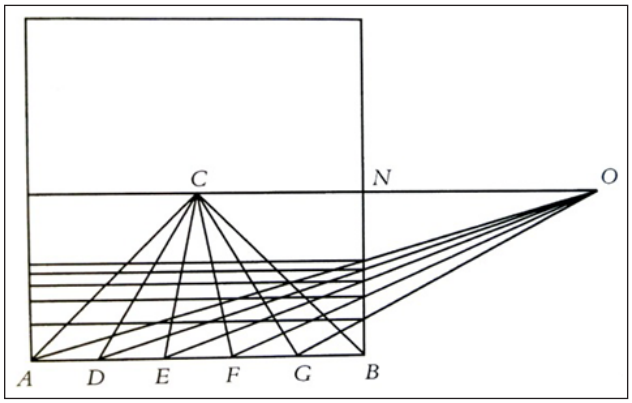

Fig. 7: Albertian perspective grid method, c. 1436.

Fig. 8: Neroccio de' Landi, Annunciation, late 15th century (Yale University).

with exceptional precision and typically with a heightened *visibility* of ratios and boundaries).[4] Alberti invented numerous shining architectural ideas, but some of them entailed a high rigidity of methodology, and this was especially true of his proportional doctrine. One need only read Wittkower's laboured description of Alberti's inflexible, cumbersome program of proportions to understand my metaphor of Alberti attempting to 'tie proportions in knots', along with his equally inflexible, purist set of ideal building typologies (Wittkower 1949: 71, 113–116; cf. Trachtenberg 2010, 376). But his ideas were not merely extreme. They were historically radical, proposing a violent swerve from standard proportional methods.

In the real world of most medieval and Renaissance architectural practice, proportion design was integrated with the flow of time and change. It was anything but tied in knots. Proportions were aligned with duration like every other aspect of planning. In building-in-time, as I term this *longue durée* pre-modern architectural regime, no building was planned comprehensively or immutably at the outset. This stood in sharp contrast to Alberti's atemporal new program of building-outside-time, which rigidly separated planning and building conceptually and temporally, positing an initial perfection of design, including proportions, to which 'nothing could be added, taken away, or changed except for the worse', to cite Alberti's well-known language.[5]

Instead, planning and building were interwoven in a fluid process that was governed by an uncodified regulatory apparatus, comprising four design principles. In building-in-time the close shaping of detail occurred only when needed for production, according to a design principle that I term 'myopic progression', in which details came into focus only as the time of their facture approached. Every level of design large and small was open to revision, especially during the very long durations usually necessary to complete an ambitious work – decades, generations, a century or more – at sites where new contingencies in the lifeworld of the rising building, new patrons, architects, finances, and social conditions forced swerves in overall concepts and detailing alike. I term this flux 'continuous redesign' – redesign not as exception but as the norm of practice. The dynamic methodology of building-in-time was thus inherently flexible, and this elasticity included proportional planning, which was an integral part of the fluid, long-term process.

In this system, change was not unlimited or without aesthetic regulation. Two further planning principles were at work producing order out of the underlying condition of flux, or at least mitigating disorder. The protocol of 'concatenation' required that every new design move be linked to an aspect of the existing scheme. In effect, concatenation was a dynamic version of the Vitruvian doctrine of *symmetria*, which required that all elements relate to each other and to the whole. Finally, the principle of 'retrosynthesis', as I term it, which is suggestive of Vitruvian *eurythmia*, required that all new planning be harmonized with the preexisting fabric and that the evolving whole always maintain formal unity through retroactive measures (Trachtenberg 2010: 130–143, on the four principles).

This understanding of pre-Albertian architecture culture sharply alters our concept of the historical transmutation of proportional methods that occurred in the Renaissance at the theoretical level. In Wittkower's influential reading of this process, both in the humanism book and the Milan meeting in 1951, the shift is posited as a sweet and simple reinforcement of the standard darkness-to-light narrative of Renaissance ideology. In Wittkower's eyes, whereas the system of strictly numerical ratios advocated by Renaissance theorists was totally commensurate and beautifully rational, the medieval system of geometric figuration, dominated by triangles and polygons, was 'irrational' because it produced incommensurate numerical relationships that ultimately were not totally definable. In his reading an insidious slippage occurs in the meaning of the term 'irrational' as it slides from the status of a technical mathematical distinction to denoting a lack of numerical precision and thence to the familiar condemnation of the entire pre-Renaissance as 'irrational' – that is, literally *without reason*, lacking and abject, even immoral and sinful, another dark part of the dark ages.

To dissect this factually and discursively dubious yet stubbornly entrenched narrative, in which many Renaissance historians appear still to take so much comfort, is beyond the scope of this paper. Here my aim is rather to shift discussion to an altogether different narrative of proportional practices, in which the essential issue is not absolute 'rationality' or its absence, but rather the inescapable factor of time, temporality, and change. The point is to grasp the underlying denial of the forces of

time in Albertianism, and to understand the alignment of proportional practice with those same forces in the fluid methodologies of building-in-time. It was the design-build system of building-in-time and its infrastructure of procedural guidelines that made possible the production of the many extraordinary long-durational works that characterize pre-modern architecture — so many that even a bare list of works might not fit in this paper. I will briefly cite just a few examples in which the dynamic, flexible process of proportion design is particularly evident.

The Pisa duomo group is a classic instance of durational proportions (**Figs. 9**, **10**). It is also an extreme case: three buildings of diverse typologies begun at intervals spanning a century (1063–1173), plus the monumental burial ground, the Campo Santo (begun 1275).[6] The entire complex was erected over four centuries by at least ten generations of builders, yet it maintained to the end an uncanny degree of harmony, often cited as a standard of architectural group relationships for all time. In good part the causes of this harmony are obvious in the uniformly lucid geometric massing and overall shaping of the buildings, their open and blind arcading, uniform material, color, and ornamental patterns, with all these aspects developing various modes of concatenate planning in their close, consistent interrelationships and cross-referencing. An omnipresent key to the unity resides in proportions and alignments, much of it hidden in plain sight. For example, the three main buildings rise to the same height, as do the facing baptistery cylinder and duomo facade, itself close to fitting within a square. Ratios of 1:1, 1:2, 3:2 — unison, octave, fifth — concatenate densely through the buildings' dimensions.

Perhaps what is most uncanny and revealing of the creative power of building-in-time is how, even as the buildings underwent change and multiplied, relationships of proportion and alignment were maintained in imaginative, disciplined concatenation and retrosynthesis. Originally in 1063 the nave and transept lengths of the duomo were proportioned 1:1. A century later, the nave determined the size and position of the baptistery, whose cylinder aligned with extensions of the nave walls, while the distance between the two buildings was set at 76 meters, or approximately the total length of the church (**Fig. 11**). Similarly, the main piers in the baptistery were invisibly aligned with the nave arcades. Rather astonishingly, when the nave was extended and given a new facade, normative proportions were maintained between the two buildings: the new nave length was made equal to the distance from the new facade to the opposite side of the baptistery (**Fig. 12**). Finally the 'secret' of the siting of the Campanile is revealed, again hidden in plain sight. Like the baptistery, its position was determined by lines extended from the duomo, but now in an asymmetrical, triangular configuration rather than parallel projection as in the duomo nave and baptistery. As seen in the plan (**Fig. 11**), the tower's southern edge was aligned with the duomo's south transept apse, while its distance from the duomo was determined by a diagonal line run along the northeastern features of the cathedral.

Fig. 9: Pisa cathedral group, from west, 1163–15th century.

Fig. 10: Pisa cathedral, south transept apse, and campanile.

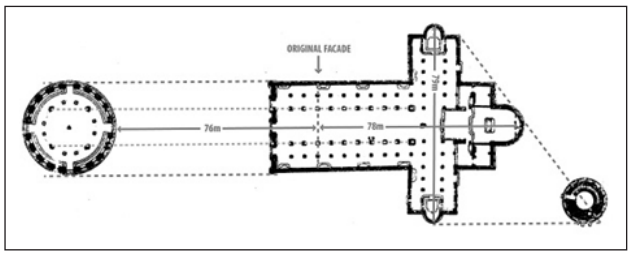

Fig. 11: Pisa cathedral group, plan showing a)original equivalence of length and breadth of cathedral b)equivalence of nave length and distance from baptistery c) alignments of baptistery with nave width and arcades d)triangular alignments of campanile with duomo.

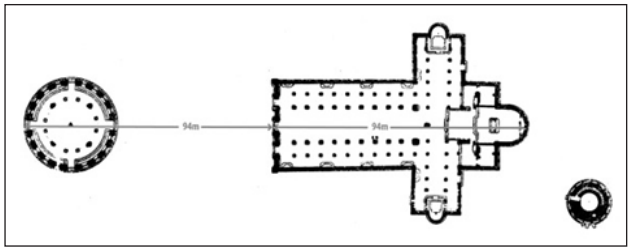

Fig. 12: Pisa cathedral group, equilivalent dimension of extended nave length and distance to back of the baptistery after plan change.

Another instance of a lucid network of proportions and alignments developing over time was the Piazza della Signoria in Florence (Trachtenberg: 1997: Ch. 3). A set of plans trace the evolution of a century-long chain of proportional concatenation. It begins with the grid of the palace plan of 1299 (**Fig. 13**), which was developed from a module (b) obtained from a preexisting site condition, the distance from the lower right corner to the edge of the old family tower left standing inside the palace (a). The doubling of this distance resulted in the length of the main wall, which, divided by five (between end wall centers), yielded the module in question (b). This operation produced a theoretically square courtyard area and a zone of great halls proportioned 2:3, with supporting piers correctly placed at modular intersections.

Next, the ideal plan of the piazza is concatenated from the palace plan around 1350 (**Fig. 14**), using the north palace wall as a new module, x, which is doubled, becoming the side of a square (A), whose diagonal (y) is then used to dimension the side of the adjacent larger square (B). In the palace commensurate numerical dimensions and ratios are employed, while in the piazza the method is the geometric, 'irrational' mode.

The final step results in a precisely aligned and proportioned perspective on the piazza. A center line divides it into optically equal wedges and the viewing distance to the visual axis of the main object in view, the palace tower, is equal to its height (**Fig. 15**). So compelling was the resulting scenography — a veritable 'proportioning in perspective' — that Brunelleschi was drawn to transform it into a demonstration of his pictorial method a few decades after its completion (**Fig. 5**). Here we ought not to forget that in the early 1420s the Piazza della Signoria, finished in the 1390s during Brunelleschi's youth, was the most monumental, unprecedentedly new cultural creation of the city.[7]

Building-in-time, like all such programs, was not always smooth sailing. In the notorious case of the failed Duomo Nuovo project in Siena, the problem was not any disdain of correct proportions (**Figs. 16**, **17**).[8] The disaster did not happen by accident or through some inadequate attention to theoretical considerations among Italian medieval architects. To the contrary, as I explain in *Building-in-Time*, the Sienese planners were obsessed with proportions, so much so that excessive attention to proportional consistency appears to have been a principal factor behind the grave structural miscalculation that lead to the abandonment of the project in 1356.

No study of Italian pre-modern architecture would be complete without new St. Peter's, which in certain respects was the most extreme of all examples of building-in-time. It involved much the same problematic as Siena, in that it was in almost every respect a disproportionate project. It was disproportionate to material and structural means, not to mention spiritual ideals, and it was only by the grace of God-sent Michelangelo, as he saw himself, that it was ever finished. Essentially this completion was achieved by sharply altering proportions, those between the central domical unit and the surrounding matrix, which was radically reduced. The story was all about proportion, disproportion, and negotiating the realms of architectural

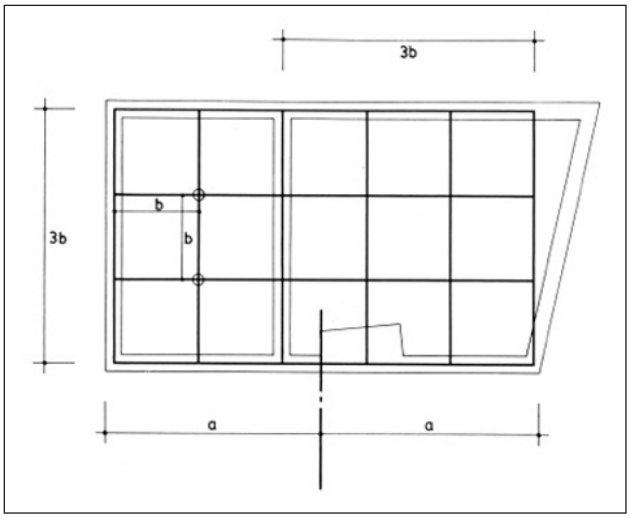

Fig. 13: Palazzo Vecchio plan, showing modular scheme, 1299.

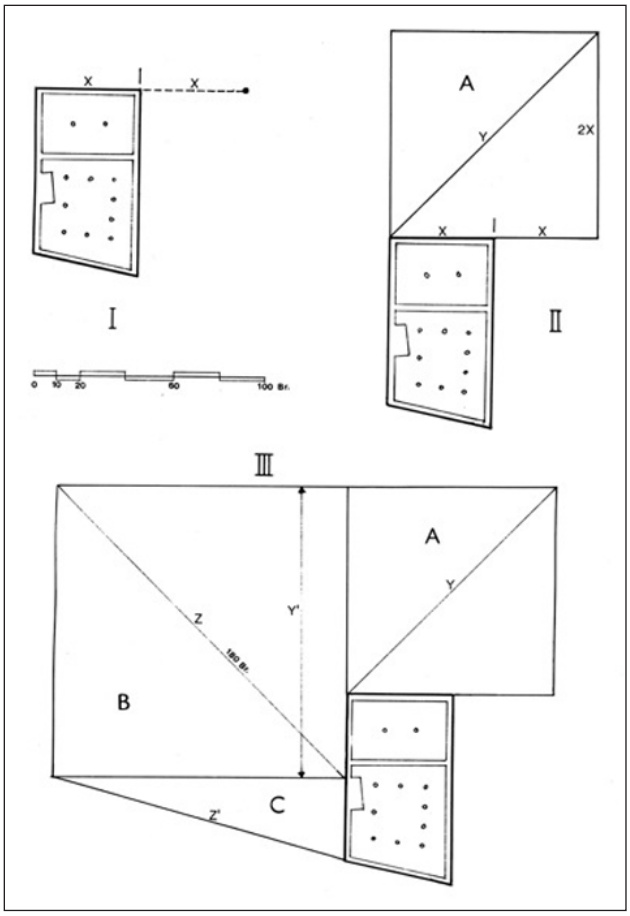

Fig. 14: Piazza della Signoria, ideal scheme of plan, c. 1350.

desire, possibility, and reality. Because of its improbable triumphant conclusion, we tend to forget that St. Peter's might well have ended like Siena's Duomo Nuovo project, in which case the Heemskerck drawing in **Figure 18** would have shown the great basilica not advancing glacially to completion, but like Siena slowly drifting through time towards a vast architectural shipwreck.

To conclude with a telegraphic proposal of three aesthetic programs that underlie the above discussion: First and most familiar is Alberti's ideal of perfect, immutable

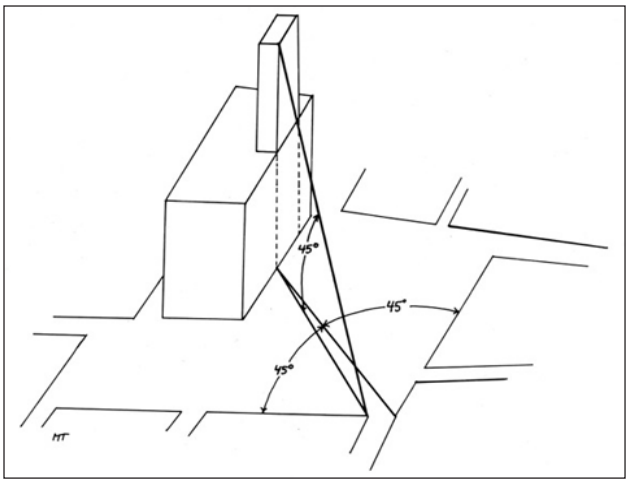

Fig. 15: Piazza della Signoria, spatio-visual geometry of the main perspective from the Via dei Calzaiuoli (mid-late 14th century).

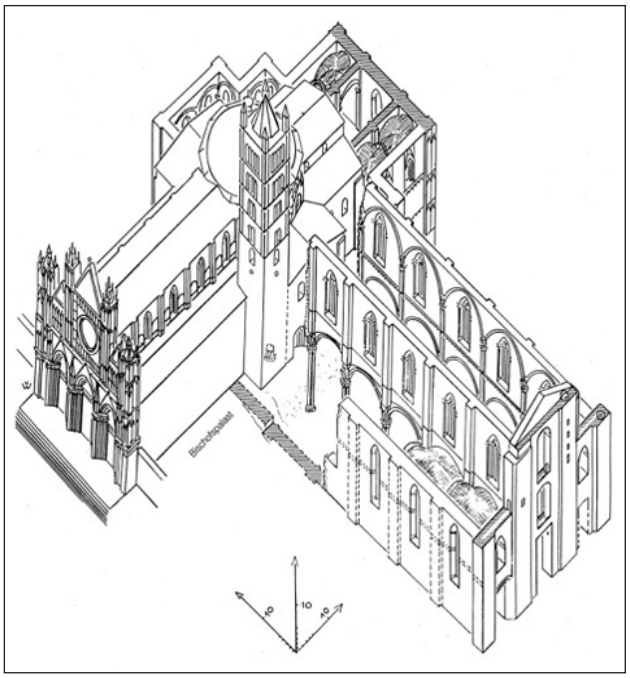

Fig. 16: Siena Duomo at point of abandonment of the Duomo Nuovo project in 1356 (Haas and von Winterfeld).

Fig. 17: Siena, Duomo Nuovo (1995).

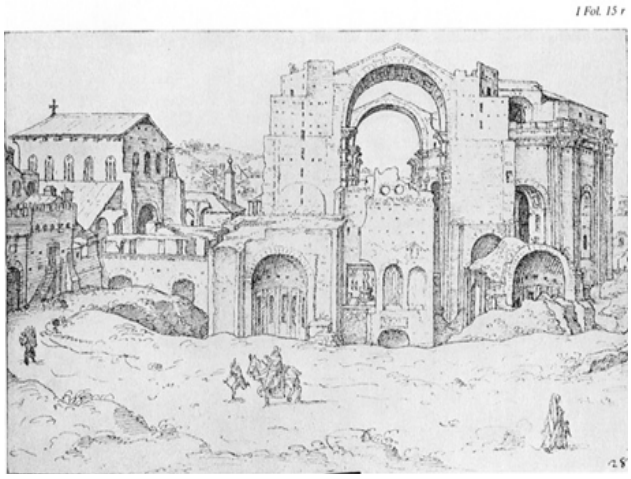

Fig. 18: Maarten van Heemskerck, St. Peter's *veduta*, sketchbook I, f. 15r., ca. 1532/6 (Kupferstichkabinett, Berlin).

form, which is a principal basis of modernism, the building as immaculate work of art: 'Beauty is that reasoned harmony of all the parts within a body, so that nothing may be added, taken away, or altered, but for the worse' (Alberti 1988: 156).[9] Second, in postmodernist thought, no formal perfection is possible, but only process, as in George Steiner's phrase, 'Form is not perfected act but process and incessant revision' (Steiner 1978: 139). Third, durational aesthetics resolves this dilemma with the concept of mutable formal perfection, which allows that perfected architectural form is produced by a process of incessant revision (Trachtenberg 2010: 127–130).

Notes

[1] 'Proportional Systems in the History of Architecture', hosted by Leiden University, 17–19 March 2011, organized by Matthew A. Cohen, Caroline A. van Eck, and Eelco Nagelsmit.

[2] On the affinity of Wittkower's work and architectural modernist thought, see Payne (1994).

[3] Compare also Santa Maria Novella. See Trachtenberg (2010: 205–231) and (1997: ch. 4).

[4] On Brunelleschi's proportions, see Saalman (1993) and Cohen (2008).

[5] For a full account Alberti's anti-durational program, see Trachtenberg (2010: ch. 3); for an abridged version, Trachtenberg (2011).

[6] Trachtenberg (2010: 235–239); on the Pisa chronology, see Peroni et al. (1995).

[7] The intricate proportional planning and re-planning of the duomo and S. Maria Novella tell further stories of the extreme flexibility and precision of architectural proportion in Building-in-Time (Trachtenberg 2010: 158–174, 205–222).

[8] On the duomo history, see Haas and von Winterfeld 2006. For a theoretically informed explanation of the failure of the Duomo Nuovo, see Trachtenberg (2010: 249–260).

[9] Alberti, *De re aedificatoria* 6.2. The phrase echoes no less than eight times through the treatise.

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How to cite this article: Trachtenberg, M 2014 To Build Proportions in Time, or Tie Knots in Space? A Reassessment of the Renaissance Turn in Architectural Proportions. *Architectural Histories,* 2(1): 13, pp. 1-8, DOI: http://dx.doi.org/10.5334/ah.bp

Published: 20 June 2014