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Plans and Models in 15th- and 16th-Century Ottoman Architectural Practice

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Although written sources frequently refer to plans and models used by Ottoman architects during the 15th and 16th centuries, these plans and models are believed to have disappeared completely. In this article, two unknown late-16th-century Ottoman plans are introduced, while other known examples thought to antedate the 17th century are redated on the basis of their previously unnoted watermarks to the second half of the 15th century. These unusual plans shed light on Ottoman architectural practice, which has remained largely unknown since Ottoman architects did not leave behind treatises comparable to those of their European contemporaries. Their drafting technique can be related to a broader context of Islamic drawings from the East, as well as to contemporary plans by European architects. However, they are also characterized by a unique set of conventions which distinguish them as a group.

After discussing these plans, the article addresses problems posed by the lack of detailed elevation drawings and the question of whether Ottoman architects used models in designing building façades. The different functions of models are traced through written and visual documents in an attempt to distinguish between commemorative models and utilitarian construction models aiding the design process. As in the case of ground plans, parallels with contemporary European architectural practice are stressed throughout.

Finally, the wider implications of these plans and models, concerning the mode in which abstract architectural ideas were communicated and disseminated throughout the Ottoman empire, are dealt with.

The unfortunate disappearance of Ottoman plans and models, which are referred to frequently in written sources, poses a serious problem in understanding Ottoman architectural practice, especially since there are no theoretical treatises by Ottoman architects to fill the information gap comparable to those of Alberti, Filarete, or Palladio. Only a small number of plans thought to antedate the 17th century have been preserved, while no architectural models are extant. This has raised doubts about their use during the 15th and 16th centuries, suggesting that much of the design process was improvised during construction following traditionally established formulae. In this paper, two unknown late-16th-century Ottoman bath plans will be introduced, together with already published plans from the Topkapı Palace archives which can be redated on the basis of their previously unnoted watermarks to the second half of the 15th century. These plans not only confirm the early existence of an Ottoman tradition of ground plans, but also raise interesting questions about the modes in which abstract architectural ideas were communicated and disseminated throughout the empire.

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1. It is believed that plans were destroyed as a group during the demolition of the atelier of royal architects at the Topkapı Palace; T. Öz, "Eski Cami Planlari ve Mimari Vesikalari" (Old Mosque Plans and Architectural Documents), 172 (1936), 4; O. Erdenen, "Eski Yapilardan Ile Plan Meseleni" (The Problem of Plans in our Old Buildings), Mimariyi, 26 (1965), 19. Some plans must have been kept at the Chief Royal Architect's office at the district of Vefa in Istanbul. According to Cafer Çelebi, Mimar Sinan's plans were in the possession of the Chief Royal Architect Mehmed Ağa; O. Ş. Gökşay, "Risale-i Mimariyye—Mimar Mehmed Ağa—Eserleri" (Treatise on Architecture, the Architect Mehmed Ağa, and his Works), in Ismail Hakkı Uzunarsılı, 'ya Armağan, Ankara, 1976, 152. For the argument that Ottoman monuments of the "classical" period were created from empirical mental images, see W. Denny, "A Sixteenth-Century Architectural Plan of Istanbul," Ars Orientalis, 8 (1970), 53.


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Early Ottoman plans

The two unknown Ottoman bath plans drawn on unwatermarked paper are pasted onto pages of a picture album in the Austrian National Library (Cod. 8615) which was compiled around 1584–1586 as the illustrated record of an Austrian embassy to the Ottoman court (Figs. 1, 2). Identified with Turkish captions, these plans were executed by an Ottoman draftsman, probably at the album owner’s request, and differ in their drafting technique from a third plan in the same album which is clearly a copy of the first. This plan, with German annotations, might have been drawn by the same Austrian who commissioned the originals (Fig. 3). While both originals are scaled drawings executed on squared paper with blind horizontal and vertical lines, forming a checkered grid network of small squares measuring 1 cm on a side, the unscaled copy is traced on a different kind of paper lacking the blind grid formed by incised indentations on the surface. Moreover, unlike the original plans, which are executed in black ink with the thickness of walls filled in by red color, the copy reproduces only ink outlines without the red tint.

The first plan on folio 151r (Fig. 1), drawn on a piece of unwatermarked paper measuring 37.5 × 25.5 cm, represents a typical small-scaled Turkish bath with a domed disrobing room, or apodyterium (#1), featuring a central fountain (şadırvân) and an L-shaped raised platform with small niches for placing shoes (çamekân şoffası); this communicates with a smaller domed tepidarium (şoğuk halvet) (#2), the raised platform (şoffa) of which is indicated by a line. This room opens to a latrine (helâ) (#3) represented by a triangle, to another domed tepidarium (orta halvet) (#4) with a platform (şoffa), and a domed octagonal caldarium (issî halvet) (#5) with fountain recesses (şudân). Next to the recesses are a cold-water reservoir (şoğuk şu hâzînesi) (#6), a hot-water reservoir (issî şu hâzînesi) (#7) heated by a furnace (kâlîfâ), and a chimneymeyed (ocâk) furnace room (kîlîfân odâsi) (#8). A statement scribbled in a different hand on the disrobing chamber (#1) reads: “This is the place where those entering the bath undress/İhammâma girenlereรถยرعا şunacak yerdir.” Together with the extremely detailed identification of each unit by legends in Turkish, it supports the hypothesis that this plan was executed by an Ottoman draftsman at the request of a foreigner unfamiliar with the layout of a typical bath. Whether it was meant to be shown to Austrians who were curious about Turkish baths, or whether it was related to an actual construction project in Austria, its unusually detailed Turkish notations explaining the functions of each space are a unique feature distinguishing this plan from other known examples. The German legends of its copy on folio 152r, drawn on a piece of paper measuring 37 × 28.5 cm, are direct translations of the Turkish ones identifying the function of each room (see Fig. 3). Austrian travelogues from the last quarter of the 16th century, with detailed descriptions and illustrations of baths in Istanbul, testify to a persistent fascination with this building type. Such an illustration, representing the exterior of a typical bath, is also found

3. Cod. 8615 was owned by the humanist Johannes Lewenkław (1541–1594) who accompanied the Austrian ambassador Heinrich von Liechtenstein to Istanbul in 1584–1585. On folio 158r is a dedication written by Lewenkław to H. Beck in 1586. It is likely that the bath plans were commissioned by him. The album also includes earlier visual material compiled during the embassy of David von Ungnad (1572 and 1573–1578), consisting of Ottoman sultans’ and vezirs’ portraits. Although the album is well known for is portraits and scenes from Ottoman life, the ground plans have not been noted before. Franz Unterkircher, Inventar der Illuminierten Handschriften, 2 vols., Vienna, 1957, 1, 121.
in the picture album which contains our plans (Fig. 4). Therefore, it is possible that the Ottoman plans were originally commissioned for publication in a travelog, a project that probably failed to materialize due to the sudden death of the Austrian ambassador prior to completing his diplomatic mission.4

The second Ottoman bath plan on folio 153r (36.5 x 25.5 cm) is identical in its drafting technique to that of the first, but its Turkish legends written by the same hand are complemented by German annotations to eliminate the necessity of producing a separate copy (see Fig. 2). The small bath represented on this plan has a different layout, consisting of a domed changing room (admekân) (#1) with a fountain in its middle (râdvan), which communicates with a tepidarium (halvet) (#2) featuring a raised platform (oça). The latter opens into a latrine (feład) (#3) indicated by a triangle, and to a small shaving room (tirazhane) (#4), as well as an octagonal pool (havzè) (#5) preceded by a corridor (dîhlîz) (#6). Circles around the pool represent water conduits (su gelicek lüle), and the corridor in front of it communicates with a caldarium (issi halvet) (#7) surrounded by an L-shaped hot-water reservoir (issi su halvanesi) (#8) heated by a furnace (küllhàn) (#9), next to which is located the cold-water reservoir (soğuk su halvanesi) (#10).

In these two carefully executed Ottoman plans drawn on a blind checkered grid, iron latticed windows are indicated by crossed diagonal lines within the thickness of walls which also feature small circles representing water pipes, while door arches (kapu) and shoe niches are shown in elevation. Parallel semicircles are used for arches of main gates or water basins, and triangles indicate latrines. Raised platforms, on the other hand, are represented by lines and furnaces with a curious bulb shape emitting heat rays. These two late-16th-century plans, specially drawn at a foreigner’s request, not only contain valuable information about the layout and terminology of a bath’s individual units, but also testify to the existence of Ottoman ground plans with easily legible conventions. They recall the representational conventions used in the ground plan of an Ottoman textile factory, believed to date from the second half of the 16th century, in which window lattices are similarly indicated by crossed lines within the thickness of walls, while latrines are represented by triangles and door arches are shown in elevation (Fig. 5). The detailed system of notation encountered in these plans strongly suggests that the roots of this tradition preceded the late 16th century. This hypothesis finds support in some earlier plans at the Topkapi Palace archives, previously thought to antedate the 17th century, but redated here, on the basis of watermarks, to the second half of the 15th century.5


5. The plan of the textile factory at the Topkapi Palace archives, to which I did not have access, is reproduced in T. Öz, *Turkish Textiles and Velvets, XIV–XVI Centuries*, Ankara, 1950, 57. Among approximately 30 plans preserved at the Topkapi Palace Archives, most of which date from the 18th or 19th centuries, only a few early ones are characterized by blind checkered grids and colored walls. For a list of these plans, see articles in n. 2. The plans have not yet been systematically surveyed due to the incomplete catalog of the archives. I hope to study them as a group when the catalog under preparation becomes available. Plans known to exist in the Başbakanlık Archives at Istanbul have not been cataloged either, and thus cannot be seen.
Fig. 3. Austrian copy of a Turkish bath plan, last quarter of the 16th century (Österreichische Nationalbibliothek, Vienna, Cod. 8615, fol. 152r).

Fig. 4. Illustration depicting a black eunuch accompanying women, their children, and servants to a bath, last quarter of the 16th century (Österreichische Nationalbibliothek, Cod. 8615, fol. 126r).

Fig. 5. Plan of a textile factory, second half of the 16th century (Topkapı Palace Museum Archives).
Fig. 6. Plan of a double bath, second half of the 15th century (Topkapi Palace Museum Archives E. 9495/7).

Fig. 7. Plan of a monumental single bath, second half of the 15th century (Topkapi Palace Museum Archives E. 9495/12).
Among them are two bath plans from the second half of the 15th century which exhibit more archaic conventions than those of the Vienna album, in keeping with their earlier date (Figs. 6, 7). Despite their larger size, these bath plans are based on simpler conventions and provide no information about the building’s superstructure nor any detailed signs representing latrines, water pipes, furnaces, window lattices, or the shape of doors. The first plan of a double bath, executed on paper measuring 39.5 × 55.8 cm with a small protrusion, is drawn in black ink over a blind checkered grid formed by squares measuring approximately 8 square millimeters, with the thickness of walls filled in by red coloring as in the Vienna examples (Fig. 6). The men’s changing room, containing 21 × 21 squares, has a flower-shaped fountain at its center and is surrounded by raised platforms on all sides. The smaller women’s disrobing room to its left, the interior of which measures 13 × 13 squares, has a separate entrance and is similarly surrounded by raised platforms with a hexagonal fountain at the center. These two dressing areas communicate with remaining sections of the bath, terminating in a long area at the back for the furnace. The blind grid fixes the thickness of exterior walls at each disrobing chamber to two squares, which is twice as wide as the other walls. This indicates that they were built higher than the rest of the building, following common practice. The dimensions of each space are thus graphically indicated by the number of squares, while raised platforms are represented by lines, with arched windows shown in elevation.

The second plan, executed on paper measuring 72 × 39.6 cm, represents a large symmetrical single bath drawn in black ink, with the walls’ thickness painted yellow (Fig. 7). Although its paper is not squared, diagonal lines joining corners of the main halls and other intersecting segments drawn blind with a pointed tool suggest that the proportional system of the bath’s elevation has been coded by these blind guidelines on the ground plan. Unlike the former plan, this one has dotted lines indicating arches of the superstructure, but details of the floor, such as fountains or raised platforms are not specified, except for small circles representing basins. Unlike the former examples, with checkered grids meant to be read by counting the number of squares, this plan could be measured only by a scaled ruler.

Two other plans in the Topkapı Palace archives, one a partial representation of an imperial mosque, and the other one showing three variations of a mausoleum project, are among the oldest to survive. The royal mosque with a dome surrounded by three half-domes and preceded by a porticoed courtyard is drawn on three pieces of paper pasted together, each measuring approximately 56 × 43 cm, with the fourth section missing (Fig. 8). Drawn awkwardly on watermarked paper dating from the second half of the 15th century, the archaic proportions of the mosque, with unusually thick piers untypical of the “classical” period of Ottoman architecture characterized by Sinan’s works (1538–1588), reinforce the impression of an earlier date. Since porticoed courtyards and two

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7. T.K.S.A.E. 9495/12, this was first thought to be the plan of a kiosk; Öz, “Eski Cami Planları,” 3. It is identified as the plan of a bath in Altan, “Eski Mimarların planları,” 199; Ünsal, “Topkapı Sarayı,” 185. Its watermark of the circumscribed eagle type is virtually identical to that of the previous double bath discussed in n. 6.
minarets are used exclusively in mosques built for sultans in early Ottoman architecture, it is tempting to propose that this plan was an experimental project for Mehmed II’s mosque in Istanbul (1463–1471), rebuilt after an 18th-century earthquake. Its similarity to hypothetical restoration plans of the original mosque is particularly striking. Again, the paper was prepared with a blind grid of squares measuring 8 square millimeters on which the plan is drawn in black ink, with the thickness of walls colored red. Its representational conventions consist of domes drawn with a compass, crossed window lattices, and parallel semicircles indicating gate arches. These features are closer to the Vienna examples than to the seemingly more archaic bath plans in the Topkapi collection.

8. T.K.S.A.E. 9495/8, published in Ünsal, “Topkapi Sarayı,” 187–188. The paper has a watermark of the crossbow-in-a-circle type, produced in Italy from the second half of the 15th up to the early 16th century. It is closest in both shape and size to (Piccard, Arbailet 2387 [Köln, 1477–1478]): G. Piccard, Wasserzeichen Werkzeug und Waffen, Findbuch IX, Stuttgart, 1980; and (Harlfinger, Arbailet 32 bottom [Florence, 1494], Arbailet 31 top, [Paris, 1484]): D. and J. Harlfinger, Wasserzeichen aus Griechischen Handschriften, Berlin, 1974, 1; as well as (Zonghi 521 [Fabriano, 1487]): Zonghi, Zonghi’s Watermarks. For the hypothetical restoration plan of Mehmed II’s mosque, see A. Kuran, The Mosque in Early Ottoman Architecture, Chicago, London, 1968, 192–193. The layout of the porticoed courtyard and the placement of minarets in relation to the steps on this early experimental project are almost identical to corresponding sections in the extant mosque which partially survived the earthquake. However, the awkward design proposed for the interior of the mosque appears to have been transformed subsequently by the addition of two columns complementing the colossal piers.

9. T.K.S.A.E. 9495/11, since the plan is pasted on thick paper, no watermark is visible; if there is one, an X-ray Betagraph is required. For the uncontested assertion that this plan was produced during the early 16th century, see Orgun, “Hassa Mimarları,” 336. This date has been challenged by Ünsal who states that none of the surviving plans dates before the 17th century; Ünsal, “Topkapi Sarayı,” 188–190, 195, 197.
prices. The cheapest single-unit structure at the bottom right, with an interior measuring 10 square cubits (argun) and crowned by one dome (bir kubbe) which rests on a hexagonal (müsedde) base, is estimated (taḫmın) to cost 50,000 aşe, but no compass has been used to draw the dome specified in writing only. The bipartite ground plan with two domed chambers (iki kubbe) on its left has an extra space (tābḥāne) annexed to the burial chamber and is estimated to cost 70,000 aşe. The most complex quadruplicate plan, on the other hand, consisting of four domed spaces (dört kubbe), each measuring 10 square cubits and identified as kubbe-i maḵābr (#1), kubbe-i tābḥāne (#2), kubbe-i miyān-ṣerā (#3), and kubbe-i şoffa (#4), is estimated to cost 120,000 aşe. A note reveals that this final project with four domes was approved by the unidentified patron.  

This plan suggests that the grid system could facilitate an accurate estimate of construction costs per square cubit corresponding to one square module on the plan (Fig. 10). Given the standardization of sizes in building materials and the Ottoman custom of paying builders per square cubit of work, it must have been relatively easy to estimate amounts of materials required and labor costs on the basis of such grid-based plans. Annotations of the mausoleum project reveal that each square module of the checkered grid equaled a square cubit (argun), since the interior spaces measuring 10 × 10 argun contain 10 × 10 squares.  

Another obvious advantage of this drafting technique was that it permitted drawing to scale, eliminating to a large degree inexactitude and arbitrariness during the construction process. It made reading a ground plan possible simply by counting the number of squares without need for a ruler, since the square modules were convertible to numerical values which guided and conditioned proportions of the overall design. The blind grid over which ground plans were superimposed must have facilitated also translating the small design to full scale on a chosen plot previously surveyed by the architect according to the "science of measurement or land surveying /‘ilm-i mešāha," defined in Cafer Çelebi's early-17th-century treatise on architecture as "measuring the ground in cubits/girā‘ ile yir ḵölmeck."  

The preservation of this drawing in the royal archives of the Topkapı Palace suggests that the patron, respectfully referred to in the third person plural (saleh ideler), might have been an Ottoman sultan. A relatively early date for this plan seems supported by the fact that sultans no longer commissioned mausolea for such little-known and seemingly heterodox dervishes after the 15th century.  


11. Gökşoy, "Risale-i Mimarîyye," 129, 180. Among qualifications sought in provincial Ottoman architects was a knowledge in geometry (‘ilm-i hendese) and the science of measurement or land surveying (‘ilm-i mešāha); Cengiz Orhonlu, "Schir Mimarları" (City Architects), Ottoman Studies, 2 (1981), 16–17.  

Fig. 12. Plan of a rectilinear garden laid out for Babur, detail from Baburnama, c. 1580 (Victoria and Albert Museum, I.M. 1913–276 and I.M. 2913–276A).

Fig. 13. Eighteenth-century plan from Iran, Victoria and Albert Museum Library (from P. Clarke, “The Tracing Board,” Pl. iv).
A series of 16th-century ground plans from Central Asia, believed to have been executed by an Uzbek draftsman, are based on a similar checkered grid system, the square modules of which corresponded to the cubit (Fig. 11). Soviet scholars' analyses of surviving Central Asian buildings reveal that their design was generated by such grids, and that the square modules determining the dimensions of architectural details were usually related to square brick sizes which varied regionally as a result of differing cubit measures. Since each square of the grid represented a fixed number of bricks, the total amount of materials required for the intended structure could be computed easily by counting the squares and multiplying by the height after deducting the openings. It seems that this drafting method, which was particularly suited to modular planning and which conveniently indicated the scale of architectural details without compass or ruler, might have been a widespread phenomenon in the post-Timurid Islamic world. This hypothesis finds support in a Mughal painting from the Baburnama (c. 1580), where a garden designer holds a plan with lines to form a grid, representing the layout of a rectilinear garden with intersecting water channels, as three gardeners stretch a rope to demonstrate that the constructed waterway conforms to the design (Fig. 12). An enlarged detail clearly shows that the sheet of paper or tracing board is ruled both ways with lines parallel to the sides which create a grid pattern. Several 18th-century plans from Iran, preserved in the Victoria and Albert Museum, demonstrate that the same drafting technique continued to be used there up to modern times (Fig. 13). These plans are similarly executed on squared paper, each square module of which is reported to have represented one or four bricks, while the thickness of walls is filled in with ink.

15. For these 16th-century drawings found in the Institute of the Oriental Academy of Science of the Uzbek S.S.R., see V. B. Baklanov, "Arkhitekturnye Chertiozhi Uzbekskogo Masters XVI Veka" (Architectural Drawings of an Uzbek Master from the 16th Century), Soobshcheniya Instituta Istori i Teorii Arkhitektury, 4 (1944), 1–21; I would like to thank Professors Oleg Grabar and Robert van Sloun for providing this article, and Irwin Schick for translating it. Also see R. Lewcock, "Architects, Craftsmen and Builders: Materials and Techniques," in Architecture of the Islamic World, ed. G. Michell, London, 1978, 114, 131–132; and Wilber, "Builders and Craftsmen," 32.


17. I am grateful to Dr. Julian Raby who brought to my attention the following reference: Purdon C. Clarke, "The Tracing Board in Modern Oriental and Medieval Masonry," Ars Quatuor Coronarii (Transactions of the Lodge Quatuor Coronati), 6 (1893), 99–107. Clarke, who acquired these 18th-century plans from an architect in Iran during 1874, describes them as fastened side by side with gum and preserved in rolls extending to about 20 feet.

On these Persian, Mughal, and Central Asian plans (Figs. 11, 12, 13), horizontal and vertical lines of the grid are laid down, unlike their blind Ottoman counterparts in which reading the plan is facilitated by the dissociation of the invisible grid from the actual design. Some of the previously discussed 15th-century Ottoman plans (Figs. 6, 7, 9, 10) show a close affinity to these examples from the Islamic East which do not employ a complex system of signs. However, the plan of an imperial mosque and later Ottoman examples from the 16th century (Figs. 1, 2, 5, 8) are characterized by a unique set of conventional signs, such as crossed window lattices, triangular latrines, circular water pipes, bulb-shaped furnaces, or parallel semicircles indicating door arches. Their use of some conventions typical of European plans, such as the drawing of arch elevations flat onto elements of a ground plan (characteristic of Western plans prior to 1500), the indication of domes with compass-drawn circles, of columns with circles inscribed in squares, or of steps with parallel lines, seems to imply contacts with European architectural practice.

Invitations of Sultan Mehmed II (1451–1481) to Italian architects have been documented together with Filaret's intention to set out to Istanbul in the summer of 1465. It has recently been suggested that Filaret, of whom nothing was heard after that date, was probably involved in planning Mehmed's royal mosque complex, the unprecedented symmetrical layout of which recalls the idealized plan of the
Ospedale Maggiore in Milan included in his architectural treatise. In this treatise, Filarete describes a method of drawing plans to scale (disegno proporzionato), through the use of a checkered grid subdivided into smaller squares (quadretti or parelli) corresponding to multiples of the cubit (braccio) (Fig. 14). The grid of the ground plan was subsequently marked out at the construction site to determine the actual building at full scale and to lay out foundations in situ. This function of the grid is described and illustrated by Filarete in relation to laying out a piazza, on the site of which cords were stretched according to the square compartments of a squared drawing (disegno lineato) (Fig. 15). The use of the grid as a simple transfer device was also common among painters for mechanically reproducing a figure drawing on fixed coordinates. In Filarete’s architectural plans, however, the modular grid is not merely a transfer device, for the parelli constitutes a parameter with a numerical value guiding proportions and measurements of the overall design.

The origins of modular planning on the basis of a hypostyle grid go back to Egyptian and Greek practices. G. L. Hersey has traced the use of a hypostyle grid system in the planning of some Italian Renaissance palaces to Vitruvius’s Pythagorean temple formulas. He shows that the modular grid matrix, used in laying out designs by some 15th-century Italian architects, was elucidated for the first time and most fully in Filarete’s treatise—a method which does not seem to have left an impact on European architectural practice after 1500. Although this drafting technique might have been grounded in medieval European practice, given Filarete’s interest in the Orient, it is not altogether unlikely that he was familiar with grid-based plans from the East. There is no concrete evidence to support this hypothesis; however, it is possible to conclude that Ottoman plans constitute a distinct tradition, characterized by a unique synthesis of Eastern and Western conventions.

Ottoman elevation drawings and models

Unfortunately, since none of the surviving Ottoman grid-ded plans corresponds to extant buildings, they cannot be used for an investigation of systems of proportions governing their elevations. While the square modules determined dimensions of walls, doors, and windows, it is not clear whether they corresponded to standardized sizes of building materials, as in the case of Central Asian or Persian brick structures, or whether detailed elevation drawings complemented the grid-based ground plans. There is only one known example of an Ottoman elevation drawing from the early 16th century; it represents the garden façade of a royal bath once located at the third court of the Topkapi Palace (Fig. 16). Schematically drawn on pasted papers measuring 82.7 × 111.5 cm, it is reminiscent of architectural representations in Ottoman illustrated manuscripts (Figs. 17, 18), or some Gothic elevations in which scientific proportions or perspective are not employed. Due to the imprecision of its graphic information, this Ottoman elevation is accompanied by marginal notes specifying the measurements and placement of a buttress added to the façade of the bath after damages from an earthquake in 1509. The buttress (tayama) on which individual stones (3 × 1 cm) are drawn minutely in ink over blind guidelines, consisted of a 15-cubit (ginâl)-high lower section, separated by a molding from the 35-cubit-high upper section built under the supervision of Emin Ali. The width of this 70-cubit-long buttress measured 11 cubits below and 6 above. The triangle at the far right schematically represents the slant of the buttress. A written explanation states that the outer perpendicular leg of the triangle indicated the building’s façade while its hypotenuse showed how the buttress leaned against that façade. Although this elevation-sum-section is very detailed, it is not drawn to


Fig. 16. Elevation of a buttress built in front of a royal bath at the third court of the Topkapı Palace (Topkapı Palace Archives E. 12307/2).

Fig. 17. Painting of the Süleymaniye Mosque in Istanbul, illustration in manuscript "Süleymännâme" (Chester Beatty Library, Ms. 413, fol. 119r).

Fig. 18. Painting of the Hagia Sophia Mosque in Istanbul, illustration in manuscript "Şehnâme-i Selim Hân" (Topkapı Palace Museum Library, A. 3595, fol. 156r).
scale, and its schematic language can only be decoded by annotations providing the basic dimensions.21

The sketchiness of this drawing might have been due to the fact that it represents a repair project, rather than a new building under construction, but there is no known evidence for the existence of more precisely rendered Ottoman architectural elevations drawn to scale on squared paper. During a visit to Iran in 1660, Raphael Du Mans had noted a similar absence of detailed elevation drawings in Safavid architectural practice. “Architects,” he wrote, “are contractors who make the plan and drawing of a large edifice. But unlike ours [architects], representing a grand palace in terms of its iconography, its orthography, or its perspective, and as if it were already capable of being inhabited is not known to them.”22 Like painters, Ottoman architects appear to have been bound by the conventions of miniature painting, which was a strictly two-dimensional system of representation, with objects depicted disproportionately despite their striking realism (Figs. 17, 18). It is difficult to imagine that Ottoman architects could transcend the boundaries of this traditional mode of representation, unlike their European contemporaries who were trained in perspective drawing and scientific methods of orthogonal projection. This is strongly suggested by the evidence of a sketchy plan of Istanbul’s water channels and aqueducts, executed in 992/1584 by Davud Agha, three years before he became Chief Royal Architect (Fig. 19). The drawing is clearly bound by conventions of the miniaturist and seems to confirm that architects’ elevations did not differ radically from those in illustrated Ottoman manuscripts. This hypothesis finds further support in a plan representing the water installations of the Topkapi Palace, which is dated 1016/1607–8 and attributed to Mehmed Agha, the future architect of the Sultan Ahmed mosque (1609–1616). It, too, is characterized by schematic elevations reminiscent of those in miniatures (Figs. 20, 21).23

Most probably, elevations of projected buildings—especially major royal buildings—were more detailed, but they are unlikely to have been self-sufficient orthogonal projections drawn to scale, from which measurements could be calculated. It seems that Ottoman elevation drawings annotated with specifications and dimensions in cubits were interpreted through traditional formulas governing the widths of doors or windows, the proportions of which were generated by the modular grids of ground plans.

Since Ottoman architects were not trained in perspective drawing, which could have enabled them to create an illusion of space on a flat surface, architectural models were perhaps the only means to visualize three-dimensional designs tangibly. The use of models in designing elevations is a strong possibility, given the widespread Ottoman tradition of ephemeral architectural props for public festivities. Large-scale paper or wooden castle models were used in simulated war games (Fig. 22), but like traditional figures of castles, comme si dès l'état capable d'estre habité, ils ne savant ce que c'est”, cited in G. Zander, “Observations sur l’architecture civile d’Ispahan,” in Iranian Studies: Studies on Isfahan, Part I, 7/1–2 (1974), 306.

23. For these drawings of Davud Agha (Fatih Millet Kitâbânesi, Ms. Tarih No. 930) and Mehmed Agha (T.K.S.H. 1815), see A. Bilge, “Fatih Zamanında Topkapı Saray Sûyu” (The Water of the Topkapı Palace during the Conqueror’s Reign), Türk Sanats Tarihi Araşturma ve İncelemeeri, 2 (1969), 215, 217–218; S. N. Nirven, İstanbul Suları (Waters of Istanbul), Istanbul, 1946, 45–47.
mosques, and garden pavilions made out of sugar for such celebrations, they throw little light on the way architects used models.24

European travelers frequently refer to small-scale wooden or ivory models in glass cases hanging among oil lamps from the domes of mosques. For example, in 1665 Thévenot saw at the Sultan Ahmed mosque “a large quantity of lamps and small gallantries inside balls of glass; one, for example, encloses a small well-equipped galley, another one a wooden design of that mosque, and others similar nicettes.” The same glass bulb containing a relief model of the Sultan Ahmed mosque is described later by de Tournefort (“inside the other globe, they have represented in bas-relief, with an admirable adornment, the mosque’s plan”) and by de Saumery, who praises its intricate workmanship.25 In 1672–1673, Antoine Galland noticed a similar miniature model encased in glass and suspended among oil lamps and ostrich eggs at Yeni Cami in Eminönü: “Among all that, one sees an ivory design of the mosque made in the round, which is enclosed within a glass


These small-scale models set in glass seem, however, to have served a commemorative function as mementoes of a building, much like the maquettes of Mecca and Medina depicted inside Süleyman I’s mausoleum in Bartlett’s 19th-century print (Fig. 23). Such a commemorative model of the Ka’ba, covered with an original kiswa sent from Mecca, was placed inside the private royal treasury of the Topkapı Palace for Ahmed I to pay a symbolic visit, since he could not participate in the actual pilgrimage. These models are described as: “On a stand near the entrance, rests an admirable model of the Mosque at Mecca, and the Prophet’s tomb, with parties of pilgrims on their way to and from the holy city; it is well executed and bears an appearance of great accuracy”; M. Pardoe, The Beauties of the Bosphorus, London, 1838, 26. The Ka’ba model in the royal treasury is described in Muṣṭafā Şāfī, Zāḥiḍet‘ī-Tevariḥ (The Cream of Histories), (Ms. T.K.S.R. 1304), fols. 139r–139v.

26. “Entre tout cela, on voit un dessin d’yvoire de la mosquée fait autour, lequel est enfermé dans une boîte vitrée”; A. Galland, Journal d’Antoine Galland, pendant son séjour à Constantinople 1672–73, ed. Ch. Scheffer, 2 vols., Paris, 1881, i, 79. A model of Yeni Cami (1603, 1660–1663) which was contained in a glass case and hanging at the harem vestibule of the Topkapı Palace is described in A. Şerif, “Topkapu Sarây-i Hümayûn” (The Imperial Palace of Topkapı), Târîh-i 6Ozmunt Encümeni Mecca”as, 2 (1329/1911), 460.

27. These models are described as: “On a stand near the entrance, rests an admirable model of the Mosque at Mecca, and the Prophet’s tomb, with parties of pilgrims on their way to and from the holy city; it is well executed and bears an appearance of great accuracy”; M. Pardoe, The Beauties of the Bosphorus, London, 1838, 26. The Ka’ba model in the royal treasury is described in Muṣṭafā Şāfī, Zāḥiḍet‘ī-Tevariḥ (The Cream of Histories), (Ms. T.K.S.R. 1304), fols. 139r–139v.
ography of architectural models presented by building patrons to saints must also have been familiar to the Ottomans from Byzantine mosaics such as those in Kariye Cami or Hagia Sophia (Figs. 24, 25).  

Determining how models were used by architects during the designing or construction process is somewhat problematic, however. As is the case in contemporary European architectural practice, models have to be grouped under different categories depending on the functions they fulfilled. A miniature in the Sûrmâme, depicting a large-scale model of the Sûleymaniye mosque that was carried by several people during a ceremonial procession in 1582, has been cited previously as evidence for the use of architectural models by Ottoman architects (Fig. 26). However, this finely worked model, praised in an accompanying text for its lavish gilt paintings, must have had a commemorative function, since a utilitarian work model would almost certainly have been simpler in its materials. Probably prepared for the processional festivities, it artfully reproduced the likeness of the prestigious Sûleymaniye (1550–1557), the most recently built royal mosque in Istanbul. The rarity of such grandiose and lavishly executed models becomes apparent, since it was the only one exhibited during the ceremonial procession of guilds in 1582. Its elongated proportions and modified features suggest that the model was not built to scale, but these distortions might also be due to the miniaturist’s inaccurate rendering.

It has been argued that, aside from serving as a permanent record of the designer’s intentions, the primary purpose of architectural models in the Italian Renaissance was not in aiding construction workers, but in persuading patrons to build. Ottoman models seem to have played a similar role during preliminary discussions with patrons who were probably unaccustomed to representational conventions of ground plans. Moreover, Ottoman pictorial limitations must have necessitated such presentation models. For example, the Grand Vezir explained to Sultan Mahmud I in 1740 the strategic layout of the Castle of Belgrade by a wooden model, rather than with a ground plan. The role of architectural models in convincing sultans to build is suggested in a treatise on the construction of the Nurûosmaniye mosque (1748–1755), where

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31. This wooden (gâseh) model (mücessem taşvîr) was placed inside the emptied pool at the fourth court of the Topkapı Palace (derîn-i havz-i kebir), into which the Grand Vezir descended for his demonstration. The Sultan watched him from the extant stone royal seat which overlooks this pool; ʿÎmâr Fendi, Rûznâme (Ms. Millet Kütüphanesi, Ali Emîrî Tarih 423), fol. 9v.
it is stated that the form of the projected building was decided on the basis of a model represented to the Sultan on a large board.32

Renaissance architects also used architectural models experimentally, to test design modifications and necessary adjustments during the construction process. Like Filarete, who urges that wooden models should complement ground plans drawn to scale, Alberti recommends the use of scaled models on which every part of the edifice could be tangibly re-examined and reconsidered. He adds that models, which were meant to be study tools to enable architects to detect errors in initially appealing ideas, should not be impecably polished or refined (rifiniti impecabilmente, forbiti e lucenti), but plain, simple (mudie e schietti), and capable of bringing out the acuteness of conception as well as the accurateness of execution.33

Clearly, the lavishly gilded model of the Suleymaniye mosque, ceremonially carried during the procession of 1582, does not fit this category. However, there is textual evidence about the Ottoman use of utilitarian architectural models as aids in issues of design and in testing details. For example, the 17th-century historian Naima describes a full-scale wooden model of the Kaaba, prepared in 1020/1611–12 as an exact replica, on the basis of its recorded dimensions. It was used to test whether the new golden drain ordered by Ahmed I to replace a silver one, together with other details, would fit their intended place before they were dispatched to Mecca.34 That models were used to test abstract ideas in plastic form, to make adjustments as construction proceeded, and to consider alternative solutions is also suggested by an incident related in Dayezyade Mustafa Efendi’s 18th-century essay on the Selimiye mosque in Edirne. Deriving his information from an original source to which he had access in the palace, Dayezyade describes how Mimar Sinan, after having completed the dome of the Selimiye mosque, which fulfilled his desire to create a dome larger than that of the Hagia Sophia, gazed at it with discontent, observing that its monumental shape which dominated the overall design too strongly had an “unpleasant” and “quite tasteless” appearance. Upon this, his talented assistant (hâlîfe) urged Sinan to counterbalance the central dome by adding eight small turrets around it, on top of each of the eight piers supporting the main dome. In order to test this idea, a three-dimensional model was immediately prepared, onto which the units to be tested were attached. This solution to the problem looked so attractive on the model that orders were given to start construction immediately.35 This rapidly produced model of the Selimiye mosque must have been close in conception to the simple study model recommended by Alberti.

**Terminology in the sources**

Written sources provide the architectural terminology for both models and plans, which seem to have been used simultaneously in Ottoman architectural practice. The definition in Cafer Çelebi’s early-17th-century architectural dictionary of the term “resm,” frequently encountered in sources, reveals that it was used synonymously with “ground plan.”36 Other sources, however, add a qualification to the term in order to indicate its two-dimensionality. Thus, for example, the term “flat drawing/resm-i mustaṭṭah” is scribbled on two known ground plans, one from 1207/1792–93 representing the Mosque of Malatya, and the other one from 1308/1890–91 depicting the third court of the Topkapı Palace.37

That the term “resm” could also refer to a three-dimensional model is revealed in Dayezyade’s essay, according to

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34. Mustafa Nâ’îma, *Târîh* (History), Istanbul, 1281/1865, 11, 91. This Kaaba model built to scale is also described by Cafer Çelebi; Gökây, “Risale-i Miriymîye,” 152–156; and Şâh, *Zübde‘ü‘l-Tevârîh*, fol. 124r.


which Sinan used a “three-dimensional mosque design/mücessem cami” resmi” during the construction of Selimiye. The same term is used by Abdurrahman Şeref to describe a three-dimensional figure (resmi-i mücessem) of Yeni Cami, which he saw hanging in a glass case at the harem vestibule of the Topkapı Palace. Similarly, a model of the Belgrade castle is referred to as a “three-dimensional likeness/mücessem tasvir,” like the model of the Nurusmaniye mosque mentioned as “three-dimensional design/mücessem terşim.” Thus, the use of “resmi” to refer to both two- and three-dimensional designs leads to ambiguity when the term occurs without a qualification.

The term “ likeness or sculptured image/timšāl” used by Ibn Khaldu’n in reference to the model of a mosque is also encountered in Ottoman sources. For example, the model of Suleymaniye depicted in the Şūrānme microbiography is identified in an accompanying text as “ likeness of the sacred mosque/ timšāl-i cāmi-i Şerf,” while the full-scale Ka’ba model is mentioned by Naima as a “wooden likeness of the Venerable House/ağzabad timšāl-i Beyt-i Mükerrer.” The term “exemplar or model/resmâne,” on the other hand, is employed for the model of a tower/“resmâne-i ḫulle” made of lining (ahtar), size (sirf) glue (tufkan), and paper (kūrta), which was used during the construction of a castle in Thessaloniki between 944–46/1538–39.

Aside from these commonly used terms, “kārnâme”—the exact meaning of which is uncertain—also appears frequently in texts. For example, a royal decree sent to the Qadi of Edirne in 1559 states that the “kārnâme” of a masjid had already been sent, but although this plan (resm) indicated two minarets, only one should be built. The terms kārnâme/resm are again used synonymously in a decree in 1568, addressed to the Commissioner of Royal Expenditures in Edirne, which orders him to build at the Edirne Palace a kiosk (kūjik) in accordance to a dispatched “kārnâme,” and to complete its construction in conformity with this plan (resm). Another firman from 1583 addressed to the Qadi of Manisa and to the supervisor of Murat III’s mosque under construction there states that they should see to the construction of this mosque in accordance with the “kārnâme” which was “written” by the architect Sinan (miṣrâb-i alan Sinān cāmi-i mezâbâr kārnâmesin yazıb) and approved by the Sultan, without paying attention to assertions and suggestions of the public.

Although the term “kārnâme” could refer to a model, textual references strongly suggest that it was used more commonly for two-dimensional designs. The previous reference to Mimar Sinan “writing” a “kārnâme” suggests that the dispatched design must have been accompanied by written specifications, either scribbled on the plan itself or on an attached piece of paper. While most Ottoman plans in the archives—except for a few 19th-century ones—have been separated from the original survey reports (keṣif) on estimated costs and dimensions to which they were previously appended, examples of early annotated drawings have survived. For example, the plan with three variations of a mausoleum (see Fig. 11), which is complemented by marginal notes about dimensions in cubits as well as estimated expenses, is explicitly identified as a “kārnâme.” Two other schematic plans depicting layouts of aqueducts and water installations, similarly scribbled with measurements in cubits and estimates, are also identified by their legends as “kārnâme” (Figs. 19, 27). It was on the basis of such a drawing annotated with dimensions, which is specifically identified as “kārnâme,” that the full-scale wooden Ka’ba model mentioned above was constructed. That “kārnâmes” were architectural drawings consisting of ground plans based on a grid system and sketchy elevations annotated with written specifications, rather than three-dimensional models, also seems confirmed by an inventory of the private royal treasury at the Topkapı Palace compiled in January 1505, which lists a chest full of “kārnâmes” next to which was stored a 1-cubit-long architectural measuring stick of brass (1 şanduq kārnâme ve 1 ḵiša pirine bīnaţa zirāti), since it is highly unlikely that three-dimensional models would be heaped up in a coffe, the argument for two-dimensionality is strengthened. The definition of “kārnâme”—probably derived from the root kār/work—as a

40. Ibn Kâhûnd, Al ta’rîf, 339; Seyyid Lokmân, Şürnâme, fols. 90v–91r; Na‘îm, Tarîh, ii, 91.
41. Barkan, Sûlâymaniye Câmi, ii, 247.
42. Cited in Barkan, Sûlâymaniye Câmi, i, 52. For the use of the term kârnâme in the Sûlâymaniye account books, ibid., ii, 184. This term is encountered earlier in a chronicle composed during Bayezid II’s reign (1481–1512) which states that Mehmed II ordered his royal mosque to resemble the plan of Hagia Sophia ("Aya Şofya kârnâmestir resminde"); Tursun Beg, The History of Mehmed the Conqueror, ed. H. İnalci and R. Murphey, Minneapolis, Chicago, 1978, Turkish text, fol. 56a.
43. Başbakanlık Archives, Mûhiimme Defteri, 7, nos. 1367, 1368.
44. For these legends referring to the term “kârnâme,” see Bilge, “Fâth Zamanında,” 215, 217–218; A. Bilge, “Mimar Sinan Hakkında Araştırmalar” (Studies on the Architect Sinan), Memorlak, 5 (1969), 17–34. The Ka’ba model was constructed according to previously recorded dimensions indicated on an annotated flat drawing (“Beyt-i Mu’azzâmân tul ve ‘âzîn beyân iden ʾaṣfa′-a resm şıhâna . . . ve ol kârnâme şıhâna . . . “); Saffi, Zübdei’s-Tevarîş, fol. 124r. For a unique Gothic elevation drawing from 1340, annotated with measurements and accompanied by a lengthy text, see Toker, “Gothic Architecture by Remote Control,” 67–95.
group of working drawings with plans and elevations drawn to scale and scribbled with dimensions in a recent dictionary of architectural terms provides further support to this argument.  

**Conclusion**

If construction supervisors received only grid-based ground plans and sketchy elevations with some basic written measurements, a wide margin of variation was inevitable, given the absence of exact specifications fixing dimensions of each detail. Since the main task of Ottoman architects, according to a 16th-century biography of Sinan, was to “construct domes and half-domes, and to bind arches in an agreeable manner depending on the abundance or scarcity of pillars, columns, and buttresses,” the key points in the elevation of a standardized building could be computed by traditional formulae deriving from proportions inherent in the geometric ground plans with modular grids.  

It is clear from written sources that in keeping with earlier Islamic traditions, Ottoman architectural training included a strong background in geometry. While Sinan was referred to by his contemporaries as the Euclid of the Age, the biographer of Mehmed Agha who built the Sultan Ahmed mosque mentions geometrical treatises used in educating architects.  

A. Kur'an has demonstrated that the proportional system of Mimar Sinan’s mosque in Karapinar, built for Selim II was based on geometrical proportions generated from its ground plan, all the key points in its elevation being derived from half the diameter of the central dome, as well as the edge and diagonal of the square defining the mosque’s interior. The success of this method of computing an elevation from the ground plan through a modular system of geometry, which was also characteristic of Gothic plan-

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ning, depended to a large degree on the personal supervision of an experienced architect during the construction process.48

However, Chief Royal Architects like Sinan, who were simultaneously responsible for a large number of building activities in a vast empire, could personally oversee only the major royal or vezirial projects based on novel designs, delegating standard commissions of secondary importance to apprentices.49 This was especially the case with provincial buildings mostly supervised by apprentices sent from the capital Istanbul with plans. While the grid-based standardized ground plans could be mechanically reproduced, sketchy elevations with only some basic written measurements inevitably produced regional as well as personal interpretations. Coupled with variations resulting from local workshop traditions, this explains why structures built in the provinces tend to be typically Ottoman in terms of their ground plans, while exhibiting a strong local flavor in their elevations. This is also true of some awkwardly proportioned buildings at the capital which were probably supervised by Sinan’s apprentices, although they are traditionally attributed to him. The construction supervisor’s role, then, was not the simple management of a predetermined plan, but one involving a certain degree of interpretation as well.50

To summarize, although there is evidence for the Ottoman use of both plans and models, it seems that grid-based ground plans together with imprecise elevation drawings played a more important role in the dissemination of architectural ideas than did models, which were seemingly prepared only for the most grandiose projects. Standardized ground plans, which facilitate a typological classification of Ottoman architecture, not only generated an overall system of proportions, but also emphasized solid masses with little plastic modeling. While the minimal plastic articulation of Ottoman buildings, in comparison to the sculptural shell of contemporary Renaissance buildings, can be ascribed to limitations inherent in the graphic expression of architectural ideas, the Ottoman emphasis on volume rather than form, and the subordination of decoration to structure also reflected an aesthetic preference in which quality and structural strength were intimately bound. The obvious advantage of the Ottoman architectural drafting method was that it assured the rapid dissemination and “remote control” of an imperial architectural style throughout the empire. This was facilitated by the centralization of all construction activities under the office of Royal Architects (hâşâ mi’ârlarî), stationed in the capital and responsible for propagating the unity of architectural style and practice despite the inevitable variations resulting from regional traditions of construction.51


