JOURNAL
of DESIGN
THINKING

The Moshabak Effect: Perforated Surface as Design Strategy in Iranian Architecture

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DOI: 10.22059/jdt.2026.416603.1207

Received: *15 June 2026,* ***Revised:*** *11 July 2026,* ***Accepted:*** *18 July 2026,* ***Available Online*** *from 18 July 2026.*

Abstract

Most studies of Moshabak concentrate on its architectural effects, including daylight control, ventilation, shade, privacy, ornament, and regulated visibility. Less attention has been paid to the physical organization through which a perforated surface produces these effects. This study investigates Moshabak as an operative surface logic by examining how void is measured, distributed, and held within material continuity. The research combines theoretical-historical interpretation with field documentation, measured drawings, and computational morphometric analysis of two Moshabak surfaces in the Jameh Mosque of Ardestan. Aperture count, density, scale, spacing, orientation, and solid–void ratio were calculated and compared. The results reveal two markedly different configurations. Type A contains 239 apertures, a void ratio of approximately 40.4%, an aperture density of 130.9 apertures/m², and an oblique line share of 67.4%. Type B contains 106 apertures, a void ratio of approximately 32.2%, an aperture density of 26.1 apertures/m², and an orthogonal line share of 97.7%. Together with the measured drawings and field photographs, these configurations support the interpretation of Type A as a filtering boundary and Type B as a framing boundary. These findings define the Moshabak Effect as the capacity of a materially continuous perforated surface to organize boundary conditions and graded interior–exterior relations through calibrated void. The study thus connects the architectural interpretation of Moshabak to measurable properties of surface configuration.

Keywords

Moshabak, Calibrated Void, Perforated Surface, Morphometric Analysis, Iranian Architecture.

Introduction

Perforated surfaces have become prominent in contemporary façade, screen, and envelope design. Digital modeling, parametric workflows, and fabrication technologies now allow designers to adjust porosity, aperture distribution, depth, density, and material configuration in response to daylight, solar exposure, ventilation, visual comfort, and environmental exchange (Kolarevic & Malkawi, 2005; Hensel, 2010; Loonen et al., 2013; Oxman, 2017). Yet technical control over these variables does not fully explain why one perforated surface operates differently from another as architecture. The more fundamental issue concerns the kind of boundary it produces: how a surface can permit exchange while retaining enclosure, provide visual connection while limiting exposure, and relate adjacent spaces without dissolving the distinction between them.

Within Iranian architecture, Moshabak offers a historical case through which this problem can be examined more closely. Used in windows, partitions, façade layers, and screened openings, it has mainly been studied in relation to daylight, ventilation, shade, privacy, and visual control (Babaei et al., 2013; Islami & Jafari, 2022). Research on the mashrabiya and related regional screens has similarly emphasized controlled visibility and the mediation of interior and exterior (Al-Kodmany, 1999; Kenzari & Elsheshtawy, 2003). Such studies establish the environmental and spatial roles of perforated screens, but the surface organization responsible for these effects remains less clearly explained. Aperture size, interval, member thickness, density, and material continuity are often discussed as separate attributes rather than as parts of a coordinated design system. As a result, Moshabak is still more often described as a historical element, an environmental device, or an ornamental screen than examined as a design logic.

This study asks how the design intelligence of Moshabak can be examined through the measurable organization of its perforated surface. It uses theoretical history not to reconstruct the chronological development of Moshabak, but to read a historical surface through contemporary questions of porosity, boundary, and architectural design. The argument begins with the void rather than the pattern. Moshabak operates through the way apertures are sized, spaced, repeated, oriented, and held within material continuity. These relations make the void an active interval rather than an empty remainder. They also allow the surface to maintain enclosure while modifying visibility, exposure, and connection across the boundary. Design intelligence is therefore located in this coordination of measurable geometric and material relations.

To examine this argument, the research focuses on two Moshabak surfaces in the Jameh Mosque of Ardestan. Both belong to the same historical, material, and spatial setting, yet differ substantially in the organization of their openings. This makes it possible to compare surface configurations without removing them from their architectural context. Field observation, photographs, and measured drawings establish the position, dimensions, and material organization of each surface. Computational morphometric analysis is then used to compare aperture count, scale, spacing, density, orientation, and solid–void ratio, while overall dimensions and member thickness are obtained from the measured drawings. The results are read in relation to material continuity, visual access, enclosure, and interior–exterior mediation.

The study connects the architectural reading of Moshabak to measurable differences in surface configuration. Rather than treating calibrated void as perforation in general, it examines the particular relations among aperture scale, spacing, density, orientation, and material continuity through which different boundary conditions emerge. This provides a basis for comparing historical perforated surfaces without reducing them to either ornament or environmental performance. The relevance to contemporary design lies in the underlying relational logic: how variations in the organization of void can alter visibility, enclosure, and connection across a surface. The following sections develop this argument through the literature, theoretical framework, method, comparative analysis, and discussion.

Literature Review: Moshabak, Perforated Surfaces, and Design Intelligence

The literature does not yet treat Moshabak as a distinct field of architectural inquiry. Relevant discussions are instead scattered across research on environmental performance, visual privacy, regional screen traditions, material craft, ornamental geometry, and contemporary envelope design. Taken together, these studies address several aspects of perforated surfaces: the modification of light and airflow, the regulation of visibility, the material and geometric construction of openings, and the control of porosity as a design variable. The review is therefore organized around three areas: Moshabak and related regional screens; perforated and adaptive envelopes; and architectural surface, material organization, and design knowledge.

1. *Moshabak in Iranian Architectural Studies: Element, Effect, and Mediation*

Research on Moshabak in Iranian architecture has largely addressed the environmental behavior of perforated surfaces. Studies of lighting, aperture proportion, transparency, façade performance, and passive environmental strategies show that the size, density, and distribution of openings affect illumination, glare, airflow, and thermal conditions (Babaei et al., 2013; Islami & Jafari, 2022; Mahdavinejad & Kia, 2019; Mazraeh & Pazhouhanfar, 2020). In this body of work, perforation is treated as a configurable part of the surface, and aperture geometry becomes a means of modifying environmental exchange.

A related body of research examines visual mediation and privacy. Altman's account provides a broader conceptual basis for understanding privacy as an adjustable regulation of interaction and access, rather than as complete withdrawal or visual closure (Altman, 1975). Studies of regional screened elements, particularly the mashrabiya, have shown that perforated boundaries can preserve a degree of visual connection while limiting exposure between interior and exterior spaces (Al-Kodmany, 1999; Fathy, 1986; Kenzari & Elsheshtawy, 2003). The degree of visibility produced by these screens varies with aperture geometry, surface density, viewing angle, distance, lighting conditions, and the relative positions of the observer and the observed. Privacy, in this context, emerges through the adjustment of visual access and concealment across the boundary.

Historical and terminological studies situate Moshabak within broader traditions of screened construction, material craft, and architectural vocabulary. In Iranian architecture, perforation appears in wood, brick, plaster, and other materials, and is used in openings, partitions, façades, and boundary elements (Parsa, 2012; Pirnia, 2005). These examples belong to different material, technical, and spatial conditions and cannot be understood as variations of a single interchangeable type. What they reveal instead is the range of ways in which porous enclosure has been constructed through differences in material, scale, fabrication, and architectural position. Comparative studies of the mashrabiya and other regional screens similarly show that the negotiation of light, air, visibility, privacy, and enclosure through perforation extends across several architectural traditions.

2. *Perforated Screens, Adaptive Envelopes, and Performance-Based Design*

Contemporary envelope research treats perforation as a variable within performance-based design. Screens and porous façade systems are examined in relation to daylight, solar exposure, glare, ventilation, visual comfort, and energy performance. Research on performative architecture and climate-adaptive building shells has framed the envelope as an interface in which geometry, material configuration, and environmental performance are considered together (Hensel, 2010; Kolarevic & Malkawi, 2005; Loonen et al., 2013).

This body of research is relevant to Moshabak, but a historical fixed screen should not be equated with a kinetic or technologically responsive envelope. The comparison concerns the use of surface configuration to regulate exchange. In both cases, relations between solid and void affect how a boundary admits, redirects, filters, or limits environmental and visual passage. The technologies and historical contexts differ, yet the geometric organization of porosity remains a common architectural concern. Digital modeling and parametric design have made this organization easier to vary and analyze. Void-to-solid ratio has also been examined as a quantifiable façade variable associated with visual preference (Alkhresheh, 2012). In performance-oriented and parametric studies, opening distribution, depth, density, orientation, and geometric arrangement can be adjusted and tested in relation to daylighting, solar-control, and visual-comfort criteria (Ganji Kheybari et al., 2015; Huang et al., 2024; Lu et al., 2019; Oxman, 2017). Here, perforation is treated not as a fixed formal pattern, but as a set of relations among measurable surface variables. These studies offer methods for relating geometric configuration to specific performance outcomes, although their main concern is often environmental optimization rather than the broader spatial condition produced by a perforated boundary.

3. *Surface Architecture, Material Organization, and Design Knowledge*

Scholarship on architectural surface offers another basis for examining perforation. Leatherbarrow and Mostafavi discuss surface through relations among construction, material practice, representation, and environmental mediation, rather than treating it simply as façade image or applied decoration (Leatherbarrow & Mostafavi, 2002). Tectonic accounts similarly emphasize material character, joints, assembly, and constructional articulation (Frampton, 1995). In the context of perforated surfaces, these perspectives redirect attention from pattern as visual composition to the material organization through which openings are formed, bounded, and sustained within a continuous surface. Edge, thickness, interval, and repetition thus form part of the architectural condition of perforation.

Design research also offers a way to understand such configurations as forms of architectural knowledge. Cross's account of designerly ways of knowing describes design as a mode of reasoning through material situations, relations, constraints, and operations (Cross, 1982, 2001). Oxman's discussion of parametric design thinking shows how design relations may be formulated through variables and dependencies rather than treated as isolated formal decisions (Oxman, 2017). In Moshabak, architectural organization can therefore be examined through relations among aperture geometry, spacing, density, orientation, thickness, repetition, and the material continuity within which openings are formed. These relations can be documented, measured, compared, and interpreted without reducing Moshabak to symbolic meaning or formal appearance alone.

Taken together, this literature addresses several dimensions of perforated surfaces. Environmental research relates aperture configuration to light, air, and thermal conditions. Studies of privacy and screened traditions examine how porous boundaries regulate exposure and visual access. Surface and tectonic theories show how openings operate within a material and constructional order, while design research supports an understanding of relations among variables as a form of design reasoning. The remaining gap concerns how these dimensions work together within a single perforated boundary: how measurable differences in aperture scale, spacing, density, orientation, and solid–void relation interact with material continuity to produce differentiated boundary conditions. The next section introduces calibrated void, productive boundary, and graded relations as an analytical vocabulary for examining this coordination.

Theoretical Framework: Surface, Void, and Boundary

Reading Moshabak as an operative perforated surface calls for a vocabulary that brings surface, void, and boundary into relation rather than treating them as separate architectural functions. Surface refers here to the material organization through which spatial limits are formed; void to an ordered interval within that organization; and boundary to a condition that preserves separation while mediating relations across it. These terms are developed through a theoretical-historical reading of architectural surface and organized into three analytical concepts: calibrated void, productive boundary, and graded architectural relations.

1. *Theoretical-Historical Reading and Surface Logic*

The theoretical-historical reading used here begins with a contemporary architectural question, not with a chronological account of Moshabak. In Benjamin's formulation, theoretical history returns to historical material in order to identify possibilities that become legible through the concerns of the present. It does not organize architecture mainly as a succession of origins, styles, or influences, nor does it treat historical forms as models for direct reproduction (Benjamin, 2006).

Moshabak is accordingly examined neither as a motif whose development must be traced through time nor as a traditional element to be revived. It is considered as a historical surface condition whose operative possibilities can be reconsidered through current questions of perforation, porosity, boundary, and surface intelligence. Attention is directed to the relations embodied in its material configuration: the organization of openings within a continuous surface, the modification of enclosure through that organization, and the differentiation of relations across the boundary. The aim is not to reproduce Moshabak as an image, but to examine the surface logic through which material and void are organized together.

2. *Surface as Enclosure and Effect: Semper and Benjamin*

Semper's account of enclosure offers the first theoretical basis for this reading by separating the architectural role of the wall from its load-bearing function. In his textile conception of architecture, enclosure is associated with weaving, cladding, and the ordering of surface. The wall gains architectural significance because it defines space through material articulation, rhythm, and boundary formation, not simply because it supports a structure (Semper, 1851/1989).

From this perspective, Moshabak can be understood as a materially continuous yet permeable surface. Material continuity does not refer to an uninterrupted solid plane, but to the connected organization that holds and defines the apertures. Openings do not negate enclosure; they take part in its construction. Through repetition, interval, interlacing, and material framing, Moshabak gives the boundary an ordered and porous configuration. Its architectural significance therefore rests on the relation between aperture and material continuity rather than on applied ornament or surface pattern alone.

Benjamin moves the discussion from surface as enclosure to the effects produced through its organization. His account of surface effects resists reducing architectural surface to either structural necessity or decorative appearance. Surface becomes architecturally consequential through its role in program, spatial reading, and the organization of relations (Benjamin, 2006).

In relation to Moshabak, this approach shifts attention from perforation as formal presence to the arrangement of apertures within the surface. Their scale, spacing, distribution, orientation, and relation to surrounding material shape degrees of visual access, enclosure, exposure, and connection between adjacent spaces. Semper explains how enclosure is produced through material organization, while Benjamin makes it possible to examine the effects of that organization. Moshabak can thus be understood as an enclosing surface whose boundary condition is modified through the ordered relation between material and void.

3. *Analytical Sequence: Calibrated Void, Productive Boundary, and Graded Relations*

These theoretical propositions are organized into three connected levels of analysis. Calibrated void addresses the measurable organization of the perforated surface. Productive boundary describes the architectural condition interpreted from that organization, while graded architectural relations concern the differentiated relations formed across the boundary. This sequence separates what can be documented and measured from what depends on architectural interpretation.

The framework also draws on accounts of architectural surface as a material and relational condition, together with approaches to design knowledge that emphasize variables, constraints, and operations rather than formal appearance alone (Cross, 1982, 2001; Leatherbarrow & Mostafavi, 2002; Oxman, 2017). In this context, the design knowledge of Moshabak resides in the relations among aperture geometry, scale, spacing, density, orientation, repetition, and material continuity.

Calibrated void describes the ordered distribution of openings within a materially continuous surface. In the case analysis, it is examined through aperture count, aperture scale, spacing, aperture density, geometric orientation, and solid–void ratio. Measured drawings establish the dimensional and architectural context in which these variables are read. Calibration serves here as an analytical term for an observable organization of void and material that can be documented and compared. It does not suggest numerical optimization, parametric modeling, or an undocumented historical intention.

Productive boundary describes the architectural condition associated with this organization. The surface continues to distinguish adjacent spaces, while its aperture system alters the way separation and connection operate across it. Productive boundary is not another morphometric variable, nor can it be inferred from aperture count or void ratio alone. It remains an architectural interpretation grounded in measured surface organization, field documentation, material condition, and spatial position. The term identifies the capacity of the perforated surface to structure visual and spatial relations across the boundary.

Graded architectural relations concern varying degrees of openness and enclosure, visibility and concealment, exposure and protection, and interior–exterior connection. No single numerical measure can account for these relations. They are interpreted by considering the measured variables together within a specific architectural setting. Morphometric data establish differences between surface organizations, while measured drawings, photographs, and spatial context support the reading of their boundary and spatial consequences.

Within this framework, surface intelligence emerges from the coordination of measurable void organization with differentiated boundary conditions and spatial relations. The analytical sequence therefore proceeds from calibrated void to productive boundary and then to graded architectural relations. This sequence structures the case analysis while preserving the distinction between morphometric evidence and architectural interpretation.

Methodology

This research uses a qualitative and interpretive architectural case-study approach to examine Moshabak as a perforated surface. The Jameh Mosque of Ardestan constitutes a single case, within which two Moshabak surfaces are selected as embedded analytical units. Their location in the same historical, material, and spatial setting provides the basis for comparison.

The method brings together field observation, photographic documentation, measured drawings, and computational morphometric analysis. Architectural documentation records the location, dimensions, member thickness, material continuity, and spatial context of each surface. Computational analysis measures aperture count, scale, spacing, density, orientation, and solid–void ratio. The results are then interpreted through the concepts of calibrated void, productive boundary, and graded architectural relations. Boundary and spatial effects are treated as architectural interpretations supported by morphometric data and contextual evidence.

1. *Research Design*

The case-study design draws on established approaches to architectural and qualitative research (Groat & Wang, 2013; Stake, 1995). Following Yin's embedded case-study model, the mosque is defined as the bounded case and the two selected Moshabak surfaces as its units of analysis (Yin, 2018). This arrangement enables comparison between different surface configurations without removing them from their shared architectural context. The evidence comes from field observation, photographs, measured drawings, and computational morphometric analysis. Together, these sources document and differentiate the two surface configurations. Their boundary conditions and spatial relations are interpreted through the theoretical framework established in the preceding section.

2. *Case Selection: Jameh Mosque of Ardestan*

The Jameh Mosque of Ardestan was chosen because several distinct Moshabak surfaces occur within its historically layered architectural complex. Its courtyard, iwans, transitional spaces, and porous boundaries offer a specific setting in which relations among surface configuration, visual access, and interior–exterior connection can be examined (Hillenbrand, 1994; Pirnia, 2003).

Safavid changes to the northern, eastern, and western edges of the courtyard increased the visual permeability of the complex and reinforced connections between the courtyard and the spaces around it (Haji-Qasemi, 2004; Pirnia, 2003). Although the two selected surfaces belong to this same architectural setting, they differ in aperture geometry, density, spacing, and orientation. Their shared context therefore permits a controlled comparison of their boundary conditions.

3. *Documentation and Data Collection*

Data collection included field observation, photographic recording, measured drawings, and published architectural sources. Field observation established the position of each surface and its relation to adjacent spaces. Photographs recorded its overall form, aperture arrangement, material continuity, and visible conditions of light and view. Published plans, restoration drawings, and architectural descriptions situated the surfaces within the spatial and historical development of the mosque (Gol-Ahmari, 2021; Haji-Qasemi, 2004; Pirnia, 2003). Measured drawings provided overall dimensions, aperture geometry, spacing, module pitch, and member thickness. Computational analysis produced measurements of aperture count, solid–void ratio, aperture density, aperture scale, spacing, and dominant geometric orientation.

4. *Analytical Procedure*

The analysis proceeded in three stages. First, architectural documentation established the dimensions, material organization, and spatial position of each surface. Second, all image-processing and morphometric analyses were implemented in Python using custom scripts. The clean line drawings were converted to grayscale and cropped to the drawing boundaries. Apertures were identified through binary thresholding, a single morphological dilation using a 2 × 2 kernel, and eight-connected-component analysis.

Pixel measurements were converted to metric units using the documented panel dimensions. Panel area was calculated as the sum of the detected material field and enclosed aperture regions, while void ratio was calculated by dividing the total aperture area by the panel area. Aperture density was calculated by dividing the aperture count by the panel area. Mean nearest-neighbor spacing was derived from the shortest centroid-to-centroid distance associated with each aperture. Orientation was estimated through Canny edge detection and a probabilistic Hough transform. Line segments falling within 10° of the horizontal or vertical axes were classified as orthogonal; all remaining segments were classified as oblique. Detection maps were exported and visually checked against the measured drawings.

Third, the morphometric results were read alongside the measured drawings, field photographs, and architectural context. This stage considered how differences in surface configuration corresponded to distinct conditions of visual access, enclosure, and interior–exterior connection.

Analysis: Moshabak Surfaces in the Jameh Mosque of Ardestan

This section compares two Moshabak surfaces in the Jameh Mosque of Ardestan as embedded analytical units within a single architectural case. Architectural documentation establishes the location, form, dimensions, and spatial context of each surface. Computational morphometric analysis then compares aperture count, scale, spacing, density, orientation, and solid–void ratio. Read together with measured drawings and field photographs, these results support the interpretation of two distinct boundary conditions and modes of graded interior–exterior relation.

1. *Analytical Units and Architectural Documentation*

Type A is located on the northern side of the mosque complex and consists of a dense triangular aperture system. Type B is located on the western side and has a more regular orthogonal configuration. Because both surfaces belong to the same architectural setting, their differences in aperture geometry, density, spacing, and orientation can be compared without removing them from their spatial context.

Figures 1 and 2 show the location, measured geometry, enlarged details, and key dimensions of each surface. Together, they provide the architectural and metric basis for comparing the two aperture systems in terms of calibrated void, productive boundary, and graded architectural relations.

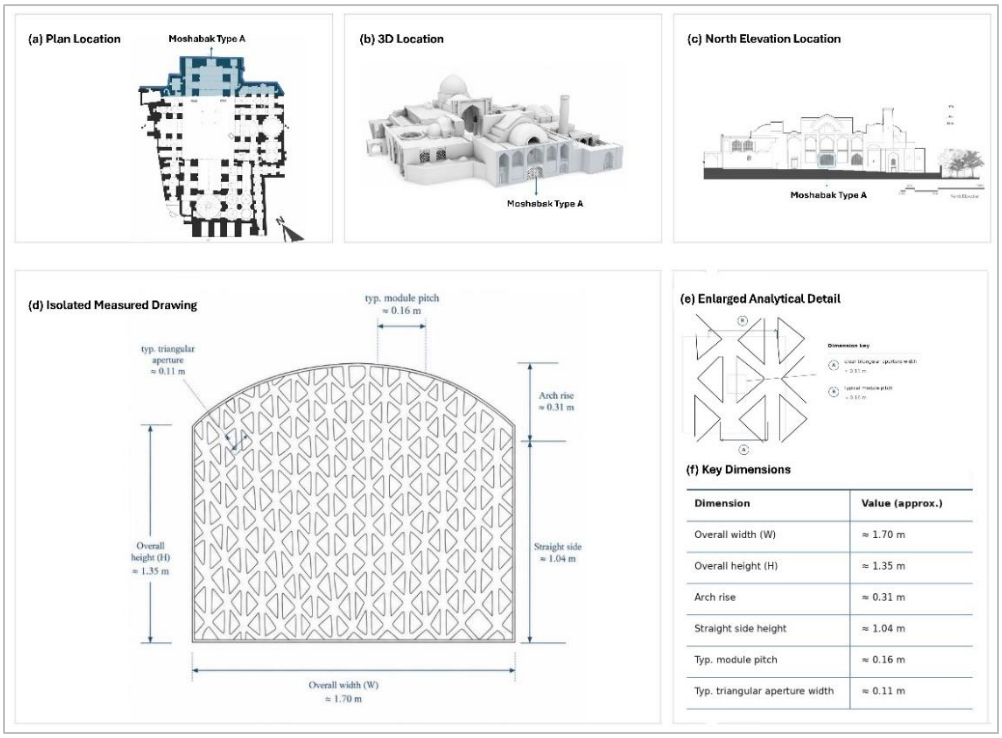

Figure 1: *Analytical documentation of Moshabak Type A in the Jameh Mosque of Ardestan: (a) plan location; (b) 3D location; (c) north elevation; (d) measured drawing; (e) enlarged analytical detail; and (f) key dimensions.*

Note. *Authors' drawings based on field documentation and Gol-Ahmari (2021).*

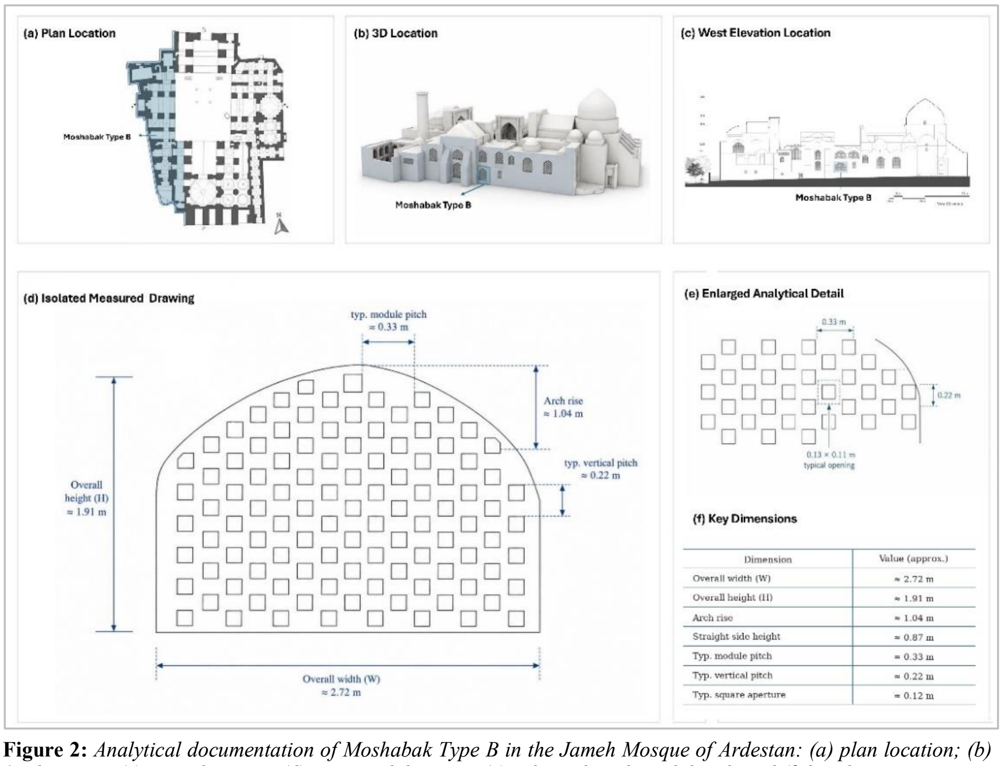

Figure 2: *Analytical documentation of Moshabak Type B in the Jameh Mosque of Ardestan: (a) plan location; (b) 3D location; (c) west elevation; (d) measured drawing; (e) enlarged analytical detail; and (f) key dimensions.*

Note. *Authors' drawings based on field documentation and Gol-Ahmari (2021).*

2. *Computational Morphometric Analysis of Calibrated Void*

The morphometric results reveal two distinct modes of void calibration. Type A includes 239 detected apertures across an approximate panel area of 1.83 m², corresponding to an aperture density of 130.9 apertures/m² and a void ratio of approximately 40.4%. By comparison, Type B includes 106 apertures across an area of approximately 4.06 m², corresponding to a density of 26.1 apertures/m² and a void ratio of approximately 32.2%.

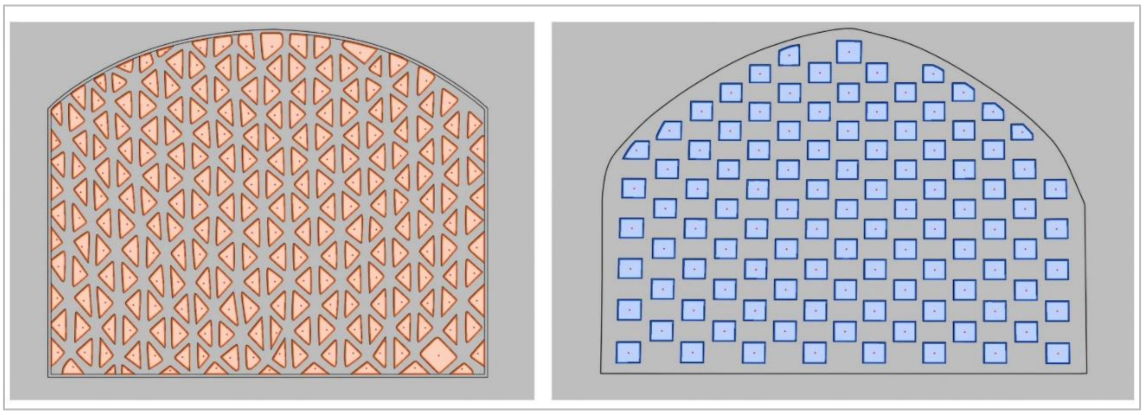

Figure 3: *Computational aperture-detection maps of the selected Moshabak surfaces: (a) Type A, with a dense triangular and predominantly oblique aperture system; and (b) Type B, with a lower-frequency square and predominantly orthogonal system. See Table 1 for the morphometric comparison.*

Note. *Authors' computational analysis.*

The mean aperture area is approximately 0.0031 m² in Type A and 0.0123 m² in Type B. Although the apertures in Type B are about four times larger, Type A has a higher void ratio because its openings are more numerous and more closely spaced. This produces a fine-grained aperture field in Type A, while Type B consists of fewer, larger, and more widely spaced openings.

The two surfaces also differ in orientation. In Type A, 67.4% of the analyzed line segments are oblique and 32.6% are orthogonal. In Type B, 97.7% are orthogonal and 2.3% are oblique. Taken together, these results indicate that void calibration cannot be explained by aperture ratio alone; it emerges from the combined effects of aperture scale, frequency, spacing, orientation, and the solid–void relation.

Table 1: *Computational Morphometric Comparison of Moshabak Type A and Type B*

Morphometric variable	Type A: triangular system	Type B: square system	Analytical implication
Detected aperture count	239	106	*Type A distributes void through a higher number of openings.*
Approx. panel area	1.83 m²	4.06 m²	*Type B is physically larger; therefore ratio and density are more important than total count alone.*
Approx. total void area	0.74 m²	1.31 m²	*Type B has greater total void area because of its larger panel size.*
Approx. void ratio	40.4%	32.2%	*Type A has higher proportional porosity.*
Approx. solid ratio	59.6%	67.8%	*Type B retains a higher proportion of solid surface.*
Mean aperture area	0.0031 m²	0.0123 m²	*Type B apertures are approximately four times larger on average.*
Aperture density	130.9 apertures/m²	26.1 apertures/m²	*Type A has a much higher frequency of void.*
Mean nearest- neighbor spacing	0.074 m	0.199 m	*Type A has closer aperture spacing.*
Oblique line share	67.4%	2.3%	*Type A is dominated by oblique geometry.*
Orthogonal line share	32.6%	97.7%	*Type B is dominated by orthogonal geometry.*

3. *From Morphometric Difference to Boundary Condition*

When considered alongside the measured drawings and field photographs, the morphometric differences point to two distinct boundary conditions. Type A combines high aperture frequency, close spacing, and predominantly oblique geometry. Its mean nearest-neighbor spacing is approximately 0.074 m, and 67.4% of the analyzed line segments are oblique. Visual access is distributed across many small, angled intervals. This supports reading Type A as a filtering boundary, where visibility is fragmented while material continuity remains dominant.

Type B combines larger apertures, wider spacing, and an overwhelmingly orthogonal geometry. Its mean nearest-neighbor spacing is approximately 0.199 m, and 97.7% of the analyzed line segments are orthogonal. Its openings appear as more discrete and frontal visual units within the continuous surface, which supports reading Type B as a framing boundary.

Boundary condition therefore emerges from the combined organization of aperture scale, frequency, spacing, orientation, and solid–void relation. Type A mediates visual relation through distributed filtration, whereas Type B does so through repeated framing. These readings are not produced by morphometric data alone; they are architectural interpretations based on the measured differences and documented spatial context.

Table 1: *Field Comparison of Moshabak Type A and Type B, Supporting Their Interpretation as Filtering and Framing Boundary Conditions*

Note. *Authors' field photographs.*

4. *Graded Relations: Comparative Spatial Reading*

The two boundary conditions produce different forms of graded interior–exterior relation. In Type A, dense, closely spaced, and oblique apertures distribute visual access across many small intervals, leaving the adjacent space only partially visible and visually fragmented. In Type B, larger, more widely spaced, and orthogonal apertures create clearer framed passages and a more direct, though discontinuous, visual connection.

Graded relation therefore depends on how void is configured, not simply on the presence of perforation. Type A operates through distributed filtration, whereas Type B operates through repeated framing. In each case, the surface retains its material presence while allowing different degrees of visibility and spatial connection. Moshabak can therefore be understood as a productive boundary that regulates, rather than removes, the distinction between interior and exterior.

Discussion: Surface Intelligence and the Moshabak Effect

The comparison of the two surfaces shows that surface intelligence cannot be explained by perforation or void ratio alone. It emerges from the coordination of aperture scale, frequency, spacing, orientation, and material continuity. Although Type A has a higher void ratio and aperture density, its openings are smaller and predominantly oblique. Type B contains fewer but larger openings arranged within an orthogonal system. When considered alongside the architectural documentation, these differences point to two distinct boundary conditions: distributed filtration in Type A and repeated framing in Type B.

1. *Surface Intelligence as Calibrated Relation*

Surface intelligence refers here to the capacity of a surface configuration to coordinate measurable variables within a coherent architectural relation. It does not reside in any single aperture or metric, but emerges from the way openings are distributed, oriented, spaced, and held within material continuity.

The two surfaces produce different versions of this relation. Type A organizes void through high frequency, small aperture scale, close spacing, and oblique orientation. Type B does so through larger openings, wider intervals, and a predominantly orthogonal order. Calibration therefore does not point to a single optimal configuration. It describes how different combinations of variables produce different forms of surface organization.

This distinction also helps define the analytical status of calibrated void. The term denotes an observable and comparable organization of material and opening rather than evidence of historical numerical optimization. Morphometric analysis identifies differences in configuration, while measured drawings, photographs, and spatial context support the interpretation of their architectural significance.

2. *Productive Boundary and Interior–Exterior Mediation*

The findings develop the concept of productive boundary by showing that mediation can take more than one surface form. In Type A, visual access is distributed across numerous small and angled openings, producing a filtering condition in which the adjacent space remains only partially and fragmentarily visible. In Type B, larger and more frontal openings create repeated frames and a clearer, though discontinuous, connection across the surface.

Filtering and framing are not separate functions imposed on the boundary. They describe how the boundary operates through different configurations of calibrated void. Both surfaces retain their material presence while permitting different degrees of visual and spatial connection. Productive boundary refers to this ability to preserve separation while altering the terms of relation across it.

This distinction also develops the theoretical connection between enclosure and surface effect established through Semper and Benjamin. Enclosure remains materially constituted, while its effects change with the organization of openings. Graded relations emerge from these differences in configuration, not from perforation as a general condition.

3. *The Moshabak Effect as Design Strategy*

The Moshabak Effect refers to the capacity of a materially continuous perforated surface to establish differentiated boundary conditions and graded interior–exterior relations through calibrated void. The case analysis makes clear that this effect does not take a single form. Similar principles of perforation can produce different modes of mediation when aperture scale, density, spacing, and orientation are configured differently.

For contemporary design, its significance lies in these operative relations rather than in formal reproduction. Current perforated envelopes and screens often treat porosity as a parameter of environmental performance, fabrication, or geometric variation (Hensel, 2010; Kolarevic & Malkawi, 2005; Loonen et al., 2013; Oxman, 2017). This analysis brings boundary condition and graded visual-spatial relation into the same field of variables. Aperture systems may therefore be assessed not only in terms of the amount of openness they provide, but also through the ways their configuration distributes, frames, or restricts relations across a surface.

The transferable value of Moshabak lies in this analytical logic rather than in reproducing a historical pattern: measurable variations in void configuration can be related to different boundary conditions and forms of spatial mediation.

Conclusion

This study examined Moshabak as an operative perforated surface whose architectural capacity emerges from the organization of void within material continuity. The comparison of two surfaces in the Jameh Mosque of Ardestan showed substantial differences in aperture scale, density, spacing, and orientation. When considered alongside the measured drawings and field photographs, these differences support reading Type A as a filtering boundary and Type B as a framing boundary.

The Moshabak Effect refers to the capacity of a perforated surface to establish differentiated boundary conditions and graded interior–exterior relations through the organization of void. Its design intelligence emerges from the coordination of measurable surface variables within a particular architectural setting, rather than from perforation as an isolated feature.

The study makes both a conceptual and an analytical contribution. It relates the architectural interpretation of Moshabak to measurable surface configuration while keeping morphometric evidence distinct from the interpretation of boundary and spatial relation. For contemporary design, its value lies in this relational logic rather than in reproducing historical patterns.

The findings are limited to two surfaces within a single architectural complex. Further comparative research across different materials, periods, and building types is needed before the framework can be applied to Moshabak more broadly.

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