The Evolution of Mashrabiya: From Traditional Patterns to Modern Climatic Adaptations

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□ ABSTRACT □

This study examines the evolution of the Mashrabiya from a traditional wooden screen associated with passive cooling and privacy to a contemporary architectural element discussed through sustainability, material innovation, and cultural identity. Drawing on a focused qualitative review of 28 selected studies, the paper examines four interrelated dimensions: historical development, environmental performance, cultural meaning, and material transformation.

The reviewed literature suggests that traditional Mashrabiya functioned not only as an ornamental feature, but also as a climate-responsive architectural device that contributed to shading, airflow regulation, and privacy control, particularly in hot-arid contexts. Contemporary reinterpretations, including parametric, kinetic, and digitally fabricated systems, appear to extend some of these functions through new materials and design technologies. However, the literature also indicates that technical adaptation does not automatically preserve the social, symbolic, and material meanings associated with the traditional element. Within the limits of the selected corpus, the review identifies three underdeveloped areas: limited comparability of environmental performance evidence, unclear criteria for assessing cultural continuity, and insufficient attention to lower-impact materials. The study therefore argues for a more integrated approach to Mashrabiya reinterpretation.

Keywords: Mashrabiya, Islamic Architecture, Passive Cooling, Cultural Heritage, Parametric Design, Sustainable Materials.

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تطور المشربية: من الأنماط التقليدية إلى التكيفات المناخية الحديثة

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□ ملخّص □

تتناول هذه الدراسة تطور المشربية من عنصر خشبي تقليدي ارتبط بالتبريد السلبي والخصوصية إلى عنصر معماري معاصر يناقش في ضوء الاستدامة والابتكار المادي والهوية الثقافية. واستنادا إلى مراجعة أدبية نوعية مركزة لثمان وعشرين دراسة مختارة، تبحث الورقة في أربعة أبعاد مترابطة، هي: التطور التاريخي، والأداء البيئي، والدلالة الثقافية، والتحول المادي.

تشير الأدبيات التي شملتها المراجعة إلى أن المشربية التقليدية لم تكن مجرد عنصر زخرفي، بل شكلت أداة معمارية مستجيبة للمناخ أسهمت في التظليل، وتنظيم حركة الهواء، وتحقيق الخصوصية، ولا سيما في البيئات الحارة الجافة. كما تشير إعادة تفسير المشربية في العمارة المعاصرة، ولا سيما من خلال الأنظمة البارامترية والحركية والتصنيع الرقمي، إلى إمكانية توسيع بعض وظائفها التقنية عبر مواد وتقنيات تصميم جديدة. غير أن الأدبيات توضح أن التطوير التقني لا يؤدي بالضرورة إلى الحفاظ على الدلالات الاجتماعية والرمزية والمادية المرتبطة بالعنصر التقليدي.

وفي حدود مجموعة الدراسات المختارة، تحدد المراجعة ثلاثة جوانب تحتاج إلى تطوير: محدودية قابلية مقارنة أدلة الأداء البيئي، وغياب معايير واضحة لتقييم الاستمرارية الثقافية، وضعف الاهتمام بالمواد منخفضة الأثر البيئي. وبناء على ذلك، تدعو الدراسة إلى مقاربة أكثر تكاملا في إعادة تفسير المشربية.

الكلمات المفتاحية: المشربية، العمارة الإسلامية، التبريد السلبي، التراث الثقافي، التصميم البارامتري، المواد المستدامة.

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Introduction:

The Mashrabiya is one of the most recognizable elements of traditional Islamic architecture. Usually formed as a finely carved wooden lattice screen, it served both environmental and social purposes. Historical and environmental studies describe the Mashrabiya as an architectural device that moderated sunlight, supported air movement, and contributed to more comfortable interior conditions in hot and arid climates [1,5,8]. Its role, however, was not only climatic. It also helped regulate the relationship between private interiors and public streets by allowing outward views while limiting visibility from outside. In this sense, the Mashrabiya was closely connected to privacy, domestic life, and broader spatial practices within Islamic societies [2,3].

Over time, the Mashrabiya also became a highly expressive architectural feature. Its geometric patterns were shaped by principles associated with Islamic art, including repetition, proportion, abstraction, and layered visual order [1,3,6]. These patterns were not merely decorative; they were connected to local craftsmanship, material knowledge, and regional building traditions. As a result, the Mashrabiya contributed to the architectural identity of many cities across the Middle East and North Africa, while also reflecting variations in climate, craft, and social use [1,8].

The twentieth century brought significant changes to the role of the Mashrabiya in architectural practice. The spread of modernist design approaches, new façade materials, and increasing reliance on mechanical cooling systems reduced the use of many traditional passive elements [4,8]. In some contexts, the Mashrabiya disappeared from everyday construction. In others, it remained as a visual reference to heritage, but with a weaker connection to the environmental and social functions that had originally shaped it. This shift raises an important question for contemporary architecture: when the Mashrabiya is reintroduced today, is it being understood as an integrated environmental and cultural system, or mainly as a patterned surface?

In recent years, the Mashrabiya has attracted renewed scholarly and design interest, especially in relation to sustainability, climate-responsive architecture, adaptive façades, parametric design, and digital fabrication. Some studies have re-examined its role in shading, airflow regulation, daylight control, and energy performance. Others have focused on its cultural significance, particularly in relation to privacy, social values, geometric identity, and the continuity of Islamic architectural traditions [1,7]. Contemporary experiments with kinetic systems, perforated panels, engineered materials, and digitally fabricated screens have expanded the technical possibilities of Mashrabiya-inspired design. Yet these developments also make the question of cultural continuity more difficult: technical adaptation does not necessarily preserve the spatial, symbolic, or material meanings embedded in the traditional element.

This study examines the evolution of the Mashrabiya through a focused qualitative review of selected literature addressing its historical development, environmental role, cultural significance, and material transformation. The aim is not simply to restate that the Mashrabiya provides shading or expresses cultural identity, since these aspects are already well established in previous scholarship. Rather, the study considers how these dimensions are discussed together, where they are treated separately, and what limitations appear in the current literature. By doing so, the paper seeks to clarify how the Mashrabiya is being reinterpreted in contemporary design and what unresolved issues remain between performance, heritage, material innovation, and cultural continuity.

Research Importance and Objectives:

The significance of this research lies in its attempt to read several strands of Mashrabiya scholarship together. Existing studies often focus on one dominant aspect of the element: its environmental performance, its cultural symbolism, its geometric character, or its contemporary fabrication. While each of these directions is valuable, they do not always explain how these dimensions interact. This is important because the traditional Mashrabiya was not a single-function element. Its architectural value came from the way it combined shading, ventilation, privacy, craft, and cultural expression within one façade system.

By bringing these dimensions into the same discussion, this study provides a more integrated basis for understanding contemporary reinterpretations of the Mashrabiya. It highlights where recent applications remain connected to the traditional logic of the element, and where they risk reducing it to a formal or decorative reference. The study also identifies areas where the literature remains methodologically limited, particularly in relation to long-term environmental evidence, cultural-continuity assessment, and the evaluation of newer materials. In this way, the paper contributes to ongoing discussions on sustainable architectural design, heritage reinterpretation, and the adaptation of traditional passive systems in contemporary practice.

Research Objectives

This study aims to achieve the following objectives:

1. To examine the historical evolution of the Mashrabiya, with attention to its environmental, social, and cultural roles in Islamic architecture.
2. To analyze how selected studies discuss the Mashrabiya's architectural significance in relation to privacy, visual control, geometric expression, and cultural identity.
3. To review the transition from traditional wooden craftsmanship to contemporary materials, fabrication methods, and digitally informed design approaches.
4. To identify the main methodological and thematic limitations in the selected literature, particularly regarding environmental performance evidence, cultural continuity, and material sustainability.
5. To derive design implications for contemporary Mashrabiya reinterpretation by considering environmental, cultural, and material dimensions together rather than as separate concerns.

Methodology

1. Focused qualitative literature review

1.1 Objective

This study adopts a focused qualitative literature review to examine how the Mashrabiya has been discussed in relation to environmental performance, cultural meaning, and material transformation. The purpose of the review is not to provide a complete systematic mapping of all publications on Mashrabiya, but to synthesize a selected body of literature that directly addresses the architectural, climatic, cultural, and material dimensions of the element.

Although a larger number of sources mention Mashrabiya or related lattice-screen systems, not all of them provide sufficient analytical detail for the aims of this study. For this reason, the review focused on 28 selected studies that offered relevant evidence, interpretation, or methodological insight. Additional references were used where necessary to support historical background, theoretical framing, or contextual

explanation. This approach allowed the selected studies to be read in greater depth and compared according to the main concerns of the paper.

1.2 Search strategy

The literature search drew on databases commonly used in architectural, environmental design, and heritage research, including Scopus, JSTOR, ProQuest, Web of Science, and the ARCC database. The search was conducted iteratively. Initial searches used broad terms such as "Mashrabiya," "Islamic lattice," "lattice screen," and "shading screen." These searches were then refined by adding terms related to environmental performance, passive cooling, ventilation, privacy, cultural identity, material innovation, sustainability, parametric design, kinetic façade, and digital fabrication.

The search strategy was intended to capture both foundational scholarship and more recent studies concerned with contemporary reinterpretations of Mashrabiya. Because the terminology differs across regions and disciplines, closely related elements such as Rawshan, Jali screens, and Islamic perforated screens were also considered when they were discussed in a culturally or climatically relevant way.

1.3 Inclusion and exclusion criteria

The selection process was guided by explicit inclusion and exclusion criteria. The core review sample prioritized studies that addressed Mashrabiya directly, or examined closely related lattice-screen systems in relation to climate, privacy, cultural identity, materiality, or architectural reinterpretation. Foundational books and selected contextual references were retained when they were necessary for historical or conceptual framing.

Sources were excluded when they treated Mashrabiya only as a decorative motif without architectural analysis, when they discussed generic shading systems without a clear cultural or climatic connection, or when they were non-academic sources such as blogs, promotional project descriptions, or unsupported online material.

Table 1: Inclusion/Exclusion Criteria

Criterion	Inclusion	Exclusion
Date	**Mainly studies published from 1980 onward, with recent studies included where relevant**	**Pre-1980 sources, unless foundational for historical framing**
Document type	**Peer-reviewed journal articles, conference papers, academic books, and selected scholarly sources**	**Blogs, promotional websites, non-academic sources, and unsupported project descriptions**
Focus	**Studies addressing Mashrabiya's environmental role, cultural meaning, material development, or contemporary reinterpretation**	**Generic shading systems with no clear relation to Mashrabiya or related cultural contexts**
Analytical depth	**Sources that offer empirical findings, cultural interpretation, design analysis, material discussion, or methodological insight**	**Sources that mention Mashrabiya only briefly or descriptively**
Relevance	**Studies connected to architecture, environmental design, heritage, craft, or façade systems**	**Purely technical or engineering studies with no architectural or cultural relevance**

1.4 Screening Process

The initial search produced approximately 80 records. After removing duplicates through Zotero, 60 unique entries remained. Titles and abstracts were screened first to identify studies with a direct connection to Mashrabiya or related lattice-screen systems. Several sources were excluded at this stage because they treated the element only as ornament, or because their focus was too general to support the aims of this review.

The remaining 45 texts were reviewed in full. From these, 28 studies were selected for the core thematic analysis. Selection was based on the extent to which each study contributed to at least one of the main dimensions of the paper: environmental performance, cultural meaning, material transformation, historical development, or contemporary reinterpretation. This process produced a focused corpus rather than a statistically representative sample. Therefore, the findings should be understood as a qualitative synthesis of selected literature, not as a generalizable account of the entire field.

1.5 Data extraction

Key information from each selected source was recorded in a structured table prepared for this study. The extracted information included the definition of Mashrabiya or related screen elements, geographical or climatic context, methodological approach, performance-related findings, cultural interpretation, material considerations, and limitations identified by the authors.

The table helped organize the reviewed material, but the analysis was not limited to summary extraction. Each source was also read closely in order to identify assumptions, contradictions, and gaps that were not always visible in the abstract or conclusion. Particular attention was given to whether studies treated environmental, cultural, and material issues as connected dimensions or as separate concerns.

All 28 selected studies are listed individually in Appendix A by their bibliographic reference number, together with their climatic context, definition of Mashrabiya, key findings, and identified gaps. The reference list at the end of the paper therefore includes both the 28 studies analyzed in Appendix A and a smaller number of contextual and theoretical sources cited in the running text to support historical background and conceptual framing. Each entry in the bibliography is therefore used either in the body text, in Appendix A, or in both.

2. Thematic analysis

2.1 Analytical approach

The selected studies were analyzed thematically. The initial categories were informed by the research objectives and by the main concerns identified in the literature: environmental performance, cultural significance, material innovation, and historical evolution. These categories were refined during the reading process as additional patterns became clearer.

The analysis combined deductive and inductive reading. Deductive coding was used to organize the literature according to the main dimensions of the study, while inductive reading allowed more specific issues to emerge from the texts themselves. For example, material transformation appeared not only as a technical issue, but also as a question of authenticity, craft knowledge, embodied carbon, and cultural continuity.

NVivo was used as an organizational tool to support the coding process. However, the interpretation remained qualitative and author-led. The software was used to manage themes and compare recurring issues across sources, not to produce statistical claims.

2.2 Coding consistency

To improve consistency, the coding process was carried out in two rounds. In the first round, the selected studies were coded according to the four main thematic categories. In the second round, the coded material was reviewed again to refine categories that were too broad, overlapping, or insufficiently specific.

This second reading helped clarify the boundaries between related themes. For instance, some studies discussed Mashrabiya as a passive environmental device, while

others treated it primarily as a symbolic or aesthetic reference. Similarly, some discussions of material innovation were linked to performance and durability, while others raised questions about the loss of traditional craft and tactile qualities. Discrepancies in classification were addressed through re-reading and comparison of the relevant passages.

No statistical intercoder reliability is claimed, because this study is a focused qualitative review rather than a multi-coder systematic review. The purpose of the repeated coding was to strengthen interpretive consistency and to make the thematic structure more transparent.

2.3 Key themes identified

- Environmental performance

A number of reviewed studies describe the Mashrabiya as an environmentally responsive element, particularly in hot-arid climates. Several sources discuss its role in reducing solar exposure, improving shading, and supporting airflow through lattice geometry [9,10,28]. Other studies address the potential of Mashrabiya-inspired systems to contribute to daylight control, ventilation, and indoor comfort [36].

The evidence, however, is not fully comparable across studies. The reviewed sources use different methods, including historical interpretation, simulation, CFD analysis, field observation, and design-based evaluation. They also examine different climates, geometries, materials, and performance criteria. For this reason, the environmental findings are treated here as reported tendencies within the selected literature rather than as directly comparable quantitative results.

Modern reinterpretations, especially kinetic and parametric systems, are also discussed in relation to adaptive shading and energy performance. Some studies suggest that responsive façade systems may improve environmental performance when they are designed according to changing solar conditions [11,12]. However, the extent of improvement depends on context, façade geometry, control strategy, material choice, and the performance indicators used.

- Cultural significance

The cultural literature presents the Mashrabiya as more than a technical shading device. It is often described as an architectural mediator between public visibility and private domestic life. Several studies link it to privacy, controlled views, gendered space, and social practices within Islamic urban contexts [13,14]. Other sources emphasize the symbolic and aesthetic dimensions of Mashrabiya geometry, connecting its patterns to broader principles of Islamic art and architectural identity [15].

A key issue emerging from this theme is that cultural meaning is often discussed descriptively rather than evaluated through clear criteria. Contemporary projects may refer visually to Mashrabiya without necessarily preserving its social function, material character, or relationship to privacy. This makes it difficult to judge whether a modern reinterpretation maintains cultural continuity or simply adopts a recognizable pattern.

- Material innovation

The material development of Mashrabiya reveals a complex relationship between tradition and contemporary construction. Traditional wooden latticework is valued in the literature for its craft, tactile quality, and climatic responsiveness. At the same time, several studies note that traditional materials may require regular maintenance and may not always meet the demands of contemporary façade construction [11].

Contemporary materials such as engineered wood, steel, aluminium, concrete, and digitally fabricated composites offer new possibilities in terms of durability, precision, scalability, and formal variation. However, these materials also raise questions about embodied carbon, sensory quality, cultural authenticity, and the loss of traditional craftsmanship [12,19]. The reviewed literature suggests that material innovation should not be assessed only through technical performance, but also through its environmental and cultural consequences.

- Historical evolution

The historical development of Mashrabiya appears across the reviewed literature as an interwoven theme. Several authors trace its role as a climatic and social device in traditional architecture, while others discuss its gradual transformation into a more symbolic or ornamental architectural element in later periods [16,27].

Recent studies extend this trajectory by examining parametric, kinetic, and digitally fabricated reinterpretations [23,30]. These works suggest that technological change has expanded the formal and environmental possibilities of Mashrabiya-inspired design. At the same time, they raise questions about whether contemporary versions remain connected to the traditional architectural logic of the element or mainly reproduce its visual language.

3. Illustrative case examples

3.1 Selection rationale

In addition to the 28 studies included in the thematic review, 29 architectural examples were examined as an illustrative layer. These examples were not treated as a separate empirical dataset or as a statistically representative case-study sample. Rather, they were used to show how Mashrabiya and Mashrabiya-inspired systems appear in different climatic, material, and architectural contexts.

The examples were selected to reflect variation in climate, design strategy, material use, and degree of cultural reinterpretation. They include both traditional or static screen systems and contemporary applications involving kinetic, parametric, or digitally fabricated façades. The purpose of this layer is to support the thematic discussion by linking ideas from the literature to built or proposed architectural applications.

Selection was guided by the following considerations:

- Climatic context: whether the project responds to solar exposure, ventilation, glare, heat gain, or seasonal variation.
- Design strategy: whether the screen is static, adaptive, kinetic, parametric, or primarily symbolic.
- Material approach: whether the project uses traditional materials, contemporary industrial materials, hybrid systems, or digitally fabricated components.
- Cultural reference: whether the project engages with Mashrabiya as a spatial, environmental, and cultural system, or mainly as a visual motif.

The table below provides representative examples rather than a complete classification of all 29 case

Table 2: Overview of Representative Illustrative Case

Climatic context	Design strategy	Main material approach	Representative example
Hot-arid	**Static or semi-static screen patterns for solar filtering**	**Stone, wood, or perforated façade elements**	**Marrakech Airport, Morocco**
Temperate	**Dynamic or kinetic shading used primarily for solar modulation**	**Steel, glass, mechanical façade components**	**Q1 Headquarters, Germany**

Tropical / hot-humid	**Porous screens supporting shade, airflow, and rain protection**	**Concrete, perforated metal, or hybrid systems**	**Pearl Academy, India**
Mixed / continental	**Adaptive or symbolic screen systems balancing solar control and identity**	**Metal, glass, composite systems**	**Arab World Institute, France**

3.2 Evaluation framework

The illustrative examples were examined according to three broad criteria: environmental role, cultural integration, and material approach. These criteria were used to guide comparison, not to produce a definitive ranking.

- Environmental role refers to the extent to which the screen contributes to solar control, daylight filtering, ventilation, glare reduction, or reduced dependence on mechanical cooling. Because the available data differs between projects, this criterion was interpreted according to the type of evidence available, including simulation results, published performance studies, or architectural documentation.
- Cultural integration refers to the extent to which the project engages with Mashrabiya as more than a surface pattern. This includes attention to privacy, visual filtering, Islamic geometric logic, regional identity, craft references, and the relationship between inside and outside.
- Material approach considers the material logic of the screen, including durability, maintenance, fabrication method, embodied environmental impact, and relationship to traditional material qualities.

To make the assessment of cultural integration more explicit, the following qualitative rubric was used:

Table 3. Cultural Integration Rubric for Mashrabiya-Inspired

Score	Description of cultural integration
1	**The project uses a perforated or patterned façade with little or no clear reference to Mashrabiya's cultural, spatial, or environmental logic.**
2	**The project refers visually to Mashrabiya or Islamic patterns, but mainly as an ornamental or symbolic surface.**
3	**The project combines visual reference with some environmental function, such as shading or daylight filtering, but gives limited attention to privacy, craft, or social meaning.**
4	**The project integrates environmental function with recognizable cultural, geometric, or spatial principles associated with Mashrabiya.**
5	**The project strongly connects environmental performance, privacy or visual control, material expression, craft or cultural reference, and contextual appropriateness.**

This rubric is not intended as a universal measurement tool. It is used here to clarify how the study interprets cultural continuity and to avoid unsupported labels such as "high" or "medium" cultural value. The rubric is applied to the comparative shading systems in Table 4 and to each of the 29 architectural examples documented in Appendix B, so that the assessment of cultural integration is transparent and consistent across both the literature-based comparison and the illustrative case sample. The scores reflect interpretive judgements based on the criteria above and are intended to make qualitative reasoning explicit, not to provide objective measurement.

3.3 Data sources

The information used to discuss the illustrative examples was drawn from peer-reviewed studies, architectural analyses, simulation-based papers where available, and project documentation. Performance-related claims were included only when supported by published studies or documented design analysis. Where detailed quantitative data

was not available, the discussion was limited to qualitative interpretation and did not claim verified performance outcomes.

Cultural interpretation was based on the way each project relates to privacy, visual filtering, geometric identity, regional context, and material expression. Because the available documentation varies from one project to another, the case examples are used cautiously. They support the thematic findings of the review but do not replace the core literature analysis.

3.4 Methodological limitations

This methodology has several limitations. First, the review is based on a focused corpus of 28 selected studies and does not claim to represent the full body of literature on Mashrabiya or related screen systems. Second, the selection process involved interpretive judgement, especially in deciding which studies had sufficient architectural, cultural, or environmental relevance. Third, the reviewed sources use different methods and performance indicators, which limits direct comparison between them. Fourth, the illustrative case examples vary in the amount and quality of available documentation. For this reason, the findings are presented as thematic and analytical observations rather than statistically generalizable conclusions.

These limitations are important to acknowledge because the aim of the study is not to produce a comprehensive systematic review, but to clarify how selected literature and examples frame the relationship between environmental performance, cultural continuity, and material transformation in the evolution of Mashrabiya.

Results and Discussion

1. Comparative Analysis of Environmental Performance

Table 4 presents a comparative reading of Mashrabiya, Brise-Soleil, and Jali screens across four dimensions: solar control, ventilation, humidity regulation, and cultural integration. The comparison is not intended as a quantitative ranking, because the reviewed studies differ in climate, method, material system, and performance criteria. Rather, it offers a thematic synthesis of how these shading systems are discussed in the selected literature.

Table 4. Comparative Reading of Mashrabiya, Brise-Soleil, and Jali

Shading system	Solar control	Ventilation	Humidity regulation	Cultural integration	Cultural integration score (1–5)
Mashrabiya	**Frequently discussed as a solar-filtering element that can reduce direct solar exposure and moderate glare, depending on geometry, depth, material, and orientation.**	**Often associated with improved airflow and passive ventilation, especially where lattice porosity and pressure differences are considered.**	**Mentioned in some traditional accounts and environmental discussions, particularly in relation to porous wooden construction and evaporative cooling practices, but the evidence remains limited and difficult to compare.**	**Strongly connected to Islamic architectural heritage, privacy, visual control, geometric expression, and craft traditions.**	**5 — The paradigmatic case integrating environmental performance, privacy, material expression, and craft tradition.**
Brise-Soleil	**Widely discussed as an effective modern shading device for reducing solar gain and controlling façade exposure.**	**Usually contributes less directly to ventilation unless it is integrated with operable façade systems or specific airflow strategies.**	**No clear humidity-regulating role was identified in the reviewed literature.**	**Mainly associated with modernist and contemporary façade expression; its cultural value depends on context rather than on an inherited symbolic tradition.**	**2 — Mainly modernist/stylistic reference without inherited Mashrabiya cultural lineage**

Jali screens	**Discussed as a perforated shading system capable of filtering sunlight and softening visual contrast.**	**Can support airflow through porous openings, although performance depends on opening ratio, thickness, and placement.**	**No clear humidity-regulating role was identified in the reviewed literature.**	**Strongly associated with South Asian architectural traditions, ornamental geometry, privacy, and regional identity.**	**4 — Strong cultural and environmental integration in a South Asian tradition closely related to Mashrabiya.**

The comparison suggests that Mashrabiya is usually discussed in the selected literature as a multi-layered architectural element rather than as a single-purpose shading device. Its environmental value is linked not only to solar filtering, but also to airflow regulation and, in some historical accounts, to limited humidity moderation through porous wooden construction and evaporative cooling practices. However, this last point should be treated cautiously, because humidity regulation is less consistently supported by empirical evidence than solar control or ventilation.

Jali screens share several characteristics with Mashrabiya, particularly in their ability to filter light, support privacy, and express regional craft traditions. Their climatic performance, however, is usually discussed in relation to shading and ventilation rather than humidity regulation. Brise-Soleil, by contrast, is more clearly framed in the literature as a modern solar-control device. It may perform effectively as a shading strategy, but it is less often associated with privacy, material tactility, or inherited cultural symbolism. The comparison therefore indicates that the difference between these systems is not only technical. It also concerns the degree to which environmental function, cultural meaning, and spatial mediation are integrated within the same architectural element.

2. Areas of agreement and disagreement in the literature

The reviewed studies generally agree that Mashrabiya and Mashrabiya-inspired systems can contribute to solar control. Most sources describe the lattice screen as a device that filters direct sunlight, reduces excessive solar exposure, and moderates glare. However, the degree of improvement reported in the literature varies considerably because the studies examine different climates, orientations, geometries, materials, and simulation or measurement methods. For this reason, the findings cannot be treated as directly comparable numerical evidence.

The literature is less consistent in relation to ventilation. Some studies discuss Mashrabiya as a passive device that supports airflow through its porosity and its position between indoor and outdoor environments. Others focus mainly on daylight, shading, or cultural identity, without testing ventilation performance directly. This creates a methodological gap: although ventilation is often mentioned as one of the traditional functions of Mashrabiya, it is not always measured or modelled with the same level of detail as solar control.

Humidity regulation is the weakest and least consistently supported performance claim. Some historical and environmental accounts associate traditional wooden Mashrabiya with evaporative cooling practices and moderation of dry air, especially where water jars or porous materials were part of the domestic setting. Yet the selected literature offers limited comparable evidence on this issue. In contemporary applications, humidity performance is rarely isolated as a measurable variable. This means that claims about humidity regulation should be presented as historically and contextually reported rather than as a confirmed general performance outcome.

A similar issue appears in relation to cultural continuity. Cultural studies often describe Mashrabiya in terms of privacy, gendered space, visual control, craft, and symbolic geometry. Performance-oriented studies, however, may reduce Mashrabiya to a shading pattern or façade component. This separation makes it difficult to evaluate whether a contemporary project truly continues the architectural logic of Mashrabiya or simply reproduces its visual language. The reviewed literature therefore points to the need for clearer criteria that can assess environmental performance and cultural continuity together.

3. Practical implications for architecture and design policy

The reviewed literature suggests several implications for contemporary architectural practice. These implications should be read as design-oriented directions derived from the selected studies rather than as universal prescriptions.

3.1 Bridging tradition and innovation

One of the main issues raised by the review is the relationship between traditional principles and contemporary design technologies. Modern reinterpretations of Mashrabiya can benefit from digital modelling, parametric design, responsive systems, and advanced fabrication. These tools can help refine porosity, depth, pattern density, orientation, and airflow potential according to environmental data. Their value, however, depends on how they are used. If digital tools are used only to generate complex patterns, the result may reproduce the appearance of Mashrabiya while weakening its spatial, climatic, and cultural logic.

A more careful approach would use computational tools to reinterpret the principles behind the Mashrabiya rather than only its image. This means treating geometry as a mediator of light, air, view, privacy, and cultural expression. It also means evaluating contemporary screens through multiple criteria, including solar control, ventilation potential, privacy, material impact, maintenance, and contextual meaning.

3.2 Material trade-offs

Material choice is another important implication. Traditional wood is valued for its tactile quality, craft association, and historical connection to Mashrabiya construction. At the same time, it may raise concerns related to maintenance, durability, availability, and contemporary building standards. Newer materials, including engineered wood, aluminium, steel, concrete, and composites, may improve durability and fabrication precision, but they may also increase embodied environmental impact or reduce the sensory and craft-based qualities associated with traditional latticework.

Hybrid and lower-impact materials may therefore offer a useful direction for future experimentation. However, their value should not be judged only by durability or formal flexibility. They also need to be assessed in relation to embodied carbon, maintenance, thermal behaviour, craft continuity, and cultural appropriateness.

3.3 Policy and design recommendations

The findings also suggest several policy-related directions. First, Mashrabiya craftsmanship could be more strongly recognized as a form of traditional architectural knowledge and as part of the broader category of intangible cultural heritage protected under international frameworks [17]. Such recognition may support the preservation of fabrication skills and encourage their reinterpretation in contemporary practice.

Second, climate-responsive design guidelines could include principles derived from Mashrabiya, especially in regions where solar control, glare reduction, privacy, and passive cooling remain important design concerns. This does not mean requiring

literal historical reproduction. Rather, it means encouraging architects to consider how traditional passive systems can inform contemporary façade design.

Third, research and design policy should support the development of lower-impact materials for culturally responsive façade systems. This is particularly important where contemporary reinterpretations rely heavily on steel, aluminium, or composite systems without sufficient attention to embodied environmental cost.

Finally, stronger collaboration between architects, engineers, heritage specialists, material researchers, and craftspeople would improve the quality of future Mashrabiya-inspired systems. Such collaboration is necessary because the Mashrabiya cannot be fully evaluated through environmental performance alone or through cultural symbolism alone.

4. Illustrative case insights

The 29 architectural examples reviewed in Appendix B are used as illustrative cases rather than as a representative empirical sample. They help show how Mashrabiya and Mashrabiya-inspired systems have been interpreted across different climatic, material, and architectural contexts.

In hot-arid contexts, examples such as Marrakech Airport illustrate how patterned screens can be used to filter sunlight and produce a strong visual connection to regional architectural identity. The environmental role of such systems is mainly associated with solar moderation and glare reduction, while their cultural role depends on the use of recognizable geometric and material references.

In temperate or mixed climates, examples such as Q1 Headquarters in Germany indicate a different direction. Here, the screen is closer to an adaptive or kinetic façade strategy than to a culturally embedded Mashrabiya. Its primary value lies in dynamic solar modulation and façade performance, while its cultural continuity with traditional Mashrabiya is weaker unless explicitly supported by design intent or contextual interpretation.

In tropical or hot-humid contexts, projects such as Pearl Academy in India show how porous screen systems can respond to shade, ventilation, and climatic exposure. Although this example is more closely related to Jali traditions than to Mashrabiya in the strict sense, it remains useful for comparison because it demonstrates how perforated façade systems can combine environmental moderation with regional architectural identity.

The Arab World Institute in France offers another important example because it translates Islamic geometric screening into a technologically mediated façade. Its adaptive diaphragm system has often been discussed as a contemporary reinterpretation of traditional screen logic. At the same time, it also illustrates one of the main issues raised by this review: technological sophistication does not automatically guarantee cultural continuity. The project carries strong symbolic and geometric associations, but its relationship to traditional privacy, craft, materiality, and everyday social use is more indirect.

Taken together, these examples suggest that contemporary reinterpretations of Mashrabiya vary widely. Some remain close to the traditional logic of environmental filtering, privacy, and cultural expression. Others borrow the visual language of latticework while shifting toward a primarily technological or symbolic façade strategy. This variation supports the need for clearer evaluative criteria when discussing cultural continuity in modern applications.

5. Synthesis of research gaps and future directions

Table 5 summarizes the main findings and limitations identified across the thematic review. The gaps listed here should be understood as gaps within the selected corpus, not as definitive gaps in all Mashrabiya-related scholarship.

Table 5. Synthesis of Findings, Research Gaps, and Future Directions

Theme	Main findings in the selected literature	Gaps and limitations	Response in this study / future direction
Environmental performance	**Studies commonly associate Mashrabiya with solar filtering, glare moderation, airflow support, and passive cooling potential.**	**Findings are difficult to compare because methods, climates, materials, and performance indicators differ. Long-term evidence on ventilation, humidity regulation, and energy performance remains limited.**	**This study presents qualitative findings drawn from the reviewed literature and does not attempt cross-study quantitative synthesis. Future studies should develop standardised performance indicators and consistent simulation or measurement protocols to enable comparison across climates and material systems.**
Cultural continuity	**Cultural studies link Mashrabiya to privacy, visual control, gendered space, craft, Islamic geometry, and architectural identity.**	**Few studies provide explicit criteria for evaluating whether contemporary applications preserve cultural continuity or only reproduce visual patterns.**	**This study uses the five-point cultural integration rubric presented in Table 3 to clarify how cultural continuity is interpreted in the illustrative examples. Future studies should further refine such criteria through user perception, heritage analysis, and design evaluation.**
Material transformation	**Contemporary materials and fabrication methods can improve durability, precision, and adaptability.**	**More research is needed on embodied carbon, maintenance, tactile quality, craft continuity, and lower-impact materials.**	**This study highlights the trade-offs between traditional and contemporary materials but does not perform a life-cycle analysis. Future studies should evaluate embodied carbon, maintenance demands, and craft continuity using consistent assessment frameworks.**
Historical evolution	**The literature traces the movement of Mashrabiya from a climatic and social device to a more symbolic and technologically reinterpreted façade element.**	**The relationship between traditional craft knowledge and computational design remains insufficiently developed.**	**This study traces the shift from craft-based to computational reinterpretations through the reviewed literature. Future studies should examine how parametric and digital workflows can integrate, rather than displace, traditional craft knowledge.**
Evaluation methods	**Several studies assess environmental or cultural aspects separately.**	**Integrated evaluation frameworks that combine environmental performance, material sustainability, and cultural continuity remain underdeveloped.**	**This study proposes a thematic structure that links environmental, cultural, and material dimensions but does not produce a unified evaluation framework. Future studies should develop integrated assessment tools that combine these dimensions within a single methodology.**

6. Future research directions

The review points to four directions for future research. First, further environmental studies are needed to compare Mashrabiya-inspired systems across different climates using clearer and more consistent performance indicators. Solar control has received considerable attention, but ventilation, humidity moderation, and long-term seasonal performance require more systematic investigation.

Second, cultural continuity needs to be evaluated through more explicit criteria. Future studies should move beyond general statements about identity or heritage and examine how privacy, visual control, craft knowledge, geometric logic, material expression, and social use are actually preserved or transformed in contemporary projects.

Third, material research should address the environmental and cultural consequences of replacing traditional wood with industrial or composite materials. Lower-carbon, biodegradable, hybrid, or locally available materials may offer promising alternatives, but they need to be studied in relation to both performance and cultural meaning.

Fourth, computational design tools should be developed in ways that integrate environmental, structural, material, and cultural parameters. Current digital approaches often optimize one dimension, such as shading or pattern generation, while giving less attention to privacy, craft, symbolic continuity, or embodied environmental impact.

Conclusions and Recommendations:

This study examined the evolution of Mashrabiya through a focused qualitative review of selected literature addressing its historical role, environmental performance, cultural meaning, and material transformation. By focusing on 28 selected studies and using 29 architectural examples as an illustrative layer, the paper has considered how the Mashrabiya has been interpreted from traditional wooden latticework to contemporary climatic and technological adaptations.

The reviewed literature suggests that traditional Mashrabiya functioned as a climate-responsive and culturally embedded architectural element. In hot-arid contexts especially, it contributed to shading, airflow regulation, visual filtering, and privacy control. These functions were historically interconnected rather than isolated. The Mashrabiya was therefore not simply an ornamental screen, but a spatial and environmental mediator shaped by climate, craft, social practice, and cultural expression.

Contemporary reinterpretations, particularly parametric, kinetic, and digitally fabricated systems, have expanded the technical and formal possibilities of Mashrabiya-inspired design. They allow new forms of solar control, pattern variation, material experimentation, and adaptive façade behaviour. However, the selected literature also indicates that technological development does not automatically preserve cultural continuity. When performance optimization or formal experimentation is separated from the social, spatial, and material logic of the traditional element, the Mashrabiya risks becoming a symbolic surface rather than an integrated architectural system.

The material transformation of Mashrabiya raises related questions. Contemporary materials may improve durability, fabrication precision, and adaptability, but they may also weaken links to traditional craftsmanship, tactile quality, and lower-impact material practices. Future research therefore needs to examine not only how new materials perform technically, but also how they affect cultural meaning, environmental impact, and the continuity of craft knowledge.

Within the limits of the selected corpus, the study identifies several areas that require further investigation. These include the limited comparability of environmental performance evidence across climates and methods, the need for clearer criteria to assess cultural continuity in contemporary applications, and the insufficient examination of lower-impact or hybrid materials. Future studies would benefit from integrated evaluation frameworks that consider environmental performance, material sustainability, privacy, geometry, craft, and cultural meaning together.

Overall, the contemporary relevance of Mashrabiya lies not in the literal repetition of historical forms, but in the careful reinterpretation of the principles that shaped them.

These principles include light filtering, heat moderation, airflow support, visual control, privacy, geometric order, and material expression. When these dimensions are considered together, the Mashrabiya remains a valuable reference for sustainable architectural design and for broader debates on how traditional passive systems can be meaningfully adapted in contemporary practice.

Declaration on the Use of AI-Assisted Tools

During the preparation of this manuscript, AI-assisted language tools were used only for language refinement, editing support, and improving clarity of expression. The author independently developed the research design, selected and interpreted the sources, revised the manuscript critically, verified the references, and approved the final version. No AI tool was used as a source of scholarly evidence, and all arguments, interpretations, and conclusions remain the responsibility of the author.

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Appendix A: Summary of the 28 Analyzed Peer-Reviewed Studies

Reference Number	Author(s)	Year	Definition of Mashrabiya	Climate Zone	Key Findings	Research Gaps
9	Fathy, H.	1986	3D wooden lattice for passive cooling	Arid	25% solar gain reduction; improved airflow and shading	No humidity metrics; lacks modern material comparisons
10	Gelil & Badawy	2014	Mashrabiya as lattice alternative to Egyptian shutters	Hot-arid (Egypt)	Simulation suggets superiority in daylight & airflow	Limited to comparative prototype scale
11	Taki & Kumari	2023	Mashrabiya as energy and identity mediator	Hot-arid (Saudi Arabia)	Indicates energy efficiency + cultural acceptance	Limited exploration of geometric variation
12	Abdel Gelil et al.	2023	Mashrabiya as smart responsive shading system	Hot-arid (Egypt)	Smart systems are reported to improve indoor comfort	Cost and Technological complexity not addressed
13	Mazzetto & Noca	2025	Mashrabiya as symbolic and spatial element in public architecture	Various	Highlig variation i and mea	No environmental or performance analysis
14	Gharib, N.	2016	Mashrabiya as transparent boundary between public and private	Hot-arid (Arabic context)	Emphasizes privacy and social control	Descriptive; lacks technical analysis
15	Mohamed, S. F.	2024	Mashrabiya as vernacular sustainability strategy	Hot-arid (Egypt)	Studio experiment suggests design viability	Small-scale experiment
16	Özsavaş Akçay & Alotman	2017	Mashrabiya as evolving systen from traditional modern		Proposes evaluative framework for transformation	Lacks application to specific climatic or material cases
18	Semary et al.	2017	Mashrabiya as high-tech daylight-responsive façade	Hot-arid	Responsive systems optimize daylight performance	Ventilation and social aspects underexplored
19	Pieczara, M.	2019	Digitally fabricated Mashrabiya	Global	Shows how traditional architectural details (including screens) are abstracted and modernized	Lacks environmental or performance-based evaluation
20	AlMaqremi & Abdou	2026	Implicit: Mashrabiya as a heritage-based passive retrofit shading element	Hot-arid (Yemen)	Reports energy savings through heritage-informed retrofitting	Does not isolate Mashrabiya geometry as a variable
21	Nair, R.	2008	heritage elements	Tropical humid (Kerala, India)	ICT tools enhance documentation and conservation	No climatic or performance analysis of screens
22	Aljofi, E.	2005	Rawshan defined as projected wooden screen filtering and reflecting daylight	Hot-arid (Saudi Arabia)	Reflected daylight improves indoor illumination while reducing glare	Limited to daylight; no ventilation or thermal metrics
23	Almurbati et al.	2016	Mashrabiya as lattice screen mediating light, privacy, and climate	Hot-arid (Middl East)	Hybrid parametric workflows enable cultural continuity	Limited real-world performance validation
24	Alkhatib et al.	2024	Mashrabiya-inspired perforated screen	Hot-humid	Digital prefabrication improves shading and	Based on abstract-level results; full

					ventilation performance	building impact not tested
25	Alsheikh et al.	2020	Sustainable urban Mashrabiya	Global	Traditional elements enhance sustainability when reinterpreted	Lacks technical evaluation of Mashrabiya
26	Ficarelli, L.	2010	Passive cooling construction in Egypt	Hot-arid (E	Structural durability of historic wooden latticework	Limited research on hybrid material applications
27	AlAzhari, O	2023	Mashrabiya cited as vernacular cooling device	Hot-arid Mediterra (MENA	Indicates a role in ventilation and solar control	No geometric or façade-scale simulation
28	Salimi et al.	2025	Mashrabiya cited as vernacular cooling device	Various (comparat	Indicates a role in ventilation and solar control	No geometric or façade-scale simulation
29	Headley et al.	2015	Mashrabiya as architectural lattice fabricated via 3D printing	Hot-arid	Digital fabrication enables scalability	Structural and thermal performance not deeply assessed
30	Bande et al.	2022	Parametric Mashrabiya-inspired dynamic façade	Hot-arid (U	Dynamic façades are reported to improve daylight and solar control	High-tech focus; cultural perception not studied
31	Hraška, J.	2018	Adaptive shading mechanism	Various	Adaptive shading improves building performance	No cultural or vernacular context
32	Naqash, M.T.	2021	Mashrabiya as perforated façade sheet	Hot-arid	Indicates structural feasibility under wind loads	No thermal or daylight analysis
33	Maksoud et al.	2023	Islamic parametric elevation derived from Mashrabiya	Hot-arid	VR enhances design validation	Cultural authenticity not critically assessed
34	Alewlani et al.	2020	Mashrabiya as screen component of Rawshan	Hot-ari (Arabia Peninsul	Strong socio-cultural value reported	Limited environmental simulation

35	**Tokuç et al.**	**2018**	**screen treated as biomimetic façade**	**Various**	**Discusses sustainability potential of nature-inspired façades**	**Lacks Islamic/vernacular specificity**
36	**Elwan, M.**	**2020**	**Mashrabiya as lattice window enabling single-sided ventilation**	**Hot-arid**	**CFD sugg ventilati effectiven**	**No daylight or social evaluation**
37	**Bande et al.**	**2025**	**Mashrabiya as retrofit shading device**	**Hot-arid**	**Significant er reduction ach**	**Single case study limits generalization**
38	**Abowardah, E.**	**2025**	**Mashrabiya as socio-cultural identity marker**	**Hot-arid (Saudi Arabia)**	**Discusses cultural sustainability and identity**	**No quantitative performance analysis**

Appendix B: 29 Projects case study profiles

Name of the project	Image	Location	Climate	Location of installation	Function	Type	pattern	Construction material	Cultural integration (1–5)
Abu Dhabi Central Market		UAE, Abu Dhabi	Subtropical arid climate.	Covers three facades	Light control Aesthetic role	Static	Vertical and horizontal louvers octagonal forms perforations	wood	3 — Islamic octagonal motifs + wood; climatic function present, craft/privacy limited
Doha Tower		UAE, Doha	Dry subtropical desert climate	Covers the whole building	Light control Glare control Aesthetic role	Static, multiple layered	Butterfly geometric pattern repeated and rotated in various densities	Metal lattice	3 — Strong Islamic geometric pattern + glare control; no privacy/craft dimensions
Mashrabiya House		Palestine, Beit Safafa	Hot semi-arid climate	Covers the whole house	Light control Airflow regulation Humidity Control Visual privacy Temperature control	Static	No patterns are used in this example but rather gaps were created from irregular spacing between the stone pieces	Stone	5 — Named Mashrabiya, local stone, all environmental functions including privacy
W-House		The Netherlands, Amsterdam	Moderate maritime climate	Covers the front and back façade of the first level	Visual privacy Aesthetic role	Static	Combination of repeatedcrossed squares and circles	Stone	2 — Geometric pattern with privacy function; non-Mashrabiya climatic/cultural context
La Tallera Gallery		Mexico, Cuernavaca	Primarily subtropical highland	Covers all facades	Light control Airflow regulation Humidity Control Temperature control Aesthetic role	Static	Triangulated lattice	Concrete	2 — Lattice pattern + multi-function shading; no Mashrabiya/Islamic reference
Mashrabiya Mosque		India, Pune	Tropical wet and dry	Covers all facades	Light control Airflow regulation Temperature control Visual privacy	Static	Range of varied hexagon perforations	Glass reinforced concrete	4 — Named Mashrabiya in religious context; multiple environmental functions + privacy
Guelmim Airport		Guelmim, Morocco	Subtropical desert climate	Covers all facades	Light control Airflow regulation Temperature control Aesthetic role	Static	Diamond shaped perforations that vary in scales and distribution, placed over rectangular panels	Low-emissivity metal	3 — Regional desert context + multi-function; limited craft/privacy lineage
Mosque of Mohamed Abdulkhaliq Gargash		UAE, Dubai	Hot arid climate	Parts of the façade and ceiling	Light control Temperature control Visual privacy Aesthetic role	Static	Range of different scaled triangular perforations	Stone	4 — Mosque context, stone, privacy and climatic functions integrated

Otemon Gakuin University Academic-Ark		Ibaraki, Japan	Humid continental climate	All outer facades	Light control Temperature control Aesthetic role	Static	Motif of cherry blossoms	Cast stainless steel	1 — Cherry-blossom motif (non-Mashrabiya); decorative façade in foreign tradition
Ali Mohammed T. Al-Ghanim Clinic		Kuwait	Subtropical desert climate	Parts of the facades	Light control Airflow regulation Temperature control	Static	Punctured mesh is placed on a segmented metal sheet	Metal	2 — Modern perforated metal in regional context; limited cultural integration
USJ Campus		Beirut, Lebanon	Intense Mediterranean climate	All outer facades	Light control Aesthetic role	Static	Various geometrical shape perforation	Stone	2 — Stone geometric perforation in Levantine context; light/aesthetic only
Louvre Museum		UAE, Abu Dhabi	Subtropical arid climate.	Covers the entire building's dome	Light control Airflow regulation Temperature control	Static	Geometric openings was inspired by the interlaced palm leaves	Stainless steel	3 — Palm-leaf reference + famous 'rain of light'; symbolic surface, not Mashrabiya logic
Social Facilities in Roses		Spain, Roses	Warm and temperate mediterranean climate	Covers the visible facades of the building	Light control Visual privacy Aesthetic role	Static	Geometrical pattern composed of different scaled circles	Stainless steel	2 — Decorative circles + privacy function; no explicit Mashrabiya/Islamic reference
Masdar city		UAE, Masdar city	Hot, dry, desert climate	Covers all the facades	Light control Airflow regulation Humidity Control Temperature control Aesthetic role Visual privacy	Static	The used patterns are derived from the traditional Islamic architecture	Glass-reinforced concrete,	5 — Patterns derived from Islamic architecture; all environmental functions + privacy
Birmingham Library		United Kingdom , Birmingham	Warm and temperate maritime climate	Covers all outer facades	Light control Airflow regulation	Static	Combination of repeated crossed circles in two different scales	Stainless steel	1 — Decorative geometric pattern; no Mashrabiya cultural lineage in temperate context
Muscat Bank		Muscat, Oman	Hot, arid climate	Parts of the facades	Light control Temperature control Aesthetic role	Static	Traditional floral pattern repeated in various scales	Stainless steel	3 — Islamic floral motif + climatic control in regional context; limited depth
Marrakech Menara Airport		Morocco, Marrakesh	Subtropical semi-desert	Covers almost all openings located on the roof and the facades	Light control Temperature control Aesthetic role	Static	Islamic ornamental motifs	Stainless steel	3 — Islamic ornamental motifs + solar filtering; mainly symbolic surface
BMCE Headquarters		Morocco, Rabat	Mediterranean climate	Covers all facades	Light control Temperature control Aesthetic role	Static	Repeated Islamic floral pattern	Stainless steel	3 — Islamic floral pattern + climatic function; limited craft/privacy

A House for a Young Man		Argentina, San Francisco	Moderate maritime climate	Covers front façade	Light control Temperature control Airflow regulation Visual privacy	Static	Repeated square voids	Brick	2 — Brick screen with airflow + privacy; no Islamic/Mashrabiya reference
Pearl Academy of Fashion		India, Jaipur	hot semi-arid climate	Covers all outer facades	Light control Temperature control Airflow regulation Humidity Control	Static	Repeated combination of circles and crossed diamond shapes	Concrete	4 — Jali tradition (closely related to Mashrabiya); all environmental dimensions
Arab World Institute		France, Paris,	Continental mild climate	Covers front façade	Light control Temperature control Aesthetic role	Kinetic	Repeated units composed of circular apertures that shifts to squares, circles, and octagonal shapes according to the amount of light that enters the facade	Stainless steel	3 — Strong geometric symbolism + technical control; cultural integration indirect
Al Bahar Towers		UAE, Abu Dhabi	Subtropical arid climate.	Covers east, south and west facades	Light control Temperature control Aesthetic role	Kinetic	Ttriangular units in the shape of origami umbrellas that unfold to various angles in response to the movement of the sun.	Aluminum dynamic frames, and fiberglass mesh infill	4 — Famous Mashrabiya-inspired kinetic system, regional context, environmental function
CH2 Melbourne City Council House 2		Australia, Melbourne	Mild, temperate climate	Covers the entire north facade	Light control Temperature control Airflow regulation Aesthetic role	Kinetic	Vertical slats that pivot vertically, opening and closing in response to the time of day and the angle of the sun.	Recycled timber	1 — Modern kinetic façade with sustainability angle; no Mashrabiya reference
The Q1 Headquarters		Germany, Essen	Moderate maritime climate	Covers all outer facades	Light control Temperature control Aesthetic role	Kinetic	Twisting fins with horizontal reflective blinds	Stainless steel	1 — Modern kinetic stainless steel façade; no Islamic/Mashrabiya reference
SDU Campus Kolding		Denmark, Kolding	Moderate maritime climate	Covers all outer facades	Light control Temperature control Aesthetic role	Kinetic	Triangular shutters that adjust to the specific climate conditions and user patterns	Perforated stainless steel	1 — Modern adaptive shading; no Mashrabiya cultural reference
Kiefer Technic Showroom		Austria, BadGleichenberg	Temperate, continental climate	Covers south facade	Light control Temperature control Aesthetic role	Kinetic	Folding square panels change their configuration in response to the intensity of the solar light fallen on the façade.	Metal covered with white plaster	1 — Modern adaptive façade; no Mashrabiya logic

Media-ICT		Spain, Barcelona	Humid subtropical climate	Covers Southeast and the Southwest facades	Light control Temperature control Aesthetic role	Kinetic	ETFE air pillows that are responsive to heat temperature	The pillows consist of three layers of plastic and two air chambers between them	1 — High-tech ETFE adaptive façade; no Mashrabiya reference
Simons Center		USA, New York	Humid subtropical climate	Covers the main west facade	Light control Temperature control Aesthetic role	Kinetic	Multiple overlapping layers transform based on the light that falls on them, changing from hexagons to circles, squares, and triangles.	Perforated metal	1 — Modern kinetic façade with geometric shapes; no Mashrabiya reference
RMIT Design Hub		Australia, Melbourne	Temperate oceanic climate	Covers all outer facades	Light control Temperature control Airflow regulation Aesthetic role	Kinetic	Panels containing movable glass disks within steel cylinders on a galvanized steel frame. They rotate according to the sun direction	Glass disks within steel cylinders	1 — Modern kinetic glass-disk façade; no Mashrabiya reference