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THE ENDURING LEGACY OF MASHRABIYA IN ISLAMIC ARCHITECTURE AND DESIGN

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Abstract

This research investigates the multifaceted significance of Mashrabiya, a traditional architectural element found throughout the Islamic world. Employing a design typology approach, it delves into its historical, social, artistic, and environmental aspects. The core focus lies in the typology's impact on functionality, including solar control, ventilation, and humidity regulation. Cultural and social values embedded within the design and craftsmanship are also explored. The study emphasizes design strategies for incorporating Mashrabiya in both historical and contemporary buildings, analysing its use as a primary decorative element. A comparative analysis with traditional Malay house screening is included. six case studies, encompassing traditional and modern applications, will be examined alongside the element's historical background, installation methods, material usage, and modern adaptations in hotels and boutiques. Finally, the artistic representation and construction techniques, particularly its connection to abstract geometry, will be explored. This comprehensive investigation aims to highlight the rich history of Mashrabiya, establish it as a valuable source of inspiration for future designers, and bridge the knowledge gap between traditional and modern forms.

Keywords: Mashrabiya, Architecture, Design, Traditional, Modern.

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INTRODUCTION

The Climate exerts a profound influence on architectural design. Each region's climatic characteristics leave an indelible mark on its built environment, shaping unique elements and fostering a distinct cultural identity (Ashour, 2018). The Islamic art and architecture is centuries old (Kamarudin et al., 2020). The Mashrabiya, a traditional component of Islamic architecture originating in the Arab world, exemplifies this intricate relationship (Dariyadi et al., 2022a, 2022b). Its intricate latticework design has captivated Western scholars for centuries, and its recent resurgence in contemporary projects like hotels and boutiques underscores its enduring appeal (Mohamed, 2015). Modern applications of the Mashrabiya vary in their adherence to the original design. Traditionally, it was a cantilevered structure with a lattice where water jars were placed to cool through evaporation as air passed through (Bagasi & Calautit, 2020). These days, the term refers to an aperture featuring a wooden lattice screen made out of tiny, circular-section wooden balusters spaced at precise, regular intervals, frequently forming an elaborate and aesthetically pleasing design as shown in figure 1.

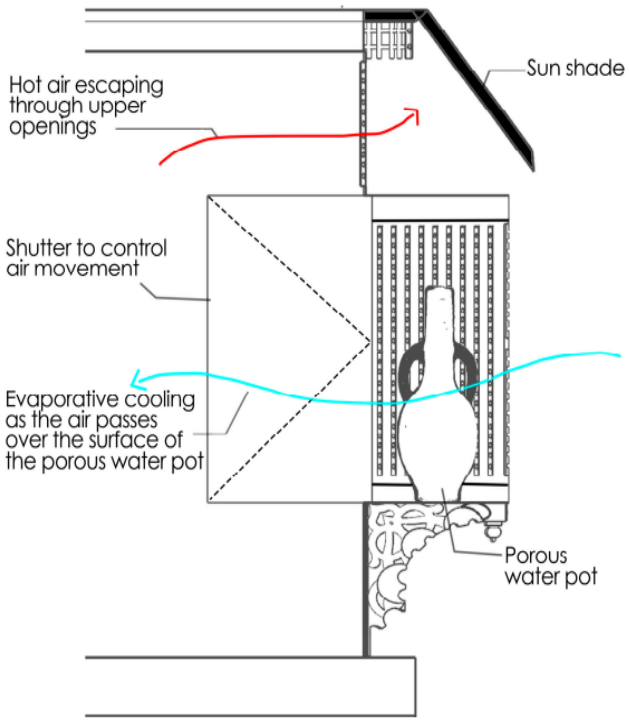


Figure 1: Indoor air-cooling system created by placing porous water jars in the Mashrabiya.
Source: (Taki & Kumari, 2023)

Originally, "Mashrabiya" referred to structures for cooling water jars, using an intricate lattice for evaporative cooling and air movement. This design tackled the harsh Middle Eastern heat and low humidity, while also serving as a means for social privacy and window closure (Headley et al., 2015). By strategically filtering sunlight and promoting natural ventilation, the Mashrabiya facilitated a comfortable "cold effect" within dwellings, a critical feature for inhabitants enduring extreme heat (Bagasi, 2022). Figure 2 shows the functions of Mashrabiya.

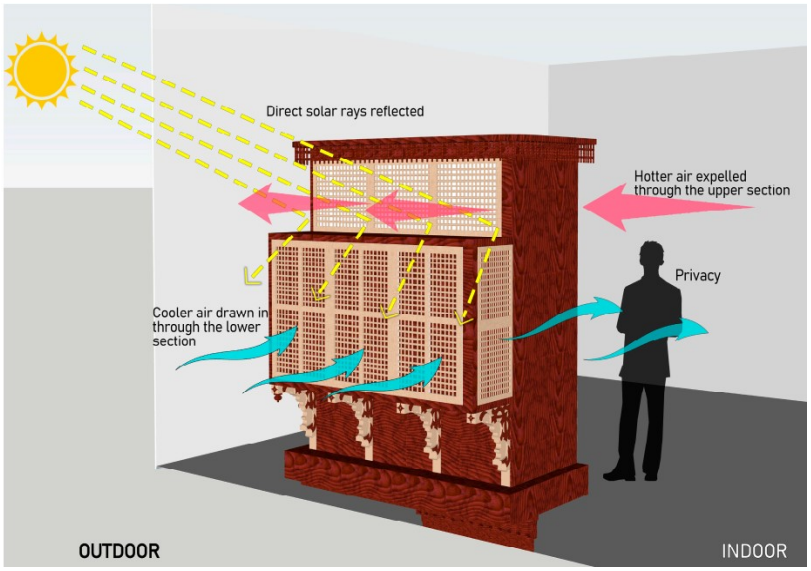


Figure 2. A schematic showing the main features of Mashrabiya.
Source: (Taki & Kumari, 2023)

The Mashrabiya has evolved from a functional element into a cultural symbol, reflecting various historical eras and imbuing buildings with unique identity. Its multifunctionality controlling light, airflow, humidity, and heat gain makes it a vital eco-friendly feature with remarkable adaptability (Amer et al., 2015).

This paper explores the evolution of the Mashrabiya, from its historical origins to its application in both traditional and contemporary architecture. Through case studies, it examines Mashrabiya's design principles materials, colours, and assembly highlighting its relevance in modern spaces, particularly hotels. The study bridges traditional understanding with contemporary use, focusing on successful examples in facades, windows, and interiors globally. It also addresses whether referencing the original form is vital for enhancing the tourism experience in modern hospitality design.

METHODOLOGY

This study explores the potential of Mashrabiya, a traditional Islamic architectural element, in contemporary building design. Using a qualitative approach, it employs two methodologies. First, six case studies both historical and contemporary hotels are analysed, categorized by installation location and historical context as shown in figure 3. The location criteria document where the Mashrabiya is used in the design (e.g., facades, windows, or interiors), while the historical context considers the era of the building's construction. This categorization offers insight into Mashrabiya's use across different periods and spatial contexts in hospitality design.

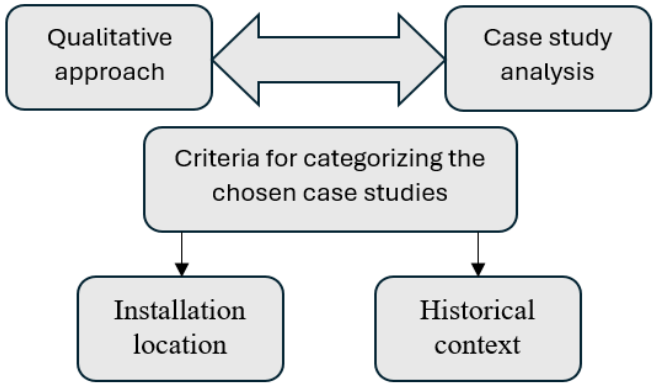


Figure 3. Categorization of case studies

The second approach focuses on data collection through semi-structured interviews and a comprehensive literature review. The review aims to clarify the concept of Mashrabiya, analyse its historical role, and connect it to its identity in Islamic architecture. Secondary data will provide an update on contemporary Mashrabiya styles and materials, presented in tables and graphs for critical evaluation. By combining case study analysis, literature review, and contemporary trends, the research offers insights into Mashrabiya's potential in modern hotel design.

Data collection

This research, employing a qualitative approach, delves into the potential of Mashrabiya, a traditional Islamic architectural element, for contemporary hotel design. Data collection centers on two primary sources: archival research and case study analysis.

Archival Research: Building a Strong Foundation

A thorough review of scholarly journals, theses, dissertations, books, and articles on Islamic architecture and design will form the study's foundation. This review has two main purposes: first, to gain a deep understanding of Mashrabiya's historical development, including its functional principles and cultural significance in Islamic architecture; and second, to provide insights into its traditional use. This knowledge will serve as a key reference for evaluating its integration into contemporary hotel spaces.

Case Study Analysis: Unveiling Mashrabiya's Potential

Six case studies will be documented to explore Mashrabiya's use in both historical and contemporary hotels as shown in Figure 4. Spanning from the Abbasid era to modern projects, these studies will track Mashrabiya's evolution and focus on public buildings, aligning with the study's goal of enhancing its role in hotels. The cases, selected from various countries, will include historical houses to understand its transition from domestic to public use. These insights will guide proposals for integrating Mashrabiya into contemporary hotel design.

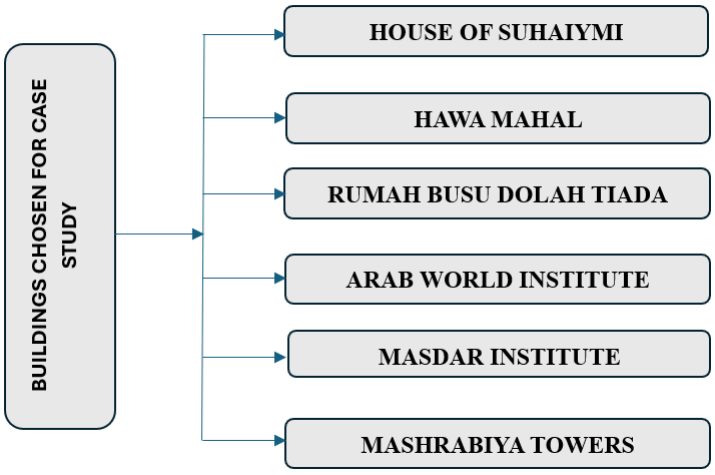


Figure 4. Chosen buildings for case study

Traditional case studies

House of suhaiymi

The Suhaymi House, located in Islamic Cairo, Egypt, serves as a valuable case study for understanding the historical application of Mashrabiya. Built in the 16th century by Abdul Wahab el Tablawy, this Ottoman-era residence, now a museum, exemplifies the integration of Mashrabiya within domestic architecture (Ocran et al., 2019). The house revolves around a central Sahn (courtyard) featuring a small

garden with palm trees. Notably, the Suhaymi House incorporates extensive Mashrabiya elements, particularly within windows as shown in figure 5.

The intricate latticework of Mashrabiya serves multiple functions. It controls sunlight, reducing harsh summer heat in Cairo, while allowing cool breezes to enhance natural ventilation. Additionally, it acts as a barrier against dust, maintaining airflow, and provides privacy without completely obstructing exterior views. The Suhaymi House illustrates Mashrabiya's vital role in traditional Islamic architecture by offering climatic comfort, privacy, and a decorative touch. This historical case study informs the exploration of integrating Mashrabiya into contemporary hotel design, which is the focus of this research.

Figure 5. Floral and geometrical patterns in the Egyptian Mashrabiya
Source: (Abdel et al., 2014)

The enduring appeal of Mashrabiya stems from both its functionality and aesthetic qualities, reflecting exquisite craftsmanship. Historical accounts, particularly in Egypt, emphasize the meticulous detail in creating Mashrabiya. The preservation of intricate marble flooring, timber furniture, and ceiling decorations in buildings like Suhaymi House demonstrates the high quality of materials and workmanship. Many historians consider Egyptian Mashrabiya the

pinnacle of this art form, showcasing the finest craftsmanship. Skilled Muslim artists expressed their engineering and artistic talents through Mashrabiya designs, featuring intricate latticework of small shapes assembled with wooden sticks. This interplay of mass, space, light, and shadow created a unique visual effect, as seen in the decorative configurations inside Al-Mashrabiya at Suhaymi House as shown in Figure 6 (a).

The dynamic interplay of light and shadow in Mashrabiya design created a "wonderful dramatic atmosphere" in the interior courtyards of Arab homes, enriching their character. Its craftsmanship and aesthetics made Mashrabiya more than just functional, elevating it to a key part of architectural and cultural heritage. This focus on aesthetics will be essential when considering Mashrabiya's integration into contemporary hotel design. While functionality is important, its ability to create a unique atmosphere and add visual distinction will be crucial for its adaptation in modern hospitality spaces as shown in figure 6(b).

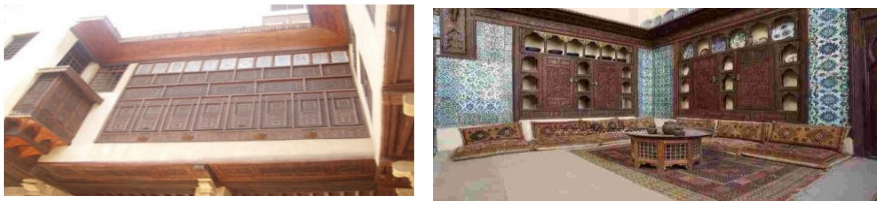


Figure 6 (a). Decorative configurations inside Al-Mashrabiya- Al Suhaimi House
Source: (Ocran et al., 2019) **(b)**Al Suhaimi House majlis
Source: (Bayt Al-Suhaymi | Know More About House of Suhaymi in Cairo, n.d.)

Hawa mahal

Hawa Mahal, known as the "Palace of Winds" in Jaipur, India, is a compelling case study that blends Rajput and Mughal architectural styles. Built in the 17th century by Maharaja Sawai Pratap Singh, it reflects an inspired vision influenced by the Khetri Mahal. The palace's striking five-story facade resembles a beehive, featuring 953 intricately decorated Jharokha windows with delicate latticework. These Jharokhas allowed royal women to observe street life and festivals while maintaining privacy, adhering to the "purdah" custom of female seclusion as shown in Figure 7 (a).

Hawa Mahal's architectural style reflects a harmonious blend of Rajput and Mughal influences. The red and pink sandstone construction, echoing the city's moniker as the "Pink City," is a signature Rajput element. The intricate latticework, geometric patterns, and small arched domes, however, showcase the undeniable influence of Mughal aesthetics. This precise repetition of these contrasting styles creates a visually captivating and historically significant structure. Figure 7 (b) shows the chambers with small windows.

Figure 7. (a) Jharokhas decorated with complicated latticework *Source: (taken by author)* **(b)** The chambers with small windows of the façade *Source: (About Hawa Mahal | Hawa Mahal, n.d.)*

Beyond its visual grandeur, Hawa Mahal's design integrates functional elements. The stone Mashrabiya, with strategically placed openings, facilitated natural air circulation through the Venturi effect, keeping the palace cool during India's hot summers as shown in figure 8. Fountains within the palace further enhanced the cooling effect, ensuring a comfortable environment for the royal residents.

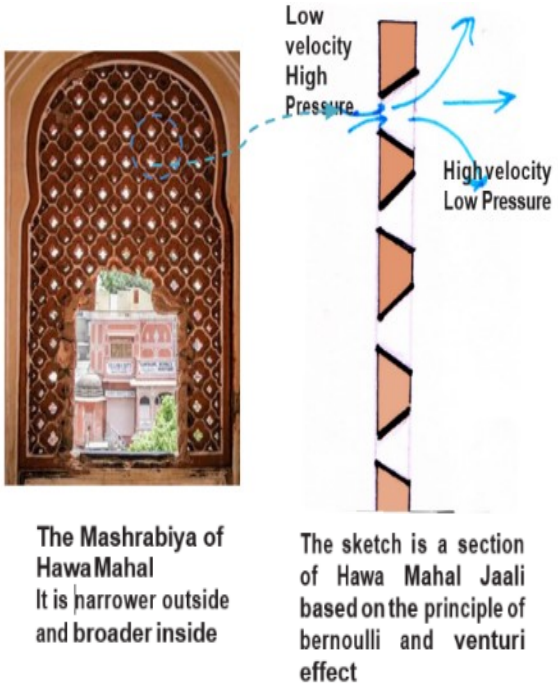


Figure 8. Bernouli and venturi effect in Hawa mahal

Hawa Mahal transcends its function as a palace, standing as a testament to the fusion of Rajput and Mughal architectural styles. The intricate facade, with its small windows, stone-carved screens, and arched roofs, continues to captivate

visitors. The contrasting use of red and pink sandstone, along with the play of light and shadow on the latticework, creates a mesmerizing visual experience. Hawa Mahal embodies the rich cultural and artistic heritage of Jaipur, serving as a landmark monument that continues to inspire architects and historians alike.

Rumah busu dolah tiada pendua

Rumah Busu Dolah Tiada Pendua in Melaka, Malaysia, is a key case study for exploring Malay architecture and its focus on passive design principles. As the only surviving traditional Melaka Malay heritage house, it exemplifies the region's cultural and artistic heritage as shown in Figure 9 (a). The defining feature of Rumah Busu Dolah is the extensive use of the Kerawang motif, an intricate floral pattern applied to the roof, stairs, windows, doors, and walls. This motif not only enhances the house's visual appeal but also symbolizes Malay cultural identity. The perforated Kerawang elements function similarly to Islamic Mashrabiya, allowing natural air circulation and light penetration, promoting thermal comfort. This aligns with Malay passive design principles, aiming to regulate indoor temperatures without mechanical means. Thus, the Kerawang motif serves both decorative and functional purposes as shown in Figure 9 (b).

Figure 9 (a). The entrance of Rumah Busu Dolah tiada Pendua
Source: (Keindahan Rumah Warisan Melaka Siri 1: April 2012, n.d.)
(b) The interior of the house showing the open wall screening
Source: (Keindahan Rumah Warisan Melaka Siri 1: April 2012, n.d.)

Rumah Busu Dolah reflects a commitment to traditional construction techniques and sustainable materials. Local builders used time-tested methods, crafting wooden carvings without nails. The primary material, Cengal wood, is known for its durability and weather resistance, ensuring the structure's longevity and ease of future repairs. Rumah Busu Dolah Tiada Pendua exemplifies the Malay people's cultural heritage and architectural ingenuity. The Kerawang motif integrates passive design principles effectively, making this case study a valuable resource for understanding cultural identity and passive design in contemporary architecture.

Modern case studies

Arab world institute

The Arab World Institute (Institut du Monde Arabe, IMA) in Paris, designed by Pierre Soria, Jean Nouvel, Architecture-Studio, and Gilbert Lezenes and completed in 1987, exemplifies the reinterpretation of traditional elements in contemporary architecture. Intended as a cultural bridge between Arab and French cultures, the building's design is inspired by the Mashrabiya, a traditional Islamic architectural element as shown in Figure 10 (a). Jean Nouvel drew significant inspiration from Mashrabiya, a traditional latticework element made from wood that provided cooling, privacy, and light control. Nouvel aimed to capture its essence using modern materials and technologies. The facade he designed features around 27,000 light-sensitive diaphragms that mimic Mashrabiya's functionality by regulating light entry. Figure 10 (b) illustrates these diaphragms.

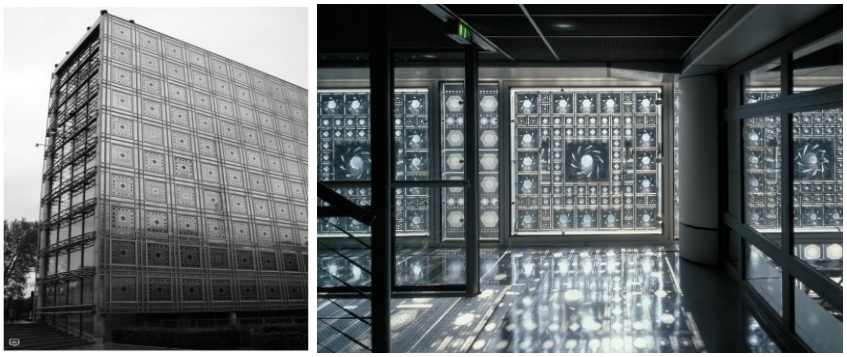


Figure 10 (a). The exterior view of the Arab World Institute
Source: (AD Classics: Institut Du Monde Arabe / Enrique Jan + Jean Nouvel + Architecture-Studio | ArchDaily, n.d.)
(b). Light sensitive diaphragms walls
Source: (قيبطتلا ةثادحو تركفلا ةلاصأ نيب ةيملاسلاا تراعملا فب ةيبرشملا Mashrabiya in Islamic Architecture between Idea Authenticity and Applying Novelty Abstract: 2018)

The facade also includes a metal screen with dynamic geometric motifs behind the glass wall, featuring 240 photo-sensitive, motor-controlled shutters. These shutters act as sophisticated sunscreens, adjusting automatically to control daylight and regulate interior temperature. This system reflects the Islamic architectural tradition of filtering natural light to create specific atmospheres.

Nouvel's reinterpretation of Mashrabiya integrates modern light control mechanisms while presenting a challenge: the extensive use of glass walls limits natural ventilation, requiring HVAC systems for cooling. This case study of the Arab World Institute highlights both the potential and limitations of modern adaptations of traditional elements, emphasizing the need to balance functional

and aesthetic considerations. Future advancements may lead to more innovative and sustainable reinterpretations of traditional architecture.

Masdar institute

Masdar City in Abu Dhabi, completed in 2015 by Foster + Partners, exemplifies the integration of traditional elements into contemporary sustainable architecture. This project balances technological advancements with cultural heritage, addressing the challenge of preserving cultural identity amidst modern architectural trends.

The Mashrabiya, a traditional Islamic architectural feature known for its natural cooling, privacy, and light control, inspired Masdar City's design. The project's self-shading facade, made of metal screening with rotating panels, modernizes the Mashrabiya's functionality. Figure 11 (a) shows Mashrabiya-inspired elements on the residential units' walls and balconies, reflecting both environmental and aesthetic goals. The geometric patterns on the facade, derived from Islamic motifs, enhance the interplay of light and shadow, merging tradition with sustainability. Masdar City's sustainability efforts go beyond aesthetics, incorporating both technological and traditional methods to reduce heat gain. Techniques such as terracotta cladding, air-filled wall panels, and metal screening play a role in this. The large spacing and rounded profiles of the metal screening resemble traditional Mashrabiya balusters, reinforcing cultural heritage. Figure 11 (b) shows the terracotta facade on the windows, while the use of palm wood and terracotta in balcony areas reflects traditional moisture control methods. These elements maintain cultural continuity and apply proven techniques for humidity regulation. Figure 11 (c) illustrates the apartment facade detail before installation.

Figure 11 (a). The Residential Units in Masdar City having Mashrabiya on the wall and balcony.

Source: (قيبطتلا ةثادحو تركفلا ةلاصأ نيب ةيملاسلاا ترامعلا بف ةيبرشملا Mashrabiya in Islamic Architecture between Idea Authenticity and Applying Novelty Abstract, 2018)

(b). Terracotta façade covering the windows.

Source: (قيبطتلا ةثادحو تركفلا ةلاصأ نيب ةيملاسلاا ترامعلا بف ةيبرشملا Mashrabiya in Islamic Architecture between Idea Authenticity and Applying Novelty Abstract: 2018)

(c). A detail of one apartment façade before fixing it to the building

Source: (Masdar Institute / Foster + Partners | ArchDaily, n.d.)

Masdar City stands as a testament to the potential of reinterpreting traditional elements for a sustainable future. The project successfully utilizes the Mashrabiya as a source of inspiration for environmental solutions, showcasing how cultural heritage and technological advancements can work in tandem to create a sustainable future for the Arab world.

Mashrabiya towers

The Mashrabiya Towers in Abu Dhabi, completed in 2012 by Aedas Architects, exemplify the modern reinterpretation of traditional elements in sustainable architecture as shown in figure 12 (a). The towers integrate cultural heritage with innovative technology to create an environmentally responsive landmark. Inspired by the Mashrabiya a traditional Islamic architectural element known for its natural cooling, privacy control, and light filtration the design captures its essence using contemporary materials and technologies to achieve a sustainable and visually striking facade. The Mashrabiya Towers' defining feature is their innovative facade, a modern take on the traditional Mashrabiya. The facade includes an automated shading system with 2,000 umbrella-like modules per tower, controlled by photovoltaic panels. These modules adjust their angles based on sun exposure, mimicking the Mashrabiya's function of providing shade and regulating light. Figure 12 (b) shows the opening sequence of the Mashrabiya Towers facade.

Figure 12 (a). Al Bahar Towers/ Mashrabiya Tower in Abu Dhabi, UAE
Source: (Abdelkader & Park, 2018)
(b). The Opening Sequence of Mashrabiya Towers Façade
*Source: (*قيبطتلا ةثادحو تركفلا ةلاصأ نيب ةيملاسلاا ةرامعلا فب ةيبرشملا *Mashrabiya in Islamic Architecture between Idea Authenticity and Applying Novelty Abstract:, 2018)*

The Mashrabiya Towers highlight the integration of sustainability and aesthetics. Their dynamic facade reduces heat gain, enhancing comfort and potentially lowering air conditioning needs. However, unlike traditional Mashrabiya, this design does not address humidity control. The towers also

provide a visually captivating experience: when closed, the folded umbrella modules mimic intricate Arabic patterns, while when extended, they reveal the building's modern mass. This blend of tradition and modernity creates a striking architectural statement. Figure 13 shows the responsive facade.

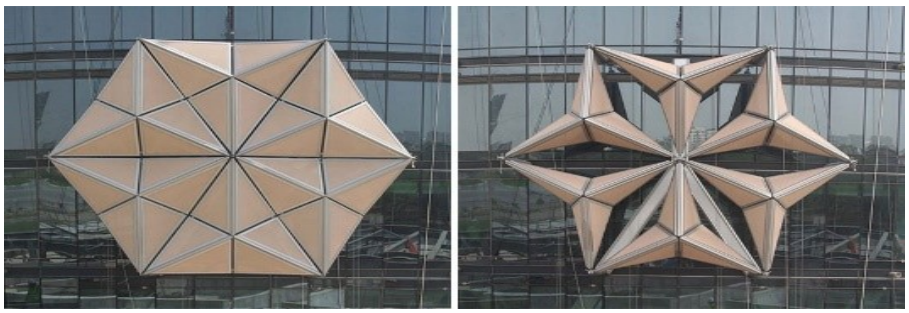


Figure 13. Umbrella Responsive Façade
Source: (Amrousi, 2017)

The Mashrabiya Towers offer an innovative approach to combining environmental and aesthetic considerations but come at a higher cost than traditional Mashrabiya designs. The project may still need air conditioning for optimal comfort. Despite the need for further exploration in areas like humidity control, the towers exemplify how modern technology can create responsive, visually compelling architecture while honoring cultural heritage. They serve as a significant example of how sustainable design can blend tradition with innovation, inspiring future advancements in the field.

IMPORTANT FINDINGS

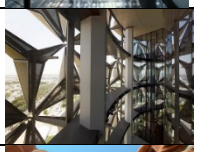
This study explores the evolution of Mashrabiya, a key element in Islamic architecture known for its versatility in decoration. Historically, Mashrabiya served both decorative and functional roles, adorning walls, windows, and ceilings with intricate patterns carved from wood or sandstone. It regulated light and ventilation, enhancing interior comfort in hot climates.

The study identifies a shift towards modern applications of Mashrabiya, where contemporary designers use new materials and techniques to create varied colors and forms. Mashrabiya now often functions as a structural component, forming double-skin facades or entire building envelopes, and visually expressing cultural identity. Additionally, modern Mashrabiya can incorporate kinetic mechanisms for dynamic control of light and airflow, improving environmental performance.

This exploration underscores Mashrabiya’s lasting significance, highlighting its transformation from a traditional decorative element to a dynamic, adaptable building component. It emphasizes the potential of

integrating traditional elements in innovative ways to achieve sustainable and culturally relevant architecture. Table 1 provides details about the case study buildings.

Table 1: Details about the buildings chosen for case studies.

Name	Location	Year	Construction	Material	Pattern	Picture
Suhaiymi house	Cairo, Egypt	1648	Adjacent to the wall & protruded With small delicate cubes, wooden balls, or rectangles and small squares connected by horizontal and vertical crossed wooden sticks	Timber	Square geometry grill Semi carved upper and lower panel linear seamless design and complex integration of floral nonperforated and geometrical perforated design.	
Rumah busu dolah tiada pendua	Melaka, Malaysia	1909	Adjacent to the wall structure Wall panels	Timber	Semi-carved floral motif and the perforated floral carved motifs.	
Arab world institution	Paris, France	1987	Adjacent wall structure A complete façade wall panel	Stainless Steel	The metallic screen unfolds with moving geometric motifs.	
Mashrabiya towers	Abu Dhabi UAE	2012	Umbrella-like modules Double skin façade	Stainless steel	Modules in the shape of an umbrella in the photovoltaic panels-controlled tower.	
Masdar institute	Abu Dhabi UAE	2015	Adjacent to the wall and balcony	Brick	Geometrical porous stars.	

Design strategies.

The discussed projects highlight the ongoing interplay between tradition and innovation in architecture. Islamic architecture is characterized by its emphasis on geometric patterns, symmetry, and the integration of natural elements to create harmonious and functional spaces (Baydoun et al., 2024). Islamic art often incorporates sustainable principles by using locally sourced materials and designs that promote durability and environmental harmony. (Baydoun et al., 2023). Analysing these projects provides insights into design strategies that balance sustainability with cultural identity.

The Mashrabiya Towers demonstrate advanced technology for sustainable design, with a dynamic facade managing heat gain effectively.

However, such solutions may sometimes lack distinct architectural identity. In contrast, the Sofitel and Mashrabiya House showcase a neo-traditional approach, incorporating Mashrabiya elements into modern designs to maintain local identity while ensuring sustainability. The Sofitel uses Mashrabiya screens, and the Mashrabiya House features a reimagined stone facade, both enhancing cultural heritage.

These projects suggest Mashrabiya's potential in hotel design globally, offering functionality in light control, ventilation, and privacy while allowing for modern reinterpretations. Modern Mashrabiya serves as a model for integrating traditional elements into contemporary, sustainable architecture. By adapting these strategies, architects can create buildings that are innovative, culturally relevant, and aesthetically pleasing. Figure 14 shows an organizational diagram of sustainability movements in hotel design.

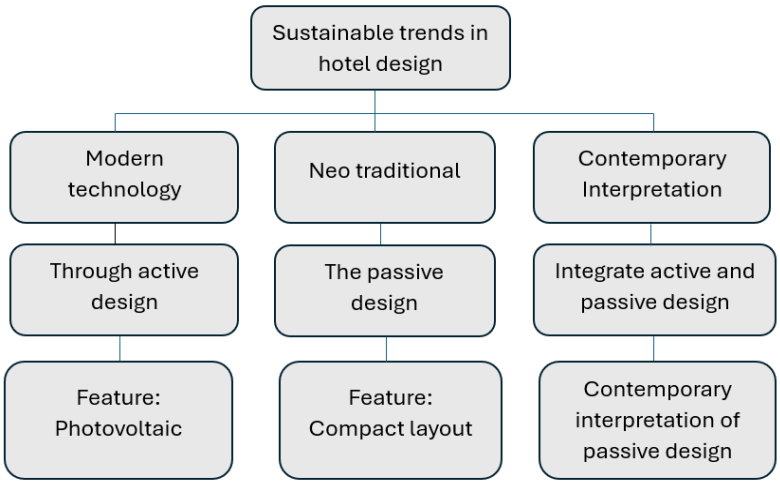


Figure 14. An organizational diagram of the sustainability movements in hotel design.

Aesthetic principles used in Masrabiya

Mashrabiya and windows are central to Islamic architecture, combining functionality with a distinctive aesthetic. This study explores their design principles, rooted in Islamic art's emphasis on unity and abstraction. The intricate geometric patterns of Mashrabiya, derived from simplified forms, reflect this focus on essential forms and harmony. The prohibition against depicting living organisms led to innovative decorative patterns, with geometric and abstract motifs often appearing as silhouettes when backlit. The principle of "horror vacui" is evident in the meticulous filling of surfaces with decorative elements, creating a visually captivating experience through intricate latticework and dynamic light and shadow interplay. Additionally, the manipulation of light

through the lattice enhances the visual complexity, while the principle of "ijtihad" fosters innovation with diverse geometric shapes and patterns. Together, these elements make Mashrabiya and windows not just functional but also a testament to the rich aesthetic values of Islamic art, continuing to inspire modern architecture.

CONCLUSION

This research highlights Mashrabiya's enduring appeal and its potential as a sustainable solution for contemporary architecture. By examining its functionality, the study shows how Mashrabiya provides natural cooling, controls light penetration, and enhances air circulation, reducing the need for mechanical air conditioning and contributing to energy efficiency. Particularly relevant for public buildings like hotels, Mashrabiya not only improves comfort and reduces energy consumption but also enriches the guest experience with its cultural aesthetic. The research, which includes six case studies of both traditional and modern Mashrabiya, provides valuable insights into optimizing design, selecting sustainable materials, and integrating cultural heritage into modern applications. Modern Mashrabiya designs, including double-skin facades, offer significant energy savings and improved building performance. Overall, Mashrabiya's evolution from historical to modern iterations demonstrates its continued relevance and potential for creating sustainable and culturally enriched environments.

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