

# The Evolving Transformation of Mashrabiya as a Traditional Middle Eastern Architecture Element

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**Abstract---** Buildings' facade is considered as the skin and the main component which covers the building and the only that has a direct contact with the outer climate. Not only the façade is considered as a building's cover component, but also it can be used as a sustainable technique for energy saving in present day architecture. Approaching the 21st century, the world has witnessed a dramatical change regarding architecture. New architecture expressions were introduced to face environment global issues. Mashrabiya which was known as a wooden window screen largely tends to be a cultural expression of form and solve environmental issues especially in hot arid climate, was reshaped and reintroduced in a different form to keep up with the modern technologies. Also, Mashrabiya didn't become limited to cover openings and windows, but also covering the entire façade of the building. Consequently, this study will explore Mashrabiya system as a traditional façade system in middle eastern countries and present the historical background of Mashrabiya as an architecture device in hot climate countries, as well as its changes throughout the history and looks at the potential application of this device within the contemporary context of the architecture. Besides, analyzing the gap between traditional and modern Mashrabiya through analyzing different case studies.

**Index Term---** Building façade, environment, Mashrabiya, Middle east, Traditional, Rawshan.

## I. INTRODUCTION

There is a complex relationship between the climate and architecture. Every region has its own climatic characteristics that affect directly on its architecture making a unique cultural identity. Mediterranean basin, has an extreme weather condition that required special solutions to overcome these conditions. The climate is characterized by hot, dry weather resulting from the fact that desert is located in many parts of the area which had a big influence particularly in the Arab culture as well as its architecture. The climatic conditions of these areas have determined specific techniques that acquired innovative passive solutions to overcome such climate problems and achieving thermal comfort. In the ancient times, structures were designed to tackle the natural conditions and provide indoor thermal comfort without relying on mechanized systems [1].

Mashrabiya screens were particularly suitable to middle eastern countries, where the dry hot weather is dominant. It was first introduced as a traditional way to cover openings and windows for social and climatic reasons creating a thermal comfort effect inside the space especially for middle

eastern countries that suffer from hot weather climate, later it became a cultural component that reflects special eras through history and an icon which provides local identity for each country. The Mashrabiya is a lattice screen that was used within Middle Eastern desert architecture to regulate light, heat, airflow, humidity and privacy. It was a highly-prized feature in these countries, not only because of its extraordinary versatility and effectiveness at controlling the climate but also because of its delicacy and beauty [2].

## II. HISTORICAL AND ENVIRONMENTAL BACKGROUND OF MASHRABIYA

Mashrabiya which was introduced in the middle east area, came from an Arabic word "*Sharab*" which literally means "To drink", the reason why was that at the first, Mashrabiya was referred to the place where one can drink water from a clay pot, later on, it was gradually developed to be a cooling object, that combines wooden lattice panels with accommodating clay pot in order to keep the water cool. Yet, another theory claimed that the term Mashrabiya was derived from the word "*Mashrafiya*" which means "To observe" in Arabic as people can see through it, though there is no certain evident to prove how the term Mashrabiya was originally derived from (fig.1). *Loredana Ficarelli* discussed that Mashrabiya corresponded to the small objects in half-light used as the basis of support for the small jars, as they needed to stay cool. He further explained that Mashrabiya was a kind of balcony that was composed of small wooden elements assembled to create a grid. Across the centuries, the term has been extended for the large wooden panels made with this technique [3].

Mashrabiya is also known under different terms according to various regions. For instance, it is known as Mashrabiya in Egypt and North Africa, *Rawshan* which is a common in the kingdom of Hejaz "Saudi Arabia" and that term derived from the Persian word "*Rawzan*" which means window. Also, it is known for "*Shanashi*" in Iraq and "*Kushk*", Turkish term which means pavilion, in Turkey and Syria.

Mashrabiya was a feature cooling middle eastern element which suited and was widely applied in middle eastern tradition houses for the reason that it deals perfectly with the extreme heat as a dominant climatic condition which was not the case in western countries. Not only the environment was the main reason why Mashrabiya spread in the middle eastern area, but also middle eastern social values

acquired specific considerations that reflected its culture which was deeply influenced by Islamic distinctive values such like privacy which was not emphasized in the western culture. Therefore, Mashrabiya had provided an effective way that adapted both environmental and social issues in middle eastern area.

Mashrabiya fulfilled ethical issues and prevented looking at the sanctuaries of others. That principle was emphasized by Islamic teachings which assured privacy between neighbors within the neighborhood and isolation between genders within the same house. That caused Mashrabiya to be rapidly spread in many Islamic areas, which adopted the same thoughts, though its forms differed and varied from one region to another. Traditional Mashrabiya was found in Asia in Afghanistan, Pakistan, Iran Passing by Middle east region and north Africa reaching Spain “Andalusia”, and later its concept inspired westerns to modify it in a different form (fig.2).

Researchers tried to identify and locate Mashrabiya origins, however, there is no definite evidence to pinpoint when the Mashrabiya was first invented. What is certain is that its development and optimization was a process that occurred over many hundreds of years. However, it's unclear when exactly the development of Mashrabiya started, in some regions, Mashrabiya faced several changes over the centuries. For example, in Egypt there are few examples of Mashrabiya in Abbasiya period that dated back to early 12th century, afterward, it was flourished during the Fatimid Period and achieved its mastering period in Mamluk and Ottoman era. Also, Mashrabiya was first applied to palaces and residential houses, later on, it became a featured element that can be seen in different function buildings such like, mosques where it was used as a barrier between women and men's zone, schools, hospitals, government and commercial buildings.

### III. COMPONENTS AND FUNCTION CONSIDERATION OF TRADITIONAL MASHRABIYA

According to *Hassan Fathy* (Egyptian architect), Mashrabiya has five functions, different patterns have been developed to satisfy a variety of conditions that require emphasis on one or more of these functions. These functions involve 1- controlling the passage of light, 2- controlling the air flow, 3- reducing the temperature of the air current, 4- increasing the humidity of the air current, 5- ensuring privacy.

Islamic architecture was characterized mainly with preserving privacy, that issue was effectively solved by Mashrabiya. Mashrabiya screen is considered as a device that separates between private and public spaces visually. In a social aspect, it used to cover openings, as its design concept based on protecting privacy by blocking the vision and preventing neighbors or the passerby in the street from looking through what beyond the Mashrabiya screen. In the same time, it didn't deprive the occupants from looking outside, as it allowed house owners to look at the street without being

observed by strangers. Vision through the wooden ornaments makes it impossible for those who are stepping in a far distance to observe the vision from behind. If communication is required, smaller window (fig.3. a.) that can be opened upwards was installed in some cases. Also, it provided privacy in another scale inside the house. As gender segregation and veiling is a core value of the Islamic religion, women quarter “*Haramlak*” was mainly covered with Mashrabiya which overlooked the courtyard, and that was to the same purpose to ensure privacy for women not to be observed by strange visitors. Additionally, for the other type of colored glass embedded Mashrabiya, it increased the light distribution which makes it impossible to be observed from the other side. In the meanwhile, through its ornamental latticework, it provided shade inside the house protecting from the sun without closing the window, so that it permitted wind breeze to enter and assured constant air flow to mitigate hot temperature in summer. Also, Mashrabiya's fine wood used to absorb the humidity from the air which served as an air conditioner beside cooling the water in the clay pot.

The expression of the “Mashrabiya” changed a lot over time and took different forms, the most popular of which is the protruding bay window fitted with timber panels composed of lathe fashioned wooden balusters creating an overall pattern of lattice work arranged at specific regular intervals, with various geometric designs [4]. In many cases, Mashrabiya was protruded from the exterior facade to the street or internally to the inner courtyard which was the core of house at that time in order to increase the floor area in upper floors. The outer part was more commonly shaped as a rectangular or semi-cylindrical closed balcony based and fixed by cantilever brackets made by thicker wood or stone. That exposure had another indirect function which creates a shade for passerby in the street and sometimes protects from rain and direct sun radiation being functioned as a shelter (fig.4).

To provide airflow into a room, a Mashrabiya with large interstices will ensure as much open area in the lattice as possible. Where sunlight considerations require small interstices and thus sufficient airflow is not provided, an open, large-interstice pattern can be used in the upper part of the Mashrabiya near the overhang. For this reason, a typical Mashrabiya is composed of two parts: a lower section with fine balusters in close mesh, and an upper section filled with a wide mesh grill of turned wood in a pattern called *Sahrigi* [5] (fig.3.b). There are many types of Mashrabiya including closed and opened ones. Open Mashrabiya overlooked the streets or courtyard. Wooden ornaments allowed light and air flow to enter the house. In some cases, closed Mashrabiya was embodied with colorful glass and was opened partially through a vertical window.

Also, there are various kinds of Mashrabiya, which vary in appearance that arose from the taste of the client and the skills of the craftsmen. Their sizes also depend on the size of the opening, which is mainly influenced by the type of

climate. it can be classified into three kinds: cantilevered, screen panels, louvered timber walls, and louvered windows [6].

Mashrabiya was made by local material reflecting each region's nature, in most of the cases, it was made of wood, while in Yemen early Mashrabiya was made by stone. Also, in some cases, it was made by gypsum clay if there is a shortage of wood. The shape of Mashrabiya didn't differ largely from *Rawshan* except having different patterns that reflect and emphasize each region's identity, in the meanwhile, its components and functions are the same. As the use of figural shapes is forbidden in Islamic ornamentation, Muslims learned to use geometrical and abstract floral patterns. Not only did Muslims produce intelligent and complex mathematically-based ornamentation, they encoded it with meaning according to religious design guidelines [7]. For example, unity principle has been shown in most of the ornaments through unifying unites. This principle was taken from the main concept of Islam of unifying gods into one god. Some units are coordinated and organized together then unified into a whole big module.

#### IV. RENOVATING THE TRADITIONAL MASHRABIYA

Mashrabiya, however, was an efficient solution to solve old times environmental issues, it inclined and proved its inefficiency in modern times. One problem of traditional Mashrabiya is its high cost expense which is represented in high manufacturing and maintaining cost. The prohibitive cost of traditional Mashrabiya owes to the time intensive skilled labor required to assemble one. For instance, in the most intricate Mashrabiya, a single square yard of latticework can be composed of as many as 2000 pieces [8]. Also, Mashrabiya has the ability to catch fire rapidly because of its material which was made of wood. Along with its social problems of providing high level of privacy which became no longer an essential requirement recently, made Mashrabiya not to become the first solution to cover buildings facades in modern times.

Consequently, Mashrabiya experienced a noticeable development revolution regarding its shape, components, and materials that embraced it in a unique way throughout the history. Mashrabiya which is considered as an Islamic fundamental unit by which architects innovated creating a distinct design, didn't stand steady only as a passive element but have taken a dramatic approach to address contemporary issues. Unlike Traditional Mashrabiya which optimized static skin system that enabled passive cooling to spaces through natural ventilation, modern Mashrabiya came to cover large spaces in term of scale and particularly high rise buildings which are fully glazed to provide a sense of light and luxury for the building. Nowadays high-rise glazed towers have become the dominant architectural typology for new buildings in Middle-East countries. However, quite obviously, this kind of building is often unsuitable for the arid and desert climates

that characterize these countries, as the annual high solar radiation can transform the building into a greenhouse with major visual and thermal discomfort issues [9]. Such buildings acquire an efficient solution to avoid the high expenses of energy consumption which led researchers to promote several experimentations to integrate a culture-based element into the modern architecture within the form of environmental control.

Creating efficient buildings is a challenge that faces architects nowadays. However, recent developments in computer-aided design programs and digital fabrication have enabled architects to explore new building forms and new treatments of envelopes, in an attempt to solve architectural design problems [10]. Since the 20th century, many architects have attempted to synthesize traditional Arabic elements into a modern design that is evocative of the architecture of the Middle East particularly in large buildings in arid climates, with complex thermal and visual requirements. The use of Mashrabiya as substitutes for all-glass facades in the Middle East seems strongly supported by modern examples. It should be noted that while there will be several examples of the adoption of the Mashrabiya within double-skin construction, the focus here will primarily be on the way in which the Mashrabiya can be integrated within various advanced facade systems [11].

#### A. *The Arab World Institute (Institut du monde Arabe)- Paris, France, 1987.*

A prime example of the modern adaptation of the Mashrabiya is in the case of The Arab World Institute which is designed by the architect *Jean Nouvel* and located in the central part of Paris, France. The institution shows a masterpiece of the design of a contemporary building reflecting Arab traditional culture. The building particularly hosted many exhibitions to boost the relationship with the Arab world through promoting culture exchange in many fields such as arts, science, technologies. The building, however, was not the first building to adapt kinetic facades concept, but it contributed a traditional element which resembled Mashrabiya with latest modern technology to come up with an innovative idea (fig.5). Mashrabiya concept was embedded in the southern and northern façade of the building that corresponded to the out surroundings environmentally.

The principal facade of the southern wing is considered as a huge screen that was made of 240 of Islamic geometric-inspired rectangular metal grids which acted as sun shading devices. The façade consisted of photosensitive shutters, each one simulated as a dynamic camera's lens which automatically opens or closes responding to the increasing and decreasing of the sunshine (fig.6). The different scale of the façade's apertures optimized sun rays' penetration into the building and allowed light to pass through internal spaces. While the lens is closed or opened, through this progress, different geometric patterns are formed in circle, square or

octagonal geometries which resembled Islamic patterns. Consequently, interior spaces are modified depending on the moving geometric motifs which created spaces with filtered light that assured comfort for occupants beside providing privacy which was the main feature of the Mashrabiya. The sensors are based on dynamic weather inputs to reduce energy demands but only when necessary so that visual demands are also met. The area of the façade is divided into several sensor readings: the movement within each square is a contraction and expansion of material influenced by climate while each bay is individually controlled by the occupants. The overall composition and design allows a rich playful façade [13].

The legacy of that innovative Mashrabiya is that it was one of the first that synthesized both technology with culture which makes the building significant. It also looked for the potential for a dynamic responsive facade to contribute to the performance of a building. The façade engaged users to interact with the dynamic Mashrabiya screen. The new design of Mashrabiya was innovative, However, the responsive façade system no longer works and previously was criticized being too noisy and unresponsive sometimes. Another criticism to be said for the responsive façade was that the maintenance aspect wasn't considered in designing process. Some of the shutters were damaged causing apertures to be blocked and it is too expensive and hard to be maintained. while acknowledging that the institute was not successful in all aspects of its design, it's considered as one of the innovative cultural oriented design.

#### B. Doha Tower, Qatar, 2012

Another case study which was designed by the same architect *Jean Nouvel* and integrated Mashrabiya as a traditional middle eastern element was Doha tower. Doha tower which is a skyscraper building located in Qatar attempted to deal with the consistent issue of such a hot arid climate in a middle eastern country. Doha tower is an office building that has a large surface of glass on its façade to reflect luxurious appearance acquires an innovative solution to balance the amount of energy needed to maintain indoor thermal comfort, especially in such a hot climate region.

The tower is characterized by its cylindrical façade design that reflects the local culture through recalling Mashrabiya screens as a traditional architectural element. the outer face included several aluminum panel layers involving one single butterfly shaped geometric pattern that was repeated and gathered to form the whole pattern. These layers were varied in scale and overlaid making different densities along the façade (fig.7). The density was made in purpose not only for an aesthetical aspect, but also it was made to be in respond to the sun orientation to avoid sun transmission by the fracturing light within every layer and protect occupants from high temperatures. The density was varied along the façade as 25% opacity covered the north, 40% in the south and 60% on

the east and west. Behind the shading layer system, a glazed curtain wall was installed for the same purpose of the aluminum panels to enhance thermal comfort beside protecting from the dust. The double façade system provided energy benefits due to the practical use of the technological and new environmental systems particularly which has a big impact in hot climate regions. Another innovation can be seen by installing LEED integrated lighting system in each floor to enhances the delicate screen making a marvelous view of the tower and the traditional façade at night. The double skin of the building had a 2meter accessible gap for maintenance. Additionally, that gap made the stack effect whereby warm air rises within the building and cools the surface of the glass. The overall façade system was estimated to reduce cooling loads by 20% providing efficient energy saving air conditioning system.

#### C. Al Bahar Towers, Abu Dhabi, UAE

However, the idea of a moving-culture oriented façade was first attempted at the Institut du Monde Arabe in Paris, it has fascinated architects but has never been delivered on any large scale. Al Bahr Towers Is a set of separated twin towers which state to be a landmark in Abu Dhabi, Emirates, represented the first time this technology which has been successfully used on this scale and opens up an exciting new direction in building design. The towers are covered by the Mashrabiya cladding system on the south, west and east elevations. North façade was designed without installing the shading device as solar heat reaches its minimum in north orientation. The tower intelligent façade served as a shell protecting from the sun beside reducing heat gain which caused to reduce energy consumption and higher building efficiency. The Mashrabiya at Al-Bahar towers is comprised of a series of semi-transparent umbrella-like components that open and close in response to the sun's path (fig.8). Each of the two towers includes over 1,000 individual shading devices that are controlled via the building management system to create an intelligent second façade [16].

According to Aedas Architects, that system consisted of a series of semi-transparent PTFE (polytetrafluoroethylene) panels fold and unfold in response to sun orientation provide self-shading for internal spaces beside reducing solar gain by up to 50%. It is estimated that the design resulted in a 40% saving in carbon emissions from the tower beside reduces cooling loads by 25% and between 20-50% reductions in solar heat gain compared with other traditional curtain wall buildings. These shading devices were controlled through the building management system to reduce the need for artificial lighting and replace it by natural lightning in most of the time, besides reducing the usage of mechanical air conditioning which provided a sustainable solution for the energy consumption as well as provide comfort for users. In that case study, Mashrabiya façade system suggested an efficient

solution to the climatic condition of a middle eastern country beside improving the environmental performance through utilizing modern technology to meet higher standards of energy efficiency. Al Bahr Towers fused the principles of vernacular architecture through integrating Mashrabiya-geometry derived from Islamic composition into a total responsive façade system, and performance through using parametric and algorithmic computer studies to come up with an efficient energy integrating system.

#### V. CONCLUSION

Mashrabiya as one of the traditional vocabularies in the middle eastern area proved an aesthetic aspect and efficient functionality in old times. However, as a clear pattern, traditional Mashrabiya's declination can be seen clearly over the time in middle eastern countries for several reasons. First, it didn't show an efficient solution in modern times and second, because of the globalization and western thoughts invasion which led to imitate western architecture and lose each regions' particular identity.

Along time ago, our ancestors found many architectural solutions, however, these solutions are not developed and no longer applicable to the contemporary changes and new environment challenges. Hence, a new approach in architecture has arisen to renovate traditional installations and contribute them with today's technique. Now reviving traditional architecture is facing enormous challenges which require to set visions for future architecture and make plans aims to preserve local identities.

In this paper, different case studies were explained to show optimistic solutions to the future of reviving traditional architecture within a contemporary context focusing on Mashrabiya as being a symbol of Islamic and middle eastern heritage. These examples explored the possibilities to improve the performance and combine a contemporary solution to the traditional philosophy of specific elements. We can found that there is an increasing desire to find ways to revive traditional architecture and recalling national's identity. To do that, architects have to think innovatively how to balance the increasingly globalized issues within a sense of respecting the cultural, social and environmental nature of the region. With the technology of 21st century, it became easier and more efficient to form buildings which have a sense of Continuation with the past.

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Fig. 1. Left: a woman observes the street through Mashrabiya. Right: Mashrabiya screens in old Cairo, Egypt. [Source: Online]

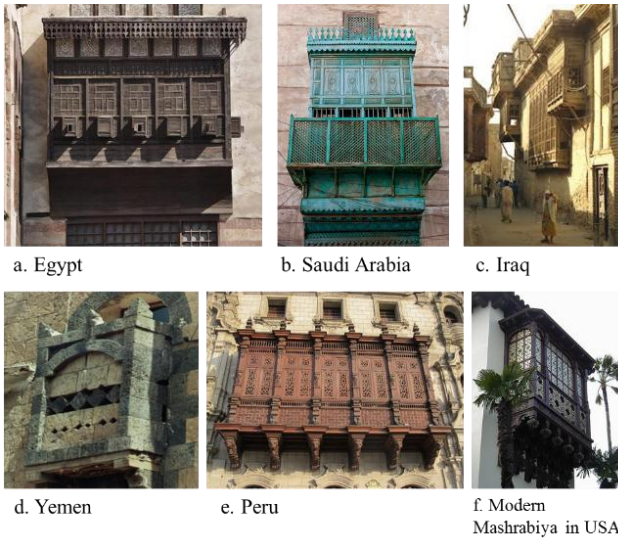


Fig. 2. Mashrabiya in different regions. [Source: Online]

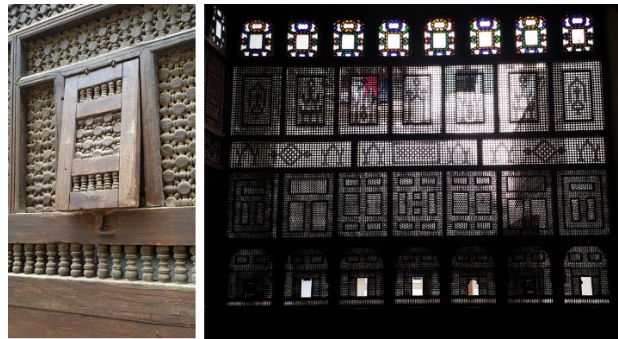


Fig. 3 a. Left b. Right. Mashrabiya at Bayt Al-Suhaymi. [Source: Author]

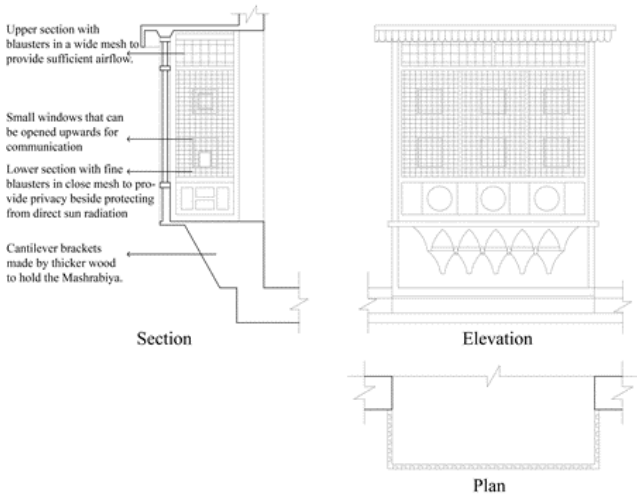


Fig. 4. Traditional Mashrabiya details. [Source: Author]

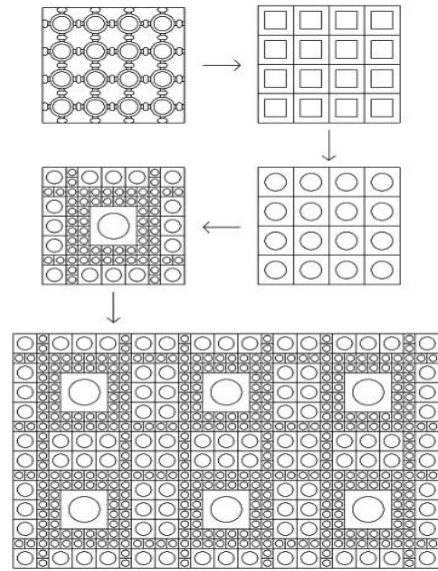


Fig. 5. Traditional Mashrabiya's pattern development in The Arab World Institute. [Source: Author]

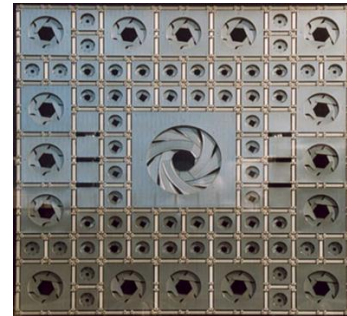


Fig. 6. Photosensitive shutters close responding to the increasing of the sunshine in The Arab World Institute. [12]

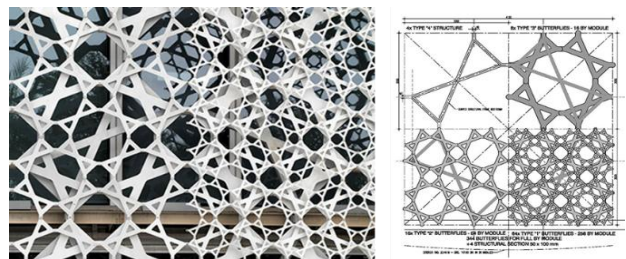


Fig. 7. Different densities of the geometric pattern along Doha tower's façade. [14]

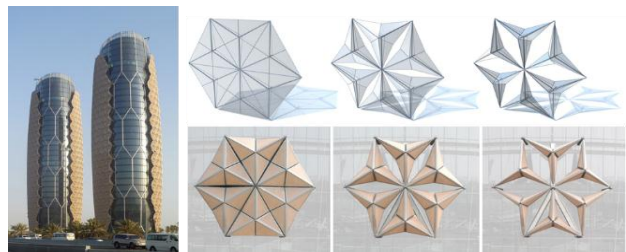


Fig. 8. Comparisons of shading units, fully closed on the left to a fully opened one on the right at Al-Bahar towers. [15]