Spatial Principles of Traditional Cairene Courtyard Houses in Cairo

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Abstract
Architectural identity reflects the characteristics of a country's people, environment, and society. Owing to recent globalization, the unique architectural identity of countries has faded so that it has become difficult to identify each country's unique local and regional identity. In particular, traditional houses in Cairo, which are known as Cairene houses, are considered an iconic style of the city's architectural history. Cairo has a unique local identity as well as spatial quality mainly found in the region. On the other hand, many of the values and qualities of the houses have been disappearing due to western influences. The objectives of this paper are threefold. First, the Egyptian cultural and environmental influences on Egyptian housing designs are discussed. Second, the spatial composition of traditional Cairene courtyard houses is analyzed. Finally, the underlying principles of spatial compositions are extracted to explain the unique spatial characteristics of the houses. Through the analysis, the distinct spatial quality of traditional Cairene courtyard houses in Cairo will be analyzed, revealing their identity and values.

Keywords: Egypt; Islamic; Cairene; courtyard; principles

1. Introduction

Egypt's cultural richness, multi-layered history, and its unique geographical position between three continents (Asia, Europe, and Africa) have afforded many opportunities for the emergence of several architectural trends and movements. Nevertheless, contemporary architecture in Egypt lacks local and regional identity, even though unique traditional, social, local, regional, and environmental characteristics in Egyptian architecture have existed throughout history.

In the past few decades, there have been radical shifts in architectural practices in Egypt, which are dramatically changing the public face of Egyptian architecture (Salama, 1999). Some attempts have been made to revive traditional architecture by simply copying the outer decorative facades. For example, cornices are used on the openings, arcs are used repetitively and even minarets are used on apartment corners. Obviously, these attempts are futile because this approach conveys no meaning. Without demonstrating the connotation of its unique architectural values, it is nothing but a distortion of the idea of reviving the traditional architecture.

Egyptian traditional architecture considers mainly the conditions of the surrounding environment and aims to harmonize buildings with the surroundings using local and available materials. Through these types of buildings, the local characteristics are highlighted to fulfill various socio-cultural needs. Among other residential buildings, traditional Cairene courtyard houses best represent the traditional styles and unique values in Egypt.

Although there have been many studies of the historical, stylistic, socio-cultural and even ecological aspects of houses, there has been little emphasis placed on the formal and spatial compositions (Behrens-Abouseif, 1989; Chowdhury, 1993; Salama, 2006; Mohamed, 2010). Thus, it is significant to expose the underlying spatial logics that structure traditional houses and buildings. Although their styles slightly differ, the houses share similar design principles. (Konig and Eizenberg, 1981; Stiny and Mitchell, 1978; Park, 2018) Therefore, this paper attempts to delineate the distinctive characteristics that form unique Cairene courtyard houses and reveal their underlying principles of spatial composition.

2. Cultural and Environmental Influences on Egyptian Houses

Traditional Cairene courtyard houses in Cairo are influenced by a wide range of secular, social, and religious factors. They contribute to the creation of architectural spaces that realize the mental and physical comfort of users while complementing the surrounding environment. The traditional architecture of the Islamic
eras also afforded great solutions and respected Egypt's climatic conditions. Islamic architectural details adapt to changes in time and location. Evidently, several Islamic elements have been used repeatedly in buildings as one of the main principles. This approach gives unique characteristics that are different from other architectural styles. These repetitions can also be seen in the ornaments, such as windows, doors, vaults, and columns, in Egyptian architecture.

In addition, several socio-cultural as well as religious issues influence the spatial arrangements within Egyptian houses. In this, privacy is a significant factor in shaping the houses (Othman, Aird, and Buys, 2015). The designs of traditional houses depend mainly on the idea of separation between inside and outside, the residents and the passer-by in the street or the surrounding neighbors. In addition, women and men from the same family need to be separated from each other after reaching adult age due to Islamic traditions. This leads to the allocation of separated men and women suites inside the house. Here, the courtyard plays a significant role within these houses; it is large enough to offer some visual privacy among family members within the internal home. Entering the courtyard, the internal spaces of the houses are separated further by stairs, corridors, and circulations to ensure privacy. As it is the most important space opened to the sky and exposed to the natural environment with a small garden or fountain in the middle, it provides natural light and fresh air.

Environmental aspects also affect Egyptian traditional houses. Egypt is characterized by a distinctly desert climate, a hot dry climatic zone, very little rainfall with strong sunlight owing to the geographical position in the North African large desert tropical strip. This leads the Egyptian traditional architecture to adapt to these tough climatic conditions. Accordingly, specific techniques of passive climate control have been favored toward better thermal comfort inside houses by ensuring light and ventilation (Ficarelli, 2009). Although the houses form a relatively closed arrangement from the outside, the courtyard provides a secluded yet open retreat for residents at any time of day.

3. Traditional Cairene Courtyard Houses in Cairo

Each culture needs to have its own unique spatial organization of houses. The design concept of traditional houses can be traced, in which forms and spaces are dictated by habits and traditions. The heritage of traditional Egyptian houses includes various forms that were developed in response to religious, cultural, and social factors along with the specificity of the local built environment.

Among others, Cairene houses have been the main traditional residential architecture in Cairo since the late Mamluk period (1259-1517) and throughout the Ottoman period (1517-1805). At that time, Egyptian architecture was influenced by Islamic architecture, while serving its climatic conditions (Mohamed, 2014). Up to now, a few traditional Cairene courtyard houses constructed during this time still exist in historic Cairo. These houses consist of a number of floors that do not exceed three or four. These are constructed from local materials, such as stone, brick walls or mud.

In particular, the spatial organization of Cairene houses is influenced directly by Islamic principles. In addition, some architectural elements are derived as a response to the distinctive climatic conditions of Egypt. These are distinctive so that it forms a new style that is different from the Islamic architecture in other countries. Although there are differences in scale due to the household status as well as its types, from palaces and houses to collective housing units, the fundamental idea of a private residence in Egypt is consistent.

Although tens of these houses still remain, only a few remain in good condition. In this study, nine different Cairene courtyard houses in Cairo from the 14th to the 18th century were selected for analysis. Their floor plans and photographs were collected, and each of the floor plans was read and redrawn to investigate their spatial relations in depth.

3.1 Courtyard

In Egyptian traditional Cairene houses, the courtyard is considered the main compositional core so that designing the house always starts from the courtyard. The courtyard is mostly open to the sky and other rooms surround it according to cultural and environmental factors.

The shape of the courtyard is formed mainly from the inside to outside according to functional needs. In
In many cases, the orientation of the courtyard's walls depends on that of the street outside and/or the shape of the plot. In other cases, the orientation prevails over other variables, and a very irregular site surrounds a square courtyard oriented to the cardinal points (Reynolds, 2002: 9). The courtyard is generally not paved, and might have a well, fountain or trees, and in most cases has a rectangular shape. In a few cases, however, it has an irregular shape (Fig.1.). Unlike courtyards in other Arabic-Islamic countries, the Cairene courtyard is considered mainly not as a social gathering place or a reception area but as a semi-private place for the inhabitants and visitors.

More importantly, the courtyard is a means of ventilation, natural lighting, and communication between various quarters of the house (Behrens-Abouseif, 1989). The courtyard is visually and acoustically separated from the outside, which provides privacy for the residents. Once one enters the courtyard, it provides controlled access to the residents and their guests.

The courtyard works to mitigate the hot weather, and also stores cool air at night to avoid the daytime hot weather and provides natural light and ventilation. In some cases, it contains trees, plants, and fountains to purify the air and give psychological comfort with minimized openings in the inner courtyard. In addition, the floor level of the courtyard is lower than the surroundings because cool air is heavier than warm air so that it remains in the court.

The courtyard is accessed from the entrance through indirect corridors called Magaz (refracted entrance). This is an indirect corridor that leads to the inner open courtyard and is designed to open into a blank wall and form one or two turnings to provide privacy for the residence so that the people outside on the road are unable to see those who are inside (Fig.2.). The courtyard also provides protection from dust and noise; it also lets cool air enter the house. In some houses, there could be another hidden door that leads to corridors then to an emergency exit. Entrances generally open onto secondary streets to avoid noise and direct contact with the main street and its activities.

The semi opened places, such as Takhtabush and Maqad as sitting places, are located close to the courtyard. The Takhtabush can be located between the courtyard and the backyard on the ground floor to ensure airflow (Fig.3.). This is a covered area dedicated to receiving visitors especially in summer. It opens completely to the courtyard, and to the backyard through a Mashrabiya to ensure the steady flow of air by convection (Fathy, 1986). On the other hand, in other cases, such as the Sennari House, the Takhtabush is not located close to the backyard. The backyard is accessible from inside the house. Because the backyard is typically larger and thus less shaded than the courtyard, the air heats up more than in the courtyard. The heated air rising in the backyard draws cool air from the courtyard through the Takhtabush, forming a steady cool breeze (Mohamed, 2010).

3.2 Adjacent Rooms

Egyptian traditional houses are divided mainly into three zones: One on the first floor, which is allocated for reception halls and used by men, called Salamlik. The other is on the second floor and called Haramlik which is allocated to women and used in daily life. Away from Salamlik and Haramlik, there are also utility and service rooms on the first floor.

Typically, the first floor contains reception halls to host visitors; they sometimes hold festivals or main events in the house. These reception halls overlook
the inner courtyard through openings that are covered mostly by Mashrabiya (wooden lattice panel). According to Egyptian social traditions, the men's room is located on the first floor. This enables visitors to pass by them first to obtain permission to enter the house or to stay in the reception hall. This also avoids visual contact with the women on the second floor. Regarding this behavior, in some cases, another secondary reception hall exists on the first floor to host visitors. This is located beside the main entrance Magaz so that visitors can have a rest first before going to the main reception hall.

On the second floor, a Haramlik, the main sitting area for women, is located to avoid direct and indirect contact with the visitors' circulation on the first floor. This has a separate entrance from the main one. The entrance is used only by women, and is another way to maintain privacy for women. This room also contains a Mashrabiya, which is a projecting oriel window, which allows overlooking of the inner courtyard and street. By covering the window with Mashrabiya, the windows and openings can be as high as possible to avoid being observed by a passerby in the street or neighbors. A Haramlik is attached to one or more wings, where each has its own living room, sleeping room, and bathrooms. The number of sleeping rooms varies according to the owner's socio-economic status. These are found on upper floors away from the reception halls to prevent any connection with the visitors' area and are almost entirely closed to protect from the heat outside.

In the same concept of the Takhtabush on the first floor, a sitting area called the Maqad is added to the second floor beside the Haramlik. The Maqad is an arched loggia that overlooks the courtyard; it also exists in the south part of the house to face the prevailing breezes from the north and can be reached through stairs coming from the main courtyard. In addition, for more thermal comfort, the upper floors are exposed to the outside through windows to add shadows to the facades and reduce heat.

In relatively larger residences, Salamlık and Haramlik as a reception hall for men and women are comprised separately of a wide hall divided into two sitting areas with a high ceiling, called the Iwan and Dorqaa. The former serves to receive the owner's guests and the latter is located in the middle of the hall. While the level of the Dorqaa is slightly lower than the Iwan, it has a Shokhshekha (dome-shaped skylight) in the ceiling to provide light and thermal comfort. This is also filled with marble, and in some cases, it contains a fountain in the middle. The Dorqaa is considered another type of courtyard that is not the center of daily life but could be a secondary social space that plays the role of a lounge. In these houses, the bathroom is divided into three sections, the toilet, massage room, and dressing room.

Although the general principles are applied in the spatial composition of the houses, there are some variations depending on the size of each house. For example, as shown in the Shabshiri House, the Salamlık is located at the second level and the Haramlik is on the third level, whereas with Takhtabush and Magaz, storerooms are located around the courtyard because these houses are too small to have a Salamlık on the first floor.

In some Cairene houses, other rooms, such as Sabil and Sandala, have specific functions. In the Al-kretlia house, the Sabil is located for the public to offer fresh water. The Sabil is considered to be a religious structure that is added to a mosque or mausoleum to provide people with water, but finding a Sabil within a residential house is a rare feature in Islamic architecture. In the Zainab Khaton House, a Sandala is found. This is a small room where a woman can stay for 40 days after giving birth. Traditionally, the mother with a baby is isolated for 40 days as a health protection measure due to the weakness of their immune system.

On the first floor, stable areas exist to keep horses safe in the house. These areas may have their own independent entrance. In addition, storerooms are located to meet the house resident's needs. Behind the room, a kitchen is typically located. Although larger residences have their own independent kitchen, smaller residences do not. Ordinary people buy their food ready-cooked due to the lack of or high expense of fuel (Behrens-Abouseif, 1989).

In Cairene houses, an element called Matbakh al-Harim or the kitchen of the women was introduced until the late eighteenth century. Al-jabarti, an Egyptian chronicler, confirmed the existence of such a kitchen in each of the rich people's houses (Al-jabarti, 1798). The main kitchen located on the ground floor is the men's kitchen in such houses. The kitchen is equipped with a mud-brick oven and a ventilation system. Everyday meals are prepared for all of the master's household and his guests, whereas the other kitchen is located for women in the upper part of the house. The kitchen of the upper floor has no oven or chimney (Lewicka, 2011). Although relatively larger residences occasionally have a kitchen, a bathroom is 'less common' in these houses (Behrens-Abouseif, 1989). The residents of those houses used the public bathroom at that time.

In addition, the façades of the houses become a result of the resident's social-cultural needs and the climate conditions. In these houses, a minimal number of openings are used to reduce heat transfer, prevent the inflow of desert dust, and protect the residents' privacy. External openings are placed in random organizations according to the inner spatial organization and functional needs. While allocating a women's sitting area Haramlik on the second floor, it makes the openings of the area as high as possible. This also ensures privacy from the street so that a passer-by on the street cannot see the residents inside.
3.3 Other Distinctive Features

There are some unique features found in traditional Cairene courtyard houses, such as the Mashrabiya, Shokhshekha, and Malqaf. Openings of the houses are covered by the Mashrabiya, which is a wooden lattice window with conspicuous geometric patterns (Fig.4.). This has three main functions: daylight control, thermal control, and social privacy (Mohamed, 2014). Its narrow openings break the sun rays and allow airflow into the building. They provide privacy to the household by letting the family see the street while preventing people on the street or the neighbors from seeing inside their house.

Although it exists mainly in the facades to provide privacy, especially for the women's rooms, it also exists inside the house facing the inner courtyard. At night, the Mashrabiya absorbs moisture carried on the wind and passing through the interstices. When heated by sunlight, it releases the moisture into the air that passes through, thereby increasing the humidity within a home and reducing its temperature.

Shokhshekha (Fig.5.) is a skylight design that is generally used to cover the Durqaa. The Durqaa is a double story high room, where windows are offered. The windows, made of mostly wood, bring natural light to the Durqaa at the top. In the hot Egyptian climate, natural cooling is best accomplished with windows that are high. This means that cool air enters through other lower openings, while hot air exits through the skylight openings. In addition, a Shokhshekha is composed of various shapes, such as square, octagon, dome-shaped, and others.

Malqaf (Fig.6.) is an inclined ending tower that has an open side (air-hole). It works as an airshaft and wind catcher. It has been used in Egypt since Pharaonic times. (El-Borombaly and Fernando, 2015) It exists behind the wall of the main Iwan and connects at roof level with a sloping vent. (Behrens-Abouseif, 1989) The Malqaf is oriented to the north to face the preferable wind so that it captures the wind and cool air inside the building. The Malqaf along with the Mashrabiya, which is opened to the courtyard, guarantees the continuing renewal of air. The Malqaf has several advantages over other openings and
windows. For example, the air passing through it is relatively dust-free owing to its unique design. Air movement is faster because the higher the air from the ground, the greater its speed so that it ventilates the indoor rooms that do not have windows to the outside. It also moderates the temperature of the rooms while air passes through them.

4. Principles of Spatial Compositions

The spatial composition of traditional Cairene courtyard houses is regulated neither by certain module orders nor any other rigid formal and geometric principles. Instead, it depends on the order of the social needs and orientation that determines the spatial compositions of the houses. The design method appears to be a result of accommodating cultural and social issues, case by case so that it is difficult to find two houses with the same modules or formal principles.

In traditional Cairene houses, the courtyard is the key element of their spatial composition. The rooms are arranged around the courtyard. That is, the rooms always start from the courtyard as a primary element that can be found in most traditional houses, and the other rooms are then arranged around the courtyard according to their functions. This concept was inspired by an Islamic principle that calls for monotheism, claiming that everything has a starting point referring to god as the World's creator. In the same manner, it also reflects another Islamic philosophy that guides a person into his own inner feelings and inner peace. These principles are represented in an abstract form that can be seen in architectural details, geometrical forms, and patterns.

Through an analysis of various Cairene courtyard houses, the surrounding rooms wrap around the courtyard. Types c, d, and e in Fig.8. are recurrent, yet Types a and b never appear. This is a reasonable result because they do not belong to typical or traditional courtyard types of houses. In type a, the courtyard is not wrapped by the surrounding rooms. In type b, the house is detached and separated into two parts facing each other.

Figs.10. and 11. present the common spatial characteristics with regard to their spatial composition and hierarchy. The spatial composition of traditional Cairene courtyard houses starts from the courtyard (Fig.10.a). The main entrance, Magaz, is located to enter the courtyard from the street. This refracted entrance serves as a transition to avoid inquisitiveness and emphasize privacy for the residents away from the neighbors and passersby (Fig.10.b). A Magaz is located at any side of the courtyard according to the location of the street. Starting from the entrance zone, one can reach the inner courtyard as a social and transitional space, while the other rooms are distributed around the courtyard, making it a core of the house. The courtyard is considered the organizing core between the different spaces inside the house.

Going forward after the courtyard, one can reach a small sitting area or Takhtabush (Fig.10.c), which is located according to the Northern direction. The location of the Takhtabush always depends on the north façade. This faces the cool wind like the Sennari House. The Takhtabush is allocated for temporary visitors or who are not important enough to be received in the more elaborate reception halls. Next to the Magaz, a reception hall (Salamlik) for men is also placed (Fig.10.d). On the other side of the first floor plan, a gatekeeper's room can be found in some cases in Cairene houses. A bench that has a one-step higher level is at times located in front of the entrance where a gatekeeper can observe the movement of visitors. In addition, there is a room assigned to him that can be seen in different examples, such as in Manzil Gamal Al-Din Al-Dahabi and Sennari House (Fig.9.).

Egyptian climatic conditions also affect the spatial organization of these houses. The sun is considered an important factor regarding space orientation; however, the wind direction is a second criterion. Previous researchers, for example Gut and Ackerknecht (1993), found that the best orientation regarding the sun factor is east-west, while the best orientation regarding prevailing winds is north-south. This leads to placing the main reception hall or Salamlik on the first floor to face east-west while orienting the Malqaf, which is installed in the ceiling to the north to take the preferred wind coming from the north direction.
The water storerooms and stables for horses are located as shown in Fig.10.e. A kitchen for men, at times, is located on the ground floor next to the storerooms. In some cases, stables have separate entrances that are located at the opposite side of the main entrance side. The service and mill storerooms are then added. These rooms have no specific orientation.

On the second floor, the Maqad is located facing north (Fig.11.b). Like the Takhtabush, the Maqad is oriented to the north to face the cool wind. The Maqad is located above the Takhtabush and is approached and connected by stairs from the courtyard. The Haramlik zone, which is composed of private stairs, sleeping spaces, and a bathroom, is allocated to the same floor (Fig.11.c). In some cases, secondary reception halls can be added depending on the house's size and owner's wealth (Fig.11.d).

5. Conclusion

This paper recapitulates a spatial logic underlying the arrangement of traditional Cairene courtyard houses in Cairo, which adequately characterizes its unique spatial designs. The analysis shows that traditional Cairene courtyard houses share common characteristics that mirror the unique local identity of Egyptian architecture. Although the spatial composition of these houses differs chronologically, there are similar spatial principles that underlie all the houses.

The courtyard is the generating center of the houses. Each room is added around the courtyard along the north-south axis according to functional, social, climatic, religious and cultural issues. The spatial composition of the traditional houses is different on each floor. The first floor is a space for men, which used to function as a social space, and for purposes such as stable and kitchen. Instead, the second floor is privately secured as a space for women. The basic spatial composition of each floor is in order from the entrance, a courtyard, a social and public reception hall and private rooms.

Throughout the analysis, there are mutual impacts and influences between Egypt's unique environment and Islamic architecture. In particular, socio-cultural and religious issues are provided as a guide and framework for residential designs. Rooms in the houses are allocated and optimized according to their specific functions. Corridors are used to minimize movement circulation. Different levels of privacy are provided for the residents and visitors so that privacy through breaking sightlines and placing detours is achieved in their spatial organizations.

In addition, the designs of the houses are influenced by the climatic conditions, in which there is little variation in temperature with minimal rainfall and...
intense sunlight. These conditions lead to architectural features including flat roofs, open inner courtyards, ventilators to direct air inside the house, while windows are minimized and placed high in the wall to exhaust hot air outside the house. Through these types of buildings, the local characteristics are highlighted and inherited through generations to fulfill social needs.

The compositional principles of traditional Cairene courtyard houses can be an important source of an Egyptian architectural identity because it has evolved with Egyptians over generations while adapting to their needs, social, cultural, and climatic environment. The lessons learnt from this study could be used as a canonical solution to the development of new Egyptian house designs, and can be utilized in contemporary design practices. Accordingly, traditions will step up the creative process and help with the realization of very creative blends within the spirit of contemporary aesthetic thought.

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