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The Integration Between Urban Design and Architectural Design as A Methodology of Design in Islamic Architecture

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ABSTRACT

The initial reading of Mamluks architecture reveals that the forms are governed by urban factors, so it is in correct to understand Mamluks buildings as a container of spaces, but it is a receptacle of a homogeneous mixture of interior architectural spaces and exterior urban spaces, notwithstanding that analyzing the performance of the buildings in its urban context in Mamluks architecture was largely unconcerned between scholars. The research problem, objectives and hypothesis revolved around a question that the research tried to answer: "How the Mamluk architect achieved the integration between the urban design and the architecture design in the design of complex buildings in Mamluks eras?". To answer this question the research shaded light on the connection elements between urban design and architectural design then it demonstrated how the design process depended on the paths, entrances, minarets and corridor as urban/architectural design tools, this led the research to suggest a design method for the complex buildings and named it "The PMEC Methodology of Design in Urban Context" which may be considered as a systematic arrangement of design steps and the validity of it appeared throughout applying it on various of case-study buildings, this led the research to reach its main results and emphasized that "in contemporary architecture achieving the integration between the urban design and architecture design in the design process of buildings is a main guarantee for the success of buildings functional/composition performance".

KEYWORDS: Urban design, Paths, Minarets, Corridors, Mamluks.

التكامل بين التصميم العمراني والتصميم المعماري كمنهجية للتصميم في العمارة الإسلامية

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المخلص

ان القراءة الأولية للعمارة المملوكية تكشف أن التكوين المعماري عادة ما يكون محكوم بعناصر عمرانية، ونتيجة لذلك، لا يمكن قراءة المباني المملوكية على أنها مجرد تكوين حاوي للفراغ ولكنها وسيط بين الفراغ المعماري الداخلي والفراغ العمراني الخارجي. على الرغم من ذلك فان دراسة الاداء العمراني/المعماري للمباني لم ينل الاهتمام الواسع بين دارسين العمارة الإسلامية، ولذلك تحليل اداء المباني في سياقها العمراني جعل مشكلة وأهداف وفرضية البحث تتمحور حول تساؤل بحثي واحد حاول البحث الاجابة عليه وهو "كيف حقق المعماري المملوكي التكامل بين التصميم العمراني والتصميم المعماري في عملية تصميم المباني المركبة في العصور المملوكية؟". للاجابة على هذا التساؤل البحثي سلت البحث الضوء على العناصر التي تربط بين التصميم العمراني والتصميم المعماري ثم وضح البحث كيف اعتمد المعماري المملوكي على المسارات والمداخل والمآذن والطرق كادوات تصميم عمرانية/معمارية. مما ادى بالبحث الى اقتراح تقنية لتصميم المباني المركبة في العصور المملوكية واطلق عليها البحث "منهجية "PMEC" للتصميم في السياق العمراني" وظهرت صلاحيتها من خلال تطبيقها على عدد من مباني دراسة الحالة، ليصل البحث الى نتيجته الاساسية ليؤكد على أن تصميم المباني في العمارة المعاصرة ضمن سياقها العمراني هو ضمانة لنجاح أداءها الوظيفي والتشكيلي.

الكلمات الدالة: التصميم العمراني، المسارات، المآذن، الطرق، الممايك.

INTRODUCTION

Studying and analyzing the built environment of Mamluks is an effective approach to formulate contemporary theories of design, so that the research presents how was design process during the Mamluks eras integrated between the urban design and architecture design to create the design of the complex buildings in Mamluks eras.

Research Problem

From studying and researching Mamluks architecture, the research observes that:

- There is no study dedicated to discover the mutual relationships between urban design and architecture design in the design of buildings in Mamluks eras.
- Scholars in the field of Islamic architecture had not given a considerable attention to the importance of gathering visual design principles and urban design rules beside architecture design basics in one methodology of design

Regard to that, the research problem can be formulated in the following question: How was the Mamluk architect integrated between the visual design principles and urban design rules beside architecture design basics in one methodology of design to generate the design of different buildings in Mamluks eras?.

Research Objectives

The research attempted to suggest a methodology of design integrates between urban design and architectural design in the design process of complex buildings in Mamluks eras, and to reach that the research formulated four sub-objectives:

- Determining the connection elements between urban design and architectural design
- Presenting the design Models/Prototype in Mamluks architecture
- Demonstrating how the designer used the paths, the minarets and the entrances as urban/architectural design tools in Mamluks eras.
- Explaining the role of transitional elements –concentrating on corridors– in shaping the design methodology of the complex buildings in Mamluks architecture.

Research Contributions

The research contribution can be summarized in three points:

- The research determined six of connection elements between urban design and architectural design, beside it present five of design models in Mamluks architecture; this helps modern architects to combine between visual design and urban design in the architecture design of complex contemporary buildings.
- The research had suggested a design methodology technique for complex buildings in Mamluks eras, this helps contemporary architects to understand how to integrate urban design with architecture design in complex buildings for present needs,
- The design of complex buildings from Mamluks periods had examined to enriching our knowledge of historical design methodologies and understands Mamluks theories of design besides describing the design criteria of Madrasa buildings from the maker's point of view.

Research Method

This study divided into four main parts: started with the research introduction (the research problem and objectives). The second part is the theoretical study, which begun with specifying the connection elements between urban design and architectural design, then it focused on design models in Mamluks architecture, then it demonstrated how Mamluk architect depended on the paths, entrances and minarets as urban/architectural design tools, and it ended with explaining the role of corridors as a

transitional element shaping the internal space syntax. As a result of these two parts the research reached in its third part to suggest the methodology of design in urban context, which the research named it “PMEC Methodology of Design”, which is a systematic applying of visual design principles and urban design rules beside architecture design basics in the building design process. The applying of the suggested methodology in the case-study buildings was presented on the applied study, which came on the fourth part. At the end the research presented its results.

1. THEORETICAL STUDY

This section begun with shading light on the connection elements between urban design and architectural design, then it focused on design models in Mamluks architecture, these two points to formulate a strong background to understand how Mamluk architect depended on the paths, entrances, minarets and corridors as urban/architectural design tools shaped the design methodology of the complex buildings in Mamluks architecture.

1.1. The Connection Elements Between Urban Design And Architectural Design

In Mamluks architecture there were design tools have urban functions beside its architectural functions, the research considers them as connection elements between the urban context and the building. Six of them were determined as follows:

1.1.1. Urban pocket

The "urban pocket" is a spatial pause along major spines or paths. The purpose of such an expansion was to reorient the observer, to acknowledge an entry into a building, or to generate a place of social interaction [Al-Harithy,2001]. Urban pockets formed immediately outside the buildings as a result of deliberate cracking in the outer wall of the building to add more flexibility to the flow along the path, this because it is a space without boundaries of its own as shown in figure 1. The urban pockets have two functions: the first is environmental function by protecting buildings from the direct sun's rays besides calming the speed of the wind crossing the path, the second is urban function by forming a social external space called Rahbas, which used to gathering markets rather than stewarding ceremonial functions.

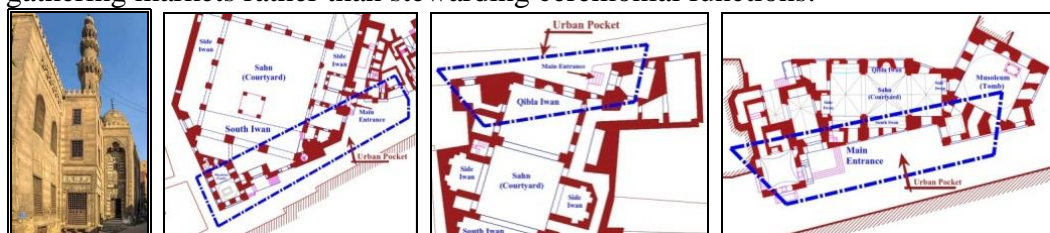


Fig. 1 Urban Pocket in Mamluks architecture: left to right - Mosque of Qijmas al-Ishaqi, Aqsunqur al-Nasiri Mosque, Sultan Jaqmaq Madrasa, Amir Khayrbak Complex [Author].

1.1.2. Urban wall

It is the building's outer wall which make a smooth connection and smooth separation at the same time between the outside urban space and the inside architectural space. These urban walls emerge when the building site is an awkward shape or when needing to turning the inside spaces to Qibla direction [Gaber & Amer, 2018]. The urban walls connected between the urban design and the architecture design through absorbing the deformation which happened in the internal spaces of the building due to the deviation of the building site from the street and the changing of its thickness was the ideal solution which the designer depended on it to reach that as shown in

figure 2, besides that it is solving the contradiction between the Qibla orientation and the street direction when occurred in the internal spaces,

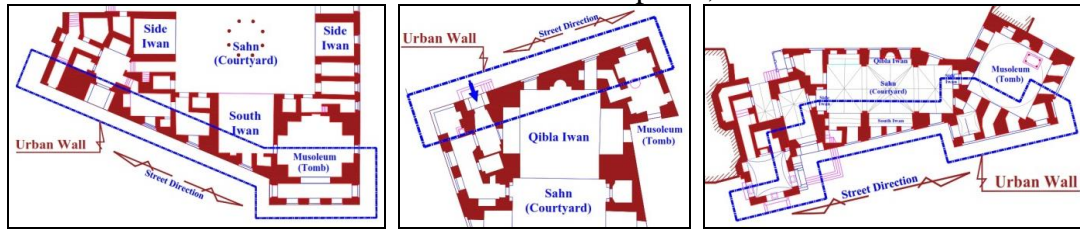


Fig. 2 The urban wall in Mamluks monuments: left to right: Amir Saraghitmish Complex, Mosque of Qadi Abd al-Basit, Complex of Amir Khayrbak [Author]

1.1.3. Urban dome

It is a dome that has an architectural function on covering the internal architectural space and has an urban role as a landmark in the visual image of the building and the urban context and the building. The urban domes have three positions in Mamluks architecture: above the Mausoleum, above the entrances (portal vaults) and in the top of the minarets as shown in figure 3.



Fig. 3 The position of the urban dome in religious buildings in Cairo of the Mamluks [Author]

1.1.4. Urban entrance

The urban entrance has two functions:

- The urban entrance transforms the surrounding urban space into a design tool and a design element that has a basic function in the design process of the building.
- The entrance becomes an essential component, an essential element, and an essential part of the external urban context and it cannot be separated from it, as shown in figure 4.

In Islamic architecture three criteria controlled the design of urban entrance, they are:

1. The entrance must have a distinguish position in the building design.
2. The entrance must have an urban role in forming the visual image of the building.
3. The entrance must form a visual connection through the path of the street.

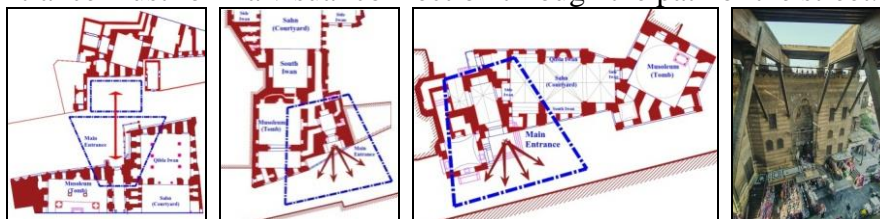


Fig. 4 Urban entrance as a component of urban context, left to right: Complex of Sultan Qalawun, Baybars al-Jashankir Complex, Complex of Khayrbak, Madrasa of Sultan Al-Ghuri. [Author]

1.1.5. Urban window

In Mamluks buildings, large rectangular windows with iron grilles were located near the floor, thereby establishing visual contact between the mosque and the street [Behrens-Abouseif, 2007]. The urban window is a connection element joined between the functions of the internal space and the functions of the external urban space as figure 5 indicates, for example the urban window in the Qibla Iwan played an architectural role in ventilation and lighting, and played an urban role in transferring

the function of the inner space to the outer urban paths by informing the passers-by in the street that the pray was established.



Fig. 5 Urban window in Mamluks architecture, left to right: (1) Mosque of Emir Qijmas Al-Ishaqi, (2) Amir Azbak al-Yusufi Complex, (3,4) Sultan Al-Ghuri Madrasa [Author]

From analyzing the fenestration system in Mamluks architecture the urban windows can be founded in four cases as follows:

- In paneling façades urban windows placed on recesses pierced
- It takes a large rectangular shape to allow visual communication with the street.
- It takes a tripartite shape with an oculus above a double arched opening (it appears for the first time in the complex of Sultan Qalawun)
- Qamariya shape: it is an inner-arched window, has a stucco grille filled with colour glass. The Qamariya was a relieving device as well as a decorative one that adored the façade and added color to the interior, rather than serving as a source of light. [Gaber & Amer, 2018]. Qamariya placed in the middle of the Qibla wall as shown in figure 6, so that it played its architectural role as a lighting element for the Qibla Iwan, in addition to the urban role in linking the path of the moon's movement with the building, which helps in determining the pray times.



Fig. 6 The position of Qamariya as an urban window in Mamluk religious buildings [author]

1.1.6. Urban corridor

The urban corridor is an external corridor that connected the two blocks of the building on every side of the street and penetrates the outer urban space, it is a corridor that does not have specific physical boundaries, but its boundaries are a mixture between buildings and urban spaces, as shown in figure 7.

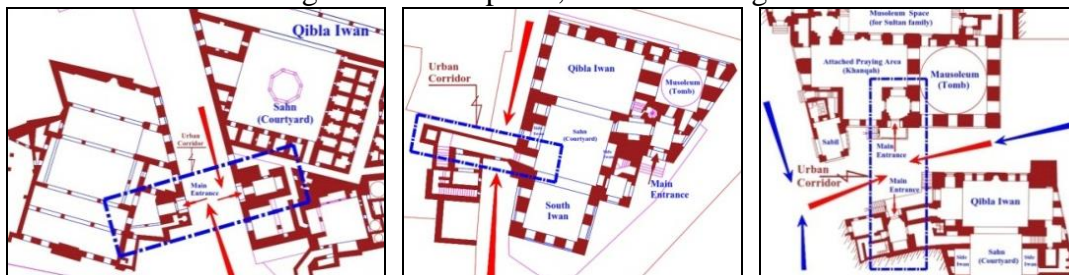


Fig. 7 The boundaries of the urban corridor: left to right: Shaykhu al-Umari Mosque, Qijmas Al-Ishaqi Mosque, Sultan Al-Ghuri Madrasa [Author]

1.2. Design Models In Mamluks Architecture

The religious buildings were essentially a flexible composition of modules combined ad hoc, according to the requirements of each site [Behrens-Abouseif, 2007] . This section shade light on three of the design models to uncover its design principles and

design criteria, this is not a historical presentation of these models, but only explains how Mamluk architects designed these buildings in pure expression or hidden order.

1.2.1. The design model of the entrance

There are four criteria form the model design of the entrance, as follows:

- 1- The entrance in the Mamluk religious buildings consists of four main parts: the entrance stair space, the portal space, the portal and the entrance hall [Gaber, 2011]
- 2- Mamluk architects used the bent entrance as a flexible connection between the courtyard and the street beside to that he used it to adapt between the entrance façade and the street orientation.
- 3- Mamluk architects covered the entrance with a semi-dome or a pointed arch vault, and to regulate the sky-line of the building they take the height of the portal equal to the rest of the elevation [Tantawy,2002].
- 4- Mamluk architects used the simple geometric shape –square or rectangle- to form the entrance hall and covered it with a squinch or groined vault or a dome.

Figure 8 demonstrates the design model and the design criteria of the entrance in the architecture of Mamluks eras.

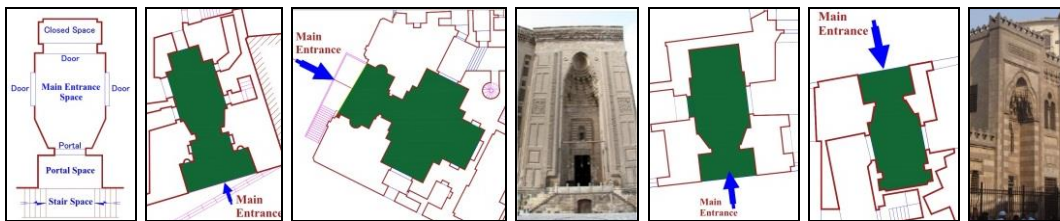


Fig. 8 The entrance model in the architecture of the Mamluks eras [author]

1.2.2. The design model of the corridor

There are two types of corridors in complex buildings: the main corridor which connects the entrance to the courtyard and the secondary corridor which connects between the courtyard and the all other functions. [Gaber & Aly, 2021].

The analysis of corridors revealed three of design criteria which the Mamluk designer relied on them, as follows:

- The doorway parallel to the street and the transition from the street to the corridor through the doorway must be in perpendicular orientation on the doorway.
- The perpendicular geometric relationship was common to connect between the bent corridor and the courtyard, so the user enters the courtyard from the bent corridor on perpendicular orientation, as shown in figure 9.
- The style of branched corridor was common in Mamluks architecture, for example many corridors can be branched from one entrance or from one corridor.

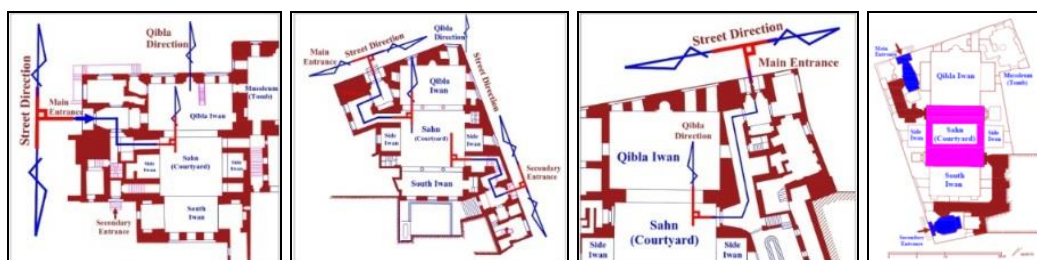


Fig. 9 The model design of the corridor: left to right: Sultan Qaytbay complex, Qadi Abu Baker Muzhier mosque, Sultan Al Ashraf Bersbay [Author], Qadi Abd al-Basit [Gaber & Aly, 2021]

1.2.3. The design model of the minaret

The Cairene minarets were the only ones in Islamic architecture to combine varying sections [Creswell,1926]. The model design of the minarets in Mamluks architecture was based on three points as follows:

- In minarets design the Mamluk architect depended on the methodology of “from taller to shorter”, so that in all minarets the lower story always taller than the upper and there was a hidden vertical axis joined between all of them.
- In Mamluk era to block the vision, the Mamluk architect deformed the minaret into different compositions: the base which formed in a square section (equal or taller than the building height), the middle section which formed in an octagonal or circular section and an onion dome rested on eight columns in the top section, and he depended on Muqarnas decoration to cover the transition zone between these different sections.
- The Mamluk architect depended on a proportions code to generate the design of the minarets, within manipulated with four types of proportions between the dimensions of the main parts of the minaret: the equal proportion (1/1), the half proportion (1/2), the third proportion (1/3). Two third proportions (2/3) [Gaber & Alzahrani, 2022], as shown in figure 10.

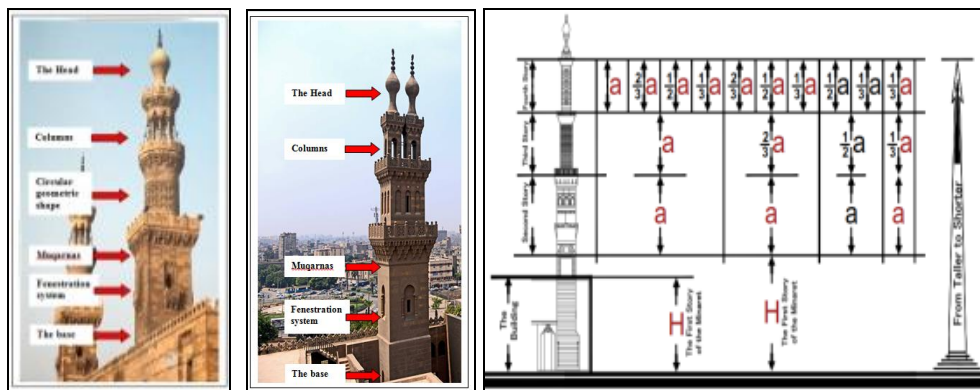


Fig. 10 The model of the minarets in Mamluks eras: left to right: The Khanqah of Farag Ibn Barquq, Qanibay Qura al-Rammah Mosque, taller to shorter methodology in the minarets design. [Gaber & Alzahrani, 2022].

1.3. Path And Entrance As Urban/Architectural Design Tools

The traditional Islamic cities appear to be composed of dissimilar parts that are aggregated and bound together by the dynamics and constraints that govern the global structure of the city, rather than locally similar elements.[Dabbour, 2021]. Path/Entrance as an urban/architecture is the underlying social generator of the physical diversity in the design of the city urban context, so that urban space in the Islamic city regarded as merely an expression of the society that produces it.

1.3.1. The paths’ design principles

Five criteria affected the design of the paths as follows:

1. All paths oriented toward the city center, which is the most important part of the city and the easiest to defend and reach.
2. The serial vision on the path started from the public plaza which in front of the congregational mosque and the visual sequence of paths determined with the outer wall of construction on its every side.
3. The difference of the path’s width was according to their importance (Main Qasabah, Al Hara, Al Darb, Al Atfa).

4. The continuity of paths, either with the continuity of the single character (commercial character) or the single architectural heritage.
5. Paths depend on generating a sense of continuity through the sudden changes in the visual image through urban pockets and urban walls.

1.3.2. Path and entrance in the visual image

The serial vision in the design of paths in Mamluks eras depended on the visual continuity, which depended mainly on the integration between the visual images across the street. The visual continuity may be in the same building or between two or many buildings across the street or occurred between two function, one of them inside the building and the other on the urban space, as shown in figure 11.

The Mamluk architect depended on four types of connection elements in the design of the city: the functional connections elements, the visual connections elements, the meaning connections elements and the construction connections elements. In the visual connection he used five of urban/architectural elements: the minaret, the dome, the fenestration system, the urban wall and the paths. [Gaber & Aly, 2021].

Entrance for the Mamluk designer was the flexible architectural element which absorbs the deviation of the building from the streets, so that design process starting with pre-design step in which the designer analysis the urban context of the building to strength the serial vision of the path. One of the clear example demonstrates this notion is the mosque of Sultan Hassan in which the designer deviated the entrance block with a fixed angle from the building façade this to strength the homogeneous between the buildings and its surrounding urban context



Fig. 11 The integration between path and entrance in the visual image, left to right: Mosque of Sultan Hasan, Al-Zahir Barquq Madrasa, Mosque of al-Muayyad Shaikh, Sultan Al-Ghuri Complex [Author]

1.3.3. The effect of the paths in the design of the entrance

Three phases indicates the effect of the paths in the design of the entrance, as follows:

- 1- **The number of the entrances:** in religious buildings, Mamluk architect depended on one main entrance or two main entrances.
- 2- **The position of the entrance in the façade:** the entrance took one of two positions: in the middle of the façade or in the corner of the façade.
- 3- **The orientation of the entrance from the path:** in this case, the entrance may be parallel to the path or deviated from the path, as shown in figure 12.

Table (1) The effect of the paths in the entrance design in complex buildings

	The effect of the paths in the entrance' design		
	The number	The position	The orientation
Complex of Sultan Qalawun	One	in the middle	Parallel
Complex of Sultan Hasan	One	in the corner	Deviated
Al - Nasir Farag Ibh Barquq Khanqah	Two	in the corner	Parallel
Mosque of Qadi Abu Bakr Ibn Muzhir	Two	in the corner	Parallel

Source: [Author]

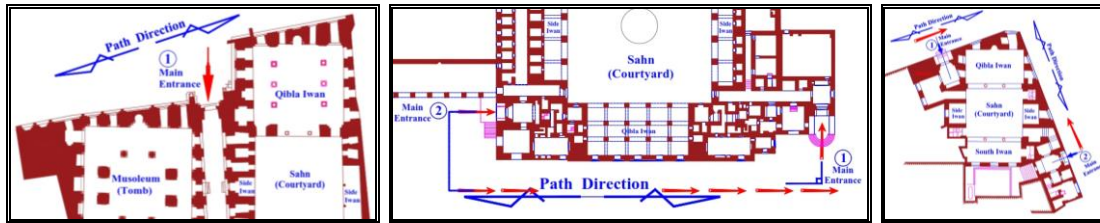


Fig. 12 The effect of the paths in the entrance design, left to right: Sultan Qalawun Complex, Khanqah of Al - Nasir Farag Ibh Barquq, Abu Bakr Muzhir Mosque [Author]

1.3.4. Types of paths and entrances in Mamluks eras

1- Types of paths

Mamluks city has two visual forms, the first along pedestrian paths, in which the human scale was the characterizing feature of the visual form, the second form was along auto transit axes, and the most striking features in these visual forms the gradation of paths from wide to narrow; this gradation was according to many factors, for instance profession, social class, relationships between inhabitants. There were five types of paths in Mamluks eras as follows:

- **The main Qasaba:** it is the main axe of pedestrians in the city so that it is the main commercial, administrative and educational axe. Commercial activity regulated along the Qasaba, also serving shops can be maintained from its back area leaving the front area free for pedestrians and transaction.
- **The Sub-Qasaba:** it is a secondary axis for pedestrian paths and the residential activity is concentrated on it.
- **Al-Hara:** it branches from the Qasaba and forms homogeneous social groups of the same profession.
- **Al-Atfa:** a narrow path ties a group of families to live around a common space.
- **Closed or invasive roads:** They branch out from the main path with a few widths commensurate with the movement of people and animals.

2- Types of entrances

The research determined two types of entrances according to the connection relationship between the entrance and the courtyard

- **Direct entrance:** it transmitted the user directly from the street to the courtyard without passing in any in-between functional spaces.
- **Pent entrance:** the entrance façade must be aligned to the street, and this led to the rise of the pent entrance which followed with the pent corridor which transmits directly the pedestrians from the street to the courtyard. The bent entrance has three functions: forming the visual image of the paths, providing privacy to the building by preventing the passers-by to see the inside and protecting the building from wind, dusts, and noises coming from the street.

1.4. The Minarets As Urban/Architectural Design Tool

In Mamluks eras the masons tried to site the minarets in relation to each other so as not to disturb the harmony of the area, as a result, though you often find several minarets on the same street, they never seem to obstruct each other; to the contrary, they seem to come together, providing what seems to be a natural contentment and a visual symphony in the beholder's eye.

1.4.1. The minarets in the visual image

Muslim cities are self-contained entities that make up a distinct society and culture radically different from that of other civilization [Al-Sayyad, 1991], and its urban pattern was divided according to: firstly, the ethnicity and the religion of the

inhabitants therefore there were some districts for Muslims, for Christians and others of Jews. Secondly, the maximum walking distance between the central mosque and the other neighborhoods because the Islamic cities were planned using the pedestrian scale. Thirdly, the maximum distance over which the residents were able to hear the voice of the ‘Moazen’ (the man who calls the prayers) when he tells ‘Al-Azan’ (the call for pray) [Moubarak, 2020], this explains and demonstrates the important role of the minaret in shaping the urban pattern and the visual image of the city, as shown in figure 13, this role can be summarized in three points as follows:

- Mamluk architect had depend on the criteria “From Building to City” to make the minaret concept emphasizing the sense of belonging to the urban fabric.
- There was a center from which the planning of Islamic cities always started this as a symbolism to the Kabaa as a center to Islamic world. The planner always placed a mosque in the center of the city, according to that the minarets played the role of landmark and visual fingerprint in the image of the city.
- Minarets transform the urban context for people to manifest their respected cultural values and history, and considering it as a place for seeking their past memories and future aspirations.

The creativity of the Mamluk designer appeared in planning these minarets as a tall buildings stand close to one another in beautiful harmony to act as urban formation factor, visual landmark for the pedestrians and vistas for the main streets



Fig. 13 The Minaret in the visual image in Muayyad Shaikh Mosque ((1),(2) [Bascal Costa], (3), (4) [Author])

1.4.2. Symbolism in the urban/architecture design of the minarets

Time passes and the minarets fascinate us, not with their structures, but with the history in which they hide, and with the secrets of life that merged with its walls and lived for centuries through nations and kingdoms. Nothing was random in the design of the minarets, not carefully planned, or not stemming from the spirit of Islam, but rather it contained meanings deeper than its utilitarian and aesthetic value [Badawy, 2008]. In his two studies, namely, “Das Ornament in der Islamischen Kunst” in 1977 and “Symbols and Signs in Islamic Architecture” in 1983, Oleg Grabar distinguished a symbol from a sign. As an example, he said that the minaret is assign that suggests a function of calling for prayer. However, the minaret becomes symbol when it reminds some one of Islam or when it appears on stamps that identify a specific country. Thus, the sign attribute is always fixed, whereas the symbol attribute is variable [Grabar,1983]. From this notion the following points demonstrates the symbolism in the design of the minarets:

- 1- The minaret goes from the earth to the sky, that is, from the lowest to the highest, from the narrow earth to the wide sky, this is a sign of the believer's departure in his spirit to the higher realms, approaching his Lord Almighty [Badawy, 2008]
- 2- The minaret is an expression of multiple stages of ascent towards the sky, and the balcony is an isthmus that separates and connects two worlds at the same time.
- 3- Like the pillar, the minaret stands upright as number “one” representing the Ahad the supreme name, the Divine Oneness, but unlike the pillar, it has no weight to

carry and its formal symbolism of oneness is thus confirmed from both angles. [Gabr, 1992]

- 4- The balconies which rested on seven transitional steps of stalactites (Muqarnas) symbolizes the seven heavens.
- 5- The cubical form of the first storey of the minaret refers to stability, solidity, perfection and the union of celestial and earthly.
- 6- The ornaments on the surface of the minarets symbolizes to the star-filled the sky
- 7- Revolving the whole minaret composition around one center point refers to the unity and the one origin beside the concept of Tawheed, and the central point in this composition referred to Kaaba. Table (2) presents meanings and signs of the components of the minaret

Table (2) The symbolism of the different components of the minaret

Element		Symbolism / Signified
The minaret penetrating the whole composition of the city		The overall existence of the Throne
The eight column carried a dome		The eight angels carried God’s throne
Banding of stone “Ablaq”		The stones of the Garden, one of silver and one of gold.
The “shorafat” or “a’reyes” cresting		The angles surrounding the throne
The geometric shapes	The square	The four corners of the seat
	The octagon	The shape of the throne
	The circle	The Infinity and the endless power of God
	The eight columns	The eight holders of the Throne
	The onion dome	The individuality of the only one God
The center point		The beginning and the end of all things, concentration of maximum energy and center of universe (GOD)
The hollowness of the minaret		The Throne containing the earths and the heavens.
The eight-point star patterns		The eight Gardens surmounted by the Throne
Stalactites or honeycomb decoration		The honey of the paradise
The playful use of lights/shadows		Shadows of trees and precious stones in the paradise

Source: [Ramzyn, 2013]after.

1.4.3. The concept of unity as a design criteria in minaret architecture

Unity in plurality in the architecture of the minarets means the realization of a composition that contains many components in an integrated whole as a single unit, table (3) presents how the Mamluk architect reached the unity in plurality in the architecture composition of the minarets.

Table (3) Express the concept of unity in the minaret’ design

Plurality in composition	Unity of design	The Idea
Many geometric shapes in minaret design	→ One form	
All the components of the minaret (base, shafts, cap and head) are articulating around one axis.	→ Verticality	
Different components of the transition zone between different storeys in the minaret design	→ Homogeneous	
The dome and the eight pillars at the minaret top	→ Religion symbol	
All decoration elements on the minaret faces	→ Unity in form	

Source: [Author]

Minaret is a type of tower typically built into or adjacent to mosques, they are generally used for the Muslim call to prayer. Its composition has many geometric shapes, many levels, and its basic form includes a base, shaft, head, many decoration elements and many fenestration compositions. Gathering these components in a tall spire with a conical or onion-shaped crown is a clear expression of unity in plurality.

1.4.4. The integration of spaces as a design criteria in minaret architecture

In minaret architecture in Mamluk architect specified two types of spaces: vertical space and horizontal space, the vertical space is the internal space which extended vertically but the horizontal space is the urban space which extended horizontally, and the minarets as a place of visual transition between outside and inside is very important to him not only because it offers him the chance to change the attitude of the visitor or occupier of the space physically and psychologically but also it helped him to emphasize the integration between inside and outside spaces.

Figure 14 demonstrates three examples to demonstrate the integration of spaces in minaret architecture and the projection of the Minaret in building composition.

- **Shaykhu Al Umari mosque:** As a result of the growth of the city the complexity of the paths network occurred and according to that the degree of fluidity through the streets increased and to face this situation in Shaykhu Al Umari mosque the designer shuttered the building into two sections across the street and with a very high degree of visual integration between the building and its urban context the building played an important role in the serial vision across the street.
- **Sultan Qalawun Madrasa:** the designer placed the minaret in one side of the façade and the dome on the other side and the entrance in the middle of the façade and all of them integrated with the mausoleum of al-Salih on the other side of the street in a very successful example of urban space syntax.
- **Sultan Al-Ghuri Madrasa:** the designer reached the integration between the horizontal and vertical space through dividing the building into two masses across the street and placed the minaret in one of them and the dome on the other one.

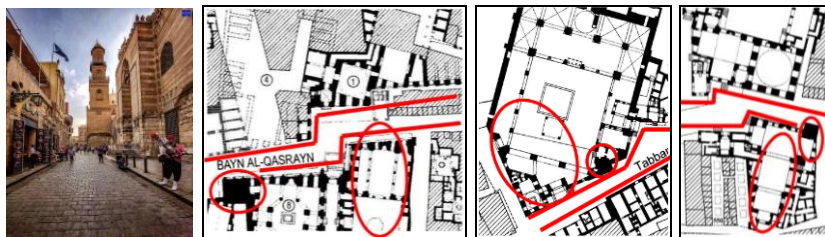


Fig. 14 The projection of the Minaret in building composition, left to right: Sultan Qalawun Complex, Mosque of Aqsunqur, Sultan Al-Ghuri Complex, The Mosque of Muayied Shiekh, [Author]

1.5. Corridor: Transitional Urban/Architectural Design Tool.

For the Mamluks architects, the main aim of the architectural works was to transmit Islamic messages and not to offer aesthetic gratification to the eye. [Ghasemzadeh, et al 2013]. Corridor architecture is widely recognized for its unique and creative designs. The designers clamp their creativity on conjures their beliefs through the use of iconic forms that arrestingly produced works of architecture. This section demonstrate four aspects in the architecture of the corridor in Islamic architecture.

1.5.1. Types of plan's design in Mamluks Architecture

The Iwan is a vaulted hall, walled on three sides, with one end entirely open. Iwans were common in the Sassanian world before Islam and rapidly became incorporated into Islamic architecture. The greatest period of diffusion was under the Ayubids in the 10th century when iwans became established as one of the basic units of Islamic architecture [Petersen,1999]. Depending on Iwans as a design element in Mamluk period there were five types of plans in religious buildings in Mamluks architecture, as shown in table (4) and figure (15).

Table (4) Types of plans (in religious buildings) and its principles of design in Mamluks eras

Bahrite Mamluk Period		Example
First Type:	Open Court and Four Covered Areas	
	<ul style="list-style-type: none"> • Four covered Iwans surrounded a central courtyard. • The entrances related to the axes of the court and not to the mass. • Entrances blocks protruded from the facade alignment. • The minarets have been placed on top of the main entrance. 	The Mosque of Zahir Baybars,
Second Type:	Collegiate Mosque Madrasa With Four Iwans	
	<ul style="list-style-type: none"> • The plan includes an open courtyard, four iwans and a bent entrance. • The madrasa/mosque was, mostly, annexed to its establisher tomb. • The minaret was placed above or close to the main portal. • The street line was respected in the mosque external configuration, while the Qibla direction was respected in the internal configuration. 	Sultan Qalawun and Sultan Hasan
Burgi Mamluk Period		
First Type:	Small Mosque	
	<ul style="list-style-type: none"> • The mosque included a durqa'a in front of the qibla iwan. • At the building corner placed the Sabil (a drink room above it the Kuttab) and the mausoleum. • The mosque has no minarets, but has bent entrance • In some cases the building is suspended, containing shops in the ground floor 	Aytmish al-Bagasi Madrasa,
Second Type:	Mosque With Four Iwans	
	<ul style="list-style-type: none"> • It composed of a central court onto which opens four iwans. • There are two types of Iwans: the first is internally divided into aisles, while the second is vaulted or covered with wooden roofs. • Residential rooms for the establisher's family, apartments for the residence of rectors (shaikhs), and students, were incorporated together with the mosque. • The mosque has drink rooms, and a Kuttab for teaching orphans. • The mosque has a bent entrances composition. • The portals were distinguished by placing minarets close to them. 	Khantqah of al-Zahir Barquq
Third Type:	Two Iwans, Two Smaller Iwans, And A Durqa'a	
	<ul style="list-style-type: none"> • In the design concept the court is replaced by the Durqa'a. • Four Iwans surrounded The Durqa'a (two grand Iwans (Qibla iwan and the opposite Iwan) and two smaller Iwans (sadlas)). • The mosque includes a drink room, a Kuttab, and a mausoleum. 	Sultan Qaytbay Complex

Source: [Center for Planning and Architectural Studies, & Center for Revival of Islamic Architectural Heritag, 1992].

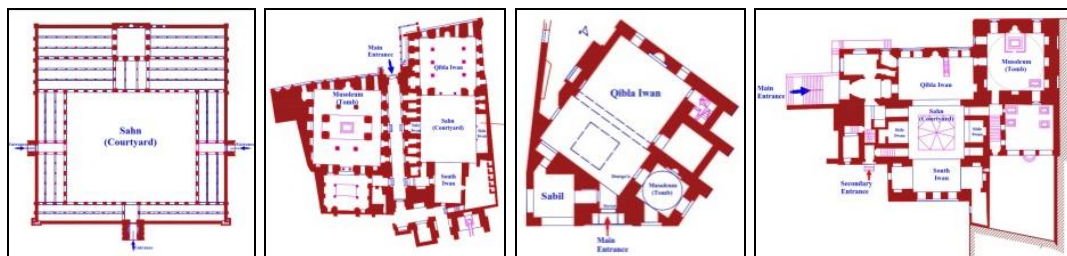


Fig 15 Types of plans in religious buildings: left to right: Al Zahir Baybars Mosque, Sultan Qalawun Complex, Aytmish al-Bagasi Madrasa, Sultan Qaytbay Complex [Author]

1.5.2. Types of corridors

Corridor is a flexible connection architectural element and a hidden secret factor which helped Mamluk designer to modify and change his design to fit and suit the

building site. This section demonstrates three criteria according to them the research could classify the different types of corridors in Mamluks architecture, this to explain the association between its form and function beside recognizing the unique functions of the corridors in Mamluks architecture.

1- Types of corridors according to the direction of movement

- a) Horizontal corridor: It connects at the horizontal level between functions inside the building, and it consists of four main components: (1) The Doorway, (2) The Vestibule, (3) The Passageway, (4) The Hallway, as shown in figure 16.

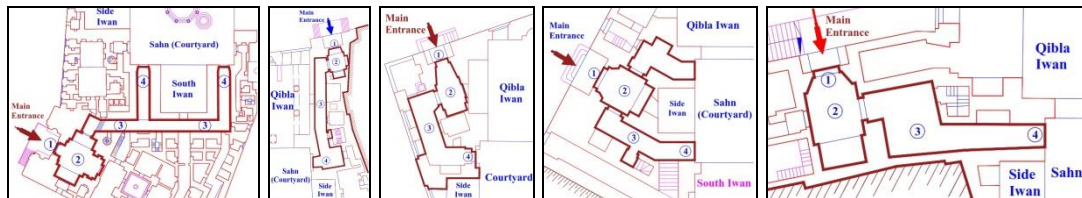


Fig. 16 The horizontal corridor in Mamluks religious buildings [author]

- b) Vertical corridor

Mamluk architect put in his mind, not only the user movement but also the air movement inside the building, this appears in the design of Malqaf (wind catcher). In Mamluks architecture the wind catcher are known as *malqaf*, They are generally shaped as right triangular prisms with the vertical side left open and facing directly up or down wind. They work best if oriented within 10 degrees of wind direction; larger angles allow the wind to escape. [Attia, 2009], as shown in figure 17. The Malqaf is a bioclimatic natural ventilation archetype as a vertical corridor allows air to pass.



Fig. 17 The wind catcher composition, left to right: 1, 2 the construction method of the wind catcher. [Author], 3- Sabil-Kuttab of Katkhuda [Author], 4-Part of a painting by Jean Leon Grome [King, 1984].

2- Types of corridors according to positioning relationship

According to positional relationship the corridors played the role of functional connection element, and it appeared in three places: Entrance-Courtyard Corridor, Entrance-Mausoleum Corridor, and Courtyard-Mausoleum Corridor, as in figure 18.

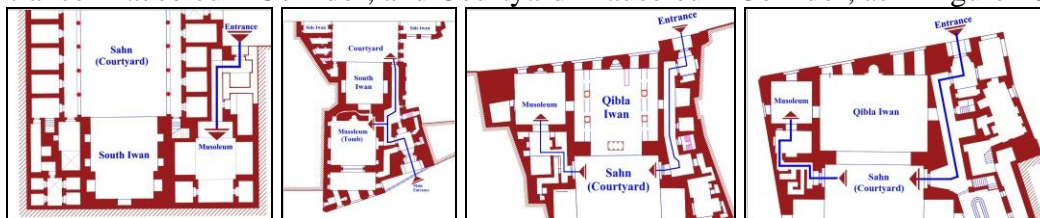


Fig. 18 Types of corridors according to positioning relationship: left to right: Kamaliyya Madrasa, Baybars al-Jashankir Complex, al-Zahir Barquq Madrasa, Al-Ashraf Barsbay Complex [Author]

3- Types of corridors according to the urban context

The distribution of corridors in buildings depended on one main design criteria which is the function continuity whether on the architecture design level or urban level.

- a) Inside corridor: to achieve function continuity it takes two phases: the first: one corridor serves many functions as in Qalawun complex, the second: two or more

corridors serves one function as in Qadi Abd al-Basit mosque. Figure 19 demonstrates the function continuity in the design of inside corridor in religious buildings in Mamluks architecture.

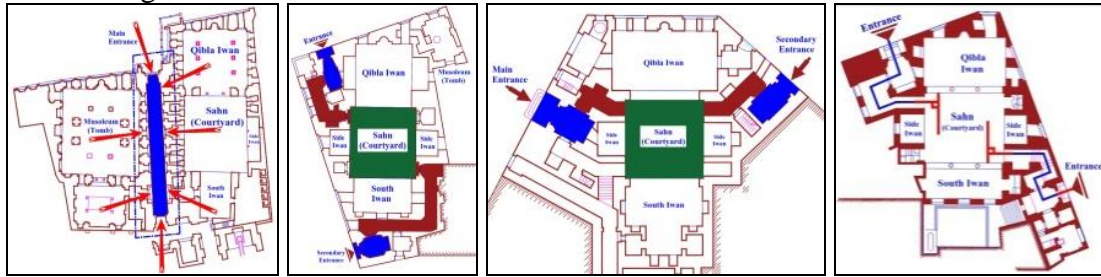


Fig. 19 The function continuity in the design of inside corridor, left to right: Sultan Qalawun Complex, Qadi Abd al-Basit Mosque, Azbak al-Yusufi Complex, Qadi Abu Bakr Muzhir Mosque [Author]

b) Outside corridor (urban corridor): the urban corridor accomplished function continuity between the building components across the street.

1.5.3. The morphological analysis of corridors

The Mamluk architect dealt with corridors not as a two-dimensional functional space, but he designed it as a dynamic-volumetric three-dimensional space. To make the morphological design of corridors more understandable, this section demonstrates three points: the geometric shapes, the geometric relationships and the geometric composition in corridors' design.

- Types of geometric shapes in the design of corridors.

There were two types of geometric shapes were common on the two-dimensional composition of corridors, they are the square and the rectangle shape.

- Types of geometric composition in the design of corridors.

There were two types of geometric composition were common on the volumetric composition of corridors, they are the cube and the cuboid, as shown in figure 20.

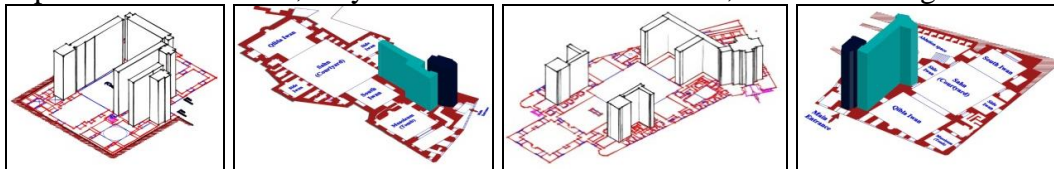


Fig. 20 Types of geometric composition in corridors, left to right: Kamaliyya Madrasa, Baybars al-Jashankir Complex, Sultan Hasan Complex, Complex of Al-Ashraf Barsbay [Author]

- Types of geometric relationships in the design of corridors

In regard to the user' path circulation, there were two types of geometric relationships were common on corridors, the parallel and the perpendicular, as shown in figure 21.



Fig. 21 Types of geometric relationships in corridors: left to right: Mosque of Abd al-Ghani al-Fakhri, Complex of Amir Sarghitmish, Qadi Abd al-Basit Mosque, Complex of Al-Ghuri [Author]

1.5.4. The design role of corridor in complex buildings in Mamluks eras

Corridor was a design tool in Mamluks architecture and the research determined three roles for it, the first is the function role which serves the spatial articulation functions, the second is the formation role which serves the connection function and the third is the environmental role to serves the religious functions. The research determined three design

criteria of the corridor in Mamluks architecture, as shown in table (5) which helped the designer to achieve the unique style of corridor architecture.

Table (5) Design criteria of corridors in Mamluks architecture

Corridor Architecture	Design Criteria	Methods of achieving
	Suitability	Composition suitability Function suitability
	Durability	Durability of the corridor construction system Durability of functions connections Durability of the connection with urban context Durability of environmental treatment of the corridors to face the environmental conditions
	Beauty	Beauty of geometric composition and ornaments Beauty of composition proportions Beauty of visual harmony with the urban context.

Source: [Author]

2. “PMEC’ METHODOLOGY OF DESIGN IN URBAN CONTEXT

The methodology is a systematic method of design in light of the integration between the urban design and the architecture design. Ten of case-study Madrasa buildings that were built in Islamic world during the Mamluks eras were used to formulate the methodology. The research tries to demonstrate how the Mamluk designer reached the integration between the urban design and the architectural design by the aid of systematic technique.

2.1. The Methodology Idea

From studying the connection elements between the urban design and architecture design (section 2.1.) the research determined two criteria helped the Mamluk architect to determine four main elements, these four elements helped him on achieving the integration between the urban design and architecture design, they as follows:

- Positioning criteria in urban design: path and minaret
- Designing criteria in architectural design: entrance and corridor

Figure 22 shows the idea of the PMEC methodology of design and its elements.

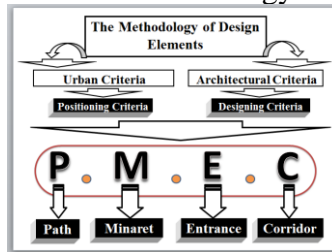


Fig. 22 The idea of the PMEC methodology of design [Author]

2.2. The Methodology Steps

The methodology steps for achieving the integration between urban design and architecture design in the process of generating the design of plan ordered in 7 steps:

Step 1: Site Analysis

The designer analyzing two factors: the first is the connection elements between the urban context and the building (mentioned in section 2.1), the second is the skewing of the building from the surrounding streets and the Qibla direction, and according to that he could generate the layout design and determine the mass composition.

Step 2: Visual Design: Placing the Minaret/Dome

In the visual design the visual harmony between the building and its urban context occurred through three elements: the entrance, the minaret and the dome, this step ended with placing the two urban visual connection elements (minaret and dome).

Step 3: Placing the Entrance

Step 4: Placing the Courtyard

The designer started firstly with the Courtyard because it is for the Mamluk architect is the backbone of the building which all components revolved around it.

Step 5: Placing the Four Iwans

Step 6: Placing the Corridors

a) Complete the Architectural Functions Relationships, b) Placing the Corridors

Step 7: The Final Design of the Building Plan

Table 6 demonstrates the sequences and the relationship between the different steps of the methodology of design in urban context.

Table (6) The PMEC methodology of design in urban context' steps

	Step 1	P	Site Analysis
Urban design	Step 2 and 3	M	Visual Design
		E	
Architectural Design	Step 4, 5, 6, 7	C	1- Placing the Courtyard/the four Iwans 2- Placing the Corridor 3- Placing the architectural components

Source: [Author]

3. APPLIED STUDY

The research applied the suggested “PMEC” methodology of design in urban context on ten of the case-study buildings, as shown in figure 23.

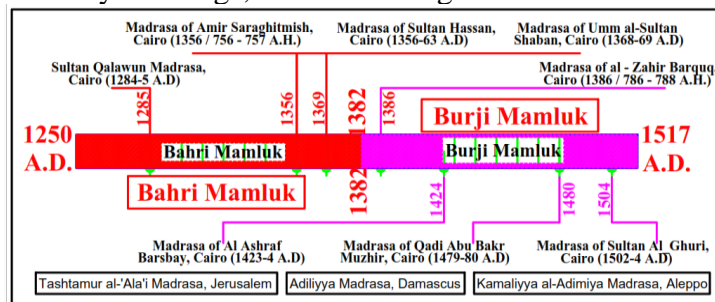
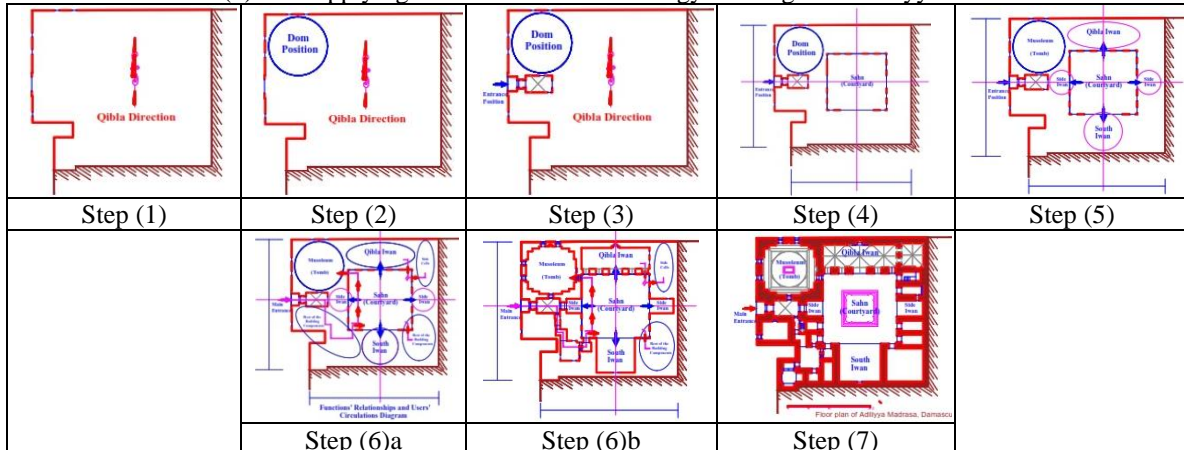


Fig. 23 The Case-Study Buildings [author]

3.1. Adiliyya Madrasa - Damascus (1215/611 AH)

Table (7) demonstrates the applying of the PMEC methodology of design in urban context on Adiliyya Madrasa - Damascus (1215/611 AH).

Table (7): The applying of the PMEC methodology of design on Adiliyya Madrasa

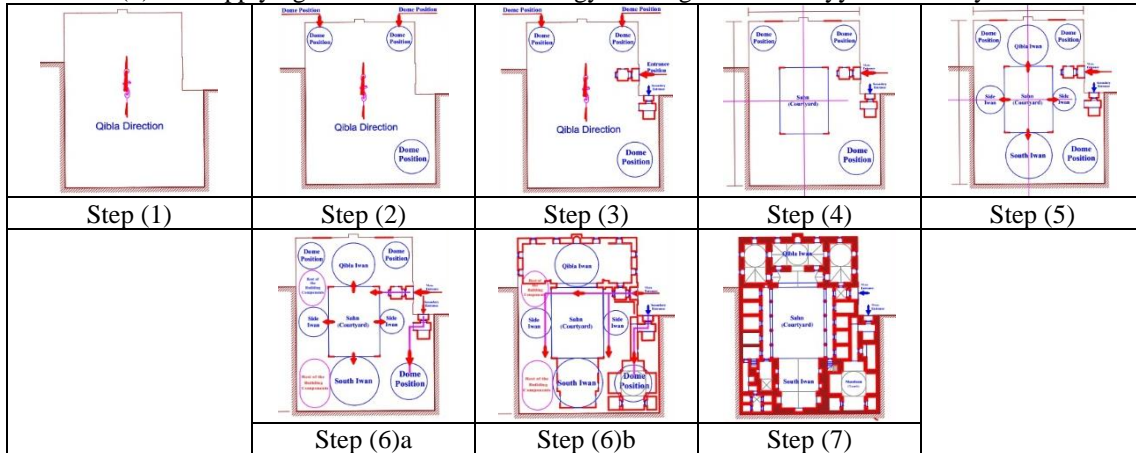


Source: [Author]

3.2. Kamaliyya Al-Adimiya Madrasa – Aleppo (1241/639 AH)

Table (8) demonstrates the applying of the PMEC methodology of design in urban context on Kamaliyya Al-Adimiya Madrasa – Aleppo (1241/639 AH).

Table (8): The applying of the PMEC methodology of design on Kamaliyya Al-Adimiya Madrasa

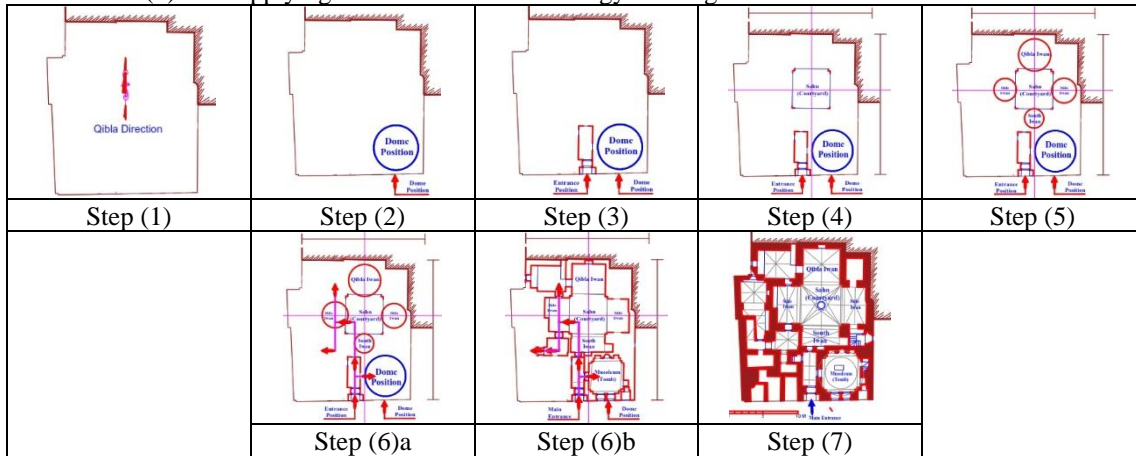


Source: [Author]

3.3. Tashtamur Al-Alai Madrasa - Al-Qudss (1382/784 AH)

Table (9) demonstrates the applying of the PMEC methodology of design in urban context on Tashtamur Al-Alai Madrasa - Al-Qudss (1382/784 AH).

Table (9): The applying of the PMEC methodology of design on Tashtamur Al-Alai Madrasa

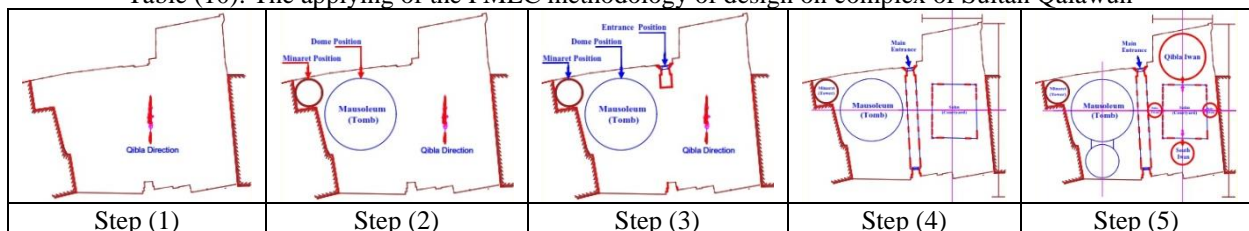


Source: [Author]

3.4. Complex Of Sultan Qalawun – Cairo (1284/683 AH)

Table (10) demonstrates the applying of the PMEC methodology of design in urban context on Complex of Sultan Qalawun – Cairo (1284/683 AH).

Table (10): The applying of the PMEC methodology of design on complex of Sultan Qalawun



Step (6)a	Step (6)b	Step (7)

Source: [Author]

3.5. Madrasa Of Emir Sarghitmish – Cairo (1356/757 AH)

Table (11) demonstrates the applying of the PMEC methodology of design in urban context on Madrasa Of Emir Sarghitmish – Cairo (1356/757 AH).

Table (11): The applying of the PMEC methodology of design on Madrasa of Emir Sarghitmish

Step (1)	Step (2)	Step (3)	Step (4)	Step (5)
	Step (6)a	Step (6)b	Step (7)	

Source: [Author]

3.6. Complex Of Sultan Hasan – Cairo (757-764 AH)

Table (12) demonstrates the applying of the PMEC methodology of design in urban context on Complex Of Sultan Hasan – Cairo (757-764 AH).

Table (12): The applying of the PMEC methodology of design on Complex of Sultan Hasan

Step (1)	Step (2)	Step (3)	Step (4)	Step (5)	Step (6)a	Step (6)b	Step (7)

Source: [Author]

3.7. Madrasa Of Al Zahir Barquq – Cairo (1386/786 AH)

Table (13) demonstrates the applying of the PMEC methodology of design in urban context on Madrasa Of Al Zahir Barquq – Cairo (1386/786 AH).

Table (13): The applying of the PMEC methodology of design on Al Zahir Barquq Madrasa

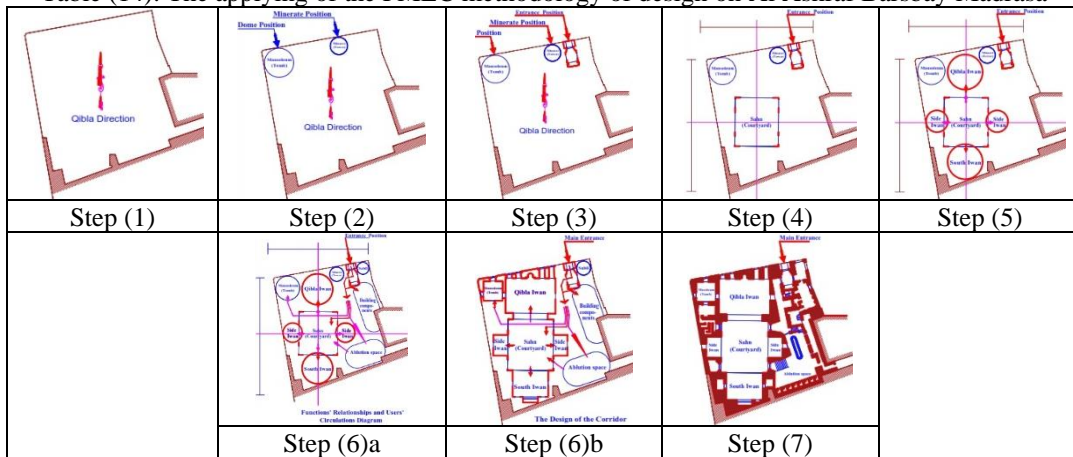
Step (1)	Step (2)	Step (3)	Step (4)	Step (5)	Step (6)a	Step (6)b	Step (7)

Source: [Author]

3.8. Sultan Al Ashraf Barsbay Madrasa – Cairo (1425/827 AH)

Table (14) demonstrates the applying of the PMEC methodology of design in urban context on Sultan Al Ashraf Barsbay Madrasa – Cairo (1425/827 AH)

Table (14): The applying of the PMEC methodology of design on Al Ashraf Barsbay Madrasa

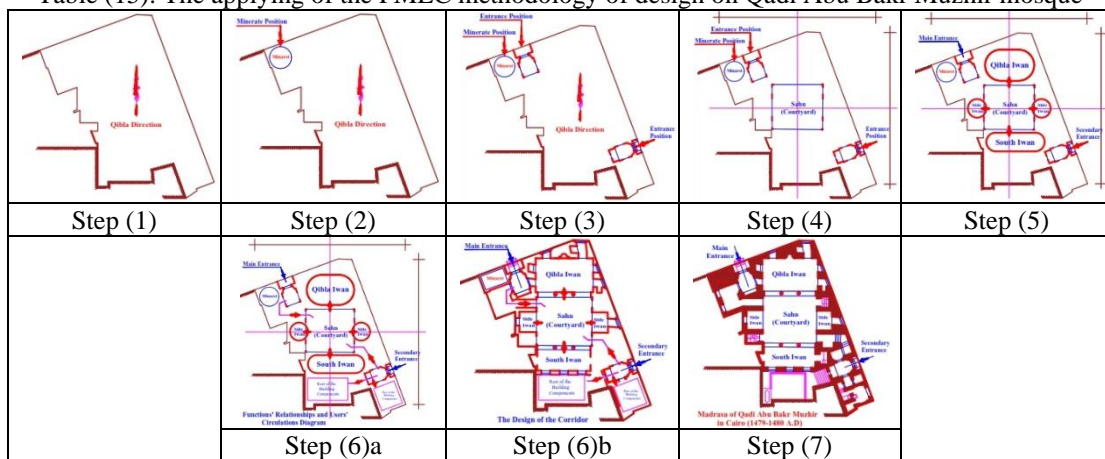


Source: [Author]

3.9. Mosque Of Qadi Abu Bakr Muzhir – Cairo (884 AH)

Table (15) demonstrates the applying of the PMEC methodology of design in urban context on Mosque Of Qadi Abu Bakr Muzhir – Cairo (884 AH).

Table (15): The applying of the PMEC methodology of design on Qadi Abu Bakr Muzhir mosque

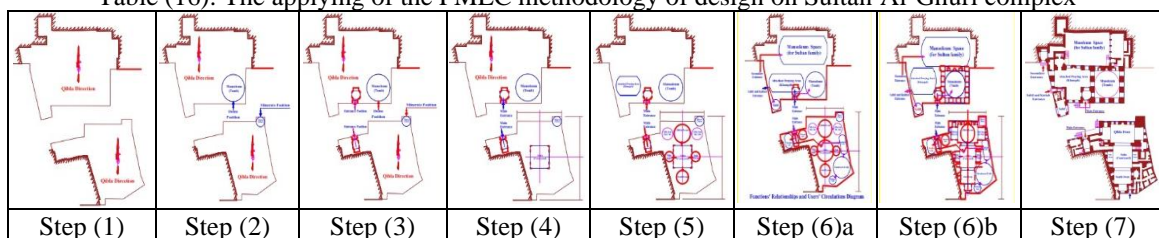


Source: [Author]

3.10. Complex Of Sultan Al-Ghuri – Cairo (909-910 AH)

Table (16) demonstrates the applying of the PMEC methodology of design in urban context on Complex Of Sultan Al-Ghuri – Cairo (909-910 AH).

Table (16): The applying of the PMEC methodology of design on Sultan Al-Ghuri complex



Source: [Author]

4. RESULTS

The main results of the research can be summarized in the following six points:

1) The Mamluk strategies of design-idea generation is an area in which no general theory seems to exist, this research introduces the idea of the design decisions for partial solutions of design problems, by which the Mamluk designer/architect utilizes assistance during the design process and from these partial design decisions of partial solutions, the overall design of the building can be derived

2) The Mamluk architect relied on a design models which are architectural spaces fixed in their composition and formation and in the process of solving architectural design problems he relied on “the simplification, analytically and integrative approach”. He started with simplifying the design problem into a group of problems, then he developed partial solutions for each sub-problem, and finally he integrated these solutions to produce the overall solution to the basic problem.

3) Linearity is an important design criterion in Islamic architecture and in Mamluks eras it was used as a design tool specially in the design of paths, minarets and corridors, for example corridors for Mamluk architects not a two-dimensional functional space, but he designed it as a dynamic-volumetric three-dimensional space, so that the research emphasized that the paths/entrance/minarets as an urban/architecture element is the underlying social generator of physical diversity in the design of the urban context.

4) The “Outside-Inside Approach of Design”, is an effective tool in designing the complex buildings., and the Mamluk architect in his ‘PMEC Methodology of Design in Urban Context’ depended mainly on it, and this explained why he started the design process from outside from site analysis in light of urban context and go deeply inside the building till he reaches the courtyard (the design hidden generator factor).

5) In Mamluks architecture design ideas and their exploration process was goal-directed, derived from the urban design vision of architect. The research explored the partial design decisions from which design ideas emerged, and built the links between design idea emergence and design solution direction, and from this notion the research suggested the “PMEC” Methodology of Design”, which is a systematic applying of visual design principles and urban design rules beside architecture design basics in building design.

6) “A Journey Through A Building”

The ”PMEC” methodology of design specified four elements composed the visual image of the building, and in order to understand the role of these elements in shaping the visual image of the building beside the serial vision of the path the research presents a journey through a building. This journey depended on the stopping of the viewer on four positions and in each position the research presents the visual image from this point :

- The first position: the viewer stood away from the building; here the role of the path appeared in connecting between all the buildings through the path.
- The second position: the viewer stood near the building; here the role of the minaret appeared in connecting the viewer with the building.
- The third position: the viewer stood in front of the building; here the role of the entrance appeared in connecting the urban space with the inside architectural space.
- The fourth position: the viewer stood after passing the entrance; here the role of the corridor appeared in conveying the users into the courtyard which is the heart of the building which connecting him with all building different spaces

The journey applied on the Complex of Sultan Qalawun, as in figure 24.

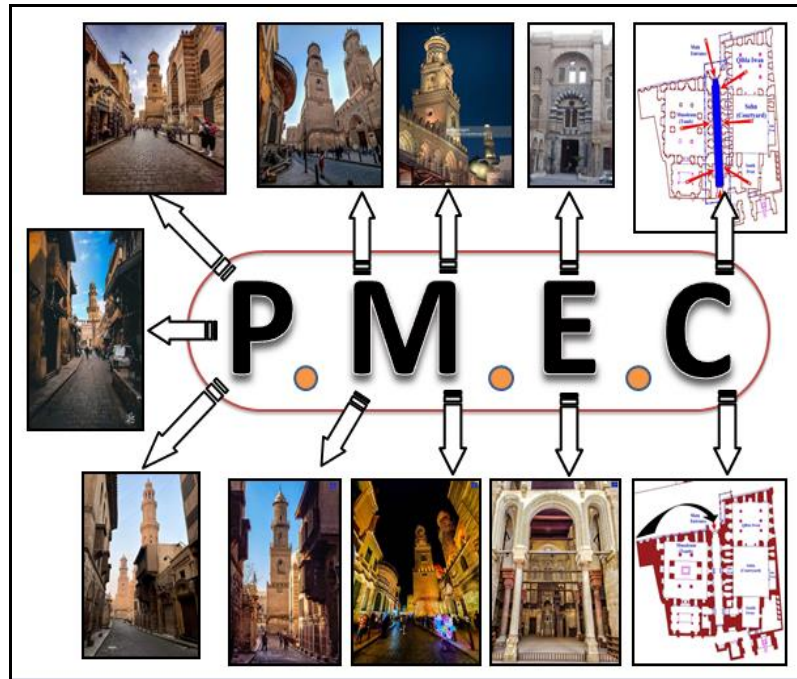


Fig. 24 A journey through the Complex of Sultan Qalawun in El Muiz street in Cairo [Author]

The research conclusion can be summarized as follows:

The most garanti for the success of the architecture design of the buildings in the level of functionality and composition is the design of the building in its urban context (not in isolation of its urban context). The research introduced a new approach of design extracted its roots and principles from Islamic architecture, it is a two dimension modeling system it has 1) effective assistance for the user to improve the conceptual designing through facilitating a discourse of his/her design ideas masses, and 2) various applications into many areas of initial design ideas of the design process. In view of the previous investigated results, the research forms a better understanding and a solid basis of innovative specific processes for generating design-ideas alternatives in initial phases of the design process.

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