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Study of The Minaret Location In The Context of Main Styles of Mosques: A Geometric-Thematic Analysis

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Abstract:
Mosque or Masjid is a place of worship for Muslims. The minaret is one of the structural components of the mosque that is used for Adhān (call to pray). Chronologically, the minaret occupied different locations in the mosque. There is a lack of research about the location of minaret within the layout of the mosque context. The current research aims to investigate the position of the minaret(s) within the context of mosques based on five main layouts of known mosque styles. It also investigates whether there is a relationship between the number(s) of minarets and their location(s). As a methodology, the study adopted geometric-thematic analysis based on codes to determine the types of minaret placements. The results show twelve models for the locations of the minarets, which vary between the prayer hall, the courtyard, the entrance, and the rooftop. It is concluded that some types recurred, and others exist only once. The research reveals that there is no relationship between the number(s) of minarets and their location within the mosque layout design.
Keywords: *Minaret, Thematic Analysis, Comparative Analysis; Mosque Architecture; Mosque Structure; Mosque Typology; Historical Mosques.*

1. Introduction

According to Merriam-Webster dictionary, “style” means “a particular manner or technique by which something is done, created, or performed” while the word “typology” means “study of or analysis or classification based on types or categories” [1] . The mosque or Al-Masjid is a place for worship in the Islamic religion. The mosque usually stems mainly from a prayer hall, mihrab, minbar, ablution area, and minaret. Prayer halls are usually oriented towards Mecca which is the qibla direction. Mihrab is a niche from the qibla wall to indicate the qibla direction. The praying space is either inside a hall or outside in a courtyard. Whereas , the Minbar is a high platform close to the mihrab in the prayer hall where the imam gives his speech to audiences. An ablution area is a place near restrooms where prayers get ready before entering the prayer hall by washing parts of their body with water. While the minaret function is for Adhān (calling for praying in Islam) [2–5]. It is “a place from which the time of prayer is announced". The minaret has several synonymous names: manarahthe , sauma’ah, midhanah. The variety of names refers to their origins and functions.The Minaret is an essential part of the mosque’s structural components.

In the history of mosques in Islam, the earliest mosque was Prophet Muhammad's (PBUH) mosque. Despite having skills for building a minaret, it was without a minaret. Because no place was proposed for building such a structural element [6, 7]. In Islam, the first Muezzin (a person who calls for prayer) was Bilal. He was demanded by the Prophet (PBUH) for calling for prayer. Bilal gave Adhān from the top of high places to be seen and heard by people who live in Mecca at that time. The idea of Adhān in Islam was from the Jew's horn (a metal tube instrument that is narrow from one side and wide on the other side) and Christian's Nāqūs (a wooden shelf or bell) .The Christians and Jews adopted those instruments for calling for their prayer time, whereas Muslims tried Adhān for announcing praying time [8, 9] After Prophet Muhammad (PBUH) many Caliphas authorized the Islamic community each of them on different periods. Thus, different styles in mosque architecture appeared. Studies deliberated and mentioned different styles of Islamic architecture. The most known styles of Islamic architecture are Marrakech, Andalusia-style, Fatimid-style, Ayyubids style, Mamluk style, Seljuk style, Persian Mughal style, Safavid style, Mughal style- India, Mughal-style Turkish, Ottoman style, Model in Afghanistan, Umayyad, Abbasid and, Timurid style [5, 10, 11]. While Hillenbrand classified the styles as Turkish style, Arabic style, and Persian style [12]. Another study classified the mosque styles into five further patterns: Hypostyle pattern, Iwan pattern, Central dome pattern, Multi dome pattern, and Triple dome with a large courtyard [13].

Some research linked the impact of traditional minaret design on the contemporary architecture of minaret. Through investigating Visual and spiritual function, number, prominence, placement of the minaret to the mosque, minaret's main components, and minaret's decoration; the studies found that being successful in meeting the visual requirements of the mosque and less success in showing spiritual functions The findings indicate that the minaret continues to play an important role and is considered a significant element in contemporary mosque architecture. The minaret's prominence within mosque design is dependent on its number, location, size, articulation, and decoration's subtlety [14–16]. The usage, of the formal and functional transformation of minarets in contemporary mosque architecture in Turkey, is also explored in contemporary minaret architecture. On this basis, the main elements, organization schemes, and planning setups of the Classical Ottoman Mosque are still preserved in Turkey. The novelty brought to their design is the usage of modern materials and techniques and a formal exploration of mosque design [17]. Other studies focused on the materials used in the construction of minaret. The finishing materials of minarets were mainly wood and stone. Historical masonry minarets were modeled using the finite element method. In addition to stress distribution in the minarets under different loading conditions, periods, and displacement [18,19]. Astrini et al. [20], through their study, tried to Identify the variety of minaret design elements in mosque architecture in Malang City, understand people's preferences for the composition of the minaret design elements, and analyze the characteristics of minaret based on community preference on the composition of mosque architecture in Malang City. The results showed that the preferred characteristics of the minaret are; the shape of the minaret is a conical octagon; the shape of the minaret head is a top dome; the number of minarets is two; it has an ornament; the minaret structure is separate from the mosque building and; has an opening.

In the beginning of introducing the mosque to the Islamic community, it was without a minaret. Many mosques constructed after the prophet's mosque under the supervision of Caliphas ruled around the world. During their dynasty, they tried to add minaret(s) for the mosque context. Chronologically, the minaret took different shapes, numbers, and placements within the mosque area. None of the studies tried to collect the styles of the mosques and compare them in terms of minaret location. Based on the last classification done by Ali & Mustafa, [13]; which concentrates on the typo morphology of mosques depending on the prayer hall's various shapes and forms which represent the main element in

illustrating mosques' pattern. The current research aims to highlight the common placements of the minaret concerning the five main layouts of mosques' general configurations. The research tries to find a typology for minaret locations based on historical mosques by using qualitative methodology. The current research tries to investigate the placement of minarets in historical mosques. The research answers the following questions:

- Where was the location of the minaret(s) within the mosque context in those patterns?
- Is there a relationship between the number of minarets and their location?

2. Methodology

The current research relied on the qualitative method for answering the research question. This is a subjective measuring method applied in research to give interpretations [21]. The research mixed between geometric method and thematic-analysis method based on code. Geometric methods were used initially for the recognition of objects [22–24]. The notion of geometry in this study refers to transferring the structural components of the mosque to geometrical shapes for indicating the location of the minaret within the context of the mosques, the purpose of easier interpretations. In this method, the authors applied AutoCAD software as a tool for analyzing floor plans. In the first step, the floor plan was divided into two main rectangles which were the prayer hall and courtyard, or one rectangle if the mosque was without a courtyard. Each related component of the mosque for the current study is represented by a geometric shape. A square showed the minaret, and a circle indicated the mihrab location; whereas smaller rectangles were adopted for showing entrances location. Then two axes of X and Y passed on the floor plan. The Y-axis was centralized to the Mihrab location, while the X-axis was centralized in a horizontal direction.

The thematic analysis mainly identifies analyzes then gives an interpretation of identified data. This method is adopted when there is a pattern that needs to be recognized. It gives codes to objects for analysis [21,25]. In the current research, two kinds of codes were given by the authors for the drawings. The first part belongs to the geometric shapes which identify the components within the context of the mosque. The prayer hall rectangle was coded as (A, B, C, D) and the courtyard rectangle was coded as (1, 2, 3, 4). The blue square color was used for showing the minaret location. The circle which showed the position of Mihrab was colored in magenta while green-filled rectangles were used for showing the prayer hall entrance and orange-filled rectangles were used as a sign for the main entrance of the mosque. In the second part, coding was given for each mosque layout to identify the typology of the minaret location. The word 'Type' which followed the English alphabet prefixes was given for each different placement condition.

The conditions achieved from this method were analyzed by a matrix. The matrix represents a set of conditions arranged in rows with a set of cases arranged in columns to find the relationship between them [26]. Then, the research compares the cases in terms of the number of minaret and their location.

2.1 Case Studies

The study samples were selected based on the five styles of mosques as mentioned in the study Ali & Mustafa, [13]. The five styles were (hypostyle, iwan style, central dome style, multi dome style, and triple dome with large courtyard style). In each style, three mosques were selected. The case studies as shown in Fig. 1. are located in different regions such as Tunisia, Egypt, Mali, Turkey, Iran, Uzbekistan, Pakistan, India, and Bangladesh.

The study described the location of the minaret for each case of the selected mosques within its style. This part represents a description of the characteristics of the existing situation [27]

Figure 1: Samples location (1)Tunisia, (2)Egypt, (3)Mali,(4)Turkey,(5)Iran,(6)Uzbekistan, (7)Pakistan, (8)India, (9)Bangladesh (Authors).

2.2 Five Main Styles of Mosques Layout Configuration

Due to the classification of Ali & Mustafa, [13], there were five main styles of mosques' general layout configuration. For each style, a table was created which illustrates the mosque's floor plan, 3D views, and a description for the case.

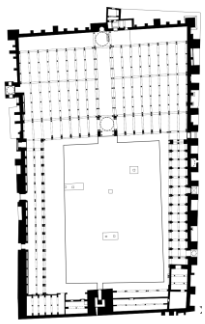
2.2.1 Hypostyle

The origin of this style started from Arab mosques, it's an Arabian style. Where the prayer hall and other rooms around the courtyard were shaped by rows of vertical support beams or columns. This style spread widely around the world. This style was seen in mosques of the Umayyad, Fatimid, and Abbasid dynasty periods [4,17]. As shown in Table 1, three mosques were selected to illustrate the minaret location in this style. The mosques were (The Great Mosque of Kairouan, Al-Azhar mosque, and The Great Mosque of Djenné). The floor plans consist of a courtyard and a hypostyle prayer hall which was structured by columns in both directions.

3.2.2 Iwan Style

The word '*Iwan'* in Persian means 'open gallery, portico, place or porch'. In architecture, *Iwan* is a rectangular hall or space, usually vaulted, walled on three sides, with one end entirely open. The formal gateway to the *Iwan* is called Pishtaq, a Persian term for a portal projecting from the facade of a building, usually decorated with calligraphy bands, glazed tilework, and geometric designs. The current style was the Persian style [31, 32]. As shown in Table 2, the three mosques selected for this style were (Shah Mosque Isfahan**,** Bibi Khanum Mosque, and Mosque of Sultan Hassan)**.**

Table 1: Description of Mosques in Hypostyle (Authors)

Name	Floor plan	3D view	Description
The Great Mosque of Kairouan			The mosque was also known as the mosque of Uqba. It was constructed in 670 AD/CE by Uqba ibn Nafi in Tunisia. The architectural style of the mosque was the Alghlabid style which was built during the Abbasid dynasty. Later the plan was enlarged by different Islamic Caliph ruled Tunisia at that time. There is one minaret

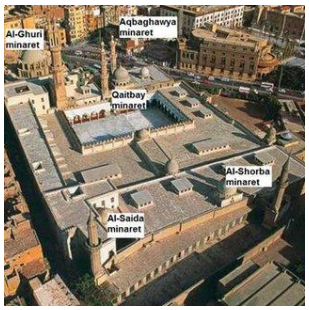
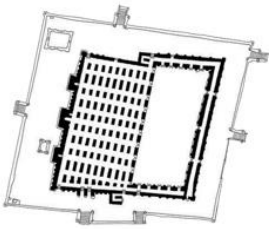
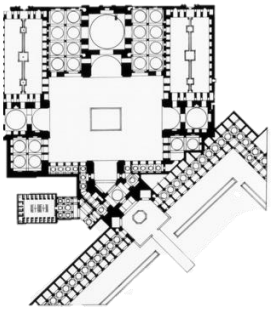
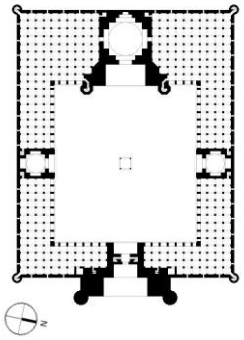
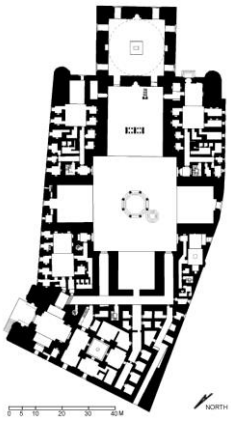
			centered on the Northern façade. Its start date belongs to the Umayyad dynasty in 836. It is one of the oldest minarets. Its location was beside the entrance opposite the mihrab [23, 28].
Al-Azhar mosque			The mosque was built in 972 A.D. in Egypt. Additions and renovations occurred to the mosques during different Islamic rulers. During different eras of Mamluk authorities, three minarets existed on the Northern side of the courtyard. The first minaret was on Aqbaghawya madrasa. The second was Taybarsiyya Madrasa's minaret. Al- Ghuri double ornament minaret was the third minaret. The last two minarets were built to the South side by Ottomans which were Al-Saida and Al-Shorba minarets [29]. In geometric-thematic analysis, only the two Ottoman minarets were considered for analysis.
Great Mosque of Djenné			Its place was in the city of Djenné, Mali. The mosque was constructed in the 13th century. It consists of a prayer hall and courtyard. The qibla wall faces east. Three minarets emerged from the qibla wall. The base of minarets was also used as mihrab [30].

Table 2: Description of Mosques in iwan style (Authors)

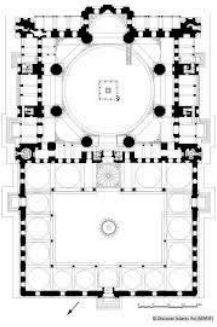
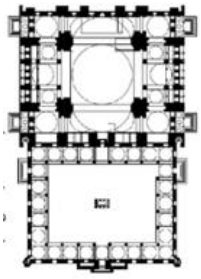
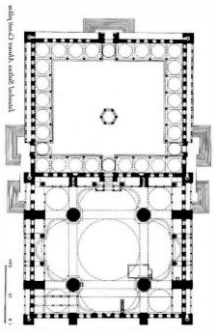
Name	Floor plan	3D view	Description
Shah Mosque Isfahan			The mosque was in Isfahan-Iran. Its construction started in 1612-1638 during the Safavid dynasty. It's an example of Persian architecture and Seljuk style. The mosque had four minarets, two of which were at the main entrance of the mosque. The other two were on the sides of the prayer hall entrance [33].
Bibi Khanum Mosque			The mosque is one of the most known features in Samarkand, Uzbekistan. It was built in the 15th century and it's an example of Timurid architecture. The mosque had a layout of four iwans on the sides of a courtyard with eight minarets. Four minarets were placed at the outer corner. Two minarets were on both sides of the main entrance to the courtyard. While two were located on the sides of the portal arch of the prayer hall entrance, the domed space [34].
Mosque of Sultan Hassan			It's one of the known historical mosques in Cairo, Egypt. Constructed between the years 1356-1363. The mosque style was Mamluk architecture. The mosque had a central courtyard and four iwans around it. It also contains a madrasa and mausoleum chamber. Two minarets stand on both corners of the mosque [35].

3.2.3 Central Dome Style

The dome is one of the structural elements of mosques in Islamic architecture. In this research, a central dome style means the mosques which had a large central dome in the middle of the prayer hall supported and surrounded by half-circle domes. This style was usually found in Ottoman architecture.

This style was very popular in Ottoman architecture [36]. In Table 3, three mosques were selected for this style which was (Selimiye Mosque of Edirne, Suleymaniye mosque, and Sultan Ahmed Mosque).

Table 3: Description of Mosques of Central Dome Style (Authors)

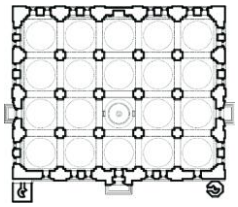
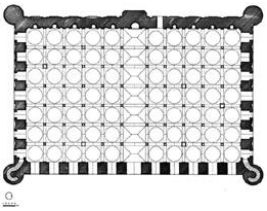
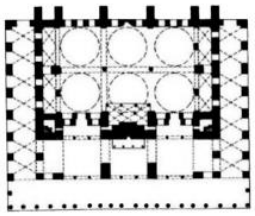
Name	Floor plan	3D view	Description
Selimiye Mosque of Edirne			The mosque was built between 1568-1575 in Edirne, Turkey. It was authorized by Sultan Selim II during the Ottoman dynasty. The mosque has two parts. A prayer hall with a central dome; and an open courtyard in front of the prayer hall. Four minarets were placed on the four corners of the main prayer hall which were considered as some of the tallest minarets constructed during Ottoman authority. The minarets correspond to show the central dome [37].
Suleymaniye mosque			The mosque was constructed in Istanbul during the Ottoman dynasty in the years 1550–57. It has a main prayer hall with a central dome over it and an open courtyard with four corner minarets. The minarets were differing in height. Two minarets adjacent to the prayer hall were higher than the two other minarets on the opposite side of the courtyard [38].
Sultan Ahmed Mosque			The blue mosque of Sultan Ahmet was located in Istanbul. It was built between the years 1609-and 1616 by Ottoman rulers. The mosque has a main prayer hall with a dome in the center as well as four minarets on the four corners. The other part of the mosque is a courtyard with two additional minarets on its outer wall. The mosque had six pencil minarets in total. The six minarets were for *Adhān* 's purpose at each corner [35,39].

3.2.4 Multi-dome Style

It’s another style of the mosque where the prayer hall is rectangular and covered by more than one dome. In other words, small domes were arranged in both directions. In this style, it's hard to find a distinctive dome, usually the domes are of the same size [40]. The three examples (Ulu Mosque of

Bursa, Sixty Dome Mosque, and Piyale pasha mosque) clearly illustrated this style, as shown in Table 4.

Table 4: Description of Mosques of Multi dome style (Authors)

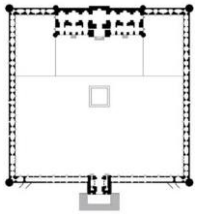
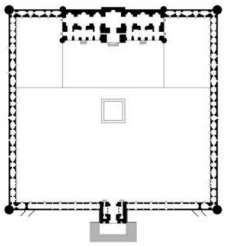
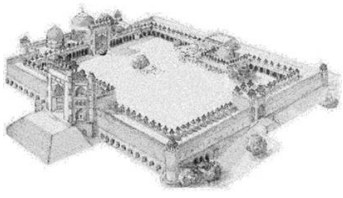
Name	Floor plan	3D view	Description
Ulu Mosque of Bursa			The mosque was one of the early monuments of Ottoman architecture. It was constructed in the years 1396-1399 in Bursa, Turkey. The mosque had twenty domes. However, it had three entrances, but the main entrance was located on the façade that had two minarets in front of it [41].
Sixty Dome Mosque			The mosque was Khan Jahan style and Tughlaq style, built by Ulugh Khan-i-Jahan in 1459 in Bagerhat, Bangladesh. Also, known as Shait Gambuj Mosque or Saith Gunbad Masjid. The mosque had seventy-seven domes on the prayer hall roof and four other domes on the top of four minarets on each corner. The total number of domes was eighty-one domes [42].
Piyale pasha mosque			It's also known as Tersane Mosque. It was built in the 16th century between the years 1565-1573 in Istanbul, Turkey. It's Ottoman architecture. The mosque had six domes and a single minaret stands in the middle of the wall that was opposite to the qibla wall but parallel to the entrance wall [43,44].

3.2.5 Triple Dome with Large Courtyard Style

In this style, the mosque has a rectangular prayer hall and a huge area of courtyard. There is one large dome in the center of the prayer hall and two smaller domes on the sides of the central dome. In this style, there are one or more main entrances for the courtyard, because the courtyard functions as

a gathering area for prayers. The courtyard in this style is larger than the prayer hall by three to four times. The current style can be seen mostly in India-Mughal styles [45]. The features of this style are obvious in the mosques of (Jama mosque-India, Badshahi mosque, and Fatehpur Sikri Mosque-Agra) as stated in Table 5.

Table 5: Description of Mosques of Triple dome with large courtyard style (Authors)

Name	Floor plan	3D view	Description
Jama Mosque, India			It's also known as Masjid-i-Jehan-Numa which was located in Delhi, India. The mosque was constructed between the years 1650-1656. The style of the mosque is Mughal architecture. The mosque had three main entrances to a courtyard. There was a prayer hall with triple domes and two minaret stands on both front façade corners [46].
Badshahi mosque			The mosque was constructed in the years 1671-1673 in Lahore, Pakistan. The style of the mosque was Mughal and Indo-Islamic architecture. The mosque had only one entrance to the courtyard. Four octagonal minarets were standing on four corners of the prayer hall which had triple domes on its roof. While four more minarets were placed on the four corners of the courtyard [47].
Fatehpur Sikri Mosque, Agra			The mosque was in India. It belongs to Mughal architecture which was built in the 16th century. The mosque had one main gate and another secondary gate to the courtyard. The prayer hall had a triple dome and two minarets placed in the back corner of the main prayer hall. Also, there were two other minarets at the front corners of the courtyard façade [48].

4. Findings and Discussion

4.1. For answering the first research question each three cases were analyzed within its main style.

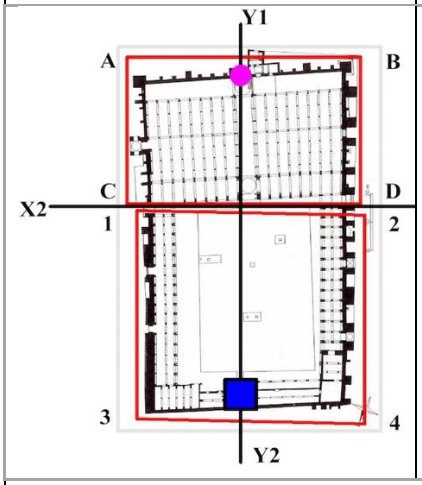
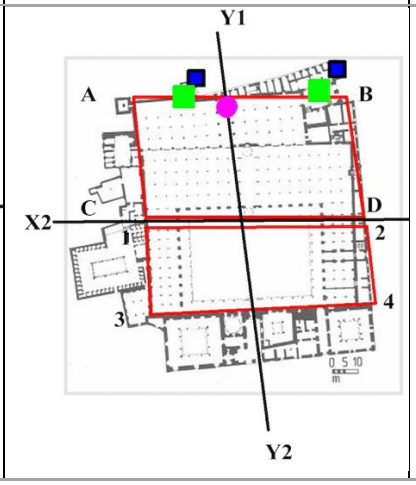
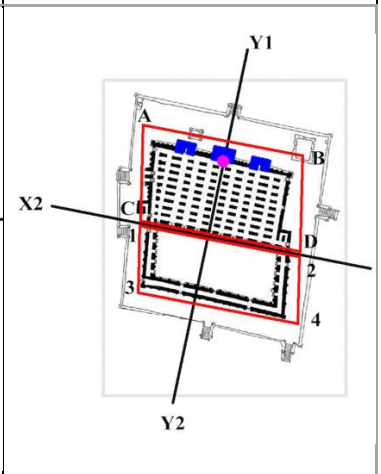
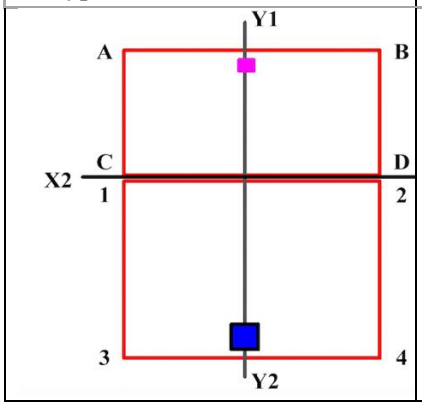
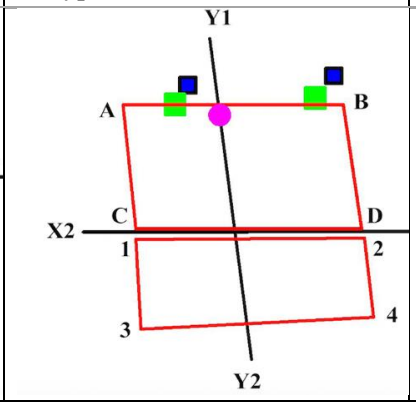
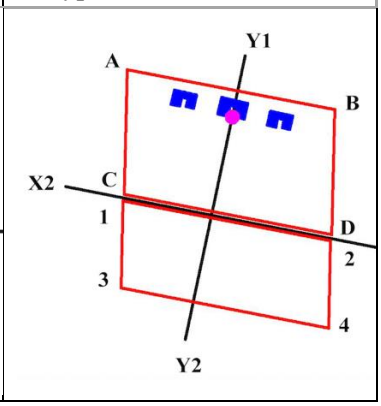
4.1.1 Hypostyle Pattern

From Table 6, a set of different minaret placements were observed. The minaret of the Great Mosque of Kairouan is placed opposite the mihrab. It was within the courtyard circumference in the middle of points 3 and 4. Where the Axis of Y1-Y2 passed from it. At that time, this feature had a visual impact on the viewers from surrounding urban areas. In Al-Azhar mosque, five minarets were noticed. But for analysis, only two minarets of the Ottoman dynasty were considered. The two minarets were on the Southern edge of the mosque. One of them is the Saida minaret which indicated the Bab Al-Saida entrance and the other one was referred to as the Shorba minaret which was with the Bab Al-Shorba entrance. The two entrances belong to the main prayer hall from the A-B side. In the Great Mosque of Djenné, the three minarets were bulged from the main wall. They were indicating the qibla. In other words, those minarets were merged with the mihrab. The Y1-Y2 axis is passing from the center of the prayer hall. From the hypostyle layout, three types of locations were achieved. A-Type was the minaret opposite Mihrab. B-Type minarets with prayer hall entrance. C-Type minaret within mihrab.

4.1.2 Iwan Layout

In the Shah Mosque, four minarets were observed. As illustrated in Table 7, two of the minarets were beside the main entrance of the mosques which were colored orange. They were between the X2-Y2 axis. Which indicated its inclination from the central line of mihrab Y1-Y2. From the green rectangle, which represents the entrance to the main prayer hall, also two blue squares can be noticed on both sides. These minarets were within the (ABCD) rectangle which represents the main prayer hall. There was no minaret in the courtyard (1234). While in the Bibi Khanum Mosque, eight minarets were observed. Four of them were on the outer corners of the main prayer hall (ABCD). But there was no minaret in the inner corners which was signed as (1234) representing the courtyard. The main building is shown as an orange rectangle where two minarets were placed on the sides of the portal arch. The last double minarets on both sides of the green rectangle introduce the main prayer hall. It’s seen that the by-passing Y1-Y2 and X1-X2 axis from the center of the mosque a symmetrical location for minarets achieved. The two minarets of Sultan Hassan's Mosque were standing at the corners of the main building. Because they were neither on the (ABCD) rectangle of the main prayer hall nor on the (1234) rectangle of the courtyard. But they were on the same line as (AB). The one to the right side of the prayer hall indicates the entrance of the sultan to the madrasa. From this layout B- Type and D-Type were repeated. E-Type belonged to minarets on four corners of the main prayer hall. While F-Type was for two minarets on the main building corners.

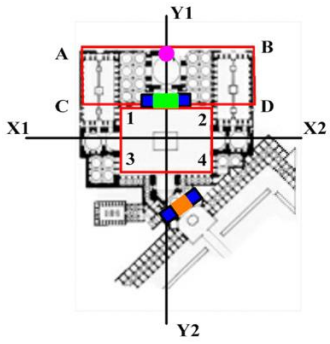
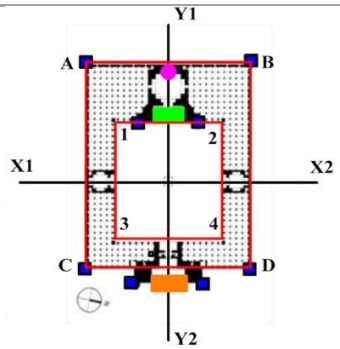
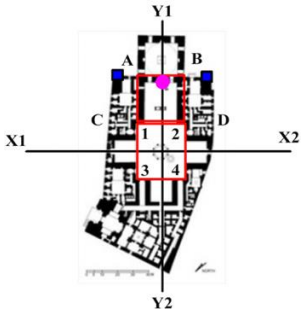
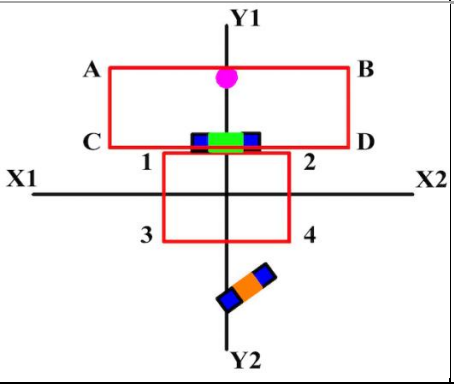
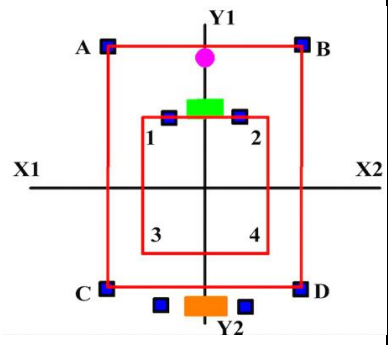
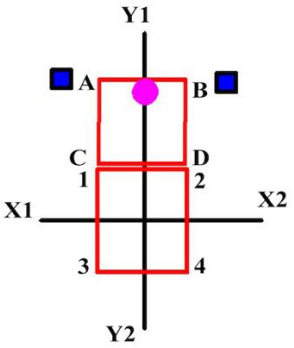
Table 6: Location of the minaret in hypostyle layout (By Authors)

Great Mosque of Kairouan	Al-Azhar Mosque	Great Mosque of Djenne
		
Minaret Mihrab Prayer Hall entrance		
A-Type	B-Type	C-Type
		

4.1.3 Central Dome Layout

As shown in Table 8, the four minarets of Selimiye Mosque of Edirne are on the four corners of the prayer hall (ABCD). whereas no minarets were seen in the courtyard (1234). The four minarets are located symmetrically on both sides of the Y1-Y2 axis. Two of them are to the North-East between Y1-X2 and the other two to the North-West between Y1-X1. Whereas four minarets of Suleymaniye Mosque of Istanbul are placed on the outer corners of the courtyard. This is opposite to Selimiye Mosque of Edirne. Two of them are between X1-Y2 and the other two were between X2-Y2. In addition to those, another sample of the Central Dome layout was the Sultan Ahmed Mosque of Istanbul. In this case, six minarets were observed. Four minarets were placed on the corners of the prayer hall (ABCD) and two other minarets were on the corners (3 and 4) of the courtyard's outer corner. Accordingly, two more types are achieved. G- Type, which was four minarets on four corners of the courtyard. H- Type, two minarets on the outer corner of the courtyard. Whereas E- Type is repeated in the mosques of Selimiye Mosque of Edirne and Sultan Ahmed Mosque of Istanbul.

Table 7: Location of the minaret in iwan layout (By Authors)

Shah Mosque of Isfahan	Bibi-Khanum Mosque	Sultan Hassan Mosque
		
Minaret Mihrab Prayer Hall entrance Main entrance		
B-Type, D-Type	B-Type, D-Type, E-Type	F-Type
		

4.1.4 Multi-dome Layout

From Table 9, as seen in Ulu Mosque although both minarets were detached from the prayer hall (ABCD). Both were on the outer side of the (CD) line which was the entrance side. Indicating the façade that contains the main entrance. If a cross axis of Y1-Y2 and X1-X2 passes from the center of the Sixty Dome Mosque four minarets could be observed each of them in one quarter. The four minarets shape the four corners of the prayer hall (ABCD). The only minaret of Piyale Pasha mosque was placed above ground level. The green rectangle represents the entrance on the ground floor while the blue square was the minaret which starts from its top. The minaret was on the same line as the entrance (CD) in the center but opposite Mihrab. Showing the qibla direction. From this typological analysis, two extra locations were detected. I- Type, which has two minarets detached from the prayer hall on the front façade. J- Type J, which was one minaret from the top of the prayer hall's main entrance. And E- Type is repeated.

4.1.5 Triple Dome with a Large Courtyard

In the layout of the Jama Mosque, as shown in Table 10, two minarets on the corners of (C and D) are observed which represent two of the prayer hall's corners. But the courtyard which was bounded by (1234) was without a minaret. While Badshahi Mosque had eight minarets. Four of them are placed on the four corners of the courtyard (1234), and the other four are located on the four corners of the prayer hall (ABCD). In each quarter of Y1-X1 and Y1-X2, three minarets are noticed. While in the quarters to the South, only one minaret was recognized for each. The minarets of the courtyard were

higher and larger than prayer hall minarets. The minarets of Fatehpur Sikri Mosque were different than the previous two samples. It had four minarets, two main minarets were located on the front façade the courtyard on points (3 and 4), and two smaller minarets were on the back façade of prayer hall corners on points (A and B) which completes the prayer hall rectangle. From the last layout of the mosque, two more types were selected. K- Type two minarets attached to the prayer hall's front corner. L- Type, two minarets attached to the prayer hall's back corner. While E- Type and G- Type are repeated.

Table 8: Location of the minaret in Central dome layout (By Authors).

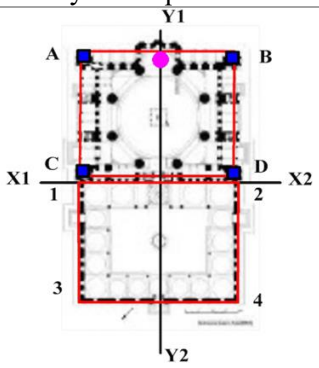
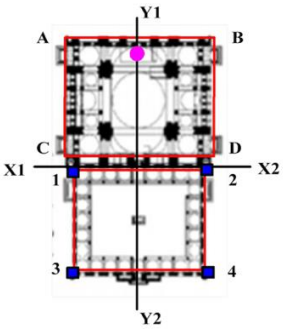
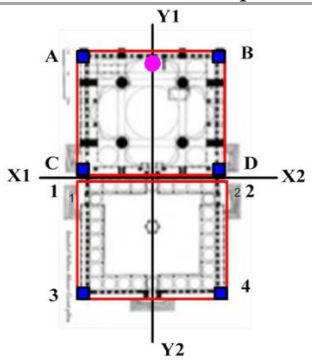
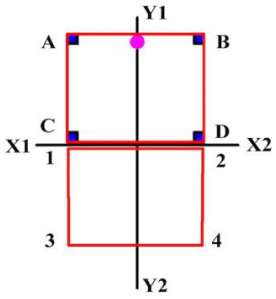
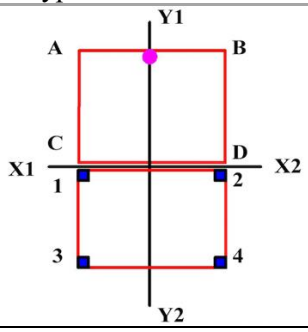
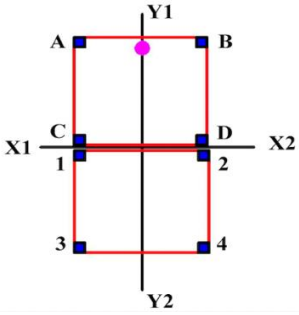
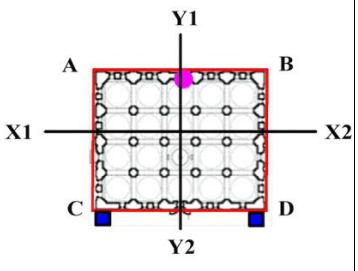
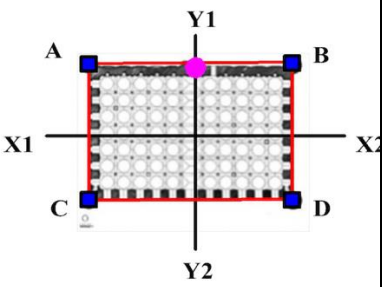
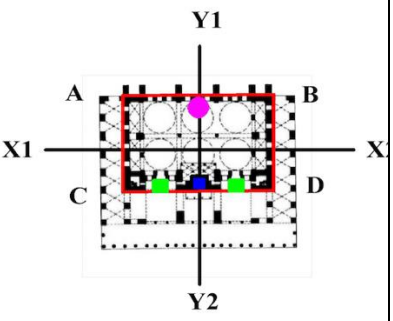
Selimiye Mosque of Edirne	Suleymaniye Mosque	Sultan Ahmed Mosque
		
Minaret Mihrab		
E-Type	G-Type	E-Type, H-Type
		

Table 9: Minaret location in Multi dome layout (By Authors).

Ulu Mosque of Bursa	Sixty dome Mosque	Piyale Pasha Mosque
		
Minaret Mihrab Prayer Hall entrance		
I-Type	E-Type	J-Type

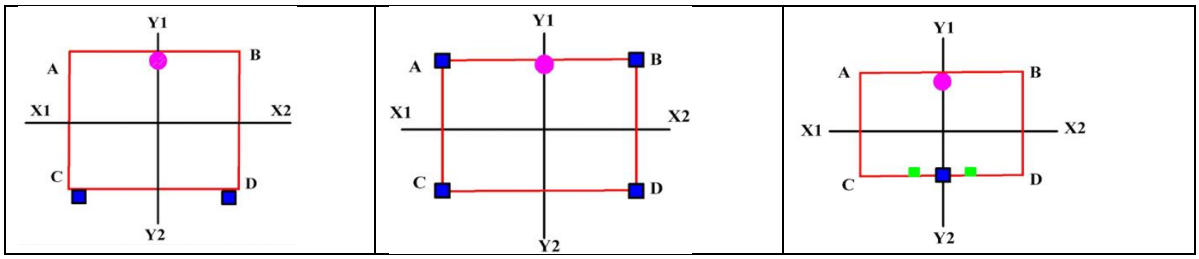
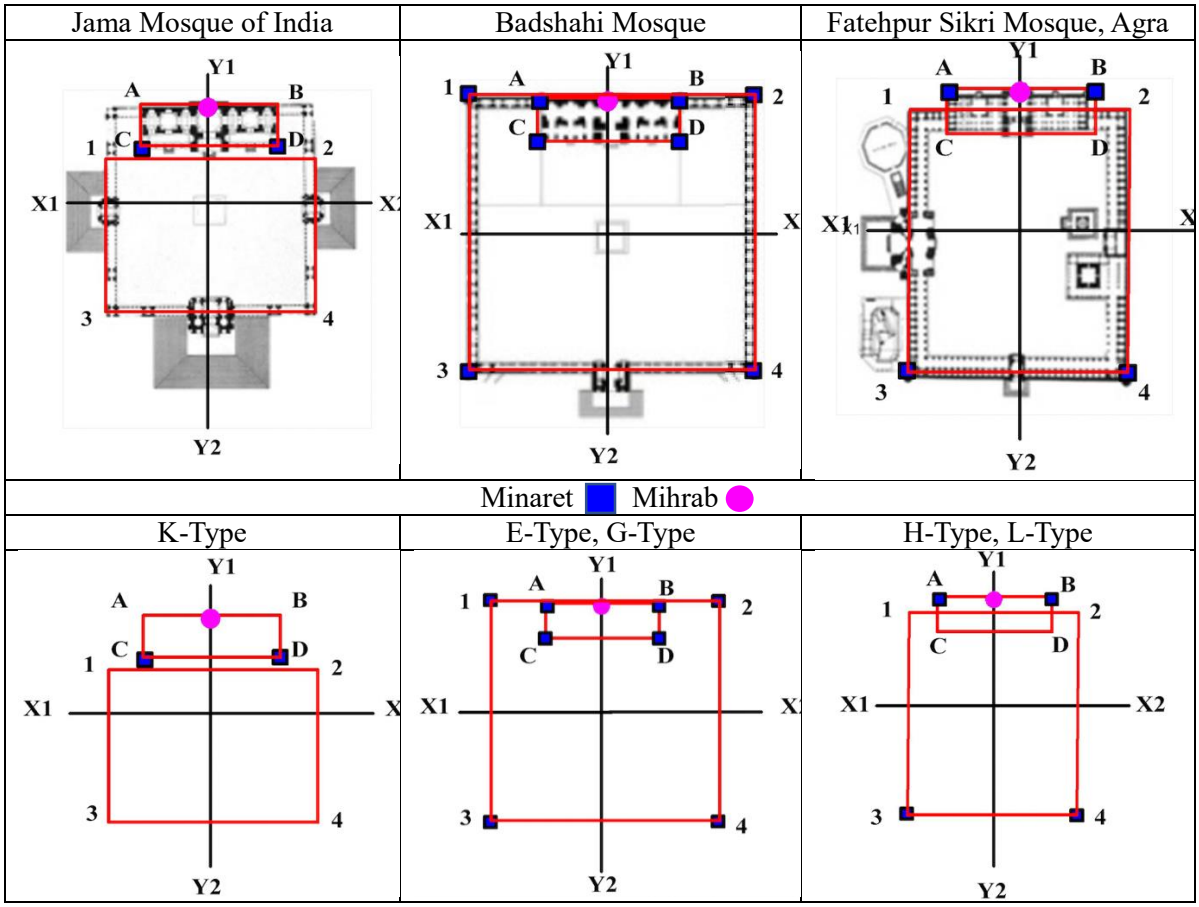


Table 10: Location of the minaret in triple dome with large courtyard layout (By Authors).



4.2. The results were summarized in Table (11) through a matrix. The types and their locations were organized in a row while the mosque names were put vertically to find the relationship.

Table 11: Typology of minaret location in historical mosques' main layouts (By Authors).

Mosques	Type of location											
	A-Type	B-Type	C-Type	D-Type	E-Type	F-Type	G-Type	H-Type	I-Type	J-Type	K-Type	L-Type
	One minaret opposite to mihrab	One or two minarets beside the Prayer hall's entrance	One minaret within mihrab	Two minarets at the main entrance of the building	four corners of the main prayer hall	two minarets on the main building corners	four minarets on four corners of the courtyard.	two minarets on the outer corner of the courtyard	two minarets detach from the prayer hall on the front façade	one minaret from the top of the prayer hall's main entrance	two minarets attached to the prayer hall's front corner	two minarets attached to the prayer hall's back corner
Great Mosque of Kairouan	X											
Al Azhar mosque		X										
Great Mosque of Djenné			X									

Shah Mosque Isfahan		X		X								
Bibi Khanum Mosque					X							
Sultan Hassan Mosque						X						
Selimiye Mosque of Edirne					X							
Suleymaniye Mosque							X					
Sultan Ahmed mosque					X			X				

Ulu Mosque of Bursa									X			
Sixty Dome Mosque					X							
Piyale pasha mosque										X		
Jama Mosque of India											X	
Badshahi Mosque					X		X					
Fatehpur Sikri Mosque, Agra								X				X

5. Conclusion

Based on the results, the locations of minarets are summarized in Table 11. The research comes out with 12 types of locations for minarets within mosque buildings. The most common location for

minarets is on four corners of the prayer hall. It's observed in (Bibi Khanum Mosque, Selimiye mosque of Edirne, Sultan Ahmed Mosque, Sixty Dome Mosque, and Badshahi mosque). All the layouts have a case E-Type except the hypostyle layout. The second repeated locations are B-Type, G-Type, and H-Type. In B-Type, the minarets are close to the main entrance of the prayer hall either one or two, such as in the cases of Al-Azhar mosque and Shah Mosque Isfahan. While in G-Type, four minarets are on four corners of the courtyard: like in Suleymaniye mosque and Badshahi mosque. The last repeated location was H-Type, which can be seen in Sultan Ahmed Mosque and Fatehpur Sikri Mosque, Agra, where two minarets are placed on the outer corner of the courtyard. The other types are observed only once.

There is no consistent relationship between the number of minarets and their location. There are two D-type minarets at the main entrance to the mosque. While in F-Type they are on the back side corners of the main building. In H-Type, two minarets are on the outer corner of the courtyard. Two minarets are mostly located in the prayer hall. In I-Type, they are detached from the front façade of the prayer hall. However, they are attached to the front corners in K-Type. But in L-Type they are attached to the back corners of the prayer hall. Moreover, four minarets are placed either in the four corners of the prayer hall or the courtyard. Furthermore, one minaret is located on the same line as the mihrab. In C-Type, it is merged with the mihrab.

One minaret indicates the direction of the qibla also it has a visual impact on the community. Four corner minarets were used for distributing *Adhān* on four sides to be heard by the remainder of the community. The position of the minaret varies in historical mosques based on the configurational layout of the mosques and the chronology of different styles of Islamic architecture.

6. Authors' Contribution

All authors were involved in the verification of the current research. the author F.Y. did the practical part and the results. The author F.M. proposed the research problem, and the title and supervised the work. While author S.R. was concerned with the theoretical part. All authors discussed the workflow together and contributed in this research to reach the results.

7. Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

8. Acknowledgment

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