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ORIGINAL RESEARCH PAPER

Architectural analysis and evolution of spaces in mosques in Aleppo City, Syria

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ABSTRACT

BACKGROUND AND OBJECTIVES: Since the mosque is one of the most important manifestations of Islamic civilization, it important to examine its spatial structures. The present study aims to identify the main constituent structures of the spaces in mosques and to investigate how they have changed over time, from the early rise of Islam to the contemporary era.

METHODS: It is interpretive-historical research carried out through a case study. The required data are collected using library study and observations. In the present study, Aleppo is selected as the case study due to its significance in Islamic civilization and the originality of the works in it, which have led to the inscription of Aleppo city on the UNESCO World Heritage List.

FINDINGS: The research findings are classified into 5 classes including four historical periods of Umayyad, Ayyubid, Mamluk, and Ottoman, and the contemporary era, based on the similarities of patterns. The results indicate the changes in the structures of mosques from functional (especially devotional) combinations of open, roofed, and closed spaces to the merely closed space and the changes in the center of the structure from the courtyard (open space) to the domed Shabistan (closed space).

CONCLUSION: The pattern of the worship space has changed from columnar Shabistan to domed Shabistan. Shabistan and minarets are the most stable spaces in the spatial structure of mosques from the Ottoman period to the present. In the contemporary period, roofed and open spaces have transition and service functions, respectively and open spaces are most unstable in the spatial structure of mosques.

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INTRODUCTION

Since the mosque is one of the most important manifestations of Islamic civilization, it is very important to examine its spatial structures to the extent that some researchers have considered the central mosque as one of the most important features of the Islamic city (Raeesi, 2018). The present study aims to fill the gap in the study of the main constituent structures of the spaces in the mosque (in this research, specifically in Aleppo city) and how they have changed over time, from the early rise of Islam to the contemporary era. So, it attempts to identify applied and original spatial and structural patterns. Although the morphology of Aleppo city has been studied in some studies (Neglia, 2020), the physical and spatial changes in the mosques of this city in different historical periods have been less considered, and this research seeks to fill this gap. Therefore, this research aim is to achieve the original patterns of mosque design in the contemporary period based on historical mosques. The innovation of this research compared to previous research is to have a comprehensive approach to the mosque design issues. Articles such as Architectural Analysis of the First Mosque in Aleppo Using Terrestrial Laser Scanning (Al- Shuaybiyya Mosque) (Orabi, 2020), The destroyed minaret of the Umayyad mosque of Aleppo, the survey of the original state (Fangi and Wahbeh, 2013), Mosque of Bahram Pasha and its endowments in Aleppo, Syria (Abd Al-razik, 2017), etc. have been done by studying single cases of mosques. In this research, the authors have sought to recognize the design pattern of authentic mosques by analyzing numerous historical and contemporary mosques. The importance of this issue in the city of Aleppo is twofold due to the recent damage. In addition, presenting the spatial patterns of mosques of each period can be helpful in the restoration and development of historical sites. In the early mosques the general structure was based on closed and enclosed spaces around the open space of the central courtyard. In some mosques, the mihrab, as an independent volume in the axis of the qibla, protruded from the main shabistan (Erzen, 2011). In the past, there were various types of spaces to respond to various functions in a mosque. Therefore, in addition to being a place for devotion and religious ceremonies, the mosques had social, educational, and political functions and they were a place for rulers' judgments (Erzen, 2011). Studying the evolution of mosques during the traditional and contemporary periods reveals the evolution of spaces in them and recognizes their original types. Deming and Swaffield (2011) defined typology as the "systematic study of types," which is considered a taxonomic classification scheme. According to them, it is useful to typologize form, structure, arrangement, etc. because "typology seeks to categorize and marshal a vast array of similar but variant design forms and components."Identifying and describing (diagramming) specific qualities and characteristics allow the researcher to establish patterns of associations that relate design elements hierarchically across scales (Deming and Swaffield, 2011). The various types of mosques have been mainly different in space composition and spatial patterns despite having similar types of space. Here, the various types of space include open, closed, and roofed spaces (Fig. 1). According to Haeri 2008) the three elements of ceiling, wall, and floor play active and effective roles in the definition of each type of space. The architectural elements of open spaces are floor and walls, and they are mainly ceiling and floor for roofed spaces, and ceiling, floor, and walls for closed spaces. Each spatial pattern simultaneously has the form, theme, and state (Haeri, 2008; Yigitcanlar and Dizdaroglu, 2015; Teimouri and Yigitcanlar, 2018), so that each spatial pattern is more in line with one of the functions of the building - the mosque. To clarify the difference between the type and the pattern, one can refer to the type of closed space in the mosque, which includes the spatial pattern of the columnar or domed Shabistan. In historical mosques, it has been tried to define a function for each type of space. In the meantime, it is necessary to discuss the factor or factors influencing the spaces in mosques in each period. According to Gideon (2020), the fundamental factors effective in the formation of the building body are stable over a period and distinguish the buildings in each period – here, mosques - from the buildings in other periods (Giedion, 2020).

In the present study, typology is provided based on the type of space, space composition, and spatial patterns of each type. To scrutinize the findings, a table is developed to compare the mosques studied by quantifying the contribution of each type. The mosques belonging to historical and contemporary periods have been analyzed in terms of spatial type to identify original patterns. Therefore, with an

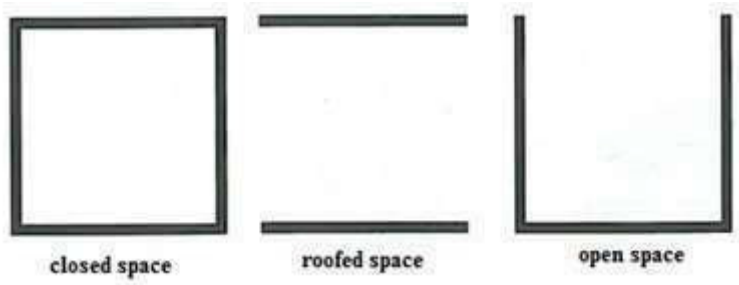


Fig. 1: Horizontal section diagram of various types of spaces (Haeri, 2008)

inductive approach, samples of mosques have been investigated to obtain the spatial patterns of the mosque. The spatial analysis of mosques allows the designers to extract the positive, useful, and efficient features of each type and apply them in their designs. This can be understood in contemporary mosques in which the architecture of historical mosques in Aleppo is modeled. This study has been carried out in Qom, Iran in 2020.

MATERIALS AND METHODS

The present study is interpretive-historical research carried out through a case study. The interpretive-historical approach is one of the few methods used to study historical contexts and issues, and this is one of its most important strengths. However, it may have weaknesses due to its interpretive nature (Groat and Wang, 2021). The required data were collected using library study and observations. In the present study, Aleppo city was selected as the case study for some major reasons. First, Aleppo is a world heritage site where there are original and pristine buildings. Second, it is one of the important cities in Islamic civilization, one of the Syrian sites, and the origin of different religions. Thus, it is important to characterize the mosque and differentiate between the places used for worship in each religion in this city. This makes it important to maintain and apply the outstanding and original spatial patterns in mosques in the contemporary era. Third, most studies on the architecture of mosques in Aleppo city are often descriptive and have often addressed the archaeological aspects through case studies (for example, “The two great Syrian Omayyad mosques: Jerusalem and Damascus” is written by Rafi Grafman and myriam rosen-ayalon or “Al-karimiyah mosques in Aleppo, Syria: an architectural and archaeological study” is written by Mansour Abd al-Razik) rather than providing applied and original patterns. It should be noted that Othman (1992) has carried out valuable studies on the structure and statics of the mosques in Aleppo. While the present study aims to physically and spatially examine the evolution of mosques over time, i.e. from the past to the contemporary era. The plans of Aleppo mosques belong to authentic university documents, including the book “Structural engineering in the mosques of Aleppo” published in the University of Aleppo, the documents of the Aga Khan Foundation in the study of the Historic city of Aleppo, and Islamic countries, and articles of valid scientific-research publications and magazines in the last 13 years for analysis. The case studies were selected from important mosques of each period. Totally, 33 mosques in Aleppo city were selected through screening. The inclusion criteria are including 1. Being original and pristine; 2. Being outstanding; and 3. Being the representative of its period. Therefore, they were selected using a non-probability sampling technique and they were a true representative of a wide range of samples. The historical mosques in Aleppo are divided into four periods: 1. Umayyad mosques including Maqam Ibrahim Mosque on the Citadel of Aleppo (Gonnella, 2008), Al-Rumi Mosque, Great Mosque of Aleppo, and Al-Dabagha Mosque; 2. Ayyubid Mosques including Citadel Grand, Mosque, Al-Shadbakhtiyah Madrasa, and Al-Ṭuranṭaiyah Madrasa (Kameliyyah (Hammad, 2004)); 3. Mamluk Mosques including Al-Rumi Mosque, Altun Bogha Mosque, Al-Ṭawashi Mosque, Al-Aṭroush Mosque, and Bashbougha Mosque; and 4. Ottoman mosques including the Al-Uthmaniyah Mosque, Khusruwiyya Mosque, Ādiliyya Mosque, Bahrāmiyya Mosque, and İpshîr Pasha Mosque. The contemporary mosques studied include Al-Rawḍa

Mosque, Al-Sabeel Mosque, Al-Siddiq, Al-Shabariq Mosque, Gamal Abdel Nasser Mosque, Usama ibn Zayd Mosque, Al-Rahman Mosque, Al-Tawhid Al-Kabir Mosque, Noor Al-Shuhadạ Mosque, Salman Al-Farsi Mosque, Al-Riḍwan Mosque, Al-Fath Mosque, Al-Ghofran Mosque, Zayd ibn Harithah Mosque, and Al-Anwar Mosque. The most information on mosques is taken from the books "Structural Engineering of the Mosques of Aleppo" and "The Image of an Ottoman City, Imperial Architecture, and Urban Experience in Aleppo in the 16th and 17th Centuries" (Watenpaugh, 2004) as well as Archnet, and Wikimedia sites.

RESULTS AND DISCUSSION

The Architecture of Aleppo mosques, from the Umayyad period to the contemporary era

In the first centuries of Islamic history, the political and cultural center of the Islamic world was the Fertile Crescent (Palestine, Syria, Iraq), i.e. a place where some of the earliest eastern and western human civilizations emerged and there are significant remnants of ancient cultures. It became one of the points where Islamic art emerged and evolved. The vast territories occupied by the Arabs came under the command of rulers sent from Damascus or Baghdad (Gardner, 2015). Although Aleppo city historically dates back to centuries before Islam and is one of the most historic cities in the Middle East (Burns, 2016), it came under Muslim rule after 661 Anno Domini (AD) and experienced a new period in its history. The Syrian region was the main seat of the Umayyad rulers, so the construction of the outstanding buildings in Aleppo began during this period. The Umayyad era was a time of ostentation of Islam against non-Muslim territories. Thus, these religious buildings competed with other religious buildings such as churches in size and height, and showed their superiority over them (Davies *et al.*, 2009). After this dynasty, different tribes ruled Aleppo. In the present study, those periods with the most influential role in the formation of the architectural style of Aleppo were considered. According to the observations and studies of the outstanding and historical mosques of Aleppo, four periods were found to be the most influential periods: Umayyad, Ayyubid, Mamluk, and Ottoman. It should be noted that some styles were seen in several historical periods but they were placed under one style due to the similarity of applied patterns. Umayyad mosques: The main factor forming the Umayyad mosques was the rulers' emphasis on the body by which Islam would show its power to Christianity. So, the -mosques were constructed in vast and tall forms (Hillenbrand, 2014). The minarets represented the significance of adhan and salah to prayer and notified local non-Muslims that the new religion was as able as its rivals in designing architectural monuments to glorify itself (Hillenbrand, 2014). The most prominent Umayyad minaret can be seen in the Great Mosque of Aleppo. The five architectural elements in Umayyad mosques that were influenced by the classical, Byzantine, and Iranian architectures are:

1) The mihrab or prayer niche (influenced by the chapel at the end of the church);

2) The pulpit;

3) The royal maqsurah or enclosure (influenced by the special place considered for the royal family in Roman and Byzantine traditions);

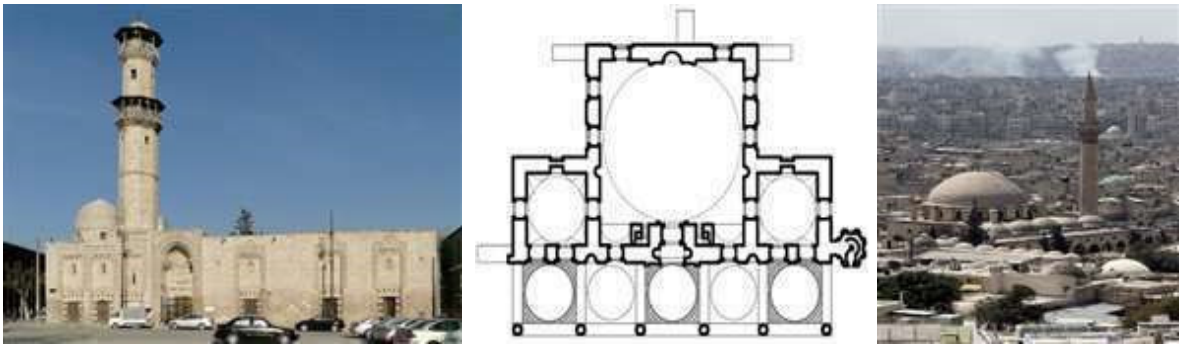
4) An aisle rising in the middle of the mosque, similar to churches;

5) A shabistan and a dome on top of the mihrab (influenced by the Iranian and Christian traditions) (Hillenbrand, 2014).

In the Umayyad mosques in Aleppo, the mihrabs protrude from the main volume of the shabistan, and in some cases, this is so significant and visible so that the mihrab itself is built as a separate domed structure, as seen in the Great Umayyad Mosque. What distinguishes the Umayyad mosques in Syria is their resemblance to churches in architecture. Some churches also became mosques during the Umayyad period (Grafman and Rosen-Ayalon, 1999). For example, one can refer to the Great Ummayad (Fig. 2a) and Al-Rumi mosques, which were churches. It is necessary to pay attention to the fact that the qibla direction in Aleppo is south. Therefore, the axis of the qibla in mosques is perpendicular to the east-west axis of churches. So, the longitudinal axis in the rows becomes the transverse axis. Accordingly, one can understand the sensitivity of choosing the site and changing the use of the church to the mosque. Moreover, this change of function naturally brought changes in the organization of spaces in the original buildings of the churches (Gokalp and Uguz, 2018).

Ayyubid mosques: The main factor forming Ayyubid mosques was the rulers' emphasis on and the public' will for those mosques where they

Fig. 2: Courtyard, a- Courtyard, The Great Umayyad Mosque, Aleppo, Syria (Fangi and Wahbeh, 2013), b- Courtyard, Al-Firdaws mosque-madrasa, Aleppo, Syria (Hammad, 2004)



Fig, 3: a- Al-Aṭroush Mosque, Aleppo (Gagnon, 2010), b- Earring layout (Hassan and Mustafa, 2013) c- Ādiliyya mosque, Aleppo (Guillaume, 2010),

could learn religious science. So, smaller mosques were built with the function of mosque-madrasa in most neighborhoods and the minaret height was greatly reduced. These mosques, which were built in Aleppo during the second half of the 13/7 century, are exemplars of Ayyubid architecture. Mosque-madrasas were built on a small scale to serve a local religion and meet local needs. Some of them have a praying room with rib vaults. For example, one can refer to Al-Firdaws (Fig. 2b), Kameliyah, and Sharafiya madrasa in Aleppo (Hillenbrand, 2014).

Mamluk mosques: The main factor forming Mamluk mosques was the emphasis on the vastness and being roofed (Hillenbrand, 2014). The general characteristic of the Mamluk mosques is the variety of minaret forms (Othman, 1992) (Fig. 3a). These tall minarets were built next to the entrances of mosques and were one of the outstanding features of Aleppo mosques in this period. These mosques were also scattered in the residential areas and this is one of the differences between the Mamluk Turks and the Ottoman Turks in the mosque construction tradition (Blair and Bloom, 2017).

Ottoman mosques: The main factor forming the Ottoman mosques was the presence of a huge closed space for worship rituals, being a landmark, and the landscape of the mosque on an urban scale (Hassan and Mustafa, 2013). Early Ottoman mosques were constructed in the form of a courtyard-free mosques with a columnar shabistan and domed ceilings on all aisles. Later, a porch or portico was added to the mosque and located in front of the shabistan (Based on Hillenbrand's images). A huge gunbadkhane forms the basic pattern of the early Ottoman mosques. Then, the earring pattern, including a gunbadkhane and two rooms on the sides of the mosque, plus a portico on a platform, become a common pattern (Hassan and Mustafa, 2013) (Fig. 3b). The evolved model of Ottoman mosques includes a central courtyard with porticoes around the courtyard and a large domed shabistan on the qibla-facing side. The shabistan has a central gunbadkhane surrounded by

Fig. 4: Al-Rahman mosque, Aleppo, Syria (Kevorkmail, 2010)

semi-domes (Hillenbrand, 2014).

The Ottomans were conservative in their design of minarets (Fig. 3c). The Ottoman minarets resembled a pointed pencil and, in a sense, a spear, as the symbol of the tradition of the Prophet Muhammad (Hillenbrand, 2014). The Ottoman mosques of Aleppo were mainly located on commercial and caravan sites. In this period, one can see the combination of mosque architecture with educational, commercial, residential, and service uses in a complex. Therefore, the buildings built in this period are often in the form of complexes.

Contemporary mosques: The main factors forming contemporary mosques are the huge closed space for worship rituals and the symbolism of the mosque on an urban scale. The architecture of most contemporary mosques follows Ottoman-style mosques; Therefore, the spaces in the mosque are organized around a domed shabistan. In the mosques of this period, the closed space has priority over everything, and the most possibility of praying in closed spaces is provided. The pattern of the closed space is often similar to the gunbadkhane pattern of the Ottoman mosques or the three-part pattern of the Ayyubid mosques. Due to the change in the urban block system, in many cases, the mosque site is not in the qibla direction. Therefore, in practice, open space is the remaining space around the main shabistan, which is usually used as a green space or service space (Fig. 4). In addition, in some mosques, various geometries and combinations have been used to compensate for the mismatch between the qibla and site shape.

Analysis of case studies

Umayyad mosques

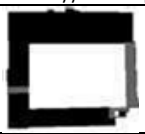
Types of space: In the Umayyad mosques of Aleppo, there is a central courtyard (open space) surrounded by closed and roofed spaces. In general, Umayyad mosques have two structures: a central courtyard and a courtyard with an L-shaped roofed space on its two adjacent sides. Also, all types of space, i.e. closed, open, and roofed spaces, have devotional functionality (Table 1a). In Umayyad mosques, the shares of spaces in the total area of the mosque indicate that closed space has a higher priority than open and roofed spaces and it is the widest space with the devotional function, followed by the open space (courtyard for prayers, especially Friday prayers). In total, the courtyard is organized and it has a spatial identity. There is usually a pond or a Wudhu Khana (roofed type) in its center. Over time, the importance of the closed space has decreased and the importance of the roofed space has gradually increased (Fig. 5).

Spatial patterns: The main micro-spaces of Umayyad mosques include the main shabistan, courtyard, surrounding porticoes for holding prayers or passing, and minaret, which are located in a centripetal, and enclosed structure (Table 2a).

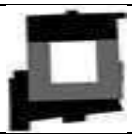
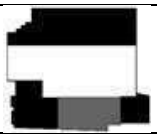
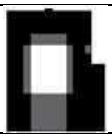
Main shabistan: The Umayyad mosques have a columnar shabistan. This type of shabistan is in a form of an elongated rectangular along with its sides there are columns. In addition, there is a mihrab in the middle of the shabistan and a pulpit next to it, which in most Umayyad mosques, independently protrudes from the main volume of the shabistan. Also, the main space of the shabistan includes a stone dome on its top at the intersection of it with the mihrab and the ceiling of the rest of the shabistan was constructed in the form of the groin vault. *Courtyard:* It had a rectangular geometry with a transverse elongation,

Table 1: The share of open, closed, and roofed spaces in the total area of historical mosques

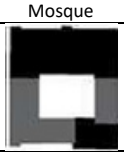
a- The shares of open, closed, and roofed spaces in the total area of Umayyad mosques

Umayyad mosques	Al-Rumi Mosque	Maqam Ibrahim Mosque	Great Umayyad Mosque	Al-Dabagha Mosque
Mosque plan				
Open space (%)	24.05	25.30	44.55	35.85
Closed space(%)	43.06	74.70	48.59	49.66
Roofed space(%)	32.86	0	6.64	14.54

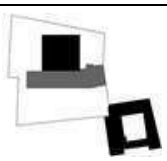
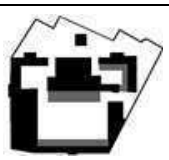
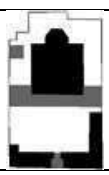
b- The shares of open, closed, and roofed spaces in the total area of Ayyubid mosques

Ayyubid Mosques	Citadel Grand Mosque	Al-Shadbakhtiyah Madrasa	Al-Ṭuranṭaiyah Madrasa	Al-Firdaws mosque-madrasa
Mosque plan				
Open space (%)	18.03	40.52	15.65	9.34
Closed space(%)	48.28	45.99	62.58	69.94
Roofed space(%)	33.69	13.49	21.77	29.94

c- The shares of open, closed, and roofed spaces in the total area of Mamluk mosques

Mamluk mosques	Al-Rumi Mosque	Altun Bogha Mosque	Al-Ṭawashi Mosque	Al-Aṭroush Mosque	Bashbougha Mosque
Mosque plan					
Open space (%)	27.50	18.95	44.56	18.44	0
Closed space(%)	51.68	25.07	28.27	42.37	100
Roofed space(%)	20.83	15.45	27.16	39.19	0

d- The shares of open, closed, and roofed spaces in the total area of Ottoman mosques

Ottoman mosques	Al-Uthmaniyah Mosque	Khusruwiyya Mosque	Ādiliyya Mosque	Bahrāmiyya Mosque	İpshîr Pasha Mosque
Mosque plan					
Open space (%)	41.09	58.80	55.54	51.92	43.92
Closed space(%)	34.15	28.08	35.37	34.64	50.42
Roofed space(%)	24.75	13.08	9.09	13.54	5.66

□ open space ■ roofed space ■ closed space

which is suitable for holding prayers, especially Friday and Eid prayers. There is a pond or a Wudhu Khana in the middle of the courtyard.

Portico: In the Umayyad era, porticoes were used to reduce the effects of hot climates and were of great importance as a roofed space for prayers. The portico of Al-Dabagha Mosque also has a mihrab. In other cases, such as the Great Umayyad Mosque, the depth of the portico is high and it is designed like the main columnar shabistan. The porticos often have a groin ceiling and its façade facing the courtyard have false arches between the columns.

Entrance: In Umayyad mosques, the entrance is not defined as a special space. In the churches converted into mosques, the entrances are often established on the middle axis of the porticoes. In

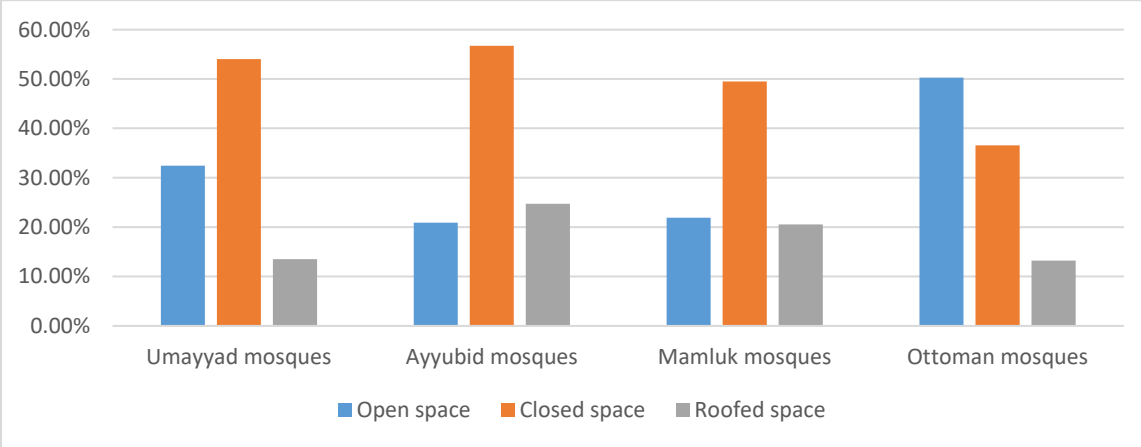


Fig. 5: The share of open, closed, and roofed spaces in the structure of the selected historical mosques

some mosques, such as the Great Umayyad Mosque, separate entrances are provided for people and government officials.

Minaret: In this period, the minarets were constructed tall and had a square or circular cross-section. They were located in the right corner of the main shabistan in the qibla direction.

Ayyubid Mosques

Types of space: Ayyubid mosques are composed of closed and roofed spaces around a square or rectangular open space in the qibla direction. The closed space is a three-part gunbadkhane and the roofed space includes the portico and huge porches (madrasa: a place for education). Coherent and diverse designs in the space composition in Ayyubid mosques are not seen in the mosques constructedin other periods in Aleppo (Table 1b). In Ayyubid mosques, closed space has a much higher priority over open and roofed spaces. In Ayyubid mosques, the spatial hierarchy of open, roofed, and closed spaces is observed in space composition. These mosques have a firm geometry in their plans with a centripetal and axis/diameter-based organization. In Ayyubid mosques, the roofed space has experienced a great change in its spatial pattern so that the quality and quantity of spaces have changed and gotten new bodies and functions (Fig. 5).

Spatial patterns: The micro-spaces of Ayyubid mosque-madrasas include the main shabistan, student rooms, transit portico, Madrasa porch (iwan) (Jarzombek *et al.*, 2011), minaret, and entrances, which are located in an axial-central organization. In this part, the students' room is not addressed because it is not observed in all samples (Table 2b).

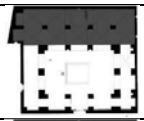
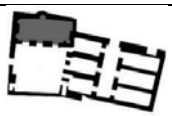
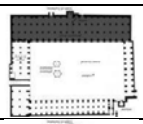
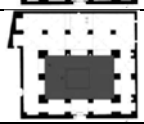
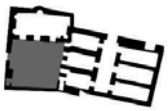
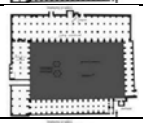
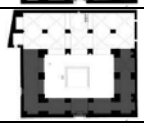
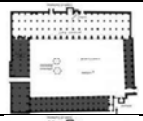
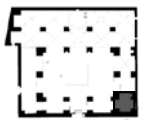
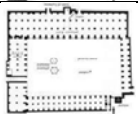
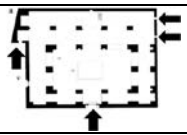
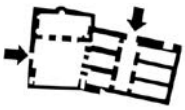
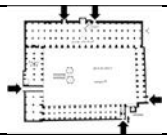
Main Shabistan: In Ayyubid mosques, the rectangular shabistans have become more proportionate and the three-part shabistan pattern has dominated the space design. In this rectangle, the middle square has a dome and the two rectangles on its sides have a domed, rib, or semi-domed ceiling. In these mosques, the mihrab is more decorated compared to that inthe Umayyad mosques.

Portico: Except for the Citadel Mosque, whose portico can be used for prayers, the porticoes of the other Ayyubid mosques have only transit and climatic uses. Therefore, the depth of the porticoes and the column diameter have been reduced and they have a longitudinal elongation due to their transit use.

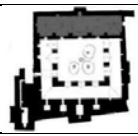
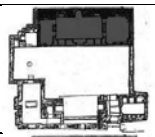
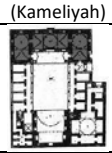
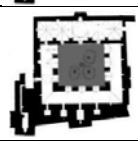
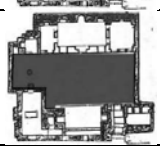
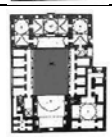
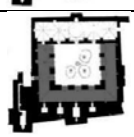
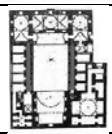
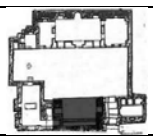
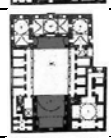
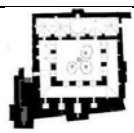
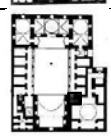
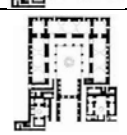
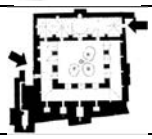
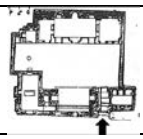
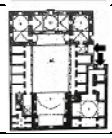
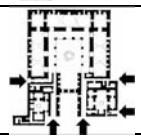
Porch: The most important roofed space in the Ayyubid Mosque is the porch, which is designed as a classroom by being closed on three sides and being open to the courtyard. It has a barrel ceiling arch in the qibla direction.

Courtyard: It is in the form of a square or rectangle with a longitudinal elongation in the qibla direction. These courtyards can be used for performing prayers. There are various beautiful ponds in the middle of them.

Table 2: Micro-functions of historical mosques *a- Micro-functions of Uumayyad mosques*

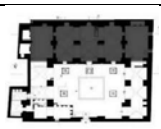
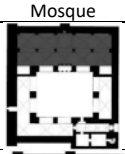
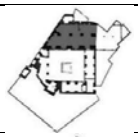
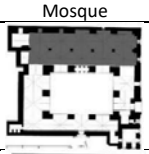
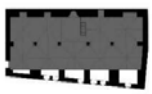
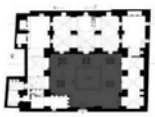
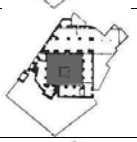
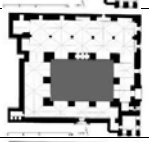
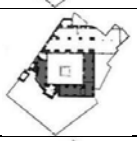
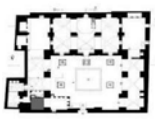
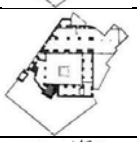
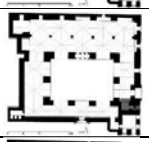
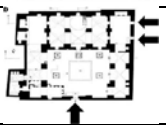
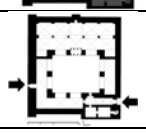
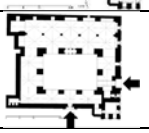
Umayyad mosques	Al-Rumi Mosque	Maqam Ibrahim Mosque	Great Umayyad Mosque	Al-Dabagha Mosque
Main shabistan				
Courtyard				
Portico		No		
Minaret		No		
Entrance				

b- Micro-functions of Ayyubid mosques

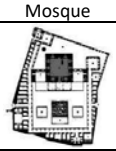
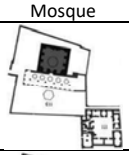
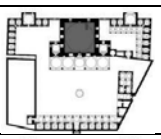
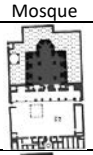
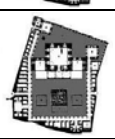
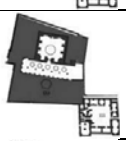
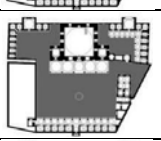
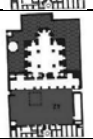
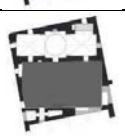
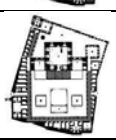
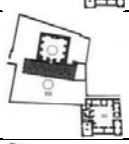
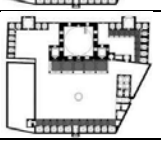
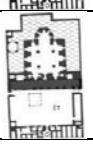
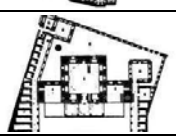
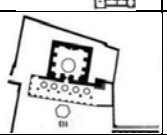
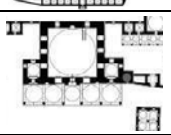
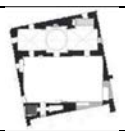
Ayyubid Mosques	Citadel Grand Mosque	Al-Shadbakhtiyah Madrasa	Al-Ṭuranṭaiyah Madrasa (Kameliyah)	Al-Firdaws mosque-madrasa
Main shabistan				
Courtyard				
Portico		No		
Porch	No			
Minaret		No		
Entrance				

Continued Table 2: Micro-functions of historical mosques *a- Micro-functions of Uumayyad mosques*

c- Micro-functions of Mamluk mosques

Mamluk mosques	Al-Rumi Mosque	Altun Bogha Mosque	Al-Ṭawashi Mosque	Al-Aṭroush Mosque	Bashbougha Mosque
Main shabistan					
Courtyard					No
Portico					No
Minaret					No
Entrance					

d- Micro-functions of Ottoman mosques

Ottoman mosques	Al-Uthmaniyah Mosque	Khusruwiyya Mosque	Ādiliyya Mosque	Bahrāmiyya Mosque	İpshîr Pasha Mosque
Main shabistan					
Courtyard					
Portico					No
Minaret				No	
Entrance					

Entrance: In this period, the entrances of mosques are not diameter/axis-based. The entrance is usually next to the porch or porticoes.

Minaret: The local scale of the Ayyubid mosques causes the minarets to be short. Their plan was also changed from the square in the Umayyad mosques to octagonal. During this period, the minarets were located in the right corner of the porch overlooking the courtyard of the mosque.

Mamluk mosques

Types of space: Mamluk mosques, like Umayyad mosques, have a central courtyard surrounded by closed and roofed spaces. Also, all types of space, i.e. closed, open, and roofed spaces, have a devotional function (Table 1c). In Mamluk mosques, the shares of open, closed, and roofed spaces have been greatly balanced. However, the closed space was still more important than other spaces, followed by roofed space and open space, respectively. The open space is an organized courtyard and the general composition of open, closed, and roofed spaces is similar to that in Umayyad mosques. Bashbougha Mosque, which was built in the late Mamluk period shows the change in space composition with the centrality of the closed space. This change of approach, i.e. from the design with the centrality of the open space to the closed space, has culminated in the early Ottoman mosques (Fig. 5).

Spatial patterns: The main micro-spaces of Mamluk mosques include the main shabistan, courtyard, the surrounding porticoes for holding prayers or passing, and minaret (Table 2c).

Main shabistan: The columnar shabistan is in the form of a rectangle with a transverse elongation. A row of columns is located in the middle axis of the width of the shabistan and there are fewer columns compared to Umayyad mosques. In addition, it has a mihrab in the middle of the shabistan and a pulpit next to it. In most of the main shabistans of Mamluk mosques, unlike the Umayyad mosques, the mihrab is inside the main shabistan. Compared to Ayyubid mosques, in Mamluk mosques, the mihrab is less decorated. Also, at the intersection it and the mihrab, the main shabistan has a stone dome with Muqarnas earrings, and the ceiling of the other parts of the shabistan includes groin vaults.

Courtyard: It is in the form of a rectangle with a transverse elongation. It is suitable for holding prayers, especially on special days. There is a pond in the form of a square in the middle of the courtyard for worshipers.

Portico: Porticoes, as the roofed space, could be used for devotion and worship. In Mamluk mosques, the depth of the portico is lower than that in Umayyad mosques. The porticos often have a groin ceiling and their facades facing the courtyard have columns with vaults between them.

Entrances: In Mamluk mosques, the entrances are often located on the sub-axes. In Al-Rumi Mosque, there are separate entrances for the people and government officials. The entrance is characterized by its recess and it is decorated with Muqarnas.

Minaret: The various minarets of this period, like the Umayyad minarets, are tall and like the Ayyubid minarets, have an octagonal plan. One of the main distinguishing features of Mamluk mosques is the location of the minaret next to the portal of the mosque entrance.

Ottoman mosques

Types of space: Ottoman mosques are the culmination of the evolution of spaces in Aleppo mosques. In this period, the closed space of the shabistan was of great importance. The closed space of the roofed portico in front of the main entrance is the central space in the space composition. The earring structure is the most common structure in the Ottoman mosques of Aleppo, which is seen in the Al-Uthmaniyah Mosque, Khusruwiyya Mosque, Ādiliyya Mosque, and Bahrāmiyya Mosque (Table 1d). Open spaces also have a significant share in the total area of the mosque in this period. The irregularity of the open space started in this period. The open space in front of the portico located in front of the shabistan is of importance and the open space behind the shabistan is left without any special design so the Ottoman mosques of Aleppo have no coherent and evolved plan seen in the Ottoman mosques of Turkey (Fig. 5).

Spatial patterns: The micro-functions of Ottoman mosques include the main shabistan, main and

secondary courtyards, porticos, minarets, and entrances in a complex with commercial, residential, service, and educational spaces. In this section, the residential and welfare spaces are not addressed because they are not observed in all samples (Table 2d).

Main shabistan: The main shabistan is a gunbadkhane with a square plan where the mihrab protrudes from the volume on the main axis. At the end of the period, the shabistan has been constructed in a three-part rectangular form with a transverse elongation in qibla direction, as seen in İpshîr Pasha Mosque.

Courtyard: The courtyard in front of the main shabistan has a rectangular geometry with a transverse elongation in qibla direction and there is a garden or pond in its middle. The secondary courtyard with a heterogeneous geometry is located behind or in the corner of the main shabistan and accommodates secondary spaces, such as Wudhu Khana or rooms.

Portico: The porticoes of this period are the main pattern of roofed space. They are constructed with a columnar structure and consecutive domed ribs - according to the number of people- on the axis of the entrance of the main shabistan. Also, in front of the rooms, around the courtyards, there are porticos with climatic and transit functions.

Entrance: The entrance is defined by the recess and the portal. Some of the entrances are placed in the form of corridors on the main axes of the courtyard and the rest of the entrances are scattered as needed. The entrances are usually located on the main axis of the courtyard or in the corners of the secondary courtyard.

Minaret: The minarets of this period with a circular section, a tall height, and a spear-like form, are one of the most different types of minarets in the historic mosques of Aleppo. They are located in the right corner of the shabistan portico, i.e. the place of earrings.

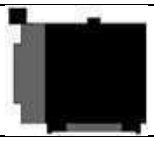
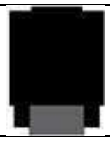
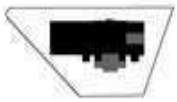
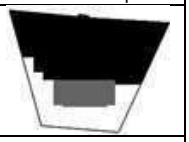
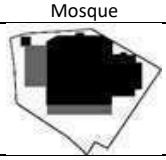
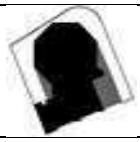
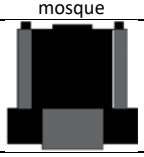
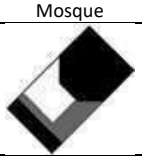
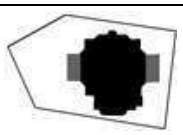
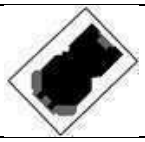
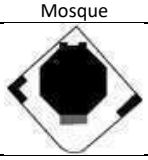
Contemporary mosques

Types of space: The greatest diversity of structure is seen in contemporary mosques of Aleppo. In this period, using Ottoman patterns in the construction of mosques, mosques are usually constructed in the form of a gunbadkhane with a square plan in front of which there is a roofed space in the qibla direction. The preservation of this structure and the varieties of its orientation and shape depend on the shape of the mosque site. Octagonal geometries or combinations of quadrangular geometries, depending on the location, quality, and quantity of the site, the limitations of the financial resources, and secondary functions for the mosque design, are used in sites that are not in the qibla direction. Therefore, the roofed space, according to the proximity of the site and the entrance of the main shabistan, is located in different directions to the shabistan and is not necessarily at the end of the qibla axis. In contemporary mosques, the open space has the least ability for devotional use and often does not have a special organization for performing prayers (Table 3).

The share of the closed space in the total area of the mosque is higher than open and roofed spaces in contemporary mosques. Providing a closed space for holding prayers has been the main goal of architects. At the same time, the roofed space is important as an entrance to the closed space. Therefore, the spatial organization pattern of contemporary mosques, considering the composition of roofed and closed spaces, has been the main issue for contemporary Syrian architects to respond simultaneously to the functions of the mosque and the limitations of the site. In general, if the mosque site is in the qibla directionand it is possible to implement traditional and practical patterns in it, the whole area of the site will be used to build the closed and roofed spaces, as seen in Al-Rawda Mosque, Al-Sabeel Mosque, Al-Siddiq Mosque, and Al-Tawhid Al-Kabir Mosque (Fig. 6).

Spatial patterns: In general, the micro-spaces of contemporary Aleppo mosques include the main shabistan, roofed pre-entrance space, toilets, the ladies and gentlemen's Wudhu khanas, the guardroom, the Imam's room, minaret, and courtyard. In large mosques, there are service spaces in the corner of the site, a guard room next to the entrance, and the Imam's room next to the main shabistan- the earrings. In some mosques, such as Al-Rahman Mosque and Al-Fath Mosque, there are secondary

Table 3: The shares of open, closed, and roofed spaces in the total area of contemporary mosques

Mosque	Al-Rawḍa Mosque	Al-Sabeel Mosque	Al-Siddiq mosque	Al-Shabariq Mosque	Gamal Abdel NasserMosque
Mosque plan					
Open space (%)	0	0	0	65.22	32.86
Closed space (%)	76.87	86.19	79.79	29.40	63.61
Roofed space (%)	23.13	13.81	20.21	5.43	3.53
Mosque	Usama ibn Zayd Mosque	Al-Rahman Mosque	Al-Tawhid Al-Kabir mosque	Noor Al-Shuhadą Mosque	Salman Al-Farsi Mosque
Mosque plan					
Open space (%)	40.94	29.01	0	9.92	20.98
Closed space (%)	46.40	59.82	65.81	66.78	60.46
Roofed space (%)	12.66	11.17	34.19	23.36	18.54
Mosque	Al-Riḍwan Mosque	Al-Fath Mosque	Al-Ghofran Mosque	Zayd ibn Harithah Mosque	Al-Anwar Mosque
Mosque plan					
Open space (%)	63.47	55.91	46.83	50.48	35.76
Closed space (%)	31.14	44.00	49.81	46.58	49.42
Roofed space (%)	5.35	8.62	3.36	2.96	14.82S
☐ open space ▩ roofed space ■ closed space					

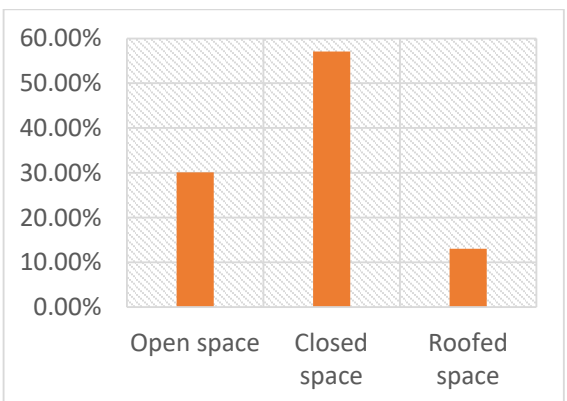
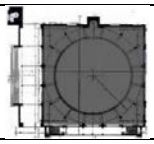
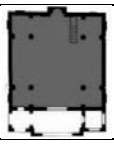
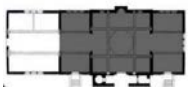
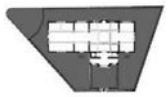
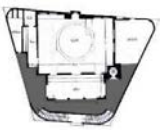
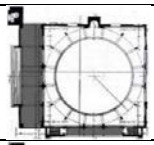
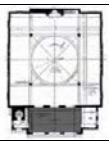
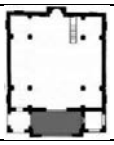
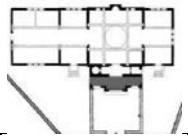
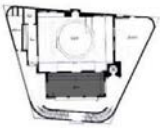
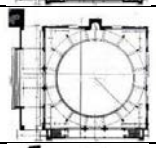
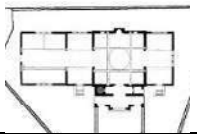
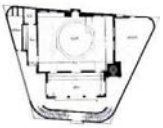
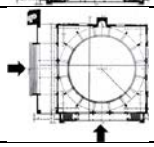
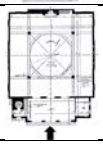
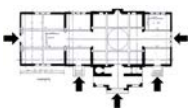
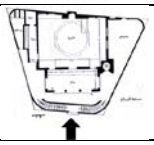
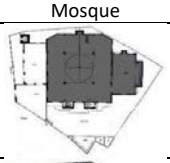
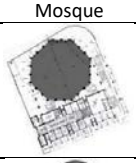
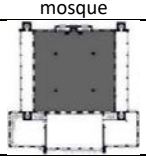
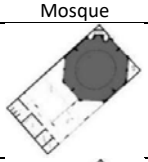
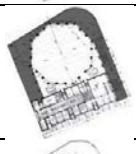
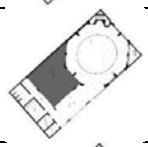
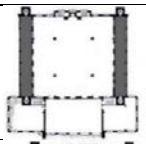
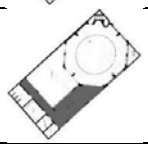
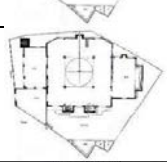
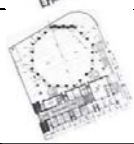
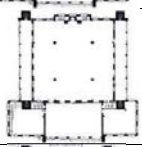
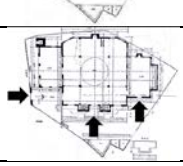


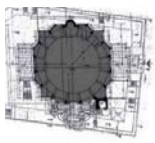
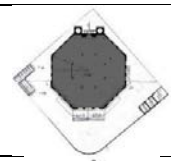
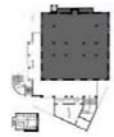
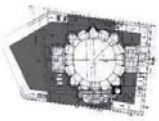
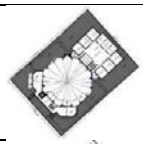
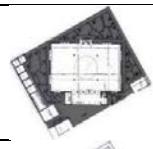
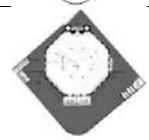
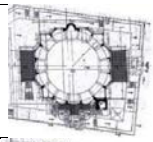
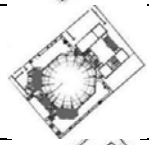
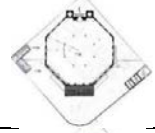
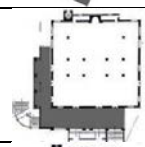
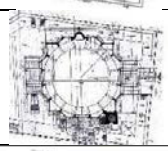
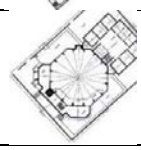
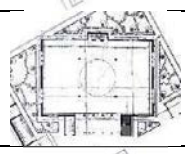
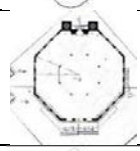
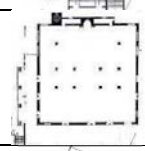
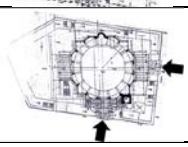
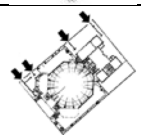
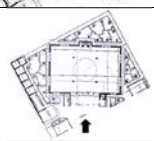
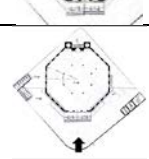
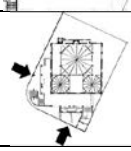
Fig. 6: The share of open, closed, and roofed spaces in the structure in selected contemporary mosques

buildings for secondary functions. These functions include cultural functions such as the library and administrative spaces, welfare-service functions such as resting rooms or dormitories, and educational functions such as religious science classrooms. In general, due to the comprehensiveness and inclusion of micro-spaces in most contemporary mosques, the main spaces are analyzed and exceptions - as mentioned - are not addressed in the analysis (Table 4).

Table 4: Micro-functions of contemporary mosques

Mosque	Al-Rawḍa Mosque	Al-Sabeel Mosque	Al-Siddiq mosque	Al-Shabariq Mosque	Gamal Abdel NasserMosque
Main shabistan					
Courtyard	No	No	No		
Portico					
Minaret			No		
Entrance					
Mosque	Usama ibn Zayd Mosque	Al-Rahman Mosque	Al-Tawhid Al-Kabir mosque	Noor Al-Shuhadą Mosque	Salman Al-Farsi Mosque
Main shabistan					
Courtyard			No		
Portico					
Minaret					No
Entrance					
Mosque	Al-Riḍwan Mosque	Al-Fath Mosque	Al-Ghofran Mosque	Zayd ibn Harithah Mosque	Al-Anwar Mosque

Continued Table 4: Micro-functions of contemporary mosques

Main shabistan					
Courtyard					
Portico					
Minaret					
Entrance					

Main shabistan: Most shabistans have a square plan with a central dome mounted on four columns in the middle of the shabistan. In sites where the axis of the site is not in the qibla direction, a regular octagonal plan is widely used for the main shabistan. In the main shabistans of all contemporary mosques, the mihrab protrudes from the main shabistan. In Al-Ridwan Mosque, the protruded volume of the mihrab is seen along all sides of the octagonal shabistan and is reminiscent of the number of protruded chapels in the churches. Another type of shabistan is the rectangular shabistan with longitudinal and transverse elongations. This geometry is also partitioned into three parts in such a way that it has a domed square in the middle and two rectangles or squares on its sides. For example, the longitudinal elongation in Noor Al-Shuhadạ Mosque has a three-part pattern in length. The transverse three-part patterns taken from the Ayyubid mosques were used with a slight change in Usama ibn Zayd Mosque, Shabariq Mosque, and Al-Ghofran Mosque and they are effective for separating male and female worshipers.

Portico: It is a roofed space located in different directions depending on the site orientation and the number of entrances to the main shabistan or other spaces. In general, there is one or more roofed spaces as the pre-entrance space next to or along the axis of the qibla of the main shabistan. These spaces have a rectangular geometry with a transverse elongation and they are attached to the main shabistan wall. Its facade has a row of columns and false arches on it. In some other mosques, such as Al-Siddiq, Al-Sabeel, Al-Shabariq, Usama bin Zayd, and Al-Tawhid Al-Kabir mosques, they are closed on three sides - like a porch - and only open to the entrance.

Courtyard: In contemporary mosques, the courtyard has no devotional function and the remaining parts are a combination of the site and the mosque building. These courtyards are often used as the green space for mosques. In some cases, such as the Noor Al- Shuhadạ and Shabariq mosques, the organized courtyard is used to divide the space or as the pre-entrance space for other spaces.

Minaret: The minarets of this period have more variety and elegance in design compared to those

of the previous periods, and there are fewer high and bulky parts in them. The minaret of Al-Rahman Mosque can be considered the most daring minaret. The minaret is usually located in the corner of the main shabistan. Most contemporary mosques have a minaret. However, there are exceptions in this regard, for example, one can refer to the Al-Rahman Mosque with six minarets, the Al-Tawhid al-Kabir Mosque with four minarets in its shabistan, and the Zayd ibn Harithah Mosque with two minarets in the two corners of the qibla side.

Entrance: The entrance of the main shabistans is more important than the entrance of the site. There is usually an entrance to the main shabistan and an entrance for the secondary functions of the mosque, without any special characteristics. The entrance to the shabistans is a small roofed space, which, of course, is not as strong as the roofed spaces of the portico and porch.

The evolution of types of space

The shares of types of space: The shares of open, closed, and roofed spaces in the total area of Aleppo mosques show that the closed space accounts for the greatest part of the building area. In Umayyad mosques, about 54% of the mosque area is closed space and in Ayyubid mosques, it is 56.7%, and no significant difference in the share of this type of space between these and previous periods. In Mamluk mosques, the importance of the closed space has decreased compared to the previous period. It accounts for about 40% of the total mosque area. In Ottoman mosques, closed space has regained its importance and with a growth of 7%, the share of closed space in the total mosque area has reached 47%. In contemporary mosques, a significant increase in the share of closed space in the total mosque area indicates the priority of closed worship spaces over other spaces. After the closed space, open and roofed spaces are more important, respectively. In Umayyad mosques, the share of open space is higher than the share of roofed space. The open and roofed spaces account for 32.50% and about 13.50% of the total mosque area, respectively. In Ayyubid mosques, the shares of open and roofed spaces in the total mosque area are very close. The importance of the roofed space has increased compared to open space and with an increase of 11% compared to the previous period, its share in the total mosque area reached 24.70%. The open space is less important than roofed and closed spaces. Its share decreased by 11% and reached about 21%. In Mamluk mosques, the roofed space has become more important and about 30% of the total complex area was allocated to this type. The open space was the least important space, but in general, its share did not changed much compared to the previous period. In Ottoman mosques, one can see a change in this structural system and the shares of open and closed spaces are close to each other. In the mosques of this period, compared to the Mamluk period, the share of the closed space increased by 7% and reached 47%, the share of the roofed space decreased by 9% and reached about 11%, and the share of open space increased by 20% and reached 42%. In contemporary mosques, a kind of balance has been established between the three types of space - albeit irregularly and due to environmental determinism. In contemporary mosques, the closed space is more important than that in historical mosques, followed by open space (about 30% of the total mosque area). The roofed space has become less important and its share (13.50%) in the total area of the contemporary mosques is the same as its share in Umayyad mosques (Fig. 7).

Space composition

In the architecture of historical mosques in Aleppo, attention to the geometry of spaces is of great importance at all quality levels. So, the purity of the geometries of roofed and open spaces is as important as the purity of the closed space geometry. So, first, the traditional architect has applied a variety of methods to simplify and purify all three types of space. This has led users to experience different types of space with different qualities throughout the day in terms of the enjoyment of natural elements such as daylight, airflow, sky view, water, and trees. At the same time, any type of space reveals the hierarchy of functions, distinguishes between main and secondary spaces, and provides the ground for entering the main space. The evolution of spaces in Aleppo mosques shows that the importance of closed space has gradually increased and the importance of open and roofed spaces has decreased. So, their architecture has tended to the use of closed space with the maximum share in the mosque area (Fig. 8). This issue has led to the construction of the mosque with main spaces and the use of the total

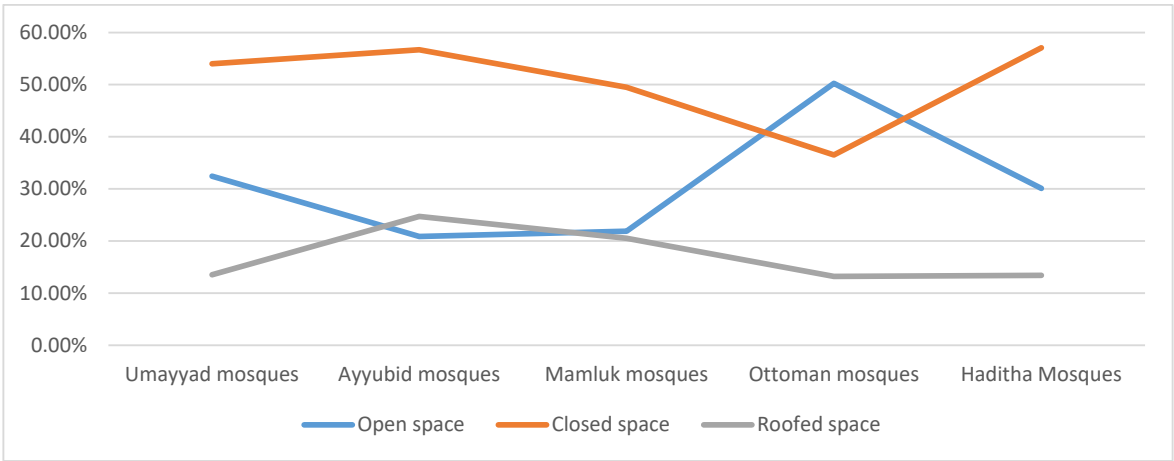


Fig. 7: Evolution of the share of open, closed, and roofed spaces in the total area of Aleppo mosques

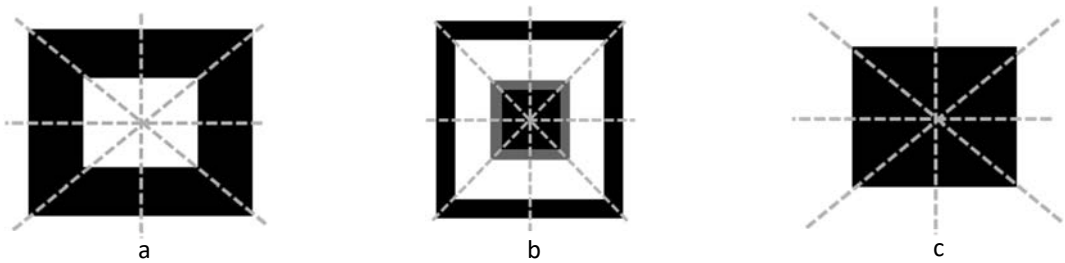


Fig. 8: Structural evolution of types of space in mosques. a- Introverted pattern, b- introverted-extroverted pattern, c- Extroverted pattern

mosque area for the provision of closed space for the main function of the building. In the meantime, the factors affecting the building design, such as climate-friendly architecture, observance of spatial hierarchy, spatial diversity, and provision of beautiful landscapes are inevitably ignored.

The evolution of spatial patterns

For the three space types in Aleppo mosques, there are various spatial patterns. The most important issue is the functionality of various spaces for devotional and social functions. In the following, it is discussed how the main spatial patterns of the three space types have changed over time:

Closed space: The "Columnar Shabistan" pattern is the most basic pattern in traditional mosques. This spatial pattern consists of a rectangular space with rows of columns that were extended by groin vaults (widely used in Umayyad mosques). Another one is the three-part pattern in the closed space which was used to connect the three parts. In some cases, one can see a three-part pattern consisting of a central gunbadkhane and two square or rectangular spaces whose longitudinal side is tangential to the main square of the gunbadkhane, and their ceilings are in the form of a dome, semi-dome, or groin vault. The three-part shabistan enhances design flexibility. Therefore, it is possible to expand the shabistan for use when needed (widely used in Ayyubid mosques). The most widely used closed space pattern is the domed pattern. The formal approaches to the domed space pattern have been different. In some cases, the dome is mounted on square space and is surrounded by a wall (widely used in Ottoman mosques). Also, the spatial pattern of the octagonal shabistan with a dome is one of the innovations of contemporary architects to compensate for the difference between the site axis and the qibla direction in Aleppo mosques (Fig. 9).

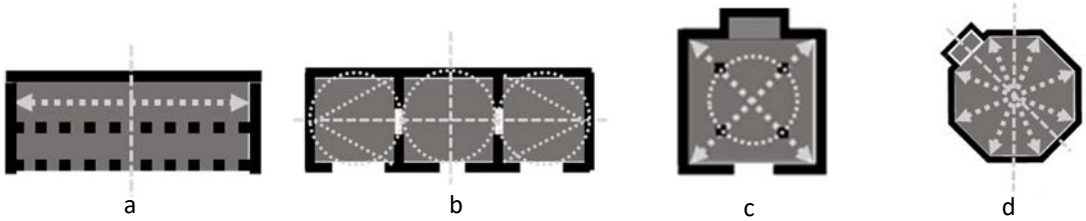


Fig. 9: Evolution of shabistan space. a- Columnar shabistan, b- Three-part shabistan, c- Gunbadkhane with a square plan, d- Gunbadkhane with an octagonal plan

Fig. 10: Evolution of open space, a- Open space in Umayyad and Mamluk mosques, b- Open space in Ayyubid mosques, c- Open space in Ottoman mosques, d- Open space in contemporary mosque

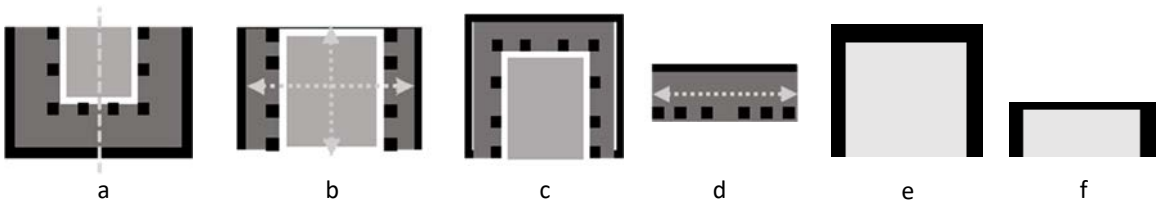


Fig. 11: Evolution of the roofed space of portico, a- U-shaped portico: devotional, b- Linear portico: transition, c- U-shaped portico: transition, d-Linear portico: transition, e- porch: devotional and educational, f- porch: pre-entrance space

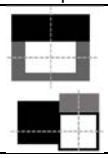
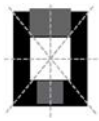
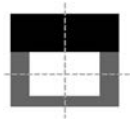
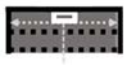
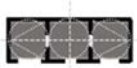
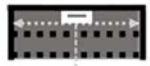
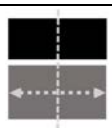
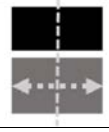
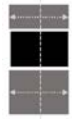
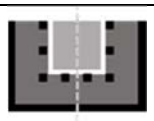
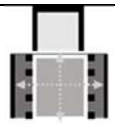
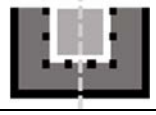
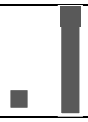
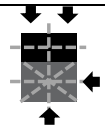
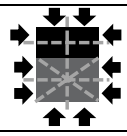
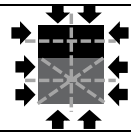
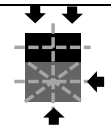
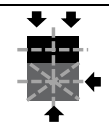
Open space

The central courtyard has been the main space of the historic mosques of Aleppo. This courtyard or courtyard could have religious and social functions in addition to the climatic function and its connection with the natural space. The courtyard was often rectangular or square. In the middle of the courtyard, there was usually a pool or ablution used for purification. From the Ottoman period onwards, green space was considered an air-regulating element and a source of physical and mental comfort, and some Ottoman complexes were designed in the middle of the garden. In contemporary mosques, the open space was limited to the service space or the green space, and the patterns of the central courtyard and open courtyard for the function of worship were practically forgotten (Fig. 10).

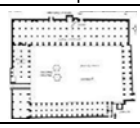
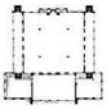
Roofed space

The most stable pattern of roofed space is the porch. Using this spatial pattern began in the Umayyad mosques and has continued until the contemporary era. The porch was initially in the form of a columnar space on which groin vaults were placed in succession and its depth was considerable. After the Umayyad period, the depth of the portico was reduced and the shallowest portico was observed in Ayyubid mosques with climatic and transit functions. After that, in the Ottoman period, the porticos seriously contributed to the external expansion of the closed space. They had climatic and transit functions. They had an entrance to the main shabistan. In contemporary mosques, the portico is used as the most efficient partition space in separate entrances - especially in the walls overlooking the shabistan (Fig. 11a, b, c and d).

Table 5: Summary of the evolution of structural and spatial patterns in Aleppo mosques

Period		Umayyad mosques	Ayyubid mosques	Mamluk mosques	Ottoman mosques	Contemporary mosques
Structural pattern						
		Enclosed introverted	Axial introverted	Enclosed introverted	Axial introverted-extroverted	Axial extroverted
Texture and scale		Natural and residential texture Urban and local scales	Residential texture Local scale	Residential texture Urban and local scales	Commercial texture Urban and national scales	Residential texture Urban and local scales
Micro-spaces	Main Shabistan					
		Columnar shabistan	Three-part	Columnar shabistan	Square gunbadkhane	Gunbadkhane, three-part
	Courtyard or open space					
		Devotional, service	Devotional, service	Devotional, service	Devotional, service,welfare	Service, welfare
	Roofed space					
		Devotional	devotional, educational, transition	Devotional	Devotional, transition	Devotional, transition
	Minaret					
		On the corners of the portico	Next to the porch	Next to the entrance	Next to the portico and shabistan	Next to the main shabistan
	Entrance					
		Non-diameter/axis-based, diameter/axis-based	Non-diameter/axis-based	Next to the minaret, diameter/axis-based	Non-diameter/axis-based - diameter/axis-based	Non-diameter/axis-based-diameter/axis-based
	Secondary function	Sanitary	Educational, residential, sanitary	Educational, sanitary, residential, welfare	Educational, sanitary, residential, welfare, commercial	Educational, cultural, sanitary, welfare, charity

Continued Table 5: Summary of the evolution of structural and spatial patterns in Aleppo mosques

Period	Umayyad mosques	Ayyubid mosques	Mamluk mosques	Ottoman mosques	Contemporary mosques
Example					
	Great Ummayad Mosque	Al-Firdaws mosque-madrasa	Al-Aṭroush Mosque	Al-Uthmaniyah Mosque	Al-Tawhid Al-Kabir mosque

Another pattern of the roofed space used in the architecture of Aleppo is the porch. The porch is a square or rectangular space that is closed on three sides by walls and one of its sides is open to the courtyard. The porch pattern has been a defined and efficient space in the architecture of Ayyubid mosques for the function of teacher and entrance. The use of the porch is due to its high efficiency in the climate of Aleppo and has been widely used due to the effect that the semi-open space and natural ventilation have on the health of the human body and soul. The use of porches in mosques did not continue after Ayyubid, except incompletely at the entrances (Fig. 11e and f). In general, the study summary of the evolution of structural and spatial patterns in Aleppo mosques is shown in Table 5.

CONCLUSION

The innovation of this study compared to previous research is to have a comprehensive approach to the mosque design. Previous studies have mostly tried to introduce historical mosques and their visual values. This research is intended to open a path for designers and architects so that contemporary mosques can have diverse spaces for worship. The study of a range of historical and recent mosques has led to the challenges and weaknesses of designing last mosques in the efficient use of open, closed, and covered spaces, with a realistic and critical attitude to find a possible solution to solve these problems in new urbanism. This research has been conducted to achieve the pattern of suitable spatial composition of mosques in the contemporary period. Considering that the city of Aleppo is qualified as World Heritage Site and also needs reconstruction due to the destruction caused by the recent civil war, it doubles the necessity of conducting this research in this city. The research results generally show that recent mosques have been more stable in receiving and continuing spatial patterns that are more symbolic, such as domes and minarets. While various space types, i.e. open, closed, and roofed space, have been unstable and in decline in terms of space creation and functionality, . The main reasons are the spatial priority depending on the open and roofed spaces, for instance the mismatch between the Gibla and the site. Domed Shabistan is the most suitable response to create great closed spaces. However, the most critical situation of space design can be seen in organizing the open space. In historical mosques, the courtyard has been the main space of worship and the center of the mosque design, but now the closed space is meant as a worship space, and the remaining vacant lots are as open spaces for a service, entrance or garden space. Roofed spaces, which had a religious function in historical mosques, are now dedicated to connecting spaces at the entrances. According to the results, contemporary mosques have been unsuccessful in creating diverse spaces for worship. Therefore by reviving the composition patterns of the open, closed, and roofed spaces, while designing harmoniously with mismatched between the qibla direction and the site, the worship function of the space should also be taken into account. Of course the current conditions of war and insecurity in Syria have caused limitations in conducting this research, and it was not possible to visit the mosques in the field. At future research, these limitations can be reduced with collegial communication and access to documents and discussions with academic professors.

AUTHOR CONTRIBUTIONS

M. Amirabadi Farahani performed the literature review, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. M.M. Raeesi performed the research materials and methods, introduction and referencing.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

OPEN ACCESS

PUBLISHER'S NOTE

ABBREVIATIONS

%	Percent
AD	Anno Domini
Fig.	Figure

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