Built Heritage

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Analyses and architectural typology of preserved traditional mosques in the old city of Herat in Afghanistan: the case of Quzzat Quarter

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Abstract

The study aims to analyse the architectural typology and determine the period of construction for the preserved traditional mosques of the Quzzat Quarter in the Old City of Herat (known as the Pearl of Khorasan). Twenty-nine mosques are located in the area, three of which are modern and 26 are traditional. Twelve out of the 26 traditional mosques still exist and have preserved their traditional landscape. Using analogy to analyse water cisterns and mosques, we determine when each mosque was developed and establish the period of development for each structure. Further analyses are carried out on the edifices' architectural details. Architectural analyses and mosque typologies suggest that five buildings were built before the Timurid dynasty; two were built during the Timurid dynasty (1370–1507 CE); and one was built after the Timurid dynasty. Two mosques incorporating elements from different periods are counted as exceptions, and the remaining two are considered to have been built during transitional periods.

Keywords Architectural analyses, Analogy, Period of development, Preserved traditional mosques, Built heritage conservation, Herat Old City, Afghanistan

1 Introduction

1.1 General background

Herat is the only Timurid city that still stands as a lively city on its original site, boasting architectural remains and preserving features of a medieval town (UNESCO 2010, Archnet2; Najimi 1988). The town was fortified and walled and represents an excellent historical example of Islamic architecture, landscape, and urban settlement (Gammell 2016; UNESCO 2010; Herawi 2005; Najimi 1988). In the early Islamic period, Herat was the most important city in the region because it was large, beautiful, populous, prosperous, with abundant gardens and abundant water, and its citizens were educated. These features made Herat both key to Asia and the heart of Khurasan (Maqdisi 2015; Astakhri 1943; Herawi 2005; Habibi 1985; Rajayee 1984; Ibn Resta 1892; Abru 1970; Hamawi 2006; Asfazari 1960; Al-Herawi 1943). Herat was the capital of the Timurid Empire in the 15th century, CE 1370–1507, and was the largest, greatest, and most beautiful city in Khorasan during that time period (Seljuki 1989; Najimi 1988; Herawi 2005; Habibi 1936). Although it recently suffered from the massive destruction of some of its monuments, such as the Musallah, the city wall, traditional houses, etc., Herat has maintained its traditional fabric (Asim and Ando 2020; Yawar 2019; Seddiqi 1984; Najimi 1988).

As an important cultural centre in the world, Herat has preserved its cultural heritage, monuments, landscape, traditional arts, and architecture dating back to the Timurid era and earlier periods (Asim et al. 2020;

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Samimi, Ando, and Kawish 2019; UNESCO 2010; Najimi 1988). The modern city was built by the Timurid kings from 1370 to 1507, when it served as the symbol of the Timurid dynasty (Loda et al. 2013; Najimi 1988; Habibi 1936). Under the Timurids, many of the city's covered bazaars, cisterns, mosques, citadels, etc., were rebuilt or renovated (Asim et al. 2020; Herawi 2005; Seljuki 1986; Habibi 1985). The city was kept in reasonable condition during the Safavids (CE 1507–1636). In 1885, the city lost its most prominent complex, the Musallah, during the time of the Afghan rulers, and the city wall was later demolished in 1950, during the reign of M. Zaher Shah (Yawar 2019; Herawi 2005; Asim et al. 2020; Seljuki 1968).

National and international researchers have conducted a great number of studies in Herat on the Citadel, Grand Mosque, and other monuments (Asim et al. 2020; Samimi, Ando, and Kawish 2019; Najimi 1988). Niedermeyer in 1916–17, Najimi, Rajayee, Seljuki in the 1970s–80s, Samimi, Kawish, Asim, Yawar, and many more in the 2000s conducted interdisciplinary research in Herat (refer to Ball 1982 section 428, Herat, for a further detailed list of studies). The monuments, urbanisation and urban planning of Herat's old city have always been debated. In particular, a book entitled <Herat the Islamic city> has embodied Herat's identity as an Islamic city. However, little attention has been paid to mosques (Najimi 1988). Herawi (2005) and Rajayee (1984) wrote about cisterns and mosques but did not discuss their types and periods of development. Although UNESCO supported some projects in Herat in the 1970s and 2000s, and the Aga Khan Trust for Culture (AKTC) conducted restoration projects from 2005–10 to conserve cultural heritage, including Herat's mosques, their reports avoided describing the origins of this heritage and the periods during which it was developed (for details, https://www.akdn.org/). A recent study discussed the typology of mosques based on the constituting material of mosques in the study area. There is no architectural feature or development analyses in the study (Asim et al., 2022).

Despite numerous studies that have offered insight into different aspects of architectural features and typologies of mosques in Asian countries, we have been unable to find a comprehensive study or document that would help us better analyse the typology and detect the mosques' periods of development. In Turkey, Mustafa and Hassan (2013) conducted extensive research on the design of mosque layouts. Mustafa classified architectural styles into six categories based on layouts but did not carry out any analysis to identify periods of development, which we did. In Malaysia, Ahmad (2014) examined typological plans and main structures for mosques whose origins were clear, but he did not focus on when these mosques were developed. In Indonesia, Budi (2004) analysed the typological analysis of Javanese mosques based on the plan and structure of the buildings, which are different from buildings found in Herat, Afghanistan. In Iran, Hillenbrand (1982) also focused on traditional brick-made structures, such as the Sugas Mosque dating from 1100, Seljuq dome chambers in northwest Iran, Seljuq monuments in Iran, the mosques of Nushabad, etc. In his article, Hillenbrand used the decorative elements of Masjid-e Jami to determine the date of the building. Since previous research has not provided us with a way to date mosques, we developed our own dating method. Hence, as a first step in this endeavour, this research analyses architectural features of mosques and creates a typology that provides a way to determine the timing of their development. Additional studies adopting different perspectives are needed; for example, studies could examine ornaments, epigraphs, history, and materials.

Many researchers have studied similar buildings in Iran, Iraq, etc., as mentioned above. As an example, the Bastam mosque and tower complex in Iran was built between 1300 and 1309, according to Wilber and Hillenbrand (1982). The building resembles pre-Timurid (1370–1506) cisterns that emerged in the 13th century under the reign of the Kurt Kings, or even earlier. Moreover, cisterns have clear origins and historical backgrounds, which are similar to those of mosques.

Even though mosques have constituted an important social facility and symbol of Islamic architecture, no researcher in Herat has been able to thoroughly study the architectural aspects of those mosques for a variety of reasons. Because of the poor economy and education level in Herat during challenging periods of war (1979–91 and 1992–2001), there have been no regulation regarding architectural monuments there. Additionally, many of the scholars who conducted research in Herat were outsiders who stayed in Herat for a short period of time due to safety concerns and studied topics such as the Citadel and the Grand Mosque.

Hence, previous research has not focused on determining mosques' periods of development based on an analysis of their architectural features. The purpose of these studies has been to analyse the types of mosques found in Herat from an architectural viewpoint, and the studies have not focused on finding the periods in which these mosques were developed. Hence, these studies have been insufficient. By creating a typology for mosques' architecture, this study identifies possible periods of development, which have remained unknown due to damage, loss, theft, or removal of mosque inscriptions during modifications or restorations. We use analogical analysis and observe mosque features to conclude that each

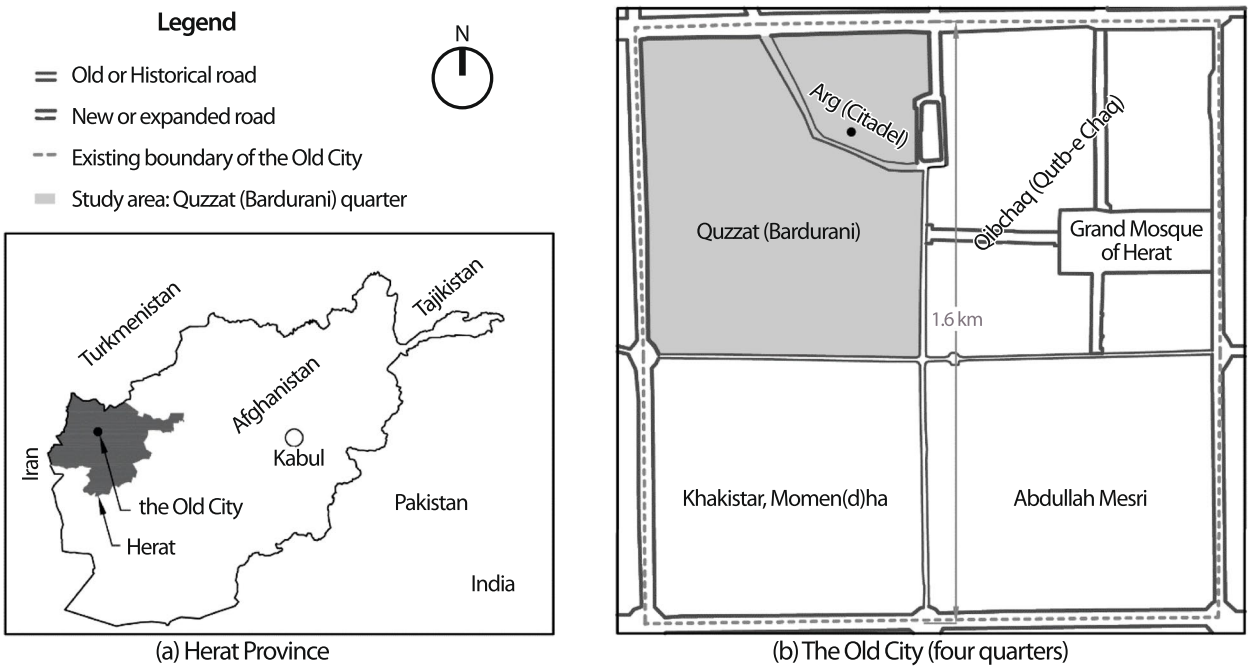

Fig. 1 Study area. 2021 (**a**) Herat province, (**b**) The Old City of Herat (Source: the authors)

mosque in Herat is typical of a particular period and style. However, the determination of the period of development remains speculative, as there is no sufficient evidence demonstrating the exact changes that a mosque has undergone. On the other hand, we assume that a mosque showing pre-Timurid architectural features was built before the Timurid dynasty or later modified (during or after the Timurid dynasty) using pre-Timurid features. This study helps researchers from similar geographical regions, cultures, and any countries where brick monuments have remained, such as Afghanistan, Iran, Tajikistan, Turkmenistan, etc., conduct further architectural research and analyses. Our findings also provide insight into the structure of mosques and subsequently help plan a preservation strategy based on the characteristics of these mosques and their architectural features.

1.2 Study area

Herat has a population of 493,600 people, making it Afghanistan's third-largest city (Samimi, Ando, and Kawish 2019; Samimi, Ando, and Kawish 2017; Loda et al. 2013b). Located in western Afghanistan, Herat borders Turkmenistan to the north, Iran to the west, and the Ghoar and Farah provinces to the south and the east. As an oasis on the Silk Road, Herat is situated in a valley surrounded by mountains and is considered the crossroad of Asia (Asim and Ando, 2020; Samimi, Ando, and Kawish 2019; Najimi 1988; Herawi 2005). Herat is located 4 kilometres from the Hari-rud (Hari River), which provides water to canals throughout the city and nearby villages. Although Herat has undergone substantial development, the site has retained its unique character and artifacts, including many valuable Islamic monuments (Samimi, Ando, and Kawish 2019; Samimi, Ando, and Kawish 2017; UNESCO 2021; UNESCO 2004). Herat Old City, with its 830 historic sites, is a unique area where the Citadel, cisterns, mosques, and many other architectural landmarks have survived (Najimi 1988).

A boundary wall (for more details and dimensions, refer to Najimi 1988; Samimi and Ando 2022) existed in the Old City until the 1930s (Najimi 1988; Asfazari 1960; Ahrari 1931). In the Old City, two main streets cross each other at the city centre, which is called Chahar-suq (in Persian: four directions) and divide the city into four quarters (Fig. 1b). Each quarter has a name: Quzzat (known also as Bardurani), Qibchaq (Qutb-e Chaq, Mahalla-e Awwal), Khakistan (Momenha, Momandha), and Abdullah Mesri (Ahrari 1931; Seljuki 1968; Seljuki 1964; Habibi 1985; Najimi 1988).

This study focuses on the Quzzat quarter in the Old City. It is there that the most significant number of traditional mosques, the Herat Citadel, which dates from the Achaemenids Empire and Alexander the Great, and the most considerable number of cisterns and traditional houses have been preserved (Fig. 1b).

2 Purpose and methodology

Documented reports exist for many buildings and others boast readable inscriptions; however, such inscriptions or reports do not exist for the mosques of Herat in Afghanistan. Furthermore, it is difficult to pinpoint when buildings were built because of their ageing or improper maintenance or absence of inscriptions. Therefore, in regions such as Herat, we developed a useful method to analyse buildings.

In the case of known buildings, researchers have been able to provide an exact date of construction so that a typological analysis has been easy and straightforward. In cases where a building's origin is clear, the kind of research in which we engage is not necessary. However, the construction date and origins of Herat's mosques are mostly unclear. Therefore, an analytical method for these structures is needed, and we developed such a new method for this purpose.

It is not clear from the available records when the mosques in Herat were built. While Herat's cisterns' origins, historical backgrounds and histories have been clearly documented, the mosques have remained undocumented (Asim and Ando 2020). Timurid cisterns were constructed in the 15th century during the Timurid dynasty, while there is no known date for the construction of mosques, which are similar to cisterns. Therefore, we conduct an analogical analysis based on feature similarity to find when mosques may have been built.

In this study, we seek to explore the architectural typology of mosques and determine when these monumental structures possibly emerged in the Quzzat quarter of the Old City. The study analyses the architectural characteristics and explains the typologies of the mosques, which have not been defined before. Moreover, the study proposes when each building may have been built. We examine historical maps, written reviews, and architectural analyses to determine the date of construction for each building.

In this paper, we use previous studies and results from a field survey that was conducted from April to July 2021. The study 1) covers all 29 mosques within the Quzzat quarter; 2) establishes the spatial distribution of the mosques, confirming this distribution during field observation, and we locate the mosques on a map using GIS; 3) explains the types of mosques present in the different quarters; 4) introduces the time period in which each building was built; and 5) provides a method for future researchers who wish to establish a building typology for masonry historic, monumental, and traditional structures in regions such as Afghanistan, Iran, Uzbekistan, Turkmenistan, Tajikistan, etc., which share similar backgrounds and cultures.

On-site fieldwork includes a literature review, data collection, and spatial analysis. First, we conduct a general search of written materials. Second, we explore governmental administrative archives to gather old maps, books, chapters, or any other relevant historical, artistic, and architectural information, as well as information pertaining to the geographical distribution of Herat's mosques.

During our field survey, inscriptions, notes, records, and photos are collected for further analysis. We include drawings, plans, and sections maps for all 12 of the traditional mosques that have been preserved, using AutoCAD and GIS for data collection and measurements. Ultimately, we combine, unify, and plot those findings on the Old City map, and we classify them.

Primary data are collected by conducting a field survey over a period of four months, as mentioned earlier. First, a review of historical studies is conducted to enhance our background knowledge. Second, we reproduce the maps and results we find in previous studies to compare the changes undergone by mosques in the quarter, analyse the situation and differentiate the between types of mosques based on when they were built. Moreover, the valuable restoration work carried out by AKTC, which prevented buildings from being demolished, are reported in a table.

There are two stages to our architectural analysis. We first analyse the typological categorisation of mosques by comparing their architectural elements to those reported in a previous study on cisterns by Asim et al. in Asim and Ando 2020. Based on these scholars' analysis (Asim and Ando 2020), a classification of mosques can be made according to the typology that was established about cisterns. Second, the mosques' typological classification is used to establish possible construction dates for each mosque, since mosques are described based on their architectural features.

3 Architectural typologies for preserved traditional mosques

3.1 Mosques' spatial distribution

Several studies have focused on the historical, artistic and social aspects of mosques' distribution and transformation in the Quzzat quarter. Gammell (2016), Najimi (1988), Rajayee (1984), and Niedermeyer (1924) plotted only a few mosques on their maps of the city's palace. Their studies did not cover all 29 mosques in the Quzzat quarter. Moreover, they did not analyse the mosques' spatial distribution or architectural typology.

'Afghanistan: Preserving Historic Heritage', edited by Jodidio in 2017, contained a map of restored buildings and mosques. The historical background, the restoration process, drawings, and images were provided

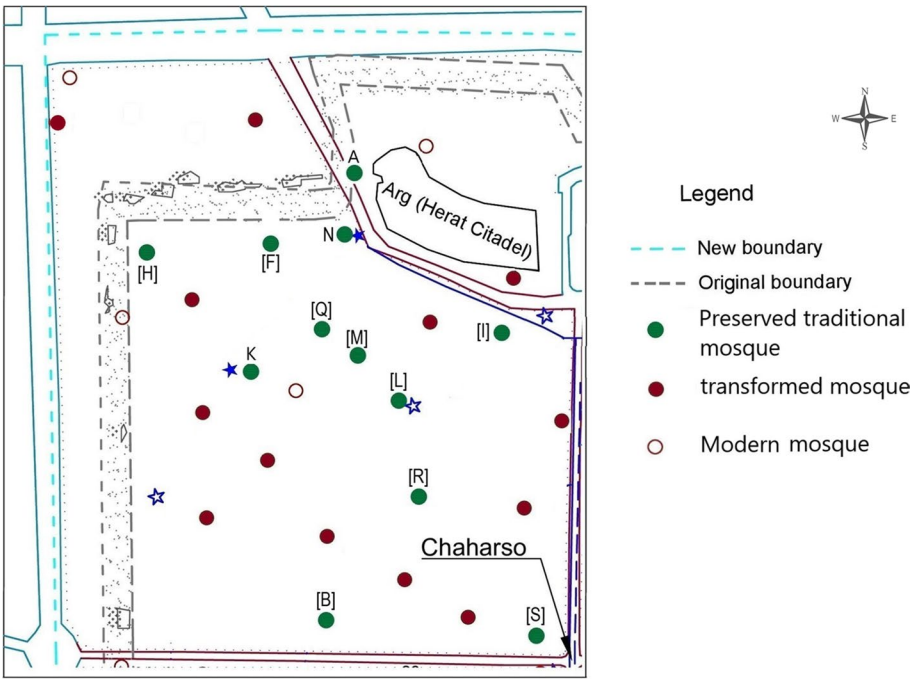

Fig. 2 Distribution of mosques, 2021 (Source: the authors)

only for four mosques and one synagogue, which was called Yu Aw (see more information in Jodidio 2017). In a study published in Herat Bastan Magazine in 1984, Rajayee mapped 88 mosque locations in the Old City and explained the historical background and features of only eight traditional mosques. He found 22 mosques in the Quzzat quarter of the Old City. In Najimi Abdul Wasey's study (1988), which was written in 1986, conducted in 1987 and published in 1988, 83 mosques appeared on the Old City's map. Najimi discovered and plotted 24 mosques and Madrasas in the Quzzat quarter of the Old City.

In our study, we find and plot 29 mosques (Fig. 2) in the Quzzat quarter of the Old City. There are three modern structures (made of reinforced concrete) and 26 traditional or preserved structures (made of unreinforced brick). Fourteen out of 26 buildings have been transformed, while 12 have been preserved in their original, traditional form. Most of the preserved mosques are located in the northern half of the quarter or to the south of the Herat Citadel, where most monuments have been preserved within their traditional landscape.

3.2 Synopsis of the typology of cisterns (an approach to analysing the typology and determining when mosques were possibly built)

In a 2020 study in the Journal of Architecture and Planning, the Architectural Institute of Japan, Asim, and Ando (2020) measured 11 existing cisterns within the Old City of Herat, drew plans and sections, analysed the typology of their structures, and clarified their building dates. These cisterns and mosques have shared similar cultural, climatic, architectural, and social origins. Three examples of cistern drawings and three images of cisterns are included in Fig. 3 to provide a more comprehensive examination of the similarities that cisterns and mosques share (Figs. 4 and 5). Building a water cistern is important to people's life, and the Quran emphasises frequently about water and providing water to people. Building a mosque is also important for people's daily praying. Indeed, prophet Mohammad said that God would give the person who builds a mosque a similar edifice in the heavens (Al-Bukhari 1990; Ibn-al-Hajjaj 1955). In Herat, the mosques have undergone more renovations than the cisterns. Therefore, the inscriptions on mosques may have been plundered, may have become unreadable due to the weathering and deterioration of plaster in some cases, or may have been damaged or broken. We develop methods to determine the architectural typology of mosques and their development period by conducting a comparative analysis of both cisterns and mosques. A brief summary of the typological analysis is presented here to assist readers in categorising the mosques and determining their development period. In terms of cistern development, we note three distinct periods: a) before the Timurid dynasty (BT), which corresponds to

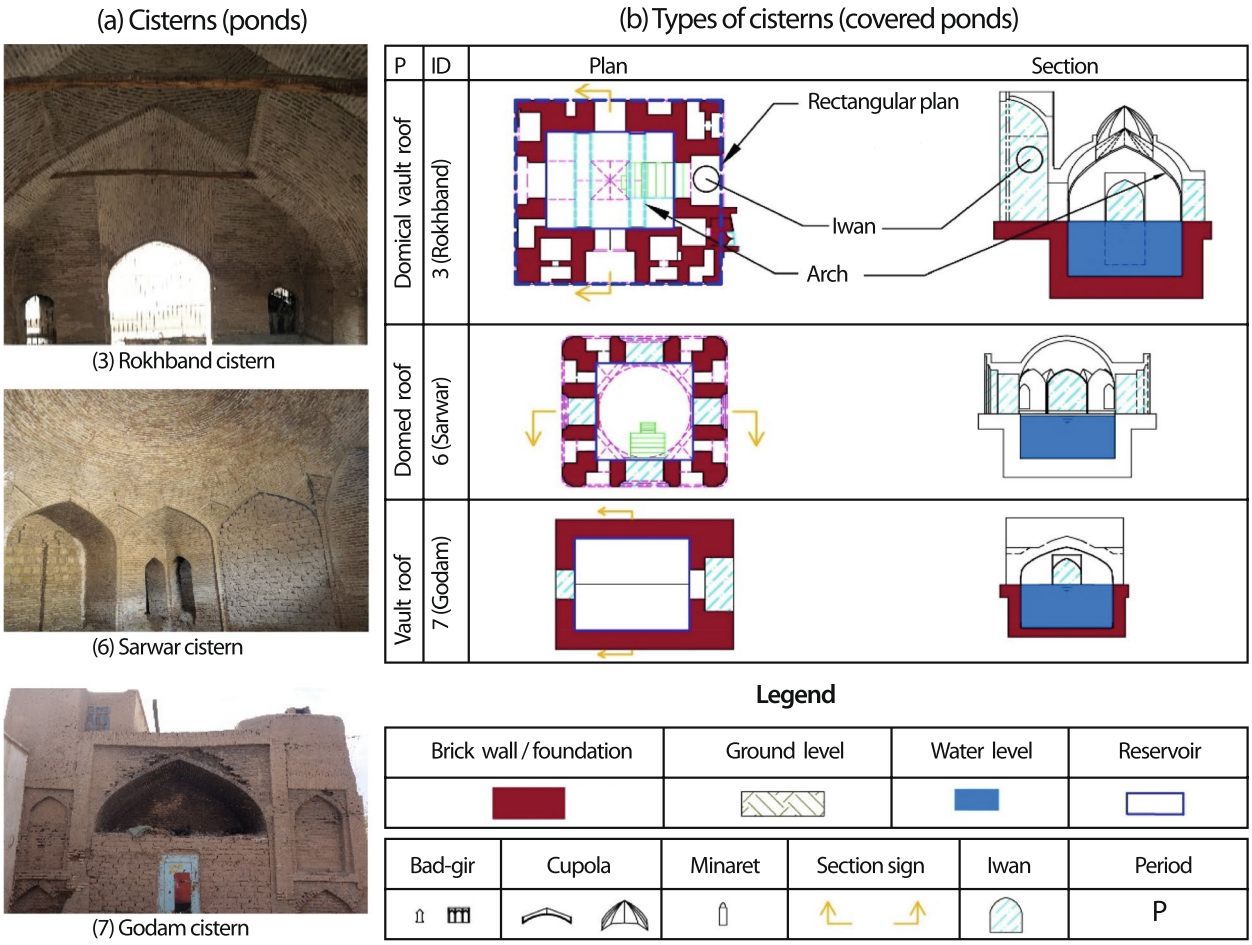

Fig. 3 Types of cisterns (Sources: a, photo by the authors 2021; b, from Asim and Ando 2020)

the time period before 1370 CE; b) during the Timurid dynasty (T), which lasted from 1370 to 1507; and c) after the Timurid dynasty (AT), which began in 1507.

The characteristics of cisterns of the first type include rectangular plans with domical vaulted roofs, a feature developed before the Timurid dynasty. These cisterns have domical vaulted roofs with parts (components) supported by arches along their entire length, or they have simple barrel-vaulted roofs with a cupola on top and, in some cases, a *Bad-gir* (wind-catcher) on top. Hence, a rectangular plan with a domical vaulted roof topped with a cupola is considered characteristic of the period before the Timurid dynasty (BT), i.e., -1370 CE.

The characteristics of cisterns of the second type include a squared plan with a domed roof, a feature that became more common during the Timurid dynasty. We find that the Timurids used domes more than other earlier domical vaulted roofs in Herat (squinch domes in cisterns). Another feature that was utilised in Timurid architecture was *Bad-gir*, which enhanced vaporisation by allowing air to circulate through the cisterns to keep the water cool. Hence, the square plan with a dome and a *Bad-gir* (wind catcher on roof) is representative of Timurid (T) architecture in the period from 1370 to 1507 CE.

Herat was occupied in 1376 CE by Timur Lane, founder of the Timurid Empire. The Timurid Empire later chose Herat as its capital. Timur's son, Shahrukh (1401–1450), and Queen Gauharshad Begum constructed a modern Herat, which became popular as 'The pearl of Khurasan.' The capital city, Herat, was expected to provide services not only for residents but also for visitors. The Timurids possessed an excellent understanding of architecture and civil engineering. They built roofs to cover the bazaars of the Old City, and a large spectacular dome was built at the intersection of four bazaars near the city centre (Herawi 2005; Asim and Ando 2020). Additionally, the Timurids built administrative buildings, mosques, caravanserais, and gardens. The city was expanded to the north outside of the Old City, and new villages were developed. During Abo Saeed's reign, the Timurids had

to build the canals of Joy-e-Now and Sultani as a result of urbanisation (Siljuki 2011; Asim and Ando 2020).

Therefore, Timurid cistern architecture consisted of squared plans with domed roofs, and this architecture was also used for mosques as well. According to Asim and Ando, 2020, the Timurids introduced (better to say used) western (today's Iran and Turkey, west Asia) structures to Herat (cisterns), such as squinches and pendentive domes.

The cisterns of the third type have rectangular designs and barrel-vaulted roofs that were used after fore the Timurid dynasty. These types of buildings are simple in structure and smaller in size. The Safavids, who emerged during the first Shia Islamic period in Herat (Afghanistan), used an architecture characterised by three-dimensional Muqarnas and decorations made of gypsum, as well as high-elevation Iwans (gates) with vaulted roofs. It is possible that the Safavids reorganised some cisterns through such modifications as a way to differentiate themselves from Shia Muslims. Hence, rectangular plans with barrel vaulted roofs and Muqarnas decorations appeared after the Timurid dynasty ended (AT), i.e., after 1507, and were mainly used by the Safavids.

Table 1 shows the abovementioned data; for more details on cisterns, refer to Asim and Ando 2020

3.3 Elements for typological analysis

(1) ***Plans*** determine the type of mosque in the first step of our study. Plans are related to the structure of the ceiling and are therefore the first criteria to be considered. Traditional mosques are designed according to two types of plans for their exteriors: rectangular and square. These plans include either rectangular interior parts, square interior parts, or both rectangular and square interior parts that coincide with certain time periods that are described later in this paper. Plans are the first indicator of the engineering strategies used during different dynasties.

(2) ***Ceilings*** constitute our second step in analysing the typology of mosques, and they are crucial. It is the ceiling that determines when a rectangular plan building was possibly constructed. It is therefore important to consider the type of roof as the second criterion. There are three types of roofs: Domical vault roofs (DVR), domed roofs (DR), and barrel vault roofs (BVR). The ceilings are divided into six subtypes and are further discussed later in the paper.

(3) ***A supportive arch*** is used in a ceiling to support a portion of the ceiling across the span of a room. Supportive arches date back to a time before the Kurts, i.e., before 1221 CE, but many of these arches were modified during the Timurid dynasty, 1370–1507 CE. While a supportive arch is not a determining characteristic in this study's typological analysis, it is an essential component of a structure. In this study, we add these arches to the engineering features of the periods, as they can be useful for future researchers to consider as determining architectural factors.

(4) ***A Mihrab*** is a semi-circular niche (space or shelf) in the western wall of a mosque that indicates the direction of Qibla towards Ka'ba, where an *Imam* or religious leader of the Muslim community preaches, sermons, or leads prayers. A *Mihrab* does not have a determining role in this study's typological analysis. Nevertheless, a *Mihrab* can be added to the previous features of the different periods as a measure that can be used in future studies as a determining factor.

3.4 Architectural typology

The data collected for this study are gathered from field observations in all mosques within the Quzzat quarter. All 12 existing main buildings are measured, and their plans and sections (Figs. 4 and 5) are drawn. We classify the mosques into four categories based on their plans: A, A1, A2, and B. The period of development is determined based on the ceiling type and architectural analysis (Table 2, Figs. 4 and 5). The four types of buildings are explained as follows.

Table 1 An overview of the typology of cisterns and periods of development

Plan	Ceiling (Roof)	Ceiling Arch	Cupola	Bad-gir	Period of Development
Rectangular	Domical Vault Roof (DVR)	√	√	-	Before Timurids (BT): –AC 1370 (Before Kurts: –AC 1243), Kurts: AC 1244–1381
Square	Domed Roof (DR): pendentive or squinch	-	-	√	Timurids (T), AC 1370-1507
Rectangular	Barrel Vault Roof (BVR)	-	-		After Timurids (AT), 1507–present (Safavids: AC 1501–1736, Duranids: 1747–1826)

Table 2 Architectural classification, and physio-typological condition of the mosques

Type	Types of Plans		Ceiling (roof)	Ceiling details			M: Muqarnas Mihrab, D; decorated (Plastic) Mihrab	Supportive Arch of Ceilings	Preserved by	(N1): Existing/current Name [N2]: Old or original Name	ID on Figs. 2 and 4
	Exterior Plan[a]	Interior (room)		C: Cupola or, B: Bad-gir	Muqarnas	G: Gypsum decorations P: Plastic decorations					
A	Rectangular	rectangular (r)	DVR	-	-	G	M	√	AKTC	Nawab (Malik)	[N]
				C+B	-	G+P	D	√	AKTC	Haji Sharif	[H]
				-	-	G	M+D	√	Residents	Faizani Allama (Fakhr Razi)	[F]
				-	-	G+P	M+D	√[b]	AKTC	Karampoor (Sarwar)	[K]
				-	-	G+P	M+D	√[b]	AKTC	Qazi G. Rasool (Maulana)	[Q]
			BVR	-	-	G	M	-	AKTC	Rokhband	[R]
A1		s + r	DVR	-	-	G+P	M+D	√[b]	AKTC	Maulana (Haqdad)	[M]
			DVR+DR3	B	√	G	M+D	-	AKTC	Bilal (YoAw Synagogue)	[B]
A2		s	QVR+DR2	-	√	-	-	-	AKTC	Sheer Shah Soori (M. Azam Khan)	[S]
			DR1	B	√	G+P	M+D	-	Residents	Khirqa	[I]
B	Square	square (s)	DR1	B	√	G	M+D	-	AKTC	Arg (Khaja Naqshbandi)	[A]
			DR2	B: Closed	√	-	M	-	AKTC	Ali (Hazrat-e Ali)	[L]

[a] Main building, *DVR* Domical vault roof, *BVR* Barrel vault roof, DR1: Domed roof (sail), DR2: Domed roof, pendentive), DR3: Domed roof, squinch, QVR: Quadripartite vault roof, [b]modified arch in later modifications, AKTC: Aga Khan Trust for Culture, B: Bad-gir, C: Cupola

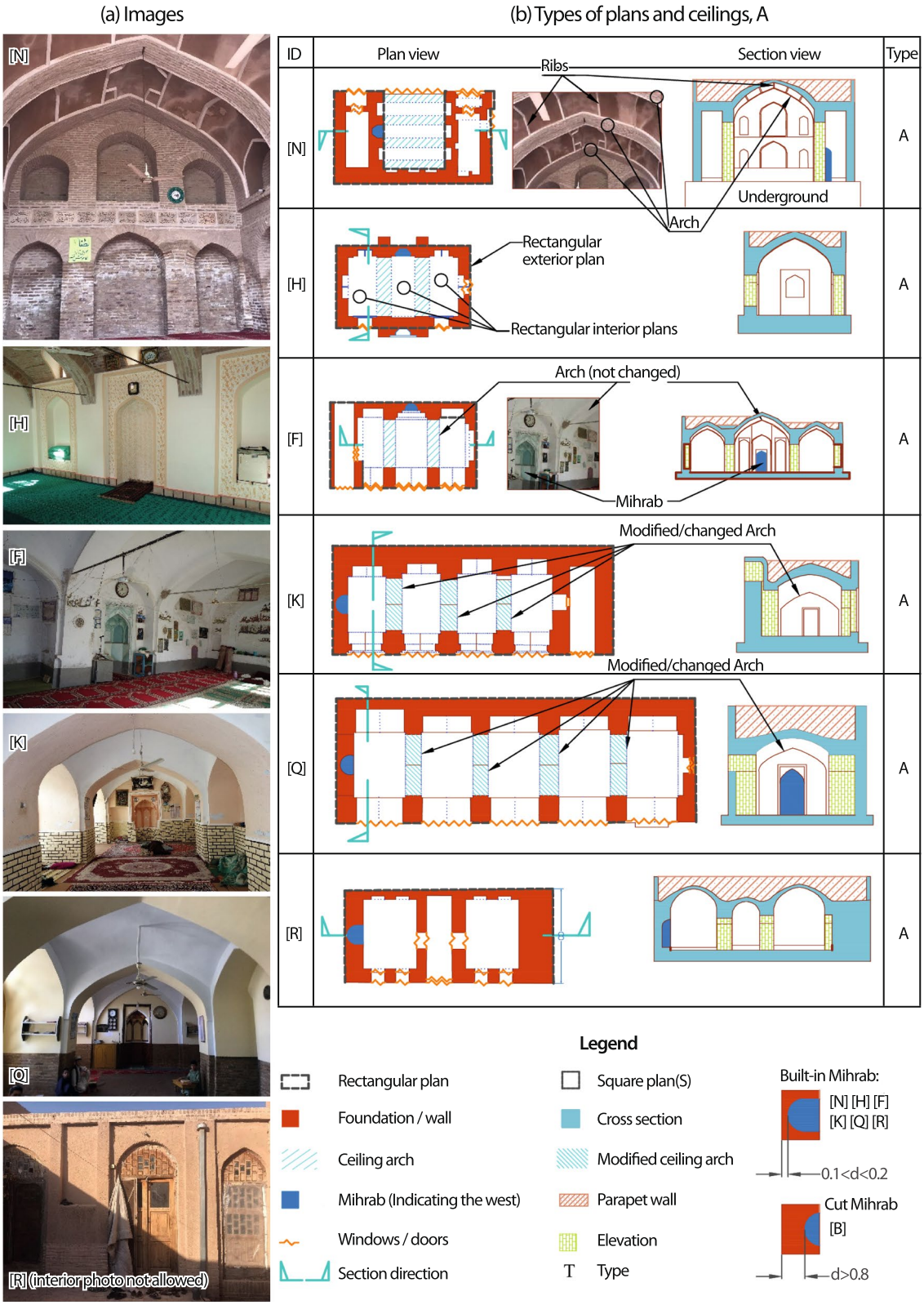

Fig. 4 Architectural classification of mosques, Type A. 2021 (Source: the authors)

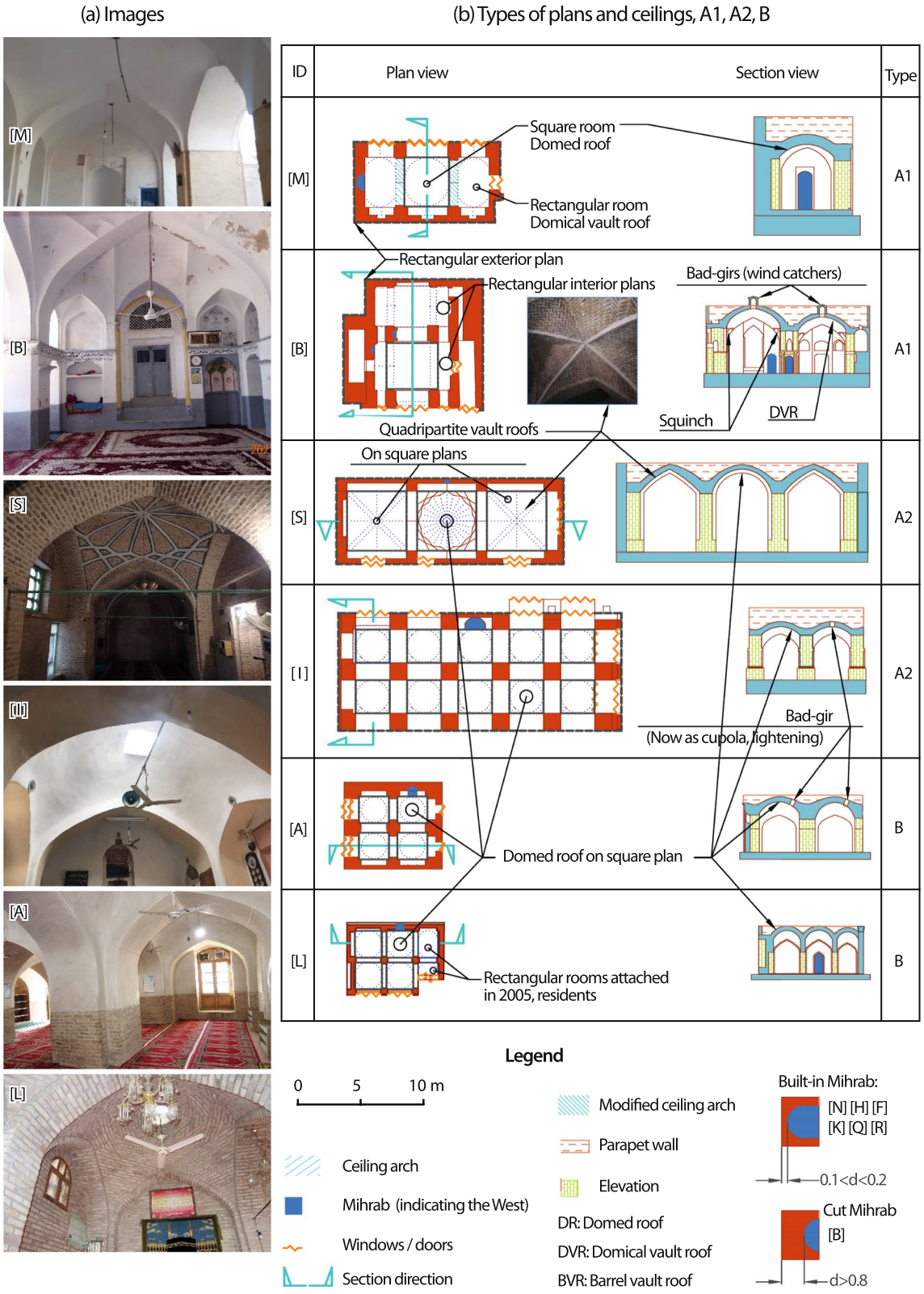

Fig. 5 Architectural classification of mosques, Types A1, A2, B. 2021 (Source: the authors)

Type A shows plans that are primarily rectangular and interior plans that consist of smaller rectangular components (rooms, plans). There are six mosques with rectangular exteriors and rectangular interiors: [N][H][F][K][Q][R]. They bear domical vault roofs that date from periods before the Kurts (−1243 BCE), i.e., from before the Timurids. Cisterns built during the same period bear cupolas for daylighting, but the mosques do not, as windows are used instead. [H] is exceptional because it has both cupolas and a *Bad-gir*, unlike other similar buildings that only have a single cupola. On the north side, the open cupolas serve as *Bad-gir* (wind catcher). Muqarnas are not observed in ceilings of this type. There is only one mosque [N] with ribs depicting a 3D view identical to Muqarnas. [H][F][K][Q][R] have gypsum decorations on their ceilings. Except for [H], which lost Muqarnas works during restorations in 2005, all other mosques have their original Muqarnas *Mihrab*. Except for [N][R], other mosques in this group are decorated with modern plastic painted decorations.

Type A1 refers to mosques with rectangular main plans and interior plans that are composed of rectangular and square rooms. The main buildings of [B][M] have rectangular exteriors and rectangular and square interiors. [B] was originally a synagogue (Jewish temple) and was transformed into a mosque, from a functional point of view, after all Herat Jews left (endangered group) the city in the 1990s and earlier. Two *Mihrab* with modern plastic paintings have been added to [B] after it was transformed from a synagogue to a mosque. It has a mixed ceiling that consists of a domical vault roof that originates from a time before the Kurts, i.e., before the Timurid period. In addition, [B] was built with Safavid muqarnas. [B] combines elements from all earlier periods since Jews incorporated engineering techniques from all earlier periods. Many researchers, for instance, Herawi 2005, confirmed that this mosque was built after the Timurid era, perhaps during the Safavid era, but with Timurid and earlier architectural and engineering skills (Herawi 2005). As we see in [M], a square room is located at the centre of the main building and is connected to two other rectangular rooms in the east and west, and it has a traditional muqarnas *Mihrab*. This structure has domical vault roofs decorated with gypsum.

Type A2 mosques have rectangular plans, but their interiors are divided into smaller square rooms and square plans. The main buildings of [S][I] mosques are square and have square rooms. [S] has a mixed ceiling comprised of a domed roof, originating from the Timurid era, and two quadripartite vault roofs, probably originating from an unknown period before the Timurids. [I] has square rooms with uniform symmetry and domed roofs built in the Timurid era. In both buildings, the ceilings are decorated with muqarnas, but [S] features more complicated Muqarnas, which are still in good condition, while [I] features simple muqarnas, gypsum and plastic painted decorations. This is the largest and most impressive mosque in the quarter, with features dating back to the Timurid dynasty and some dating back to the era after the Timurid dynasty. The building's rectangular exterior plan represents the architectural style developed before the Timurids, possibly by the Kurts, and the construction style is reminiscent of Timurids' engineering. [S] has windows for daylighting and muqarnas on the ceiling with no *Bad-gir*. The ventilation openings are closed, and the building is equipped with modern air conditioning. Despite having an air conditioning system, [I] still has a traditional *Bad-gir* for ventilation and windows for daylighting. The edifice exhibits tile decorations in the Timurid style, as well as muqarnas and plaster decorations. There are numerous Persian inscriptions on the exterior surfaces of the building, along with artistic tile work.

Type B refers to mosques whose main structures are square with an interior area that consists of square components (plans and rooms). Both [A] and [L] are square buildings that have square rooms. The ceiling of [A] consists of a sail type domed roof, which has twelve arches on nine columns, each supporting four ceilings. This edifice contains no decorations, and muqarnas were possibly removed during restoration or reconstruction. Four solid columns at each corner support [L]'s pendentive domed roofs. In 2005, a small annex was added to the north of the main building.

3.5 Mosque typology modification assessment

Among the 12 mosques that have been preserved, six (50%) have supportive arches (Table 2). In three out of the six mosques, the supporting arches remain in their original condition or form. The supporting arches in the other three mosques have been modified or reconstructed. During the Timurid period in the 15th century, these mosques lost their original arch and were affected by Timurid architectural reconstruction. As a result of a lengthening of the mosque, one large ceiling with two or three large supporting arches did not seem feasible for these buildings. Therefore, the building was divided into smaller rooms, and the support arches were also modified, making further structural analysis necessary (Figs. 4 and 5, mosques [K][Q][M]). In previous periods, mosques were built with ceilings supported by numerous arches. Structures dating back to the Timurid period or to a time after the Timurid period do not show supporting arches for their ceilings because they have more extensive exterior plans and smaller interior rooms; therefore, the ceilings no longer need to be supported. In contrast, those mosques built before the Timurid era are larger and

require more arches to support them Fig. 3 (refer to section 3.2 for drawings).

According to Table 2, the *Mihrab* is the most decorated part of a traditional mosque in the Quzzat quarter of the Old City, however, only one mosque today has the most decorated ceiling. Among the 12 mosques, 10 (83.4%) have traditional muqarnas *Mihrab,* 7 out of the 10 have colourful plastic paintings too, while 3 out of the 10 have no colourful plastic painting and only muqarnas *Mihrab*. Furthermore, 2 (16.6%) out of the 12 mosques do not have muqarnas; one out of these 12 has modern colourful plastic paintings, and one has a simple *Mihrab* without Muqarnas.

Interior parts, particularly the ceiling finishing, are decorated in three stages: 1) original artistic brickwork was created; 2) when the brickwork became old and damaged, it was plastered with gypsum; and 3) recently, the brickwork was covered with plastic layers. Eight of the 12 buildings show gypsum finishing, while four have no plaster at all. Five out of eight gypsum-decorated buildings are modernised with plastic decorations.

As observed in the introduction, scholars have analysed mosques' architecture and created typology for them. Our methodology, typological analysis, and classification are new and different from those found in prior studies by Mustafa and Hassan (2013), Ahmad (2014), Budi (2004), and Hillenbrand (1982).

4 Determining construction periods (based on the type of mosques)

The cisterns illustrate three different architectural periods, as explained in 3.1. The first period is that of the domical vault roof in which the building has a rectangular plan with a dome-shaped roof and cupola at the top; this roof is characteristic of the time before the Timurids. Second, the period of domed roofs, in which a square plan is combined with a domed roof (pendentive or squinched) topped with a *Bad-gir* on top, is characteristic of the Timurid era. The third period of vault roofs is characterised by a rectangular building structure with a barrel vault roof, a feature of the period that came after the Timurids.

Based on the above analysis, it is possible to estimate the development period of mosques by analogical analysis using their architectural characteristics. The types of mosque buildings differ across different time periods. In ancient times, researchers, artisans, and archaeologists reported, as Herawi did in his book, that many of the buildings inside the old city had been reconstructed, renovated, or restored. However, the buildings' original shape, quality, and condition remained (Herawi 2005). Based on the typology and features of cisterns, mosque buildings can be categorised chronologically based on the period in which they were developed (see Table 3).

By analogy, mosques [N][H][F][K][Q], which have the characteristics of edifices built before the Timurid era (1370 CE), are classified as domical vault roof buildings (DVR). There are slight differences in the slope of the arches in each building that require further examination of these arches. At the same time, mosque [M], which combines elements characteristic of time periods both before and during the Timurid era, is considered to have been built during a time of transition from the pre-Kurts era to the Timurid dynasty, possibly around 1350 to1400 CE. Building [I], although new inscriptions were added to it during recent restorations, incorporates the designs of Timurid (1370–1507) and Safavid muqarnas (1507–1636 CE); these designs were developed during a period after

Table 3 Determining the period of development

Type	ID/Name	Plan		Ceiling (Roof)	Ceiling Arch	Period of Development
		Exterior plan[a]	Interior plan			
A	[Q]	Rectangular	R	DVR	√	Before Timurids (BT): –AC 1370
	[K]			DVR	√	
	[F]			DVR	√	
	[H]			DVR	√	
	[N]			DVR	√	
A1	[M]		S+R	DVR	√	Transition to Timurids: AC 1350–1390s
B	[A]	Square	S	DR1	-	Timurids (T): AC 1370–1507
	[L]			DR2	-	
A2	[I]	Rectangular	S	DR1	-	Transition from Timurids: AC 1507–1636
A	[R]		R	BVR	-	After Timurids (AT): AC 1507–present
A2	[S]		S	QVR+ DR2	-	Exception (Mixed): T+BT
A1	[B]		S+R	DVR+ DR3	√	Exception (Mixed): T+BT+AT (S)

[a] Main building, *DVR* Domical vault roof, *BVR* Barrel vault roof, *QVR* Quadripartite vault roof, DR1: Domed roof (sail), DR2: Domed roof, pendentive., DR3: squinch Domed Roof, B: Bad-gir, C: Cupola. S; square, R: rectangular

the Timurid dynasty, possibly under the Safavids (1507–1636 CE). Additionally, square mosques with square rooms, which resemble edifices built by the Timurids or Safavids, are considered to have been built in the period when domed roofs were commonly built. These structures may have originated during the Timurid or early Safavid eras, as their domes show significantly improved features. Additionally, only [R], which shows the characteristics of Durranid-era edifices, can be categorised as a vaulted roof originally constructed during the Durranids period.

As observed in Table 3, two mosques, [B][S], are not harmonious stylistically, as they show mixed features from different periods. Mosque [S] has a rectangular plan characteristic of the era before the Timurids, square interior plans (rooms) from the Timurid period, one domical vault roof dating back to a time before the Timurids, and two quadripartite roofs. A cistern building similar to [S] is not included in Asim et al.'s 2020 study (Asim et. al. 2020). Thus, categorising [S] is not possible in this study due to its unique architectural characteristics. Due to the complexity of its structure, the last building, [B], incorporates features found in periods both before and after the Timurid dynasty. As a result, [B] is regarded as an exception and requires further investigation.

5 Conclusion

Considering existing literature, this study represents a new methodology and analysis and differs from previous studies. The paper identifies different types of mosques and uses this categorisation to account for possible construction dates through analogical analysis.

There are 29 mosques in the Quzzat (Bardurani) quarter of the Old City. There are twelve mosques that are still in their original condition despite having been restored, maintained, and preserved. Most of the mosques that have been preserved are located in the northern half of the quarter or in the southern part of the citadel. In the course of our field survey, GPS points are collected, and each building is placed on our map through GIS spatial analysis. We could conduct research at the Herat library and collect relevant sources, which helped our analysis and the development of our study. A laser metre is used to read measurements for each structure as part of site visits and to draw plans and sectional views of each building for further investigation. Using drawings and photos, the architectural typology of mosques is determined in the laboratory.

In this study, we examine the architectural typologies of traditional mosques that have been preserved in the Quzzat quarter of the Old City and are the primary monuments in the Herat city. This study analyses and classifies these preserved mosques along a typology, explains their architectural features, conducts an analogical analysis, and determines probable construction or origin period for each building.

According to the study, six mosques have rectangular plans and domical vault roofs. Five of these mosques correspond to the architectural style found before the Timurids (before 1370 CE), and one corresponds to the architectural style found during the period of transition from the Timurids to the Safavids. Two mosques have square plans with domed roofs and correspond to architectural characteristics found in the Timurid period (1370–1507 CE). Currently, only one mosque has barrel vault roofs, coinciding with characteristics found after the Timurid rule (1507 CE to the present). The last two mosques incorporate architectural elements found in different periods, making it difficult to determine when they were built. Indeed, further research is needed to identify when these two mosques were developed. It is necessary to conduct additional research from different perspectives, including ornamental, epigraphical, historical, and material. Altogether, timber architectural features are observed in most of the buildings, suggesting that a great deal of construction, reconstruction, or restoration occurred over time.

In addition, this research offers a framework and method for further investigating architectural typology and indicating when masonry historic, monumental, and traditional structures were built in the region, which can be useful to future scholars from neighbouring countries with similar cultures, geography, and climate.

Since mosques all show features similar to those of cisterns (based on architectural features above the ground level, such as exterior and interior plans, roofing systems, and arches), we can say that mosques have the same typology as cisterns. Thus, it is possible that, based on these many shared features, mosques were originally developed at the same time as cisterns or during the same period.

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Declarations

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