

Iranian innovations in mosque lighting techniques: A historical survey

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ABSTRACT:

From the viewpoint of preserving the values of sustainable architecture, daylight in the interiors of mosques in hot and dry climates has always faced limitations. The need to use daylight to provide the required lighting and, in contrast, to prevent the scorching desert sun from entering the spaces led to innovative techniques in Iranian architecture. These techniques have gradually evolved along with the development of semantic concepts of space in different periods of Islamic architecture, which has resulted in slight differences in their application in mosque buildings. In this article, while analysing the place of light in mosque architecture, the standard techniques in lighting mosques located in Iran's hot and dry climate are studied. The employed research method is a combination of qualitative and quantitative approaches. As the current historic-architectural research cannot be based solely on perception-based definitions, authors had to convert the conceptual features into a measurable index. To achieve this, a numerical index with the scale from 0 to 3 has been defined. The scoring was based on documents such as plans, images, etc. Although most case study objects were built over the centuries, they have general characteristics that distinguish them from a specific historical era. The authors studied the application of these techniques in some examples of selected mosques from four periods of Islamic architecture and present the results in the form of trend charts. Furthermore, they observed the principle of continuity in Iranian architecture from the historical period from the beginning of the Islamic period to the Qajar period, and, in accordance with the theoretical foundations of research, analysed the reasons for the ups and downs of each of the techniques.

KEYWORDS:

mosque, Iranian architecture, lighting, hot and dry climate, Islam

INTRODUCTION

The genius of the Iranians in developing environmentally friendly architectural techniques created works of architecture in the deserts of the country which are masterpieces not only from an aesthetic point of view but also from an engineering point of view and which, centuries later, are still highly valued by researchers in various scientific and artistic fields. The features of traditional Iranian architecture reflect the natural, geographical, and cultural needs. The unfavourable climate in the central regions of the country always requires adaptation to harsh conditions such as heat and hot summer sun, daily temperature fluctuations, low humidity, dehydration, and sandy and gusty winds. Hence, traditional design has found solutions to these problems, as Iranian architectural and urban planning methods testify to these solutions [1].

The influence of the climate on architectural solutions over the centuries gradually transferred in the form of Iranian architectural methods which, throughout history, have led to the devel-

opment of sustainable values in the hot and dry climate of Iran, with features such as symmetry, continuity, man's dependence on God, proportions between volumes and lines, simplicity outside and beauty inside and connection with the outside nature [2].

Among public buildings, mosques have an exceptional value for Muslims, which fact is an essential cultural factor with regard to preserving and protecting public buildings of mosques. Knowing that mosques are the houses of God on earth, Muslim architects did their best to bring the most appropriate arts and crafts to the forefront in mosques. In Islam, the mosque is the beating heart of the life of Islam and of the society, where Muslims from various parts of the city gather five times a day and renew their faith. Therefore, *"the mosque is not only the most important and significant Islamic building but also a key to understanding Islamic architecture [3]."*

Today, in the desert regions of Iran, mosques from different periods, which have been preserved to a considerable extent in

their original form, are remembered in all their glory, and pave the way for the study of researchers in this field. In traditional Iranian architecture, the climate has significantly influenced architecture formation and dramatically helped the Iranian artists form the architecture with unique characteristics. For example, one of the effects of sunlight on these buildings in the desert climate of Iran is that Iranian architects have opted for a higher southern facade and higher windows to bring in sunlight. By using coloured windows with varied dimensions and sizes, they have created harmony with beautiful light shining in through open windows in heavenly colours in the space behind the windows [2].

A mosque is a place of worship and a place where the architect seeks to create an atmosphere in which the audience can feel the presence of God and worship Him better than in other spaces. Muslim architects believe in the holy verse *"Only those shall maintain Allah's mosques who believe in Allah and the Last Day, and..."* [4].¹⁶ They strive to create the best effect for the worship of the Lord. In this way, they seek something beyond matter to create a spiritual space; "Light" is an immaterial thing that is seen. In the Qur'an, God is called light; *"Allah is the Light of the heavens and the earth"* [4].¹⁶

Thus, directing light into the interior spaces of mosques has always been one of the concerns of Iranian mosque architects. In addition, in Iran's hot and dry climate, the long hours of sunshine during the day have been one of the motivations for innovation in the natural lighting of mosques. Therefore, in this article, the main focus of this article is *"the role of light and the use of each of the lighting elements in shaping the interior of mosques in the hot and dry climate of Iran during the four historical periods of Islamic architecture."* This issue is explored through theoretical and case studies.

MATERIALS AND METHODS

In this part of the article, based on library resources and documentary research followed by the explanation of the theoretical foundations of the research, the case study of mosques located in Iran's hot and dry climate from the perspective of lighting is discussed. Since the advent of Islam to the plateau of Iran, there have been many mosques in the country's desert areas that were destroyed or have undergone fundamental changes. So, the selection of eighteen examples studied in this case study was made based on the following criteria: Firstly, adequate information should be available (mainly sufficient images and plans); secondly, the mosque's construction should reflect the salient features of the architecture of the relevant historical period. Among the various lighting methods, the most common of all the lighting elements are described in the theoretical foundations of the research. Then, in the case study section, based on plans and visual information of mosques of each period, the application frequency of each element has been measured and evaluated at four levels. The results of the case studies are presented in the form of tables and graphs. Finally, after trend diagrams connecting the points were created, the tendency to apply each method can be seen, and in the interpretation of the diagram, the causes and factors that shaped

this trend are addressed. This method has also been combined with the other descriptive methods in similar researches [5].

The methodology employed in the research is a combination of the precedent standard methods with innovative extra components. As this is not a pure numerical study and the descriptive parts are undeniable, we merged both numerical-analytical and descriptive methods. So, we formulated a novel method that engages both aspects. The theoretical framework is one of the defining steps in research and is based on the case study, so its theoretical sources are discussed in the following sections:

Architecture in the hot and dry climate of Iran

Since climate plays an essential role in forming a building and architecture cannot be studied without its context, it is necessary to know this context in architectural studies. It is not easy to determine the territory of hot and dry areas in our country because the criteria for determining the desert differ from place to place, and everywhere, depending on the conditions of the place, some variables are superior [6]. Therefore, it is necessary to refer to the views of Iranian climatologists; Professor Kardvani classifies arid regions into four groups: real deserts, arid desert areas, arid regions, and semi-arid regions [7]. While Dr. Mahmoudi divides the deserts of Iran into two large groups of coastal deserts and inland deserts, the inner deserts are divided into two subgroups: 1. warm deserts with sweltering summers and mild winters 2. relatively warm deserts with hot summers and cold winters [8]. Dr. Khalili divides the arid climates of Iran into super-arid climates and arid climates. The super-arid climate of Iran with an area of 573,884 square kilometres can be observed in the largest area of the country's lands [9]. Dr. Hassan Ahmadi believes in an ecosystem theory, which identifies Iran's deserts with three criteria: climatic, terrestrial, and vegetation, and can be considered a new method [6]. (Fig. 1)

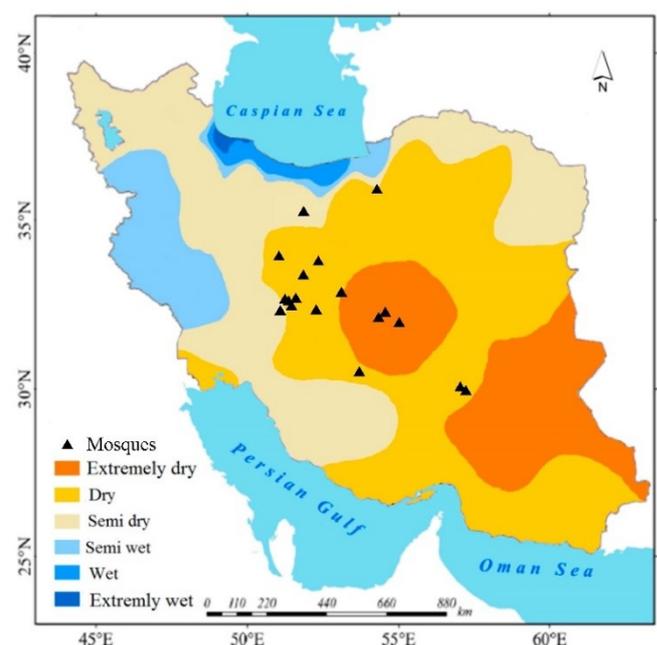


Figure 1: The climatic map of Iran and studied cases (mosques).
Source: Authors and [36]

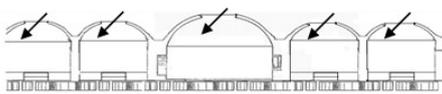
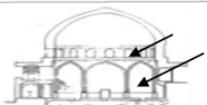
Regardless of the climatic classification, what directly affects the formation of architecture are the characteristics of the hot and dry climate plains of Iran, which generally include: hot and dry climate in summer and cold and dry one in winter, very little rainfall, very low humidity, very little vegetation and large temperature fluctuation between night and day; and dusty winds affect the air temperature during day and night [10]. According to different climatic divisions, "about 2/3 of the area of Iran is located in arid and semi-arid climates" [6]. These special climatic conditions have played a significant role in the development of architecture in harmony with the environment. They have influenced the architectural methods of desert areas of Iran, but also, due to the size of the geographical area, have influenced the way the architectural needs of other climates are met. Thus, the architectural works of Iran's desert climates in the studied historical periods were the basis for different styles of Iranian architecture.

Functions of natural light in architecture of public spaces

While avoiding excessive heat from the sun entering the interior is an important goal, the need for natural indoor lighting is essential and valuable and necessary for human activities [11]. The life-giving light of the sun has a substantial effect on human health. Sunlight is one of the most critical factors in destroying infectious viruses. Sunlight increases the number of superficial white blood cells in the body and effectively relieves joint and bone pain [12-14]. Daylight is also noticeable as a free energy source. What is more, "an average of 11 to 13 hours of light a day is psychologically and biologically vital for humans." [11] Therefore, in Iranian architecture, special attention has always been paid to the use of light.

Regardless of the physiological functions, in the traditional architecture of Iran, each of the public buildings required a unique solution for lighting. However, all of them needed daylight to create variety in the spaces. As regards the special functions, different techniques considered to be remarkable building workmanship were used in each of them. (Tab. 1)

Table 1: Comparison of natural light functions in public space architecture [15].

Space quality	Daylight diagrams and drawings of public spaces
Public spaces	 <p>Section of Bazaar Movement / Rhythm</p>
	 <p>Section of Mosque Mysterious space / Indirect light</p>
	 <p>Public bath – house ventilation / Daylight and privacy</p>

Daylight in the architecture of Iranian mosques

Light is one of the prominent aspects of Iranian architecture and one of the elements of divine knowledge. Light is a symbol of the face of God that appears in mosques. The manifestation of the spiritual aspects of light in the physical appearance of the building is one of the basic principles of the aesthetics of mystical Iranian architecture [16]. According to Titus Burckhardt, "no fuller symbol of light can be found for spiritual unity. That is why Muslim artists look for materials that vibrate light in a certain way. This feature is represented on the interior surfaces of the mosque [17]."

Daylight in religious buildings reminds man of the presence of his Lord and evokes a sense of humility. Depending on the function and importance of the space, the interiors of buildings vary in different degrees of light: from light to darkness and from darkness to blur and vice versa. For example, direct sunlight is used purposefully to create a bright environment that is in complete contrast with the darkness [11]. In general, according to the Qur'an and the views of mystics, light is a sign of God's existence. There is light; there is God, so the light enters the heart and opens it to the heavens [18]. Therefore, one of the functions of light in the mosque's interior is to emphasize the qibla axis^c. (Fig. 2) Daylight in traditional architecture and function is also important from the spiritual and decorative point of view. Thus, it is so intertwined with the architectural elements that they cannot be separated or removed [19]. When the presence of light is felt as a transcendental truth that shines like a ray in the heart of darkness, its presence is felt like the emergence and manifestation of high and lofty truth. It draws the human heart to the source of light.

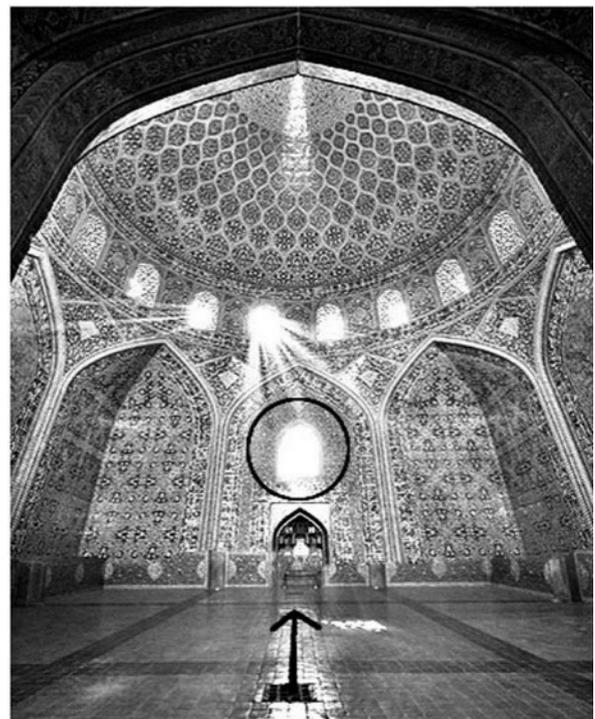


Figure 2: Dome of Sheikh Lotfollah Mosque; emphasis on the central axis of the mosque (towards the qibla) accentuated by the light entering from the reticular window located at the top of the altar.

Source: Authors

Case study: the use of lighting elements in the mosques of hot and dry climate

Since this research studies mosques located in Iran's hot and dry climate, the geographical area studied in Iran is often the country's central region. On the one hand, there is no information on the buildings of all mosques located in the area. On the other hand, during the relevant historical period (from the beginning of the Islamic period to the middle of the Qajar period) which covers more than a thousand years, many of these buildings fell into ruin or underwent significant changes. In view of this fact, the best surviving examples have been selected based on the available images, documents, plans, and building information and classified based on the historical periods of Islamic architecture. According to Iranian Islamic architecture historians, Islamic architecture in Iran is classified into four main

styles: *Khorasani*, *Raazi*, *Azeri*, and *Isfahani*, corresponding to critical historical periods: early history, Buyid and Seljuks; Ilkhanate, Timurids and Muzaffarids; Safavid, Zand and Qajar [20]. Based on the famous classification, every style has a prominent characteristic that distinguishes it from others. The emphasis on simplicity is the strongest in the *Khorasani* style. Decorations are mostly absent or very modest. *Raazi* style uses massive structural systems, and decorative elements are not utilized in a wide range of variety but limited to brickworks. In *Azeri* style, tiles create complex acrography patterns, and lofty spaces are vivid. Various kinds of imported decorations, innovative spaces, and multi-colored harmonious architecture can be defined as a general feature of *Isfahani* style. In compliance with this classification (Tab. 2), the mosques studied in this study are arranged as shown in the table below:

Table 2: Classification of mosques based on architectural style.
Source: Authors

Islamic periods of Iranian history	Early Islamic history (first and second centuries of Islam) 622 to 934 A.D.	Middle Ages (Buyid and Seljuks) 934 to 1231 A.D.	After the Mongol Invasion (Ilkhanate, Timurids and Muzaffarids) 1231 to 1501 A.D.	From Safavid onwards (from Safavid to mid-Qajar) 1501 to 1870 A.D.
Iranian Islamic architectural styles	Khorasani	Raazi	Azeri	Isfahani
Mosques in hot and dry climate of Iran (selected examples)	1 - Fahraj* [26] 2 - Tarikhaneh Mosque - Damghan [27] 3 - Naein* [27]	1 - Isfahan* [28] 2 - Zavareh* [29] 3 - Ardestan* [28] 4 - Barsian* [30] 5 - Malek Mosque of Kerman [28]	1 - Varamin* [31] 2 - Yazd* [32] 3 - Mir Chakhmaq Mosque of Yazd [32] 4 - Oshtorjan* [28] 5 - Abarkuh* [33] 6 - Kerman* [34]	1 - Abbasi Great Mosque of Isfahan [26] 2 - Sheikh Lotfollah Mosque [26] 3 - Hakim Mosque of Isfahan [28] 4 - Agha Bozorg Mosque of Kashan [35]

* Jameh Mosque

The building elements that have been employed to use natural light in traditional Iranian architecture are studied in two ways: the first group as light controllers that regulate the light entering the building. The second category includes light-catchers, which are often responsible for transmitting light to the interior. The elements that are considered light-catchers have different names, which are: *Rowzan*, *Shabaak*, reticulated door and window, *Iwan*, *Jamkhaneh*, *Horno*, *Orsi* (Sash window), *Roshandan*, *Goljam*, *Palkaneh*, *Fenzer*, *Pajang*, and *Tehrani*. Some elements such as *Iwan*, Arcade, curtains, Louvers, awnings and *Sabbat* often control the light and adjust it to enter the building. Elements such as *Shabaak* also play a role in controlling light while light-catching [21]. From the research perspective, some of these elements have been more commonly used in mosque architecture. The application of these elements has been investigated in the above-mentioned classified samples and the explanation as to the type of lighting technique has been provided as well. The methods are shown in the relevant tables:

Shabaak

A *Shabaak* is a network made of tiles or bricks or wood or plaster to control the climate and the view of the interior of a building. The part of the wall that is made up of full and empty space

is called *Shabaak* [22]. The changeable weather of Iran, the scorching sun, the wind and the rain, the storms and the tornadoes, and the particular national and religious beliefs required that the building have a *Shabaak* for protection inside the building. These grids absorb the intensity of light and create weaker light from side to side. The deflection of the light rays was caused by the collision with the painted edges of the light distribution network, which contributed to the uniformity and light distribution. (Fig. 3) Although all the space outside was quickly visible from the inside, there was no view from the outside during the day [21].

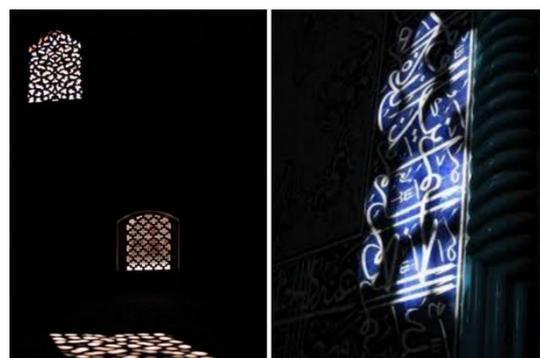


Figure 3: The dynamic combination of light and shadow in the Sheikh Lotfollah Mosque in Isfahan, created by Shabaak [16].

Window

It is one of the most basic lighting methods, and based on the amount of light to enter the building windows are usually made in the form of one and two lattices in different sizes [22]. The purpose of a window is usually to provide light and airflow, and a view of the outside world without disturbing the privacy. Lattice windows create a balance between outside and inside light. Whenever viewed from the inside, a balance blocks out intense sunlight. It also protects the eyes from getting tired in the face of bright outside light. The designs used in the construction of lattice windows are often such that they regulate the light inside the room. Lattice windows distribute the dim light outside and adjust it, and when the light is not intense outside, the windows pass all of it into space [21].

Rowzan

A small chamber has its role not only in lighting, but also in ventilation. It should be noted that the *Rowzan* is not openable and is designed to be fixed in a small frame [22]. *Rowzan* can be considered a small window usually used above the door and sometimes on both sides to get light and provide open air for closed spaces. (Fig. 4, 5) In other words, the *Rowzan* refers to the holes that are embedded in the stigma or shoulder of the vaults [21]. In some cases, if they are openable, they open and close circularly or axially [22].



Figure 4: Similarities in the lighting technique of the dome with the *Rowzan* in the mosques from two different historical periods (right: Jameh Mosque of Isfahan – 5th century A.H. (1009 CE – 1106 CE); left: Jameh Mosque of Varamin – 9th century A.H. (1397 CE – 1495 CE)).
Source: Authors

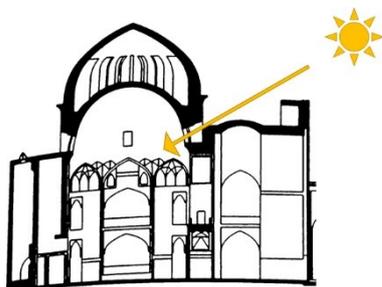


Figure 5: *Rowzan* in the architectural section and sunlight beams.
Source: Authors

Horno

It is called a light-catcher above the ceiling. *Horno* is a generic name for ceiling light-catchers. In *Kolombo* vaults (Fig. 6), we mostly see this kind of lighting technique because it is implemented at the end of the *Towghe Chin*^D [22]. Because it is impossible to implement the rest of the parts near the sharp

edge of the dome, so close to the area, architects do not fill the hole to enable the lighting above the vault. For example, in the ceiling of Bazaars, the *Horno* is often open due to lighting and ventilation purposes [21]. (Fig. 7)

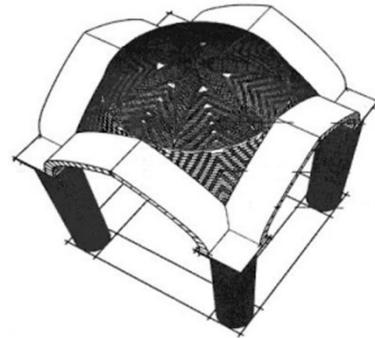


Figure 6: The *Kolombo* vault [23].

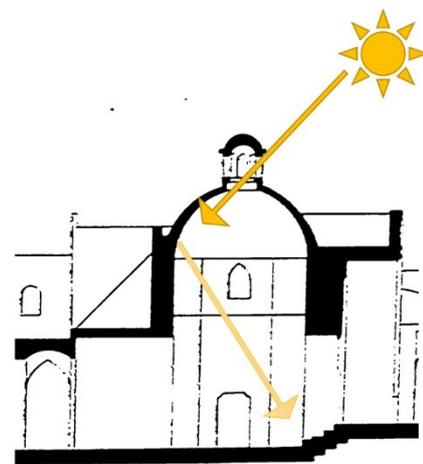


Figure 7: *Horno* in the architectural section and sunlight beams, a light director.
Source: Authors

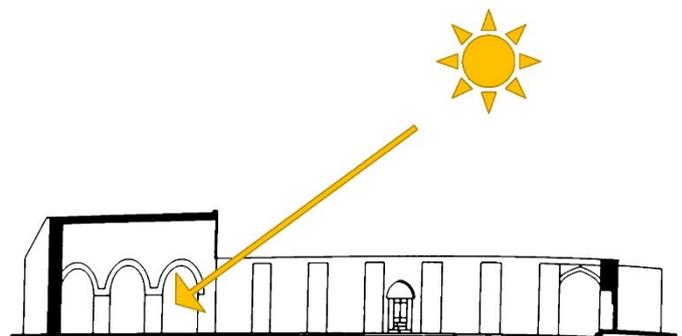


Figure 8: *Iwan* in the architectural section and sunlight beams, a sun-shade role.
Source: Authors

Iwan

The *Iwan* is one of the main elements in the architecture of Iranian mosques. The *Iwan*, which usually consists of a barrel vault, closes on three sides and opens on one side to the yard (U-shaped space). Although the main task of the *Iwan* is not limited to lighting, in the buildings of Iran's desert climate, it

plays a vital role in ventilating and providing light to the building. In desert areas, *Iwan* is a space to get rid of the scorching sunlight [22, 24]. (Fig. 8) One of the decorative methods used inside the *Iwan* that has been very popular is the use of *Muqarnas*^F. In addition to utilizing sunlight for the elegance, it makes the most of it and causes light to spread inside. In this case, uniform and decentralized lighting are created [21]. *Muqarnas* is often used to trap light and propagate it in the most subtle hierarchy [17].

RESULTS

As the nature of this research is a qualitative one, all the numerical indexes and the method used endeavor to convert the

postural findings of the research to make them more interesting for the readers. In this review process, which has been specified earlier, four indexes are determined for measuring each of the criteria. These indexes are: "absence or insignificance" of the technique, which numerically equals 0, "abundant" occurrence of the technique, which numerically equals 3, "rare" and "average" occurrence is also considered for two cases between this quantitative interval, which equals 1 and 2, respectively. With this method, after calculating the frequency of each of the research data, the more common value of each lighting technique can be displayed in the form of diagrams, and in the historical review, the main tendency of the Iranian architects with regard to the utilization of any technique can be analysed in the ups and downs diagrams. (Tab. 3)

Table 3: Results of evaluation of the use of various lighting techniques of the 18 mosques.
Source: Authors

Historical period of Islamic architecture	Mosque	Lighting Technique																			
		Shabaak				Window				Rowzan				Horno				Iwan			
		absent /insignificant	rare	average	abundant	absent /insignificant	rare	average	abundant	absent /insignificant	rare	average	abundant	absent /insignificant	rare	average	abundant	absent /insignificant	rare	average	abundant
Early Islamic centuries 622 to 934 A.D.	Fahraj*	*				*				*				*							*
	Tarikhaneh Mosque Damghan	*				*				*				*							*
	Naein*			*		*				*				*							*
Middle Ages 934 to 1231 A.D.	Barsian*			*		*				*				*				*			
	Malek Mosque of Kerman			*		*				*				*				*			
	Isfahan*				*	*						*			*			*			
	Ardestan*			*		*					*		*		*			*			
	Zavareh*		*			*					*		*		*			*			
After the Mongol Invasion 1231 to 1501 A.D.	Oshtorjan*	*				*				*			*							*	
	Abarkuh*	*				*				*			*		*			*		*	
	Varamin*	*				*				*			*		*			*		*	
	Kerman*		*			*				*			*		*			*		*	
	Yazd*			*		*				*			*		*			*		*	
	Mir Chakhmaq Mosque of Yazd			*		*				*			*		*			*		*	
From Safavid onwards 1501 to 1870 A.D.	Sheikh Lotfollah Mosque				*	*				*			*				*		*		
	Abbasi Great Mosque of Isfahan					*				*			*		*			*		*	
	Hakim Mosque of Isfahan					*				*			*		*			*		*	
	Agha Bozorg Mosque of Kashan						*				*		*		*			*		*	

* Jameh Mosque

DISCUSSION

Historical experience shows that there has always been a continuous trend in Iranian architecture; the preservation and development of pre-Islamic architecture and its blending with the values of the Islamic period is itself a shred of evidence to this claim. Lighting elements as architectural solutions in mosques in hot and dry climates have not been an exception to this general rule, as they have maintained this continuity. As can be seen in the diagram below, the very prominent use of *Iwan* in mosques of the early Islamic centuries (7th to 9th century A.D.) as one of the essential elements of mosque architecture provides the main light for the interior spaces. The dominant characteristics of these mosques are the simplicity and minimal use of decorative elements. It is said that this trend decreased sharply in the Middle Ages, but it increased slightly after the Mongol Invasion and remained almost constant in later periods. (Chart 1)

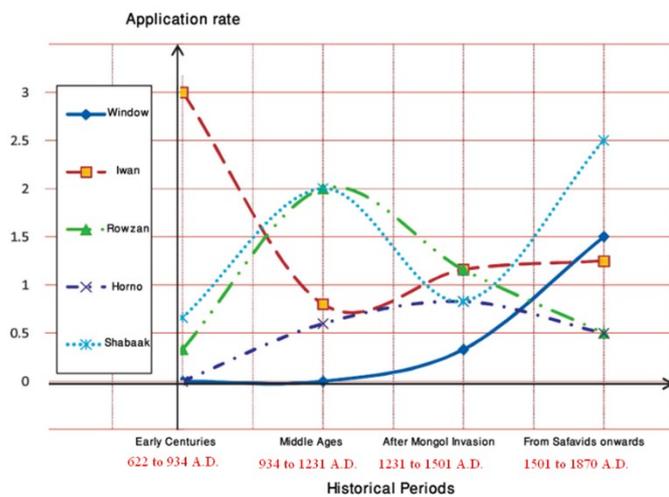


Chart 1: Chart comparing the trend of using standard lighting techniques in mosques of Iran's hot and dry climate in historical periods. Early centuries refer to 7th to 9th cent. A.D. – the period of the advent of Islam in the world. Source: Authors

In this study, it was found that *Horno* is an element which, although known in the early centuries, was almost useless. Its use in later periods has not been significantly developed, and in most of the studied samples it has been used to a small extent only. In *Raazi* architectural style, the use of *Rowzan* has been more common in the mediaeval mosques, as in the mosques of Isfahan and Ardestan; and remarkable examples of this element can be found, but in later periods, the intensity of its use has decreased due to the use of other methods of lighting, especially the use of windows, which was not very common in the architecture of mosques in the hot and dry climate of Iran until the post-Mongol period. Among the studied elements, only window seems to be an imported technique, and the trend can be seen in **Chart 1**. Obviously, the development and prevalence of the windows started just after the Mongol Invasion and reached the peak in the Safavids era and afterwards, because of the contacts of Iranian states with various western empires. Especially during the time from the Safavid period to the Qajar period, one of the factors contributing to the window prevalence

was the development of construction methods and the advances in carpentry and metalwork in that period. Agha Bozorg Mosque of Kashan is one of the best examples showing the combination of window and *Shabaak* well together. (Fig. 9)

Shabaak, which was very common in both periods during which Iranian architectural techniques flourished (Seljuk and Safavid eras), is one of the most elegant architectural elements that bears a tremendous semantic load in the lighting of the interior spaces of mosques. (Fig. 3) Theorists of Islamic art liken it to alchemy: "The artist changes the surfaces into lattice pieces to filter the light ... Islamic architecture is the transformation of stone into light in which transformation is transmuted into the crystal [17]." According to Pope, "embedding light in Sheikh Lotfollah Mosque is one of its remarkable features, and through the windows that are designed under the dome, after passing through two mesh filters, it makes the space dreamy and spiritual [25]." In this way, in addition to giving dynamism to the decorations and paintings, the light passage creates light from the darkness, but this light is not ambiguous because it is a sign of the spiritual direction of the worshiper in the mosque.



Figure 9: Agha Bozorg Mosque of Kashan; one of the most beautiful examples of window and *Shabaak* combination. Source: Authors

CONCLUSION

Iranian architecture has witnessed countless ups and downs in various historical periods. As the nature of architecture itself, these changes have been subject to social, political, cultural, religious, technical, and economic factors. However, the essential information to remember about Iranian architecture is that despite various political changes and even changes in religion

at the time of the Arab invasion, it never abandoned its roots in past civilizations and continued to exist and advance to even higher quality. With the advent of Islam, Muslim architects formed the basis of Islamic architecture, in which attention to the spiritual aspects of the environment was considered the leading factor, and their best and immortal works can be found in mosques - the buildings of mosques that shine with the utmost firmness on the face of the dry and vast deserts of Iran.

Innovations of techniques and methods of providing natural light in the design of the interiors of mosques in hot and dry climates led to the creation and evolution of elements that the Muslim architect can combine to create a spiritual atmosphere emphasizing the dignity of the owner of the building; an environment that, while protecting from the glare of the desert sun, is a refuge for the worshipers, with mosques as houses of God on earth. In order to abide by this obligation, Muslim architects tried to draw all the attention to Allah by creating centrality in the building and the connection between the outer and inner space through natural light.

It is worth noting that daylight has been used to meet human beings' basic needs, but these methods have been intensely used to induce the sense of sincerity, innocence, insight, and spiritual purity in the interior spaces. To achieve that, elements such as Iwan, Shabaak, window, Rowzan, and Horno were implemented. Furthermore, some elements, such as windows, could balance ventilation and provide light at different hours of the day. In different seasons of the year, other elements, such as Shabaak, ventilated and filtered light at different times of the day so that it could shine in the heart of darkness with eye-catching forms. The history of the architecture of mosques in the hot and dry climate of Iran shows that in all of its architectural styles, from *Khorasani* and *Raazi* to *Azeri* and *Isfahani*, the lighting elements have consistently advanced to "environmental balance," "spirituality and concepts" and "symbolism in the space." One of the best examples illustrating the use of daylight is the Sheikh Lotfollah Mosque of Isfahan. One of the factors considered by Iranian architects, especially during the Safavid era, is the observance of the hierarchy of light. For example, a person who enters Sheikh Lotfollah Mosque, while being impressed by the whole space and the way the lighting inside the building is filtered with natural light, also realizes the presence of God. The design of the space with changes in respect to the proportion of space, light, colour, and other elements involved in the architectural space encourage the visitor to feel spirituality and attain divinity. Thus, in addition to their material function against light, lattice walls, openings, and apertures in the architecture of mosques in hot and dry climates create a unique situation for the Muslims who realise their mortality before the Almighty God. The architecture of the historical mosques of Iran has preserved lighting techniques as steadfast steps in the development of today's architecture and as a model for future designs. The spread of abundant lighting techniques in the current mosque architecture might result in the extinction of unique and traditional techniques. Unfortunately, majority of the modern techniques do not have any relevance to Iranian architecture. It is strongly suggested that Iranian architects utilize authentic techniques for their new designs.

REFERENCES:

- [1] Tavassoli, M. (2002) 'Construction of the city and architecture in the hot and dry climate of Iran', Payam Publication, Tehran, Iran.
- [2] Jamshidi, M. (2006) 'Principles of sustainable Iranian architecture lie in desert architecture', In: Regional Conference on Desert Architecture. Islamic Azad University; Ardestan Branch: Ardestan, Iran.
- [3] Hillenbrand, R. (1997) 'The emergence of mosques in Islamic lands in the first centuries'. *Art Quarterly*, 1(33), pp. 446-479.
- [4] (1989) 'The Holy Quran: Arabic text with Tamil translation', Tilford: Islam International, p. 1407.
- [5] Shahidi, M., Bemanian, M., Almasifar, N., Okhovat, H. (2010) 'A Study on Cultural and Environmental Basics at Formal Elements of Persian Gardens (before & after Islam)', *Asian Culture and History*, 2(2), pp. 133-147.
- [6] Ahmadi, H. (1996) 'Criteria for recognizing the deserts of Iran, in The Second National Conference on Desertification and Different Methods of Anti-Desertification', Deputy Minister of Education and Research, Ministry of Agriculture, Forests and Rangelands Research Institute: Kerman, Iran.
- [7] Kardavani, P. (1988) 'Dry Areas', Vol. 1, University of Tehran, Tehran, Iran.
- [8] Mahmoudi, F. (1988) 'Deserts of Iran', *Journal of Geography Education*, 1(17), pp. 4-13.
- [9] Khalili, A. (1992) 'Arid and post-arid climates of Iran', In: Proceedings of the seminar on desert and desert areas of Iran. Research Center for Desert and Desert Areas of Iran, Tehran, Iran.
- [10] Ghobadian, V. (2009) 'Climatic study of traditional Iranian buildings, University of Tehran, Tehran, Iran.
- [11] Espina, C.S.P. (1995) 'Architectural Daylighting of Interiors, in Efficient Lighting Management Curricula ASEAN (ELMCA)', University of the Philippines: Philippines, p. 37.
- [12] Molavi, M.A., Samar, G. (1984) 'Public Health', Chehr Publication, Tehran, Iran.
- [13] Hernandez-Alvarez, N., Pascasio Acevedo, J. M., Quintero, E., Fernandez Vazquez, I., Garcia-Eliz, M., de la Revilla Negro, J., Crespo Garcia, J., Hernandez-Guerra, M. (2017) 'Effect of season and sunlight on viral kinetics during hepatitis C virus therapy', *BMJ Open Gastroenterol*, 4(1), p. e000115.
- [14] Schuit, M., Gardner, S., Wood, S., Bower, K., Williams, G., Freeburger, D., Dabisch, P. (2020) 'The Influence of Simulated Sunlight on the Inactivation of Influenza Virus in Aerosols', *J Infect Dis*, 221(3), pp. 372-378.
- [15] Arjmandi, H., Tahir, M.M., Shabani, M.M. (2010) 'Application of transparency to increase day lighting level of interior spaces in the dwelling apartments in Tehran- A lesson from Iranian traditional architecture', *Journal of Design + Built*, 3(1), pp. 41-55.
- [16] Arjmandi, H. (2011) 'Psychological and spiritual effects of light and color from Iranian traditional houses on dwellers', *e-Bangi Journal of Social Sciences and Humanities*, 6(2), pp. 288-301.
- [17] Burckhardt, T. (2009) 'Art of Islam: Language and Meaning'. World Wisdom, Inc., London, UK, p. 239.
- [18] Vaughan-Lee, L. (1995) 'Travelling the path of love: sayings of Sufi masters'. Golden Sufi Center, Inverness, California, USA, pp. xiv, 231.
- [19] Ayvazian, S. (2004) 'Light in traditional and Islamic architecture of Iran', *Architecture & Urbanism Magazine* 8(2), pp. 12-38.

- [20] Pirnia, M.K. (1993) 'Introduction to Iranian Islamic architecture', Iran University of Science and Technology, Tehran, Iran.
- [21] Nemat Gorgani, O. (2002) 'History of light in architecture and lighting fixtures in Islamic art of Iran', *Asar Journal*, 2(35), pp. 316-323.
- [22] Bozorgmehri, Z., Khodadadi, A. (2010) 'Iranian Coatings'. Soroushe Daanesh, Tehran, Iran.
- [23] Memarian, G. (2012) 'Iranian Architecture: Construction Science', Vol. 1, Naghmeh NoAndish, Tehran, Iran, p. 368.
- [24] Atef Shamaileh, A. (2021) 'The contemporary reality of Iwan in interior architecture: Investigative study', *Materials Today: Proceedings*.
- [25] Pope, A. U. (1969) 'Persian architecture', *Library of introductions to Persian art*. Oxford University Press, London, UK, p. 115.
- [26] Pirnia, M. K. (2005) 'Stylistics of Iranian architecture', Iran University of Science and Technology, Tehran, Iran.
- [27] Haji Ghasemi, K. (2010) 'Dictionary of Iranian Islamic Architecture: Mosques', Vol. 6, Rowzaneh, Tehran, Iran.
- [28] Honarfar, L. (1971) 'Isfahan Treasures and Historical Monuments', Saghafi Publication, Isfahan, Iran.
- [29] Rafiei Mehrabadi, A. (1973) 'National Monuments in Isfahan', Anjoman Asar Melli, Tehran, Iran.
- [30] Ḥamd Allāh Mustawfī, Q.n., Le Strange, G. (2017) 'The geographical part of the *Nuzhat al-qulūb*', Gibb Memorial Trust, Leyden; London, UK, pp. xix, 322.
- [31] Golombek, L., Wilber, D.N. (1988) 'The Timurid architecture of Iran and Turan', *Princeton monographs in art and archaeology*. Princeton University Press, Princeton, New Jersey, USA.
- [32] Afshar, I. (1975) 'Yazd Monuments: Introduction of historical buildings and antiquities', Vol. 2. Anjoman Asar Melli, Tehran, Iran.
- [33] Mostafavi, S.M.T. (1996) 'Climate of Pars', Iranian Cultural Honors Association, Tehran, Iran.
- [34] Etemad-ol-Saltaneh, M.H.K. (1989) 'Meraat Ol-Baladaan', Vol. 4, University of Tehran, Tehran, Iran.
- [35] Naraghi, H. (1969) 'Historical monuments of Kashan and Natanz', Anjoman Asar Melli, Tehran, Iran.
- [36] Hadi Pour, S., Abd Wahab, A. K., Shahid, S., Wang, X. (2019) 'Spatial Pattern of the Unidirectional Trends in Thermal Bioclimatic Indicators in Iran', *Sustainability*, 11(8), pp. 1-24.

^A Quran 9:18

^B Quran 24:35

^C Qibla is the direction towards the Kaaba in the Sacred Mosque in Mecca, which is used by Muslims in various religious contexts, particularly the direction of prayer.

^D When the arch's construction is completed in Iranian architecture, the final row is made round with bricks called *Towghe Chini*.

^E *Muqarnas* is a form of ornamented vaulting in Islamic architecture.