

## Original Research Article

# Comparative Comparison of Iwan Proportions in Safavid Mosques of Isfahan

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## Abstract

**Problem statement:** Given the importance of the Iwan as a main element in the architecture of mosques, this research is an attempt to investigate the proportions used in the Iwans of these buildings as a tool to create a desirable and lasting architectural effect. This research compared the geometrical proportions of Iwans in seven mosques as targeted samples. The mosques of the Safavid period of Isfahan were chosen because the Iranian-Islamic architecture reached its peak in this period and Isfahan was the capital of these manifestations. The Safavid period in Isfahan is divided into three periods from the history and governance point of view. From each period, mosques were selected and analyzed based on the distribution of the time when they had the most geometric diversity in the Iwan.

**Research objective:** Given the importance of mosques in the Safavid period, it seems that specific proportions were used in the design and construction of the Iwans of these mosques, and the present research was aimed at discovering the proportions of the Iwans of selected mosques.

**Research method:** The research method is inductive. The investigated samples were selected non-randomly, and the dimensions and sizes of mosque Iwans were analyzed and checked by examining the proportions in a quasi-experimental way. The data used in this research has been collected by reviewing library documents, map analysis and field survey.

**Conclusion:** Among the examples compared, as targeted samples of the Safavid era in Isfahan, the same proportions can be observed between the Iwans of each period, and in the view of all the examples, Iranian proportions are derived from regular hexagons. These ratios are closer to 1:1. 18 and 1:1. 3 in the first period, 1:1. 18 in the second period, and 1:1. 7 and 1:1. 14 in the third period.

**Keywords:** *Geometric proportions, Regular hexagon, Iwan geometry, Mosque Iwan, Safavid mosques.*

## Introduction

Mosques are special places for worshipping God and one of the holy Islamic places that have a special place in city and village architecture. The architecture of mosques can be considered influenced by various elements such as military, political, climatic,

economic, and cultural elements (Abbaszadeh, Qaisi & Rezapour, 2017, 44). The buildings of first Iranian mosques were built with influence from the structure of the Prophet's (Muhammad) Mosque, as the first mosque, and the body of the buildings of ancient Iran. The integration of Iranian buildings and the Prophet's Mosque led to the creation of new

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forms of Iranian mosques. From the geometric point of view, these buildings followed certain proportions and rules, and this has created a remarkable identity for the contemporary period. Recognizing and rereading these proportions can play a significant role in the restoration and reconstruction of historical buildings and their use in future architecture and can elevate contemporary architecture (Nastaranpour & Tabasi, 2022, 8). One of the new forms added to mosques in Iranian architecture was “Iwan”. The Iwan is one of the important spaces and an indicator of Iranian architecture, the history of which dates back to the historical site of Hasanlu (fourth floor, 9th to 11th century BC). The use of the Iwan over the centuries and millennia in Iranian architecture shows that the Iwan is a stable structure and an ancient model in Iranian architecture, which has maintained its continuity from the oldest evidence to the later examples (Rezaeinia, 2017, 127) and as one of the main components of the building are included in the architectural works and visually it has a special place in the urban space. The Iwan, with its quantitative and qualitative features, is a distinct space from other spaces in the building, which has existed in Iranian architecture from the past to the present. A flexible space that has been seen in a variety of uses. In the era before the arrival of Islam in Iran, the Iwan with more or less different characteristics in spatial organization, spatial communication, structure, and facade can be traced in the buildings (Safari & Pournaderi, 2015, 10). After the introduction of Islam in Iranian mosques, even though the Iwan was placed with special use and in a different space and sometimes with changes in form, it still maintained its characteristics and organization and became a prominent landmark in many mosques. The way the mentioned mosques were classified based on the number of Iwans used in them; Single Iwan, double Iwan, and four Iwan mosques, which shows the value of this irreplaceable element of architecture in Iranian Islamic mosques. During the Safavid period, Iwan enjoyed a special position due to the importance of urban spaces.

This article compares the golden proportions used in the design of the Iwans of Khayat-ha, Ali, Sheikh

Lotfollah, Imam (Abbasi Mosque), Hakim, Sheikh Ali Khan Zanganeh, and Lonban mosques of the Safavid period in Isfahan city, so that, on the one hand, the proportions used in the Iwans of the seven mentioned monuments and on the other hand, to reveal the differences, commonalities, and harmonies between the geometrical proportions of the Iwans in these masterpieces of Islamic Iranian architecture. Also, this article intends to address the question of whether the Safavid architects had specific proportions in mind in the design of the Iwans of these buildings, and if the answer is positive, whether the difference in the function and importance of the buildings led to the difference in the proportions of the Iwans. In this article, after introducing known geometrical proportions, including rectangles derived from index squares and regular hexagons, the proportions of the balconies of each building have been adapted to index ratios. Then a table is presented for each case and finally, a comparative table is presented to compare the proportions of all the studied cases and the results of the research are stated.

## Research Background

First, to provide a general overview of existing research among related research and articles in the field of proportions and geometry used in architectural works, the article “Investigation of golden proportions and geometric principles derived from nature in the physical components of historical houses (case study: Qajar houses of Ardabil)” (Javadinodeh, Shahcheraghi & Andalib, 2022, 35-48) was selected and investigated due to the effort in presenting the concept of geometric proportions used in architecture and its relationship with nature. This article has also analyzed and compared some examples of houses in Ardabil from this point of view. Another referenced research related to geometrical proportions, which examines the proportions in a part of the mosques, “The study of courtyard proportions in Safavid mosques of Isfahan” (Attarian, Momeni & Masudi, 2016, 67-81), an article that examines the changes and characteristics of the proportions deals with the courtyards of the mosques

of the Safavid period and by dividing the mosques of this period, it reminds the audience of the importance of the proportions governing the architecture of the Safavid era.

However, regarding the importance of “Iwan” in architecture, which is considered an important part of this research, the article “Iwan in Iranian architecture before the arrival of Islam” (Safari & Pournaderi, 2015, 13-3) was examined, which refers to the phenomenon of Iwan. As an element of identity in the pre-Islamic period, he has discussed in detail the differences in the spatial organization of the Iwan in the mentioned period. This research was also reviewed to strengthen the comparative aspect of the research. Another research that was investigated is “Recognition of the concept and function of the Iwan in Iranian architecture with an emphasis on the impact on the architectural structure” (Shirin Jani, Samadi Fard & Sharifian, 2015, 23-2), which tries to prove other influential aspects in the background of the Iwan. In addition to its physical element, principles such as aesthetics, climate, and function have been looked at, and in this regard, it examines some prominent Islamic Iranian buildings. Also, “The form of the Iwan in Iranian architecture, from the beginning to the first Islamic centuries” (Rezaeinia, 2017, 125-144) is an article that first tries to present the concept of the Iwan and enumerate the types of the Iwan in terms of shape, and then the history of its formation and form changes. But in the organization of spaces and communications, the Iwan has always undergone physical changes throughout history, and these changes in ancient Iran in the research “The evolution of the Iwan in the architecture of ancient Iran from the Median era to the Sasanian era” (Rahmani, Kazemzadeh Raef & Mir Derikvandi, 2021, 241-254) has been analyzed.

After finding the roots of the concept of the Iwan and dealing with important aspects such as usage, spatial and structural system, and a brief history of its developments, it was felt that we need to delve into the background and origin of the Iwan and also the ambiguities and hypotheses in this regard should not be overlooked. Therefore, we reviewed the article

“Research and critical analysis of the hypotheses of the origin of the Iwan” (Rezaeinia & Laleh, 2014, 59-71), which dealt well with this issue, and once again, after enumerating the importance of the Iwan, we analyzed the origin of this wonderful structure from a critical point of view. Therefore, to get closer to the subject of research and investigation of Iwans in mosques, which itself requires a complete discussion in an independent opportunity, the research “The basic position of Iwans in improving the functional efficiency of mosques” (Kiaei, Peyvastehgar & Heydari, 2017, 68-83) examined the influence of Iwans in the development and improvement of functionalism in Iranian mosques. Dealing with the findings of this valuable article provided great help in advancing the present article. The previous research that has investigated the golden proportions in the architectural landmarks of Iran is summarized in Table 1.

Although the issue of the geometrical proportions of the Iwans has been less studied, due to the fame, glory, visual, historical, and practical beauty, Iwans still have enough attraction for experts and even the general public to work hard and spend time with. Hence, to further address this issue, in this research, the proportions of the Iwans of seven selected mosques (purposeful samples) during the mentioned historical period have been subjected to a new investigation, and by comparing the obtained data, tries to initiate a path that will open a new perspective for researchers and architects.

## Research Method

In this research, a quasi-experimental method was used to test the conformity of proportions and geometry with the dimensions and sizes of mosque Iwans. Since the number of mosques was not homogeneous in the historical period under review, the mosques were chosen non-randomly; An inductive method was used to evaluate and study the samples. In this way, the geometric proportions of the Iwans of the investigated mosques were determined using the Iranian proportions, and based on them, the findings of the research have been evaluated. To select sample mosques, the research period (Safavid era) was divided into three periods based

Table 1. Research background. Source: Authors.

The writers	Title	Summary of research path
Ansari, Okhovvat & Taghvai (2011)	Research on the historical course of proportional adjustment systems in architecture with an emphasis on practical and aesthetic considerations	Proportional systems in architecture are examined and introduced.
Amirkhani, Baghai & Bemanian (2009)	Investigating the transformation of proportions governing the Timchehs of Iran during the Qajar period	The physical characteristics, dimensions, and proportions of 12 Timchehs have been examined.
Najafgholi Pour, Etessam, & Habib (2017)	Survey of geometry and golden proportions in Iranian architecture	It has investigated the proportions in the traditional houses of Tabriz city.
Attarian, Momeni & Masudi (2016)	The study of Courtyard Proportions in Safavid Mosques of Isfahan	It has investigated the proportions of the yard plan dimensions of Isfahan mosques in the Safavid period.
Khoshrovi & Asgarizad (2019)	Geometrical analysis of Isfahan Grand Mosque plan with emphasis on its physical evolution in different periods	They have found a kind of harmony in accordance with the golden geometry in the plan of this mosque.
Ziainia & Hashemi Zarjabadi (2016)	Golden proportion and Iranian-Islamic proportions system in Qaen Grand Mosque	It has studied the proportional system used in Qaen Grand Mosque.
Safari & Pournaderi (2015)	Recognizing the concept and function of the Iwan in Iranian architecture with an emphasis on influencing the architectural structure	It has addressed the phenomenon of Iwan as an element of identity in the pre-Islamic period.
Rezaeinia (2017)	The face of the Iwan in Iranian architecture, from the beginning to the first centuries of Islam	It tries to present the concept of the Iwan and enumerate the types of the Iwan in terms of shape, and then the history of the formation and changes in the form of the Iwan.
Kiaei, Peyvastegar & Heydari (2017)	The basic position of the Iwan in improving the functional efficiency of mosques	It has addressed the influential role of Iwans in the development and improvement of functionalism in Iranian mosques.
Limitations of previous research	Previous research has been done in the field of the plan and has neglected to check the proportions in the height (in this research, the facade of the Iwan).	
General research framework	Identifying the golden ratios used in the construction of selected mosque Iwans in a non-random manner in the Safavid period and the city of Isfahan.	

on the power and strength of the king at that time and the attention of the king and the heads of government to the matter of construction. Based on the scientific and historical indicators of the analysts, the beginning of the reign of Shah Abbas I created growing changes in the architectural structure of Iran. Although construction declined after the death of Shah Abbas I, from the beginning of his reign to the end of Shah Abbas II’s reign, it can be considered a flourishing period in Safavid architecture (Sajjadi Naini, 2008). Therefore, the writers divided the Safavid era into three periods (before the reign of Shah Abbas I, during the reign of Shah Abbas I to Shah Abbas II, and after the reign of Shah Abbas II) and seven mosques have been selected based on the date of construction, distribution, and also the difference in the number of Iwans (Table 2). Then, the dimensions required for analysis were obtained from the maps in the treasure books and cultural heritage documents of Isfahan province and field observations. In the next step, the proportions governing the Iwans of selected mosques were determined and compared.

### Theoretical Foundations

Almost all works of art are based on some form of proportion. In this sense, proportionality is one of the basic principles of the work of art, which expresses the harmonious relationship between its components. Usually, recognizing the appropriateness and creating appropriate relationships between the parts of an artwork and between the parts and the whole work is based on the experience, skill, and aesthetic taste of the artist. The purpose of all theories of proportions is to create a sense of order between the components of a visual composition (D. K. Ching, 1999, 297). In fact, proportion is a mathematical concept that in architecture and visual art implies the relationship between components and the whole work, and while it is an effective factor for harmony, it has been and still is one of the constant debates in architecture. Proportion in architecture is a ratio that shows the relationship between two or more sizes. The Iwans, whose proportions are examined in this research, often have a quadrangular shape and often a kind of rectangle; For this purpose, known

Table 2. Dividing the period of Safavid rule into three periods. Source: Authors based on Sajjadi Naini, 2008.

Epoch	Constructed mosques	King's name	Years of rule
First	Ali, Qotbiyeh, Zolfaghar, Khayat-ha	Shah Ismail 1	1526-1551
		Shah Tahmasab 1	1551-1605
		Shah Ismail 2	1605-1606
		Sultan Mohammad Khudabandeh	1606-1607
Second	Jarchi, Maqsoud-Beig, Sheikh Lotfollah, Sorkhi, Imam, Aqa Noor, Namaki, Saro Taqi, Mesri, Haj Younes, Hakim	Shah Abbas 1	1659-1607
		Shah Safi	1673-1659
		Shah Abbas 2	1698-1673
Third	Sheikh Ali Khan Zangeneh, Ilchi, Lonban, Khan, Khalvat	King Suleiman	1726-1698
		King Soltan Hoseyn	1756-1726
		Shah Tahmasab 2	1765-1156
		Shah Abbas 3	1769-1765

rectangles are considered as measurement tools in this article. A rectangle whose length and width ratio are the same seems to be the most proportional shape of the rectangle, and this means that it has the closest form to the most beautiful form that a normal person imagines in his mind (Kurt Grutter, 1996, 361-362). Therefore, to check the geometric proportions of the Iwans of the mentioned buildings, the proportions obtained from the dimensions of the rectangular form of the different parts of the Iwans of the mosques have been measured and compared with the Iranian proportions, which are a clear manifestation of a geometric proportion. At the same time, proportion in sizes follows certain rules, which are called principles and rules of golden divisions or golden proportions, which are widely used in architecture and art. Based on the golden proportions, a line segment Fig. 1 can be divided into two parts such that the ratio of the smaller part to the larger part is equal to the ratio of the larger part to the whole line segment (Ayatollahi, 2010, 196). This type of division is visual and also logical, it creates beautiful relationships between parts with each other and with the whole, which has been used a lot in architecture.

Another of these ratios is the proportions obtained from a regular hexagon, the size of the rectangle obtained from a regular hexagon is  $3\sqrt{3}$  and it is also known as a "Platonic rectangle" (ibid., 191) (Figs. 2 & 3).

From the intersection of regular hexagon diameters, another quadrilateral is obtained in the middle, the ratio of its dimensions is 1:1.7 (Mustaghni, 1995, 542). Other quadrilaterals resulting from the intersection of the diagonals of regular hexagons are rectangles with ratios of 1:1.3 and 1:1.7 (Fig. 4).

### Examining the Proportions of the Samples

In order to check the proportions used in the view of the Iwans, the variables of the height and width of the Iwan are used, and the golden proportions in vertical dimensions are specified in separate tables.

#### • Proportions of the Iwans of Ali Mosque

The dimensions of the rectangle around the "eastern and western Iwans" Fig. 5 of the Ali Mosque are similar to each other, with a ratio of 1:1.18, and according to the previous explanation, it is a rectangle obtained from the intersection of the diagonals of regular hexagons (Figs. 6 & Table 3).

#### • Proportions of the Iwans of Khayat-ha Mosque

The dimensions of the rectangle around the "eastern and western Iwans" Fig. 7 of Khayat-ha Mosque are also similar to each other, with a ratio of 1:1.3, and according to the previous explanation, it is a rectangle obtained from the intersection of the diagonals of a regular hexagon (Fig. 8 & Table 4).

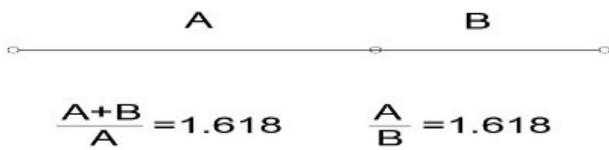


Fig. 1. Golden ratio using line segments. Source: Ayatollahi, 2010, 198, redrawn by the Authors.

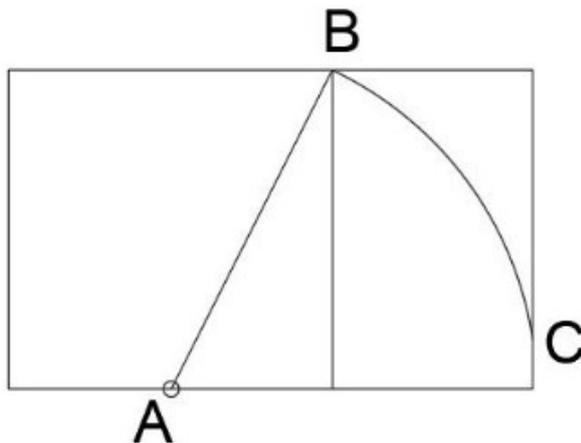


Fig. 2. How to geometrically draw a golden rectangle with the help of a square. Source: Bozjani, 2005, 122, redrawn by the Authors.

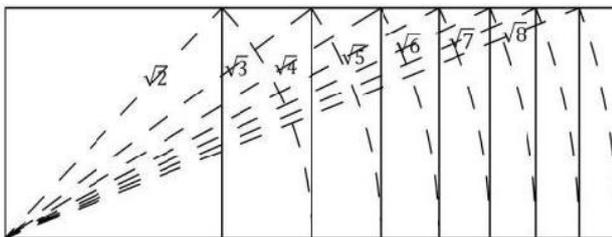


Fig. 3. How to expand the golden rectangle and the root proportions of  $2\sqrt{}$ ,  $3\sqrt{}$ ,  $4\sqrt{}$  and... Source: Bozjani, 2005, 125, redrawn by the Authors.



Fig. 4. Regular hexagons and rectangles derived from it. Source: Authors' drawing.

### Proportions of the entrance Iwan of Sheikh Lotfollah Mosque in Isfahan

According to the investigation, the dimensions of the rectangle surrounding the “entrance Iwan” Fig. 9 of the Sheikh Lotfollah Mosque have a ratio of 1:1.18, and a rectangle obtained from the intersection of the diagonals of regular hexagons, while the ratio of the height of the

Iwan arch to the width of the Iwan entrance is 1:1.7 which is equal to the ratio  $3\sqrt{}$  (Fig. 10 & Table 5).

### • Proportions of the Iwans of the Imam Mosque (Abbasi Mosque) in Isfahan

The dimensions of the rectangle around the “northern, southern and western Iwans” Fig. 11 of the Imam Mosque (Abbasi Mosque) are similar to each other, with a ratio of 1: 1 and have sides of equal size, while the ratio of the height of the arch to the width of the entrance of the Iwans It is 1:1. 18 and according to the previous explanation, it is a rectangle obtained from the intersection of regular hexagon diameters (Fig. 12 & Table 6).

However, the dimensions of the rectangle surrounding the “eastern Iwan” of the Imam Mosque are different from other Iwans and have sides with a ratio of 1:2, and the ratio of the height of the Iwan arch to the width of the entrance of the Iwan is also 1:2, which according to the explanation given, a rectangle is obtained. According to the definition, it is equal to  $4\sqrt{}$  (Fig. 13 & Table 7).

### • Proportions of the Iwans of Hakim Mosque in Isfahan

The dimensions of the rectangle around the “north and south Iwans” Fig. 14 and also the ratio of the height of the Iwan arch to the entrance width of the Iwan of the Hakim Mosque are different from the other two Iwans and equal to 1:1. 18 and the rectangle is obtained from the intersection of regular hexagon diameters (Fig. 15 & Table 8).

But as mentioned, the difference is the dimensions of the rectangle around the “eastern and western Iwans” Fig. 16 and similarly the ratio of the height of the Iwan arch to the width of the entrance Iwan of Hakim Mosque is 1:1. 3 and the rectangle is obtained from the intersection of the diagonals of the hexagons is regular with the same ratio (Fig. 17 & Table 9).

### • Proportions of the Iwans of Sheikh Ali Khan Zanganeh Mosque

The dimensions of the rectangle around the “north and south Iwans” Fig. 18 of Ali Mosque are similar to each other, with a ratio of 1:1.7, and according to the previous explanation, it is a rectangle obtained from the intersection of the diagonals of a regular hexagon (Fig 19 & Table 10).

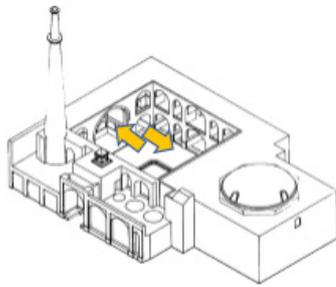


Fig. 5. The perspective view of Ali Mosque, the location of the investigated Iwans. Source: Authors.

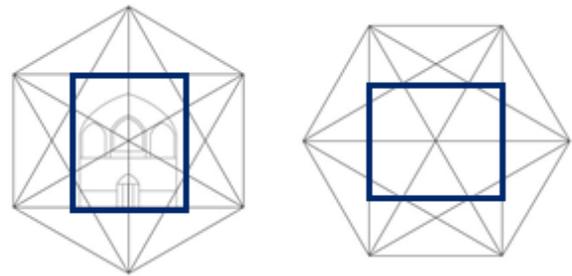
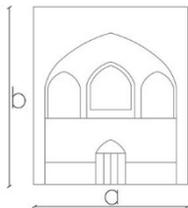
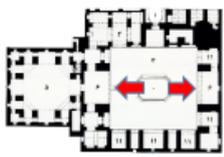


Fig. 6. The rectangle was obtained from the intersection of the diagonals of regular hexagons with an aspect ratio of 1:1.18. Source: Authors.

Table 3. Investigating the geometric proportions of the east and west Iwans. Source: Authors.

The dimension ratio of east and west Iwans			View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch	$b = 1.18 a$		
	The height-to-width ratio of the Iwan facade	$b = 1.18 a$		
Geometric fit of the Iwan	$b = 1.18 a$			

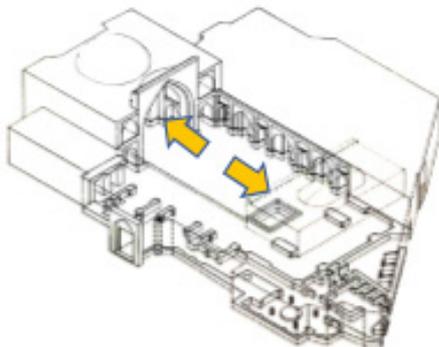


Fig. 7. The perspective view of Khayat-ha Mosque, the location of the investigated Iwans. Source: Authors.

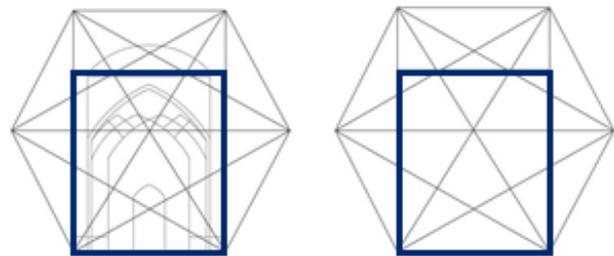
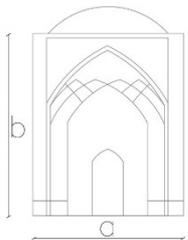
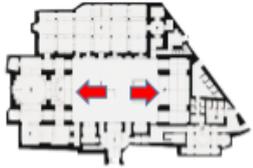


Fig. 8. The rectangle obtained from the intersection of the diagonals of regular hexagons with an aspect ratio of 1:1.3. Source: Authors.

Table 4. Investigating the geometric proportions of the eastern and western Iwans. Source: Authors.

The dimension ratio of east and west Iwans			View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch	$b = 1.3 a$		
	The height-to-width ratio of the Iwan facade	$b = 1.3 a$		
Geometric fit of the Iwan	$b = 1.3 a$			

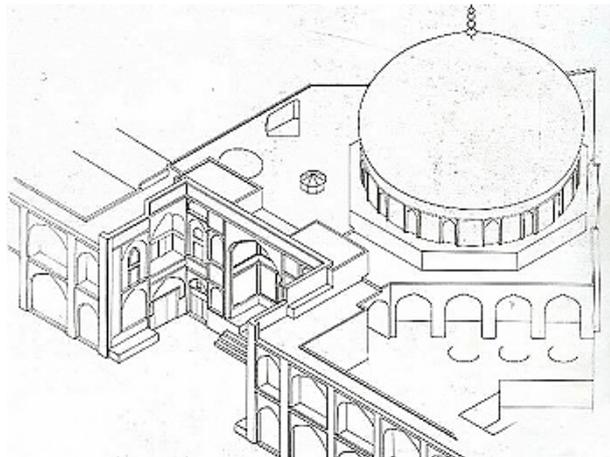


Fig. 9. Perspective view of Sheikh Lotfollah Mosque, the location of the investigated Iwan. Source: Authors.

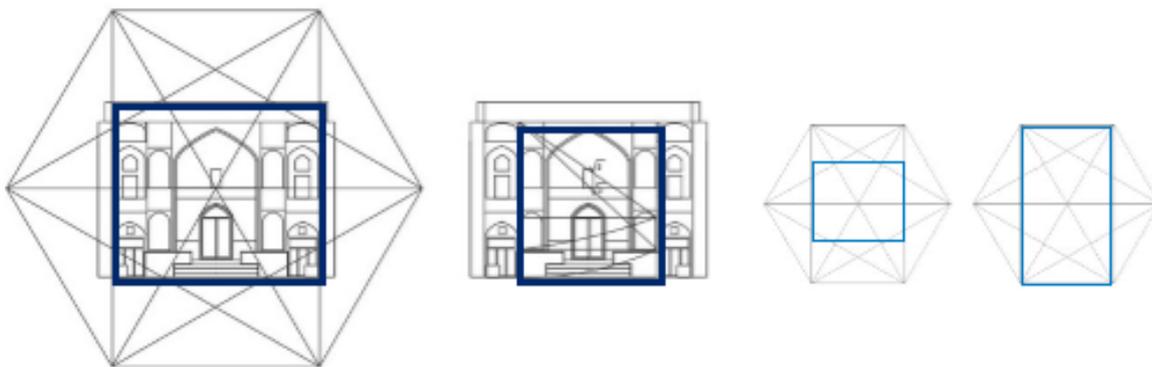


Fig. 10. The rectangle obtained from the golden ratio with the aspect ratio of 1:1.18 and  $3\sqrt{}$ . Source: Authors.

Table 5. Checking the geometric proportions of the entrance Iwan. Source: Authors.

The dimension ratio of the entrance Iwan			View of the Iwan	The position of the Iwan in the plan	
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch	$b = 1.7 a$			
	The ratio of vertical to horizontal dimensions	$c = 1.18 b$			
Geometric fit of the Iwan	$c = 1.18 b$				

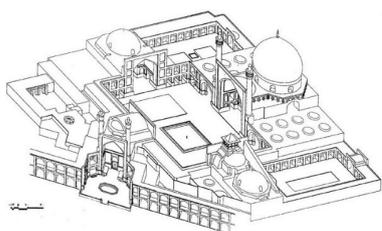


Fig. 11. Perspective view of the Imam Mosque, the location of the investigated Iwans. Source: Authors.

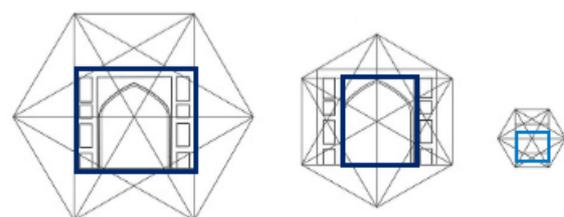
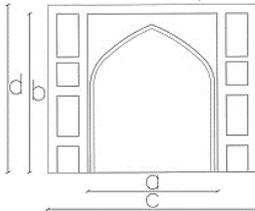


Fig. 12. The rectangle obtained from the intersection of the diagonals of regular hexagons with an aspect ratio of 1:1.18. Source: Authors.

Table 6. Investigating the geometric proportions of the north, south, and west Iwans. Source: Authors.

The dimension ratio of north, south, and west Iwans		View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height to width ratio of the Iwan arch		
	The ratio of vertical to horizontal dimensions		
Geometric fit of the Iwan	$b = 1.18 a$		

• **Proportions of the Iwans of Lanban Mosque**

The rectangle around the “north and south Iwans” Fig. 20 of the Lonban Mosque has sides with a ratio of 1:1.14 or  $\sqrt{2}$ , and the ratio of the height of the Iwan arch to the entrance width of the Iwan is also  $1:1.14 = \sqrt{2}$  (Fig. 21 & Table 11).

**Discussion**

The comparative analysis of Table 12 shows that the geometric proportions played a significant role in the design of the Iwans of selected mosques of the Safavid historical period in Isfahan. According to the data, it has been determined that the Iwans of the selected mosques of this research in the Safavid era of Isfahan follow a certain geometrical proportion and all the Iwans explored in this research were designed and built using a regular hexagon and a rectangle derived from it. To be more precise, these proportions in the first Safavid period in the Iwans of the Ali Mosque are equal to 1:1.18 and in the Khayat-ha mosque are equal to 1:1.3, both of which are rectangles obtained from the intersection of the diagonals of regular hexagons.

In the second period, investigations have shown that the south Iwan of the Imam Mosque (Abbasi Mosque) has a ratio of 1: 2 and obtained from the golden ratio of  $4\sqrt{}$ , the eastern and western Iwans of the Hakim Mosque have a ratio of 1:1.3, the entrance Iwan of the mosque Sheikh Lotfollah, the north, east and west Iwans of the Imam Mosque (Abbasi Mosque) as well as the north and south Iwans of the Hakim Mosque were built with a ratio of 1:1.18.

In the third period, the geometric proportions in the design and construction of Iwans had a basic position, and the investigations in the present research show that the Iwans in Sheikh Ali Khan Zanganeh Mosque have a ratio of 1:1.7 and obtained from the golden ratio of  $3\sqrt{}$  and the Iwans of the Lonban mosque, which are made of a rectangle obtained from the golden ratio of  $\sqrt{2}$ , are built with a ratio of 1:1.14.

**Conclusion**

This article shows that the Safavid architects used certain geometric proportions in the design of mosque Iwans as an important visual element, the result of which is a double attraction that is evident in the architectural works of the subject of research. Among the seven examples compared, as targeted examples of the Safavid era in Isfahan, the same proportions can be observed between the Iwans of each period, and the architects’ adherence to geometric golden proportions for the design and construction of the Iwans in the aforementioned mosques is a clear and unmissable feature. Another point that can be seen from the present research is the importance of mosque Iwans in this period. It is as if this importance for the architect was a kind of ideal that caused him to use a special geometry with amazing clarity in the design of the original spaces in addition to using and placing Iwans in the centers of the sides; All the Iwans explored in this research were designed and built using a regular hexagon and a rectangle derived from it.

At a glance, the prominent architectural spaces have unique characteristics, these special characteristics have

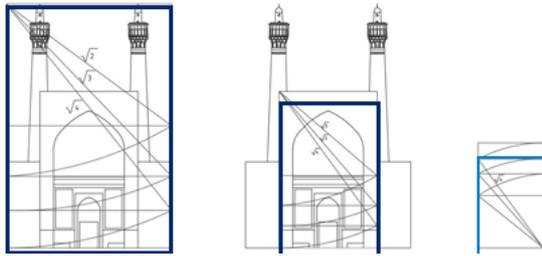


Fig. 13. Rectangle obtained from golden ratio with aspect ratio 1: 2 or  $4\sqrt{}$ . Source: Authors.

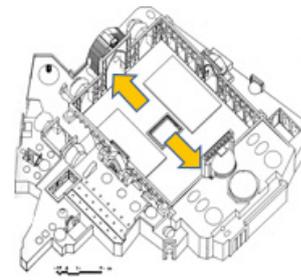


Fig. 14. Perspective view of the Hakim Mosque, the location of the investigated balconies. Source: Authors.

Table 7. Investigating the geometric proportions of the eastern Iwan. Source: Authors.

The dimension ratio of north, south, and west Iwans			View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch	$b = 2 a$		
	The ratio of vertical to horizontal dimensions	$d = 2 c$		
Geometric fit of the Iwan				
$b = 2 a = \sqrt{4}$				

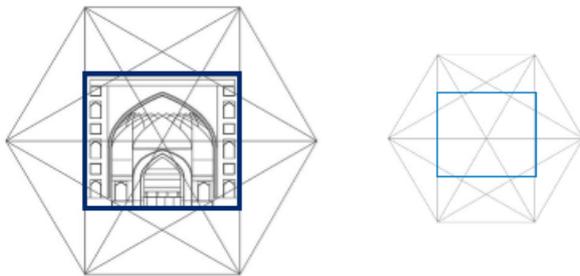


Fig. 15. The rectangle obtained from the intersection of the diagonals of regular hexagons with an aspect ratio of 1:1.18. Source: Authors.

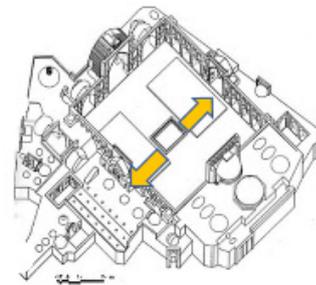


Fig. 16. Perspective view of Hakim Mosque, the location of the investigated Iwans. Source: Authors.

Table 8. Investigating the geometric proportions of the north and south Iwans. Source: Authors.

The dimension ratio of north and south Iwans			View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height to width ratio of the Iwan arch	$b = 1.18 a$		
	The ratio of vertical to horizontal dimensions	$d = 1.18 c$		
Geometric fit of the Iwan				
$b = 1.18 a$				

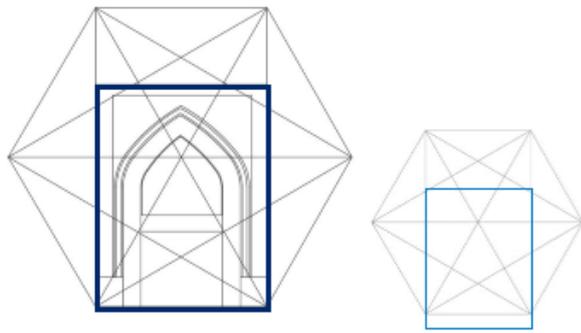


Fig. 17. The rectangle obtained from the intersection of the diagonals, a regular hexagon with an aspect ratio of 1:1.3. Source: Authors.

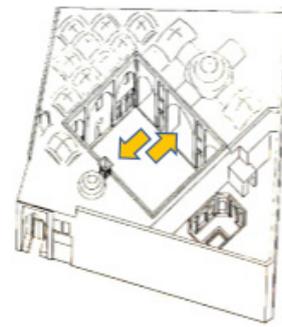
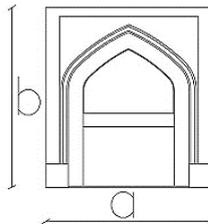
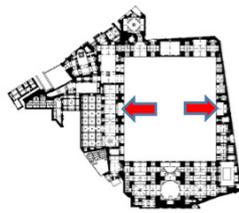


Fig. 18. Perspective view of Alikhan Mosque, the location of the investigated Iwans. Source: Authors.

Table 9. Investigating the geometric proportions of the eastern and western Iwans. Source: Authors.

The dimension ratio of east and west Iwans		View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch		
	The ratio of vertical to horizontal dimensions		
Geometric fit of the Iwan	$b = 1.3 a$		

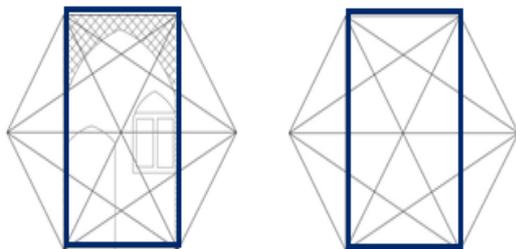


Fig. 19. The rectangle obtained from the intersection of the diagonals of regular hexagons with an aspect ratio of 1:1.7. Source: Authors.

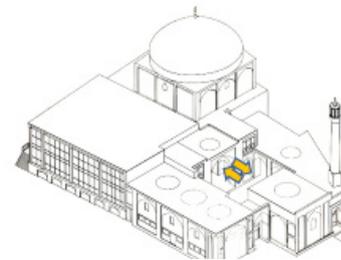
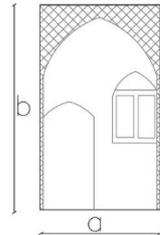
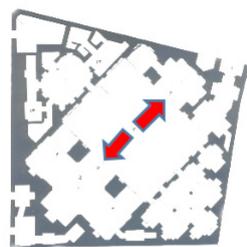


Fig. 20. Perspective view of Lonban Mosque, the location of the investigated Iwans. Source: Authors.

Table 10. Investigating the geometric proportions of the north and south Iwans. Source: Authors.

The dimension ratio of north, south, and west Iwans		View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch		
	The ratio of vertical to horizontal dimensions		
Geometric fit of the Iwan	$b = 1.7 a$		

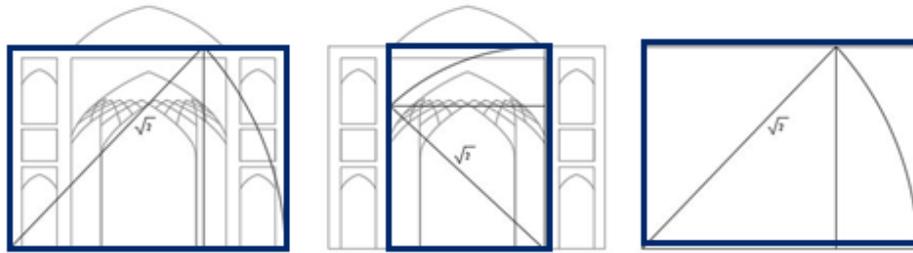


Fig. 21. Rectangle obtained with aspect ratio  $2\sqrt{2}$ . Source: Authors.

Table 11. Investigating the geometric proportions of the north and south Iwans. Source: Authors.

The dimension ratio of north, south, and west Iwans			View of the Iwan	The position of the Iwan in the plan
The ratio of vertical to horizontal dimensions	The height-to-width ratio of the Iwan arch	$b = 1.14 a$		
	The ratio of vertical to horizontal dimensions	$c = 1.14 b$		
Geometric fit of the Iwan	$b = 1.14 a = \sqrt{2}$			

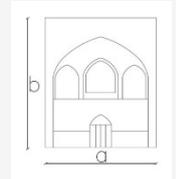
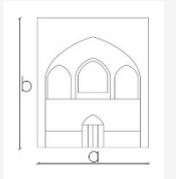
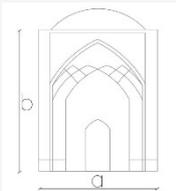
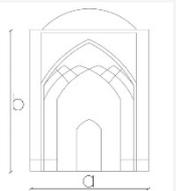
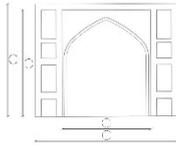
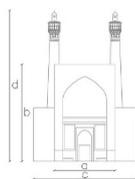
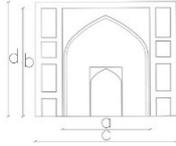
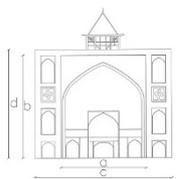
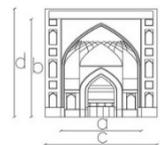
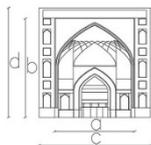
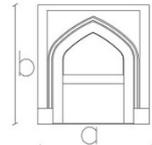
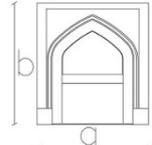
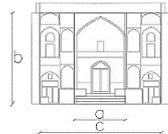
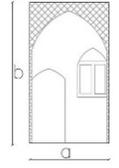
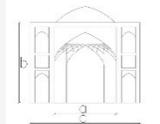
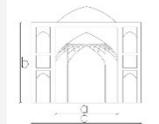
caused the stability of the use of special patterns in the architecture of such buildings, in this way, knowing and introducing the geometry used in them can be an effort to help today’s architects and In line with wise and original design. A tool that, in addition to helping to create desirable architectural works, also realizes the continuity of Iranian architecture.

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Table 12. Comparative study of the proportions of the Iwans of the buildings. Source: Authors.

Epoch	Mosque	North Iwan	South Iwan	East Iwan	West Iwan
First	Ali			 $b = 1.18 a$	 $b = 1.18 a$
	Khayat-ha			 $b = 1.3 a$	 $b = 1.3 a$
Second	Imam	 $b = 1.18 a$	 $b = 2 a = \sqrt{4}$	 $b = 1.18 a$	 $b = 1.18 a$
	Hakim	 $b = 1.18 a$	 $b = 1.18 a$	 $b = 1.3 a$	 $b = 1.3 a$
	Sheikh Lotfollah	 $b = 1.18 a$			
Third	Sheikh Alikhan Zangeneh	 $b = 1.7 a = \sqrt{3}$	 $b = 1.7 a = \sqrt{3}$		
	Lonban	 $b = 1.14 a = \sqrt{2}$	 $b = 1.14 a = \sqrt{2}$		

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