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Factors Affecting the Formation of the Orchin Dome
(Case Study: Imamzadeh Seyed Salahuddin Mohammad- Abdanan, Iran)

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Abstract
The architecture of the Orchin Dome was one of the hallmarks of the tombs in the southern and southwestern parts of Iran, Which has been less studied in scientific research. The main purpose of this study is to identify the factors influencing the formation of the dome of Imamzadeh Seyed Salahuddin Mohammad in the city of Abdanan. In this regard, the influence of historical, geometric (physical) and structural factors on the formation of the dome of this shrine has been discussed. This research has been done by descriptive-analytical research in the form of qualitative studies and its information has been collected based on library studies and field observations. According to field studies and observations, the study of the damaged dome was multi-faceted. One of the main indicators of this dome is the simplification of polygons in its corners. The dome architect seems to have used a semicircle to increase the height of the dome and to align the spiers. Other research findings show historical factors such as geographical location, historical background of Abdanan city, proximity to Elamite civilization, ziggurats and other historical tombs of Khuzestan plain (tomb of Daniel Nabi in Shush and tomb of Imamzadeh Rudband and Yaqub Laith Saffari in Dezful) as well as the physical shape of Seljuk tombs in the region, they have affected the physical shape of the study dome. Structurally, the dome of this building is mostly made of local materials and efforts have been made with the help of appropriate geometry. Prevent asymmetric and tensile forces. Therefore, numerical relationships in the proportions of their similar shapes in the floors and the proportions of the components of the dome, including the height of the floors, openings and other components of each with special relationships, create a transcendental (fractal) pattern. Also,The use of this unique geometry in the dome has prevented the absorption of sunlight into the dome. On the other hand, the height, shape and color of the dome affect the landscape and visual appearance and make the building stand out.

Keywords: *Islamic Architecture, Tomb, Dome, Rack(spire), Orchin.*

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Introduction

The dome-making method in Iran is always done using the exact mathematical order in the design and construction and by applying the correct methods, so that both in the pre-Islamic and Islamic eras, it has pursued its own executive and cultural characteristics. It is noteworthy that the types of curved coverings, especially the dome, have different climatic and shape characteristics (Kiani, 2014, 403). In the meantime, domes with different forms were formed. Orchin domes in Iran are only limited to the south and southwest of the country, and their number is limited and unique because this style was different from the structure of the dome in the central and northern parts of Iran. There are also a small number in Iraq (Zumarshidi, 2008, 263). In this research, the lexical and semantic roots of Orchin dome and also the dome of Imamzadeh Seyyed Salahuddin Mohammad (AS) have been evaluated from the historical, geometric and structural point of view.

Problem statement

The history of the construction of the Orchin dome dates back to the Seljuks (seventh and eighth centuries AH). Architects in the Seljuk period developed factors such as four arches and a domed square hall, which became the basis of religious architecture and some non-religious buildings (Hilen Brand, 2008, 316).

In this period in the south of Iran, dome construction in tomb buildings, unlike the important buildings of its period in the north of Iran, found its own style.

It has been distinguished from other types of domes in other parts of Iran and a new type of dome, which is the same as Mudzar or Orchin, has appeared in the tombs (Grubeh, 2009, 54).

Based on the geometric relationship between inside and outside, this type of dome is divided into two types of domes with a dome and polygonal base (Eghtedari,1995, 86).

Take a comprehensive study of the origin of this style dome and historical approach, geometric constructions on empty, the geographical area in South and South-West Shrine of Syed Salahuddin Muhammad and the Dome concerned.

The purpose of this article is to decipher the importance of the historical course as well as the hidden geometry in the design of the Orchin dome of this building and to reiterate the privileged position of geometry in the design of ancient architecture, which helps to achieve a more accurate concept of traditional architecture.

Research questions

- How did historical, geometric and structural factors affect the formation of the dome of Imamzadeh Seyed Salahuddin Mohammad (AS)?
- What is the arrangement of bricks in the dome of Archin Imamzadeh in terms of geometric structure and structures? And how does the force enter the soils?

Research Methods

This research has been done in a descriptive-analytical method and then in the form of comparative research in the form of qualitative studies with historical research on the Archin dome and their structural analysis The method of data collection was based on library studies, field observations, review and evaluation of similar specimens of concave domes in Khuzestan province and filing of publications. The following diagram describes the hierarchy of research methods and data collection (Fig. 1).

Background research

Regarding the tomb buildings with a domed, in the book of Historical monuments of Khuzestan architecture (1995), he has studied the mentioned buildings in the area of present-day Iran. In these studies, no reference is made to the building of Imamzadeh Seyed Salahuddin Mohammad (AS). In some articles of researchers in recent years, a

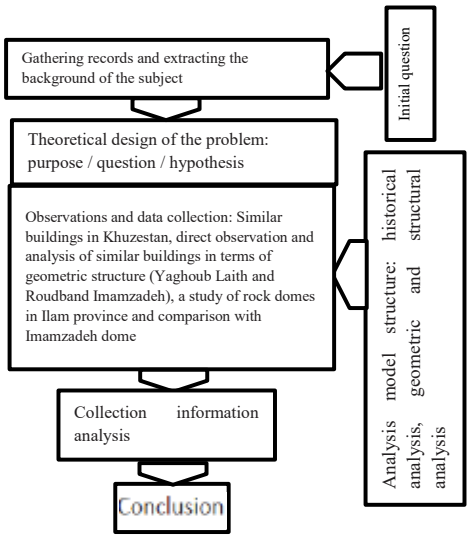


Fig. 1. Research method and collection of research information. Source: Authors.

similar example has been referred to this historical monument, which requires further study of the dome of this shrine.

1. The book "Iranian Architecture (Islamic Period)" has examined how the domes evolved in the Islamic period and how they were executed in different periods and their differences with Roman architecture (Kiani, 2014, 403-422).

2. The book "Iranian Architecture"; The role of Imamzadeh in the formation of arrays and architectural works in the formation of post-Islamic architecture has been evaluated. These works of art have made Iranian architecture last and it can be said that each of these tombs is an architectural museum (Pirnia, 2013, 311-339).

3. In the book "Arches and Arches in Iranian Architecture", he examines the changes of arches in different periods; Arches and arches have undergone many changes in Iranian architecture from the past to the present. But each of these arches and arches in each period of history, has decorations and arrays of its time and has a high architectural value (Zumarshidi, 2008, 21-32).

4. In an article entitled "Evolution of Orchin Dome based on effective factors in the formation of an architectural symbol"; Has studied the importance of cognition and natural and vital commonalities in Orchin domes and their values; As a result, some symbols are common to many cultures; Sometimes these common symbols have a single meaning. The symbolic and generative value of architectural art in the structure of the dome depends on the culture and history in that area (Zamani, Saeidian, Ansari & Bemanian, 2013, 111-127).

5. An article entitled "A Study on the History and Architecture of the Dome in Iranian Architecture"; Has studied the concave domes in terms of history and distribution of this type in Iran. The history and morphology of this type of dome dates back to pre-Islamic times and Mesopotamian architecture in present-day Iraq and Khuzestan. The main symbol of this type of domes is mentioned in ziggurats and according to studies, their main source is in the drawer of Iraq and Syria (Salehi Kakhki & Sepidnameh, 2013, 11-11).

6. An article entitled "Study and analysis of the dome in the structure of traditional Iranian buildings"; Although in traditional Iranian buildings, it has an inescapable connection with other elements and gives meaning to the function and form of Iranian architecture, but it alone has the mysteries as well as the said and unsaid and they have been studied. The results show that the lack of strong and elongated wood and the abundance of ecological materials available to architects, has caused the replacement of the cover of the the narrative dome at that time (Majidi & Fardinmehr, 2015, 30-35).

7. In an article entitled "The Role of the tomb complex of Iran as urban spaces (case study: Daniel" s tomb at shoosh)" an analytic look on the building elements and its effects on the city is shoosh; the findings of this study reveal the role of the tomb complex as urban spaces, dome diversity, ornamentation, as well

as the architectural tools such (Fallah Rnjbar, 2015) .

Theoretical foundations and research framework

In Dehkhoda Orchin dictionary, saddle, base, ladder and step are mentioned. There is disagreement about the origin of Orchin. "Or" means ascending and "Orchin" means step by step (Pirnia, 2008, 574). This type of dome is from the "Rack" family in the form of steps (mozzareh) which is made with a high height like mozzarend sugar mound (Zumrashidi, 2008, 135). Most experts believe that the primary cause of the dome form is the covering of a large opening with compressive materials. Traditional materials, especially in Iran, generally have only the ability to be loaded by compression, so the shape of traditional structures follows patterns that are compatible with this type of bearing (Mashayekhi & Tehrani, 2013, 292). Curved shapes with a negative second derivative coefficient (curves with maxim) have such a property and almost the period or extension of such lines are present in all different traditional architectural works, arches and domes are created on the same basis (ibid. 2013, 292), (Fig. 2).

In Orchin domes (optional) the cover is made in the form of white mortar or cream with steps of 80 to 150 cm. But there are also many differences between simple Rok and Orchin domes. First, it is the cradle of the Rok domes in the northern region of Iran, and the Orchin domes are in the southwestern region of the Iranian plateau and Mesopotamia to Asia Minor; Second, the formal roots of the Rok domes may have been a sloping roof to drain rainwater and a rainy area to the north, but the same cannot be said of the Orchin domes.

Field studies

• Introducing the building

The tomb of Imamzadeh Seyed Salahuddin Mohammad (AS) is built on a hill in the southeast of Abdanan city. The date of construction of the building according to its similar domes dates back to the Middle Ages, there is an old cemetery around this tomb, which is still used as the cemetery of Abdanan city. This work was registered as one of the national works of Iran on March 8, 2002, with the registration number 7975 (Fig. 3).

Imamzadeh is built on an almost square design in the north-south direction with a width of 23.35 meters and in the east-west direction with a length of 23.61 meters. The dome of this building has two roofs and has an external dome (Orchin) with a height of more than 15.25 meters and a parietal.

The plan of this building has changed during the historical period. The tomb consists of two parts, the old body and the new body. According to the old plan of this building, it can be said that the building first has a four arches and according to the old buildings in the region dates back to the Sassanid period (Fig. 4).

Perched Dome (Orchin) This building has a polygonal

A B C

Fig. 2. Types of domes of the Islamic period. Source: Authors, 2018.
A. Dome of Orchin Imamzadeh Seyed Salahuddin Mohammad (AS) - (Ilam Province).
B. Dome of Rack Imamzadeh Ibrahim - (Ilam Province).
C. Dome of Sheikh Lotfollah Mosque - (Isfahan).

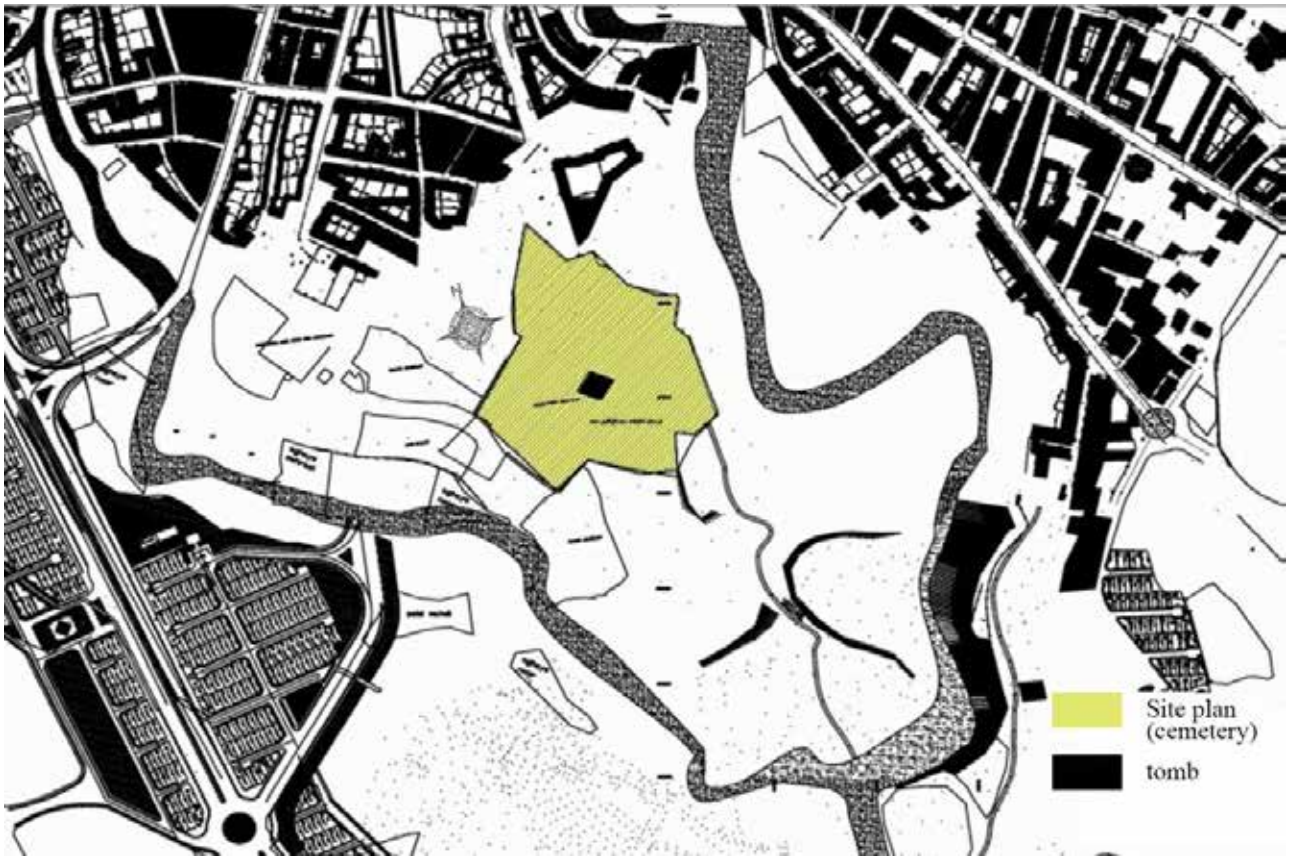


Fig. 3. Imamzadeh Seyed Salahuddin Mohammad (AS) Plan Site. Source: Authors.

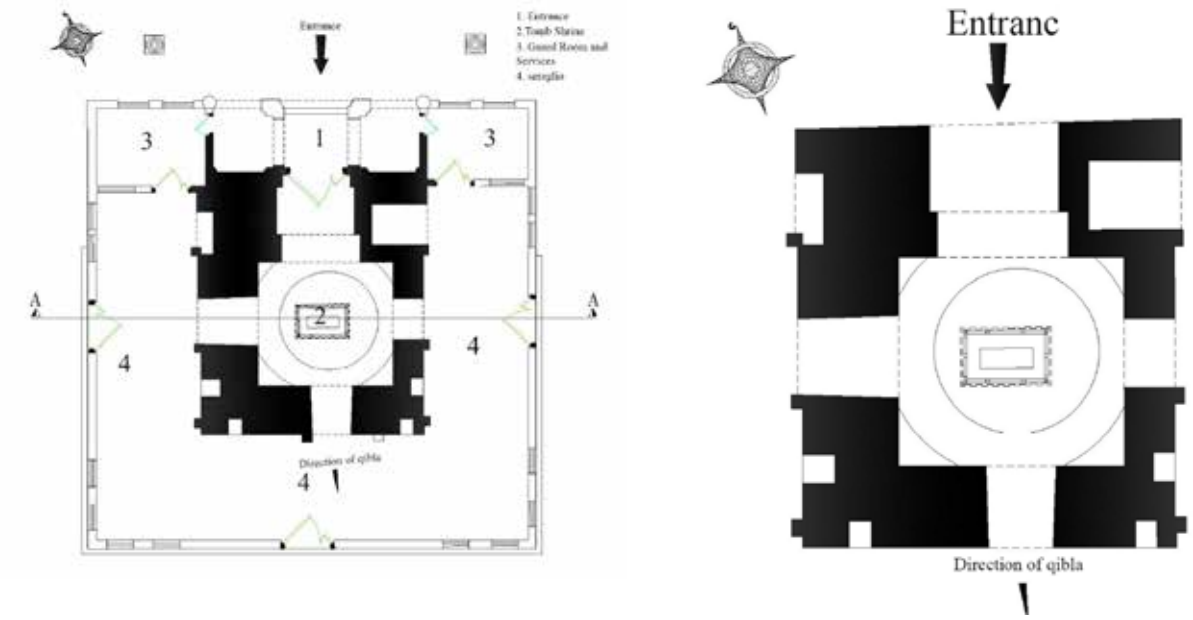


Fig. 4. Spatial developments in the tomb of Seyyed Salahuddin Mohammad (AS). Source: Authors.

plan, in this type of regular polygonal domes, so that each ridge of the dome is cross-sectional with a polygonal base that is re-peated throughout the dome. In addition to the structural factors, the erection of the dome in order to create an effect that affects the visual landscape brings to the fore the emer-gence of its value and social status.

The building consists of two parts, new and old. The old body of the building consists of two parts, the entrance room and the tomb room (dome of the house). The materials used in the old part of the rubble and gypsum were semi-percussive and the outer dome (itself) was made of semi-percussive brick and gypsum. Stone powder mortar and white cement have been replaced by gypsum to repel moisture and deal with snowfall and cold weather.

The new body also has a nave that surrounds the three sides of the building in the west-east and south. In the new part, more bricks and cement mortar have been used. Last year, the surface of the dome was repaired with nano paint and insulation after repair, to prevent damage caused by moisture penetration into the inner body of the dome (Fig. 5 & 6).

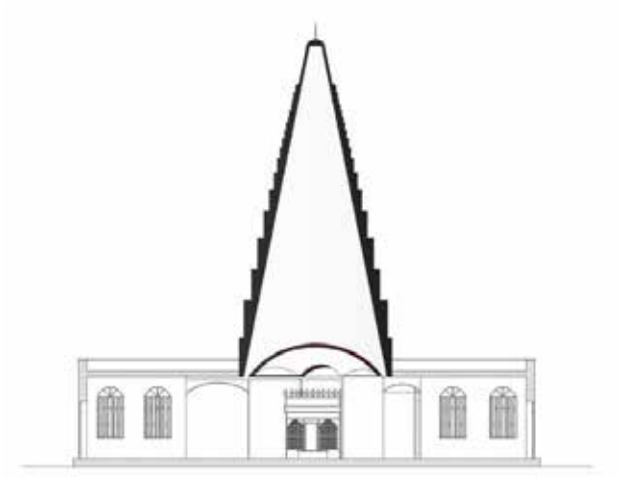


Fig. 5. Cut A-A Imamzadeh Seyed Salahuddin Mohammad (AS). Source: Authors.

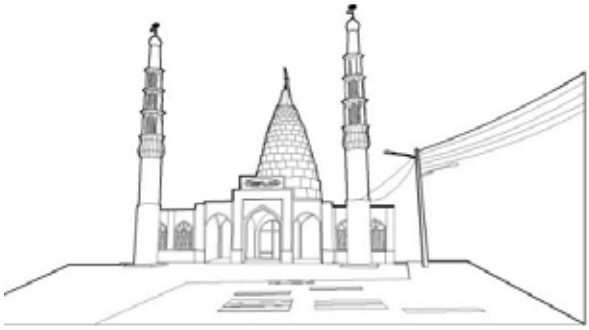


Fig. 6. North view of Imamzadeh Seyed Salahuddin Mohammad (AS). Source: Authors.

Findings of Factors Affecting the Occupancy of the Orchin Dome of Imamzadeh Seyed Salahuddin Mohammad (AS)

• Historical

The history of Orchin domes or domes with different sides in Islamic architecture dates back to the Middle Ages and has spread to a region as large as the Seljuk lands from Sistan to Damascus (Hilen Brand, 2008, 275-279). With the emergence of this type of domes and its cohesive architecture, it became the golden age in Islamic lands, which is the source of many innovations in the Seljuk rule. Seljuk architects developed four porches and a domed square hall, these two elements became religious architecture and some non-religious buildings (ibid., 279-281). In addition to religious buildings such as mosques, other buildings such as tombs during this period, along with religious architecture, developed their full course and found their place among the people. But the main origins of this type of dome can not be attributed to the Seljuk period, because the muddy dome of Iran and Mesopotamia had a special symbolic value (ibid, 282).

In the story of Gilgamesh, a world of planets is mentioned, which shows it as a ziggurat seven times; In fact, this is the same style of ziggurat architecture in Mesopotamian and Elamite civilizations that has become a reality in the world. The map of the ziggurats with a square base that is repeated several times and decreases in each floor is very close to the map of the dome of Orchin. Therefore, it can be said that the architectural style of masonry stepped domes are very ancient and perhaps with the dawn of the history of human urbanization in the Mesopotamia

and Khuzestan plains, and its original and delicate examples were invented by the Elamite Anzans and all changes and possessions are innovations in this style. Elamite architecture has been around since its incep-tion; It is related to the mythological principles and reli-gious prayers and intellectual principles of the ancient tribes in this great and ancient plain, But this style is also evident in the architecture of other governments (Fig. 7 & 8).

From the steps of Persepolis to the tomb of Cyrus in Pasargadae and the tomb of Mandana, the mother of Cyrus in the Bezpez plain and the Sassanid fireplaces as religious buildings of that period, show the importance of this type of architecture in religious tombs and tombs in those ancient periods. And it is a place for man and God to be together.

The mausoleum stairs in the mausoleum buildings have used this symbol of many conceptual meanings and the burden of their existence. For this reason, there is no trace of the tomb under the mausoleum dome of the Imamza-deh, and the builder places the tomb under a smaller spherical dome so that it does not compete with the identi-ty of the mosque in its architecture and sacred place (Fig. 9 & 10). Therefore, the higher the number of sides (n), the smaller the ratio and the closer the perimeter and circumferential radius of the dome, and finally the arrival of the dome at the current height of the dome is less proportionate (Fig. 11).

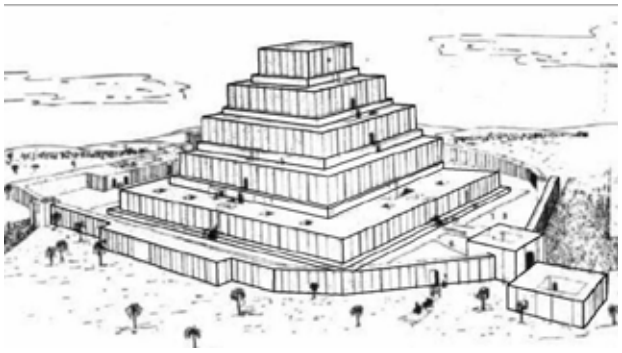


Fig.7. Choghazanbil Ziggurat in the present-day Susa region, a religious temple of the Elamite period. Source: https://naghshonegarad.ir/

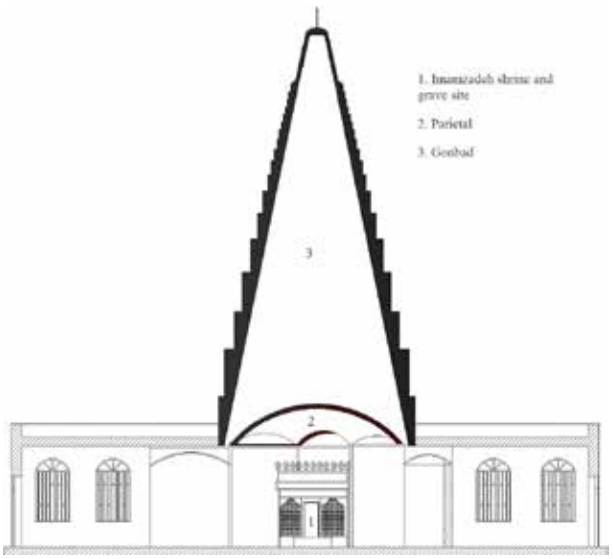


Fig. 8. How to place the grave under the dome of the Imamzadeh. Source: Authors.

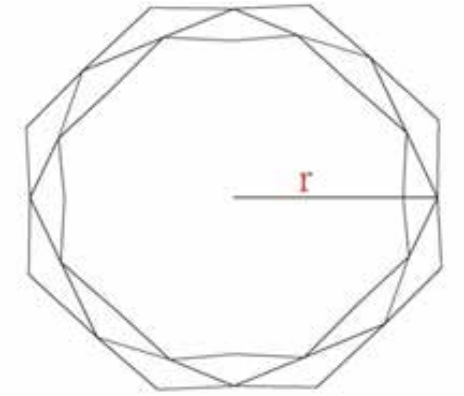


Fig. 9. Two floors of the dome of the shrine. Source: Authors.

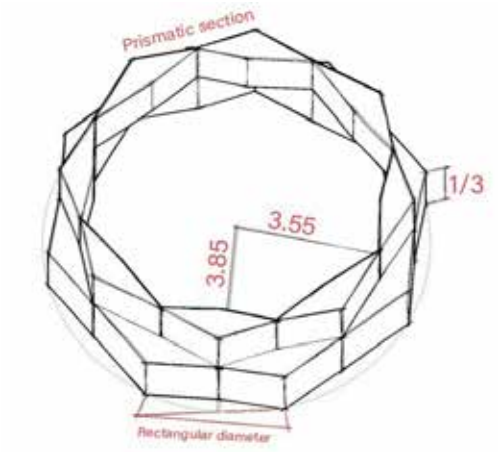


Fig. 10. How to place the first and second floors of the Imamzadeh dome. Source: Authors.

According to Formula 1, the circumferential and circumferential radius of the dome of all floors is measured and based on the following calculation, this structure is fixed in the dome[1]:

$$\cos\frac{\pi}{n} = \frac{\textbf{The radius of the enclosing circle}}{\textbf{The radius of the circumferential circle}}$$

$$Saddle\ first = cos\frac{3.14}{8} = \frac{3.55}{3.85} = 0/92$$

$$second\ saddle = \frac{3.1285}{3.3977} = 0/92$$

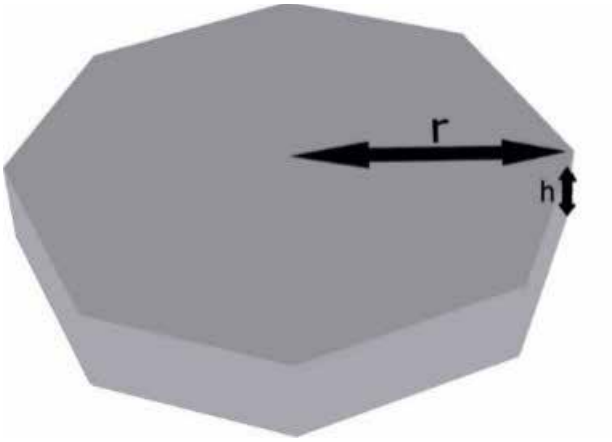


Fig. 11. The relationship between height and radius of each floor of the Imamzadeh dome. Source: Authors.

Calculating the ratio of the radius of the perimeter and circumference of the dome of the Imamzadeh of Seyed Salahuddin Mohammad (AS).

Accordingly, in Table 1, the circumferential and enclosing radius of the dome of Seyyed Salahuddin Mohammad (AS) is calculated and in field studies it corresponds to the structure of the dome.

The problem of the structure in the construction of the dome, like many other structures, is the transfer of weight and other loads to the dome to the support (Mashayekhi & Tehrani, 2018, 302). As mentioned, the traditional materials used in Orchin domes often have very little ability to withstand tensile forces. Therefore, it seems that asymmetric and tensile forces can be prevented by proper geometry as much as possible. It is also necessary to distribute the applied forces effectively throughout the structure so that increasing the pressure at one point does not cause local damage. According to the studies, it can be said that in the same way, in the walls of plain Chinese bricks, each brick is placed right between the two bricks in the lower row (ibid.). In the dome of Orchin Imamzadeh, it is located at the top of each lower floor, so that the forces entering at a high height can be transferred to each part by means of two rings and spread over the length of the support. Another advantage of this method is that the rings are placed on top of each other, connecting each vertex of the ring with four arcs on adjacent floors. This means that the dome is more cohesive and more integrated when dynamic loads are applied. Since the total difference between the radii of the circumferential circles is 8 and the circumference is equal to the radius of the circumferential circle of the first circle So we can write its exponential relation according to Formula 3:

$$r_1\left(1-\cos\frac{\pi}{n}\right)+r_1\left(\cos\frac{\pi}{n}\right)^1\left(1-\cos\frac{\pi}{n}\right)-r_1\left(\cos\frac{\pi}{n}\right)^2\left(1-\cos\frac{\pi}{n}\right)+r_1\left(\cos\frac{\pi}{n}\right)^3\left(1-\cos\frac{\pi}{n}\right)$$
$$=\sum_{i=o}^{n} r_1\left(1-\cos\frac{\pi}{n}\right)\left(\cos\frac{\pi}{n}\right)^i = r_1$$

By simplifying this relationship, the following result is obtained[2]:

$$\lim_{n\to\infty}\left(1-cos+\frac{\pi}{n}\right)\sum_{i=o}^{n}\left(\cos\frac{\pi}{n}\right)^{i}=1$$

According to the formula of magnitude, the ratio is 0.92 and this radius of the dome in the closet to the radius of the first ring of the dome is 0.4507, ie about half of the radius of the dome is halved in the tenth ring.

The height ratio of the dome also rises from the sequential rela-tion of the subset of the heights of the rings in the form of stairs. In relation to the ratio of the total height of the dome can also be obtained from the following relation:

$$h+h\left(\cos\frac{\pi}{n}\right)^1+h\left(\cos\frac{\pi}{n}\right)^2+h\,(\cos))^3\ +\cdots\ldots+h\left(\cos\frac{\pi}{n}\right)^t=H_t$$

Therefore, the total height of the dome is equal to:

$$\text{equal}\quad :\quad 13.32_{19}\frac{h\left(\left(\cos\frac{\pi}{n}\right)^n\right)-1}{\left(\left(\cos\frac{\pi}{n}\right)\right)-1}=H_t+\frac{1}{92}$$

Table 1. Peripheral radius and enclosure of dome ornaments. Source: Authors, 2019.

Saddle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Half baldness
Radius	3.85	3.28	3.036	2.804	2.591	2.394	2.211	2.043	1.887	1.744	1.611	1.488	1.375	1.270	1.174	1.084	1.002	0.925	0.855	0.790
Enclosing radius	3.55	3.03	2.79	2.58	2.38	2.20	2.03	1.88	1.74	1.60	1.43	1.37	1.26	1.17	1.08	1.00	0.924	0.853	0.788	0.728

The height of the initial saddle is 1.32, this height is constant in all formulas and is calculated in Fig.12. The total number of floors of the building is 19 and the half-timber with a height of 1.92 cm is added to their height and the total height of the dome reaches 15.24 meters.

This type of structure causes the force to be distributed to the saddles and the load is transferred to the lower saddles in a gradual manner and prevents the dome from breaking and twisting. Fig. 13 shows this type of structural behavior.

Typology analysis of polygonal domes and rock domes in Ilam province

Orchin domes have a variety of hollow structures. Due to geometric or structural reasons, in different regions, there have been changes in the geometry and the way the plan is transformed into regular polygons with each other. Based on this, concave domes with a plan of polygonal domes; The lateral surfaces are often slightly concave and rarely convex. Most of the domes can be assumed in terms of external shape enclosed in a cone, but in the dome of Imamzadeh Seyyed Salahuddin Mohammad (AS) like Imamzadeh Rudband (Dezful) and Yaqub Laith (Dezful), the dome is enclosed in Shaljami.

But the structure of Orchin dome in Ilam province can rarely be seen and most of the rock domes have been used. The main reason is the relatively high rainfall in the region. In Fig. 14, the typology of crooked domes and in Fig. 15, the domes of Rok and family in Ilam province, which can be studied to the dome of Seyyed Ibrahim (AS) in Zarrinebad, Dehloran and Pir Mohammad in Jaber Ansar village of Abdanan city. The common face of the domes in Ilam province has been used as a pilgrimage tomb to face them and most of the buildings

Conclusion

Some symbols are common to many cultures around the world. Sometimes these common symbols have a single module, and this adds to their importance in

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Half baldness	H
1.301	1.201	1.109	1.024	.0946	.0874	.0807	.0746	.0689	.0637	.0588	.0543	.0502	.0460	.0428	0/4601	.0365	.0337	0.392	1.92	15.24

Fig.12 Calculating the height of the saddle and dome of the Imamzadeh. Source: Authors, 2018.

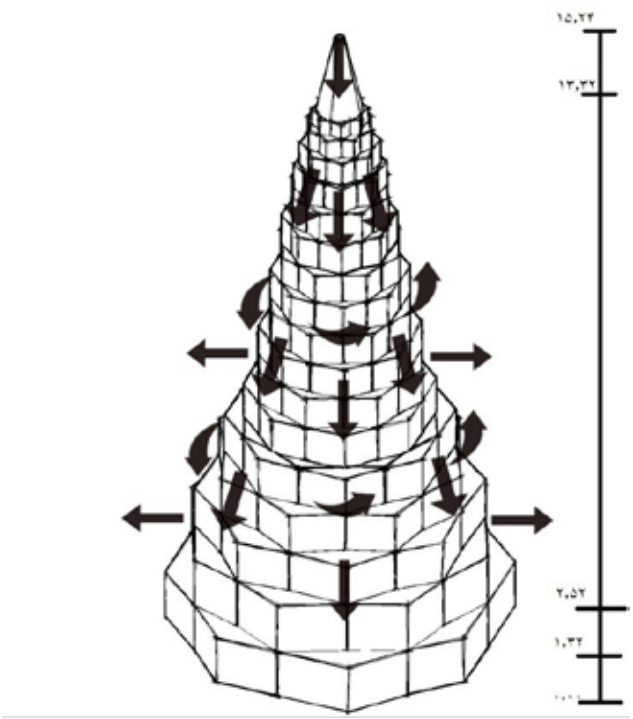


Fig. 13. Height of Imamzadeh dome Behavior of structures according to the geometry and structure of the dome. Source: Authors.

recognizing their innate and revelatory commonalities. One of the most important structural parts in traditional Iranian buildings that have a great impact on the formation of architecture and urban landscape are the coatings, especially domes. Traditional Iranian domes are one of the most prominent examples of traditional Iranian construction for thousands of years. Many of them still survive after many centu-ries. Dealing with the method of dome construction, recognizing their types, studying the performance of structures, drawing methods, stylistics, execution methods and related issues has always been the con-cern of Iranian architects. The meaning of existence lies in its fabric. The dome of Orchin Imamzadeh of Seyed Salahuddin Mohammad (AS) located in Abdanan city is one of the domes that has been pre-served for centuries. In this study, the effective fac-tors in the formation of the dome were studied histori-cally, geometrically and structurally. Studies show that, historically, the geographical proximity of the city of Abdanan near the Elamite civilization (presentday Khuzestan) and

A

A. Sayed Salahuddin Muhammad (AS).
City abdanan.
- orchin,- 7-8th
century AD
- To be facing the qibla,
- adjective,
- The main materials of the brick and the previous surface of semi-permeable gypsum and now stone powder with cement and nano paint
- Has a parietal and two shells.

B

B. Sayyid Ibrahim (AS). Iran .dehloran.sity zarin abad
- Rack and octagonal,
- Chpyrh
- 7-8th century AD
- To be facing the qibla
- Conical
- The main materials of the brick and the previous surface of semi-permeable gypsum and now stone powder with cement and nano paint.
- Has a parietal and two shells

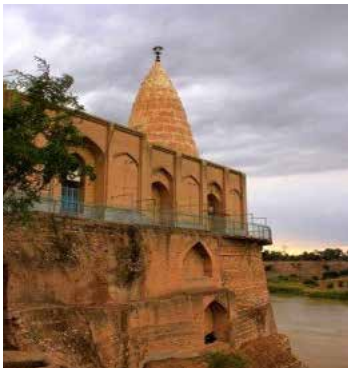
C

C. Abdanan-Jabransar ansar. Jaber-e Ansar village
- Rack and octagonal,
- No Chpyrh
- Dome construction from the roof.
- 7- 8th century AD
- To be facing the qibla
- Conical
- The main materials of brick and the previous surface of semi-percussive gypsum and now stone powder with cement and nano insulation,
- Has a parietal and two shells

Fig. 14. Analysis of Rack domes in Ilam province. Source: Authors.

the structural study of his-torical monuments, including ziggurats, the most sig-nificant buildings of the Elamite period and the tomb of Daniel the Prophet (PBUH) in Susa and Yaqub Laith and Imamzadeh Roband (AS) in Dezful, related to the Seljuk period and the emergence of coherent architecture is, In the geometry of the dome, the ar-chitects have tried to increase the surface to-volume ratio to make it possible to transfer heat and thus cool the dome. Adapt to climatic conditions. Structurally, the dome is mostly made of native materials, and architects with proper geometry have prevented the emergence of asymmetric and tensile forces in the dome. In the plan of Imamzadeh dome, like other Orchin buildings such as Yaqub Laith dome and Rudband Imamzadeh, the top of each floor is located exactly on the top of the lower rafters, which has maintained balance and symmetry in the structure of this type of domes and Imamzadeh dome. In the geometry of the dome, the architects tried to increase the surface to volume ratio to make it possible to transfer heat and thus cool the dome.

A



B

C

A. Seyed Salahuddin Muhammad (as) .City of Abdanan, Iran.
How to turn the plan into a dome: a regular octagonal square to the Orchin dome,
- The conversion of saddles is 16 domes.,
-Eliminate half baldness and simplify polygons in the calluses,
-Use of darkness in the dome,
-Existence of two holes in the north and south of the dome in the form of an arch to create blindness and swelling inside the dome and the entrance to the interior space from the north hole and also four holes under the pavilion to drain and enter fresh air into the building.,
- Changing the rhythm of the dome in the sails,
- The dome is made of brick
- The dome is surrounded by turnip.

B. Shah Rudband-Iran-Dezful
-How to turn the plan into a dome: a regular octagonal square to the Orchin dome,
- The conversion of saddles is 20 domes.,
-Eliminate half-baldness and sim-plify polygons in the aisles,
-Not using tar in the dome,
-Four holes in the form of arches on the four sides of the dome in order to pay attention to the presence of light in the spiritual space of the dome and also to create blindness and air conditioning of the rough dome,
-Changing the rhythm of the dome in the sails,
- The dome is made of brick
- The dome is surrounded by turnip.

C. Yaqub Laith-Iran-Dezful
-How to turn the plan into a dome: a regular octagonal square to the Or-chin dome,
-The conversion of saddles is 20 domes.
-Eliminate half-baldness and simplify polygons in the aisles
-Use of darkness in the dome
- There are four holes in the dome, two of which are covered and a hole under the parquet to drain and fresh air into the building
-Changing the rhythm of the dome in the sails,
- The dome is made of brick
- The dome is surrounded by turnip.

Fig. 15. Typology analysis of similar domes (polygons). Source: Authors.

Endnote

1. Calculation of the exponential relationship of the radius difference between the surrounding and peripheral circles of Imamzadeh. Source: Mashayekhi, Tehrani, 2018, 297-298).
2. Calculation of the exponential relationship of the difference between the perimeter and the circumference of the Archin dome. Source: ibid

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