Structure of Wooden Domes In the North West of Iran

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ABSTRACT

Background: Domes have a long history in Iran. The most common type of flat ceiling was used in Achaemenid era. Since during this period it was difficult to bring cedar from Lebanon, Otlack curved arch and dome as structural and geographical phenomenology were replaced in Iranian architecture. The remained wooden domes from Safavid period represent the background of these wooden domes in Iran dating back to periods prior to the beginning of Safavid period (17th century) proved by the artistic skills performed in these domes. Since wood is destroyed faster than many other structural materials, there are few old wooden constructions left intact. Some of these domes belonging to Safavid period are remained in Azarbaijan in which woods were located on the squinches of the main base and repeated to shape the domes. This paper tries to study structure and construction of these kinds of wooden ceilings.

INTRODUCTION

Circle is a shape that conveys the timelessness, since it does not have neither beginning nor end (time), therefore we could consider the circle form other architectural standpoint. Gradually it has taken the meaning of moving, wheel, dolly and sun and it conveys the meaning of loyalty and bond. Circle has changed to the loop of sun or sign of God in Forouhar symbol and in most of the cultures shows commitment, Trans and love. Generally, the space inside the circle is holy and protected. Archeological discoveries in the ancient gunmetal era, around three thousand years B.C in the west of Iran plateau in sites such as Yaniq Tepeh and Haftvan, created circle plans that restored designs of them, shows the dome form with light materials such as trees and mud-coated surfaces [10].

Then, the oldest form of covering the curves in Iran has been observed in the lower covers of Chogazanbil Zigurrat that belongs to the second millennium B.C. The glorious architecture of Achaemenian 550 B.C with high and level cover is in the climax of power and function, however, before that era or after that because of special economic condition it was impossible to bring teal tree from Gondareh or Cedar from Jabal Amel, and it was not possible to find suitable wood in the jungles and plains of Iran. Therefore, curved vaults and domes find their position easily in the Iranian architecture as a structural and climatic phenomenon. Of course, vault covering in Achaemenian era was a known architectural method. For example, we could refer to the vault ceiling of the Persepolis treasure. In the next era, Parthian did not follow the architecture of Achaemenian, and used mostly the architecture of Medias, and even Elemi. They used local materials that it was unusual in the vault coverings of the era. In Sassanid era, (224) dome construction was so developed that from that time dome construction came to be a pattern and an inclusive instruction remains even now. The oldest dome belongs to Parthian and early Sassanid era in Firouzabad whose mouth is 16.10 m.

Dome construction method whether in Sassanid era or Islamic era, is very exact and based on mathematical calculations, and all the domes are resistant against the pressing and drifting forces. Although from the early Islamic era until now, there have been some changes; however, dome construction has followed special executive and cultural specification.

Methodology:

Construction of Corner And Dome:

In geometrical definition, dome is the geometrical place of points that is created from rotation of defined arch around a right axe, however in architectural language; dome is a covering that is built on a circle ground. Dome usually, is located on bases or walls with different plans, since in Iranian architecture, rarely do we face
circle plans, and plans usually are circle, square or rectangle and with a Chaptra they can change to a circle and then dome are constructed over it. Therefore, having Chaptra in dome 3 construction is significant. Since having round ground makes the final construction makes dome building possible.

Usually, in plans that covering is designed a dome, the ground is considered as square and it easily could be changed to 8, 16, 32 parts and finally to a circle. Dome construction in Iran, rarely has been executed in rectangle similar to square. In this case, the rectangle changes to 6, 12 parts and finally takes the shape of oval and the dome is built over it. This type of dome, whose horizontal section is oval instead of circle, is called Kambizeh. Samples of these domes are observed in the oval plan of Hadj Rajabalı mosque in Tehran and Imam Zeyd Ibn Ali in Varamin[11].

Chapireh:

One of the methods for building domes is using Chapireh method. Corner building or Goushebandi means building and changing the four-corner plan to eight-corner with respectively 16 and 32 corners and finally changing to circle. Changing the rectangle similar to square of 6 and 12 corners makes it similar to oval. Of course, using different functions in the traditional Iranian architecture, most shapes could be changed to circle. The first corner building is carried out by wood and even the dome itself could be built by wood. The method was to install the woods in the corners of the volume and continued it until it was like a basket and the wooden dome was constructed. In Armenian architecture, we see many of these domes. The spaces under these domes are biggest room. In village houses, the ceiling of the biggest room, that oven is located in, has a wooden dome.

The woods in Iran are not firm enough and usually are used to cover the mouths of 3 to 5.2 m. Since the same, in Iranian previous architecture, especially Achaemenian era, in order to cover the Persepolis, thick Lotus trees were brought from Lebanon. Since transportation of these trees were expensive, in Parthian era it was quieted and arch curve was used instead. Unfortunately, nothing remains from the Parthian architecture, from which arch covering starts. Out of Iran, we face some samples of arch covering, one of which is Hattra or Alhazar and the other is Assyrian palace, however the remaining illustrate nothing. In Hoor region in Khurasan between Khañ and Nishabour, there is a dome, whose corners are made of wood and the dome itself is made of ballast. The building belongs to late Parthian era and early Sassanid, generally it does not lead us to anything much. Thus, there are very few of the fully wooden domes in the villages.

Making corners with wood gradually was quitted in spite of the strategies and main reason is that termite is found in many parts of Iran (termites live in central Iran from Tehran to Kashan and in Kerman and Yazd have the highest number. A type of termite, which is called Tordeh -mud maker-, is very dangerous and in some hours makes wood as mud). Although, architects use a type of salty wood, which is made of poplar, and sometimes the salty wood of tamarisk is used in structures either. Moreover, this wood was covered with a bitter material called Esheh with frankincense or it was covered with bitumen and then plaster was applied over on it then it did not have any contact with soil and termite was unable to penetrate it.

The oldest sample remaining of corner making with wood is in Hoor region that was mentioned before. In Fahraj part of Yazd, which there is many termites (because of Fahraj wood), there is a shrine whose corners are made of wood. The wood in the corners has been corroded however; the adobes behind it remain miraculously. Nevertheless, nothing remains of the dome. Late eighth and ninth century, in Khurasan region near Mashhad and Toos and in the mountainous region of Kerman that termites are less, using wooden cover develops. A sample of them is the corners in the shrine of Shah Nematollah Vali in Kerman, however, in order to make corners with wood, a 16 line shape has changed to 32 one. In Harounieh dome of Toos, the same has been repeated. In the dome of Jami Mosque in Qazvin, wood is used in corners.

![Fig. 1: Corner making and covering the dome with wood (Pirnia, 1991. 10).](image)

Perfect And Untouched Wooden Domes In North West of Iran:

North West of Iran, there remains unique wooden domes that some of them have been protected by people or organization of cultural heritages. We refer to some of them below:

1. House domes in Ushtubin village
2. The domes of the houses in Hamianava village
3. Charchi in Azarshahr
4. The dome of Maria the Virgin church in Nakhchivan Tepe in Urmia

The wooden domes of houses in Ushtubin village:

Ushtubin is a village in the boundary and in an aslant foothill in Julfa region of East Azerbaijan. The village is located in a valley and it is surrounded in three directions with mountains. The village is registered under number 2692 dated 1998 in the list of national monuments of the country. The documents obtained from stone carvings shows the establishment of the village as 1569 and 1440; however, the architecture goes back to historic period.

The houses of the village are historical works that mostly are in two floors. The ground floor is allocated to barn and warehouse (life materials) and the first floor is for living. This diversity in using the floors has affected the appearance of the village. In building the ground floor, ballast has been used in a case that the walls of the upper floors are made of adobe and observing these cases is based on structural principles, since making the lower floors heavier and upper ones lighter causes the building to be resistant against the 5 natural disasters such as storm and earthquake. Temperature fluctuation from climate standpoint makes fewer changes in upper floors.

Considering the gradient direction, view direction is towards the east (river). The dominant form of the buildings is square-rectangle and without yard, the roof is used as yard. Consequently, the function of roof increases and in far view creates a stairway form. The residential areas have diverse functions in comparison with urban areas. The residential traditional houses include rooms, terrace, food store, oven, garden house, barn, yard in the roof of the neighbour and toilet. In new houses, bathroom is added to the functions.

Fig. 2: View of Ushtubin village houses (Source: author).

Fig. 3: Sometric of the wooden dome. (Source: archive of Cultural Heritages Organization)
Boneh baghi:

These houses are among the special architectural elements of the village, we can call them hidden houses either, since its position dictates the word. Except a hole in the ceiling there is nowhere for light entrance and ventilation. The building method is in a way that in the middle of the room, four columns are raised in a distance from walls and are located on four beams horizontally as a firm coil. After placing the columns and horizontal beams, spreading the second layer is carried out and four horizontal beam with less diameter from lower ones and in a counsel like it has entered the frame and the first layer spreader and it has continued until the end of the ceiling.

Finally, since the horizontal wooden spreaders gradually lose their thickness in diameter, thus a pyramid is formed. It deserves to mention that stanchion cap are used for the said columns and are decorated with great designs and there are niche and fireplaces inside the walls. (Source: archive of Cultural Heritages Organization)
Hamianabad:

It is a village in the Kosar district of Salmas region in West Azerbaijan. A part of the village is located on cliff bed. A carving on the cliff shows the history of the village. However, since it is unreadable it is impossible to speak clearly. The village is sparse and residential houses are scattered. Villagers live on agriculture and animal husbandry. All the residential units are in one floor and include different parts such as rooms, store, oven house, barn and toilet. The bathroom is public and newly it has entered the residential units. The yard has less space. The most important element in these houses are wooden domes to cover the architectural spaces, these spaces usually are dining room or rarely oven house. The space with wooden dome is square or rectangle and brick walls or adobe walls with cob wall façade. Only there is an entrance without any hole or window for light and the only light comes through the hole in the wooden dome.

Inside this space, there are four columns in some distance and four strong beams are located over them, in the next stage smaller beams are placed on these beams and gradually the mouth becomes smaller and takes the shape of pyramid and the hole is at the end of this dome. Usually, wood pieces are nailed on them and then a mat covers them and over the mat there a layer of mud. Since the height of the dome is more than the main ceiling, it is out of the roof in a semi-arch shape. One of the houses in the village had the biggest wooden dome, however unfortunately 10 years ago it was destroyed. The height of the dome was 7 meters and its structure was like the former one.

Fig. 9: planes of Ushtubin village houses with wooden dome (Source: archive of Cultural Heritages Organization).

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Fig. 10: One of the houses with wooden dome (Source: author)
Charchi (Charsuge) in Azarshahr:

Azarshahr is one of the towns in East Azarbaijan, and the capital town is Azarshahr, either. The old name of the town was Toufarghan and it has many fruit gardens with grapes and nut.

Charchi spring is located in Sutuvar borough of Azarshahr in a small square that forms a cross for four alleys. A vault of 8 wooden columns shades the spring.
Fig. 16: View of Charchi in Azarshahr

Fig. 17: Internal facade of Charchi in Azarshahr
(Source: author)

Fig. 18: Internal facade of a wooden dome (Source: author)

Fig. 19: Facade of Wooden capital (Source: author)
Whose history goes back to Qajarid era the column bases were hexagonal and the stanchion cap belongs to Safavid era. The plan of this Church is hexagonal and the dome cover is completely wooden. Wooden beams are placed over columns according to the hexagonal plan and in the second stage the woods are placed with a 60 degree circulation in proportion to former ones and a little inside the dome. In the third stage like the first one, the wood are placed and connected, therefore the wooden and basket like dome is formed by wood. Then, wood piece are nailed over them on the roof, then soil is spread and finally it is covered with mud.

The importance of this small church, in addition to its historical value, is using the ancient tradition of dome construction of Armenians that immigrant Armenian in previous centuries has transferred their tradition to North West of Iran. Nakhchivan Tepeh is a small village located in the 22nd kilometre of North East Urmia. 30 Turk and Armenian families live in the village and mostly are farmer and stockbreeder. The church is located in the eastern margin of the village inside the residential texture in a big yard that does not have geometrical shape and its four sides are open.

For the first time a delegation from Milan University studied the churches of Iranian-Armenians by the leadership of Professor Adriano Alpago-Novello with a team from Shahid Beheshti University in 1976. The exact building date of the church is not known and there is no carving or document remaining. The Italian delegation that studied the church completely, believed that building date is seventeenth century and in Safavid era. However, probably the church is older. The present building is restored in 1803. This date is based on the date, which is carved in Armenian language over the transom, and it is translated as: “the church of Mari the Virgin is renewed in 1803” (Adriano Alpago-Novello). After one century and a half, in 1957, the Armenians of the village renewed the church again. Nowadays, it is in good condition and it is used in religious ceremonies. The church is built by big ballasts, adobe, plaster and wood.

Fig. 20: Plan of church (Source: Khan Mohammadi)  Fig. 21: Section of church (Source: Khan Mohammadi)

Fig. 22: The internal facade of the church and alter  Fig. 23: The facade of the northern wing of the church
Results:
The church includes a praying room of rectangle, in east to west axe that is made by big ballast, adobe, plaster and wood. Its elements are placed in the direction of alter. The church is in the same level with other places and it has one entrance in the northern wall which there is two half-columns in tow sides of it. The church is made in Basilica form and there are five wooden columns in internal space in two linear rows and in the same direction of alter, thus bear the weight of the ceiling. These columns are cylindrical and without column bases. The rectangular alter of the church in the last and eastern part and in the highest level of the church are divided to three parts from function standpoint of public, singers and alter. These parts are divided by level difference. The singers were located higher than public and alter was higher than them, and the bigger space was allocated to prayers.

The ceiling of the church is covered in two forms: 1. Level covering: that includes most parts such as public, singers and side rooms and it is made of wood. 2. Dome cover in Hazarashn style [9]: this wooden cone dome is located over alter and most of church’s importance is because of that.

Hazarshin is Armenian word that means thousands of pieces and since there are many pieces in dome, it is called y this word. Using dome construction is very old in architecture history and goes back to the era of Urartus and it seems that in the first Christian centuries are used in the churches of Armenians and significantly in Uchmuyazin church [9]. Although, these domes were replaced by cone domes afterwards, however most researchers believe that conic Armenian domes is an imitation of these dome construction. Gradually using this method became common in some churches, local buildings and villages of central Armenia and even Georgia. Hence, it was famous as Soghoomnashin or Gerogian dome. In some churches, many pieces of square or cubic rectangle stones are used. Stones are placed besides each other in polygonal form (heptagonal or hexagonal). In addition, with smaller scale and some prominence the stones are placed over each other and gradually take the shape of cone. Among these churches, we can refer to the dome of praying room of Van Araklitous (twelfth and thirteenth century) church in Tavoush region of Armenia. In some smaller churches, using stones instead of wood pieces was usual. For example, using Hazarshin style in Iranian churches and Sourp Hovanes Sangh Baran church in Isfahan (eighteenth century) is apparent [5].

Discussion and Conclusions:
As it was mentioned in the samples, the use of circle structures in pre-Islam Iran and after was holy, and especially the immigrants of northern strip in the margine of Araz River and around the Urmia Lake has used it in construction of the houses and even stone tombs. They have been used continuously in the region; however, because of wood’s weakness against decline they have disappeared and were not recognized afterwards. The samples that mentioned in present paper, all are dated to 16th and 17th centuries. The technique and method of execution in one hand and the ancient aspect of the region on the other hand is a reason for recognizing the
wooden materials, capabilities, function restrictions of the residents that used them in the case of need. The existence of some designs such as wheel and lotus shows the continuation of the tradition. Considering the few remaining samples, we must respect them, recognize, analyze their techniques, and protect them, either. In this regard, the Cultural Heritages Organization has protected most of these structures such as wooden dome of Ushtubin, Azarshahr Charchi, and the church of Mari the Virgin.

REFERENCES