IRANIAN VERNACULAR ICE-HOUSES: NOTABLE EXAMPLE OF A TRADITIONAL ARCHITECTURE IN PROPORTION TO ITS CLIMATIC CONDITIONS

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ABSTRACT

Iranian architecture is shaped in related to its Hot-Dry climate and has provided interesting answers to the Iranian's needs. In this climate, most of the buildings are constructed by mud or sun-dried bricks. There are so many facilities that Iranian architecture has provided for better living such as: Wind-Catcher (which exhausts warm air from buildings during the day), Cisterns (which have a cylindrical store place in the depth of the earth for storing the cold fresh water during the hot seasons), Ice-Houses with walls behind which water in shallow channels friezes at nights, etc. The great heritage of Iranian architecture and traditions are still not known until now. The constructing traditions of vernacular architecture in Iran, reveals the mystery of using natural energy sources that reduce the need to fossil fuel. Among different Iranian cultural heritage, Ice-Houses are selected as the main subject of this article.

Key words: Ice houses; Vernacular Architecture; climatic conditions; Iran

1. INTRODUCTION

Iranian traditional architecture is based on climatic conditions. It compensates the lack of natural resources. For, there is no attention to preserving such mud-brick buildings; most parts of them are ruined. The fierce climate of plateau accelerates this process.

IN a country such as Iran, which is vastly comprised of hot and dry lands of desert, preparing potable and healthy water, is one the main problems of Iranian, nevertheless, in contribution with climatic specification, natural potential and natural resources of their land, they could provide water and ice for the whole year.

This article aims to represent Ice-House, one of the elements of Iranian architecture that is constructed in relation to natural environmental energy and sustainable architecture, without damaging the environment. In this way it wants to transmit the traditional heritage of Iranian architecture to the Iranian and the world entire. Because of the technologic cooling devices, this Iranian element is unused at present. Without constant maintenance, Ice-Houses are deteriorated soon. This heritage that is remained for us, should be identified, transmitted and reused. This architecture, in the one hand, respects its natural environment and on the other hand, was built by the people themselves, and at their service for better quality of life. [1]

The present article is the result of the research from 2006 A.D. During this period, the existent examples of ice-house are investigated and different kinds of it are categorized.

Ice-Houses indicate Iranian intelligence and imagination. Their invention for supplying the cool, fresh water is still unrivaled. The view points of travelers who had come to Iran, and their itinerary are used to validate this article.

2. ICE-HOUSES

Before the technologic world present refrigerators to the global society, Iranian could produce ice by inventing Ice-House. This building is used to store ice in winter and use it in the warm seasons. According to this fact that Iran is situated in hot and dry region, and summers are long and very hot, it has been so pleasant for Iranian to have ice pieces and drink cold water. The procedure is based on high discrepancy of temperature between “day and night”, “summer and winter”. [2] The principle governing the function of ice-house is to make use of below-zero temperature of winter nights for producing ice and preserving it for a long period and finally reusing it in warm seasons. Some of the ice-houses are related to Qajar period (1794-1925 AD) and some others are related to the flourish of Silk road (nineteen century). Most of Ice-Houses were of public Utility and all of the people could use the ice in it. [3]

Ernest Hoeltzer explains that there are many ice-houses in Esfahan and Iranian carry the big pieces of ice on donkey to sell them all over the city. (Figs1-2) He has also taken some related photographs:

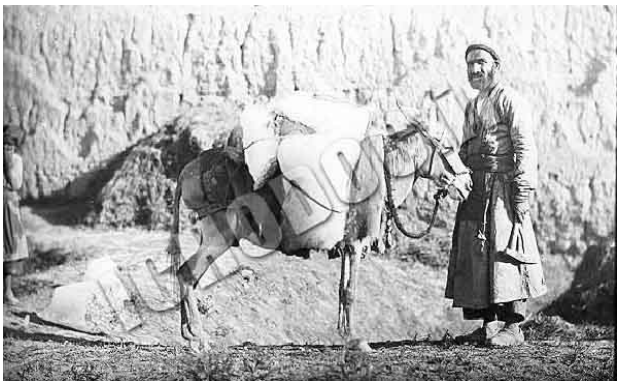

Fig. 1. Carrying the ice, Isfahan

Fig. 2. A person who sells the ice in the town, Isfahan

The most common examples of Ice-House had a shade wall, pond and a deep well, covered with a big dome that is actually a warehouse for storing ice pieces. Ice-houses are made up of the materials such as stone, adobe, mud, wood and lime which are the vernacular materials of the region. They were built near the fresh natural sources of water. During the winter nights, some water is poured to the large shallow pond, about 100x10 m and, 40-50 cm height, which is shaded completely by great wall at the south side of it during the day. The height of the shade wall reaches 12 m. It is made from the earth which was excavated from the pond. Because the pond is in the shade of the wall, during the day and because of the below zero temperature of winter nights, the water in the pond, start to freeze from beginning of the night and this process continue till dawn. Each time the pond is filled with 1-2 inches of water. [4] When the first layer freezes, the next layer is added. When the thickness of the ice, would be 6 inches, the ice is broken into pieces and transmitted to the deep well, on the south side of the wall. The depth of the container is more than 6 meters. Therefore as a result of “Earth’s Seasonal Heat Delay Effect”, the container keeps it's winter's condition during hot seasons. Also large thickness of container's dome, using masonry (with low coefficient of heat transfer) and its external thatched coverage have the role of thermal insulation to prevent thermal conductivity between interior and exterior of storage and wasting the energy. It is worth to mention that the air in the warehouse could easily circulate because of the height of the dome and a large hole on top of it that would let the warm air out. The warm air goes up. So the layer of the air, upon the ice would be cool. This circulation helps the ice not to be melted. [5] (fig3)

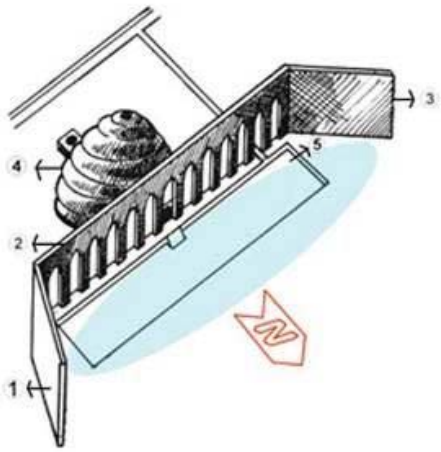

Fig. 3. Perspective of an Ice-house with the shade wall and the shallow channel

This container has an entrance door, which is related to the pond with slop for easy transportation of ice, and an external door for exporting the ice from the storage. The more the ice grinded the freezing will be better. Pieces of wood and straw are used between each layer of ice to avoid sticking to each other. This process continues up to the time that the well would be full. This well is actually a big container which has a huge dome on it. The air in the warehouse could easily circulate because of the height of the dome. The warm air goes up. So the layer of the air, upon the ice would be cool. This circulation helps the ice not to be melted. After that, the door of the warehouse would be closed until the warm season. At the commencement of hot season, when the temperature goes up, the door of the warehouse would be opened and the ice–mass is extracted from the ice-house through a happy ceremony, by the people. What is surprising and desirable, is the beauty and clearness of the ice. Not even a little dirt and darkness in the ice can be seen.

Krenlin was a Dutch who entered Iran in 1702 AD. He has driven a picture of ice-house in Ghom that is one of the most important historical documents of Safavid period (1501-1722 A.D.). The conical dome in the right and the shading wall, in the left, can be seen. [6] (fig4)

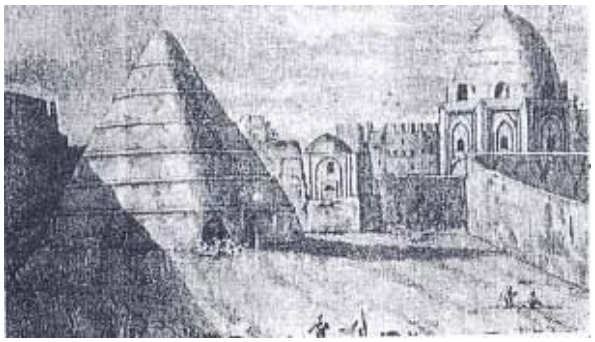

Fig. 4. Ice-house in Ghom, Krenlin Bervin

Another picture is driven by Dutch Jules Lawrence in nineteenth century. This picture shows the Do-Namak Caravan-sera (thirty km to the town of Garmsar) and its big ice-house. The dome of the ice warehouse is stepped and the shading wall is at the north of it. This wall is ruined and it cannot be seen clearly. [7](fig5)

Fig.5. Ice-house and Caravan-sera in Safavid period, designed by Jules Lawrence

Two kinds of ice-houses:

1- Ice-house with dome container: these kinds of ice-houses are dispersed in the regions with hot and dry climate. It has a conical giant hole that is covered with a stepped adobe[1] dome, which its thickness varies from two meters at bottom to thirty centimeters on top. Since the melting water of stored ice accelerates the melting process, a well is dug in the middle of ice-house storage. [8] Also there is a geometrical stair to reach lower layers of ice.(figs. 6-10)

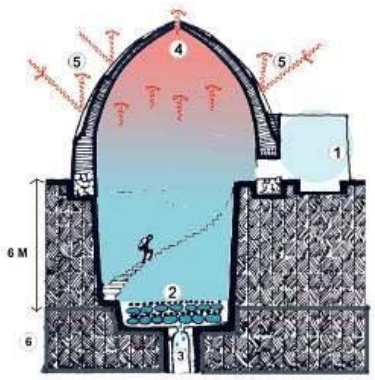

Fig. 6. At day:

1-The high walls throw a shadow on the pond. So the earth of the bottom of the pond does not absorb much heat.

2- Pieces of wood and straw are used between each layer of ice to avoid sticking to each other.

3- There is a small hole at the bottom of the well to vacate the melted ice.

4-Cold and fresh air goes down. So warm air goes up and exit from a hole on the top of the dome.

5- “Large thickness of container's dome”, “using masonry (with low coefficient of heat transfer) “, and” its external thatched coverage “have the role of thermal insulation to prevent thermal conductivity.

6- As a result of “Earth’s Seasonal Heat Delay Effect”, the container keeps it's winter's condition during hot seasons. (According to this fact, temperature of 6 meters below ground level has a constant amount of the average temperature of summer and winter.)

[1] -mud and sun dried mud bricks

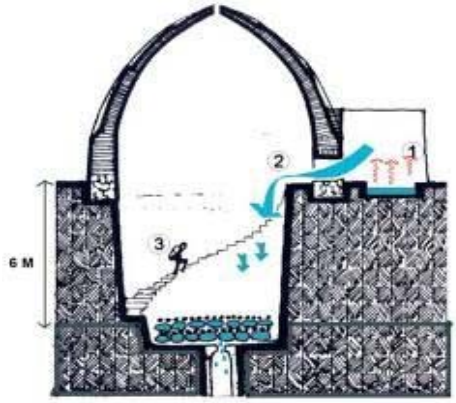

Fig. 7. At night:
1- Water in the pond loses heat.
2- Cold air goes down the ice-house and covers the upper layer of the stored ice.
3-A staircase connect the door of the ice-house to the lower level of it, to store the ice pieces in a deeper level of the earth.

Fig. 8. Internal view of the ancient ice house of Kashan

Fig. 9. Dome of the ice-house of Kashan

Fig.10. Warehouse of the ice house of Kashan.

2- Underground tunnel dome: These kinds of ice-houses are dispersed in regions with cold and temperate climate. The storage of these kinds of ice-house is like a long rectangular room, which resembles tunnel. It is mainly situated underground with a rib-vault or a barrel-vault covering. [9] (Figs. 11-12)

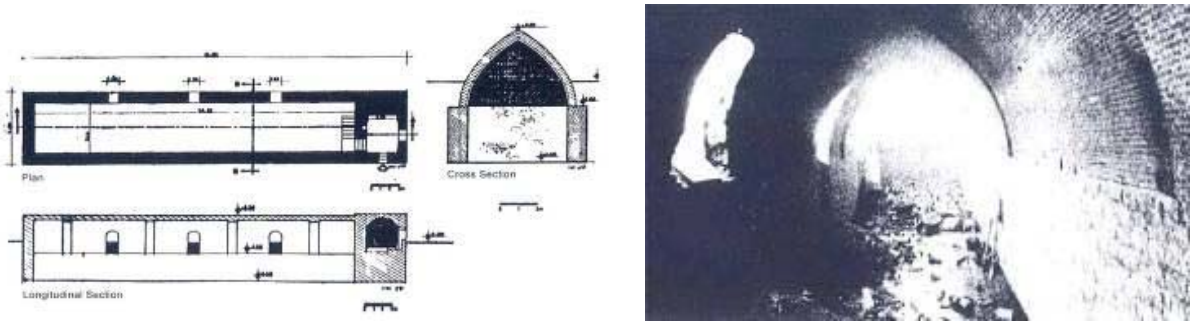

Fig. 11. Nine stairs ice-house in Oroumiye, Azerbaijan(before repair)

Fig.12. Nine stairs ice-house in Oroumiye, Azarbayjan(after repair)

3. CONCLUSION

The great Iranian tradition is as yet little known in the West and there is much to be learnt both from it and the building techniques which are integral with it. It is the fate of vernacular buildings throughout the world to be neglected until they are nearly extinct. The Folk Museum and the Museum of Buildings are relatively new ideas in Europe, where they are thought of primarily in terms of conservation and education in history and the arts. [10] In Iran their value could be even greater since these functions could be combined with those of an institute of intermediate technology. Not only is the building tradition itself still alive, but there is much to be gained from a knowledge of a highly developed technology which makes such ingenious use of natural resources without the

consumption of additional power. [11] The Persian ice-house with its great shade wall could hardly be described as small, but the technology it represents is certainly beautiful in its simplicity. However, unless positive action is taken, most Iranian cultural heritage buildings will have crumbled.

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