SHAVADAN; The Sustainable Architecture in the city of Dezful in Iran

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Abstract

To make adjustment with nature, Iranian native architects in different climates of hot, dry and semi-arid of Iran have created a lot of innovations. Air traps, under grounds, water reservoir and ice chests are some examples of these sustainable innovations. One kind of these sustainable architectures that has been built underground, is called SHAVADAN. Shavadan is a place which was built in the depth of 5-12 meters underground in the region of Khuzestan, particularly in cities of Dezful and Shushtar.

This article explains the particulars of the inhabitants’ life style in Shavadan which is located in hot and semi-humid area in Dezful. Also, it explains the usage of this method in old buildings in the past. We can also use this method at present time in order to save energy.

Introduction

The native architects from every corner of this world were trying hard to find solution for a better living of human beings. Although to be in harmony with merciless mother nature is not an easy job to do, but they tried to take advantage of every opportunity to make their wish come true.

Chinese used to store ice for thousands of years before Christ. Greeks and Romans in ancient time kept their wine cool by putting them in a man-whole covered with straw.¹

In reviewing the Iranian old architecture, we can find evidence of IRANIAN’s innovation and creativity. The following examples prove their creativity:

a. Air Traps were used to create air current in the building. (fig. 1.)

b. Underground water reservoirs for keeping rain water for future use. (fig. 2.)

c. Underground ice chests for keeping ice to use in the summer time. (fig. 3.)

Among these, Shavadans have been built specifically for the hot regions

¹ National Geography, Vol. 171, No. 1, Jan 1987, p. 92
of Dezful and Shushtar cities in south west of Iran in the Province of Khuzestan.

Hot and semi-humid climate of Dezful, and its nearness to Dezz river, cold flowing water of river and the elevation of the city all in all gave shape to the formation of Shavadan. The native architects of Dezful, could take advantage of very cold river water and the moderate temperature in the depth of the ground, to create favorable living condition in the temperature of more than $50^\circ$ degrees centigrade before any refrigerator or air-conditioning system was invented.

**Geographical and Ecological Situation of Dezful City**

City of Dezful is located in the province of Khuzestan, in south-west of Iran in $32^\circ,25^\prime$ latitude and $48^\circ,25^\prime$ eastward longitude according to Greenwich meantime (GMT). This city is on the eastern coast of Dezz river and South-west of Zagros chain of mountains.¹

Behind this region (Dezful) is Zagros chain of mountains and before it lies the plains of Khuzestan which extend as far as Persian Gulf. Therefore it has ecological situation between central desert of Kavir cities and coastal regions of Persian Gulf cities. Temperature in the summer time rises more than $50^\circ$ degrees above zero. Since its distance is rather far from Persian Gulf (250 km) the humidity is less. Therefore it has warm and semi-humid climate. (fig.4.)

Ecological condition of this region requires dense architecture context and air current with considerable shade from the sun. In the old texture of this city, you can find a lot of narrow alleys and covered passages- awning. This city was built on a type of Conglomerate with elevation of Dezz river surface and the river in this city has always had clear and cold running water from Zagros chain of mountains. (fig.5.)

¹ - Articles on history and geography of Dezful by Mr. Seyed Mohammad Ali Emam, p. 23

Fig. 4. Geographical Situation of Dezful

Fig. 5. Dense urban context of Dezful with narrow passages
The level of Dezful’s subterranean is low and this gives rise to the formation and expansion of Shavadan. In other cities of Khuzestan Province such as Ahwaz and Khoramshahr, it is impossible to dig Shavadan because in the depth of about two meters, we will reach underground water. The city of Dezful is \( \frac{1}{140} \) meters above the sea level and its elevation from Dezz river is from \( \frac{1}{2} \) to \( \frac{1}{30} \) meters. (fig. 6.)

### Description of Shavadan

Shavadan is an underground space dug under the buildings in the old regions of cities of Dezful and Shushtar. Its depth is from \( \frac{1}{5} \) to \( \frac{1}{12} \) meters which can be reached by many different stair cases. According to the geotechnical specifications of the soil in Dezful area, Shavadan is an underground space in the depth of ground and lacks structural materials. (fig. 7.) In some cases, the walls of Shavadan are covered with gypsum and most of them are not decorated. Most of these Shavadans are interconnected through underground corridors. Therefore a neighborhood-like connection will be formed underground. These twisting labyrinth structures connect many old buildings of the city together through underground tunnels. In the end, through Shavadans neighboring buildings it is connected to Dezz river bed.

The best time to use Shavadan was the hot summer days, in other words besides living in the city, there was another living style in the heart of Shavadan’s underground life. In hot days of Dezful, in summer when the heat is absolutely unbearable and the temperature rises up to \( \frac{50}{2} \) degrees centigrade, the temperature in the underground of shavadan is stable between \( \frac{22}{10} \) to \( \frac{25}{5} \) degrees centigrade. This suitable temperature in underground space of Shavadan was a desirable shelter for the daily life of the citizens. Otherwise people in cities and villages who had no Shavadan facilities had to work and live under the shades of trees and tent in summers. (fig. 8.)

Creating shade, air current and the use of air traps or tents, shading trees can be clearly seen in the sustainable architecture of hot and humid regions of Iran. The effect of above-mentioned elements created narrow shady alleys parallel to current of air.

Although in sustainable architecture of these two cities (Dezful and Shushtar) narrow shady alleys can be seen, Shavadan underground spaces with low subterranean water are the blessings which are given by God to these two cities and this will lead the creative architects of Dezful and Shushtar to build this attractive architecture with identity. Therefore this intensive architectural network with narrow shady alleys and covered corridors made living possible in certain hours in the city; but life in hot hours of the

\[ ^* \] Dr. Ali Akbar Sarami, Sustainable values in the architecture of Iran.
day is only possible in Shavadan. In certain seasons, the roof of the house is an ideal place for sleeping at nights.

Life in Dezful has several aspects. The life goes on continuously from Shavadan underground space to open space of roof tops. Sleeping on the roof and living in Shavadan are sometimes going on habitually and have not forgotten until now.

Depth, dimension and the area of Shavadan are affected by the following factors: A: square meters of the house. B: the quality of the soil and access to the resistible layers. C: Financial capability of the house owner. D: neighbors and family relations.

In some parts of Shavadan there were some tall earthen jars. Inside of them there was water and they were in the direction of air current. The air current after striking the sides of HABANEHs became cold and it made the whole Shavadan more pleasant. The water itself in HABANEH became cool and drinkable. Also these cool spaces were desirable place for keeping perishable food safe when there was no refrigeration system.

We can understand from this, that contrary to cities of Iran on the desert side which had in most places Ice-chest; the old Dezfuly people had always access to cold water. This cold water was either from Dezz river or HABANEHS. Therefore there was no need to build water reservoirs or ice-chests. In earlier times camel-thorn which is a desert shrub put in the direction of air current and by spraying water on them the air became cool!

**History of Shavadan**

We don’t know anything about the time that Shavadan was built, regarding to the history of Dezful and its historical buildings, for example the old bridge which was built in “Sasanid Kingdom” it is probable that Shavadans have been built since then.

The grand mosque of Dezful also has Shavadan. Most of the Shavadans in Dezful were in use until the invention of air conditioning systems. Shavadans were abandoned before Iran-Iraq war in 1980 and they were very much used as shelters during the war when air-strike threatened the life of people in Dezful. After the end of the Iran-Iraq war in 1988 When there was less use for Shavadan, they were abandoned for the second time. Some of these Shavadans were closed and others were used as storage. Some Shavadans which were connected to each other were closed by the Police Department in Dezful in order to prevent the city criminals to use these Shavadans as refuge. After the end of the war the new movement for renovation of war damaged building started in Dezful and also other cities in Iran. During these years many old structures in the city were destroyed and the new structures took their place and in the period of renovation and rebuilding many of these Shavadans were filled with debris.

At present time many of these Shavadans in Dezful are used as storage and most of them remained useless and very few of them are used periodically.

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1. These earthen jars are called “HABANEH” in Dezfuly language.
2. Sasanid Kings were living from 224 AD to 651 AD in Iran
3. This mosque was built in 14th century AD.
Parts of Shavadan

a: stairs

PELA” are connecting parts of Shavadan and in some Shavadans the number of these stairs reaches forty. “PELA” were in the different parts of the building, for example bedrooms, yard, terrace, hall and connected them to shavadans. These stairs-cases were build in different forms. The most common forms were direct staircases winding stair-cases and two way stair-cases. The largeness of the property was the most important reason for these forms. PELAPAM is a wide surface which is used as a foot-rest between some stairs, and reaches the main hall in Shavadans. The big Shavadans could have more than two PELAPAMs, some of these foot-rests have exits which lead to other Underground spaces which were called SHABESTAN. The depth of SHABESTAN is not too much. SHABESTAN’s ceiling was higher than the yard and was used for the time when it was not very warm.(fig. 9.)

![Stairs](image)

Fig. 9. Stairs

b: the main hall

Every shavadan has a main hall. This main hall is used for the center of a activities and the other parts of shavadan were connected to it. Since the soil of Dezful is conglomerate, therefore it was possible to build big halls. These gave builders freedom to build more spaces without building extra structure.(fig. 10.)

![Main hall](image)

Fig. 10. The main hall

c: underground passages

Horizontal narrow canals connect neighboring Shavadans to one another. These tunnels besides having connection between Shavadans, cause the current of air.

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* - “PELA” in dezfuly language means stairs.
^ - “PELAPAM” in dezfuly language means foot-rest

1 - This mianhall is called “SAHN” in Dezfuly language.
1’ - These passages are called “TAL” in the Dezfuly language.
In some cases, these TALS establish the connection between a few neighboring Shavadans. These TALS lead to river side through the nearest Shavadans. The connecting point of canals and river side is a place which is called: “KAT”\(^{11}\). The cool air of the river side flow through these tunnels to Shavadan. In some cases the “TALS” were built in the form of net-like to protect the private properties and only let the cool air pass through. (fig. \(^{11}\).)

\[ \text{Fig.} \, ^{11}. \text{Underground passage} \]

\( d: \text{Vertical passage of air}^{12} \)

Vertical passages were dug in cylindrical form with one meter diameter for light and circulation of air in Shavadans. These canals connected the upper spaces of houses to Shavadan and caused the cool air pass from Shavadan to housing spaces. There were DERIZEHs built for removing the soil to upper surface during digging of Shavadans. In some examples the windows of DERIZEH reach the surrounding alleys and even the roof of the houses. Therefore the air was always circulating. (fig. \(^{12}\).)

\[ \text{Fig.} \, ^{12}. \text{Vertical passage of air} \]

\( e: \text{Small Rooms (KATs)}^{13} \)

There are some small rooms attached to the main hall (SAHN) which are called “KATs”. These are to be considered more private parts in Shavadan. Each Shavadan consists of more “KATS” depending on its largeness. “KATs” in some cases are elevated from the main hall, about \( \frac{30}{40} \) centimeters. (fig. \(^{13}\)).

\(^{11}\) - “KAT”s are resting places at the river side, specially in summer time.
\(^{12}\) - Vertical passage of air is called “DERIZEH” in the Dezhfuly language.
\(^{13}\) - There are two meanings in this Dezhfuly word:
\( a: \) means small rooms which are attached to the main hall.
\( b: \) the connecting point of “TAL” to the river side is which also called “KAT”
Shavadans and the social connections

The underground connections of neighboring Shavadans and the access to the river side for coping with the danger of enemies and keeping the heat away in the hot summer time caused the formation of underground gathering in the old Dezful period. In some Shavadans we could see all the necessary facilities for a comfortable living. Some social activities were performed in these underground spaces and businessman, in the hot summer days transferred their offices to these cool underground for business transactions and negotiations. Daily activities together with respecting people’s privacy same as what was going on over the ground, were being practiced alike in these Shavadans underground. Shavadans were like private residents and “TALs” acted as neighboring borders.

Conclusion:

Conglomerated soils and condition of Shavadans’s position in the depth of earth has helped them remain until the present time. The condition of activities in Shavadans and air circulation such as its harmony with hot and humid climate of the region contributed to form a sustainable architecture. This sustainable architecture has been forgotten in the modern time of technology and air conditioning system. While the world is facing crises of energy and world architecture is face with energy consumption problem and a group of architects under the name of echo-tech, are benefiting from this god-given natural opportunity to save energy. We can see that an example of sustainable architecture in Iran is being threatened; ^1^ While a lot of Shavadans, are abandoned, and are useless. Today all the houses in the city are equipped with electrical cooling and heating systems with high consumption too. Attentions are now being focused on rehabilitation of the existing Shavadans so that they can be used as heating and cooling storage both in summer and winter time.

Reuse of Shavadan:

I have advised to one of my graduated student in school of architecture in Azad University south campus of Tehran to study and design a museum in Dezful without heating-cooling installation room and use of natural air conditioning system of Shavadan. This proposal aims to introduce a developing pattern for saving energy and access to an ecological design. In this design we aim to reuse Shavadan and create air current, suitable air at 22 to 25 degrees. This cool air moves from lowest part of Shavadan to higher levels and desired temperature will them be achieved this way. By designing a tea house or restaurant in Shavadan, we can give a new face to these old underground spaces. Rehabilitation of this points will be

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^1^ - Besides Shavadan, “SARBRTAGH” is also another example of sustainable architecture in Dezful. SARBETAGHS were spaces which were like cellars which went directly to the depth of the earth to the location where the water was flowing and sometimes it went down as far as hundred stairs. This space provided the required water from the canals called “GHOMESH”. The GHOMESH brought the water from the upper region of Dez river to the city and people used the river water through these underground spaces. SARBETAGHS were closed after city water network circulation became active.
adaptable to contemporary architecture and will also introduce new view to the present architecture of the city of Dezful. 15

References:


15 - The word “sustainable development” has been used frequently after oil crisis in 1973. The climax of this discussion was held in 1992 in Rio de Janeiro under the name of “The earth Conference” which was later called the “Rio Forum”. The conference issued a resolution to introduce strategies to the countries of the world for a sustainable development process. The countries of the world were forced to follow the instruction. The most important description of sustainable development in Rio Forum was as follows. A development which meets the present requirement of human beings without endangering the needs of future generations. It is also emphasized that care must be taken to safe guard environment and future generations. To pay attention to culture, native traits and past experiences, also to benefit from recycling energies and to avoid the use of unrecycling energies and the principles of sustainable development