International Association
for Hydro-environment Engineering and Research (IAHR)

Fountain

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HAKIM SABZEVARI UNIVERSITY

SABZEVAR 1

Providers:

Samaneh Motamed
Amirmohammad Khalvati
Delaram Aliakbari
Ali Bashtani
Maryam Akbari
Naser Nikmaram

LIST

Qanat

Introduction

Qanat as one of the most wonderful products of teamwork in the history of mankind. A qanat is a gently sloping underground channel to transport water from an aquifer or water well to surface for irrigation and drinking. This is an old system of water supply from a deep well with a series of vertical access shafts. The qanats still create a reliable supply of water for human settlements and irrigation in hot, arid, and semi-arid climates. The qanat technology was developed in ancient Iran by the Persian people sometime in the early 1st millennium BC, and spread from there slowly westward and eastward. Qanat may be several kilometers long up to the surface and its water outlet is called qanat head.

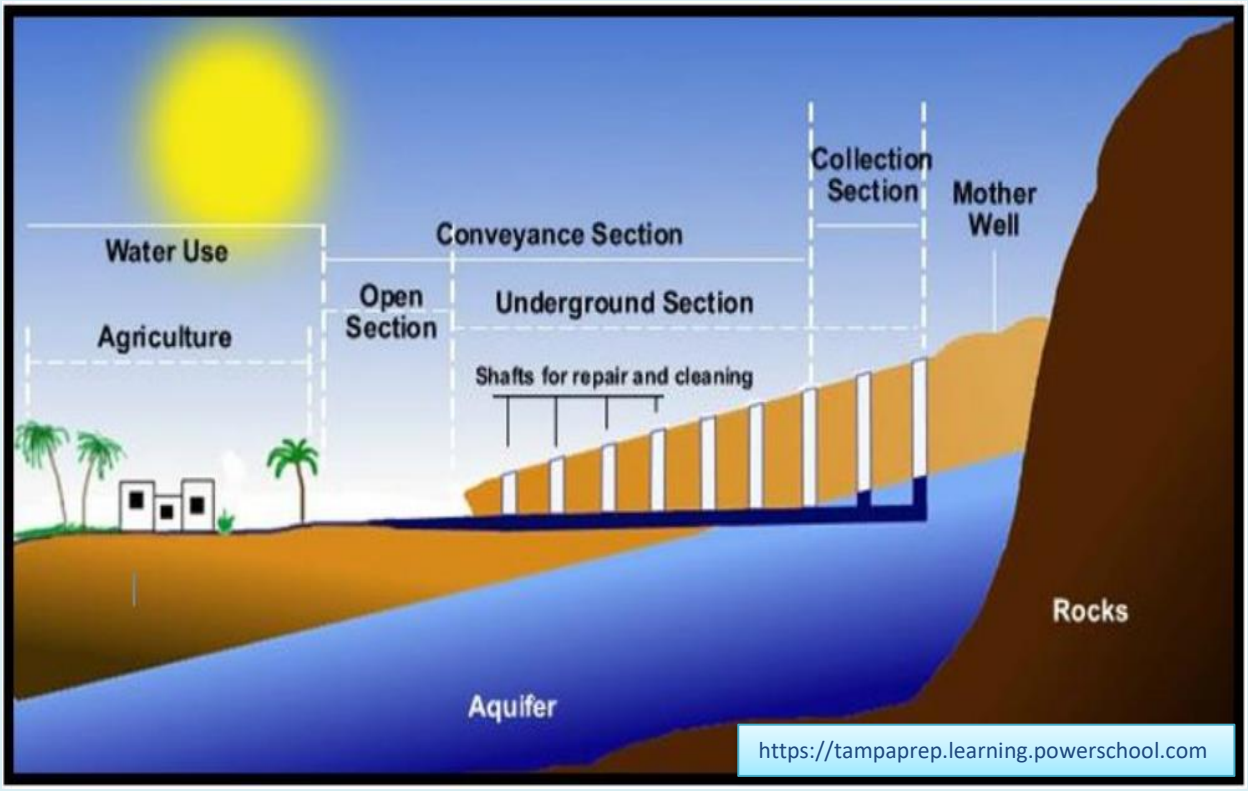

Fig.1. Cross-section of a qanat.

History

Several researchers attribute digging qanat to Achaemenid period. This is so because there are few inscriptions from pre-Achaemenid period and since there is no written evidence of the history prior to Achaemenians, this period is falsely called Prehistory.

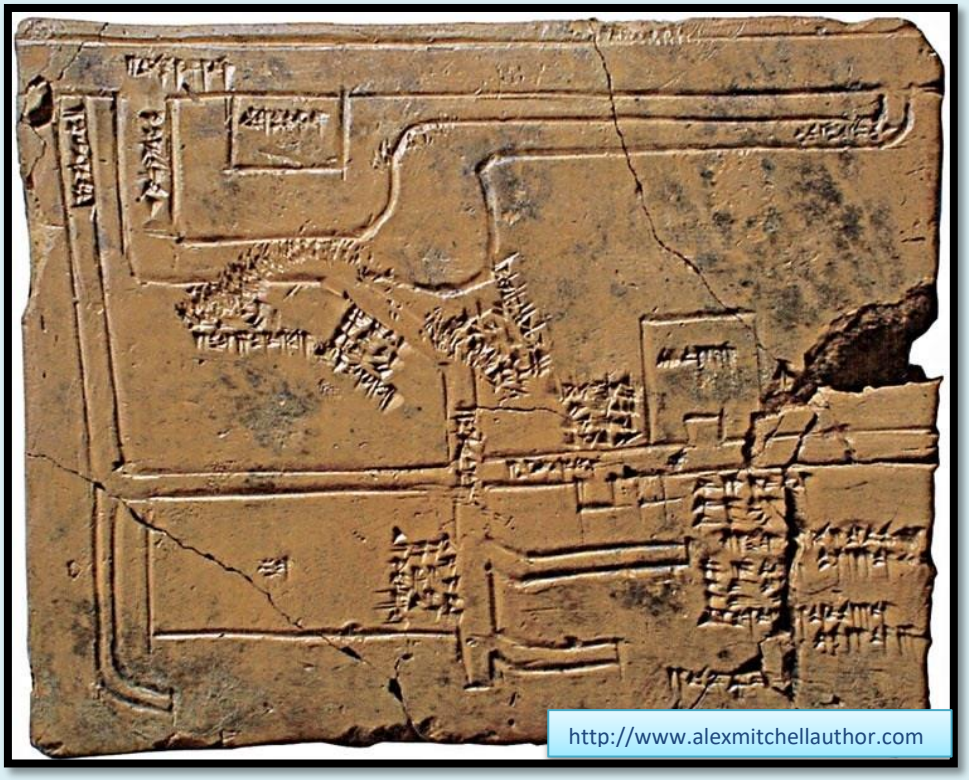

Fig.2. Clay tablet showing a map of qanat in Achaemenid period

Varied applications of the qanat in Iran and in the world

Supplying drinking water for human beings, livestock and farming which human survival depended on it are one of the most useful applications of qanat. In Sabzevar and even in the same region, explorers and geographers have mentioned many villages which there is no trace of them todays. These villages have been abandoned mainly due to their relying on qanat water which later dried up. In some cases, earthquake and contagious diseases such as plague led to evacuate and abandon the villages. Desalination of land by revitalizing qanat: Not only do qanats result in subterranean water extraction, but such a system also desalinates saline land regions.

- Supplying fresh water to tropical islands such as Persian Gulf islands.
- Artificially recharging subterranean water reserving layers through harnessing qanat
- Reviving deserts by qanat
- Environmental balance by qanat
- Creation of the role of helpers and traditional cooperatives by qanat
- Qanat system as a factor involved in prevention of urban flooding
- Qanats as a contributing factor in cadastral value of farms
- Qanats are considered precise regulators in groundwater depletion as well as economical applications for human beings.

Sources of this sort, preserving natural hydrogeological conditions of aquifers represent an overflow regulator during wet seasons or drained areas and regulator on water outlet and as a puppet valve when there is either a dry or a wet season.

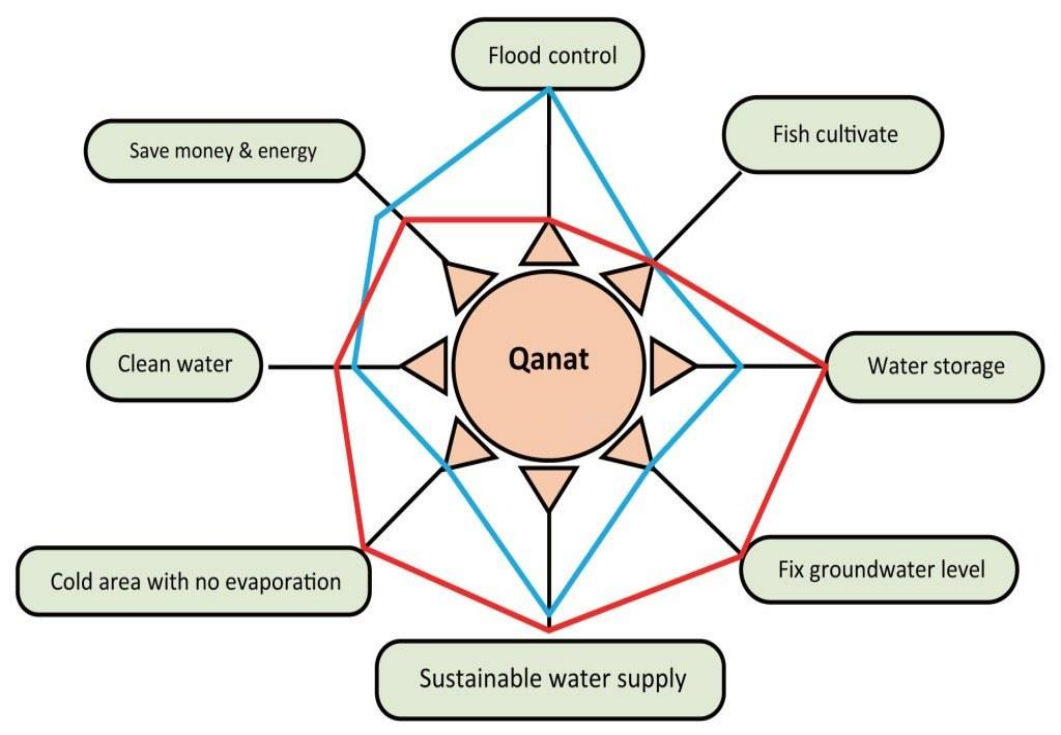

Fig.3.The benefits of qanat

How to identify groundwater ?

A. Groundwater identification through understanding the area
B. Groundwater identification with respect to vegetation and animal existence or flying insects
C. Groundwater identification based on ground shape and color
D. Groundwater identification by employing new methods

What are qanats mainly composed of ?

Kariz is composed of an open mouth (Haranj) and an underground straight slope channel. A series of vertical wells eventually link this underground channel to the surface of the ground. The wells – also called bars during excavation – would carry out the ventilation of the underground channel as well as transferring excavation material up to the surface. They are connecting routes used for dredging, repairing and visiting the interior parts of Kariz. The beginning of Kariz is the mouth of it which is also called “Mazhar”. Mazhar is where water visibly flows out of Kariz and can be used for irrigation and other uses.

Fig.4. Stream from the underground kariz emerging above ground

The end of Kariz is called “Pishkar” which hosts at its last section of parent well of Kariz. Iranian parent wells are normally reported to be 3 to 400 meters deep. Parts of Kariz that doesn't yield water by excavation are called “Khoshke Kar” and the water-loaded part (the last section) is named “Abdeh”. Furthermore, the bed of Qanat or the corridor of Qanat is called “Kooreh” which was stone-furnished long time ago and then as time passed, they used pottery, then brick pottery and cement for it recently. Each qanat is about 100 to 200 meters space around which no other qanat can be excavated within qanat space border. There are other qanats built in two levels, mostly observed in Yazd region such as Mehriz, Zarch, Ashkzar and also in Kerman and Khorasan.

How to dig a qanat ?

After the pitman (qanat expert) guessed that digging an area would lead to an aquifer, he would then begin digging wells known as boreholes in order to evaluate the signs. These wells determine whether the guess has been correct. Constructing the well upon of qanat confirmation that the well is located on top of qanat and then it will be called the parent well.

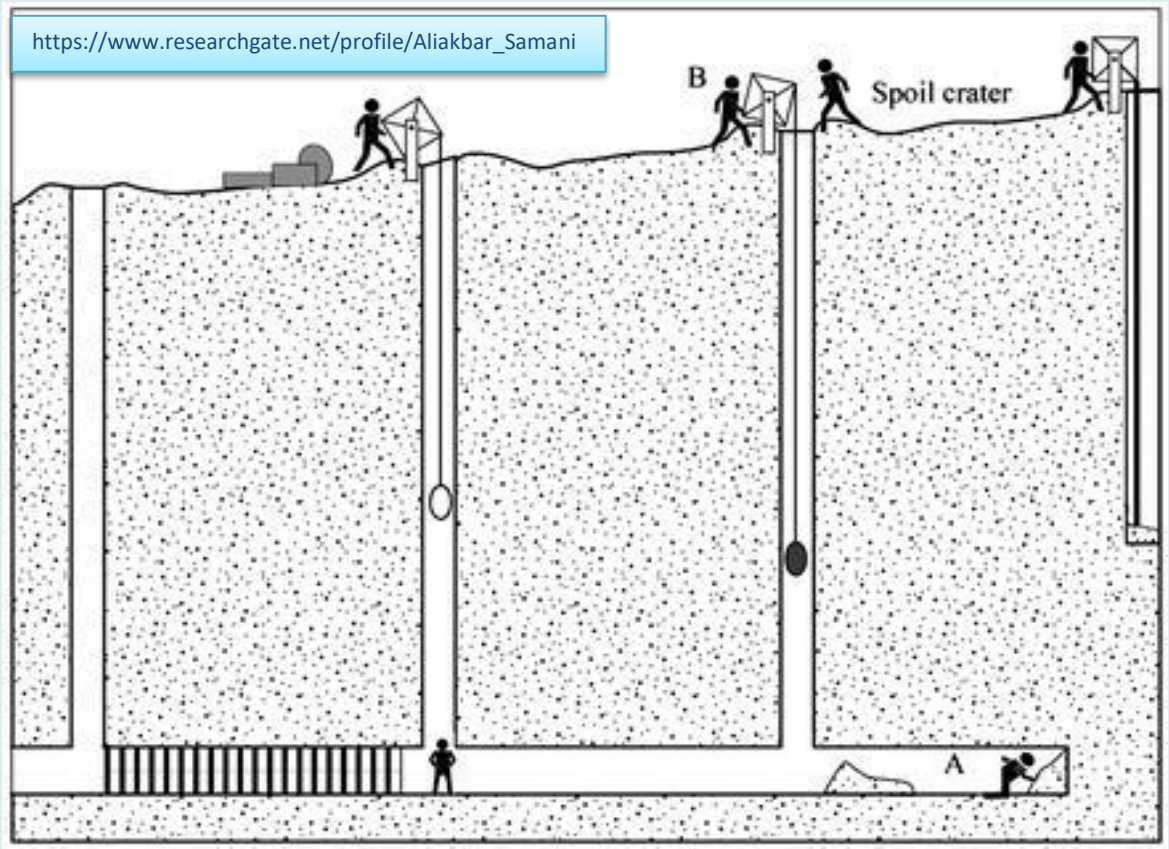

Fig.5. Schematic diagram showing the construction of the underground section of a qanat

Recharging qanats

1. Examining the effects of earth dams on qanats' water discharge increase

Construction of plans that may help aquifer reserve water will be an effective action in order to preserve the qanats existing in different regions and to increase their water discharge. One of the ways is artificially recharging them. In several countries, this is actually considered a technology employed for compensating subterranean water, improving the quality of drinking water, agriculture and etc. One of the most important measures that could be taken is to construct earth dams over on the rivers which can have increased qanats' water discharge in various regions by keeping much flowing water after every rain.

2. Using underground dams in order to recharge aquifers and regulate qanat' water

One proper solution in order to recharge subterranean aquifers is to increase water discharge and to control qanats water by using underground dams which can be employed in two ways: They could be constructed in a proper place where they would cut the flow of underground water, keep it and preserve it. Or, they could be used as barriers inside qanats in order to temporarily hold water and delay the flow so that it can be used when it is deemed necessary.

3. Artificial recharging of aquifers using sandy reservoir dams

In case climatic and geographical conditions make it impossible to use existing water resources optimally, one proper solution is to use sandy reservoir dams. These dams are commonly constructed at the width of valleys and in some cases extend down to bedrock. The reservoir upstream is carried by sand, gravel or rocks on flooding streams and makes up an artificial aquifer upon being filled up by water. Then, it will be recharged by surface and interflow streams. This kind of artificial aquifer is recharged by surface and interflow streams every year. Such an artificial aquifer recharged every year by rainfalls and interflow streams and reserves water for dry seasons.

The advantages of sandy reservoir dams are optimal exploitation of existing sources of water, prevention of surface and interflow water wastage, preservation of water for a proper season to be used, reduction in the amount of evaporation and improvement in health conditions in the region.

A number of qanats in Iran and Sabzevar

There are 7000 qanats in Khorasan Razavi province. Among them, 1012 strings are located in Sabzevar. There are 1012 strings of qanats as long as 1155 km with an extraction discharge of 4500 liters per second in this city. Currently, the deepest qanat in Iran is Ghasabeh in Gonabad with a 340-meter-deep parent well and the longest qanat belongs to Yazd region with a length of 100 km. Gonabad Ghasabeh qanat dates back to 2500 years ago and irrigates over 2000 hectares of farmland in a traditional way.

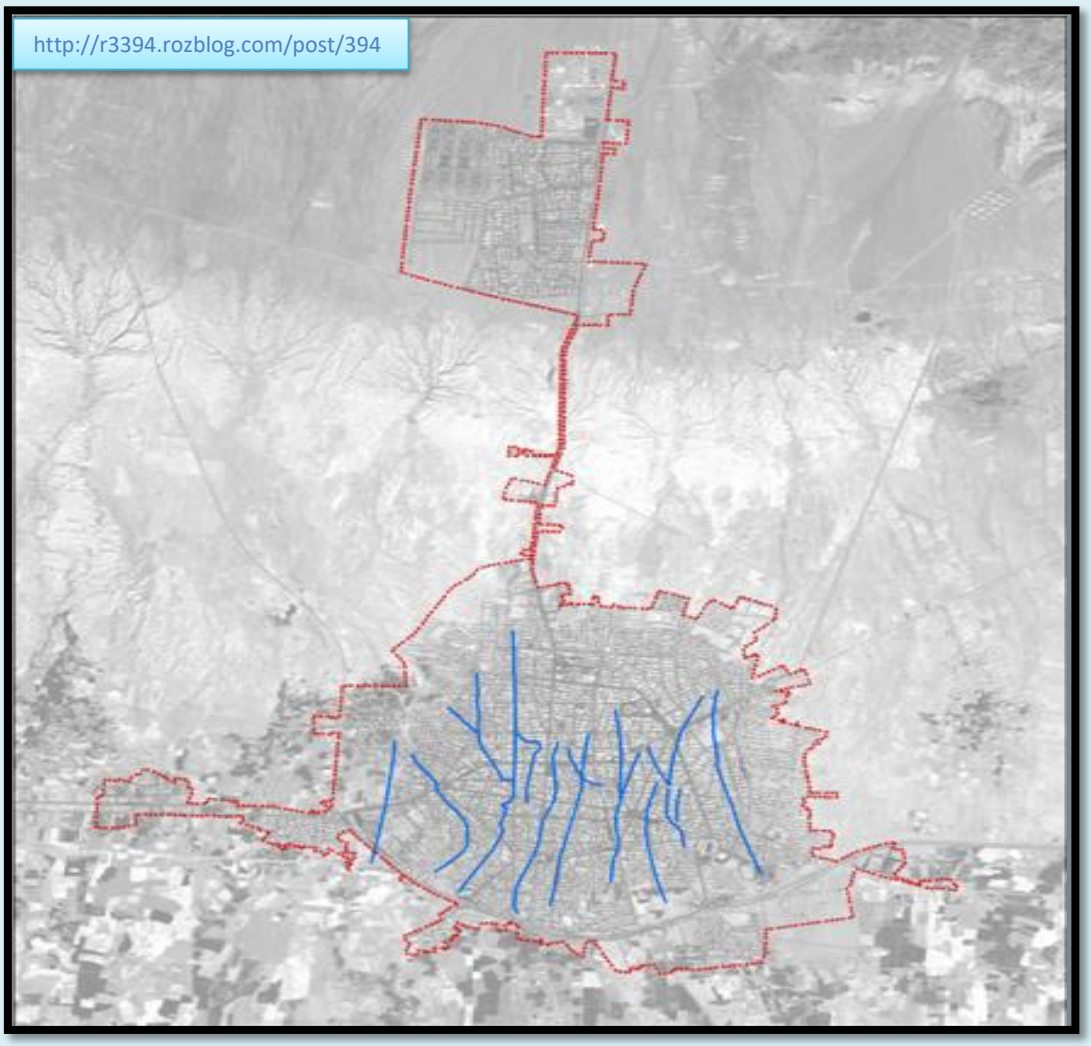

Fig.6. Satellite image of Sabzevar's qanats

Conclusion

If we assume a rational definition for development and exploitation increase for sources of water, it is inevitably necessary to assign an optimum function to native structures. This process will require attention to recognition of qanat technique. Other than theoretical definitions, examination of hot and dry climate which widely extends to the eastern half of Iranian plateau suggests that the quantitative and qualitative survival of the societies living in such regions – especially villages as the living cells of regional and national development system – is still to a large extent dependent on efficiency of qanat. Now, considering the three main points: 1-difficult climatic conditions, 2-growing need of water sources, and 3-realization of stable development, even if it is not feasible to revitalize every aspect of qanats, it can be assumed that such a technique as well as relying only on modern methods is highly uncertain. Therefore, by contemplating the contribution of future knowledge and future options, preservation of this method and adapting new methods may not be illogical.

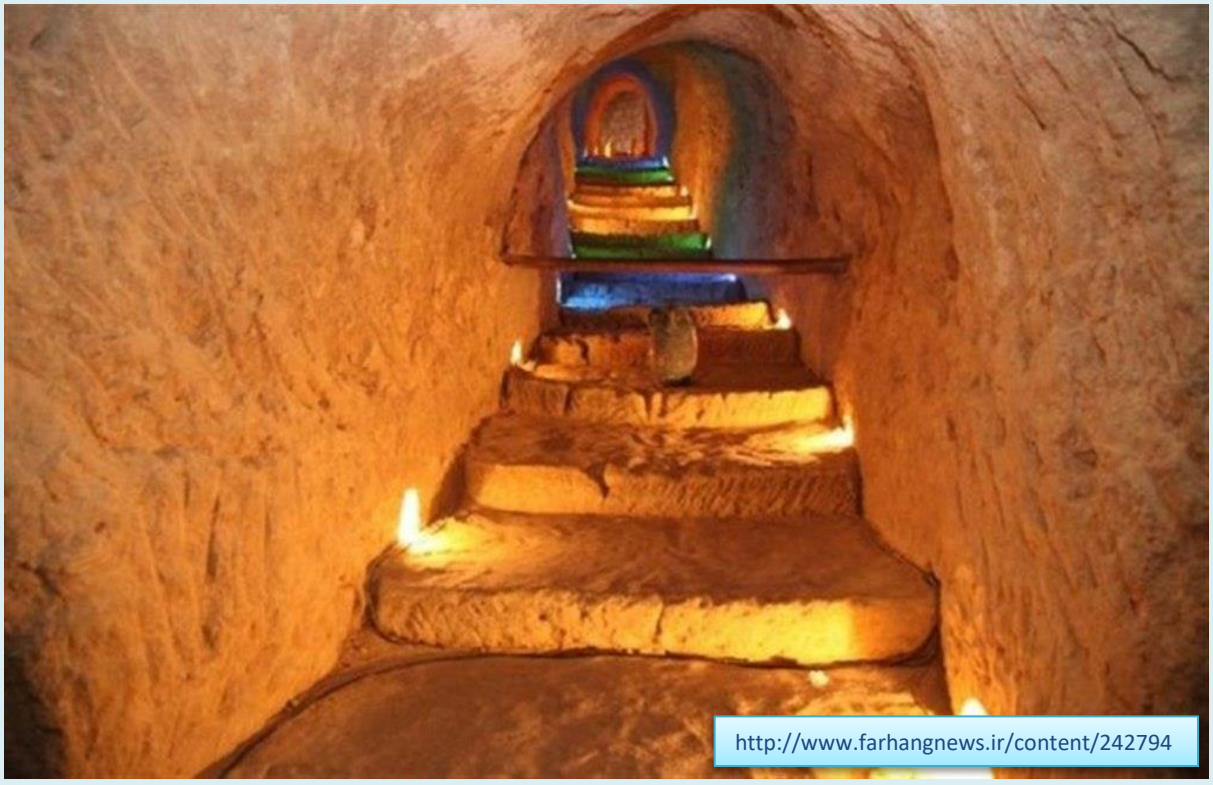

Fig.7.Another design of qanat

According to scientific research evidence, it should be admitted that qanat will still remain a reliable and stable option for utilization of subterranean aquifers. According to research, the following recommendations are presented for management and improvement of qanats.

- Allocation of an organizational section in municipality network structure entitled "Sabzevar Urban qanat Organization"
- Discovery of qanat parent well – by discovering parent wells of qanats mostly in northern parts of the city, the water can be used for revitalization of urban green space. In return, treated waste water from city refinery can be given to qanat owners to use for farming.
- Completion of Urban Sewage Project, because if such a project is finalized, water inlet in qanats will reduce and less water will consequently be concentrated at the lower layers of the ground.
- Employing skilled pitmen for dredging those qanat which have not yet suffered such a problem can prevent subsidence in other parts of the city.
- Using modern technologies such as video-robots which carry cameras into qanat routes can help identify existing problems including downfall, congestion and etc. and dredge such routes before any accident occurs.

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Written by: Amir-Mohammad Khalvati

Maryam Akbari

Delaram Aliakbari

Naser Nikmaram

Winter in Hakim Sabzevari University

Historical ice-boxes of Sabzevar

The southern ice-boxes of Sabzevar are the pyramids of the city because they are triple and have a lever shape.

Fig.1. ice-boxes of Sabzevar

There were more than 23 big and small ice-boxes in this city, of that number, 5-ice-boxes have existed in the city's southeast, 16-ice-boxes in the southwest and 2-ice-boxes in the North West, Kushk district, which were especially for the people of the same place. Now, there are 4-ice-boxes in the south of the city next to the belt which have been registered as cultural heritage. The northern inhabitants have used the northern ice-boxes and the southern inhabitantns from the sourthern ice-boxes. The northern ice-boxes have been destroyed many years ago and there is no trace of them. This type of structure is the most resistant to earthquake which smart architects have chosen it.

The ice-boxes are a kind of building which in the ancient architecture of iran were made for production and maintenance of ice. Usually each ice-boxes had a pool, a long wall (fence or shading walls), and a domical repository. The fence was made in away so that the whole day its shadow would fallon the pool, and it prevented the pool from warming up. People broke the ice-box, and stored them in the treasury and used over time in the heat season. The preparation of ice was the duty of the ruler or the municipality (baladie) and ice-boxes are made for this purpose.

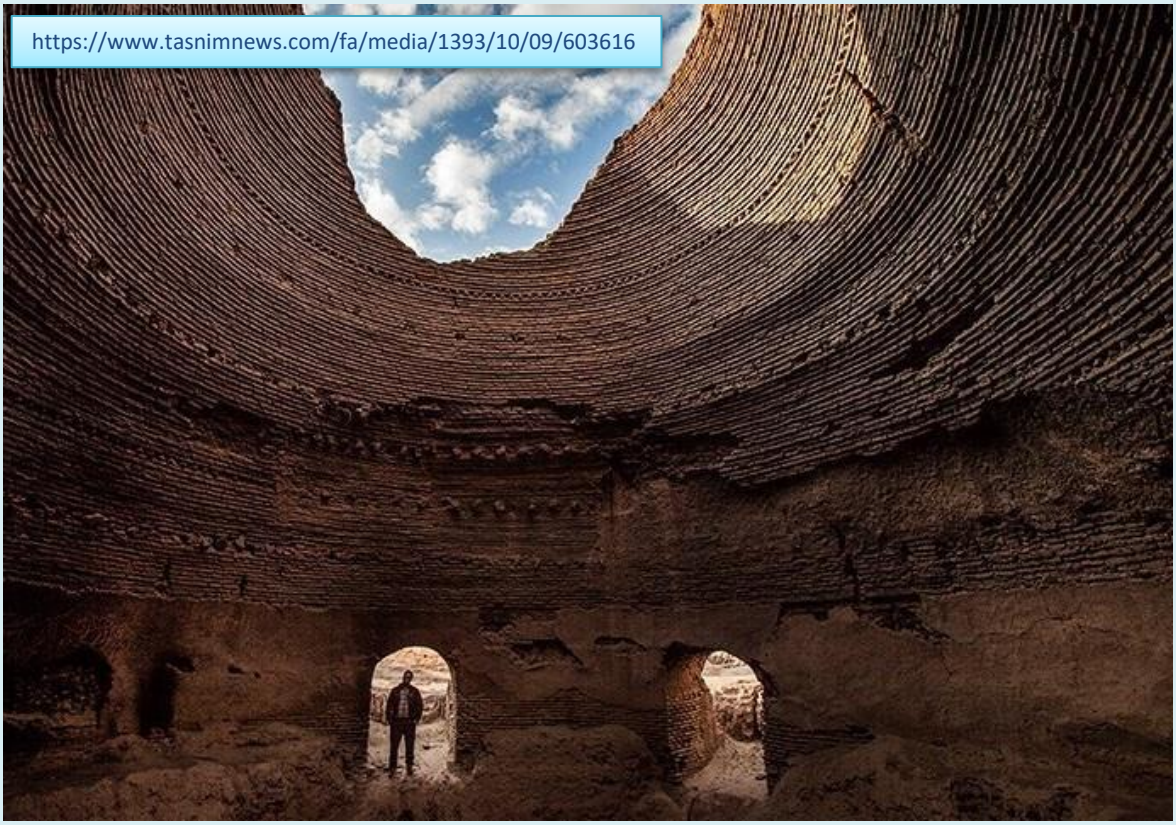

Fig. 2. Interior view of ice-box

Before making the ice-boxes, during the winter, some people on the orders of the ruler went to the near mountains like mountains of Sheshtamad and tabas. They felt snow on the grooves, holes and existing pits and hit them. Then, in late winter or early spring, they covered them with straw and then soil so, they could use this snow and stored ice in summer and its high heat. Of course, after a while, they built ice-boxes near the town and saved the ice-required in the summer in these ice-boxes. The water of ice-boxes were provided with adjacent aqueducts, and maintained in shallow basins and a deep channel. Shaded walls around the holes were built.

From the sunrise to the sunset, the shadow of these walls fell on the water and it prevented the melting of ice during the day. Mir ice or workers of ice-boxes poured water on the ice over night to make it thicker. Then, they placed it in an ice channel, and after thickening, by pouring it into the ice pit had drainage well to remove the moisture of the pit.

When the ice-box was filled with ice, it was covered with straw and soil and then its door was closed with mud to be used in the summer. This was done by the same workers of the municipality who were a few. There were two rooms around the ice-box: on for selling ice and another for security. The room of the workers with house cathedra was there, too.

Fig. 3. Ice boxes of the villages of Sabzevar

Our fundamental problem in restoring historical monuments is the sever lack of experts anal knowledgeable people in these matters. However, there are many educated and experienced students, but few have the ability to do so.

Refrence : Architectural and architects of Sabzevar book.

Written by: Ali Bashtani