

Typology Classification of Water Storages in East of Isfahan (From Ezhie to Varzaneh)

Samira Tafazzol¹, Ahmad Salehi Kakhki² (PhD), Mahsa Foroughi³ (M. Arch) (Corresponding author), Rouhollah Shakouri⁴

¹ Lecturer, Department of Architecture, Non-profit Sepehr-Isfahan Institute of Higher Education, Isfahan, Iran

² Associated Professor, Department for Conservation of Historic-Cultural Objects, Faculty of Conservation, Art University of Isfahan, Isfahan, Iran

³ Department of Architecture, School of Architecture and Build Environment, Tehran Art University, Tehran, Iran

⁴ Department of Architecture, Faculty of Architecture and Urbanism, Art University of Isfahan, Isfahan, Iran

Abstract: According to the climate of Iran, water storages, which were the old system of water supply, were inseparable from the buildings of the arid land. In this paper, these water storages in the east of Isfahan, Ghourtan to Varzaneh area, which are located at the end of the Zayandehrood River, have been studied. Based on the importance of these ancient buildings and the lack of research which done in this field, the need for research in this area is recommended. In this paper, in addition to determining the location of water storages of the area which include five regions, it's tried to prepare architectural documents, including plans, facades, sections and describe aspects of the architectural perspective and examines various aspects of the water storages in terms of physical characteristics, such as form: how access to water, how to ventilate, decorations and etc. Finally, based on the review of five water storages, it's identified that these were belong to Ghajar period and divided to two types. The main difference of these types is in their structures; as the first roof is multi-domed with low rise and the second has a high rise dome. Of the buildings, Pechviz, Belan, Oshkohran and Haj Muhammad Ja'far water storages are classified in first type and Haj Mirza water storage is classified into second type. The research method was descriptive-analytical-historical and collecting data was on the basis of field research and library studies.

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Introduction

Water storages in East of Isfahan (from Ezhie to Varzaneh)

The rich architecture of Isfahan and its villages have been studied by numbers of researchers. However, it has more hidden secrets which are important to track them and introduce them to the architecture society in Iran.

In fact, there are not notable studies about water storages of Ghourtan to Varzaneh area until now and just a little information is available about some of water storages plans in Isfahan Cultural Heritage. Due to the lack of written information in this field, this study is based on field research and analysis which have been done before. The overall aim of this article is to introduce a range of different types of water storage, planning and spatial structure. In this paper the situation of water storages and evidence of architectural plans, facades, sections and perspective are provided. They are then classified based on the analysis of these documents.

Research Method:

In addition to the field research, the information, analysis and implementation has also been extracted from library references.

Literature Review

In general, some researches like the book of Public buildings were written for bridge, water storage, dam and bathroom (Mollazadeh and Haghdoost, 1993). However, there are some books which include some detail such as: "A Note about Desert Architecture: which water storages of Yazd were investigated (Memarian, 1993). This paper is a case study of water storages of Iran. At the end of Zayanderoud River was investigated which has not yet been studied before.

Introduction of the study area

Isfahan province has 9 states. The study area of this research is Bonroud which located in Isfahan province.

Based on political division, Varzaneh city is center of Bonroud region which involve two villages named Eastern Rodasht and Gavkhoni. The center of Eastern Rodasht is Kafran-Farfan Village with a population of 4815 and the center of Gavkhoni is Ghourtan village with a population of 1492 (Hosseini Abri, 2000).

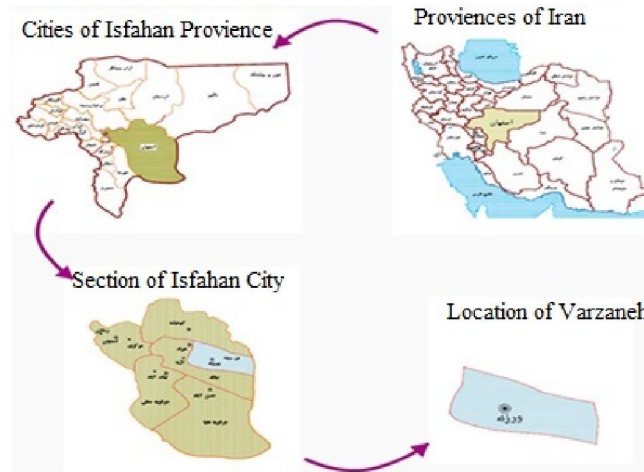


Figure 1 - Location of study area in Iran

Varzaneh city located in hundred kilometers of east of the Isfahan city, at the end of the Govkhoni- Isfahan path. It is one of the top large cities of this province.

Water resources along with low rainfall and high evaporation caused serious problem for the city's supply of drinking water. In addition, the aqueduct water was salty and not potable in this region. Because of these problems, the most important service to supply water was water storages. When it rains, water storages had been filled and used over the year. Based on people's demand, they were

distributed equally in urban and rural areas with a simple access.

Varzaneh City

The longitude of this city is 32/25 min and the latitude is 52/39 min. Average elevation of the city is 1477 meters above sea level. Varzaneh city had circle shape with moat around it which has been filled with soil and used as an avenue after Iran revolution in 1979. Zayandehrood River, crossing north of the city, divided it into two parts, north and south. Northern part of the city has been formed after 1979 and named Imam Jafar Sadeqh town (Comprehensive Plan of Varzaneh).

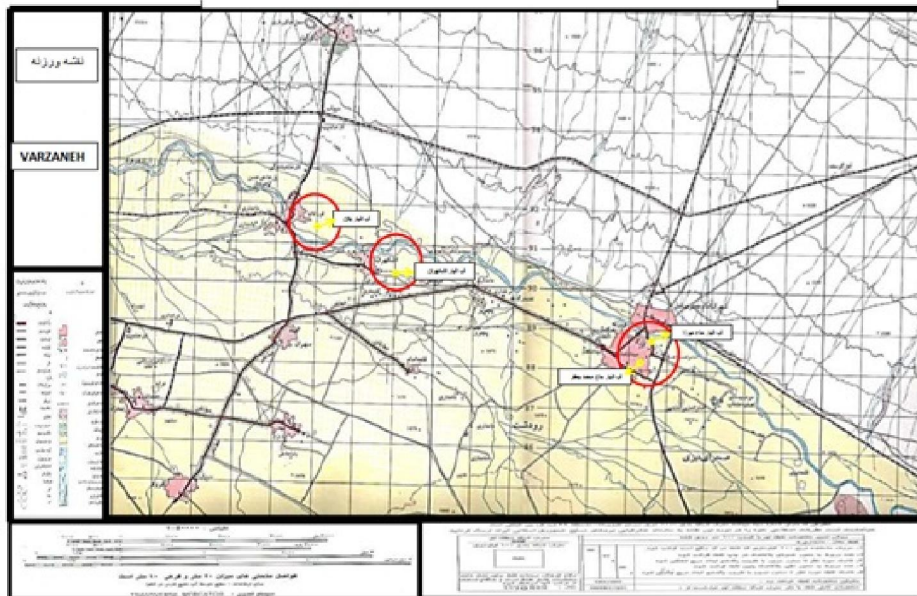


Figure 2 - Map of water storage location in the area of Ghourtan to Varzaneh. (Source: The authors)

Haj Muhammad Jafar water storage (Figure 3)

The water storage located in city of Isfahan, between Bonroud town and West Varzaneh. Longitude of this village is (40-38-52) and its latitude is (11 - 25-32). Based on the rest of works in this town, this water storage probably is constructed in Qajar period.

Appellation: Because it is made by a man named Haj Muhammad Ja'far, it is known with the same name.



Figure 3 - Haji Muhammad Ja'far water storage (Photo by Samira Tafazzol)

The water storage capacity is 450 cubic meters and an area of approximately 260 square meters. It includes storage space, entering the water storage tank and the windward in the north. Both of its front entrances have stone bench which were used for sitting and relaxing. As it is observed (Figure 4), there is a room in the northwestern part which is said to have been water retention.

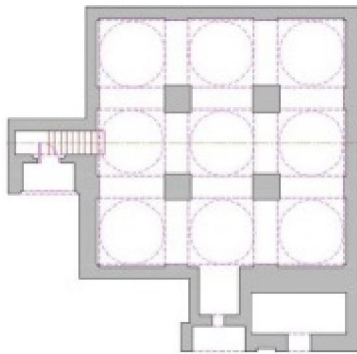


Figure 4 - Plan of Haji Muhammad Ja'far Water storage (Source: authors)

The total water storage is in the form of a cube with two small square protrusions (Figure 5). It did not have Pashir (a secondary place of taking water, replaced main tank to prevent tank's water pollution) to use water, but a stair located in the east.

The water reservoir has two entrances (Figure 6). The main entrance is on the east side

(Figure 7). It has ten steps (height 26.5 cm) into space tank.

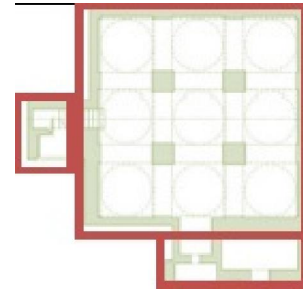


Figure 5 – The overall shape of Haji Muhammad Ja'far water storage (Source: authors)

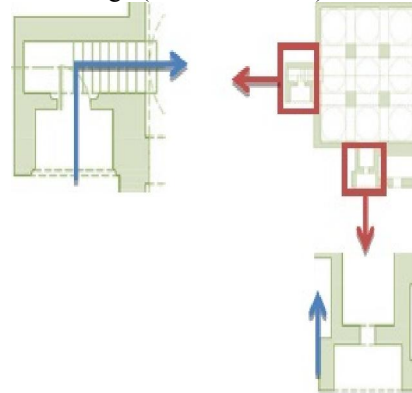


Figure 6 –Ways of access to the tank of water storage (Source: authors)



Figure 7 - The east side of Haji Muhammad Ja'far water storage (Photo by Samira Tafazzol)

Another door is located on the north side, and above it there is a wind catcher. It is notable that this door had about a meter high and no stairs to enter the tank. Maybe when the water level is too high this part is used as ventilation. This water storage has two doors, perhaps because of the large number of users in Varzaneh. However, this conjecture can be reliable if they were similar in terms of shape.

There are two water entrances in south which will be closed after filling tanks.

Ventilation is carried on through a wind catcher which can be seen in Figure 3. The wind

catcher is located in the northern part of the main water storage and above a small access hatch. Based on the water storage capacity of the reservoir, there were some problems for ventilation which were eliminated by building larger windward. There is a worthy brick decoration in faced of wind catcher. This also can be seen above east entrance.

Haj Mirza water storage

The water storage located in city of Isfahan, Bonroud town, West Varzaneh. It is inside of town. Based on the rest of works in this town, this water storage probably constructed at Qajar period (Fig. 8).

Appellation:

Because it is made by a person named Mirza, is known by the same name. The water storage area is about 250 square meters and has a capacity of 370 cubic meters. The building has entrance to the reservoir tank. The water storage has eight stairs which each of them is 30 cm. Two water tanks had been built in the north entrance and will be closed after filling of this section. The overall shape is a cube with a domed roof (Figure 10).

Location of the stairways:

As can be seen in Figure 11, stairs of the building has been rotated 90 degrees, perhaps because the reservoir formation. In addition, axis of stair is not in the line with tank and located in a corner.



Figure 8 – Haj Mirza water storage (Photo by Samira Tafazzol)

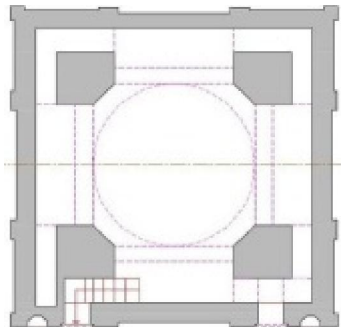


Figure 9 - Plan of Haj Mirza water storage (Source: authors)

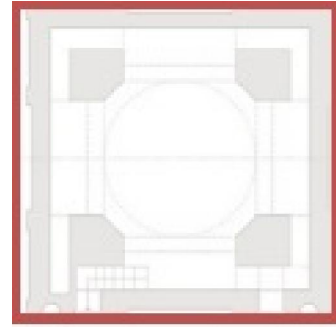


Figure 10 - General form of Haj Mirza water storage (Source: authors)

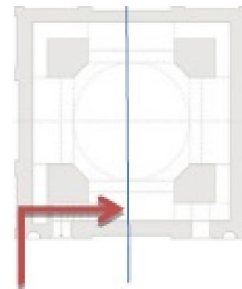


Figure 11 - Stairway of Haj Mirza water storage (Source: authors)

The way to access water:

This water storage does not have Pashir to use water, but a stair located in the southwest was used to get water.

Water storage ventilation:

This water storage does not have wind catcher for ventilation and cooling water is done with four windows in four sides of the tank. (Figure 12)

As seen in Figure 13, the structure of the thick columns are a feature of the building, this is because of dome position to transfer its load to the ground.



Figure 12 - stairways and gate of Haj Mirza water storage (Photo by Samira Tafazzol)



Figure 13 – Interior space of Haj Mirza water storage
(Photo by Samira Tafazzol)

Roof:

There is a big dome over the water storage building which has both structural and climatic role. Because of its shading, it can be caused coolness through air circulation in its atmosphere.

Position in the context:

It is similar in appearance to the four walls can see why it is important to consider all four sides, and an emphasis on texture is located in the middle of the water reservoir.

Belan water storage:

The water storage located in longitude 26 - 32/921, and its latitude is 33-52/334. Its height from sea level to 1417.80 m. probably old water reservoir in the rest of the city dates back to the Qajar period. (Figure 14 and 15)



Figure 14 - View of Belan water storage on the hill
(Photo by Samira Tafazzol)

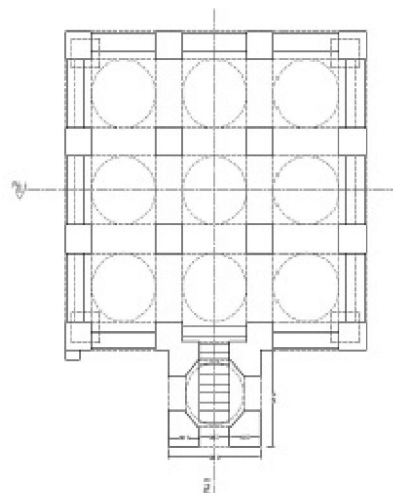


Figure 15 - Plan of Belan Water storage (Source: authors)

Appellation:

Because it is near the village of Belan, is well-known for this name.

Its position in the context:

Belan water storage has large-scale area and had public role to supply water for two villages of Ghurtan and Belan. This water storage is located in a low distance from the village of Belan and Ghurtan.

Physical specifications:

The water storage area is about 420 square meters and has a capacity of 290 cubic meters. The building has an outdoor pool and four wind catchers side in the entrance to the reservoir.

The water storage has eight stairs which each of them is 30 cm. There are two water tanks on the north side entrance of this area which had been closed after filling.

Reservoir consists of a square room covered with skullcap and long zigzag arch that rests on four pillars that are square shape. External parts of water storage and entrance to the pashir with a zigzag arches in the water reservoir is located on the south side stair to access the roof. The general shape is formed from two cubes (Inputs, water storage). (Figure 17)

The axis of tank is in line with the axis of stair (Figure 18), and the Stair way is located exactly in the middle of the south side. The specific shape of stairs that formed a cubic space and attached to the tank is a special feature of this monument.



Figure 16 - View of roof and wind catcher of Belan water storage (Photo by Samira Tafazzol)

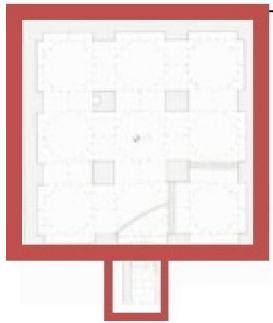


Figure 17 - General form of Belan water storage (Source: authors)

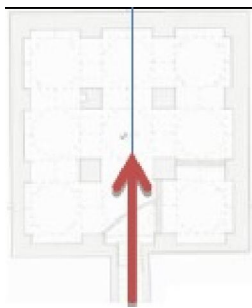


Figure 18 - Analysis of stairways for Belan water storage (Source: authors)

Water storage ventilation:

Ceiling height is 4.20 meters with two deflectors located on the south side of the funnel with four-way path. (Position of wind catchers are shown in the shape). (Figure 16) South wind catchers were destroyed when digger the earth to get treasures and it has been damaged. Today, it has been refurbished which added decorations that were not present in the original.

There are windows on the north side as like as in the south side and possibly because of present wind catcher around it, there was not any other wind catcher on the roof. So, it's being difficult to recognize true ventilation in the past. The wind

catcher has been a four sided, blade coated with plaster which was thin and light and there was requirement that each season has led to indoor air fresh and cool air through vents to the outside of water storage, in the Western and Eastern fronts, under arches openings for airflow and embedding. (Location of ventilation openings is shown in Figure 20.) Due to available ventilation openings on the roof, air flow come across down and move on the water and finally, back through the openings to exit. This air flow helps to maintain healthy water in the water storage.



Figure 19 – The position of wind catchers in Belan water storage (Source: authors)



Figure 20 – The position of aperture in Belan water storage (Source: authors)

The way to access the water:

This water storage does not have Pashir and used stairs in the south side of the water storage. According to this approach and in terms of access to health care for the water storage area which is not desirable and it can be seen blade walls near the entrance of water storage; this seems that these blades prevent the water to reach the stairs, and so it act like a Pashir.

The conservation of water storage building:

The remarkable point of this water storage is type of protection. It's rumored that there is a treasure in the walls of the village, to deliver costs over time by its suppliers. So authorities say that people of the region, making holes in the wall to catch dreamed treasures. Because of that, water

storage destroyed. Special decorative in brickwork and corners of water storage, make it one of the water storage in the region.



Figure 21 – One of the wind catchers of Belan water storage (Photo by Samira Tafazzol)

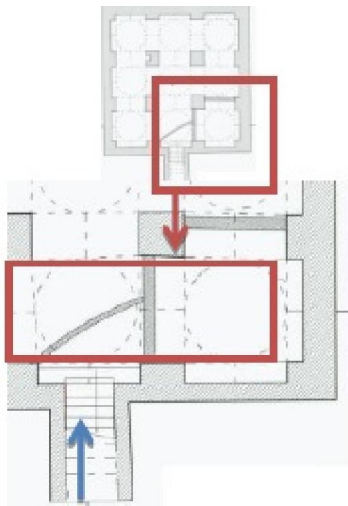


Figure 22 - Location stairs (Source: authors)

Oshkohran Village

Oshkohran village has a warm and dry climate (cold winters and hot, dry summers). In this village, longitude is 52 degrees 38 minutes and latitude is 32 ° and 25/5 minutes and its elevation is 1475 meters above sea level. It's located in ninety kilometers of the East of Isfahan and near Isfahan-Varzaneh course.

Oshkohran water storage:

This water storage is located in Isfahan province - Isfahan city - Bonrood region and West of the Varzaneh - at longitude 25/26 -32 and latitude of 38/34-52. This building is built in Qajar period and

due to other buildings in this village; its name is same Oshkohran. Its area is approximately 330 square meters with a scale length of 19/66 mm, width 19/66 mm and height 7/60 meters. (Figure 23 and 24) The water storage tank is very large and has a capacity of about four cubic meters of water. That can be considered for the following reasons:

- Because the water of this region is salty, then the only way is to use rainwater and so the tank should be large enough to accommodate the stored water (Due to low rainfall in this region should take advantage of the desert to collect water at times of low rainfall to meet the needs of the people).
- Another reason is existence of bath in front of water storage. Likely because the water of bath was enhanced by this water storage.



Figure 23 – Southern view of Oshkohran water storage (Photo by Samira Tafazzol)

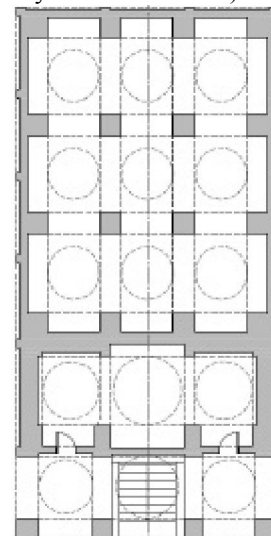


Figure 24 - Plan of Oshkohran water storage (Source: authors)

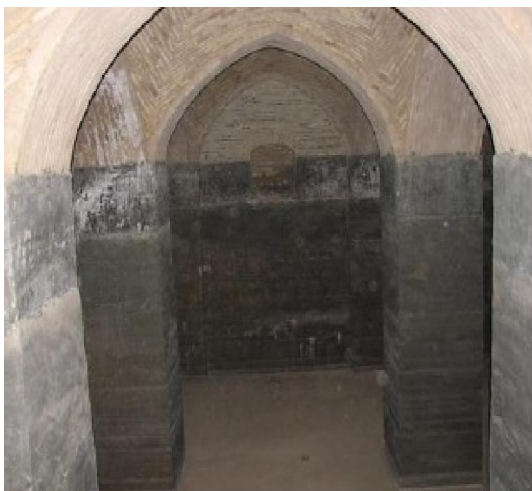


Figure 25 – Interior space of Oshkohran water storage (Photo by Samira Tafazzol)



Figure 26 – Interior space of Oshkohran water storage (Photo by Samira Tafazzol)

Water storage was including tank and pashir and rooms in the upper space of pashir. These rooms were built to protect water storage. These rooms have applied as prayer room (Fig. 27), which today became governmental office.

The water storage position against the square, it can be said that south part of the building is the main facade of the building. In the opposite direction of water storage, there's a bathroom. The decoration was done on the body because of the placement of the buildings around the square.

In southern part, there is pashir and there is on both sides a side-roofed (Ivan) which is located above the ground level by a platform that can be expressed in this way:

A place to relax and sit for native people because could achieve pleasant and cool shadows. South view (Fig. 28) is the main part and of the water storage because of presence of pashir in water storage and also two porches. The reason of this formation is

existence of castle and the square around this water storage. The shape of water storage is formed of 2 cubes (Figure 29).



Figure 27 – Prayer room of Oshkohran water storage (Photo by Samira Tafazzol)



Figure 28 - Southern view of Oshkohran water storage (Photo Samira Tafazzol)

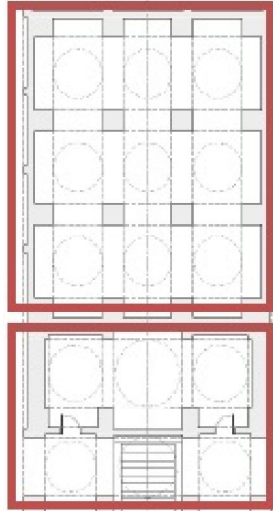


Figure 29 - General form Oshkohran water storage (Source: authors)

Location of the stairs:

Stairs and along the main axis of the reservoir is located.

Access to water:

There is a pashir in water storage which could be accessed from south side of the field, it is noteworthy that it is important to keep the water clean and health and that's why the water entering the tank water is separated. To access the pashir, 15 stairs with an average height of 22 cm is mounted.

Water storage ventilation:

Four-sided wind catchers in square form are connected to the water tanks. These wind catchers were transferred chill wind need for ventilation to a tank based on the requirements of each seasons. Today wind catcher opening will blocked with lace and pin to keep the water clean, but the preservation of the building changed and has been caused some of the damage. (Figure 30)

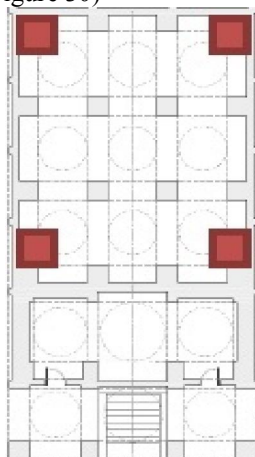


Figure 30- location of wind catchers in Oshkohran water storage (source: authors)

Water storage conservation:

Changes in the two space sides of water storage (house of stranger and prayer room) to the governmental office, was due to get budget and keep the water storage, officials said. According to the changes on the wall of the water storage which is obvious in the pictures such as panel installation, covering the internal walls of the building was destroyed. In western part of water storage, there's a space to reach to the roof. (Figure 31)



Figure 31- The tank and wind catchers of Oshkohran water storage (Photo by Samira Tafazzol)

As you can see in the pictures, due to the structure and cover of water storage, roof of the water storage is not flat. These domed buildings would provide shade on the roof and making lower heat transfer to the tank and makes it possible that the longer the water stays cool in hot days.

Pechviz Water Storage:

This water storage is located in Isfahan Province- Isfahan city- in Bonrood region. The area of this water storage is 63.30 m² which its length is 22 m and its northern width is 9.6 m and its southern width is 8 m. (Fig. 32 and 33)



Figure 32- Perspective of Pechoviz water storage (Photo by Samira Tafazzol)

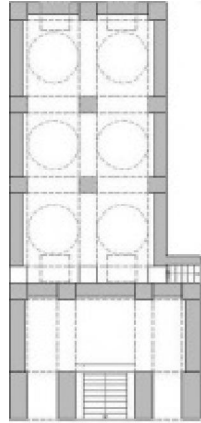


Figure 33- Plan of Pechoviz water storage (source: authors)

This building includes the tank, pashir and a space in the above of pashir section. Pashir is built in northern part and two stone benches are available in entrance section for clients to rest. In both sides of entrance section, there's two opening doors that make a cooling an air conditioning space to sit down. The overall shape of water storage is rectangle cube which one of them is built in entrance section and also in side space and the other in the tank of water storage. (Fig. 34)

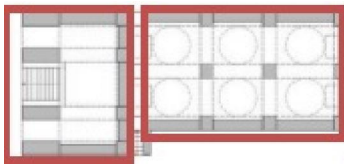


Figure 34- The overall shape of Pechoviz water storage (source: authors)

The position of stairways:

As it obvious in Fig. 35, the water storage has wide stairs in line with the main axis of building. It's noteworthy that there is another small stair in west part which makes access to the roof. This water storage has pashir and makes easier the harvest of water. (Fig. 36)

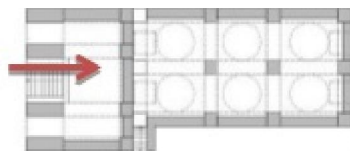


Figure 35- The position of stairway of Pechoviz water storage (source: authors)



Figure 36- Pashir of Pechoviz water storage (Photo by Samira Tafazzol)

Type of ventilation in water storage:

As you can see in figure 37, the water storage has four wind catchers which two of them were built in northern part and two other wind catchers were built in southern part. The wind catchers are four sided and has no special decoration.

In this water storage, there's no special decoration, except bricklayer on the head of building and there's also Shirsar with plant decoration on the roof.

On the water storage building and between all four dome columns, there's a low slope which help to have cool water in water storage.

In this building, in contrast with four other samples which have been considered before, there are two other columns which could say that its reason is low width of water storage. (Fig. 38)

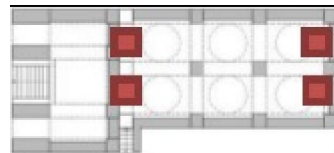


Figure 37- The wind catchers of Pechoviz water storage (source: authors)



Figure 38- The interior space of Pechoviz water storage (Photo by Samira Tafazzol)

The result of comparison of water storages in the region and around of it

Based on the investigations on the available documents about Yazd water storages, these results obtained. As we move forward toward Yazd, tanks became cylindrical and roof of tanks are below the ground level. So, the way of stairs became longer and in Ghourtan-Varzaneh region, the water storages are above the ground and the long of stairs are short. It's noteworthy that researchers should investigate these features in the future.

Conclusion:

Types of water storages in study area

Based on the investigation of water storages in Ghourtan-Varzaneh region, two types of water storage is available. Four water storages namely Pechviz, Belan, Oshkohran and Haj Muhammad Ja'far are classified in first type and Haj Mirza water storage is classified in another type. The main difference of these two types of water storage is in their structure and ceiling construction. Haj Mirza water storage has four thick column and also has a big dome with high slope (rather than four other water storages); however, in the first type each of them has one dome among their columns and it's noticeable that there are some domes with low slope. All these five historical water storages have square plan and the reservoir space has four columns. In contrast with Haj Mirza's thick polygon shape columns, the other water storages have thinner columns with square shape. (It's noteworthy that Pechviz water storage has two columns in tank space which its width is little because of small area of water storage).

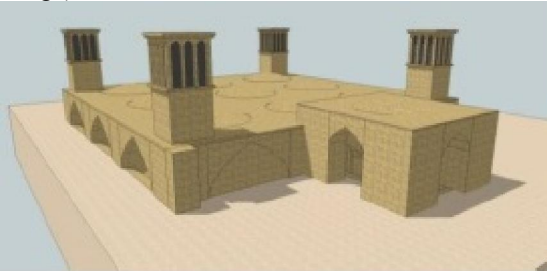


Figure 39- 3D picture of Belan water storage – Type 2 (source: authors)



Figure 40- 3D picture of Haj Mirza water storage – Type 1 (source: authors)

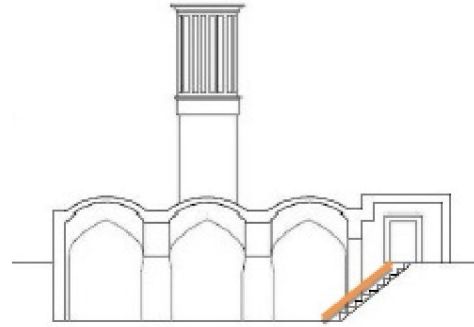


Figure 41- The section of Haj Muhammad Ja'far water storage (source: authors)

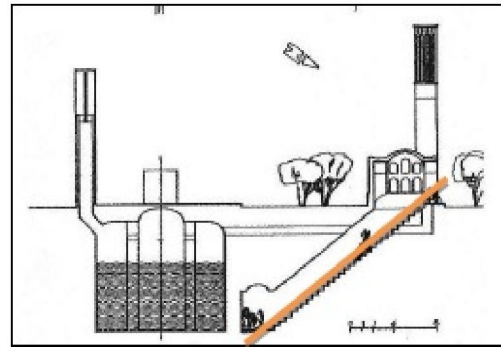


Figure 42- Mosalla water storage (Naenin) (source: Dehghani, 2010:58)

In contrast with desert samples which the biggest part of water storage are shaped in the ground, in reviewed samples, the low depth is noticeable. In these water storages, the roof of them is above the ground. So, the length of stairs in all parts are short and based on this fact, there's no need to the light catcher and the light will be enhanced from entrance section. The stairs in the type two is located on the axis and has direct route and in the type one, not only the stairs are not on the main axis, but they make two-way route with 90 degrees rotation.

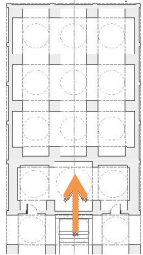
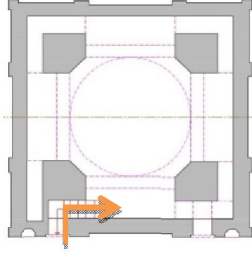
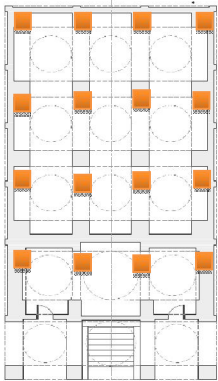
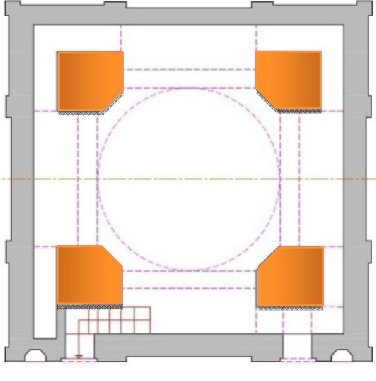
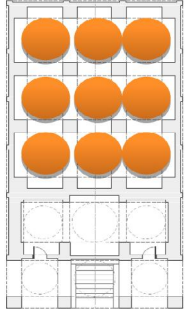
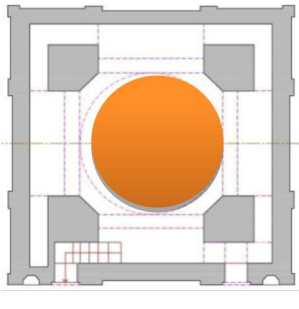
In the following Table, these two types being classified.

Today's, the most active water storages went outside of benefit because of use of tap water and thus, it begins to gradual decay and destruction of the buildings (Ghobadian, 1984, 308).

Based on this important issue that each of these old buildings is part of our national identity, it's our duty that to do our best to maintain these valuable legacy.

Corresponding author:

Mahsa Foroughi (M. Arch)
foroughi.mahsa@gmail.com

	Type 2: Oshkohran, Belan, Haj Mohammad Jafar, Pechviz	Type 1: Haj Mirza Water Storage
Stairway	Two way route with 90 degrees rotation and with landing	Short and straight route without landing
		
Column	Thick polygonal columns	columns
		
Roof	A big dome with high slope	Combination of several dome with low slope among 4 columns
		
Entrance	Without platform	With large entrance section and platform around of it
Main axis	Stairway is located in the corner	Stairway is located on the main platform

References:

1. Comprehensive plan for the city of Isfahan, Naghshe Jahan Pars Consulting Engineers, 1997.
2. Comprehensive plan for the city of Varzaneh, Naghshe Razboum Consulting Engineers, 2001.
3. Dehghani A, Water in Iran Plateau: Aqueduct, Water Storage, Glacier. Yazda Publication, Tehran, 2009.
4. Ghobadi V, Regional study of Iranian Traditional Structures. Tehran University Publication, Tehran, 1994.
5. Hoseini Abari S.H, Zayanderood: From Source to Lagoon. Golha Press, Isfahan, 2000.

6. Memarian Gh, A Note on Desert Architecture: An Investigation on Water Storages of Yazd. Science & Technology University Publication, Tehran, 1993.
7. Mortazavi Mahdiabadi, S.M. & Bagheri M, Desert Hydration Technology: Aqueduct and Water Storage. 10th Civil Engineering Conference, Tehran, 2003.
8. Mollazadeh K. & Haghdoost Z, Iranian Historical Constructions Encyclopedia: No 4- Public buildings such as water storage, Bazar, bridge and dam, bath, Art Scope Press, Tehran, 2000.
9. Niazi M, Kashan's Water Storages. Journal of Culture and People in Iran. 2007; 10:191-213.

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