

# Ab-Anbar, the Ancient Underground Water Houses of Iran

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## abstract

Throughout the history, the people of Iran have battled the dryness by innovations to preserve every drop of water that lands from the rare clouds, or from a stream flowing out of distant springs. Water is precious and held with highest respect, whether stored for drinking at an Ab-Anbar, or for washing and farming at the Houz in the middle of their oasis homes and orchards, or sourced at a Qanat spring or Jooy under ground.

How it is that drinking water as cold as a mountain fall is found in desert of Iran? Ab-Anbar is an ancient means of water preservation and cooling through an underground building structure. These underground structures have been present in Khorasan and other desert provinces of Iran as public or private water storage facilities, widely used before the installation of public plumbing systems in the late 1950s. Although many of these structures are still functional, most have been protected by government for restoration or viewing by the public as historical heritage. Khorasan natural dry climate and the massive surrounding deserts have been a breeding ground for many designs of Ab-Anbars. Today the existing number of such facilities stands in the province of Khorasan. Usually these structures were built in populated areas, also there are some forms of such structures on old trade routes and roadways leading to and from populated towns. This paper considers the history of Ab-Anbars in Khorasan as well as other relevant aspects such as types, components, construction methods and materials, filling and withdrawal systems.

*Key words* : Ab-anbar, Desert, Water shortage, Iran's heritage

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## 1. INTRODUCTION

The term ab-anbar is common throughout Iran as a designation for roofed underground water reservoir.

The ab-anbar was one of the constructions developed in Khorasan (north east of Iran) as part of a water management system in areas reliant on permanent (springs, Qantas) or on seasonal (rain) water. A settlement's capacity for storing water ensured its survival over the hot, dry season when even the permanent water supply would diminish. Private ab-anbars were filled from Qantas (man-made underground channels), while surplus flood water could often be stored in open tanks, as well as in the large, public, covered cisterns. Water was brought to the ab-anbars by special channels leading from the main quanta or holding tanks and was controlled by sluice gates. The ab-anbar, with a proper ventilation system, could then provide cool water throughout the summer months. Often rooms or pavilions were built within the complex of the ab-anbar to provide a comfortable resting place as well.

Two types of structures have been noted, a cylindrical reservoir with a dome and a rectangular one supported by piers or pillars each was marked by a portal. The portal opened into a steep, barrel-vaulted passageway, leading down to the reservoir.

The prime objective in constructing an ab-anbar is to provide a totally waterproof container for a large volume of water while allowing for proper ventilation and access. The excavation was lined with overfired brick and it was then covered with a layer (about 3 cm) of waterproof mortar (sarooj). Larger ab-anbars were often lined with an additional double layer of bricks, covered with another layer of sarooj of slightly different composition, and finished with a hard plaster coat.

Ab-anbars are built in towns and villages throughout Khorasan, as well as at crossroads, caravan series. While town ab-anbars may be filled with rain water or from Qantas, most ab-anbars along caravan routes are filled from the spring torrents of nearby streams; during the dry season gradient weirs are constructed in the stream bed in order to divert water to the ab-anbars when the winter snows melt and the streams rise.

## 2. MODE OF CONSTRUCTION

Ab-anbars built inside private dwellings are usually square or rectangular; public ab-anbars in towns or along the caravan routes are generally round. While the former have a flat roof and are often built into the foundation of the house, the latter have a distinctive hemispherical or almost conical roofing.

Water remains quite cool inside the ab-anbar, since it is generally built beneath ground level and is insulated by very thick walls. In the south of Iran, most particularly in Yazd province, one or more ventilation towers (*badgir*) is built along the edge of the ab-anbar's roof, directly on the tank wall and connected by a duct to the upper part of the ab-anbar chamber under the domed roof. Fresh air entering through these ducts keeps the air inside the ab-anbar chamber circulating and the

water cooled. In the case of ab-anbar with domed or conical roofs, the center of the roof is sometimes pierced, and a short ventilation chamber made of brick is built directly over the ab-anbar chamber. A duct inside the ventilation chamber leads from the openings or slats (that catch the breeze on top) directly inside the roof, again circulating air inside the ab-anbar chamber. The height of these ventilation chambers is generally about one meter, though some can occasionally be seen that reach a height of two or even three meters (Fig. 1)

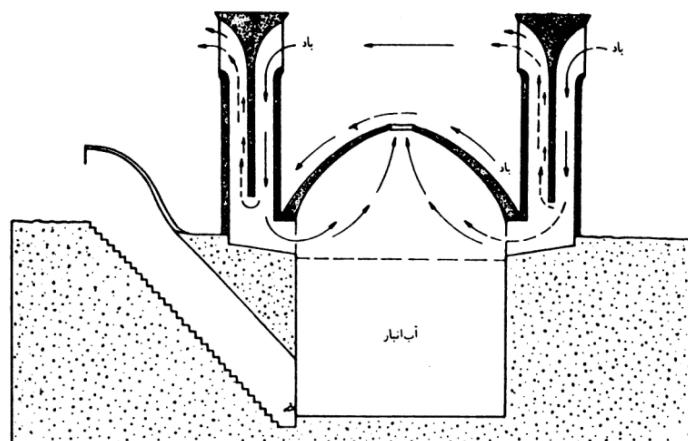


Figure 1. Cross section of Ab-anbar with ventilation tower

### 3: CONSTRUCTION MATERIALS

Materials used consist essentially of stone or baked brick with lime-mortar and plaster. After the pit that will house the ab-anbar has been hollowed out, the bottom is covered with slaked lime-mortar. When this floor hardens, the builder erects the tank's walls, made of baked brick or stone. The bricks are generally plunged in water before being laid. The filling between bricks or stones consists of lime-mortar. After the roofing of brick and slaked lime is laid, the tank's floor and walls are finished with a coating of plaster.

A type of ab-anbar, made of poured lime-plaster, is considerably cheaper to build. First the perimeter of the tank's walls is marked out, and the earth within the wall area is dug out to the desired depth. Next lime-mortar is poured into the square or rectangular trench until it is filled nearly to the ground level. This is left for a week or two until the mortar settles and is solidified. Then the area of earth bounded by the mortar walls is dug out down to the prescribed floor level. The floor is built by pouring lime-mortar; and, finally, when the walls and floor are dry, they receive a coat of plaster.

Plaster is an indispensable material in the construction of the Iranian ab-anbar, since the essential function, containment of water, is achieved by the watertightness of the plaster. The type of plaster most commonly used, called *sarooj*, is a compound from six parts clay, four parts lime, one part ash, and an amount of seed's pod sufficient to keep the compound from cracking. The first step in the preparation of this plaster is the mixture of the clay and lime, to which water is added. All of this is made into a relatively hard, clayey substance which is worked for one or two days. Next the ashes and pods are poured into this mixture until the various components have been thoroughly blended. This pounding is done with wooden sticks about 10 cm in diameter and one meter long, one end of which has been tapered to serve as a handle. This last step is important, because the more the mixture is pounded and kneaded, the more durable it is. When the plaster compound is ready, it is spread on the walls and the

floor of the ab-anbar with a trowel. The next step is to score the plaster surface with a stone that fits in the palm of the hand. This scoring goes on for several days until the walls and the floor of the tank begin to perspire, a sign that the components in the plaster are holding together fast. Only then is the ab-anbar filled with water.

#### 4. DRAWING WATER

Ab-anbars may be provided with a tap. When the place for the tap is reached in the course of construction, an additional pipe for it is built into the wall; and a plaster compound (half clay and half lime) called "batard" is pounded into the space above the pipe. Water is taken from this type of ab-anbar by means of a separate chamber, containing a staircase, about as deep as the adjoining tank chamber. The stairs are wide enough so that persons going up and down with buckets, gourds, or leather bottles will not get in each other's way. Two, three, or even more taps are sometimes installed. A few ab-anbars have been observed to have two separate stairs on opposite sides. In the case of the ab-anbars built alongside roadways, however, the normal procedure is to construct the staircase within the ab-anbar chamber itself, so that the water is drawn directly from the tank.

#### 5. CAPACITY

The capacity of the traditional cylindrical ab-anbar varies generally from 300 to 3,000 cu m. This upper limit is dictated by the fact that the maximum diameter allowed by the method of construction is about 20 m. If the depth of the tank is up to 10 m, its capacity would be about 3,000 cu m. In a few localities the ab-anbars have an even greater capacity, and some exceptional examples have been cited as able to hold up to 100,000 cu m. These are not round tanks, however, but square or rectangular ab-anbars with columns placed in the middle of the tank chamber in one or two rows. These support a roof consisting of a series of domes or barrel-vaults.

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