

## Ancient Iran, the Origin Land of Wind Catcher in the World

<sup>1</sup>Mehdi Pirhayati, <sup>2</sup>Shahrzad Ainechi, <sup>3</sup>Milad Torkjazi and <sup>4</sup>Elnaz Ashrafi

<sup>1</sup>Sama Technical and Vocational Training College, Islamic Azad University, Boroujerd Branch, Boroujerd, Iran

<sup>2</sup>Restoration and Rehabilitation of Historical Building and Contexts, Islamic Azad University, Center Tehran Branch

<sup>3</sup>Department of Architecture, Islamic Azad University, Gorgan Branch

<sup>4</sup>Architecture Academic Board of Architecture, Islamic Azad University, Khameneh Branch

**Abstract:** In this study, wind catcher originality has been investigated and their ancient kinds in Iran were characterized. Iranian vernacular architecture is full of creativity and innovation which indicate the intelligence and ability. Unbearable heat, especially in the central plateau of Iran, is one of the factors which sometimes can be unbearable and create serious threats for most of the individuals' life in the absence of necessary arrangements. Wind catcher is an engineering architectural masterpiece of earth to deal with this unbearable heat. Wind catcher is among the manifestations and symbols of Persian civilization. It is not exactly obvious that in which city the first wind catcher is built, but medieval travel writers have frequently talked about desert wind catchers in Yazd. History and background of using the wind catcher is unknown due to its position at the highest level of structure and because is the first place at the risk of damage. The wind catcher, belonged to the eighth century AH is the oldest wind catcher which has kept safe from the harmful events in Iran. Architects and designers of this architectural element have applied this element in their designs with understanding the principles of thermodynamics, aerodynamics, heat transfer, material strength and thermal human comfort. However, the historical evidence certainly indicates the use of wind catcher in Iran before the Arabs and the Persian Gulf area. This study seeks to answer the questions such as the identity and origin of wind catcher, the construction technology and its types, as well as proving the Iranian identity of wind catcher and providing the appropriate and scientific responses for the researchers such as Hassan Fathy (famous Egyptian architect) and Abdel Moneim EL Shorbagy (UAE researcher), each of whom have attributed the background of wind catcher to the locations except Iran, by the study of available historical resources and exploring the history of wind catcher in Iran.

**Keywords:** Desert, Iranian identity, Persian civilization, vernacular architecture, wind catcher

### INTRODUCTION

Early humans utilized the nature for preserving against the natural forces and sheltered in the caves, trees and among the rocks against the natural damages. Human gradually learned according to the nature to make a permanent shelter; thus, the first civilizations of the world, architectural styles and methods related to the region were created according to the climate of that region. Basic architectures were derived and inspired from the nature and environmental conditions and utilized the elements of nature with the best way related to the architecture.

But unfortunately, every day and especially after the industrial revolution, the modern human have quitted this kind of architecture and frequently utilized the handmade methods, which are mainly incompatible with their environment. The wind is one of these natural

factors which play an important role in the heat and humidity exchange and suspended particles transmission and even can save money in fossil fuels and preventing damage to the environment.

According to the location of cities (Inside the city) and using the architectural genius, the Persian architects could create an element, named Wind Catcher, which ventilated the environment properly as well as being used as a cooling and decorative element for the facade of desert and border cities of Persian Gulf.

By understanding the principles of thermodynamics, aerodynamics, heat transfer, material strength and thermal human comfort, the architects and designers of this Persian architectural element have applied this Persian masterpiece in their study's and attributed the Rosenthal of inventing this element to Iran where was limited to Mesopotamia in Abbasid era (Kasmaei, 1984). Winds and air flow are considered as

the effective and major climatic factors in different regions of Iran. Wind flows have had a significant effect on the location, shape and architecture of human residence. Variety of winds in terms of direction, speed, humidity and blowing season has had various influences on the biological communities and persuaded the thoughtful human to make a better use of this natural energy. Wind catcher is the appropriate way in using the wind optimally and as the result of it the natural ventilation and human comfort limit are created in the structure.

Given the climate in different areas, especially in dry and hot and humid and hot regions, this architectural element has been built in different forms and types and direction of each of them is according to the direction of winds in the region (Kiani, 2004). Amazingly, the countries like the UAE, where has no history and civilization and has been created approximately 60 years ago, claim to have invented this architectural element! This study seeks to recognize the Iranian identity of wind catcher as well as providing the scientific and appropriate response to those who consider the place except Persia as the origin of this architectural element.

## MATERIALS AND METHODS

Wind catcher is an Iranian innovative way to create a cool space in hot desert areas. This proper ventilation system has made the Iranian people's life space bearable since long years ago. Wind catchers have been often the small regular quadrilateral and polygonal turrets in which there can be seen no triangular structure. Turret of wind catcher is almost higher than the other parts of house. As a tool, which flows the air without need for mechanical energy of engine, etc., the wind catcher creates cooling in summer of desert, thus the wind flowing out of the house is controlled and moved into the house. The wind catchers have been usually designed according to the household requirements; in other words, the more the number of families was increased, the more the wind catcher became larger in order to enter a greater volume of air into the house.

## RESULTS AND DISCUSSION

**History of wind catcher in the world:** Since the past years, the wind catcher was built in various shapes and forms in different parts of the world and had numerous types. Interestingly, all of them had had the same function despite the differences in the shape and form.

Wind catcher has always been defined as a traditional structure for ventilation and has been used with various names and forms across the Middle East from Pakistan to the North Africa (Bahadori, 1985).

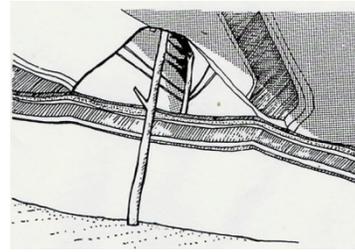


Fig. 1: Bedouin tents in Sri Lanka Mahmoudi (2007)

It is very difficult to guess that from which region the wind catchers have been created exactly, but the primary ideas of wind catcher can be seen in the tents used by tribal societies in the Middle East. These tents consisted of a wool fabric which was fastened by 3 pieces of wood and these woods were fastened together by a strong rope. This helped to cool the inside of tent (McCarthy, 2005). The initial concept like a wind catcher can be considered as the simple pores on "Bedouin tents in Sri Lanka"; according to the structure of these tents the weight of tent is borne by a piece of wood protruding from the tent and while the tent is erected and its side, facing the wind, is closed, there is a small opening at the top of it which is able to direct the air flow to the center of tent (Roaf, 1982). An image of this tent in Fig. 1.

According to an image obtained from one of the tombs of Egyptian Pharaohs in Tal el Amarna, some of the researchers like Abdel Moneim EL-Shorbagy have made great efforts to assign the history of wind catcher to Egypt. (Roaf, 1982)

In this figure, two triangular wind catchers, which are located on top of luxurious house, can be seen. Roaf (1982) pointed out that the wind catcher was located with two wind ventilators at the back of Babel royal hall (600 H).

Roaf (1982) states that: "Probably these elements are the same stairs leading to the roof", but certainly he noted in another text that the samples, in which the angular roof peak meets the external wall, are very likely the wind catchers (Mahmoudi, 2007).

EL-Shorbagy named the wind catcher "MALQAF" and states that the successful samples of wind catchers can be seen in the architecture of Middle East in countries such as Pakistan and India and all of them indicate the effect of Persian architecture on these regions (Mahmoudi, 2007). He notes that a change was occurred in the architecture of houses in the Mamluk Sultanate in 12th century and they covered the top of yard and named it QA'AH. QA'AH was usually a space composed of central region with high ceiling and two balconies. Vernacular architects invented Malqaf for ventilation and it was located in the northern side of QA'AH and at the top of roof. Malqaf was only able to direct the wind into the QA'AH in a direction. The size of Malqaf depended on the outside air temperature and



Fig. 2: An example of a wind catcher Fathy (1986)

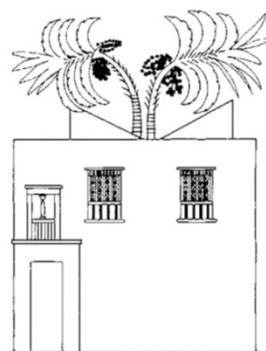


Fig. 3: Image of Egyptian wind catcher of Nebamun tomb Bahadori (1985)

the more the temperature is increased, the more the size of Malqaf will be decreased.

Hassan Fathy, the famous Egyptian architect, assigns the emergence of wind catcher to Egypt and states that then it has been developed in the Middle East, North Africa, India and so on and has reached its high position by the Islamic architects. He noted that it was called as "Wind catcher" in Iran, Iraq and the Persian Gulf border countries, with this difference that the wind catchers in these regions are bi-directional and multi-directional unlike Malqaf in Egypt. An example of this wind catcher is shown in Fig. 2.

He assigned the origin of wind catcher to Egypt according to the painting of Nebamun tomb in 1300 BC; it is shown in Fig. 3.

Unfortunately, the archaeological excavations could not also help to understand the history of wind catcher in the world because the wind catcher had been at the highest level of structure and had been the first element, exposing the natural disasters, thus it had been destructed. Only a few guesses have been made at its history according to some of remained paintings.

**Wind catcher function:** Wind catchers are classified into two categories in terms of the function:

- Wind catchers which cool inside the structure through convection: This kind of wind catcher is used in hot and humid areas with high humidity such as Bushehr and Lar, etc.

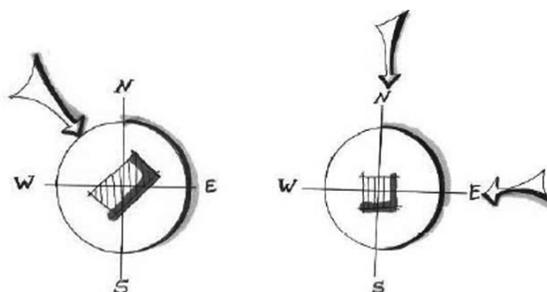


Fig. 4: Direction of wind catchers in Yazd and *Lengeh Port* (Bandar *Lengeh*)

- Wind catchers which cool the structure through convection and evaporation. This method includes several types:
  - The flow air over a water pond or canal.
  - Putting the mat and thorny shrubs and pottery at the opening of wind catcher and sprinkling them.
  - Separating the wind catcher from the building and putting it away from the building and making the connection with the underground canal (Vafamehr and Pourjafari,?).

**Wind catcher locations:** Generally, the wind catcher has been used in two types of buildings:

- Houses
- Water storages

**Houses:** The wind catchers in houses had been mostly used in the place for staying in summer and sometimes they had been combined with elements such as a pool, garden, trees, tailwater in order to enter the fresh air into the space of human life.

**Water storages:** The uni-directional wind catchers had been usually used in the direction of favorable wind blow in the water storages. It prevented the growth of microorganisms by passing the wind from inside the wind catcher of water storage and passing the water on the water of water storage in the hot areas with no ventilation. After passing the surface of water from the opposite direction, the wind would be sent out (Danby, 1993).

The direction of wind catchers in Yazd and *Lengeh Port* (Bandar *Lengeh*) is shown in Fig. 4.

Another significant point is that the wind catchers are larger and with lower height in the south of country because the maximum wind blowing occurred at lower height in these areas. Furthermore, there is not black wind in these areas such as Bandar *Lengeh* (*Lengeh port*) in Hormozgan province. There are similar wind catchers in some southern areas of Persian Gulf and the United Arab Emirates and Bahrain and they are all derived from the architecture of southern Iran. In

central and desert areas of Iran, the wind catchers have higher height and smaller volume because the severity of wind in these areas occurs in higher height of earth surface; these kinds of wind catchers can be seen in cities such as Yazd, Naein and Zamrashidi (2002). Furthermore, direction of wind catchers towards the geographic direction is different in various cities according to the direction of appropriate wind blowing. For instance, direction of wind catcher in Yazd differs from Bandar Lengeh (Lengeh port).

**Wind catcher development process:** Wind catchers have been faced with numerous changes during their lives. Process of these changes is according to their shape and form and these changes are provided as follows:

- **Uni-directional wind catcher:** The generation of wind catchers has been started with this kind of wind catcher, so that 1 or 2 wind catchers are led into the inside and the rest of them use the suction property and send the warm air out. This type of wind catchers is called "give and take"; the oldest type of this type of wind catchers has remained from the Safavid era.
- **Multi-directional wind catcher:** This generation of wind catcher is more advanced and has four openings and diagonal vertical and cross blades across the wind catcher. This type of wind catcher dates back to the Safavid era.
- **Blade multi-directional wind catcher:** In this kind of wind catchers, numerous perpendicular and parallel blades were made in the opening of four sides of wind catcher. This generation of wind catcher has been created after the Safavid era and Fath Ali Shah Qajar sultanate.
- **Two-ranch wind catchers:** It is the last stage of -wind catcher evolution and its middle part is risen independently from each 4 sides to higher height. (Kiani, 2004)

**Wind catcher classification:** Wind catchers are classified based on different ways such as direction, plan form and performance.

- **Classification based on direction:** Roaf (1982) classifies the wind catchers into 4 categories according to the direction:
  - **Uni-directional wind catchers:** This type of wind catchers is usually located toward the northwest or north direction. They have a steep roof and one or two opening. Roaf believe that approximately 3% wind catchers of Yazd are among these types.
  - **Bi-directional wind catchers:** This type of wind catchers is classified into two parts by vertical bricks and like the previous type has only 2 openings and they are named according to their direction such as north-south wind catchers. This type of wind catchers had been typically used in

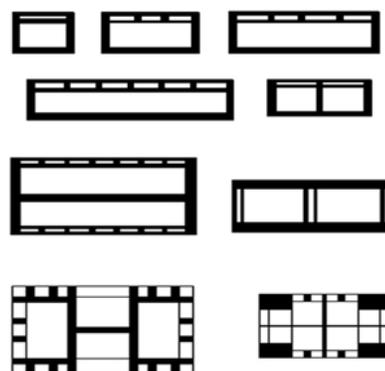


Fig. 5: Types of wind catcher based on direction Zamrashidi (2002)

normal houses and 17% of these wind catchers had been among these types.

- **Tri-directional wind catchers:** This type of wind catcher has not been usually common. A few kinds of them are found in Tabas.
- **Quadr-directional wind catchers:** Studies indicate that the frequency of this type of wind catchers is higher than the rest of wind catchers. They have four vertical openings which have been divided with partitions. Half of these wind catchers in hot and dry areas are among this type which is also called as "Yazdi Wind catcher". Almost all wind catchers available in warm and humid areas are among this type (Roaf, 1982).

The following Fig. 5 shows the types of wind catcher based on direction.

- **Classification of wind catchers according to their plan form:** Basically, talking about Iranian wind catchers introduces various types of them in plan and form such as circular, oct-directional, multi-directional, square and rectangle. McCarthy (2005) Fig. 6 shows the types of wind catchers based on its form and plan, despite the fact that the triangle wind catcher has not been used anywhere else in the Middle East. The wind catchers with circular cross sections are very rare and almost never seen anywhere in Yazd. the square wind catchers have been used in quadr-directional wind catchers in Yazd. Rectangular wind catchers include Uni-, bi- and quadr-directional wind catchers. Oct-directional wind catchers also have an oct-directional plan (Givoni, 1976). The most specific type of this kind of wind catcher is located in Yazd Dolatabad Garden. (Mahmoudi, 2007) However, the wind catchers have been also classified into another types based on their other features, but they are not discussed in this study.
- **History of wind catcher in Iran:** Finding the history of wind catcher in the works remained from the Iranian architecture is too difficult, because the destruction happens in ceilings and high height of

Form	Samples of plan	
Circle		
Square		
		
Rectangle		
		
		

Fig. 6: Types of wind catcher based on the plan form Mahmoudi (2007)

building at the first stages of demolition and the wind catcher is also among them. The available samples of wind catcher in Iran dates back to the 8th century AH and the previous samples have been defined. Unfortunately, a credible understanding of wind catcher history in Iran has not been found in archaeological excavations. Since Arg-é Bam (Bam Citadel) dates back to the pre-Islamic era, it should be noted that only the bases of walls have thousand years history and other parts of structure have been built and repaired during different eras; hence, the wind catchers of Arg-é Bam (Bam Citadel), all of which have been ruined unfortunately, do not date back to the pre-Islam (Mahmoudi, 2007).

- **History of wind catcher in Iran with relying on the literature:** Referring to the ancient literary texts can be as an evidence of the history of wind catcher in Iran and the way of its architectural structure. The wind catcher is mentioned in the travel literatures, poems and encyclopedias.

In travel literatures, the wind catchers, which are not existed today, have been referred like the wind catchers in Shiraz, Lar and Bandar Abbas cities. Travel literatures such as travel Nasir Khusraw Safarnāma (5th century AH) and Marco Polo travel literature (7th century AH), which are the ancient samples of travel literatures in Iran, refer to the existence of wind catchers in Iran at that time (Mahmoudi, 2007). Referring to the water storages of historic city, Naein,

Nasir Khusraw wrote: "This structure has been built to store the rain water and its domes and wind catchers are obvious from far distance" (Kasmaei, 1984).

Marco Polo, who had been traveled to Iran in the 7th century AH equal to the thirteenth century AD, had announced about using the simple and initial wind catchers in Hormuz city. "The weather in Hormuz is too hot and intolerable. Therefore, its residents have the tools like the fan which brings the air flow from the outside into the house (Kasmaei, 1984). The travel literatures such as Tonat, Sharon and Tavernier travel literatures are other travel literatures in which the wind catcher has been referred to.

Since the past years, the wind catcher has been applied in Iran and according to its ancient and various names like "Vateghz", "Badhanj", "Batghan", "Khishkhod" and "Khishkhan", it is an ancient phenomenon in Iranian architecture (Pirmia, 2002).

The word "Wind Catcher" is written in Dehkhoda Dictionary as follows:

- The opening or hole, which is built in house; and refers to the words "Badkhor" and "Badparva".
- The house has wind catcher in each four sides due to the wind blow.
- The arch of house has the wind catcher from all four sides.

**Mohsen Karim-rast:** My heart is happy for the familiar wounds/ my house has the air because of the wind catcher.

**Masih Kashi:** As soon as we put my heart in the fire of house/the wind catcher fights against my fire Even the Arabs have used the Persian word "Badhanj" in their poems.

It is also written that it is the high structure, built in the top of houses and there are holes at each side in order to enter the wind from every side into the house (Nazim Alatba). It is a long outlet like the stokehole at the top of the structure and building with the special style that the wind is continuously moved from it to the lower level and the air is flowing for conditioning and cooling. The place, in which the wind flows more than the other parts, is called the place for flowing the vernacular wind from the wind catcher. Badagi is called the place where the wind dominates it. Badagi (Nazim Alatba). Badras, Badghar, Badghara, Badghad, Badkhan, Badkhan, Badghan, Badghas, Badghand (Pirmia, 2002).

It can be noted that given the use of the Persian word for this masterpiece of Iranian architecture in Arabic poetry, the way of building it also has also reached beyond the Persian Gulf. The term "Badjir" is actually the wind catcher which has been changed to "Badjir" due to the lack of letter "G" in Arabic (Mahmoudi, 2007).

In an area, called "Bastak", where is now on the outskirts of Dubai, the samples of wind catcher can be seen. In fact, Bastak is the region near Bandar Lengeh (Lengeh port); and as the result of conflicts between Sunnis and Shiites in 1889 AD, Basti Sunnis migrated to beyond the Persian Gulf in current Dubai (Roaf, 1982). Wind catchers in Dubai are probably built by Iranian immigrants. Akin considers Ghiyasiyeh Kharghard School in Khorasan as the oldest structure in which the wind catcher is seen while this structure has been built in the ninth century AH. Several works in Iran are remained in Yazd from the eighth century AH - and they are much older than Ghiyasiyeh Kharghard School (Pirnia, 2002).

It is mentioned that there was the wind catcher with the air-rotation system in Sassanid fire temple in Firuzabad in the 250 AD (Roaf, 1982).

- **Recognizing the Iranian identity of wind catcher by using the archaeological sources:** In 1969 AD, the famous archaeologist, Masuda, found two hills in his way from Shahrud to Gorgan and named them the Flint Hills. These two hills, which are called the eastern and western hills, are located in 8 km north Shahrud and near the southern slopes of Alborz. Masuda dug two hills during the years 1971 and 1973 AD and estimated the approximate date, 7800 years before now for it through carbon-14 test (Kiani, 2004). In plans, provided by Masuda from the explorations, he introduced the locations of residential plans as the fireplace. In his article, he noted that the existence of ashes in some of these places is because they are fireplaces (Roaf, 1982).

People had considered these places as the holy places for the fire. Because these fireplaces had not been used permanently, thus there was no ash in most of them. Sometimes, the wet carbonic substrates had been used in wind catchers and the air entered the room after passing these substrates and cooled the room (Abdel-Mohsen *et al.*, 1990). This text can make true this probability that these places were the wind catchers.

## CONCLUSION

Iranian traditional architecture has been developed with respect to different states and weather. Perhaps the weather has had the greatest impact on the architecture and traditional elements of Iranian architecture.

Creation of wind catcher is the response to Iranian architects' understanding of the nature and wind phenomenon. Given the mentioned cases, the invention of wind catcher dates back to Before Christ, but it is relatively difficult to say certainly that which country had invented it for the first time. Egyptians like their

famous architect, Hassan Fathy, assigned the origin of wind catcher to Egypt according to the painting of Nebamun's tomb in Tal el Amarna in 1300 BC, but according to Masuda's excavations, which date back to 4000 years BC, the hypotheses of researchers such as Hassan Fathy and Abdel Moneim EL-Shorbagy are voided. Arabs have used the Persian term "Badhanj" in their poems and this can be a reason for the history and background of wind catcher in Iran. Nowadays, the word "Badjir", which is used by the Arabs, is also the Arabic form of the Persian word Badgir (wind catcher). Moreover, the first wind catchers of United Arab Emirates have been built in Bastak near Dubai and its first residents were the Iranians who had been living there. Thus given the obtained evidence, it can be stated that the Iranians had been the inventors of this Persian masterpiece element; and like several architectural elements, this architectural element had been sent to other countries from Iran and had been their inspiration source (Fathy, 1986).

## REFERENCES

- Abdel-Mohsen, S.M., F. Hassan and D. Balkrishna, 1990. Two regional architects in the context of modern architecture. Ph.D. Thesis, University of Georgia, pp: 86,104.
- Bahadori, M.N., 1985. An improved design of wind towers for natural ventilation and passive cooling. *Solar Energy*, 35(2): 30-41.
- Danby, M., 1993. Privacy as a Culturally Related Factor in Built Form. In: Framer and Louv (Eds.), *Companion of Contemporary Architectural Thought*. Routledge, London.
- Fathy, H., 1986. *Natural Energy and Vernacular Architecture*. The University of Chicago Press, Chicago.
- Givoni, B., 1976. *Man, Climate and Architecture*. 2nd Edn., Applied Science Publisher Ltd., Amsterdam.
- Kasmaei, M., 1984. *Climate and Architecture*. Iran Housing Corporation, Department of Architecture, Asr-e Zarrin, Tehran.
- Kiani, M.Y., 2004. *History of Iranian Architectural Art during the Islamic Era: The Organization for Researching and Composing University Textbooks in the Humanities (Samt)*. Dekhoda, "Dictionary", Tehran.
- Mahmoudi, M., 2007. *Wind Catcher: The Symbol of Iranian Architecture*. Yazda Publications, Tehran.
- McCarthy, B., 2005. Consulting Engineers, Ahmadinezhad (translator), "Wind Towers". *Proceeding of Passive and Low Energy Cooling in Buildings Conference*, Greece, pp: 23-29.
- Pirnia, M.K., 2002. Developed by Gholam-Hossein Memarian, "Islamic Architecture of Iran". Science and Technology University Press, Tehran.

- Roaf, S., 1982. Wind Catchers: Living With the Desert. In: Beazley, E. (Ed.), Air and Philips, England.
- Zamrashi, H., 2002. Iranian Architecture: Building the Structure with the Traditional Materials. Zomorod, Tehran.