



# **A Comparative Study of Sustainable Patterns in Iranian Underground Architecture**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Iranian native architects created many innovations at different levels of altitude in the past, using various sources and natural clean energies in order to create natural adaptation in different climate climates. Garden Pit and Shawadan are among examples. These underground elements have created a pleasant atmosphere in high temperate and humid environments by utilizing the high thermal capacity of the soil. Time-lapse and inappropriate use of technological advances have led to the neglect of indigenous methods and unlimited use of fossil fuels. Shawadan and Garden Pit are two elements of underground architecture where Shawadan is used in a warm and humid climate and garden pits are used in the warm and dry climate. These architectural elements are often found in Yazd and Kashan cities as desert cities (warm and dry) and Dezful and Shushtar are built on the Gulf coast due to weather conditions. The study aimed to re-read and adapt these elements in terms of functional similarities using analytical-descriptive library method.

**Keywords:** *Sustainable architecture; underground architecture; garden pit; Shawadan.*

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## 1. INTRODUCTION

Vernacular architects in every region of the world have thought several measures to create a better life. Although it is difficult to harmonize with the cruel nature, it has been used wherever it was possible. Negative effects of human over nature have not a long history, and this disruption is a relatively new phenomenon, which is related to two important factors. One of them is increasing human population and the other one is his control over nature, which was emerged by modernity and caused imbalances of nature and inconsistent relationship between man and nature. In the modern world, human life on this planet has changed dramatically with the advent of the industrial revolution and its great effect. Thus, its ability in the use of environmental resources and nature became more and more without thinking its maintaining or balance. In fact, the industrial revolution became the scourge of the environment apart from the provision of human welfare and technological progress. However, the issue is that by changing the environment, human has reached such a critical stage of its history so that continuing a healthy life on earth requires a revision of the assumptions that common models of planning and development are on their basis [1].

By evaluating the ancient Iranian architecture, we can find some evidence of sustainable innovation and creativity. Windcatchers, water storages, and refrigerators are examples of this type of sustainable innovation. These cases are uniquely coined for arid and semi-humid regions in the cities of Dezful and Shushtar, in southwestern of Khuzestan "Shodan" and arid and dry regions in the central plateau of Iran "Sunken courtyard". Vernacular architectures of these regions could create spaces in the depth of earth that can invent any ventilation and cooling device at temperatures above 50 degrees Celsius. This was realized using the cool water of Dez River and due to the high altitude of the city to the river in the formation of Shodan in the arid and humid region and due to the moderate and cool temperature of the earth in the

appearance of Sunken courtyard in the arid and dry region.

Frequently asked questions of the research are:

- ✓ How much traditional underground elements were effective in increasing human comfort in different climates?
- ✓ How were moisture and heat load increased by embedding underground elements in different tropical and humid climates?

### 1.1 Hypothesis

- ✓ It seems that maintaining and restoring old architecture can be effective in tourist attraction and highly can manifest the old architecture in addition to preserving the environment.
- ✓ It seems that emulating the traditional architecture was effective in maintaining more clean energy in addition to rehabilitation of the past architecture.

### 1.2 Problem Statement

Considering climatic issues in architecture designing is one of the most important aspects of architecture and urban design sustainability. The use of natural energy in buildings saves fuel consumption, increases the quality of comfort, residential environmental health, and leads to a healthy environment. As a result, housing design based on climatic conditions is the first defence line against outside agents of the building. Today, coexistence with the natural and climatic conditions has become one of the most important measures in architecture and urbanism. Therefore, designers are required to follow certain rules and principles in this respect. In designing residential context, climate considerations have an important role in terms of comfort for the residents of environments with minimal cost. The purpose of this paper is to achieve appropriate climate patterns and principles in the design of residential context through analyzing the examples of climatic using in the past architecture of Iran.

### 1.3 Research Literature

Table 1. Research of literature writers

No.	Author name	Year of publication	Resource name	Conclusion	Resource
1	Qobadian, Vahid	1998	Climatic investigation	The importance and necessity of considering climatic conditions in	The second edition,

No.	Author name	Year of publication	Resource name	Conclusion	Resource
			of traditional buildings in Iran	the design and construction are important from two terms: On the one hand, buildings in harmony with the climate or buildings with climatic design have a better quality in terms of comfort. On the other hand, buildings in harmony with the climate save energy consumption needed to control environmental conditions in these buildings.	published by Tehran University, Tehran
2	Sayadi, Ehsan	2012	Sustainable Architecture	In sustainable architecture, building not only adapts itself with the climatic conditions but also establishes a reciprocal relationship with it. Thus, according to Richard Rogers, buildings are like birds, which cap their plumage and adapt themselves to new conditions, and adjust their fuel and compromise.	The first edition, published by Lotus, Tehran
3	Kasmaei, Morteza	2010	Climate and Architecture	The climatic design causes creating better comfort conditions in buildings. Buildings provide comfort conditions without noise and with no fan or other devices without maximizing the productive activity of devices instead of imposing pressure on heating and cooling systems.	Volume I, Sixth Edition, soil publication, Isfahan
4	Moradi, Sasan	2012	Regulating environmental conditions	One of the most important environmental issues is the role of the environment in shaping human behaviour or so-called environmental determinism. This can be investigated at different levels. In a sense, human behaviour is influenced by ecological forces on a global scale. These forces limit what man can achieve regardless of considering the goals and limits of human motives.	First edition, Arman Shahr publication, Tehran
5	Alizadeh, Amin	2009	Weather and climatology	Different rates and combinations of climatic factors caused by the different geographical regions created different climate zones, which have special features. Environment, cities and even monuments related to the climatic areas achieved special features tailored to their climatic conditions.	thirteenth printing, Published in Ferdowsi University of Mashhad

(Reference: authors)

## 2. DEFINITIONS

### 2.1 Definition of Sunken Courtyard

Baghchal or sunken courtyard in traditional Iranian architecture was built in the middle of the central courtyard and a floor inside the ground. Examples of this space are seen in very arid desert climates such as in Kashan, Yazd, and Naeen. Sunken courtyard provided access to subterranean water in addition to supplying the required soil of the used bricks in the building. Therefore, we often see running water in the sunken courtyard that fills the middle pond and its overflow went to other houses.

### 2.2 Definition of Shodan

Shodan in the architecture of southern Iran- especially Dezfoul and Shushtar, due to arid and humid weather conditions- is a cellar space in the basement to provide comfort conditions and comfortable life. Considering the adverse climatic factors of the region, using subsurface levels such as nave and Shodan is required. They make possible to live in the hottest days of the summer in temperate climates. Shodan, which is also called Shobadan, is placed in the lower level of the nave. It is like a deep basement in adverse climatic conditions.

## 3. CLIMATIC DIVISIONS IN IRAN

Basically, in many parts of the world, the climate is determined by latitude and longitude. Iran is located on 20 and 45 degrees of northern latitude in an arid region. In terms of height, it is a high plateau whose overall levels of a height, which is less than 475 m, include a very small percentage

of the entire country. Four divisions of Iran's climate are:

- ✓ Temperate and humid climate (the southern coast of the Caspian Sea)
- ✓ Old climate (the Western Mountains)
- ✓ Arid and dry climate (Central Plateau)
- ✓ Arid and humid climate (southern coast) (Kasmaee, 1382: 82).

## 4. USING THE EARTH'S FRIGIDITY

The only tank that a building can continuously transfer its additional heat through conducting is the earth. Thus, the potential value of the land can be realized as a cooling tank with an approximate estimation of global temperature. Building design in the basement meets many of the needs and problems related to water and air, including the thermal control, protection against the wind, sustainability against the effect of humidity on material and protection against other abnormal conditions such as a fire caused by atmospheric agents, hurricanes, and extreme sounds. The thermal mass of the earth regulates the annual cycle of temperature fluctuations and delays it [2]. In arid and dry climate and arid and humid climate, earth frigidity is used to control the heat to escape from the high-intensity sunlight.

## 5. STUDY AREA

The study area is in the arid and dry climate of Yazd and Kashan and in the arid and humid climate of Dezfoul and Shushtar. The reason for the selection of these areas is the presence of these architectural elements in these cities.

**Table 2. Geographical coordinates the study area**

City	Longitude	latitude	Height above sea level
Kashan	51 degrees and 30 minutes East	34 degrees and 05 minutes East	982 m
Yazd	55 degrees and 0 minutes East	32 degrees and zero minutes north	1230 m
Dezfoul	48 degrees and 30 minutes East	32 degrees and 20 minutes north	140m
Shushtar	48 degrees and 35 minutes East	32 degrees and 26 minutes north	65 m

(Reference: Authors)

## 6. CLIMATIC FEATURES

**Table 3. Climatic features**

<b>Climatic features of arid and dry regions</b>	<b>Climatic features of arid and humid regions</b>
Arid and dry in the summer and cold and dry in winter	Arid and humid in the summer and temperate in winter
The low-temperature difference between day and night, the lack of ground moisture	The low-temperature difference between day and night
Very low vegetation cover	High-intensity sunlight
Low rainfall and very low humidity	Using the cool sea breezes
Winds associated with dust	

[3]

**Table 4. Climatic conditions**

<b>Type of climate</b>	<b>Material type</b>	<b>Plan type</b>	<b>Roof type</b>	<b>Orientation</b>	<b>Connection of building with earth</b>	<b>The level and number of windows</b>	<b>The amount of using natural ventilation</b>	<b>Texture collection</b>	<b>Exterior colours</b>
Arid and humid	Low thermal capacity	Widespread	Flat	South to southeast	On the ground	Medium	Low to high	Sporadic	Light
Arid and dry	High thermal capacity	Compressed	Arch Dome	South to southeast	On the ground	Low	Low	Dense	Light

[4]

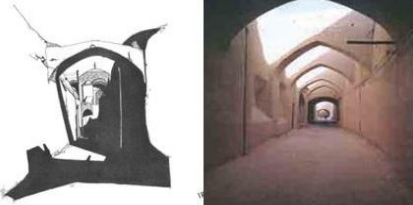


## 7. THE ARCHITECTURAL FEATURES IN KASHAN AND YAZD





Residents of arid and dry regions could interact with climatic conditions of this region by applying some measures. In general, in this area, buildings have been built with materials including mud brick that has a high thermal capacity. In areas where weather conditions are extreme, they have brought the time delay to infinite with the construction of houses in the hills or underground. Therefore, they have used the balanced thermal conditions of the depth of the

ground. Buildings' plan is compacted as possible and it is tried that the exterior surface is low compared with its volume. Buildings are usually built in dense texture and compressed sets. Therefore, it is tried that the largest shadow to be created on the exterior surface. In most of these areas, roofs are in the form of arc, arch or dome without skeleton with adobe and mud due to low rainfall and lack of wood. In these areas, the number and area of buildings windows are to the minimum possible and windows are embedded in the upper walls to prevent intrusion beams reflected from the surface of the ground [4].

### 7.1 Indicator Elements in the Formation of Architecture in Arid and Dry Areas

Table 5. Indicator elements of in arid and dry areas

Elements	Description	Document sample
Passage	Covered passages and narrow alleys with high walls are cool passageways in the summer and there is shade in most of the day, especially in the hot summer afternoons.	
Yard	In old houses, the yard is the centre and the heart of the building. The central yard with a porch on each side was the feature, which was seen in Iranian architecture in the distant past. In addition, the local yard was used for holding various events such as religious festivals, weddings and family gatherings. They were usually rectangular. The dimensions of the yard were determined by the number and performance of the surrounding space. Each yard has a pool and some gardens, which differ based on different conditions such as weather and different forms of cultural factors.	
Sunken courtyard	It is space lower than the yard, in which polls and trees are located. On the edge of the yard, a number of semi-open rooms were built. Usually, pomegranates, pistachios, and figs trees were planted in these sunken courtyards. Due to being smaller and lower, using the moisture and coolness of the ground, in addition to the moisture and coolness of the water, these courtyards were shaped in more climatic spaces than the yard.	

Elements	Description	Document sample
Domed roof	The dome shape of the roofs increases the entire surface of the roof. Consequently, the sunlight intensity is divided on a broader surface. Therefore, the average temperature roofs and heat transfer into the building are reduced.	
Wind catcher	In the summer, the houses in the desert margins or the South Sea border the main hall, in some cases, earrings have used the airflow of wind catchers. Windcatcher room is any space on the first floor of summer side space that uses the wind catcher air. Decoration of this space is such as a porch decoration.	
Bedchamber	This space is used in mosques as the prayer space on both sides of the dome or around porches. It is often used in the winter. This space is used in some times of day in the summer, spring, and autumn and sometimes as a warehouse. Its structure and decoration are along with the first-floor plan.	
Orangery garden	Orangery garden is a small yard in the inner set that provided the possibility of keeping plants, which are sensitive to desert night freezing in addition to supplying the light of the around space. Its small size and its vicinity with arches and building masses, which were heated during the day with solar energy, caused maintaining the limited temperature above zero by discharging this energy during the night.	

[5]

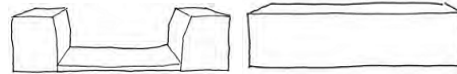
## 7.2 Sunken Courtyard

One of the indicator elements of architecture in arid and dry regions is creating a sunken courtyard. The cavity of these houses prevents shining the down-home point of this house. This self is effective in moderating the air in the lower part of the house and makes it a perfect place for

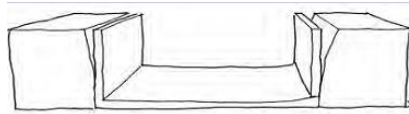
the hot summer. To use the subterranean water, the house floor should be lower than the ground. Ancient architecture masters used the excavation soil for the construction of other parts of the house. In fact, it was a kind of saving time and money. Another reason for the construction of houses in the form of the sunken courtyard was higher resistance against earthquakes.



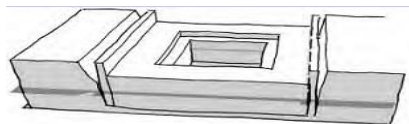
Fig. 1. The sunken courtyard from the exterior and interior of Pirnia House [6]



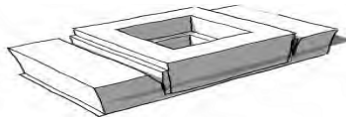
**1. Ground bed and excavation to use the soil of that place**



**2. Implementation of the protective pillar that has the role of soil backing.**

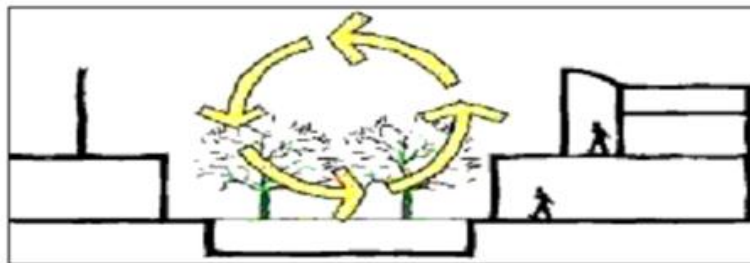


**3. Construction of the building in the basement floor and construction of a sunken courtyard**



**4. Implementation of the main building above the ground and the entrance spaces**

**Fig. 2. The process of building a sunken courtyard [5]**



**Fig. 3 The optimum air circulation in the centre of the residential area [7]**

### 7.2.1 The functional system of a sunken courtyard

Sunken courtyards are built on a higher depth than the ground. This causes atmospheric factors and temperature fluctuations have very little impact on the underground buildings, and the earth's crust protects the building against these changes. Storm and wind cannot penetrate into the ground. Earth's crust prevents heat transfer into the ground as thick thermal insulation [7].

### 8. THE ARCHITECTURAL FEATURES IN DEZFUL AND SHUSHTAR

The impact of weather on the composition and deployment of buildings in the cities of Dezful and Shushtar, which are located in an arid and humid region, is in such a way that shadows and the airflow become important in different directions. According to the weather patterns of these two cities, the heat factor is the most important and influential factor in shaping its native structure. Weather patterns of Dezful and



Shushtar according to the regional conditions in the bioclimatic map indicate that optimal environmental conditions were in the short time of the year, and in most months of the year, shade and airflow are needed. Due to adverse climatic factors in the field of heat factor and inhibiting it in this region, it is recommended to use the subsurface lands such as Shodan. Therefore, living in a temperate space would be possible in the hottest days of the summer [8].

In warm and arduous weather of Dezful, which sometimes reaches 50 °C, Shodan's temperature is between 20 and 25 degrees. This cool atmosphere was the best shelter for the daily lives of citizens with its suitable temperature. Creating shade and Curran and using elements such as wind catcher and tent and planting shady trees make living possible in some hours of the day. However, in very hot hours of the summer days, living is possible in cool Shodan [9].

## 8.1 Shodan

Shodan, which is given in the book of cities of Iran in the Parthian and Sassanian era, is from the root of Shotapoata. This word, which came in the oldest texts related to underground spaces in the Pahlavi language, means being a partner is digging. Some experts believe it is drawn from a combination of night and Abadan, but since the use of Shaodan is in the very hot hours of noon, the first root can be more relied [10].

In identifying the root of Shodan and bedchamber, we face with terms that justify its field. From the standpoint of matter Pirnia regarding this word in the local region of Yazd, Shiv means under and underground that applying the word of "Shivground" is common as basement among people especially in rural areas. Other words such as "Workshiv" means "underwork" and "underarc" means "understructure" are common in the popular culture. Therefore, the combination of "shiv" with location extension of "dan" can justify the cellar space of "Shodan". While, the word of the night means covered in Iranian literary culture with the suffix "setan" expresses the character of "Shabestan" (bedchamber) in the Iranian architecture [11].

### 8.1.1 Introducing Shodan

Shodan is one of the intelligent strategies of traditional Iranian architecture in protecting

residents against overheating in the cities such as Dezful and Shushtar. Shodan, in fact, is a space drilled under buildings in the old part of Dezful and Shushtar, to a depth of 5 to 12 meters, which can be accessed through steps. Most of Shodans are connected through underground corridors. Thus, an underground connection will be shaped in the underground that this underground connection will provide access to a number of old houses. This winding collection is finally through Shodans in neighbouring houses in the river-to-river bed and uses its coolness [6].

The most time for using Shodan is in hot days of summer. In other words, there is a lifestyle in Shodans under the city in addition to the ongoing life in the city. In fact, attention to adverse climatic factors and ignoring heat factor and its inhibition in this area creates the plan of using underground surface and spaces such as bedchamber and Shodan. Shodans not only is a cool space, which was used as a cool and calm place in the summer but also had a significant impact on air conditioning and cooling buildings so that the cool air in Shodan was distributed through channels in different parts of the building [12].

### 8.1.2 Shodan history

Basically, Shodan and planning such a space is known from the Safavid era in Dezful and Shushtar. Syed AbdullahJazayeri in Shushtar biography narrates: They built flat and large seating area around the water in the basement and people in every neighbourhood satisfied with the canal. However, for a long time, aqueducts are all barren, most of the ocean gyres are over, and building of the mud-walled house is obsoleted. Inevitably, some humorists who cannot tolerate heat chose Shodan, and many houses have multiple Shodans. Creating large bedchambers along the old creek (Dariyoon river under Salasel Castle in the north of Shushtar) and under Salasel Castle floor and in the rock can occur 20 degrees temperature difference in summer [11].

Many of Dezful Shodans have been used up to Qajar and Pahlavi era. After the invention of the electric cooling equipment, the use of Shodans is reduced except in special cases. Shodan had become a derelict space before the war of 1980. However, it was considered as the best shelter for citizens in times of war and Iraq's air and missile strikes to Dezful. After completing the war

and the lack of need for Shodan, it was forgotten for the second time. These underground spaces that were connected to each other were closed by the police because they had been turned into a shelter for criminals. By the end of the war over two decades, a huge wave of construction was formed in cities. This time, many of Shodans were destroyed in order to the renovation of the old city and they were filled with construction debris. Currently, a number of Shodans in Dezful and Shushtar are used for storage. Many of them are abandoned and unused, and a few of them are used with repurposing.

### 8.1.3 Shodan structure

Shodan is a relatively wide inlet, which is usually located in a part of the yard. In some cases, it is placed in a stoop in adjacent the yard and it is often without door [10]. Stairs start from the beginning and continue to the end of this underground space. The connection structure of Shodan is very different from one another, but they are similar in a general framework. The temperature of Shodans is equal to the average temperature throughout the year, which is about 25 degrees Celsius.

### 8.1.4 Shodan space

In the days when the weather becomes very hot, the coolness of bedchamber can no longer meet the needs of residents and the temperature of bedchamber is onerous for living and doing the activity. For this reason, traditional skilled architects and builders have predicted Shodan space in more depth. Thus, the stairs continue to down after bedchamber in a surface lower than bedchamber to a basement with a depth of 6 to 20 meters from the yard, which is Shodan or Shabadan. Shabadan is a space cooler than bedchamber, which was used when the weather in bedchamber was too hot [13-18]. Shodan is an element separated from the total structure that its access has various forms including through bedchamber or through one of the side-yard spaces, or even the courtyard. In hand made Shodan, there is no building material in the walls and ceilings. Bricks were only used in constructing the floor and stairs. This was achieved because of the soil type in these regions. This space acts as cool basements in hot summers in Dezful, which send cool air to the rooms with the holes that are continued from it to rooms.

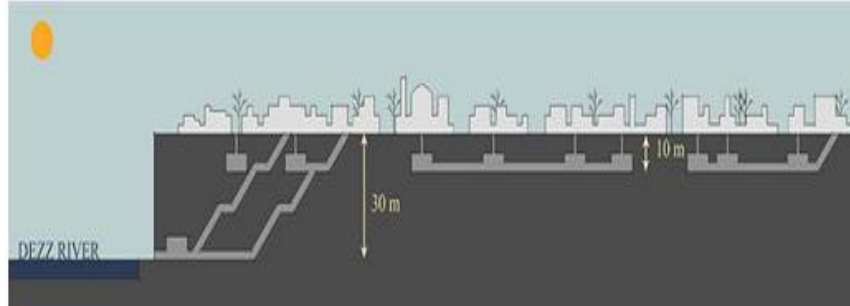


Fig. 4. Profiles of Shodan in Dezful (Reference: Bona, 2008)

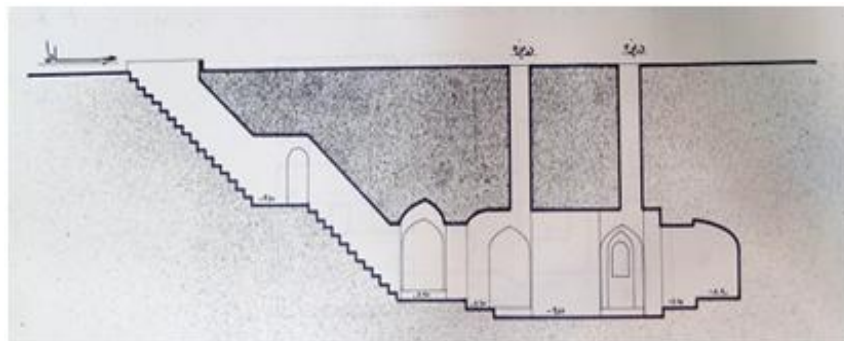


Fig. 5. Profile of Shodans in Dezful [12]

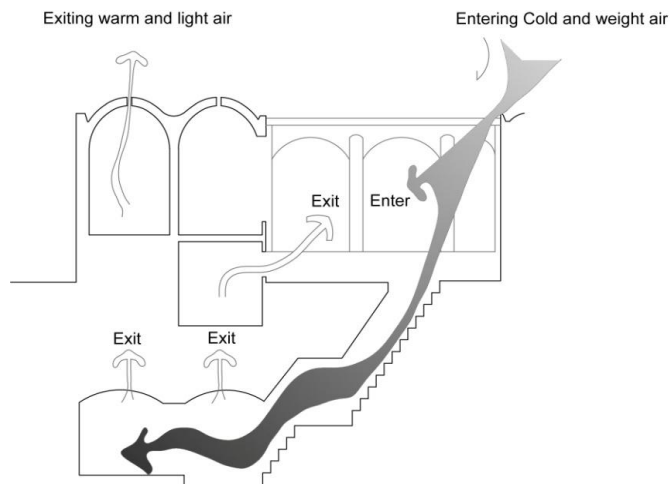


Fig. 6. Vertical cutting of Shodan-air circulation [6]


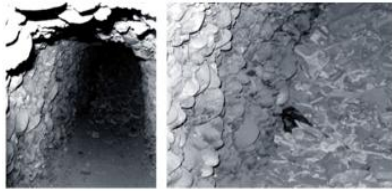

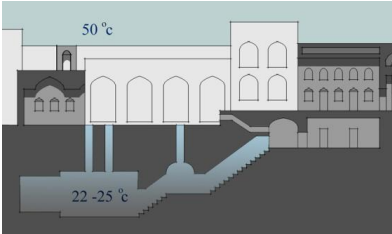


Fig. 7. The interior space of Shodan [9]

### 8.1.5 Shodan components

Table 6. Different parts of Shodan

Shodan components	Description	Document sample
Stairs and plapem	Stairs are the connecting component of the building to Shodan that some of them have 40 stairs. Stairs are connected to Shodan from different parts of the building such as porch, alcove, rooms, and yard. Plapem or wide step is a wide surface or level, which was built for rest after the main stairs. After that, other steps reached the floor (quadrangle). Large Shodans could have two or three Plapem.	

Shodan components	Description	Document sample
Quadrangle	All Shodans have the main space. This main space is called quadrangles. Quadrangle is the main centre of life activity in Shodan and ancillary parts were connected to it. Due to the type and strength of soil in Dezful, it is possible to drill the ground without arch and using structural elements. This provided freedom in building quadrangle and Kats.	
Tal	They are low width horizontal channels that provide a ground connection between adjacent Shodans. These tunnels cause flowing air in addition to accessing. Sometimes these Tals provided the connection between several neighbourhoods and local units, which have led to rivers.	
Derize	They were cylindrical pores with a diameter of about 1 meter to provide light and vertical ventilation of Shodan. These channels connected the upper spaces above the house to Shodan, which caused flowing cool air to the house space. In addition, some Dezires were drilled in the yard as routes to raise soil when digging Shodan. In some samples, their valves were connected to alleys, passages and even roofs. In this way, the air was always circulating.	
Kat	The sinkage in the soil is called Kat. Kat is used in two senses: Sinkage in the river coast, which was connected to Shodan through Tal. Rooms or several sinkages, which were derived from the main floor, were named Kat. Katsweremore private spaces than Shodan. In some cases, Kats were 30 to 40 cm above the main hall. Each Shodan had more Kat depending on its size.	

(Reference: authors)

## 9. CONCLUSIONS

Our predecessors acted consciously to meet their needs in dealing with the environment. In the design and construction of underground elements, all aspects of sustainability, including environmental, economic, and social aspects have been considered. Regarding the energy crisis in the contemporary era, following the elements such as sunken courtyard and Shodans are not only an option but also are a compulsion. Therefore, we must preserve these valuable elements and follow the way of the past architects in dealing with geographical and environmental factors.

In two arid and dry, and arid and humid climates, heat and intensity of the sunlight cause creating one of the cases of forming architectural elements in these regions. Considering their differences in appearance, these elements are the same in the meaning and both of them were common in using the cryogenic energy of the earth, and adobe and brick materials. In addition, due to the lack of need for moisture in an arid and humid climate, constructing Shodans were in order to reduce moisture, and this moisture was supplied in the sunken courtyard by injecting moisture in arid and dry climate by creating pools.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Bahraini Seyed Hassan, Maknoon Rezz. Sustainable urban development from thought to action. Ecology Journal. 2001;27.
2. Qobadian Vahid. Climatic design, seventh edition, published by Tehran University, Tehran; 2005.
3. Qobadian Vahid. Evaluating climate in traditional buildings of Iran, published by Tehran University, Tehran; 2003.
4. Kasmaee Morteza. Climate and architecture, Sixth Edition, Soil Publications, Isfahan; 2003.
5. Memarian Gholam Hossein. Familiarity with the residential architecture of Iran, University of Science and Technology, Tehran; 2006.
6. Saremi Ali Akbar, Radmard Taghi. The value of sustainable architecture in Iran, Abadgaran Publications, Tehran; 1996.
7. Khanboloki Sasan. Sunken courtyard, a pattern in traditional architecture of the Central Plateau of Iran, National Conference Hundred Years of Architecture and Urbanism Iran, Karaj; 2008.
8. Rabobi, Mustafa. Knowledge of Iranian local housing and city in arid and semi-humid climate. The Association of Students of Tehran University, Tehran; 1974.
9. Safai Mohammad. Shodan sustainable architecture in the city of Dezful, Gaam Publications, Tehran; 2008.
10. Bina Mohsen. Climatic analysis of Shodan in Dezful houses. Fine Arts publication. 2008;33.
11. Rabobi Mustafa. Shodan-bedchamber, Asar magazine, number 2, 3, and 4; 1980.
12. Imam Syed Mohammad Ali. Papers about the geographical history of Dezful; 2002.
13. Pirnia Mohammad Karim. The stylistic of Iranian architecture, Soroush Danesh Publications, Tehran; 2005.
14. Ardala, N, Bakhtiar L. Sense of unity: The Sufi Tradition in Persian Architecture, Chicago, London: The University of Chicago Press; 1974.
15. Bachelard G. Poetics of space (extract), In Leach N, (Ed.), Rethinking Architecture: A Reader in cultural Theory. New York: Routledge. 1997;85-97.
16. Buttimer A. Home, Reach, and the Sense of Place, In Buttimer A, Seamon D, (Eds.). The Human Experience of Space and Place. St. Martin's Press. New York. 1980; 166-187.
17. Creswell JW. Qualitative Inquiry and Research Design: Choosing Among Five Approach, Thousand Oaks, California, London: Sage; 2007.
18. Given LM, (Ed.). The Sage Encyclopedia of Qualitative Research Methods. London, Thousand Oaks: Sage. 2008;1&2.

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