

Isfahan's Urban Design Sustainability with Climate During Safavid Period

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Iran is located in southwestern Asia between the Caspian Sea and Persian Gulf, in the region known as the Middle East. Iran is divided into twenty-eight provinces.

The name of Iran is the Modern Persian derivative from the Proto-Iranian term *Aryānā*, meaning "Land of the Aryans", first attested in Zoroastrianism's *Avesta* tradition. The term *Ērān* is found to refer to Iran in a 3rd-century Sassanid inscription, and the Parthian inscription that accompanies it uses the Parthian term "aryān" in reference to Iranians.




Fig. 1-2. Location of the provinces

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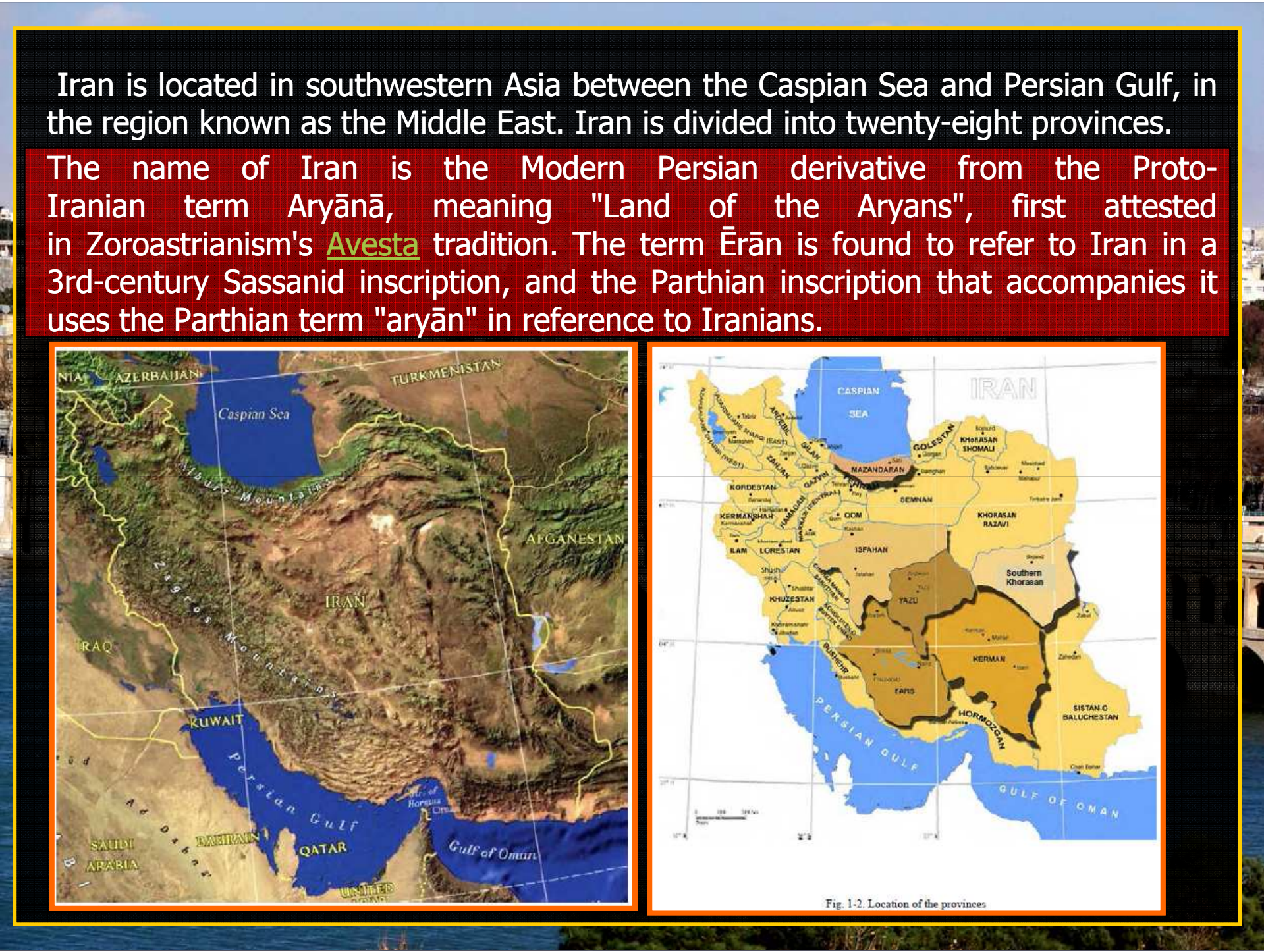
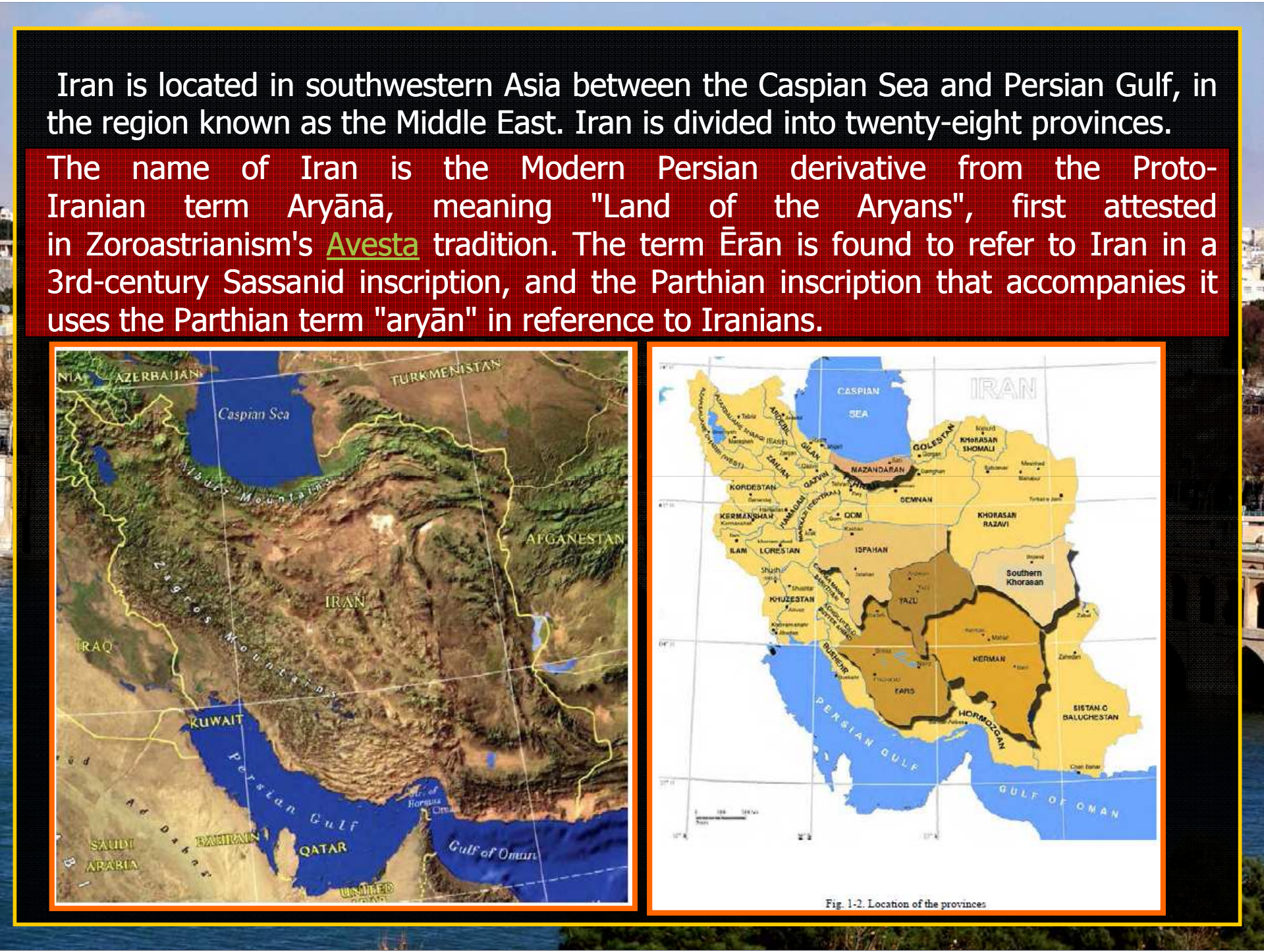


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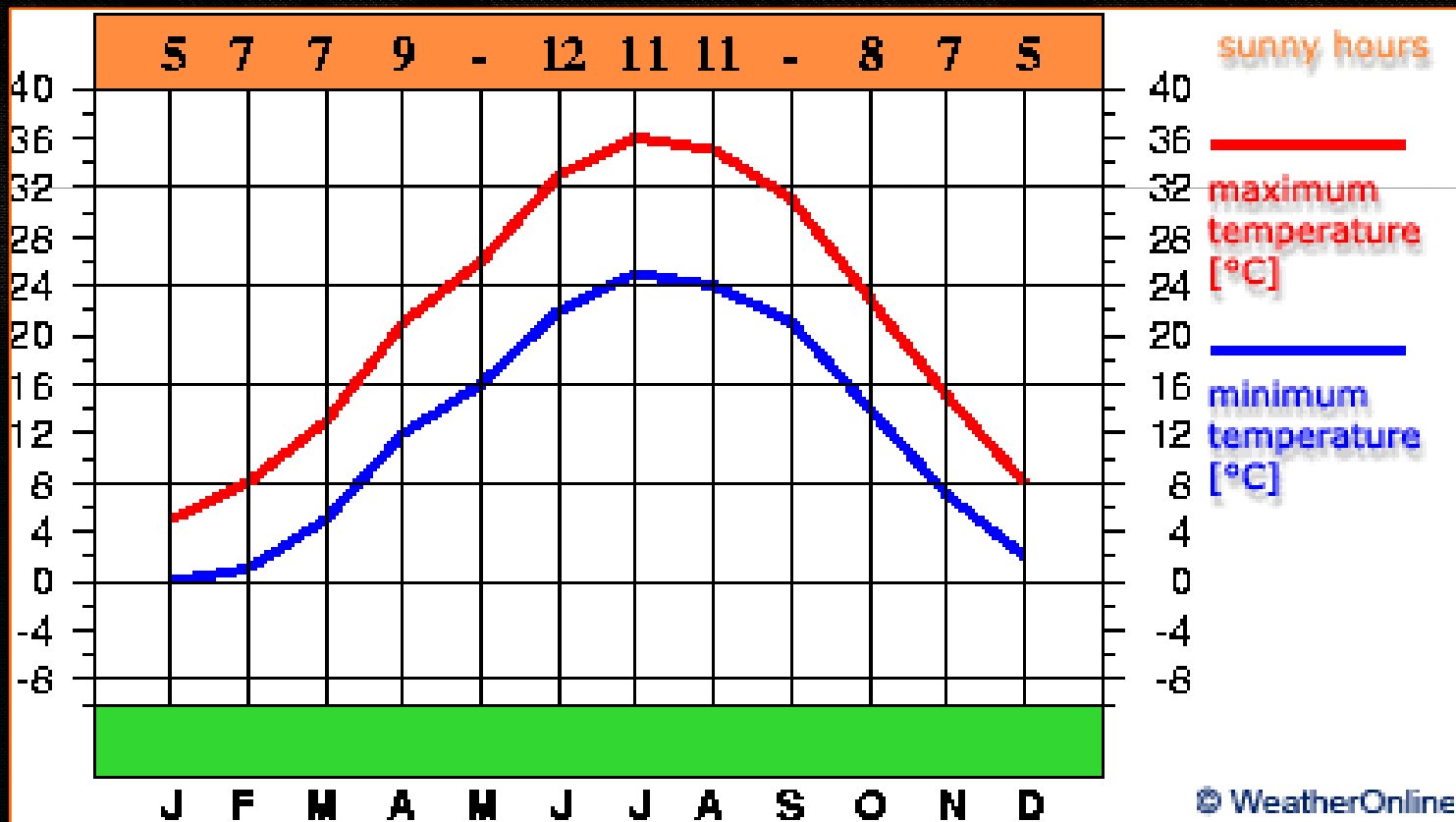
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The figure consists of two side-by-side maps. The left map is a topographical view of Iran and surrounding regions, including Azerbaijan, Turkmenistan, Afghanistan, Iraq, Kuwait, Saudi Arabia, Bahrain, Qatar, and the United Arab Emirates. It shows major geographical features like the Caspian Sea, Persian Gulf, and Zagros Mountains. The right map is a political outline map of Iran, labeled 'IRAN' at the top, showing its internal provincial divisions. Major cities are indicated by dots. Surrounding bodies of water include the Caspian Sea, Persian Gulf, and Gulf of Oman. A scale bar is present at the bottom left of the right map.

Fig. 1-2. Location of the provinces

In Iran, there are several unique climatic regions, each having special characteristics. As a result, Iran resemble a small continent. All of Koppen's climate zones and their deviations in one place.

Iran has an arid and semiarid climate with subtropical areas along the coasts. There are four seasons: spring, summer, a brief autumn, and winter. The central deserts and Persian Gulf coast are especially hot in summer, with some of the world's highest recorded temperatures occurring in the desert. Iran's climate is dry, except for belts of high humidity along the Caspian Sea and Persian Gulf. Strong seasonal winds often whip up dust and sandstorms.



Iran's average annual precipitation is 27 centimeters (11 inches) during non-drought years. Less than 14 percent of the land receives more than 52 percent of the precipitation.



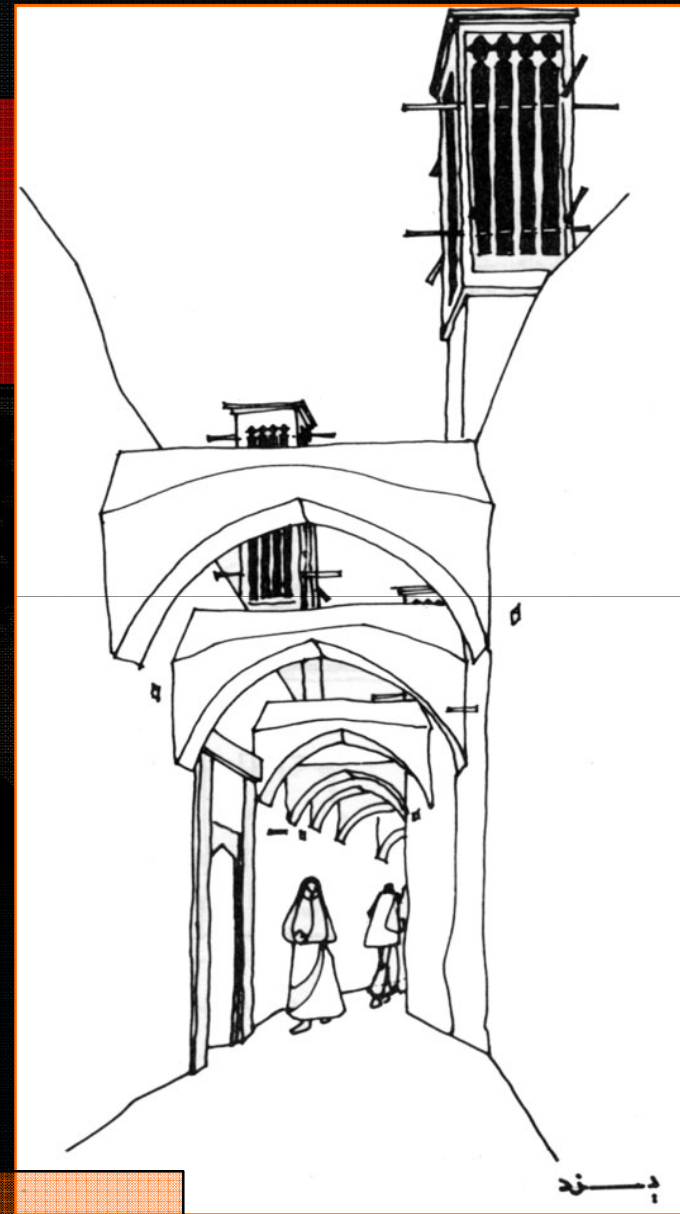
- Caspian Mild and Wet
- Caspian Mild
- Mediterranean with Spring Rains
- Mediterranean
- Cold Mountains
- Very Cold Mountains
- Cold Semi-Desert
- Hot Semi-Desert
- Dry Desert
- Hot Dry Desert
- Hot Coastal Dry
- Coastal D

The Iranian Architecture and Urbanism

One of the most important elements in Iran's climate is the shadow. Sunlight and its heating effects were important influences to consider for Iranian architectural and landscaping design.

Textures and shapes were selected by architects to harness as much light as possible during winter periods and shadows in the summer time

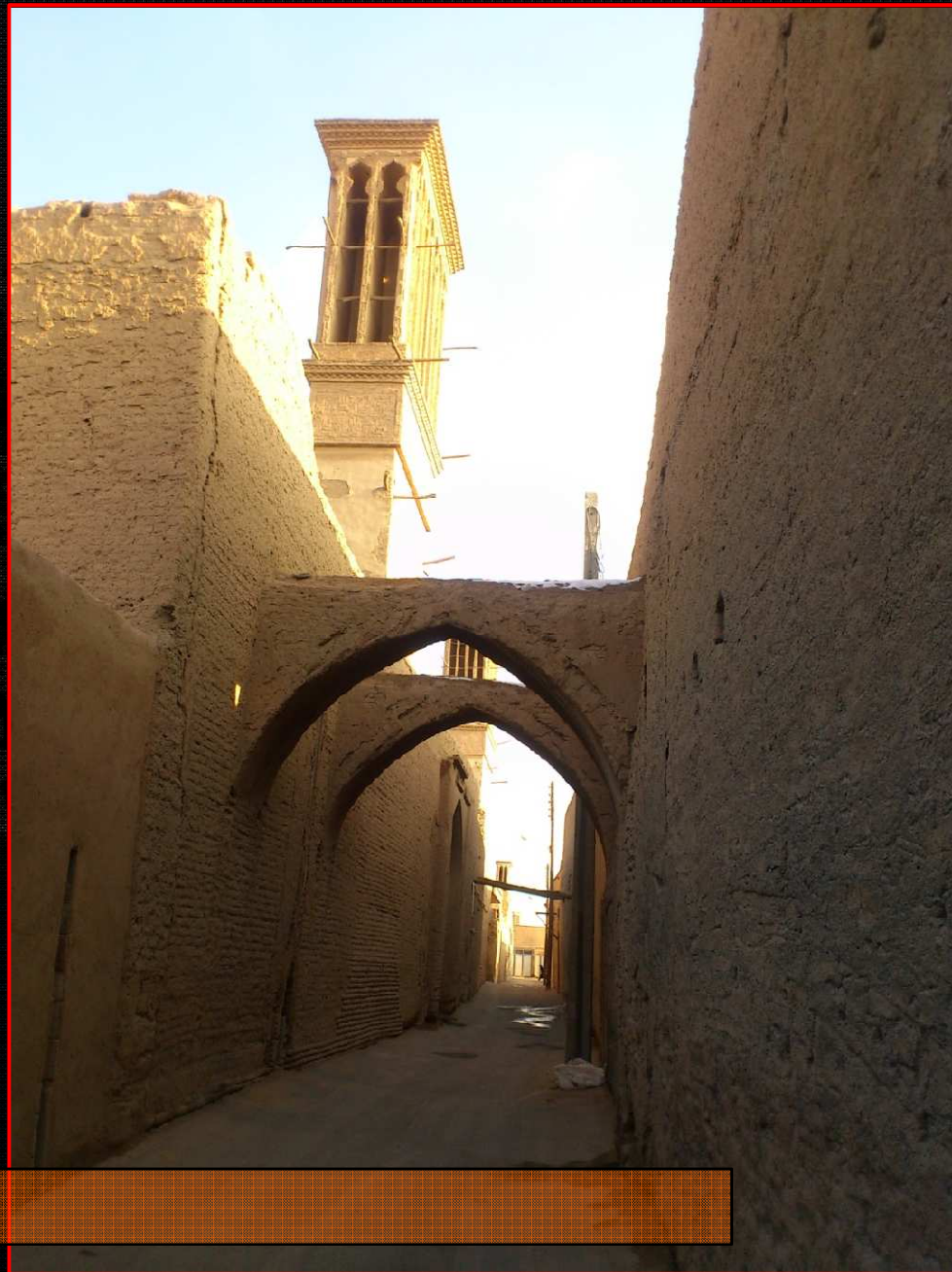
The villages and cities of hot-arid regions consisted of urban spaces, pathways, yards and buildings are completely protected against undesirable winds and at the same time desirable winds and sun radiation are used with special arrangements. The urban texture is condensed and compressed to each other in these regions.



Yazd

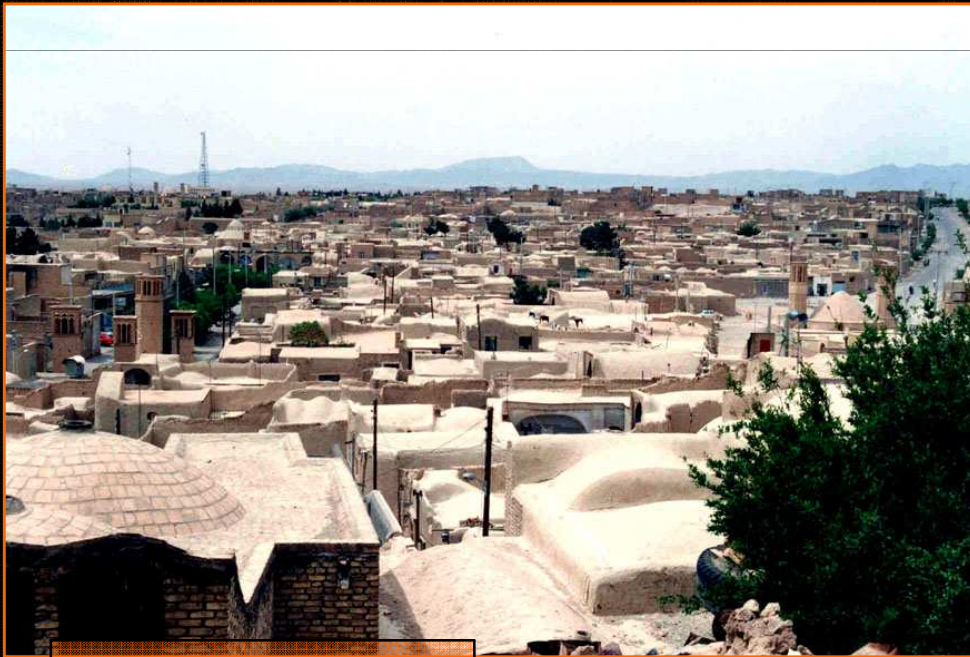


Yazd



Urban texture is harmonized with conditions of life and climate conditions. Urban texture in this climate has these factors:

- *1-Urban texture is very concentrative.*
- *2- City spaces are completely surrounded.*
- *3- Narrow irregular and some covered alleys.*
- *4- Buildings are attached together.*
- *5-Buildings have been located for using sunray and wind*



Naeen

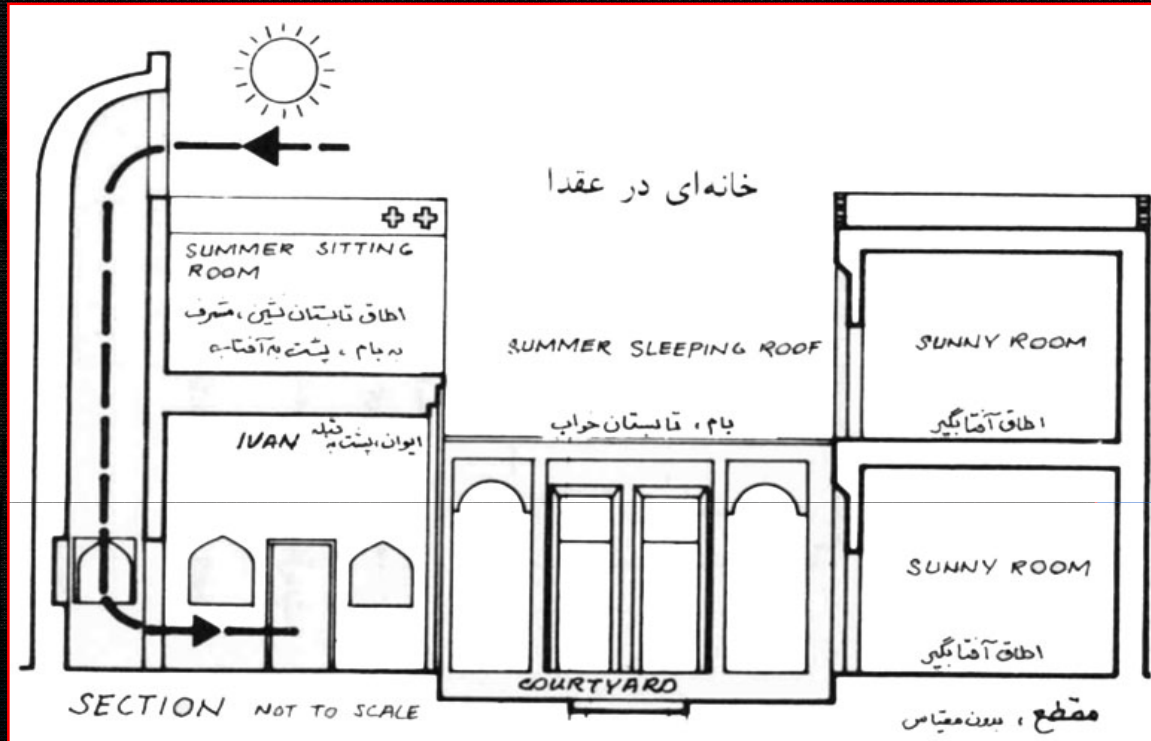


Naeen

	Characteristic s	Result
Urban Texture	Dense and very compact	Thermal loss is lowered
Urban Environment	Enclosed	<ul style="list-style-type: none"> •Prevents high velocity wind and sand storms. •Prevents the invasion of enemies from all side. •Internal temperature is more stable than external .
Alleys	Narrow and irregular	Prevents direct sunshine for long hours during the day.
Buildings Arrangement	Compressed to each other and merged wall	<ul style="list-style-type: none"> • Less thermal exchange between inside and outside. • Cool environment in summer and warm environment in winter.
Orientation & Configuration	Near to the orientation of north to south	Absorbs maximum heat in winter and provides most shadows in summer.

Table: Urban texture and architecture's Characteristics in Iran arid climate

Court Yards, Wind catcher towers (Badgir) and dome shape roofs where often used to adopt to the all year round climatic conditions.



A wind catcher tower (Badgir) in a hot and dry region brings about comfort by evaporation and air motion but a wind tower in a hot humid region only moves the air and conveys the wind into spaces. Different function and shapes were designed for different climates.

Badgir towers



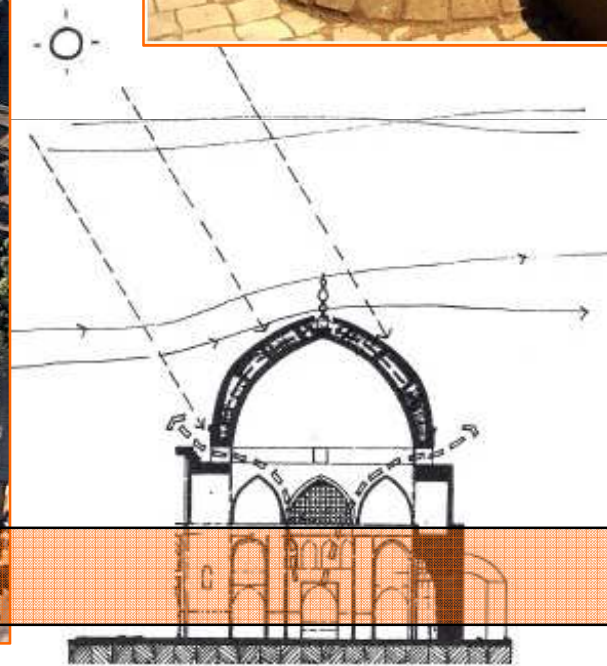
Laft



The dome shape for building's roof.



Isfahan



Climate of curved arches and domes in hot
and dry climate

Persian Garden and Gardening

Is there any special garden design features in this climate ?

Persian Garden and Gardening

The most adjustment between climate and architecture has used in Persian Garden. In large scale, Persian Garden constituent elements are ground, water and plants.

In small scale, Persian Garden constituent elements are :

- ▶ Major and secondary axis.
- ▶ Correlate elements with flowing water.
- ▶ Waterfront
- ▶ Wall and portal.
- ▶ Pavilion(Kooshk).
- ▶ Green cover such as trees, shrubs and ornamental flowers.
- ▶ Derivation made elements.



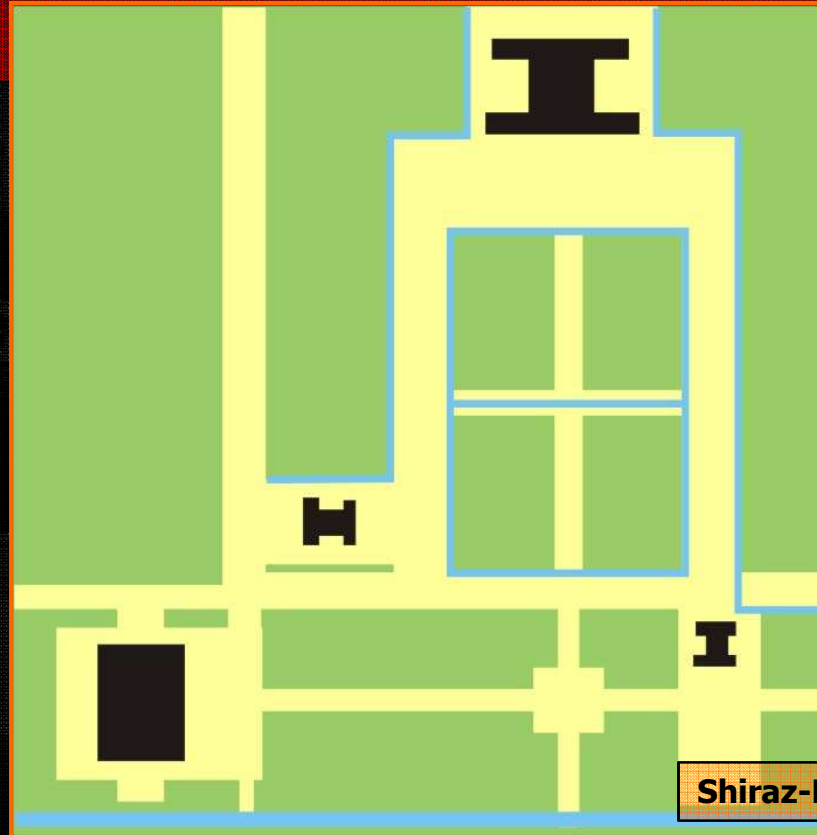
Kashan-Fin Garden



Kerman-Shazdeh Garden

Bagh-e Shahzadeh Mahan

The four part is the original concept of Persian Garden which has followed by Muslims after Islam.



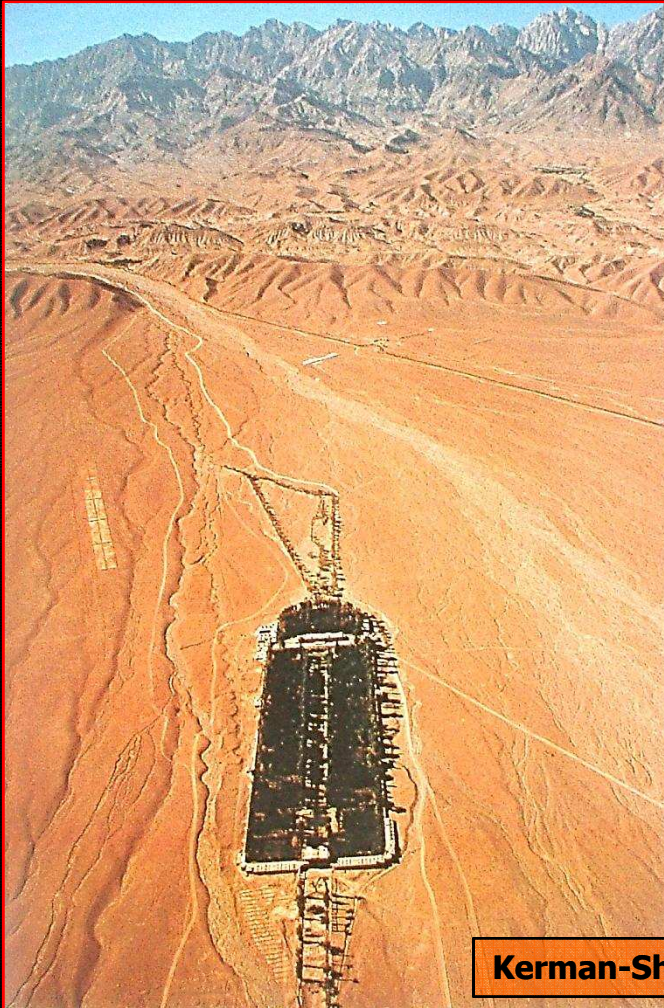
According to the four-part (Charbagh) concept, Moslems designed Islamic gardens as an image of Heaven in this world. They desire to experience on earth the paradise that the Quran describes.

Persian Gardens according form and function divide to 15 types which has named at below:.

- 1- Garden City.
- 2- Bagh Kooshk(Pavilion Garden).
- 3- Bagh Hayat(Court Garden).
- 4- Bagh Maghbereh(Tomb Garden).
- 5- Bagh dar Bagh(Garden inside Garden).
- 6- Bagh Chador(Tent Garden).
- 7- Bagh Ghaleh(Castle Garden).
- 8- Bagh Tajir(Garden with Semitransparent wall).
- 9- Bagh Takht(terrace garden).
- 10- Bagh-e Vahsh(Zoological Garden- Such as Tavoos khaneh va Shir Khaneh in Isfahan).
- 11- Bagh-e Shekar(Hunting Garden).
- 12- Bagh-e Aab(Water Garden).
- 13- Bagh-e Melli(National Garden).
- 14- Bagh Bisheh(Forest Garden).
- 15- Bagh-e Giah shenasi(Botanic Garden).

climate qualities had used by Persian Garden's designers in the best form in physical and spatial structure of gardens. Therefore They had reached to the conflict place with outline environment which has thermal comfort in peak.

The wall has used against warm wind, trees for getting shade and also water has used for irrigation and obtaining sound and moisture.



Kerman-Shazdeh Garden



Kashan-Fin Garden

The Comparison between Persian and European gardens with emphasize on climate and the difference between inside and outside of garden shown in below figure.



Kerman-Shazdeh Garden



Now, there is a question:

Have people used same methods for adjustment with climate in ancient Iran?

**Certainly No
Iranian have been selected method according local condition and real facilities.**

In continue, we will explain the Isfahan during Safavid period.

Safavids (1501/1502 AD to 1722 AD) used different urban design and architecture method against hot and dry climate in the Isfahan during the city development on Safavid period.

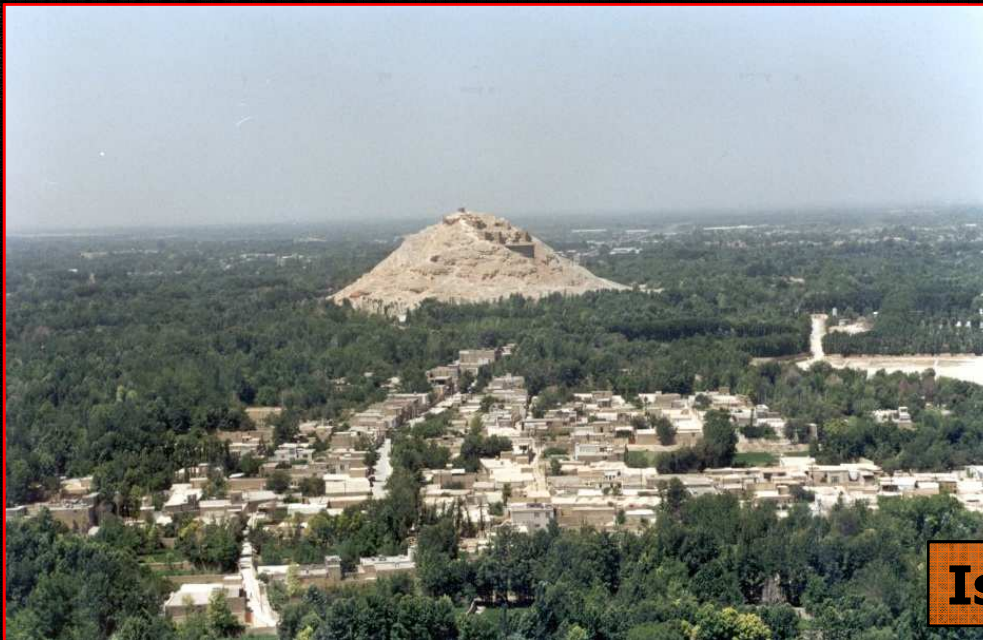


Isfahan

THE CITY OF ISFAHAN

Isfahan's history began twenty-five hundred years ago (in the Sassanian era). Isfahan became the capital of the Safavid dynasty (1596) during the reign of Shah Abbas (1587-1629) and it was transformed to such a large city. Safavids used garden city model for city development.

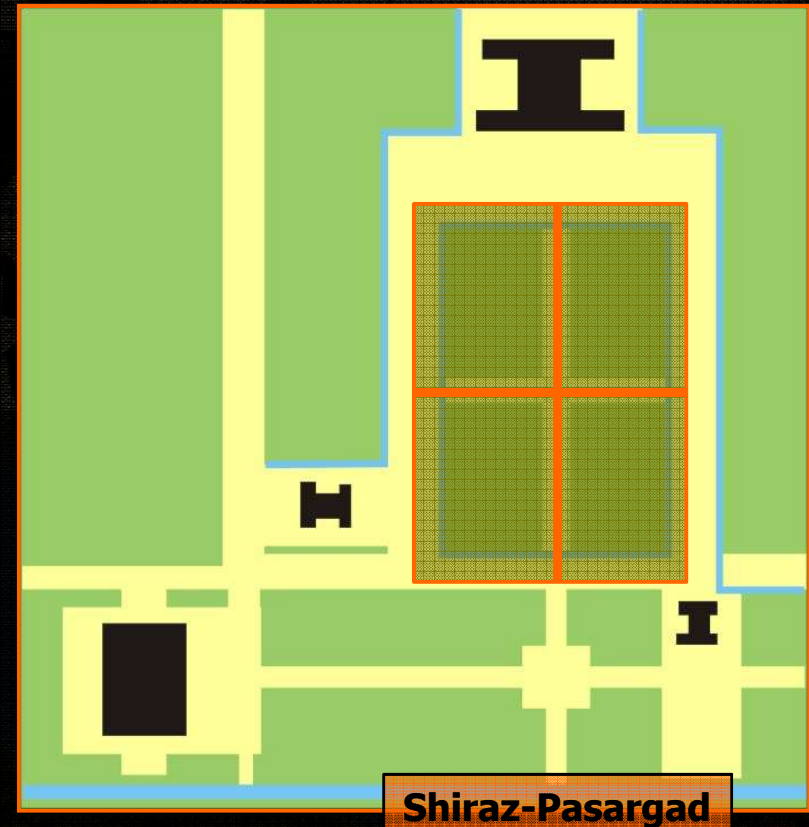
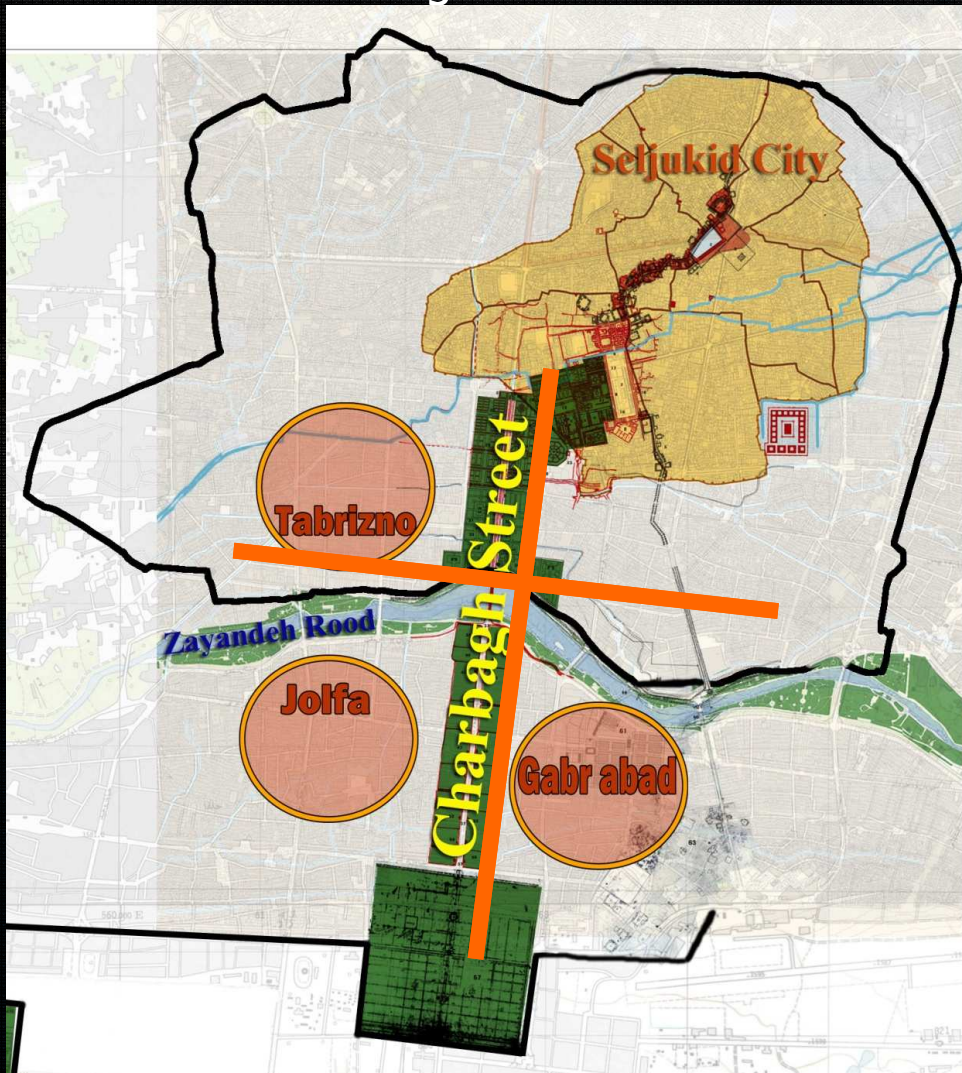
Garden city is the Islamic concept of the Ideal City, formed according to the Garden of Eden which was primarily taken into consideration in the Safavid period. Gardens as parables of Heaven were often used as composing elements in urban design. This idea resulted in the primary basis for city planning.



Isfahan

3-1- Garden City Concept.

Two major axes can be described in the main structure of Isfahan in the Safavid period. The first is Charbagh Street and the other is the Zayandeh-Rood River which organized as same as Persian garden model(Charbagh).



THE CITY OF ISFAHAN

This is a different way which was used by the Safavids to provide thermal comfort in Isfahan's hot and dry climate. This initiative was made possible only by the presence of enough water in Zayandeh-Rood. The Zayandeh-Rood River gave inexpensive and easy access to water.



Chehel-sotoun Garden



Hasht Behesht Garden



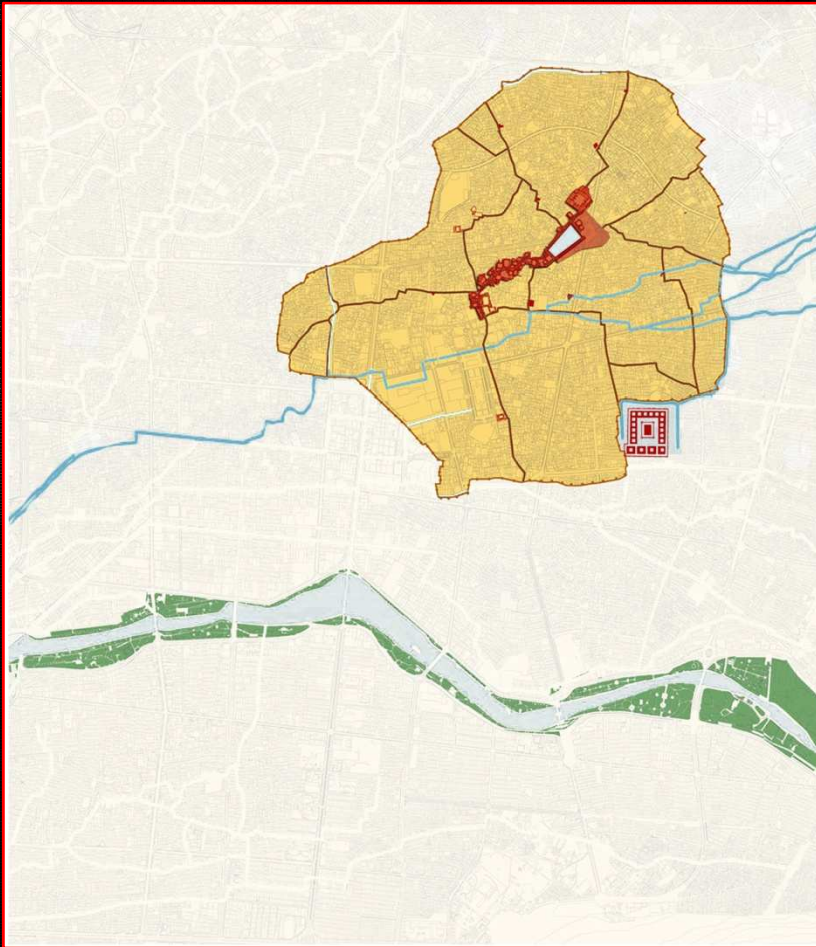
Charbagh School



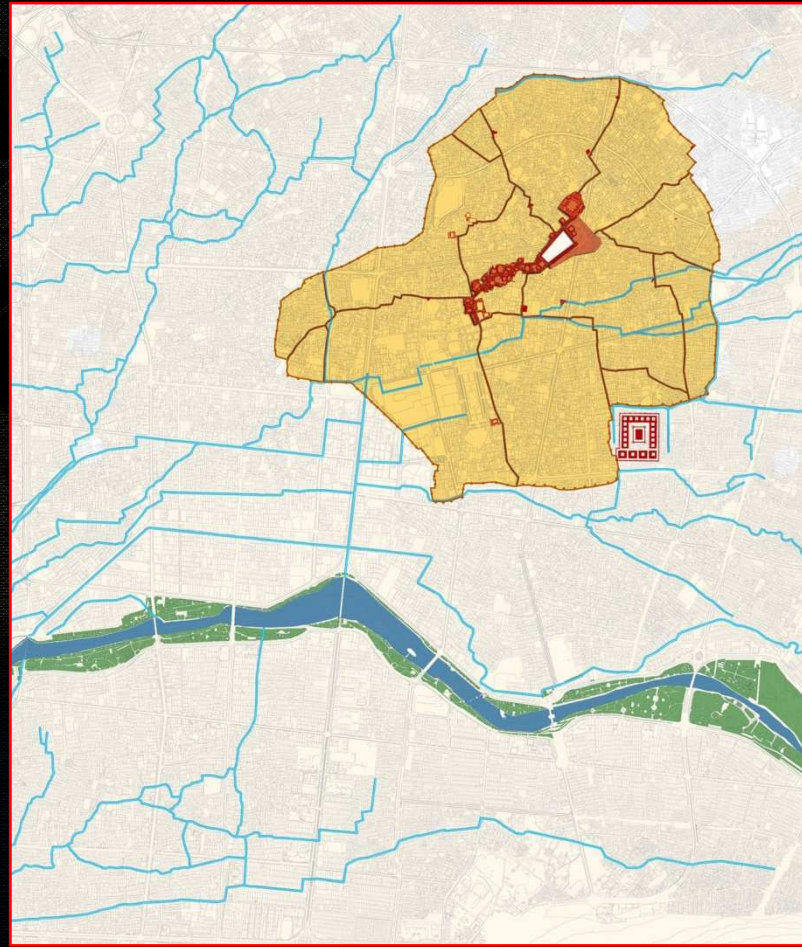
Niasarm Madi

THE CITY OF ISFAHAN

In order to create long-lasting green cityscapes, the Safavids developed and used dug canals (*maadi*) which branched off the river.



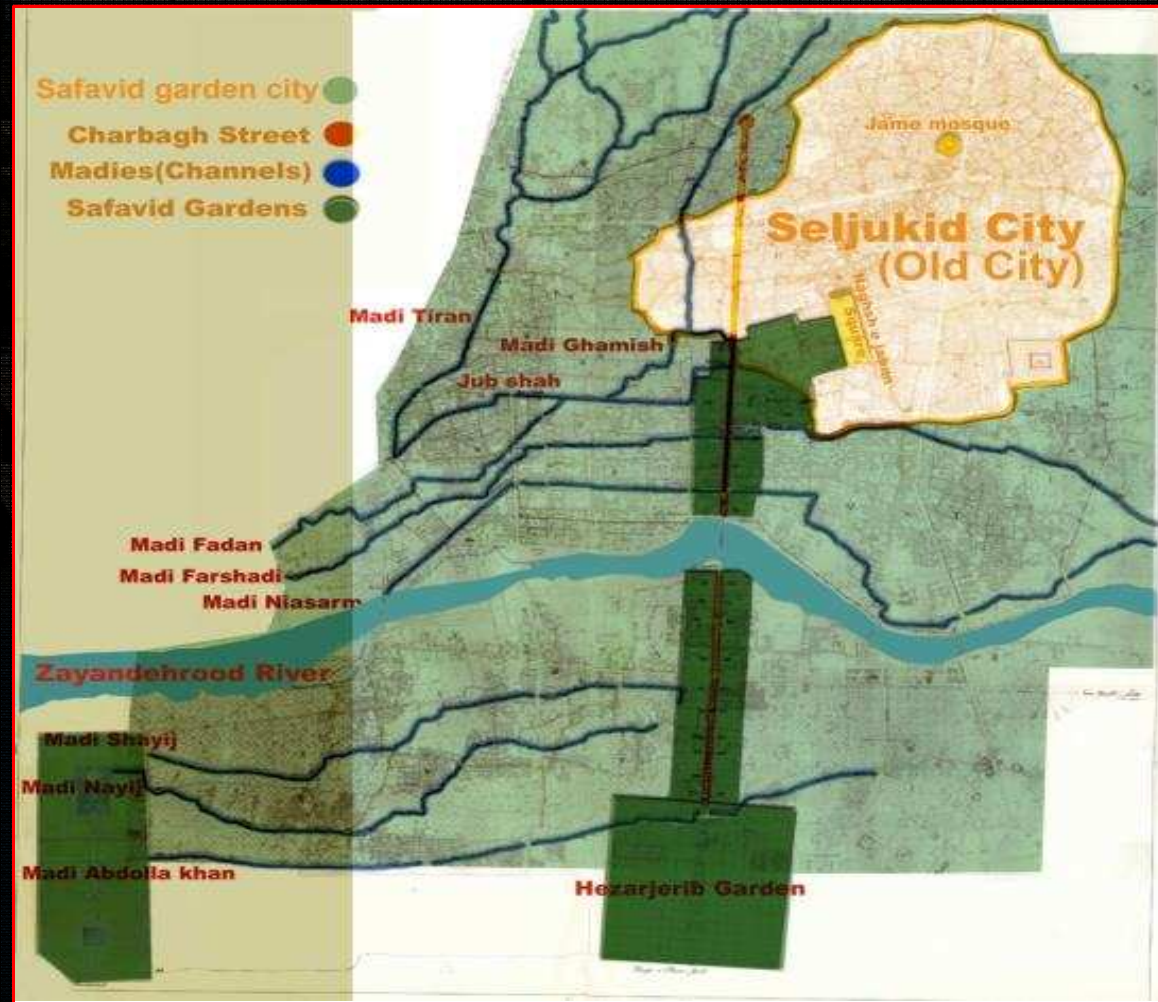
Dug canals before Safavid



Dug canals after Safavid

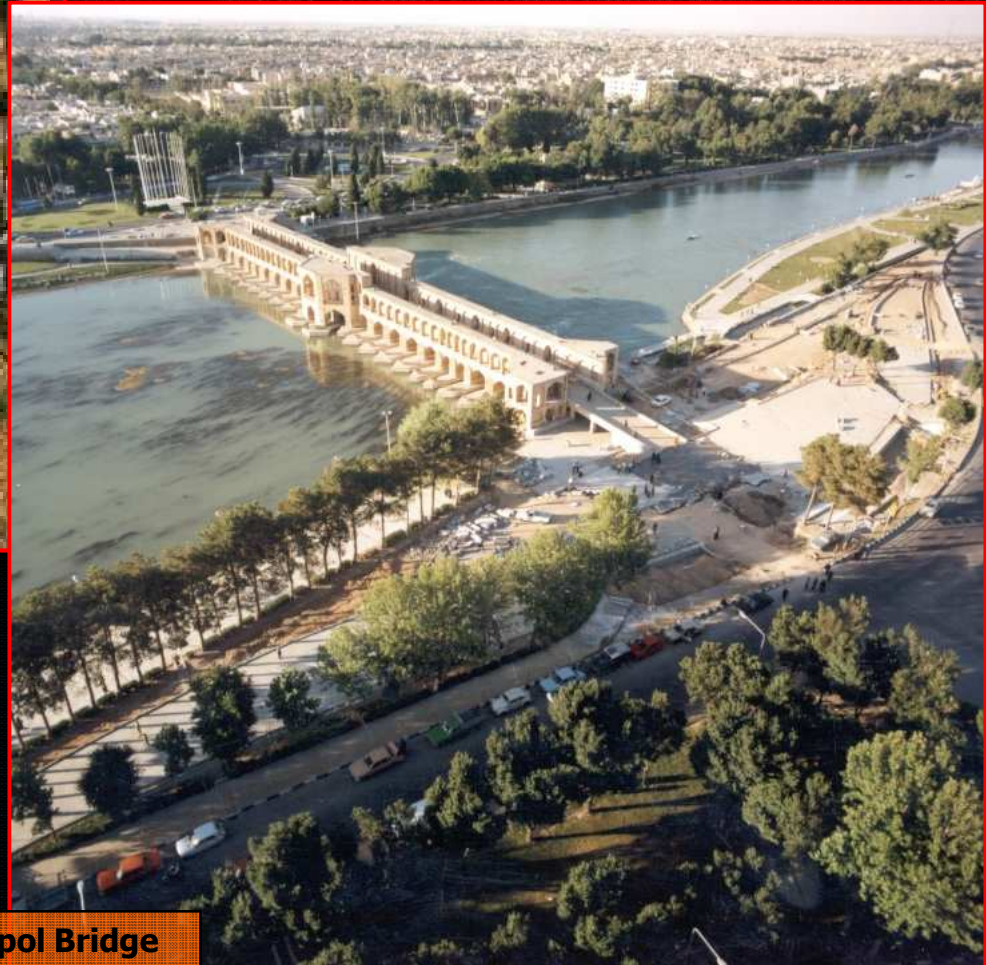
3-1- Garden City Concept.

The city has been designed and planned for the best interest of its citizens' health and wellbeing. Climate adaptation and water supply problems were solved in Isfahan's urban design as shown in below figure.



3-1- Garden City Concept.

Safavid's had applied these special methods for attaining sustainable water supply and proper shaded spaces to produce urban vitality for the hot and dry climate of Isfahan.



Isfahan-33pol Bridge

3-1- Garden City Concept.

The image of the town was altered by water ways that ran all around the city and the expansion of gardens as a major physical composer element along Charbagh Street and other new city regions. The subjective image of the new city depicts an ideal figure of Heaven integrated with nature and beautiful gardens.

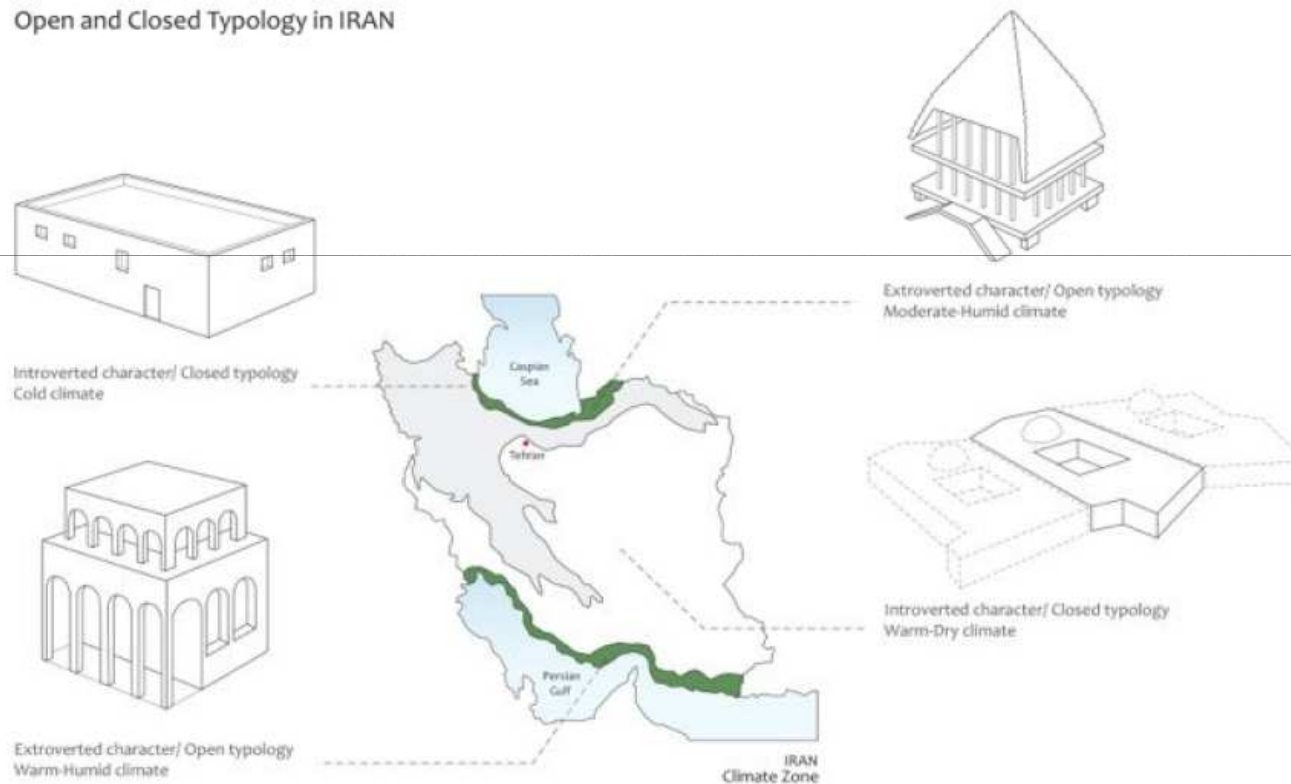


Isfahan-Chehel Sotoun Garden

THE CITY OF ISFAHAN (before Safavid period with introvert building)

Some Safavid's buildings were formed according to an introvert model as same as other building in middle of Iran but they have had big courtyards as gardens which provided thermal comfort.

Open and Closed Typology in IRAN



THE CITY OF ISFAHAN(before Safavid period with introvert building)

Isfahan buildings which have had big courtyards as gardens. This method provided thermal comfort as below picture shows.



Old Isfahan

THE CITY OF ISFAHAN (during Safavid period with extrovert building)

During Safavid period most of the new buildings were constructed inside gardens as pavilion and changed to extrovert model (below figure). This is a new innovative technique to sustainably adapt to the City's climate.



Chehelsotoun Garden



Namakdan Pavilion



Aeineh khaneh Pavilion

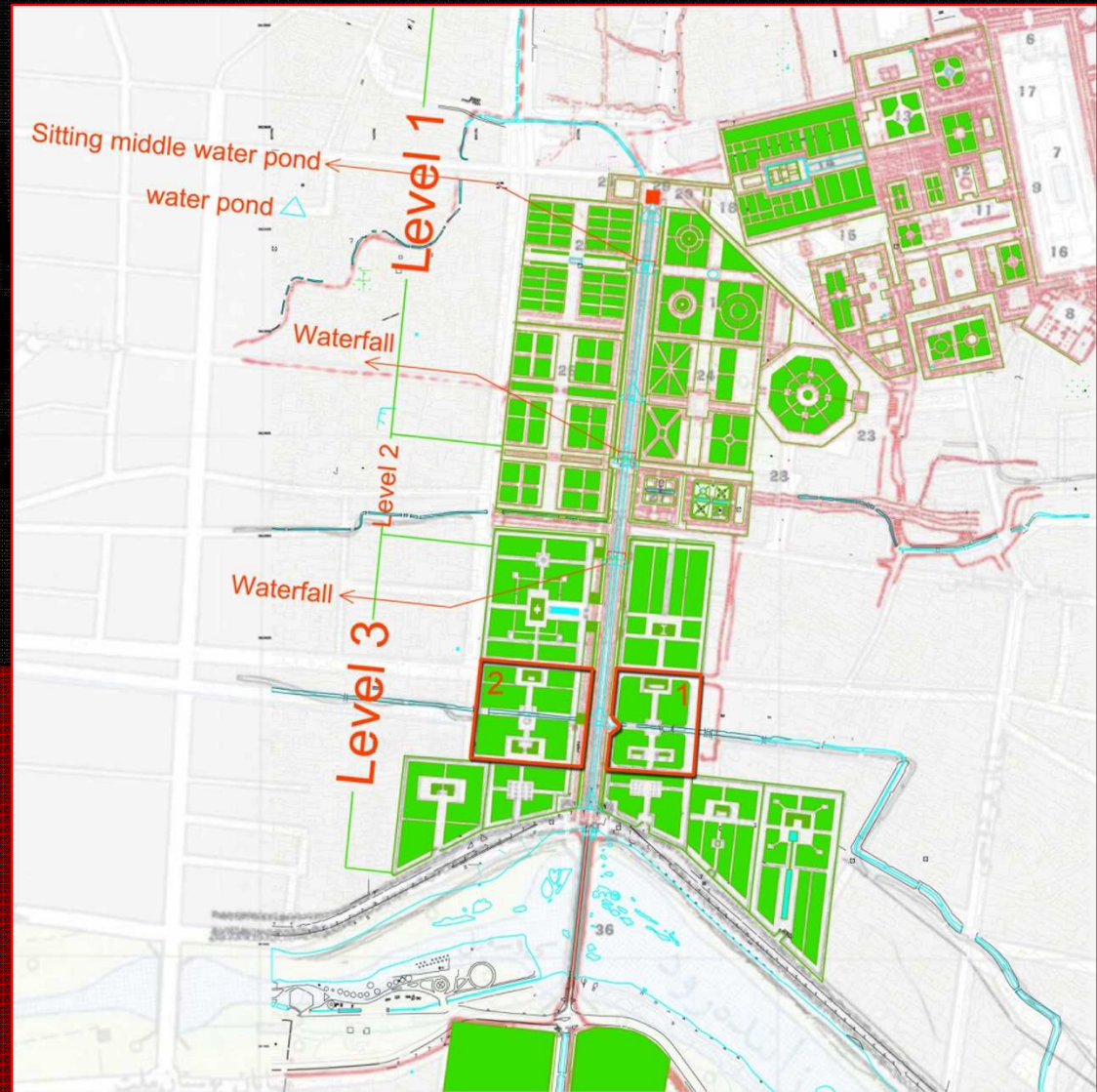


Aeineh khaneh Pavilion

CHARBAGH STREET AS A MAJOR LINEAR OPEN SPACE

Charbagh Street was a major manmade axis connecting the new and old sections of the city and conforming to the multifunctional aspects of Persian garden axes such as: dividing, connecting and the drawing the eye to specific vistas, central water canal and linear rows of trees.

This is a method which Safavids had applied for attaining thermal comfort. They had used gardens in both sides of street, water ponds and canal in middle and also tree lines.

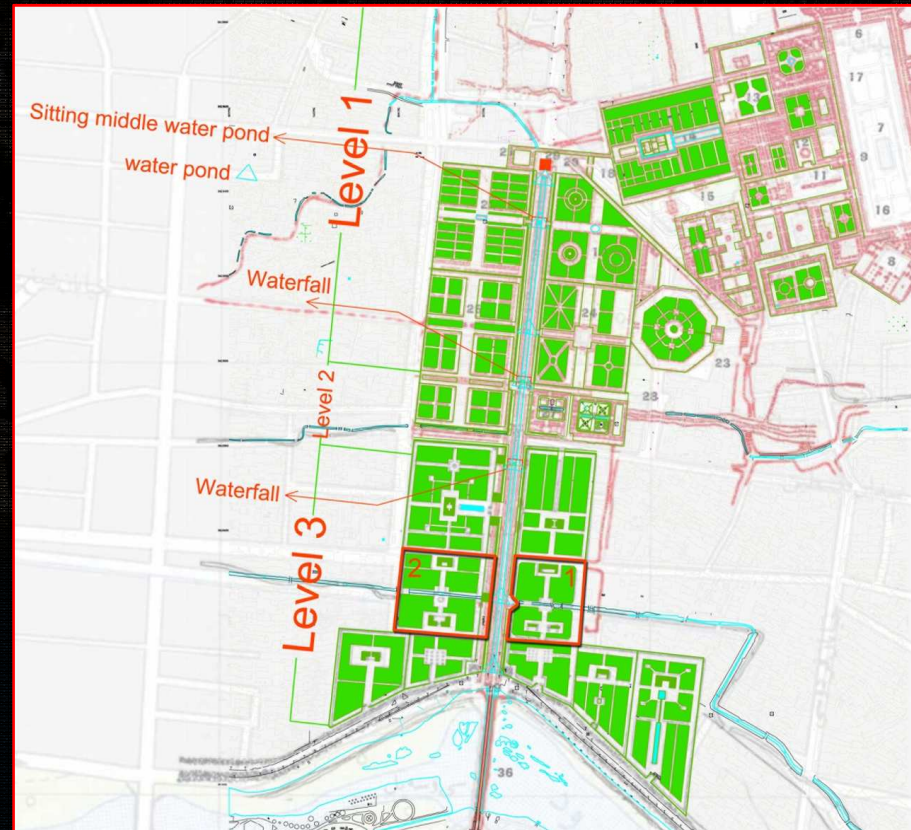


CHARBAGH STREET AS A MAJOR LINEAR OPEN SPACE

This is different by which has
done before in middle of Iran
and also before Safavid Period
in Isfahan.



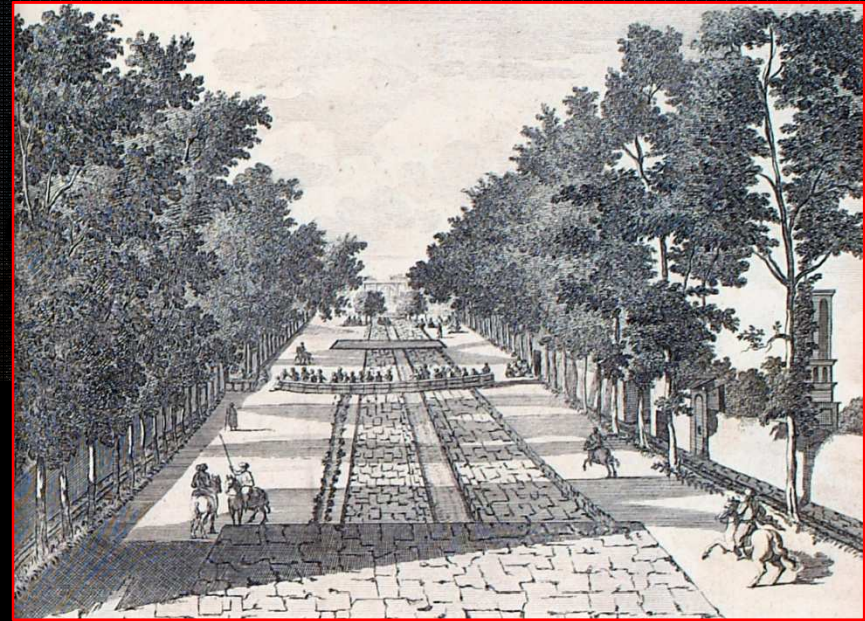
Dense and very compact texture



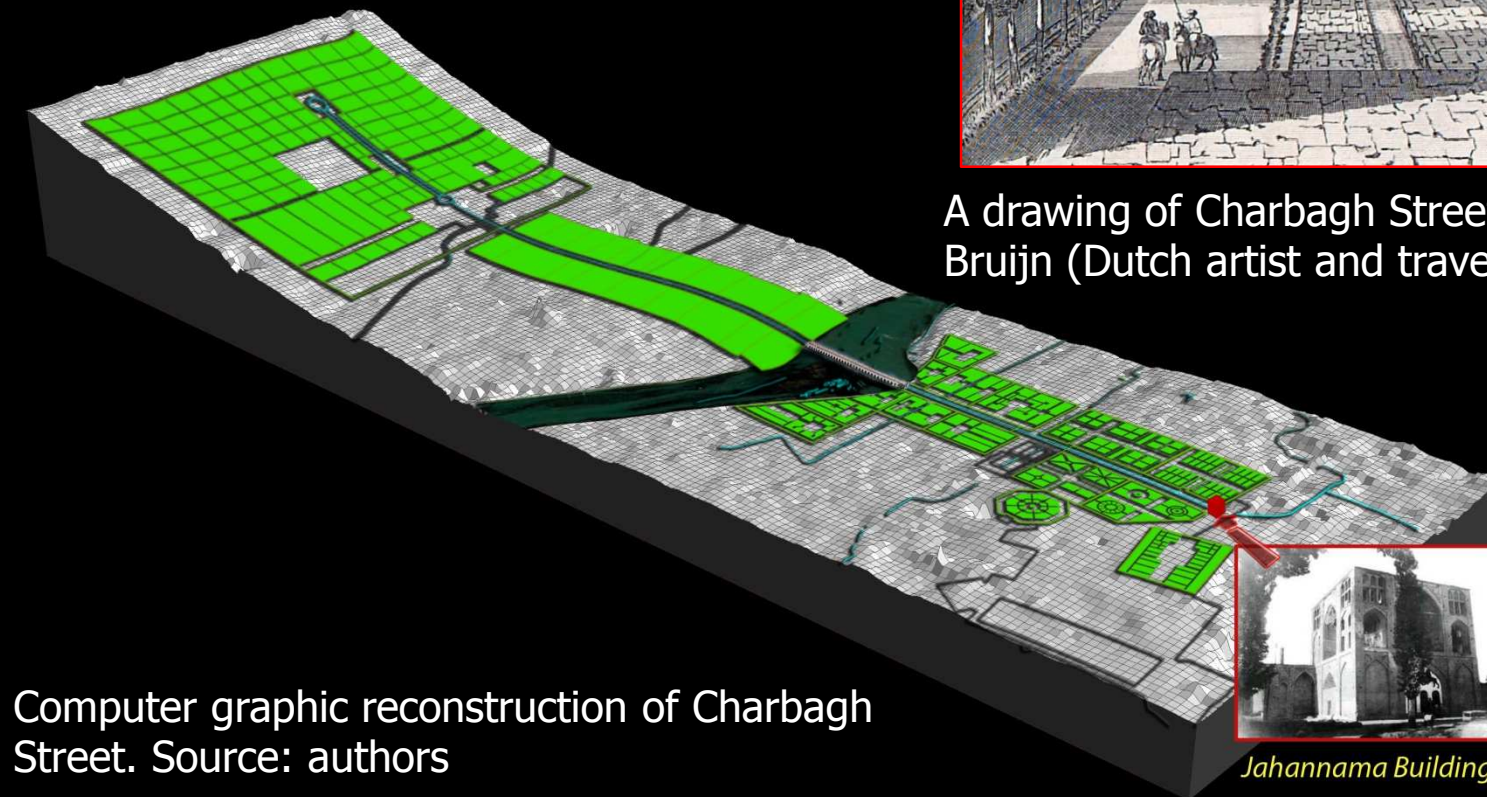
Linier open space with gardens and water features

CHARBAGH STREET AS A MAJOR LINEAR OPEN SPACE

The boulevard stretched from two major monumental elements , Jahannama Tower to Hezarjarib Garden



A drawing of Charbagh Street by Cornelis de Bruijn (Dutch artist and traveller) 1704-5.



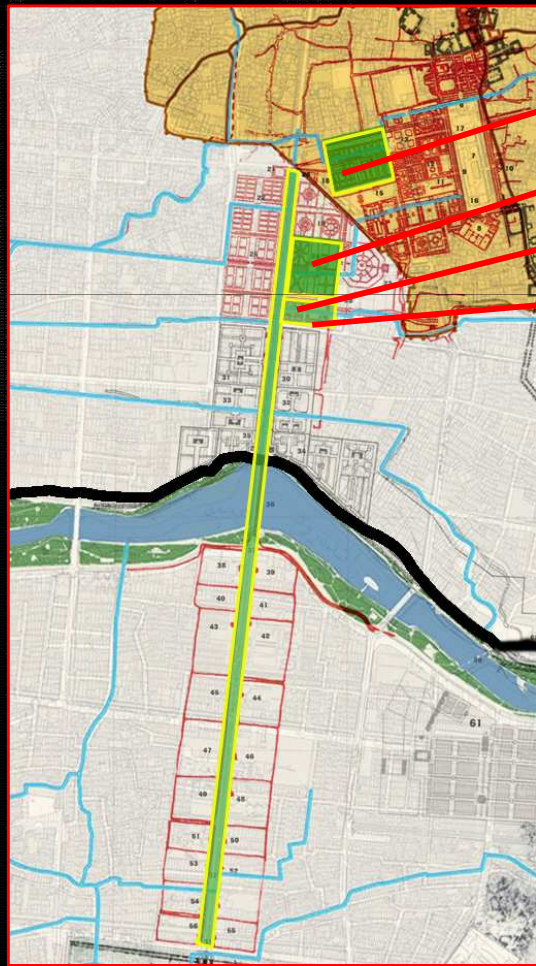
Computer graphic reconstruction of Charbagh Street. Source: authors



Jahannama Building

CHARBAGH STREET, Gardens and Madies AS Green Heritage and Infrastructure

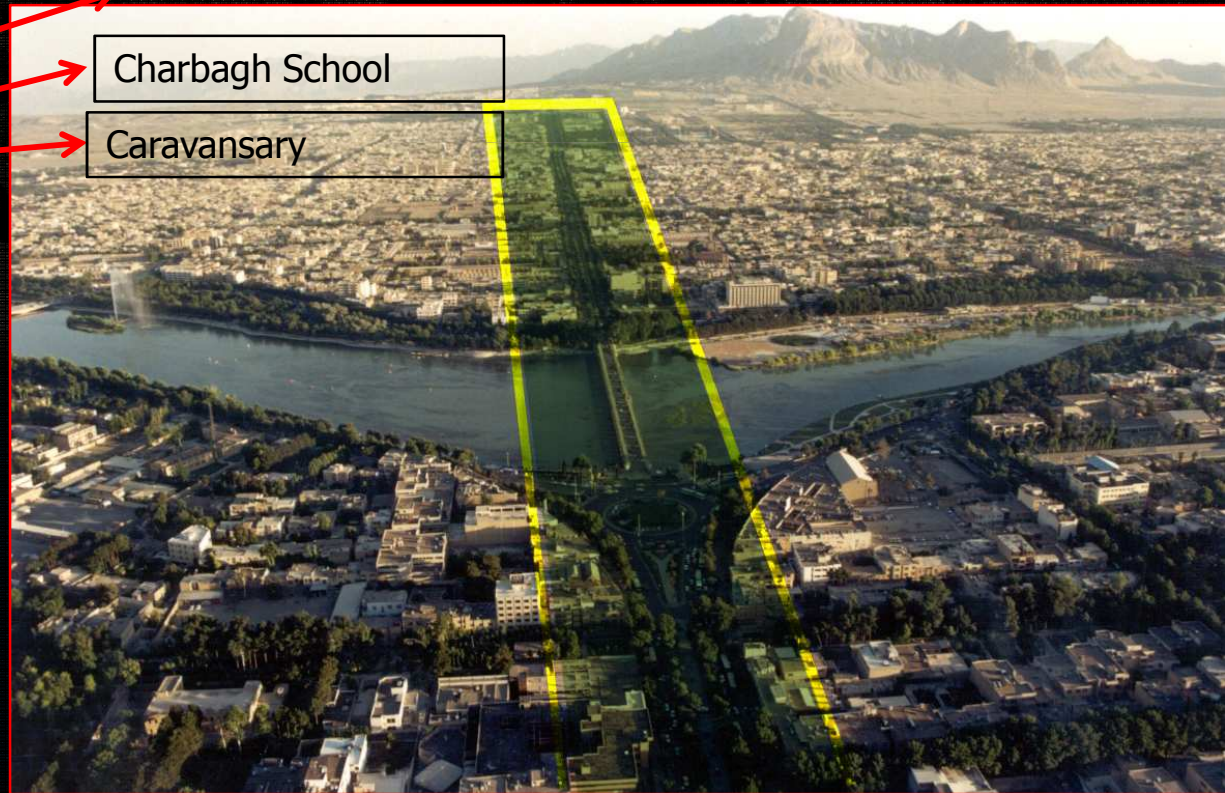
Today only remained 2th of those Safavid gardens, Charbagh School, caravansary and some water channels(Madi).



Chehel-Sotoun Garden
Hasht-Behesht Garden

Charbagh School

Caravansary



Conclusion

Considering the previous information, it can be concluded that new sections of Isfahan was structurally formed by the use of two linear organizing elements (Charbagh and Zayandehrood) that mentioned in this paper. Charbagh as the manufacture element and river(Zayandehrood) as the natural element. This special design method has derivate from Persian Garden's design origins and made city has formed as a large garden.

The principles, which have used in Isfahan, create longevity in the design of the city and its environment. The usage of water canals in order to transfer water from the river to the city and irrigation of the gardens had ensured its natural environment sustainability.

This study shows that during the Safavid period, Isfahan's urban design principles and garden city model were used specifically to suit the climate condition, in order to provide a sustainable design for the city and its environment. During Safavid period most of new buildings have been constructed inside gardens as pavilion and changed to extrovert model . Some buildings formed according introvert model with big courtyard as garden. Therefore, the gardens provide thermal comfort as the new technique. This innovation was the new solution to be adapted to the climate.