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SINCE ANCIENT PERSIAN GARDENS TO MODERN VERTICAL GARDENS AND ROOF GARDENS

Mohammad Baharvand

Department of Architecture, Faculty of Engineering and Architecture, Istanbul Gelisim

University, Istanbul, Turkey

E-mail: mbaharvand@gelisim.edu.tr

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ABSTRACT

Iran is a plateau surrounded by mountains, and with the exception of some rivers in the north and south, it is a relatively bare country. In this situation, creating manmade gardens and green lands need not only scientific information about water management and land properties but also need a professional aesthetic view. Persian gardens that are created in this severe climate are some of the most beautiful and thoughtful manmade structures in the world. Although the structures influence other countries by different climatic conditions, the structures have remained stable for centuries. In this study, the attempt is made to understand what the gardens are and why humans try to create gardens. The question is how Persian gardens were formed in the beginning and how their structures have persisted over time in different climates and different topography. Currently, due to the busy modern lifestyle and land limitations, the connection between human and gardens is fractured. Therefore, some ideas, such as applying vertical gardens and roof gardens, are described as a replacement to increase the connection between humans and greenery.

INTRODUCTION

A paradise is a place that God has promised to the faithful people after they pass through this world. This belief is common in most religions and is the most prevalent opinion about life after death. Holy books describe that human genesis is related to paradise, with Adam and Eve having been expelled from paradise to live the remainder of their lives outside of paradise. Paradise is described as a great garden, full of trees with beautiful rivers. There are different stories and fictions about the Garden of Eden. For example, in ancient Iranian mythos, Manouchehr Pishdadi ordered the planting of various seeds and called it "Boostan", which means the place of pleasant smells. Therefore,

he is known as having been the first to create a garden, although some sources introduce Jamshid-Shah as the first garden creator (Khansari et al., 2015). One of the famous Islamic stories is Shaddad's paradise on earth. Moreover, the historical hanging gardens of Babylon are well known around the world. Their irrigation system still raises questions, and it is categorized as one of the Seven Wonders of the World.

Attention to nature and trying to form a close connection to nature in the form of gardens is an inherent human need since the earliest records of human history. It can be said that gardening is a human effort to abstract the heavenly paradise on earth to answer man's inherent mental, psychological, and biological needs.

Social effects of gardens

Since humans are a part of nature, connecting and relating to nature is fundamental to reach perfection. The Iranians considered water and plants to be god indications; therefore, the relationship between humans and nature is formed based on respect and coexistence (Mehdi-Nejad et al. 2015). Due to psychological sciences, the social and aesthetic effects of plants and green areas are important and undeniable. Researches show that not only does the presence in nature reduce stress and fatigue, but also just looking at a picture or movie or hearing the sounds or any experiences from nature have the same effect (Mehdi-Nejad. et al. 2015). In addition, the natural environment, especially green areas, are a place for rest, relaxation, and recreation. Connection to nature and the natural environment has a positive effect on elderly people, and it is beneficial for the training and growth of children. Natural elements in hospitals also have a positive effect on patients' recovery (Perini et al., 2011).

Creating manmade green lands in garden form is an attempt to expand the connection between nature and humans. Gardens linked with various applications are evidence of this issue. Creating gardens around the palaces for pleasure, recreation, or relaxation of kings is called palace-gardens, and it was common in the history of Iran. Trees in cemeteries near graves and mausoleums in the form of mausoleum-gardens were used for their social and consolation effect (Figure 1). In these places, the type of trees was selected based on symbolic and mysterious ideas. As an illustration, in ancient Persian, the Cypress was the symbol of death and corpse and had the power to preserve the body against corruption (Daneshfar and Sedigh, 2013). Therefore, it was used in cemeteries. It was also the symbol of subtlety and happiness and was the most popular tree in Persian gardens. The Plane tree was a symbol of glory and training. The people believed that this tree prevented fever and infectious diseases. The pine tree was the symbol of elation, life power, fertility, silence, life length, and faith (Daneshfar and Sedigh, 2013). Depending on selected specific climatic conditions in Iran, the trees are respectable elements, but praise for ancient sycamore and trees such as Cypress, dates, pomegranates, and so on are not specific to Iranians and are respected by most of the cultures around the world (Masoudi, 2009).

Gardens played a fundamental role in the lives of ancient Iranians and were commonly attached to different applications such as the yards of houses, schools, mosques, and so on. In fact, the gardens were witness to the history of Iranian life. Apart from the positive social and psychological effects of gardens, they have numerous positive effects on the environment and surrounding area.



Figure1: The Tomb of Hafez (Left) and Sadi (right), two Great Persian poets in the form of Mausoleum Gardens

Environmental benefits of gardens

Gardens provide numerous benefits and mitigate some environmental severity. One of the important operations of plants is absorbing carbon dioxide and restoring oxygen. A mature tree, for example, generates 200 kilograms of oxygen per hour while absorbing the same rate of carbon dioxide (Rostamkhani and Laghayi, 2003). Fluffy leaves, branches, and trunks with hard skin absorb dust, pollen, and bad smells, which are then washed by the rain and fall to the ground. In fact, all kinds of plants absorb air pollution, but their resistance is different. In air-purification by trees, attention to the agglomeration of tree planting is a significant subject. Dense tree planting has less effect on air purification than sparse planting (Rostamkhani and Laghayi, 2003). The greeneries reduce the sound annoyance. Tree trunks and branches act as buffers and deviate the sounds while their soft leaves absorb sounds. The trees with dense and wide leaves and a high level of gum have a better sound reduction effect than other types (Rostamkhani and Laghayi, 2003). The shading effects of leaves and the branches of plants are substantial elements in temperature reduction. Moreover, soft screens of greenery reduce the reflection of solar radiation, and it has an important role in temperature reduction. Plant photosynthesis not only absorbs heat and cools the environment but also increases the humidity, which is an important factor in thermal comfort conditions, especially in dry areas.

By creating a small microclimate (Figure.2), the garden reduces some of the climatic hardships and moderates the weather condition. The Iran plateau consists of different climatic statuses, ranging from fertile areas in the north to drylands in the central part. Persian gardens are interesting because they are adapted to different climates and topography while following the same

structure. How the same structure supports different climates and has continued to do so throughout the centuries is one of their brilliant properties.

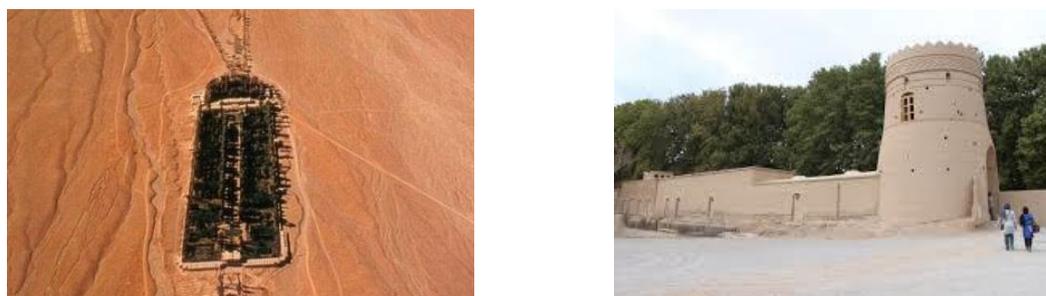


Figure.2: Persian Gardens Create a Microclimate in a Dry Plateau

The structure of persian gardens during the time

Persian gardens are well known based on their quartet division known as Chahar-Bagh; however, there is no exact agreement on the beginning and the base of this structure. Some researchers believe that in the beginning, the structure was a quartet, and Persian gardens were divided into four quarters, and some others believe that in the beginning, the structures were divided into two parts by one axis, and over time the quartet shape is developed (Figure.3). The discussions and reasoning are based on epigraphy, historical books, remaining evidence, and so on.

Geometry is a kind of agricultural achievement, and the origin dates back to Egypt and Mesopotamia, but in gardening, the main agreement is that the first man who ordered the planting of trees in regular and geometric shape was Cyrus the Great 6 (BC). In this way, the geometric structure of gardens dates back to the Achaemenid and royal gardens of Pasargadae. This structure is the main core of Persian gardens and the base of a well-known structure of Chahar-Bagh. The reign of the Achaemenid lasted around two centuries, but their gardens structure has remained.

The framework and skeleton of all historical gardens are based on the order of the water system, planting system, and architectural features (Shahcheraghi, 2012). Water is a necessary and crucial subject in gardening, and garden survival is related to the water source for irrigation. In the dry plateau of Iran, finding a proper source of water was a vital issue. It seems that the geometric structure of Persian gardens is formed based on water requirements. Regarding Pasargadae, only one stone channel was found in the archeological excavation, and the theory is that there was only one axis, and gardens were divided into two parts (Figure.4). David Stronach, a famous archeologist of Iran history due to the popularity of the common structure of Chahar-Bagh in Iran, assumed that there was a crossover axis in Pasargadae and one of the axes was demolished over time (Masoudi, 2010). In this way, the doubt and misgiving of the mono axis or double axis expanded. However, Shahcheraghi (2015) studied the terminology of Chahar-Bagh, which means four gardens, by studying historical texts and remaining inscriptions, which showed that in the past, there were no words meaning four, forth, or quartet. Moreover, some

remaining monuments from the Sassanian dynasty, such as the palace gardens of Khosrow-Parviz II, near Qasre-Shirin city, were formed based on a mono axis. In addition, some information from the historical logbooks consists of worthy information from the initial gardens. Chevalier Jean Chardin, the researcher of Persian artifacts in the 17th century, said that Persian gardens have the main corridor in a direct line that divides the garden into two parts (Khansari et al., 2015). Applying the mono axis structure was common in other arts such as Iranian carpets and Miniatures (Figure.5). Based on the evidence, it can be said that in the beginning, the structure of Persian gardens was regular geometry and the application of the mono axis.

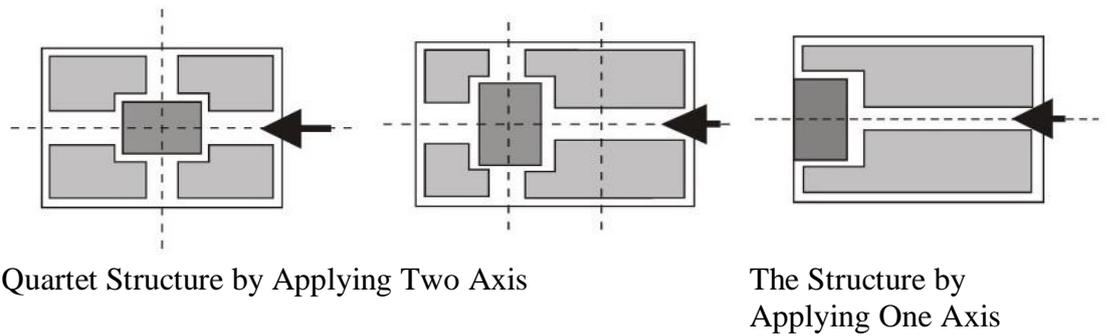


Figure.3: Structures of Persian Gardens

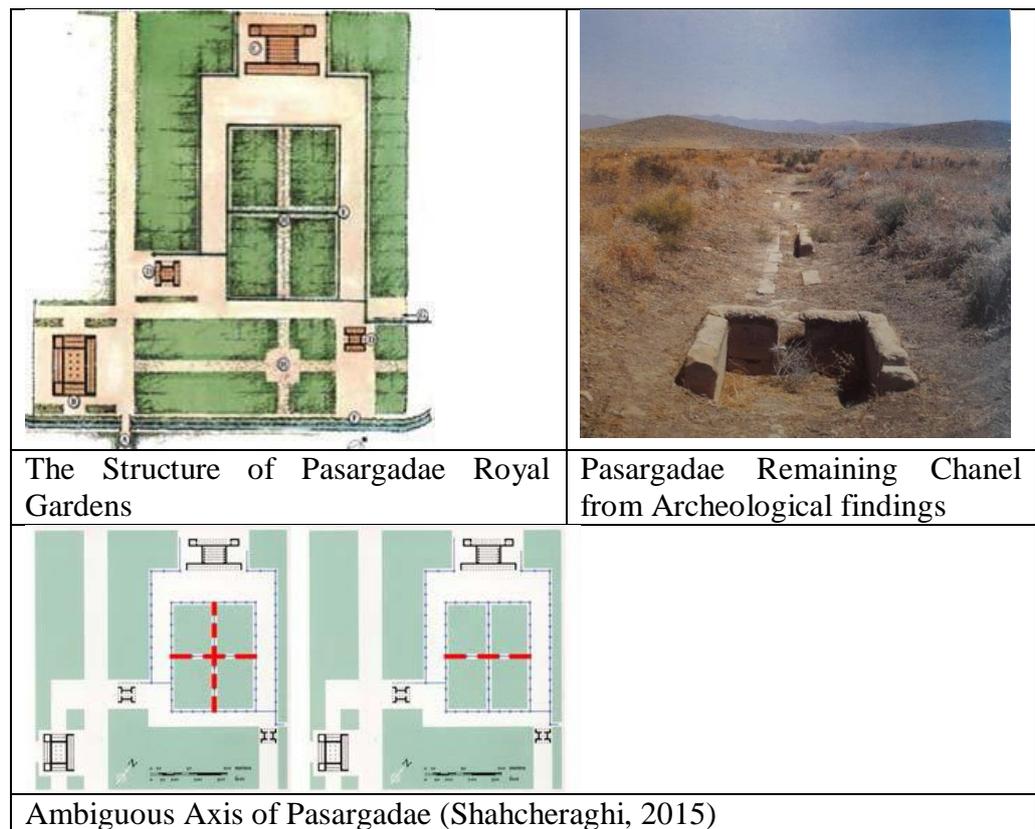


Figure.4: The Water Axis of Pasargadae Royal Gardens



Bakhtiyari Carpet



Farahan Carpet



Farahan Carpet



The Miniature Related to Ali ibn Abi Taleb and Gabriel



The Miniature Related to "The Seven Thrones" of Jami



The Miniature Related to Khamsa- Nezami

Figure.5: Mono Axis Carpet and Miniature Design

One of the factors in the two-axis creature was Iranian acquaintance with described heaven in the Quran. After Iranian became familiar with Islam, Arabian Muslims faced new architectural structures. Whatever they saw in the dry plateau of Iran was similar to the Ferdous (heaven), which was described in the holy book, Quran, which described the heaven as a great garden that is divided into four parts by creeks full of water, milk, wine, and honey. Therefore, Muslims and Iranian artists tried to form the garden structures well as the described heaven in Quran. Applying gardens around Islamic palaces were inseparable, and Islam had a great impact to declare Persian gardens to the world.

On the other hand, the theory of dividing an area into four parts dates back to the ancient traditions of Asians that the world is formed based on four regions, usually separated by four rivers (Khansari et al., 2015). Moreover, Mandala and quartet divisions are common in most cultures, and it can be said that they are the heritage of human culture (Masoudi, 2009).

The archetype of Persian gardens is still ambiguous and doubtful. The issue is more controversial when the theory of two parallel axes and garden division into three parts is mentioned in some references (Shahcheraghi, 2012), but it can be said that the quartet structure of Persian gardens by applying crossover axis evolved during the history and Persian garden evolution to perfection. Moreover, in the junction of axis, ponds or pools were added and merged in Persian gardens.

Base on Masoudis report (2010), in the first Persian gardens (for example, Pasargadae), there was no central basin, but due to the Stronach hypothesis, there was a basin out in the garden that was used for improving water volume flow rate. Limited volume flow rate cannot provide adequate water for plants that required submerged irrigation. Water should be saved in a basin as a source, then used by a suitable volume flow rate (Figure.6). In addition, some small subsidiary basins were used for sediments. During this time, these basins were used as a central component of gardens. The descriptions show that in the beginning, the pool was an applied element and used as the water source of the garden before being later used as a decorative element (Masoudi, 2009). The evolution process of Persian gardens show that the geometric structure based on the axis and applying central pool and basin in gardens was not only for being similar to the holy book description, but it was also important and essential for improving garden irrigation systems.

Safavid dynasty (1501 to 1722 BC) was the glory era of Persian gardening, and these gardens were in the pinnacle while they were the main elements of urban physical structure. As an illustration, the structure of Isfahan province, which was the capital of the Safavid dynasty, was formed based on the junction of the greenery axis (the green street full of trees and gardens by the name of ChaharBagh) and water axis (Zayandeh-Rood river) (Figure.7). At that time, the new idea of the garden city was formed base on urban areas, streets, squares, and gardens.

By connection to Europe, European gardening patterns like diagonal parterres, oval pond, and statues and sculptures were seen in Persian gardens, and the combination of Persian and European gardens increased. In this way, through time city parks and urban green areas were replaced by Persian gardens.



Figure.6:The Basin Outside the Garden

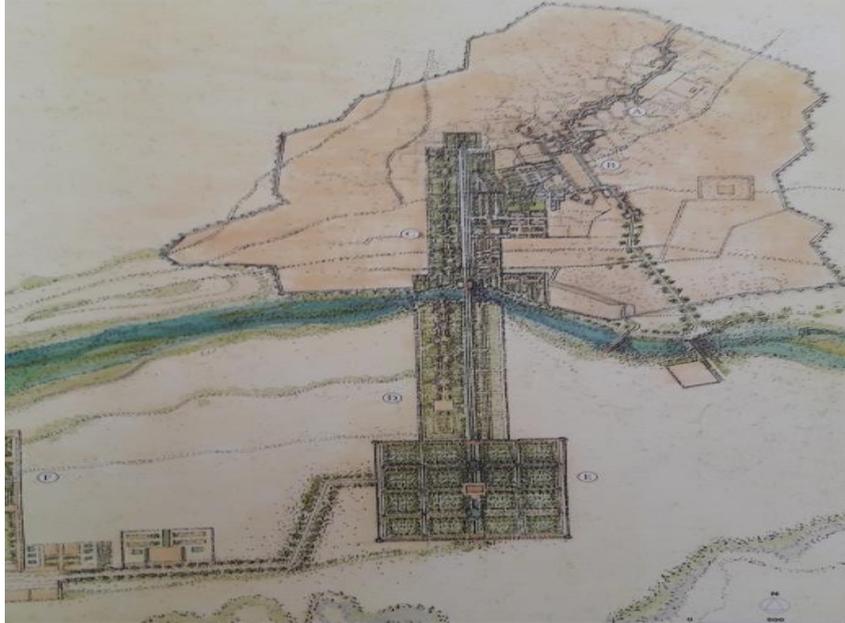


Figure.7:ChaharBagh Structure of Isfahan City in the Safavid Dynasty

The replacement of persian gardens

Currently, the need for greenery is supplied by applying urban green areas instead of ancient gardens. Urban green areas can be natural or manmade, and they are created and maintained based on specific rules and criteria (IranNejadi and Tajamolian, 2011). In the design of green areas, there are two fields, namely, green surfaces and green spaces. It is better to refer to green surfaces like the surfaces covered by grasses, lawn and cover crops, and green spaces as the areas covered by trees that have mass and height (IranNejadi and Tajamolian, 2011). In any case, both groups have social, economic, and environmental benefits.

In urban areas, greeneries are divided into public, semi-public, and private. Public green areas are the most important of urban greeneries because anyone can use them, and they have a great social and psychological impact. The semi-public green areas such as yards, courtyards, and open spaces of hospitals, garrisons, government offices, educational centers, and so on have more ecological benefits than the social ones because of the limitation in users. Private green areas like evergreen or fruitful personal gardens, agricultural lands, and private courtyards do not have social worth because the

public generally cannot use them, though they have environmental and ecological benefits. In this way, fruitful gardens in the cities are not in the category of urban green areas (IranNejadi and Tajamolian, 2011). The important point is that the ecological performances of private green areas are not durable, because based on the land cost, it is common to destroy these gardens and construct buildings.

Today, due to the high expense of land and high city population, the relation between humans and nature is separated, and the psychological and environmental request for greenery is more than available. Different methods are needed to combine the natural environment and diurnal workaday life.

Some ideas to increase greenery in urban areas

One idea to combine the natural environment in dense and crowded urban areas is applying plants and greenery on the surfaces in the form of roof gardens and vertical gardens. Covering the roofs by plants is called green roofs, and they are beneficial both on a wide scale for urban and small scale for a building or structure. History shows that the idea of green roofs is not new, but applying modern green roofs and technical application is new and needs more concentration. Green roofs are divided into two main categories: extensive and intensive green roofs (Figure.8). In a simple category, intensive or passive, the depth of soil is limited (about 7 to 10 cm); therefore, limited plants can grow, such as sedums, grass, and lawn. Usually, the irrigation is naturally by the rain, there is no need for a specific irrigation system, and the drainage system is simple. Hence, there is a limited extra load on the building structure (Safikhani et al., 2012). The other category is an active system or intensive known as roof gardens. They have about 40 cm of soil depth, and different plants can grow, such as small trees. Therefore, these systems need a strong structure, irrigation system, drainage, and technical attention, and high cost. Due to visitors, roof gardens have both environmental and social benefits. Meanwhile, they create a green skyline for the city, and they can provide bio landmarks (Safikhani et al., 2012).

Vertical gardens are one category of vertical greenery systems. As bio landmarks, they have an important role in human and natural environment connection, even if the people cannot touch them. At first, the idea of vertical gardens was to create pleasant views and for aesthetic purposes. Patrick Blanc (2008), known as a modern vertical garden creator, believed that observing plants and greenery in urban areas is more attractive than nature (Figure.9). Meanwhile, it is not possible to ignore environmental and ecological benefits. Due to the plant's cooling effect, vertical gardens reduce the ambient temperature as well as the temperature of the buildings. Moreover, as a shade, they control solar radiation and reduce the indoor temperature. Vertical gardens can attach to the surface of the buildings, while they can stand independently and provide no extra load to the buildings.

Applying green offices is another movement to improve the connection between human and natural environments (Figure.10). The researches show

that creating green areas in workplaces while during work times or rest times improves the performance of workers (Taib, 2010). These green areas can be located in workrooms, restrooms, or corridors as small gardens, vertical gardens, terrace gardens, and so on.

Another good idea is creating small green lands around the car parks. In this way, the messy and unpleasant view of cars are hidden, and air pollution and noise disturbance of cars are mitigated (Figure.11). Moreover, the trees can provide shade for cars and control the overheating inside the cars. In this way, people are forced to pass between the parking area and the buildings or urban areas from nature and the natural environment. Applying trees along the avenues, streets, and sidewalks is aesthetically pleasing while providing shade and controlling direct solar radiation (Figure.12). Moreover, creating small green areas in the junctions or putting up flowerpots in terraces are some simple and available ideas to expand the greenery in everyday life.



Figure.8:Extensive Green Roof (Left) and Intensive Green Roof (Right)



Figure.9:Patrick Blanc Vertical Garden examples in France



Figure.10:Green Offices Examples



Figure.11:Green Parking



Incorporate Everyday Life and Greenery

Figure.12:Incorporating Everyday Life and Greenery

CONCLUSION

Attention to history shows that gardening is rooted in human beliefs. Persian gardens are wonderful organizations that provide noteworthy places for rest and recreation while controlling microclimate. The geometric structure of Persian gardens is admitted while the doubt of the mono or crossover axis is still ambiguous. Although the structure of the Persian garden has been promoted over time and adapted themselves to weather conditions and landscape, their basic structure has remained the same. Therefore, it is correct to say Persian gardens are not only a type of garden, but they are also a specific style of garden. This specific structure was not just for environmental and ecological advantages but is tied to Iranian belief and spirituality.

Presently, by increasing urban problems and difficulties, the connection between humans and gardens is limited. The relation between humans and nature plays an essential role in human health, even somatically or spiritually. In this way, humanity to combine the natural environment and everyday life by applying different methods. Installing roof gardens, vertical gardens, office gardens, or applying other methods to increase greenery in urban areas are acceptable answers that require both government support and the cooperation of the people.

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