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A Comparative Study of Persian Gardens Design and Five Principles of Pirnia Iranian Architecture

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Abstract

This paper scrutinizes the recognition of the principles and parameters of traditional Iranian architecture in its historical gardens. Iranian traditional architecture has followed common principles and methods over millennia, encompassing a wide range of buildings such as houses, mosques, schools, and gardens. Among Iranian architecture scholars, Pirnia is known as one of the most prominent, having proposed five principles of Iranian architecture through studying traditional architecture and urban design in Iran. Studying these principles in each type of Iranian architecture can assist in understanding more about the architecture of Iran. Given the special significance of the Persian garden as a valuable example of the historical landscape and cultural heritage of this land, the authors of this paper aim to compare the features of the Persian garden with Pirnia's five principles of Iranian architecture. To ensure accuracy in this research, these principles will also be studied and analyzed in four valuable types of Persian gardens from different historical eras that UNESCO has registered and contain living vegetation. In this study, with the descriptive-analytical method, five principles of Iranian architecture compiled by Pirnia are compared with natural elements (water and plants) and built elements (pavilion) of selected gardens, and the principles of Iranian architecture are identified and described in them. The results show the compatibility of these principles with Persian garden design, which can also be utilized in contemporary landscape design.

Keywords

Persian garden, Five Principles of Iranian Architecture, Prinia.

Introduction

Ancient civilizations have influenced human life in various ways, and Iranian civilization is no exception. A country's cultural and natural heritage reflects its historical background, civilization, culture, and natural attractions that have developed over many years. Iranian architecture and landscape have a rich history in the Middle East, with characteristics that followed fixed principles until the 19th century, before modern and Western architectural patterns entered the region (Pirnia, 1994).

Researchers such as Andre Godard, Arthur Pope, Maxim Siro, and others have contributed valuable research to the history of Iranian architecture. However, Mohammad-Karim Pirnia stands out as one of the first Iranian researchers of the contemporary century who, while studying the architectural history of Iran, examined various types of Iranian architecture and landscape, including houses, mosques, schools, markets, and gardens. Moreover, it can be acknowledged that most historians and scholars of Iranian architecture were not Iranian before Pirnai. Pirnia considered the research methods of Iranian architecture to have many problems due to the unfamiliarity of these scholars with Iranian culture (Heydari Delgarm et al., 2017). Through his examination of the buildings and components of Iranian architecture, Pirnia formulated a series of principles in accordance with the region's cultural, indigenous, and climatic conditions. These principles can be generalized to contemporary Iranian architecture and landscapes with similar climatic and cultural conditions.

While introducing his five principles, Pirnia did not specifically mention any particular type of architecture and only provided examples for each principle. In the last few years, a few researchers have studied the adaptation of the Prinia's principles to various Iranian spaces and elements. For instance, Peyvastegar et al. (2017) have investigated these principles in the traditional houses of Yazd, and Sharbati et al. (2021) in the rural houses of Kolamo village. Zolfaghari and Koleini (2020) have also extended the five principles of Iranian architecture to Iranian historical artifacts, which is a new model for the stylistics of Iranian artifacts. Therefore, it is essential to examine each of these principles in every element of architecture, landscape, and urban design in Iran to understand their characteristics better. One of the noteworthy features of Iranian landscape architecture is its ancient gardens.

Gardens in all countries around the world represent the culture and identity of the people, stemming from social and religious beliefs and traditions. A garden is a human experience that encompasses the relationship between life, nature, and the world of meaning (Gholinejad Pir Bazari et al, 2020). As a model from the historical and ancient perspective of artificial space and cultural heritage in Iran, the Persian garden has significantly provided human comfort throughout history. The garden, which is several thousand years old, has been the subject of numerous research studies by both Iranian and non-Iranian scholars (Fadaie et al., 2019).

Methodology

The research method of the present paper is descriptive-analytical. This paper is in response to this question: "*How are the five principles of Iranian architecture manifested in the design of the Persian garden?"* The data collection includes two parts: library studies and document analysis. To be more accurate in this research, four gardens are selected from the existing Persian gardens, and these principles are examined and analyzed in these selected examples. In the present paper, after introducing Pirnia and the five principles that he proposed, the Persian garden, its characteristics, and constituent elements are described. Then, the mentioned principles are compared with the characteristics of the Persian garden.

1. *Data Collection Method*

The data of this research is prepared through documentary studies and viewing pictures and maps related to selected Persian gardens. The data collection steps are as follows:

Documentary review: resources related to Prinia's principles and the characteristics of Persian gardens. These sources are used to develop a theoretical framework and identify the principles of Iranian architecture of Prinia, as one of the most famous scholars in traditional Iranian architecture. In addition to the Iranian architectural principles, information about the Persian gardens' design was obtained from related sources.

2. *Data Analysis Method*

Content analysis is done qualitatively, and comparative analysis is as follows:

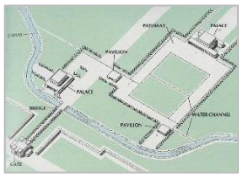
- The theoretical framework of Iranian architecture principles is based on Pirnia's view, where things such as human-oriented, avoiding non-essential, self-sufficiency, introversion, etc., are selected as the basis of analysis. Furthermore, recognizing the design patterns and elements of the Persian garden.
- The assessment and evaluation table that shows the compliance of selected gardens' elements with Pirnia's principles using visual coding (black squares for compliance and white squares for non-compliance).

3. *The selection of case studies*

In order to conduct a precise study, in this part, samples of Persian gardens are selected for further analysis. Among the nine Persian gardens registered by UNESCO, four gardens, each belonging to a specific historical period, have been chosen. Other criteria for selecting case studies are gardens currently available with clear borders and a well-maintained vegetation and planting system (their trees should not be dry).

Table 1 shows the characteristics of nine gardens registered by UNESCO. According to the listed criteria, four gardens - Eram, Dolatabad Abad, Chehel Sotoun, and Shazdeh - have been selected as case studies.

Table 1: *Introducing Examples of Persian Gardens in Different Historical Periods that were registered by UNESCO.*

Garden	City	Geographical Location in Iran	Historical Period	Construction Date	Current Situation	Picture
Pasargadae	Near Shiraz	South west	Achaemenid era	6 B.C	Ruined & devoid of planting	 Khansari et al. (2003)
Eram	Shiraz	South west	Seljuk era	11-14A.D	Restored & having a planting system	 Norouzborazjani (2004)
Fin	Kashan	Central district	Safavid era	16A.D	Restored & having a planting system	 Norouzborazjani (2004)

Abbassabad	Behshahr	North	Safavid era	17A.D	Restored & having a planting system	 URL3
Chehelsotoun	Isfahan	Central district	Safavid era	17A.D	Restored & having a planting system	 Norouzborazjani (2004)
Dolatabad	Yazd	Central District	Afsharid era	18A.D	Restored & having a planting system	 Norouzborazjani (2004)
Akbarieh	Birjand	South east	Qajar era	19 A. D	Restored & having a planting system	 URL2
Pahlevan pour	Mehriz-Yazd	Central District	Qajar era	19 A. D	Restored & having a planting system	 URL1
Shazdeh	Mahan-Kerman	South east	Qajar era	19 A. D	Restored & having a planting system	 Norouzborazjani (2004)

Eram garden

The construction of Eram Garden in the city of Shiraz spans several centuries, dating back to the 11th-14th centuries, with its main pavilion being built in the 18th century. The garden boasts a diverse range of plant species, and its botanical garden is currently managed by the Shiraz Faculty of Agriculture (Heidari & Iranibehbahani, 2009).

Chehelsotoun garden

The Chehelsotoun garden was built in the 17th century during the Safavid period and is one of the two surviving royal gardens of that era, located in the city of Isfahan, the capital of Iran at that time.

Dolatabad garden

The Dolatabad garden of Yazd was constructed in the 18th century. Originally located outside of Yazd, it is now situated within the city due to its development. Dolatabad is a "*residential-government*" garden, with the outer garden serving as a space for government ceremonies, sports events, and city administration. In contrast, the inner garden was considered a private and residential part of the complex (Naeema, 2004).

Shazdeh garden

The Shazdeh garden was built in the 19th century on the slopes of Joupar Mountain, six kilometers from Mahan city. This garden is located on a slope and has made optimal use of the natural conditions, including fertile soil, sunshine, gentle wind, and access to qanat water (Heidari & Iranibahbahani, 2009).

Theoretical Framework

1. *Persian garden*

The Persian Garden is one of the most significant achievements of Iranian civilization worldwide. In addition to the age of Iranian civilization, the most crucial evidence of this is the word "*Pardis*," which was imported from Persian to Arabic and European languages and refers to types of gardens. Based on the ancient beliefs of Iranians, the garden was a space "necessary to exist," like a temple; it was considered a place to connect the earth to the sky for believers in the power of Mehr and Anahita and their symbols in nature. In this way, the Persian garden was created to be a place to praise sacred symbols: water, unique trees, infinity, sky, confinement, etc. (Mansoori, 2018)

The Persian Garden has been essential to Iranian life and architecture since ancient times. The art of gardening is one of the oldest arts of the Iranians, which has valuable traditions and spiritual power in which the elements of water and plants are present with different aspects. Iranians have drawn the tree with flowing water, the most desirable sight in a dry land. After water, trees play the most crucial role in forming the Persian garden (Pirnia, 2009).

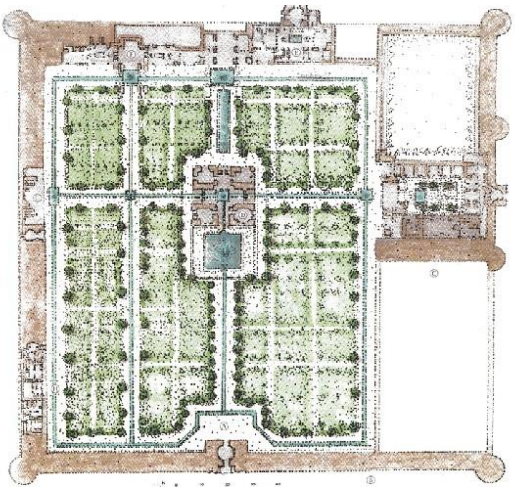


Figure 1: *The Geometry of Persian Garden with its Planting and Irrigation Systems (Fin Garden in Kashan)* (Khansari et al., 2003).

In general, the Persian garden can be considered a cultural phenomenon. In this environment, water, plants, and architectural spaces are combined in an enclosed environment with a geometric and physical system. The body of the Iranian gardens worldwide consists of three systems of irrigation, planting, and establishment of buildings, which have been formed by these lands' political, cultural, social, geographical, and climatic conditions (Shahcheraghi, 2009). These systems correspond to the geometric structure of the body of the Persian garden. In other words, the geometric structure of the Persian garden is such that the natural systems of watering, planting, and the artificial system of the building are integrated and have created a body with a regular and geometric structure. The most important feature that distinguishes the Persian garden from other gardens worldwide at a glance is its geometry (Mostafazadeh, 2007).

2. *Mohammad-Karim Pirnia and his Architecture Principles*

Mohammad-Karim Pirnia (1920-1998) was one of the most prominent scholars of Iranian architectural history. Pirnia was a university professor, researcher, author, and theoretician of Iranian architecture, considered the father of traditional Iranian architecture. He dedicated several decades of his life to studying Iranian architecture (Beheshti, 2021). Pirnia's activities between 1324 and 1360 can be divided into two parts. The first is design and building construction, and the other is serious research in the field of traditional architecture and methods of restoration and maintenance of Iranian buildings and practical measures related to them (Masrat, 2019).

Pirnia categorized the legacy of Persian traditional architecture into six historical styles. As a significant outcome of his studies and research in this field, he proposed five principles that could define the characteristics of Iranian Traditional Architecture, later known as Pirnia Principles in Iranian architecture. It seems that Pirnia has achieved principles and parameters after observing traditional Iranian buildings and deriving from the practices of experienced architects (Hosseinian et al., 2020). These principles have formal and conceptual characteristics. Their appearance aspects are suited to the needs of Pirnia's times and may not be efficient and suitable for today's researchers, but their conceptual characteristics are a valuable solution for understanding Iranian architecture in the context of Iranian culture (Qayyoomi Bidhendi and Abdollahzadeh,2015). Unfortunately, Pirnia did not live long enough to articulate and clarify these principles in all architectural types of works (creations). In this paper, besides explaining these principles, the authors aim to follow and embody them in Persian garden architecture.

Pirnia was the first scholar in Iran to propose some general principles for Iranian architecture. These principles have been the result of his field studies over many years. In this process, he has tried to extract these principles by taking advantage of field studies and dealing with experienced people who have local knowledge of Iranian architecture (Hosseinian et al., 2020). From the term "principles of Iranian architecture," it can be understood that Pirnia believed in an independent identity for Iranian architecture, which has been realized by Iranians in this land throughout history (Qayyomi Bidhendi & Abdollahzade, 2015). The principles have been introduced in the form of five principles: Human-oriented, Avoiding Non-essentials, Structural rigidity and homogeneous protection (Niyārish), Self-sufficiency, and Introversion (Pirnia& Memarian, 2018) as follows:

3. *Human-orientated*

Human-oriented (mardum-vāry) is one of the first principles Pirnia proposed, maintained, and further developed. He claimed he learned this principle from skilled Iranian traditional architects: “When we discuss the ancient methods of this human and expressive art with skilled Iranian [traditional] architects, they state that the work must be mardum-vār” (Qayyoomi & Abdollalizadeh, 2015).

Mardum in the Persian language means humans and people (Dehkhoda), and so mardum-vār means like humans and mardum-vârî means having a human-oriented. In other words, respecting the proportion between different parts of the building with human organs and paying attention to human needs in construction works. It can be seen in various elements of traditional Iranian architecture (Pirnia & Memarian, 2018).

This concept is manifested in the architectural environment in two areas: observing the human proportions of the space and meeting the various needs of people, including the material and spiritual needs of the individual. The dimensions include respecting the spatial scale, avoiding the high height of the building, and meeting the different needs of the residents (Peyvastegar et al., 2017). Furthermore, consideration of climate and environmental comfort can be cited as key characteristics of Human- orientated. According to Pirnia, "*Roon*" (attention to orientation) has always been significant in Iranian architecture and urban planning. Disregarding it has resulted in cities lacking resilience against the unpleasant climatic conditions, such as cold, storms, and poor ventilation. Although he has not directly used attention to climatic conditions as one of his principles, his belief in "*Roon*" has shown the importance of climate in Iranian architecture and urban design (Heydari, 2018).

4. *Avoiding non-essentials*

In traditional Iranian architecture, efforts have been made to avoid unnecessary construction and extravagance (Pirnia & Memarian, 2018). Four conditions are necessary for avoiding non-essentials. Firstly, it should serve a purpose and be beneficial; secondly, it should be used in moderation; thirdly, it should be tested for efficiency before implementation; and finally, it should align with logic and beauty (Naderi et al., 2012).

According to this principle, all architectural components serve a function. Examples of architectural features related to this principle include moderation in decorations, avoiding excessive building height, respecting size and width, and creating multi-functional spaces (Peyvastegar et al., 2017).

5. *Structural rigidity and homogeneous proportion (Niyārish)*

Structural rigidity and homogeneous proportion in architecture refer to all efforts made to ensure the stability and resistance of a building. This includes the fields of statics, material studies, and structural techniques (Qayyoomi & Abdollalizadeh, 2015).

In traditional Iranian architecture, using a fixed module was a criterion observed to determine the proportion between building components (Pirnia & Memarian, 2018). This principle was used to create aesthetically pleasing works, indicating that traditional architects considered both the structural dimensions and beauty of the building (Peyvastegar et al., 2017).

6. *Self-sufficiency*

Self-sufficiency in traditional Iranian architecture refers to the maximum use of available facilities and natural materials. Builders aimed to source materials from nearby locations to expedite construction, ensure harmony with the surrounding nature, and maintain availability during renovations (Pirnia & Memarian, 2018). Traditional architecture employed various techniques and methods, such as suitable location and provision of thermal and cooling comfort to achieve self-sufficiency in terms of material procurement and construction technology (Peyvastegar et al., 2017). Self-sufficiency in the concept of localism implies something that has been revealed in the contemporary period in the movement of sustainable architecture (Qayyomi Bidhendi & Abdollahzadeh, 2015).

7. *Introversion*

The world's buildings consist of two types regarding the order of their open and closed spaces: Inward-looking (Introversion) and outward-looking. Many structures in the West, India, and the Far East face outwards due to the natural characteristics of their lands. In Iran, it is the opposite, and due to the importance of valuing people's beliefs in Iranian architecture, most buildings, especially traditional houses, are built introverted (inward-looking) in a hot and dry climate.

Therefore, by organizing the spaces of the building around one or more courtyards, they separated the building from the space outside the house. Only one vestibule connected the two (Pirnia, 1994). Based on this, it seems that paying more attention to the interior spaces of the house and, at the same time, showing its external appearance in a simple and uncontaminated manner is more than anything rooted in the religious

beliefs of the people regarding paying more attention to the interior instead of the exterior (Peyvastegar et al., 2017).

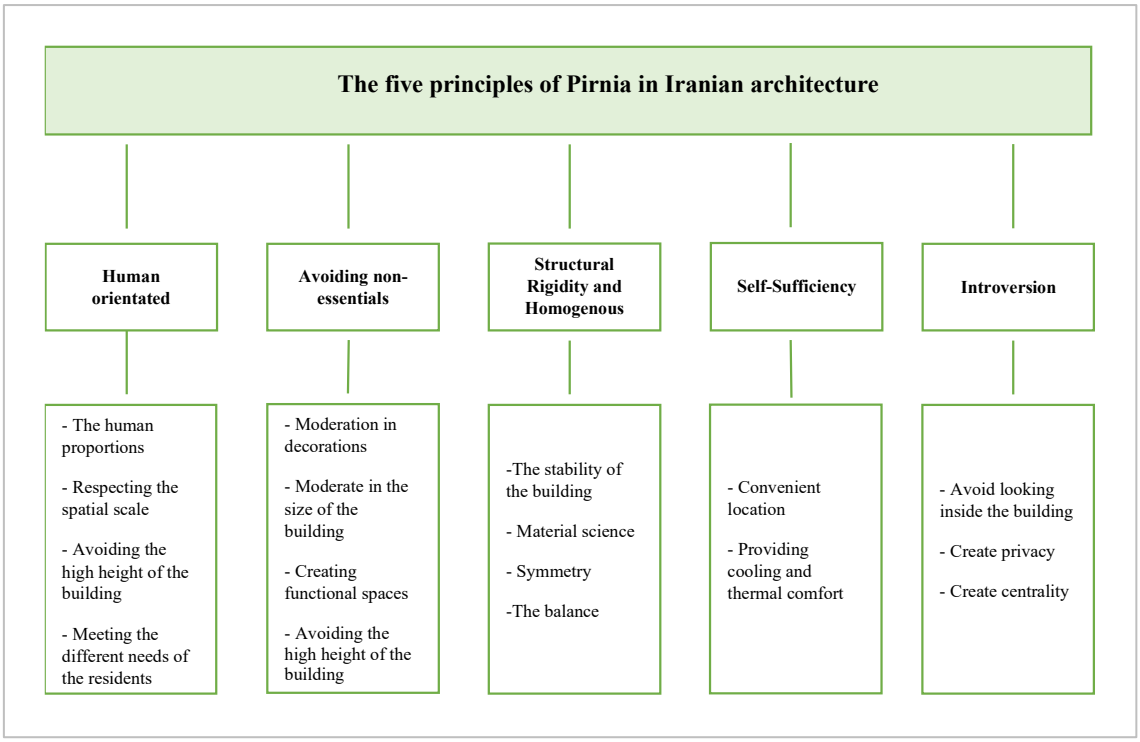


Figure 2: *A Review of the Five Principles of Iranian Architecture of Pirnia*

Results & Discussion

Five Principles of Pirnia in the Persian Garden

1. *Human-oriented*

In addition to paying attention to human scales and proportions, the principle of human orientation also focuses on human needs, such as physical comfort, which has been carefully considered in Persian gardens. These gardens were built on both flat and sloping land, and their size and shape were based on the size and shape of the land. Persian gardens are known for their vastness, creating a virtual extent based on geometry and topography. The presence of a straight landscape in the longitudinal axis of the garden in front of the pavilion, with tall trees planted on both sides, creates a perspective that makes the garden appear longer (Diba & Ansari, 1995). Additionally, Persian gardens stimulate all five senses when a person enters. They integrate natural and built spaces to create landscapes and focus on the sense of sight while also transferring the smell of flowers and plants, the sound of birds and running water, and the wind into the pavilions, affecting the senses of smell, hearing, and touch, respectively (Shahcheraghi, 2011).

Figure 3: *The Virtual Extent of the Persian Garden-Shape of Garden Follows the Slope (Shazdeh garden in Mahan)* (URL4).

2. *Avoiding non-essentials*

Traditional Iranian architects strove to ensure that no effort was wasted in the construction of buildings and to avoid extravagance. This principle was also reflected in the design of Persian gardens, where plants served both aesthetic and practical purposes, such as protecting the garden from natural disasters. The plants in Persian gardens were categorized by use, including fruit trees, shade trees, and ornamental trees. Fruit trees were prioritized for their economic benefits, while ornamental trees were planted sparingly. (Bahram, 2006). The selection of trees in Persian gardens was tailored to the region's climate. Flowers with medicinal properties were also planted for their dual purpose of beauty and health (Pirnia, 1994). Additionally, the planting of a local shrub plant called "*Espest*" was widespread in Persian orchards due to its low water consumption and ability to reduce air temperature (Zamani et al., 2009). In terms of irrigation, Persian gardens were designed to minimize water consumption by utilizing the slope of the land and implementing a geometrically aligned irrigation system (Ansari, 2000). The traditional water irrigation method in Persian gardens often involved using "*Qanat*," an underground system invented by ancient Iranians to transport water from mountain beds to distant locations through interconnected wells (Fadaie, 2022). Given that many Persian gardens were located in arid regions with limited water sources, garden architects would create the illusion of flowing water by scratching the bottom of stone basins known as "*Sine Kabki*" to compensate for the lack of water (Pirnia, 1994). This innovative approach demonstrated the commitment to avoiding non-essentials and making the most efficient use of available resources in Persian garden design (Figure 4).

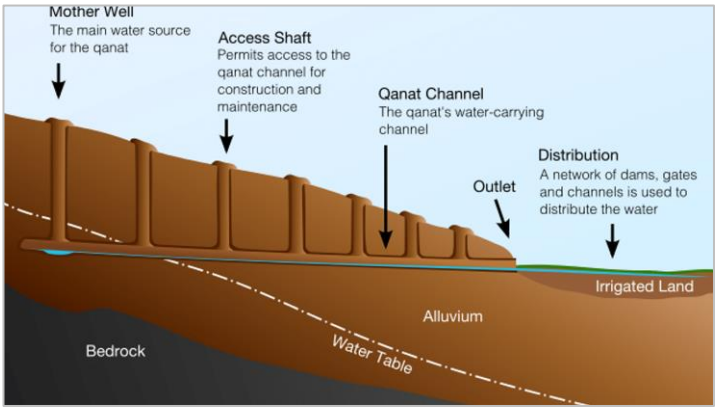


Figure 4: *The Irrigation System of Qanat* (URL5)

3. *Structural rigidity and homogenous protection (Niaresh)*

The Persian word "*Niaresh*" encompasses concepts such as structure and construction, with its most prominent feature being the use of a fixed module in architectural design. The plan of the Persian garden also followed a specific geometry and modular network. In this way, two perpendicular axes divided the garden into four parts, and then these four parts were further divided into smaller squares by axes parallel to the original two. Based on this feature, the irrigation and planting systems of Persian gardens also followed the geometry of the garden and its modular network (Pirnia, 1994). In the Persian garden, the geometry of the open space inside the garden defined the geometry of the building (Masoudi, 2009). Moreover, spatial organization around the middle axis and relative symmetry are the main geometries of Persian gardens.

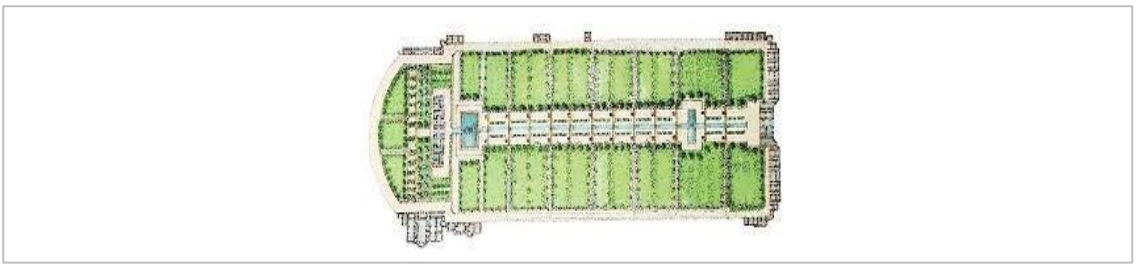


Figure 5: *Adaptation of Planting and Irrigation networks of Persian Garden with its Geometrical System (Shazdeh Garden in Mahan)* (URL4).

4. *Self-sufficiency*

Persian gardens had structural and ecological harmony with their surroundings. Moreover, like other traditional Iranian buildings, Persian gardens had the characteristic of self-sufficiency in utilizing the maximum available facilities and local materials. Not only were local materials such as bricks, adobe, and tiles used in the main building of the garden "*pavilion*," but the selection of vegetation was also based on the climate and native plants of the region. For example, saffron was planted in the gardens of Birjand city, which was not planted in the gardens of other regions.

5. *Introversion*

Based on Iranian beliefs, respect for individuals' private lives and privacy were highly valued in the organization of traditional architectural buildings, leading to the introversion of the buildings (Pirnia, 1994). The Persian Garden, like other traditional buildings in this land, was introverted. By building a wall around the garden, it was enclosed, and the possibility of seeing from the outside to the inside became inevitable. As Pirnia pointed out, the only way to enter the garden was through its gate. People could enter the vestibule and corridors through the gate and then enter the garden (Pirnia, 1994).

Figure 6: *The Enclosure of Persian Gardens by Walls (Left: Fin Garden in Kashan, right: Chehelsotoun garden in Isfahan)* (Faghih & Sadeghy, 2012)

Pirnia's five principles in Selected gardens

Since the Persian garden is composed of both natural and built elements, in this part, Pirnia's five principles are analyzed in the natural elements (Water and Vegetations) and the pavilions (as the main built space of the Persian garden) of the selected garden:

Human-orientated

Natural Elements: Eram Garden is oriented along the northwest-southeast longitudinal axis, facing its water source. In Shiraz, prevailing winds come from the northwest and west (Moghani Rahimo & Porbar, 2013), leading to the planting of evergreen cone-shaped trees like cypress along the main axis to act as a barrier against strong winds and intense solar radiation. Water is prominently featured in the garden, flowing in various forms along the main axis, including a water channel in the northern part, a main pool in front of the pavilion, and narrow streams and ponds throughout the garden. This water feature helps cool the air and increase humidity when the wind blows across it (Norouzborazjani, 2004). In Isfahan, the Chehelsotoun garden is located along Naqsh Jahan Square and is oriented in the northwest-southeast direction. The placement of evergreen trees along its main axes acts as a barrier against the prevailing winds from the west and northwest (Mohammadi & Shaykh Baygloo, 2010). In the Dolatabad garden, human comfort is also considered. For instance, the main axis of the garden runs along the northwest-southeast longitudinal axis with a 30-degree difference from the southeast, providing shading and preventing the penetration of dusty winds into the garden. The significant water feature in this garden is located exactly on the main axis, and its dimensions are proportional to those of the octagonal pavilion, which holds the

highest windcatcher in the world (Norouzborazjani, 2004) (Figure 7). Additionally, water streams are placed under the trees on the main axes to cool the garden. Evergreen trees are planted on the northwest and west sides of the garden to act as barriers against local dusty winds due to the prevailing winds from the north and northwest of Yazd (Fadaie, 2016). The main axis of the Shazdeh garden is angled towards the north, allowing the cypress and plantain trees to create shade in this axis during the day (Figure 5) (Masoudi, 2009).

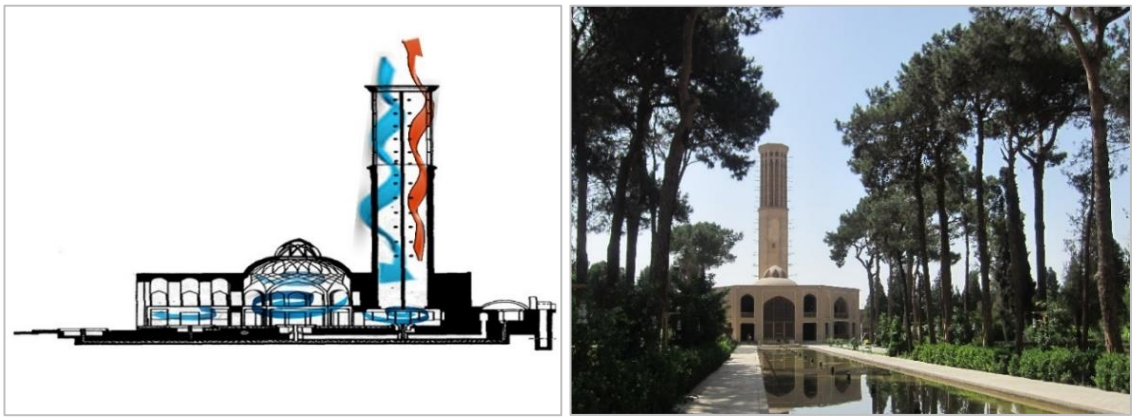


Figure 7: *Left: Natural Ventilation by Wind Catcher in Dolatabad Garden* (Neema, 2004), *Right: Shading by Trees in the Main Axe of Dolatabad Garden* (Authors, 2014).

Built Elements: The Eram pavilion's design, with its narrow width and windows on the north and south sides, along with the placement of the main pool to the south and the water channel to the north, allows airflow to pass over the water, promoting evaporation (Figure 8). Additionally, constructing an underground space with a water canal and pond inside creates evaporative cooling, providing a comfortable environment during hot seasons.

Figure 8: *Eram Garden and its* Pavilion (Authors, 2014).

In Chehelsotoun, the location of the pavilion at the western end of the main center of the garden and the main Talar on its eastern side creates a cool and comfortable environment. The orientation of the pavilion (northwest-southeast) is a strategy against the intensity of sunlight and heat. The Talar, with its pitched roof resting on wooden columns, provides optimal lighting control and air conditioning, making it the best place for physical comfort at dust (Figure 9) (Alemi, 1997).

In Dolatabad Garden, the pavilion that is used during the summer is located at the southern end of the garden. Windows and balconies are located on the north, northwest, and northeast sides of the building and open to the cool atmosphere of the garden (Fadaie, 2024). In Shazdeh garden, the garden's location on a

slope provides an attractive feature where observers can see the pavilion upon entering the garden and then observe a comprehensive view of the garden when close to the pavilion (Diba & Ansari, 1996).

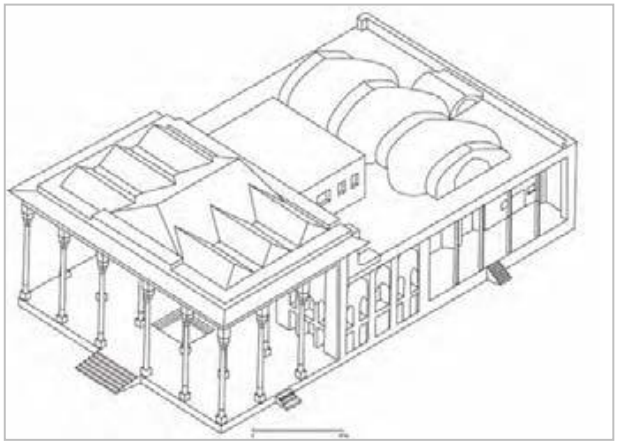


Figure 9: *Chehelsotoun Pavilion with its Talar* (Norouzborazjani, 2004).

Avoiding non-essentials

Natural Elements: In Eram Garden, strategically planting evergreen trees such as cypress and pine helps control sunlight intensity and create shade along the main paths. Water streams placed under these trees not only enhance environmental cooling but also prevent excessive evaporation and water wastage. Furthermore, planting short vegetation on the main axis aids in absorbing solar heat. In the Chehelotoun Garden, the irrigation system is based on the branches of the city's main river, "*Zayandeh Rood*", known as "*Madi*". Additionally, the garden features two large ponds on the east and west sides of the pavilion, connected by a narrow stream built around the pavilion. "*Madi*" supplies the water for these two pools (Heidari & Iranibahbahani, 2009). The source of irrigation in the Dolatabad Garden is a 60 km-long qanat (aqueduct) that irrigates the entire garden and other fields and gardens (Norouzborazjani, 2004). Due to the heat of Yazd, the running water in the Dolatabad Garden is placed underground and brought out only when necessary, preventing evaporation and water loss in the arid region. The source of water supply in the Shazdeh garden is a qanat, which irrigates the garden before leaving to irrigate the surrounding gardens and fields. Water only flows in the main axis and two parallel streams, while in other streams and canals, water flows only during irrigation. The deep and extensive roots of the garden trees allow for efficient water absorption and prevent water loss (Masoudi, 2009; Norouzian Pour, 2012). The irrigation systems of all these gardens are designed to prevent water wastage.

Built Elements: Except for the role of the natural elements in creating passive cooling, the roof of the Eram pavilion features crescents and a pitched roof with two shells, serving to both enhance the building's aesthetics and prevent solar radiation from penetrating and heating the building (Khansari et al., 2004). Thus, it can be mentioned that in addition to beautification, the decorations also had a practical role in the building. The main porch of the Chehelsotoun pavilion, in addition to being able to see the garden, has been a cool shelter for accommodation in hot seasons. In the Dolatabad garden, the water in the rectangular ponds inside the pavilion flows steeply to the three ponds outside the pavilion and then flows out of the main gate of the garden through two streams to irrigate other gardens and farms (Naeema, 2004). In addition to saving water consumption, the presence of small windows in the pavilion with colored glass has been used to beautify and prevent adverse winds. In the Shazdeh pavilion, the terrace is located in front of the garden, which provides the opportunity to enjoy a beautiful view and a favorable wind.

Structural Rigidity and Homogenous Protection (Niaresh)

Natural and Built Elements: The design of all four selected gardens is based on a specific geometrical system, and the planting and irrigation systems of the gardens adhere to this geometry (Figures 10, 11). Also, symmetry is one of the main factors of *Niaresh* (Shervani Tabar et al., 2024), and the principle of

symmetry around the central axis has been considered in the design of selected gardens and their pavilions. The coordination of the garden with the topography of the site is one of these principles that can be clearly seen in Shazdeh Garden.

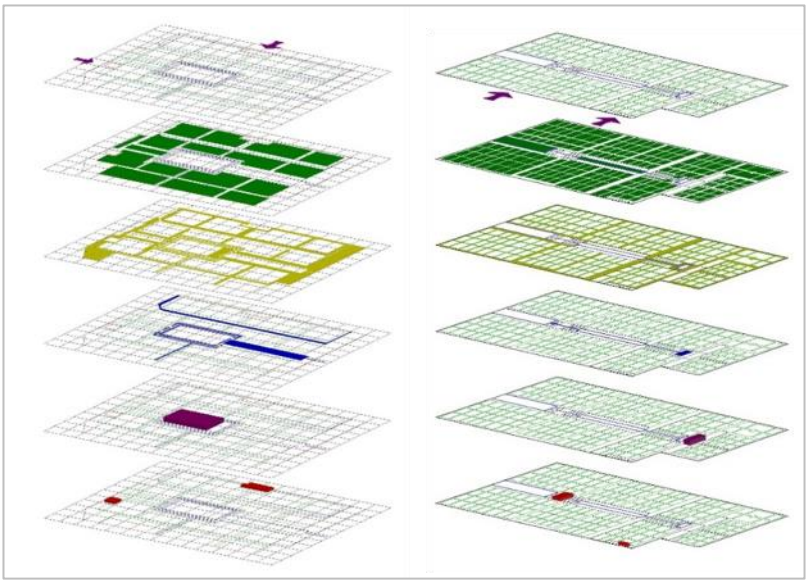


Figure 10: *Adaptation of Planting and Irrigation networks of Chehelsotoun garden (Left) and Eram Garden* (Right) *with their Geometrical Systems* (Authors).

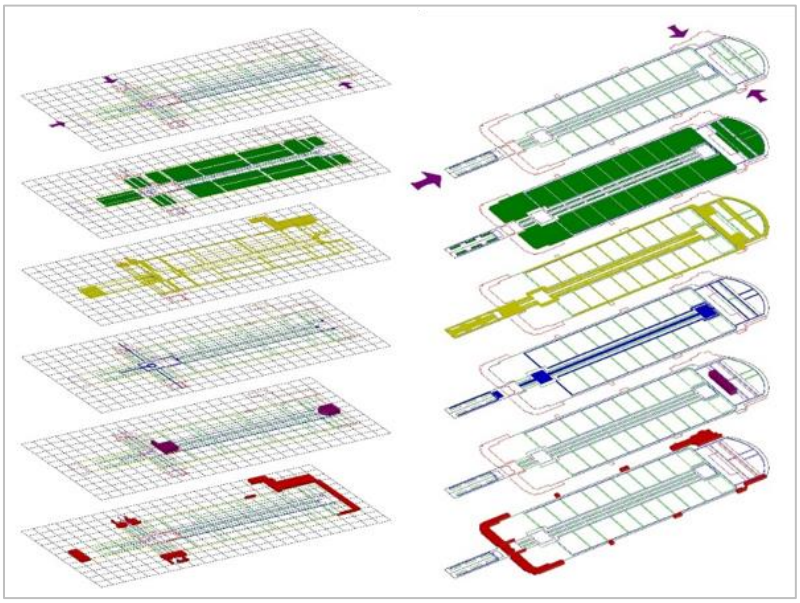


Figure 11: *Adaptation of Planting and Irrigation networks of Dolatabad Garden (Left) and Shazdeh Garden (Right) with their Geometrical Systems* (Authors).

Self-Efficiency

Natural Elements: The vegetation in Eram Garden includes native and non-native fruitful plants. Non-fruitful trees such as Cypress, Pine, Maple, Willow, and Eucalyptus are strategically planted to provide shade and control sunlight intensity. Fruit trees, including Pomegranates, Citrus fruits, Apples, Plums, Apricots, Pears, etc., are also part of the garden (Heidari & Iranibahbahani, 2009). The Chehelsotoun garden is integrated with the urban fabric of Isfahan. Throughout the Safavid era (16th-17th centuries), the city's development was influenced by the structural relationship between the garden and the city (Mirfendereski, 1994). Furthermore, the vegetation of this garden includes native trees such as pine, maple, elm, and fig (Heidari & Iranibahbahani, 2009). The vegetation in the Dolatabad garden includes Pine and Cypress trees

in the principal axes, and fruit trees such as Figs, Berries, Grapes, and Pomegranates in other axes. Roses are also planted in the spaces between the trees, which are used to make rose water (Norouzborazjani, 2004). The Shazdeh garden is in harmony with its context and has an ecological relationship with the surroundings, such as following the slope of the land. Additionally, planting native shade and fruit trees (Heidari et al., 2009) is another feature of this garden's self-sufficiency.

Built Elements: The use of local materials with high thermal mass and recyclability, such as bricks, adobe, and tiles, in the construction of the pavilions of selected gardens is considered a climate strategy in their design.

Introversion

Natural and Built Elements: The Eram Garden is surrounded by adobe walls like other Persian gardens, and the planting of tall trees along the sides creates a sense of enclosure and privacy within the space. In the Chehelsotoun Garden, there are walls and adjacent gardens surrounding it, creating a safe atmosphere for its residents (Figure 6). The Dolatabad Garden is surrounded by adobe walls like other Persian gardens and consists of two outer and inner parts to maintain privacy for its residents (Figure 12). Adobe walls surround the Shazdeh Garden and create an oasis in the middle of the desert. The wall acts as a barrier between the closed ecosystem of the garden and the desert, maintaining the cool air and humidity of the garden (Figure 12). Among the traditional Iranian buildings, the pavilions are the few extroverted buildings due to their placing in the closed ecosystem of gardens.

Figure 12: *Introversion with the enclosure of the gardens by the adobe walls (Left: Dolatabad garden in Urban fabric, right: Shazdeh garden in desert)* (Norouzborazjani, 2004).

Table 2: *Summary of the principles of Pirnia in the architectural Features of selected gardens*

Garden	Human-orientated	Avoiding non-essential	Structural Rigidity	Self-sufficiency	Introversion
Eram	Creating comfort through the garden's orientation, utilizing evaporative cooling via ponds and pools within the garden and the pavilion, and positioning the pavilion's main façade to face the garden's pleasant air.	-Planting trees adapted to the climate -Prevent water loss in irrigation	Adaptation and coordination of irrigation and planting systems with garden geometry - Symmetry and balance in garden architecture and its pavilion	-Planting native plants -Using local methods in irrigation (Qanat) -The use of local materials in the construction of the building(pavilion)	Enclosing the garden by the adobe walls
Chehelsotoun	Creating comfort through the garden's orientation, utilizing evaporative cooling via ponds and pools within the garden and the pavilion, and positioning the pavilion's main façade to face the garden's pleasant air, shading by using semi-open spaces, balconies, talar, etc.	-Planting trees adapted to the climate -Prevent water loss in irrigation	Adaptation and coordination of irrigation and planting systems with garden geometry - Symmetry and balance in garden architecture and its pavilion	-Planting native plants -Using local methods in irrigation (Madi) -The use of local materials in the construction of the building(pavilion)	Enclosing the garden by the walls& surrounding gardens

Dolatabad	Creating comfort through the garden's orientation, utilizing evaporative cooling via ponds and pools within the garden and the pavilion, and positioning the pavilion's main façade to face the garden's pleasant air, and evaporative cooling by using a wind catcher and ponds inside the pavilion.	-Planting trees adapted to the climate -Prevent water loss in irrigation -Taking water into the ground to prevent evaporation and loss	Adaptation and coordination of irrigation and planting systems with garden geometry - Symmetry and balance in garden architecture and its pavilion	-Planting native plants -Using local methods in irrigation (Qanat) -The use of local materials in the construction of the building(pavilion)	Enclosing the garden by the adobe walls
Shazdeh	Creating comfort through the garden's orientation, utilizing evaporative cooling via ponds and pools within the garden and the pavilion, and positioning the pavilion's main façade to face the garden's pleasant air.	-Planting trees adapted to the climate -Prevent water loss in irrigation	Adaptation and coordination of irrigation and planting systems with garden geometry - Symmetry and balance in garden architecture and its pavilion	-Planting native plants -Using local methods in irrigation (Qanat) -The use of local materials in the construction of the building(pavilion)	Enclosing the garden by the adobe walls

Table 3: *The comparative evaluation of the principles of Pirnia with the architectural Features of selected gardens.*

Garden	Human-orientated	Avoiding non-essential	Structural Rigidity	Self-sufficiency	Introversion
Eram	■	■	■	■	■
Chehelsotoun	■	■	■	■	■
Dolatabad	■	■	■	■	■
Shazdeh	■	■	■	■	■

Conclusion

In this paper, after describing the five principles of Iranian architecture presented by the contemporary researcher "*Pirnia*," the authors investigated and explained the five principles in Persian gardens in general. To further clarify the research and answer its question, these principles were recognized and reinterpreted in four of the nine historical Persian gardens registered by UNESCO. The information in Tables 2,3 show the full compliance of Iranian architecture principles of Pirnia in the selected gardens. It also shows that despite the differences in shape, body, and the positions of these gardens, the same architectural principles have been used in the design of all of them. The information obtained from the features corresponding to each of the five principles of Iranian architecture in the selected Persian gardens provides an answer to the question of this research, which is briefly shown in Table 4:

Table 4: *Common features of selected gardens in accordance with the five principles of Iranian architecture.*

Five Principles of Iranian Architecture	Description
Human-orientated	Taking advantage of the appropriate view Applying climatic strategies in design to provide physical comfort for the residents.
Avoiding Non-essentials	Using proper irrigation and planting methods to prevent waste of water.
Structural rigidity and homogenous protection	The design of the garden is based on the specific geometry and the conformity of the planting and irrigation systems with the geometric network of the garden.
Self-efficiency	Using local materials in the construction of garden buildings and planting native fruit trees inside the garden.
Introversion	Separation and privacy of the garden from its surroundings by walls.

The data from Tables 2, 3 and 4 identify the five principles of Pirnia in all selected cases such as, the creation of closed ecosystems and the appropriate design of these gardens against the climatic conditions are the principle of Human-orientated, the optimal use of water and materials in the architecture of the

gardens is the principle of avoiding non-essential, the use of local methods of irrigation, the planting of native plants and the use of local materials in the construction of pavilions are the principle of Self-sufficiency, garden design based on the geometry and centrality can be considered as Niaresh principle, and finally the enclosure of all these gardens by walls is the principle of Introversion. These data can be an answer to the question of this paper about how to show the five principles of Pirnia in the Persian garden design.

In addition, Table 4 indicates that the design of Persian gardens built in various historical periods, despite different locations and shapes, has followed the five principles of Iranian architecture with similar characteristics. Therefore, studying and recognizing the five principles of Pirnia in Persian gardens can be a suitable strategy in the design of today's green spaces and meet citizens' physical and psychological needs.

The findings of this study can be the basis of future studies, as follows:

1. The study of the five principles of Pirnia in other types of traditional Iranian architecture.

2. Detailed and scientific analysis of each of the 5 principles separately in Persian gardens.

3. Feasibility study of five principles of Iranian architecture in contemporary architecture design and landscape.

References

Alemi, M. (1997). The Royal gardens of Safavid period: Types and models. gardens in the time of great muslim empires, theory and design, *ed Attilio Petroccioli. Brili. Leiden. Newyork. Koln.* 72-96.

Ansari, M. (2000). Values of Persian Garden (Safavid Isfahan), unpublished Ph.D. *Dissertation, Tehran University, Iran.*

Bahram, M. (2016). Botanical. Rapooyan Sharif, Tehran.

Beheshti, M. (2021). About Mohammad Karim Pirnia: the biography and scientific and cultural services of the late Professor Mohammad Karim Pirnia. *Publications of the Association of Cultural Artifacts and Masters, Tehran*, 39-43.

Diba, D., & Ansari, M. (1995). Persian Garden. In proceeding: 1st Congress of History of Architecture and Urbanism, Tehran: Iranian National Heritage Organization: 25-42.

Dehkhoda, dictionary, under the word of “Mardum”. Tehran.

Fadaie Tamidjanie, H., (2016). Iranian Gardens in Arid Regions from Sustainable View, unpublished Ph.D. Dissertation, Science & Research Branch, IAU, Tehran. Iran.

Fadaie H., (2022). Recognition of a desert garden through the lens of landscape sustainability case study of Shazdeh Garden in Mahan, Iran. *Journal of Urban Management and Energy Sustainability (JUMES), 4*(1), 146-163. https://doi.org/10.22034/ijumes.2024.2025969.1209

Fadaie H. (2024). Investigating the effect of hot and arid climatic factors in the design of pavilions in historical gardens from Safavid to Qajar Era (Case Studies: Chehelsotoun, Dolatabad, and Shazdeh Pavilions). *Interdisciplinary Studies on Iran Architecture. 3*(6), 93-115. https://doi.org/10.22133/isia.2025.481738.1106

Fadaie tamidjanie, H., Mofidi, M., Mamsoori, A., & Feizi, M. (2019). A comparative study with the Iranian cities of Chehl Seton and Behesht of Isfahan with parameters of landscape stability in response to the climatic goals of the hot and dry region. *Urban Identity journal. Tehran,* 31-42. https://doi.org/10.30495/hoviatshahr.2020.14223

Faghih, N., Sadeghy, A. (2102). Persian Gardens and Landscapes. *Architectural Design, 82*(3), 38-51

Gholinejad Pir Bazari, A., Khakzand,M., & Kiani, K., (2020). Analysis of the spatial pattern with the gardens registered in the World Heritage List case example: the gardens of Iran, China, and France. *41*, 324-307.

Heidari, F., Iranibehbahani, H., 2009. Persian Garden, Hamshahri. Tehran.

Heidari Delgarm, M., Bemanian, M.R., & Ansari, M. (2017). Purposes and Elements of Stylistic Narrative in the Works of Mohammad Karim Pirnia and Donald Wilber. *Journal of Iranian Architectural Studies, 5*(10), 31-48.

Heydari Delgarm, (2018). Three Roons, Six Orientations, Seven Climates: Investigating History of Roon Concept. *Journal of the History of Science, 15*(2),149-171. https://doi.org/10.22059/jihs.2019.276572.371474

Hosseinian, H., Soltanzadeh, H., & Kalantar, S. (2020). The Investigation of Prinia's Works Effect on Lexical Morphology in Islamic Iranian Architecture Principles. *Journal of Architecture in Hot and Dry Climates, 8*(12),83-99. https://doi.org/10.29252/ahdc.2021.14085.1357

Khansari, M., Moghtader, M.R., & Yavari, M. (2003). The Persian Garden: Echoes of Paradise, Mage Publishers, UK.

Kharabati, S., Sereshki, S., & Shaeri, M. (2021). The principles of Iranian architecture in rural housing (Case Study: Kolamo Village of Shahroud). *Journal of Urban Planning and Architectural Environment Identity (JUPA-EI), 2*(6),40-52. 10.22034/(jrupa-ei).2021.303953.1095.

Massoudi, A. (2009). Acquaintance with Iranian Gardens; Baghe- E-Shazdeh, Faza Publication, Tehran.

Maserat, H. (2014). A man with a strong and bright belief (The life, works, and thoughts of Professor Mohammad Karim Pirnia), Mohammad Karim Pirnia Foundation, Yazd.

Mansoori, A. (2019). The origin of beauty in the Iranian garden. *Manzar Magazine, 47*, 3. https://doi.org/10.22034/manzar.2019.89062

Mirfendereski, M.A. (1994). The garden as the ancestor of the city. *1st Congress of History of Architecture and Urbanism, Bam, Iran.*

Mohammadi, J., & Shaykh Baygloo, R. (2010). Analysis of climatic parameters of wind and rainfall considering on urban design (Case Study: Isfahan). *Geography and Environmental Planning, 21*(3),61-82. https://dor.isc.ac/dor/20.1001.1.20085362.1389.21.3.4.2

Moghani Rahimi, B., & Porbar, Z. (2013). Climate and Architecture of Shiraz. *Scientific Research Quarterly of Geographical Data (SEPEHR), 22*(87), 64-67. https://dor.isc.ac/dor/20.1001.1.25883860.1392.22.87.11.2

Mostafazadeh, M. (2008). The design of the Iranian garden museum based on the culture of gardening in Iran. Master's thesis in architecture. *Tarbiat Modares University, Tehran*.

Naderi, N., Nadimi, H., & Jadidi, A. (2012). Denial, proof or reflection? (Pirnia and verifying the principles of Iranian architecture). *Sofeh Magazine, 59*, 14-15. https://dor.isc.ac/dor/20.1001.1.1683870.1391.22.4.2.3

Naeema, Gh. (2004). The Gardens of Iran. *Payam Publishe, Tehran.*

Nourouzborazjani, V. (2004). Persian garden: Ancient wisdom, new landscape. *Tehran contemporary Art Museum.*

Norouzian Pour, H., Motahari, M., & Motaghi pishe, S., (2012). Persian gardens are sustainable gardens: Scrutinize the sustainability features in Persian gardens. *In proceeding: 2th International Conference on Architectural Transition through the Silk Road. Nishinomiya, Japan*, 280-285.

Peyvastegar, Y., Heydari, A., & Eslami, M. (2017). Recognition of the five principles of Pirnia in traditional Iranian building and Its analysis with reference to Islamic religious sources; Case study: The Yazd Building, *Iranian Islamic City Studies Quarterly, 27*, 51-66.

Pirnia, M.K. (1994). Persian Garden, *Iranian Journal of Abadi, 4*(15), 12-23.

Pirnia, M.K., & Memarian, Gh. (2018). Principles of Iranian architecture. *Pajoohandeh publication, Tehran.*

Pirnia, M.K. (2009). Persian Garden. *Iranian Journal of Golestan-e Honar, 12*, 30-33.

Qayyoomi, B., & Abdollalizadeh, M. M. (2015). Architecture, Land, and Man; Rereading, reviewing and criticism of Pirnia's suggested principles for Iranian architecture. *Kimiay-ye-Honar Quarterly, 11*, 72-99.

Shahcheraghi, A. (2011). Paradigm of paradise (Recognition and Re-creation of Persian Garden). *Jahad Daneshgahi, Tehran.*

Shervani Tabar, F.,Nejad Ebrahimi, A., Chenaghlou,M.R.(2024). The Structural System of Karbandi, Definition Formation and Influential Factors. *Knowledge of Conservation and Restoration Journal*,7(1),41-54. http://dx.doi.org/10.61882/kcr.7.1.41

Zamani, E., Leylian, M.R., Amirkhani, A., & Okhovat, H. (2009). Recognition and Analyzes of Persian Gardens' Elements with Respect to Ethical Principles, Bagh- E Nazar. *The Scientific Journal in the Field of Theoretical Studies of Art and Architecture, 6*(11), 25-38.

Zolfaghari, M., & Koleini, N. (2020). A comparative study of Pirnia's principles in architecture and artifacts with industrial design styles. *Journal of Iranian Architecture and Urbanism,12*(2), 205-216. https://doi.org/10.30475/isau.2021.275192.1698

URL1:https://mehriz.ir/ (Access date:2020)

URL2:https://www.persiantourismguide.com/2016/10/13/akbarieh-garden/(Access date: 2016)

URL3:https://visitmazandaran.ir/(Access date: 2022)

URL4:https://whc.unesco.org/en/list/1372/(Access date:2023)

URL5:https://www.worldhistory.org/qanat/(Access date: 2023)