

The Study of Process of Formation and Development of Spiral Staircases in Pre-Islamic Architecture, Iran

Abstract

Iranian architecture has been a pioneer and innovator in the structural, technical, and artistic fields in the world and has produced valuable masterpieces in historical times. Despite this, there are many unknowns and ambiguities regarding its various aspects. These include discussions related to design, execution, techniques, and architectural elements. In this regard, despite Iran is one of the pioneers in the design and execution of the first spiral staircases, as well as the important role of this element in the architecture of various historical periods, no scientific research has been conducted, and its origin, formation process, and evolution are not clear. Focusing on these ambiguities, relying on archaeological sources and data, the present study descriptively and analytically attempts to determine Iran's roll and position in the construction of spiral staircase. Based on the research conducted and considering the reference in Latin sources to the first identified example of a spiral staircase in Italy dating back to 480 BC, the first identified example in Iran is much older and dates back to the late second millennium BC. Although similar examples have been identified in the Syria and Mesopotamia region before Iran. The process of their formation and expansion in the architecture of the first millennium BC in the northwest (Hasanlū V and IV) and western Iran (Bābā jān III and the main Median settlement in the Nush-i jan site) and its continuation in the Achaemenid (Susa site), Parthian and Sasanian periods (Qal'a-ye Dukhtar and the palace of Artaxerxes I in Firuzabad) can be studied and followed. This architectural element has found a permanent place in the Islamic period.

Keywords: Spiral staircase, architecture of Iron Age, Median architecture, historical area of Susa, historical area of Hasanlū.

1- Introduction

With a history of about ten thousand years, Iranian architecture has pioneered and innovated in various structural, technical and artistic fields and has presenting valuable masterpieces to the world across different historical and Islamic periods. Despite the research history of about a hundred years on various aspects of traditional Iranian architecture, many untold stories and details unfortunately remain unstudied and unclear due to a lack to a lack of historical documents and limited architectural remains. These include issues related to design, execution, techniques and elements of architecture. Meanwhile, despite the fact Iran is one of the pioneers in the design and implementation of the first spiral staircases, and the important role of this architectural element in various historical periods, scientific research has not been conducted on this matter, and its origin, formation process, and evolution are not clear. The origin of this

architectural element, its formation process, and evolution have been introduced in different ways in other cultures.

Flat beamed roofs are common in the architecture of various regions of Iran, especially in the Zagros region. Access to the roof (and later to the upper floors of the building) was a necessity due to the preservation and maintenance of the thatched roof and its various functions. For this reason, solutions have been considered from the prehistoric period to the present to provide easy and quick access to the roof or upper floor. Typically, portable wooden ladders were the simplest solution in the early period and were often used through the outer wall of the building. However, gradually, for quick and safe access in buildings with important functions, considering the climatic conditions, especially in the Zagros region in the cold seasons and the high density of a number of settlements, the staircase was moved inside the building and implemented with more sustainable materials; however, the same previous method in simpler buildings has continued in the architecture of the region to this day. Considering the importance of architectural space, architects preferred to implement the staircase in the best possible way and in the most limited space possible. The spiral staircase has been the best option. In such a way that thousands of years after its formation, it has been used in approximately the same way in various governmental, religious, tomb, memorial, etc. buildings by different ethnic groups.

1- 1- Statement of Problem Corrected

As mentioned in the introduction, the spiral staircase is an important element with a long history in Iranian and world architecture. However, so far, no scientific research has been conducted on its origin, formation, and reasons, its evolution, and its architectural details in the prehistoric and historical periods of Iran, and there are fundamental unknowns in this regard, which the present study attempts to answer using archaeological evidence from different prehistoric and historical periods.

Recognizing and scientifically studying the formation and evolution of this architectural element can highlight the role of Iranian architecture and its pioneering role in presenting new ideas to world architecture, and lead to the revision of theories about the history of spiral staircase construction and its evolution.

1- 2- Literature Review

The data and information available have been published in the form of excavation reports of the sites and descriptions of the remains obtained from them. The results of Dyson's excavations at Hasanlū have provided information on the first spiral staircases related to the Iranian Iron Age in the architecture of the northwestern part (Dyson, 1977; 1989 a, b). Goff's excavations at Bābā jān have shown the continuity of the construction of such staircases in western Iran (Goff, 1968; 1970; 1977). The results of the excavations of the Stronach Archaeological Team at Nush-i jan have shown more complete designs of such staircases in the Median period (Stronach & Roaf, 2007). The construction of spiral staircases continued to

a limited extent during the Achaemenid period (Ladiray, 2013; Perrot, 2013; Hesse, 2013). Different types from recent examples have been reported in the Qūmis site from the Parthian period (Hansman, 1968; Hansman et al., 1970; Hansman & Stronach, 1974). Such staircases are found in the Qal'a-ye Dukhtar of Firuzabad (Huff, 1976; 1978 a, b; 2005) and the Firuzabad Palace (Michell & Eaton, 1992).

1- 3- Methodology

In this research, data collection was done through field studies and library method and their processing was done through descriptive - analytical method. The time frame of the research includes from the time of the emergence of the spiral staircase in the second half of the second millennium BC. to the end of the Sassanid period and the geographical framework of the research includes the Iranian plateau. However, to study the stages of formation of this architectural element and its analysis, cases outside the aforementioned geographical framework have also been addressed.

2- Spiral Staircase and Reason(s) for Choosing It

A “Spiral Staircase” is a set of steps that are constructed with different materials and methods, with a central column or pillar and a surrounding wall that was initially quadrilateral and later became circular, and in most cases revolves clockwise (and counterclockwise in cases of the Babajan and Hasanlu) around the central pillar and provides access to the roof or upper floor(s). Based on this definition, a spiral staircase is distinguished from later spiral staircases that lack a central pillar (Helical Staircase).

A spiral staircase is more complex in design and execution than conventional staircases, and consequently, its inventors must have good reason(s) for their work;

It seems that the main reason for this choice, which remains valid to now, is the limited space required to implement this type of staircase compared to conventional types. Optimal use of architectural spaces has been and remains a fundamental principle for many designers, architects, and building users.

Another reason is to limit access to the upper floor(s) and to control it easily. This issue arises due to the importance of security and control of hesitation in historical times. This issue is true in relation to the staircases of castles and important and governmental buildings. Many spiral staircases of medieval European castles and buildings of the historical and Islamic periods of Iran had a narrow width and a dark space and their rotation was in accordance with the direction of movement of the hands of the clock. The construction details of the spiral staircase hindered attacker, who typically wielded sword with their right hand from effectively striking defenders due to inadequate visibility. While it was easier for the defender, who fought from the upper steps to the lower steps, to strike the sword. In other words, the central column or pillar acted as a defensive shield for the defender.

The third reason, which is perhaps more applicable to staircases of the later period, is the aesthetic aspect and attractiveness of this type of staircase compared to other conventional types.

The aforementioned reasons and Structural reasons have led to the fact that after its formation, this type of staircase has been widely used in the architecture of different geographical regions, civilizations and cultures, and for religious and non-religious buildings such as castles, churches, mosques and even tomb buildings, and has been implemented with different materials and methods.

3- An Introduction to the History of the Construction and Use of Spiral Staircases

Although the use of stairs and staircases in their conventional forms is as old as architecture itself, the spiral staircase, with its complex and evolutionary design, has been formed in more recent times. The remains of the foundation of the staircase of Temple A of Selinunte in Sicily, Italy, date back to around 480 BC. It is presented in most sources as the oldest surviving example of a spiral staircase (Miles, 1998: 2, Fig. 1). Also, in this group of sources, the middle staircase of Trajan's Column in Rome is also described as the first surviving staircase in the world (Lancaster, 1999, 425, Fig. 4), which was built in 113 AD. It has been completed (Ibid: 419). According to written sources, the history of such staircases goes back to ancient times. In the Old Testament, it is mentioned about the building that the Solomon built in the fourth year of his reign (about 966 BC): ... and they went up with winding stairs into the middle chamber, and out of the middle into the third” (Old Testament, Kings I, 6, 8). None of the sources on the history of architecture mention older examples left in Iran that best demonstrate the process of formation and evolution of this architectural element.

New archaeological data provide a more illustrative picture of this architectural element. The limited remains of prehistoric architecture make it challenging to study all architectural details especially access between spaces. However, considering the archaeological excavations of the Syria and Mesopotamia regions, it seems that the first stages of the formation of this type of staircase are related to this region and around the third millennium BC. M. In the Eshnunna site, a palace of the ruler has been excavated from the late third millennium BC, where a spiral staircase was found next to the reception hall and its entrance space (Stronach & Roaf, 2007: 187). This type of staircase was later repeated as a standard in a similar location in the palaces of the Assyrian Empire, although they differed in some details (Ibids).

In the middle of the second millennium BC in the northwestern area of Iran in the ancient site of Hasanlū (Dyson, 1989 a, b). We witness the formation of a special architecture, the main core of which was the columned hall, and gradually in the late second millennium and early first millennium BC, the spiral staircase and later the columned portico were added to this architecture, and it became a fixed part of this type of architectural plan and spread in different regions (Stronach & Roaf, 2007; Goff, 1968; 1970; 1977). This architectural element has had a special place in Iran's architecture in later periods as well. Therefore, it is important to examine the process of its formation, evolution, and continuity in the Iron Age, Median,

Achaemenid, Parthian, and Sasanian periods, which have not been studied and introduced so far.

4- The process of formation of spiral staircase in Iran

The first identified examples of spiral staircase in the Iran's plateau are related to the Iron Age I (1450-1200 BC). The Iron Age in Iran and beyond is a period with various and important developments in the fields of technology, economy, culture, communication, etc., including the growth and development of architecture and its components and elements (especially the spiral staircase, which is the subject of the present study) (Mollazadeh, 2014: 211-212). The different stages of the formation and development of architecture in this period, which later laid the foundation for Median and Achaemenid architecture, and in particular, the formation and development of the use of spiral staircases, should be studied in the site of Hasanlū. This site was the center of a wealthy local state with extensive commercial, political, and cultural ties during the Iron Age I, which continued to exist until about 800 BC (Dyson, 1977; 1989).

1-4- Iron Age I and II: Hasanlū site

The Hasanlū site is located in West Azerbaijan Province, on the Solduz Plain and the southwestern edge of Lake Urmia, and represents a settlement from the 6th millennium BC to the Ilkhanid period (Dyson, 1989 a: 6). According to Dyson's chronology, Level V of this site corresponds to the Iron Age I settlement (1450–1250 BC) and Level IV to the Iron Age II (1250–800 BC) (Roaf, 2012: 2). However, this chronology has been revised recently by Michael Danti (Danti, 2013: 53–142). However, for the purposes of this article, this discussion does not make any difference.

In the level V, we witness a new architecture compared to the previous period, whose main plan is a columned hall with a counter, a spiral staircase and rectangular rooms around it (Fig.1). This plan was expanded and developed in terms of dimensions, design and other details in the level IV and was a model for the architecture of the Median and Achaemenid periods and has continued in a way until the recent period in the architecture of the Zagros region.

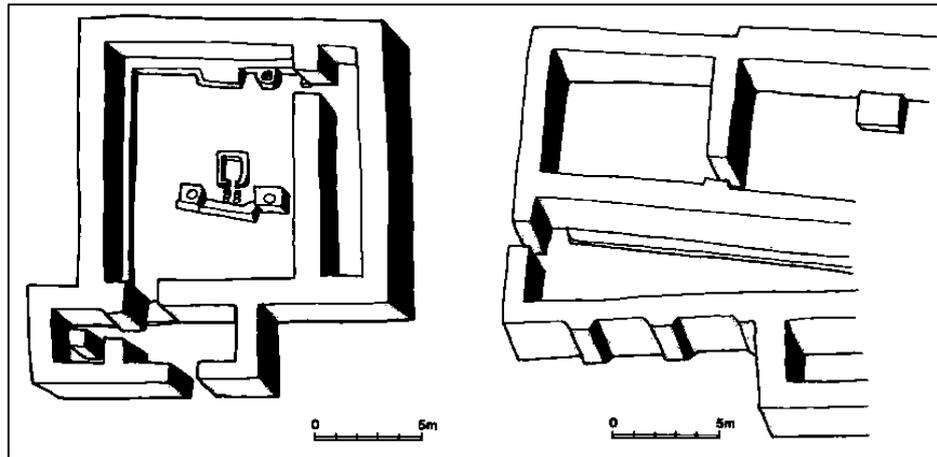


Fig. 1- Isometric drawing of architectural remains discovered in the Level V of the Hasanlū site (Dyson, 1989 b, 108, Fig. 2a, b).

So far, the first spiral staircase found in Iran is related to the level V of Hasanlū around 1450-1250 BC. (Fig. 2). In this level, two residential units including a counter, staircase, columned hall, rectangular rooms around the hall and mud-brick benches have been discovered. Of course, the limited scope of the excavation did not allow for the reconstruction of the plan and other architectural elements of the complex, and it is possible that there were more staircases on this level. As mentioned, each of the residential units in the counter appears to have a spiral staircase. Each staircase consists of a square space with an entrance from the counter and a central mud-brick pillar. The foundation of the building is made of rubble stone and the upper parts of mud-brick. No other architectural details of the staircase survive to comment on the construction method of the steps. However, based on the remains of the staircase of the BB IV on the level IV of the site, it seems that the steps were constructed with mud-brick in the lower parts and wood in the upper parts, and perhaps a mud-brick arch around the central pillar.

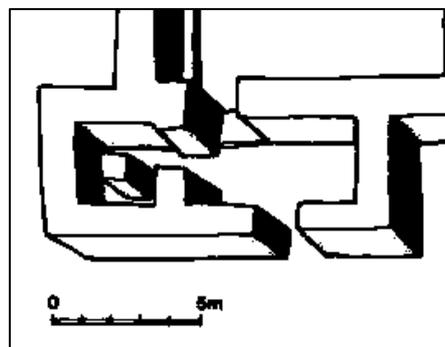


Fig. 2- Isometric drawing of the architectural remains of the counter and the spiral staircase discovered in the Level V of the Hasanlū site (Dyson, 1989 b, 108, Fig. 2a).

A relatively complete building in Level V was excavated at the northern end of BB VII in Trench RS22-23, and based on the results of carbon 14 experiment, a date of 1360–1290 BC has been proposed for it (Dyson, 2012: 34). Based on reconstructions based on Level IV buildings, the building had a counter measuring 2.6×8.85 m, with a staircase at its southern end measuring 2.6×2.6 m with a central mud-brick pillar measuring 60×80 cm. It seems that the steps were made of raw mud-brick and started from the floor of the room and spiraled around the central pillar, giving access to the second floor and the roof of the passage (Ibids.).

With the gradual expansion and evolution of architectural designs in Level IV (1250-800 BC), we witness the discovery of seven spiral staircases in religious, governmental, and residential buildings of Level IVB (Fig. 3). Four of the staircases are on the right side of the entrance and three on the left side of the entrance, in proportion to the overall plan of the building (Fig. 4). The central pillar and its four peripheral walls in the staircases have different dimensions in proportion to the overall proportions of the building. Some are square-rectangular in shape (BB II), some have a more irregular plan (BB V), and the example discovered in BB IW, which is the newest building on this level, has the most regular plan compared to recent examples and a plan close to a square. The dimensions of the staircase room and its central mud-brick pillar in the buildings of level IV range from 4×5 (in BB III) to 2.7×2.9 (in the BB IE) and their central pillar vary from 1.3×1.2 m (in BB III) to 0.7×0.7 m (in the BB IE) (Dyson, 2012: 34 and 35). The steps ran counterclockwise upwards. The columned halls were one-story, but the side spaces were two-story, and access to the flat roof has been essential in the architecture of the region from prehistoric times to know for certain tasks, such as the annual repair of thatched roofs and the use of the roof seating area during the warmer months of the year.

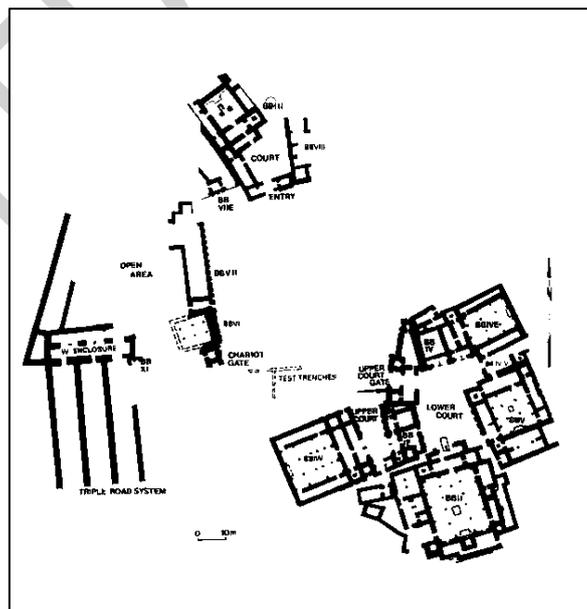


Fig. 3- Map of architectural remains discovered in Level IVB of the Hasanlū site (Dyson, 1989 b, 112, Fig. 6b).

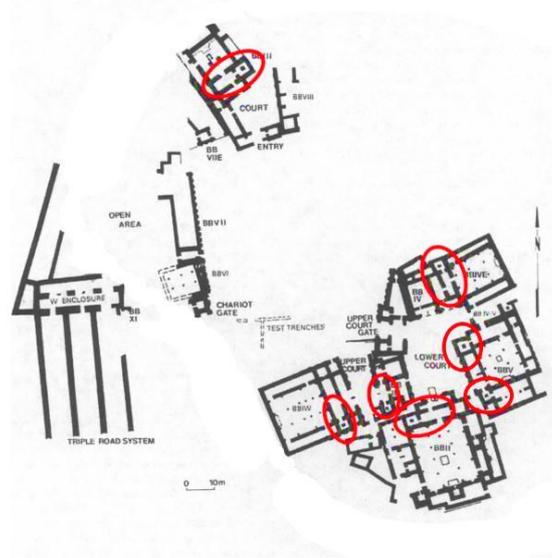


Fig. 4- Map of the architectural remains of the counter and the spiral staircase discovered in the level IVB of the Hasanlū site (red parts) (Dyson, 1989 b, 112, Fig. 6b).

The steps in the lower part were built using mud-bricks and directly on the ground. The amount of architectural remains is not sufficient to provide precise information regarding the method of construction of the steps in the upper parts and the distance between the central pillar and the surrounding four walls. It is possible that the steps in this part were supported by wooden beams (Dyson, 1989 b: 119). Given the availability of innovative arching techniques in the Median period, the use of arches in the spiral staircase was common in the Nush-i jan site (Stronach & Roaf, 2007: 187). However, such evidence has not yet been identified in the Hasanlū site.

Considering the data presented, it seems that the history of the construction and use of spiral staircases in the Iran's Plateau in the Iron Age I (1450-1250 BC) has been formed and expanded in the Hasanlū site. The environmental conditions of the Zagros region, the formation of the ruling class and the ruling architecture, and the extensive cultural connections with neighboring regions, especially Mesopotamia and Syria (in this regard, see: Young, 2012: 81-102) have played a role in this connection. Accordingly, the architecture and staircases implemented in the northwestern region of Iran in the 9th and 8th centuries BC have spread to the western region of Iran, and their evolved examples can be observed in the Bābā jān and Nush-i jan sites in chronological order.

4- 2- Iron Age II: Bābā jān Site

The Bābā jān site is located in the Delfan Plain near the city of Nurabad in Lorestan Province. The site was excavated by Goff between 1966 and 1969 AD. 9th-century BC administrative complex was discovered on the eastern hill of the site, with a spiral staircase in counter of it (Fig. 5-6) (Goff, 1970: 150-151). Like the examples from the Hasanlū site, this staircase

consists of a four-walled enclosure with a central cubical pillar. After its entrance, there is a sloping surface of mud-brick that runs around the central pillar. After the first landing, the height of the ramp decreases, which seems to have been due to the continuation of the step and its connection to the next landing using several steps or a sloping surface made of wood. Burnt wooden remains were found in this section. The central pillar was built independently. However, it is connected to the ramp at the top and to the west. This is the support for the remains of an arch on the second landing, which was probably connected to the northern wall of the staircase area. The arch did not survive the excavation and its remains had collapsed before more detailed documentation (Ibid.). According to the evidence and reconstructions carried out, the staircase provided access to the rooms on the second floor and the roof of the building (Goff, 1977: 113). The staircase in the discovered example from the Bābā jān site was counterclockwise, like the examples from the Hasanlū site.

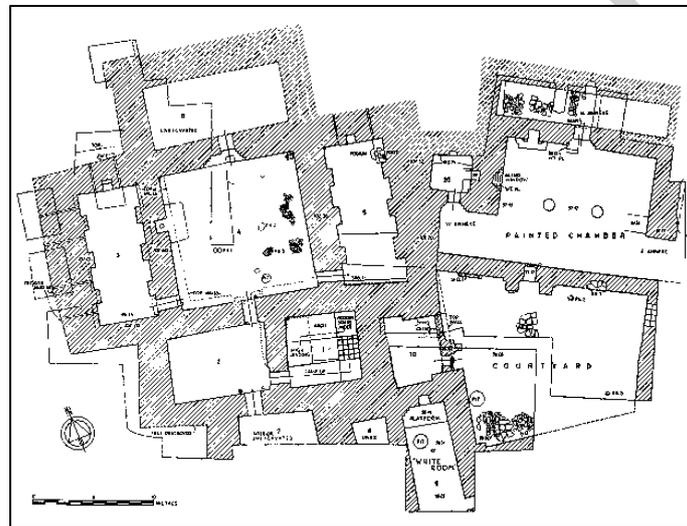


Fig. 5- Map of the architectural remains discovered from the level III of the eastern mound of Bābā jān site (Goff, 1977: 104, Fig. 1).

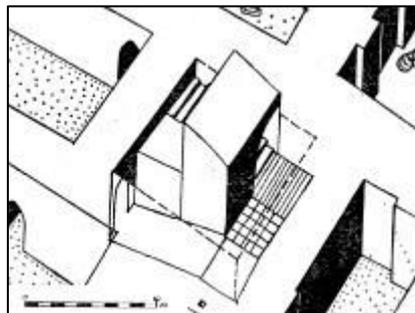


Fig. 6- Isometric reconstruction of the architecture of the spiral staircase discovered from Level III of the eastern mound of the Bābā jān site (Goff, 1977: 110, Fig. 6).

Considering the similarity of various parts of the architectural plan of the Bābā jān complex (such as the columned hall, the counter, the spiral staircase, the portals and the stair-shaped niches) with the architectural plan of the Hasanlū complex and considering the dating of the Hasanlū examples, it seems that the architecture developed in the northwest region in the 9th century BC found its way to western Iran through connections between local governments and cultures and became a common tradition in the construction of government buildings and traditional architecture of the Zagros region in the later period.

4- 3- Median Period: Nush-i jan Site

The Nush-i jan site located in the Malayer plain and south of Hamedan province, is one of the most prominent sites of the Median period, which is unique in terms of the permanence of its architectural components and elements and has a special place in the history of Iranian architecture (Mollazadeh, 2014: 103-137). This site was excavated from 1967 to 1977 by an archaeological team led by Stronach (Stronach & Roaf, 2007). A religious complex from the Median period (around 750 to 625 BC) was discovered in this excavation, and its inhabitants, when leaving the site, had filled the spaces with special arrangements and prepared the ground for its permanence. The discovery of four examples of spiral staircases, some of which are highly preserved, is important in the present discussion (Fig. 7). The four staircases mentioned are related to the buildings of the central temple, the old western building, the Fort, and the northern area.

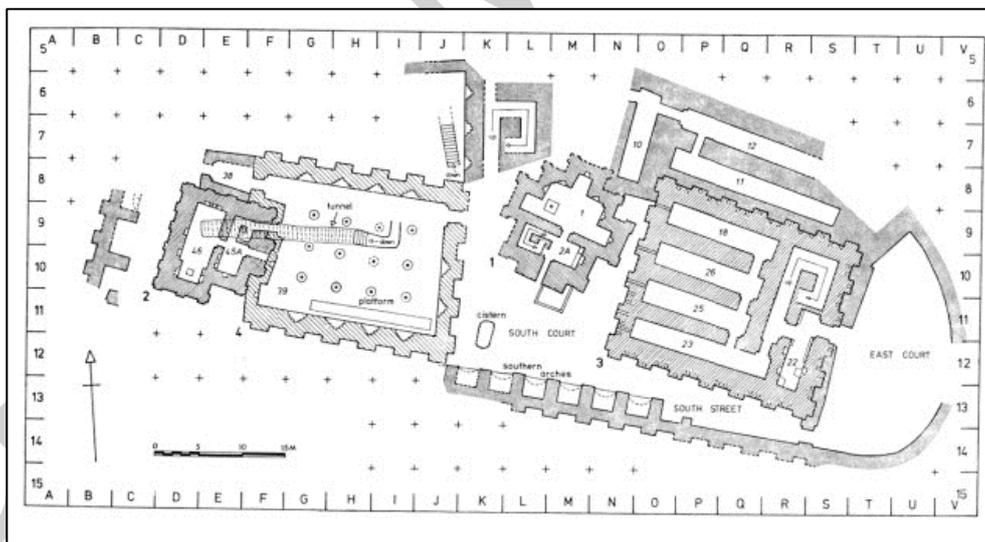


Fig. 7- Map of the architectural remains of the Median settlement in the Nush-i jan site (Stronach & Roaf, 2007: 55, Fig. 1.9).

The central temple's staircase, despite its mud-brick structure and vaulted covering, has been well preserved due to the arrangements made by its inhabitants when they left the site (Stronach & Roaf, 2007: 171), and unlike the examples in the Hasanlū and Bābā jān sites, its

architectural details can be studied (Fig. 8). This staircase was located on the western side of the counter space and to the left of the entrance, providing access to the second floor of the counter and the roof. Three and a quarter of the full turn of the staircase (the identifiable height of this structure relative to the floor of the counter is 8 meters) was in place during the excavation.

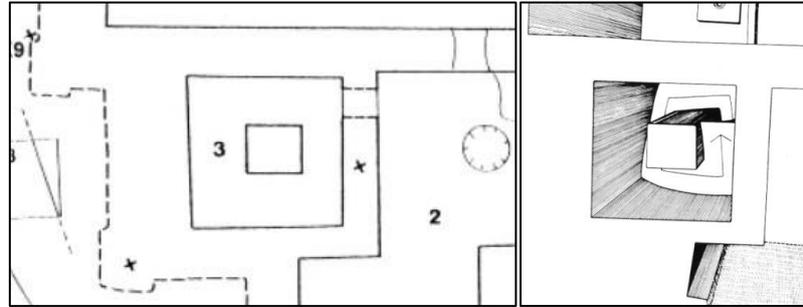


Fig. 8- Isometric map and design of the architectural remains of the spiral staircase discovered in the central temple of the Nush-i jan site (Stronach & Roaf, 2007: 69, Fig. 2.3; 70, Fig. 2.4).

The general structure of the staircases of the Nush-i jan complex is similar to the examples of the Hasanlū and Bābā jān sites and consists of a quadrangular space with a central pillar, with steps rotating counterclockwise around the central pillar; although the execution of the steps and their covering is different from the aforementioned examples. The width of the staircase is 0.80 - 1.10 meters, which revolves around a rectangular pillar measuring 0.95×1.10 meters. On average, the height of the structure increases by 50 centimeters with each flight of steps, or in other words, 2 meters for a complete rotation. Therefore, the average slope of the staircase was about a ratio of one to four. The staircase covering was implemented with mud-brick battens. The battens are short and without curvature (Fig. 9). The length of the blocks is 55-60, their width is 10-11, and their thickness is 13-14 centimeters. The arrangement of the mud-brick arches creates a stepped arched covering, and this shape is repeated in the mortar covering over it. So that every four pairs of the mentioned arches next to each other form a step, and the next four pairs at a higher height form the next step (Stronach & Roaf, 2007: Fig. 2.4; *Ibid.*: 79; Mollazadeh, 2014: 114).

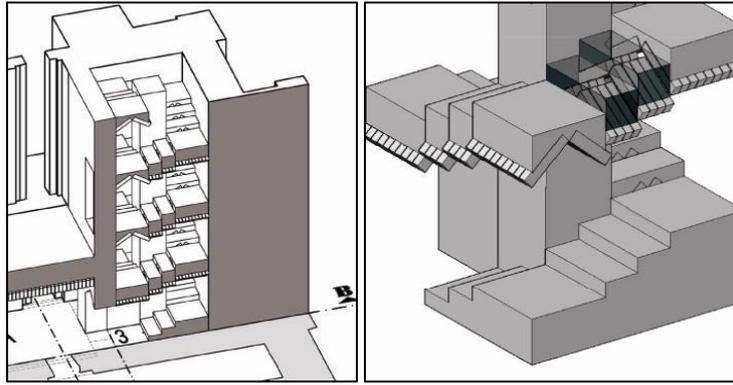


Fig. 9- Isometric drawings of the method of implementing stepped arches in the exposed spiral staircase in the central temple of the Nush-i jan site (Molazadeh and Mohammadian Mansour, 2011: 128, Fig. 12; *ibid.*: 129, Fig. 14).

The staircase of the old western temple (space 44), unlike the central temple, is located to the right of the entrance and on the northern side of the counter (space 45 A) and provided access to the second floor of the counter and the roof (Fig. 10). A full turn of this staircase remained during the excavation, reaching a height of 230 cm. The construction and execution of this staircase is also similar to that of the central temple. The mud-brick arches used are 18 cm wide and 9 cm thickness (Stronach & Roaf, 2007: 100 – 101). It seems that the staircase of the old western temple was used after the temple was abandoned, with some modifications, to access the roof of the main columned hall (Stronach & Roaf, 2007: 187; Mollazadeh, 2014: 124). The staircase turns clockwise and it revolves around a 2-meter-wide pillar. Accordingly, it seems that the location of the staircase and its direction of rotation depended on the building plan and did not follow a specific tradition, since the central temple and the old western temple of Nush-i jan were built with a short interval of time. Evidence of five turns of the staircase of the old western temple can be identified. However, seven turns were necessary to reach the roof at a height of about 640 centimeters (Mollazadeh & Mohammadian Mansour, 2011: 131).

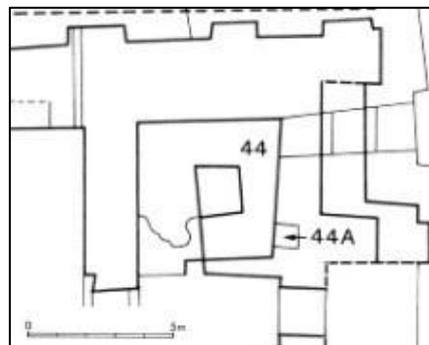


Fig. 10- Map of the architectural remains of the spiral staircase discovered in the old western temple in the Nush-i jan site (Stronach & Roaf, 2007: 93, Fig. 3.1).

The Fort building (warehouse complex) (space 20) also has a spiral staircase that seems not to have been built just to access the roof (Fig. 11). It also provided access to the second floor of the building. This staircase, like the one discovered in the old western temple, is located on the right side of the entrance and its direction of rotation is clockwise. The entrance to the staircase is 2 meters high and slightly less than 2 meters wide. The surface of the staircase initially slopes gradually towards the north and circles around a large mud-brick pillar with an area of 2 square meters. Seven turns were necessary to access the upper floor or a height of about 6.40 meters. Traces of the arch covering the staircase remain on different sides of the middle pillar. The covering of this staircase was also carried out with a stepped arch using mud-brick arches, and each step consisted of four opposing mud-brick arches. Each mud-brick arch was 18 cm high and 9 cm thickness (Stronach & Roaf, 2007: 113, Fig. 4.6).

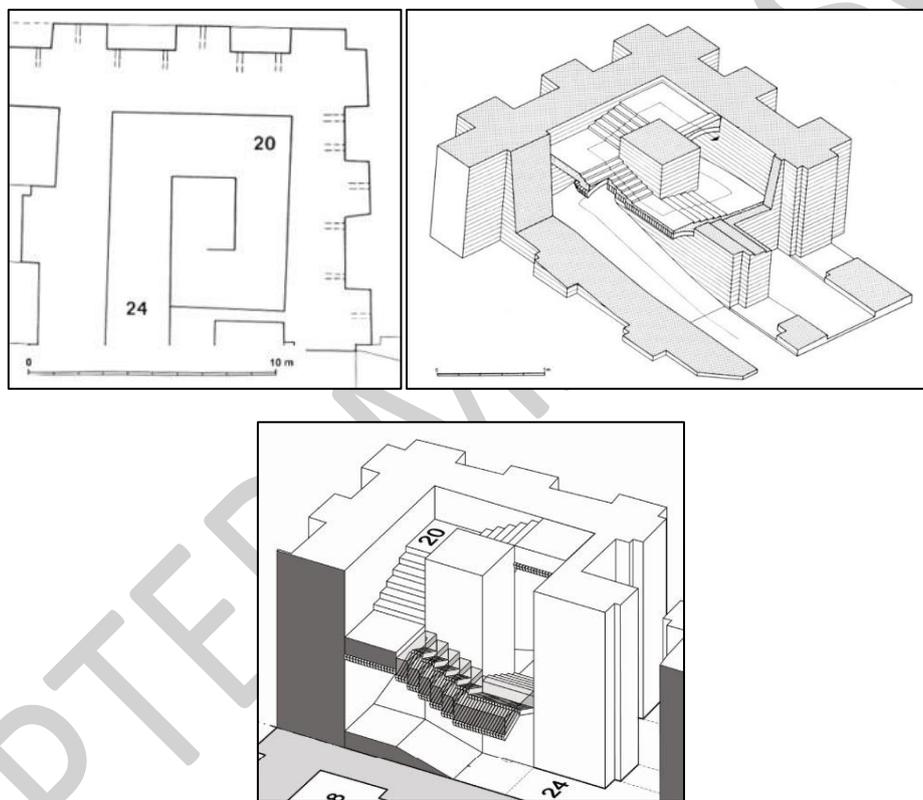


Fig. 11- Map and isometric drawings of the architectural remains of the spiral staircase discovered in the fort building of Nush-i jan site (Stronach & Roaf, 2007: 113, Fig. 4.6; Mollazadeh & Mohammadian Mansour, 2011: 132, Fig. 18).

The considerable number of spiral staircases and the advanced and elaborate way of covering them, which is evident in the arching of a number of spaces in the Nush-i jan complex, are a mature stage in the construction of spiral staircases, the first examples of which can be seen in the Hasanlū site. The placement of the staircases in the Nush-i jan Median complex, their direction of movement, dimensions and other details are a function of the overall plan and the importance of the building; although the overall structure and the method of their execution

are similar. The use of mud-brick arches to execute the stair-shaped arch was identified for the first time in this site and its continuation can be studied later in the Achaemenid and Parthian periods (Mollazadeh and Mohammadian Mansour, 2011: 136-137).

4- 4- Achaemenid period: Susa site

With the establishment of the Achaemenid Empire and the formation of its architecture, although we witness remarkable changes in the dimensions of architecture, materials, techniques and elements used, decorations and similar matters compared to the architecture of the previous period in Iran, a number of designs, including the columned hall and the columned porch as the main and central core of Achaemenid architecture and elements such as the spiral staircase, continued in higher dimensions and quality. In the Pasargadae complex, as the first architectural complex of the Achaemenid period, the spiral staircase has not been identified, perhaps due to the limited survival of architectural remains. However, in the gate building of the Susa palace complex dating back to the period of Darius I (522-486 BC) and the Shaūr Palace dating back to the period of Artaxerxes II (405-359 BC), study able examples have been identified (Fig. 12-13).

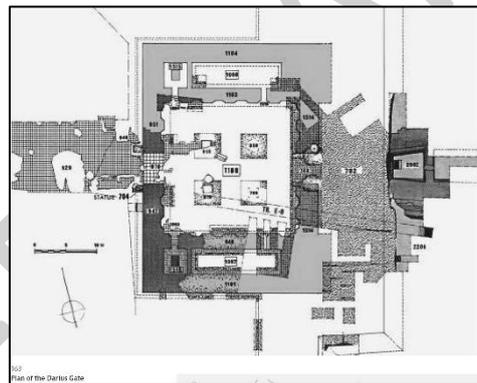


Fig. 12- Map of the architectural remains of the gate of Darius I discovered in the Susa site (Ladiray, 2013: 169, Fig. 168).

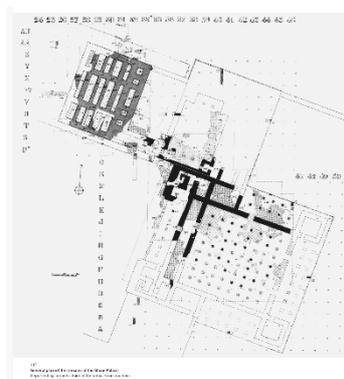


Fig. 13- Map of the architectural remains of the Shaūr palace discovered in the Susa site (Hesse, 2013: 378: Fig. 419).

The Gate of Darius I: The Darius I Memorial Gate is a freestanding rectangular structure measuring 28×40 meters in an east-west direction. The structure has a central hall with four columns measuring 1.21×1.21 meters, flanked by rectangular rooms (14×3.5 meters) on either side, and rooms with spiral staircases in the corners (perhaps in two corners). A trilingual inscription of Xerxes I is carved on one of the columns of the central hall (XSa), which refers to the completion of the building founded by Darius I (Kent, 1931: 225; 1953: 113; Lecoq, 1997: 261 – 262). The remains of two spiral staircases have been identified in the northwest and southwest corners of the rooms adjacent to the hall, which provided access to the upper floor and the roof (Fig. 14). These staircases are small, cubic spaces with a quadrangular pillar in the center, and the steps revolved around this pillar. Only the first step was left during the excavation. The other side of the building was heavily damaged, and the existence of such staircases on the other side is not known. The steps revolved clockwise around a mud-brick pillar inside a rectangular space and provided access to the upper floors and the roof (Ladiray, 2013: 168, Fig. 168, 169 & 171).

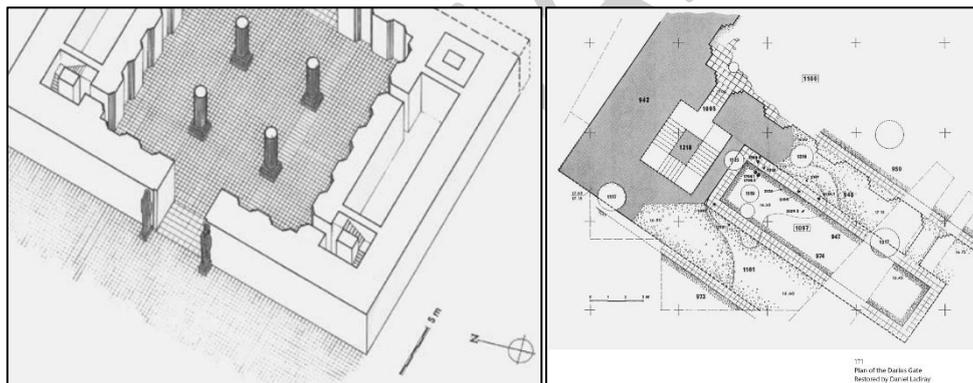


Fig. 14- Spiral staircase discovered in the gate of Darius I, Susa site; left) map (Ladiray, 2013: 170, Fig. 171) and right) isometric drawing (Ibid: 169, Fig. 169).

Shaūr Palace Complex: The remains of the Shaūr Palace Complex, dating from the reign of Artaxerxes II (404-359 BC), have been excavated on the west bank of the Shaūr River, approximately 50 meters from the Apadana of Darius I, and are located only a few meters above the plain, and their name is derived from the adjacent river. Shaūr Palace consists of a complex consisting of a large columned hall and residential and recreational buildings on a plot measuring 150×220 meters. These remains were excavated in the 1970s by Remy Boucharlat and Audran Labrousse, and their map was prepared and completed by Albert Hesse. Based on the reconstructed map, the Shaūr Palace Complex consisted of three main buildings, courtyard or open spaces, and other destroyed buildings. The main columned hall (Building I) measures 34.6×37.5 meters and its plan is similar to that of the Apadana of Susa, with its central ceiling

resting on eight rows of eight columns. In the middle of each side of this hall, there was a columned porch. On both sides of the western columned porch, there were corner towers, the remains of which are only left in the northwest part. Inside these towers, a room and a spiral staircase were created, which were accessible through the western porch (Fig. 15). The direction of movement of this staircase was opposite to the direction of movement of the clockwise (Hesse, 2013: 373-403). No other spiral staircases have been identified in the main palaces of Susa and the Persepolis complex, and perhaps the reason for this is the extensive destruction of the buildings. It seems that with the expansion of architectural dimensions and the need for easy access to large and main buildings, most conventional large staircases were implemented with landings and spiral staircases, which are suitable for limited spaces, were used less often.

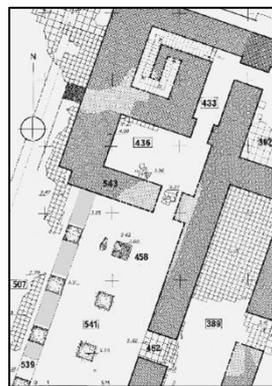


Fig. 15- Spiral staircase discovered in the western porch of the Shaūr palace, Susa site (Hesse, 2013: 382, Fig. 426).

4- 5- Parthian period: Qūmis site

Not many remains from the approximately five hundred-year Parthian period remain on the Iranian plateau, and very little information is available about the type and architectural details of the staircases used in this period. The only identified examples from this period are from the Qūmis site, which was excavated by Hansman between 1967 and 1972 AD. Three religious buildings have been discovered in this site, which are particularly durable due to their accumulation and burial during the Parthian period (Hansman, 1968; Hansman et al., 1970; Hansman & Stronach, 1974) (Fig. 16). The plan, architectural details, and function of these buildings are very similar to the central temple of the Nush-i jan site from the Median period (Mollazadeh, 2011: 124). However, its staircase, despite some similarities, especially in the way the arch was executed, has some differences from the spiral types of previous periods. The discovered staircase in the Qūmis site is in a rectangular space with a central wall, which uses a stepped arch to provide a sloping corridor for access to the second floor and the roof, and its direction of rotation is opposite to previous examples and is clockwise (Fig. 17). Despite the lack of discovery of examples of spiral staircases from this period and considering the

continued use of these staircases in the Sassanid period, it is likely that the use of such staircases was also common in the Parthian period.

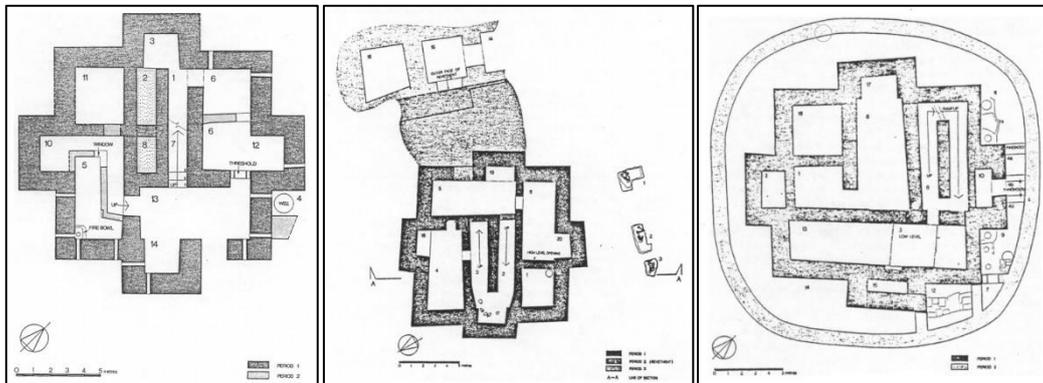


Fig. 16- Buildings with spiral staircases discovered in the Qūmis site; left) site 4 (Hansman & Stronach, 1974: 9, Fig. 1), center) site 7(Ibid: 13, Fig. 2 b) & right) site 13(Ibid: 15, Fig. 3).

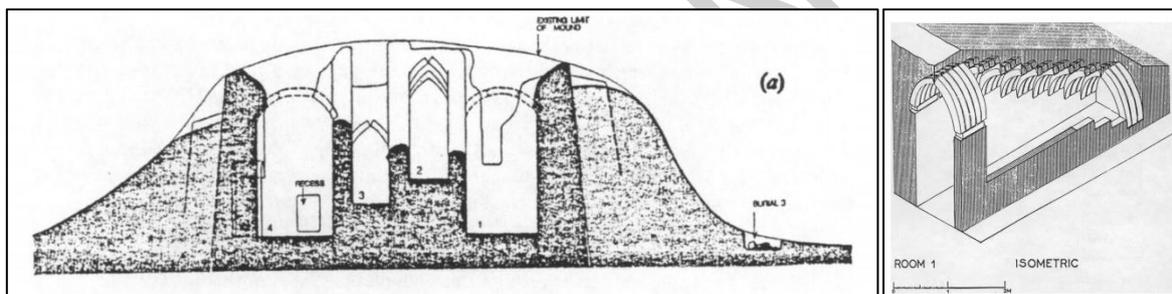


Fig. 17- The method of implementing the arch in two discovered buildings in the Qūmis site; left) Longitudinal section of site 7 (Hansman & Stronach, 1974: 13, Fig. 2 a) & right) Isometric plan of Room 1, site 4 (Hansman et al., 1970: 50, Fig. 10).

4- 6- Sassanid period: Palace and Qal'a-ye Dukhtar of Firuzabad

Firuzabad, the first seat of Ardašir I of the Sassanid dynasty (224-240 AD) (from the early Sassanid period and according to another version from the late Parthian period) has the architectural remains of two spiral staircases and another specific example, which, in addition to being evidence of the expansion of the use of this architectural element until the Sassanid period, also shows the transitional stage from the spiral staircase with a cubic external section to a circular one. The first building is the Firuzabad tower, which was a monumental building with original dimensions of 18×18 meters and a height of about 40 meters, which consisted of a central cubic core, a staircase that circled the central pillar, an outer wall, and a room or space at the upper end (Hoff, 1987: 91). Today, apart from the remains of the central core, other parts, including the spiral staircase, have disappeared (Huff, 1989, fig. 5). This tower, which is located at the focal point of the city of Firuzabad and likely played a role in the circular design of the city, is a monument that is contemporary with the Trajan (113 AD.) and Marcus (196

AD.) columns in Rome, which were built with a circular cross-section and smaller dimensions and are considered among the first Roman buildings with a spiral staircase.

Another building is the Qal'a-ye Dukhtar of Firuzabad, which was built on a mountain overlooking the Firuzabad plain and was a palace-fortress with an area of 500 square meters, which was built by Ardašir I of Sassanid in the early years of his rule and probably before the overthrow of the Parthian government. This complex was built on a sloping mountain surface and on three different levels, and its main part includes a large porch and a domed hall behind it. Around the porch and hall, there was a corridor and rooms on the second floor that were accessible via a spiral staircase with a circular section (Herrmann, 1994: 93; Huff, 2005: 373 - 374). This example is the first staircase with a circular section that has been identified in Iranian architecture so far (Fig. 18).

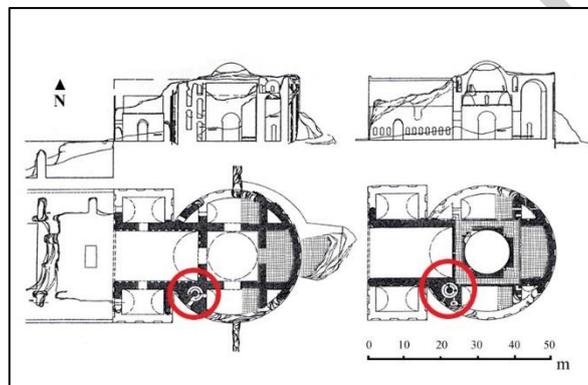


Fig. 18- Plans and sections of the Qal'a-ye Dukhtar of Firuzabad; discovered spiral staircase (marked in red) (Huff, 2005).

The third building is the palace of Ardašir I in Firuzabad, also known as the “Ataškada” building (Fig. 19). This building was built on a plain facing a lake and consists of two reception and residential sections (or outer and inner). Its reception or main section consists of a large porch with side pavilions and three dome-shaped rooms behind them. There was a corridor and rooms for the king’s family on the second floor and around the porch and halls, which were accessible through a large spiral staircase in the center of the northwest side. Unlike the example of Qal'a-ye Dukhtar, this staircase was designed and built with a square section (Huff, 2005: 373-374) (Fig. 20). Perhaps the reason for this difference is the limited space in the Qal'a-ye Dukhtar building and its more defensive aspect. The materials used in Sasanian buildings are rubble stone (in some cases, hewn) and plaster mortar, and the type of ceilings used in the staircases are vaulted.

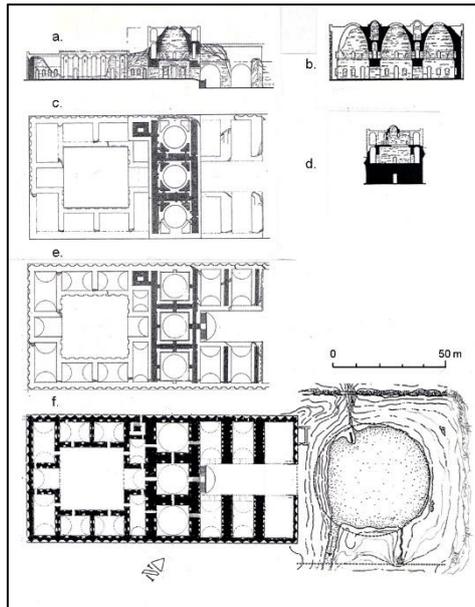


Fig. 19- sections and plans of the Firuzabad palace (Michell & Eaton, 1992).

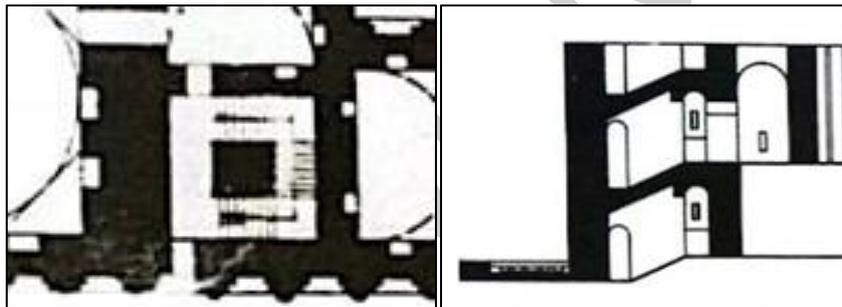


Fig. 20- Discovered spiral staircase in the Firuzabad palace; left) plan (Michell & Eaton, 1992) & right) Longitudinal section (Ibid).

Table 1- Architectural details of spiral staircases in the historical period of the Iranian Plateau(Authors, 2025).

Site	Architectural features	Level	Chronology	Building	Location in the building	Direction
Hasanlū		V	Iron Age I (1450-1250 BC.)	Residential House	Left Side Of The Counter	Clockwise
		IVC	Iron Age II (1250-1050 BC.)	BB II	Right Side of The Counter	Counterclockwise
				BB III	Right Side of The Counter	
				BB IV E	Left Side of The Counter	
				BB V	Right Side of The Counter	
		IVB	Iron Age II (1050-800 BC.)	BB I E	Right Side of The Counter	
				BB I W	Left Side of The Counter	
				BB V-IV	Right Side of The Counter	
		Bābā jān		III	Late Iron Age II	Fort
Nish-i jān		-	Iron Age III (800-650 BC.)	Central Temple	Left Side of The Counter	Counterclockwise

			Old Western Temple	Right Side of The Counter	Clockwise
			Fort		
Susa	-	Darius I (Around 518 BC.)	Palace-gate (Probably 2 cases)	No Counter	Clockwise northwest staircase
		Artaxerxes II (404-359 BC.)	Shaūr Palace		Southwest Staircase Counterclockwise
					Counterclockwise
Qūmis	-	Parthian (247 BC. – 224 AD.)	Site 4	No Counter	Clockwise
			Site 7		
			Site 13		
Firuzabad	-	Ardašir I (224 – 240 AD.)	Qal'a-ye Dukhtar	No Counter	Counterclockwise
			Ataškada or Palace	Right Side of The Counter	Clockwise

Analysis and Conclusion

The reasons for the widespread use of flat roofs with straw and mud in the Middle East region and the construction of multi-story buildings were access to the upper floors, which were the main places of residence, access to the roof for the various uses that the roof had in this region, and repair and renewal of the roof covering. In areas with different and humid environments where truss or gable coverings were used or areas with hot and dry climatic conditions where vaulted and dome coverings were often used, the roof did not have a specific use and, consequently, there was no need to create solid and fixed structural access. For this reason, wooden staircases and in some cases, structures were effective for accessing the upper floors. The aforementioned necessity in the ancient East provided the basis for the creation and implementation of different accesses to the upper floor or roof from the very first periods of architectural formation, especially with the expansion of architectural dimensions in the fourth and third millennia BC, as evidenced by archaeological data. Considering the pioneering role of the Mesopotamian and northern Syrian regions in many civilizational achievements, it is natural that they would also be pioneers in relation to the staircases under study. The tribes living in northwestern Iran in the late second and early first millennium BC were the Hurrians who had cultural affinities and various connections with the inhabitants of northern Syria and Mesopotamia, and it is likely that they received some cultural and architectural elements in this way. However, the architectural theme is a function of environmental conditions, and considering the general architectural design of the region and its continuity during the Median and Achaemenid periods, focusing on halls, columned porches, and lateral spaces, which were not common in Mesopotamia, it is possible that such a design, along with spiral staircases, was independently formed and developed in the northwestern region of Iran, and later spread to other regions of the western half of Iran. It seems that the discovered example from the V level of the Hasanlū site is the first spiral staircase. The Hasanlū site witnessed the formation of the ruling class and the architecture of the ruling class during this period. As Huff has presented in his research on the architecture of the ruling house, the large halls and adjacent spaces on the first floor were for receptions and service matters, and the spaces on the second floor were dedicated to the living room of the ruling family, which in a way provided better protection against the problems of humidity, dust, and pollution, and provided better ventilation for the residents, and was also connected to the hall and reception spaces through openings (Huff, 2005: 372-374). Considering this issue and the importance of the second floor and access to the roof, secure and solid access was necessary and could be part of the arrangements that were formed in relation to the architecture of the ruling house, in accordance with the environment of the Zagros region and other architectural elements of this period in the region itself.

The architectural designs implemented in northwest Iran probably reached western Iran through connections between the local governments of the region in the 9th century BC and underwent some changes in their evolutionary process; especially in the Median period in the Nush-i jan site, where we witness the use of stepped arches using mud-brick arches in the implementation of the staircase covering, which seems to have been an innovation that Iranian tribes brought from their original homeland in Central Asia (Mollazadeh, 2011: 135). This is because the architecture of the Zagros region has relied on flat, beam-covered coverings since prehistoric times, which, considering the easy access to wooden beams, lower cost, simpler

implementation, and the possibility of diverse use of the roof, was the right choice and suited to the environment.

In the Achaemenid period, despite the expansion of architectural dimensions and changes in design, technology, and materials used, spiral staircases were still used; however, due to the expansion of architectural dimensions and the lack of limitations in design and execution, and to facilitate movement, conventional and wide staircases were a common option (the staircases inside the corner towers of the building known as "Apadana" in the Persepolis and Susa sites were built in this manner).

Unfortunately, few architectural remains with study able details have survived from the Parthian period, and the investigations of this study have not reached specific examples. However, considering that the examples from the period of Ardašir I of the Sassanid Empire are related to the final years of the Parthian period in terms of construction time, it shows that the tradition of building spiral staircases continued throughout the Parthian period and reached the Sassanid period. Especially since Sassanid architecture is a natural continuation of the architecture of the Parthian period in many characteristics.

It can be said that the general plan of the spiral staircases and the direction of the steps did not change fundamentally during the period under study (around 1450 BC - 3rd century AD) (Table 1). However, at the end of this periods, we witness the presence of a spiral staircase with a circular plan (Qal'a-ye Dukhtar of Firuzabad), which seems to have been created to overcome the limitations of space and perhaps under the influence of Roman architecture. The direction of the steps in identifiable cases is counter clockwise. This is likely a function of the design of the counter space, the location of the entrance to the staircase space, and most importantly, the movement from the right, which is likely an ancient tradition that has continued to this today. In relation to materials and construction technology, the studied staircases, influenced by the environment and cultural traditions, were built with materials such as mud-brick (Iron Age - Achaemenid period), brick (in the foundation of Achaemenid examples), and stone and plaster (Sassanian period). The dimensions of the mud-bricks used during this period vary. In Hasanlū, large square bricks measuring approximately $12 \times 45 \times 45$ cm were used, in the Median period, rectangular mud-bricks measuring approximately $10 \times 25 \times 42$ cm and mud-brick arches were used to cover the staircases, and in the Achaemenid period, mud-brick and in some cases square bricks measuring $10 \times 33 \times 33$ cm were used.

There is no precise information regarding the details of the covering of the Hasanlū and Bābā jān staircases, and it seems that this covering was carried out with mud-brick arches or with the help of small wooden and mud-brick beams. However, the covering of the Median, Achaemenid, and Sasanian types was of the arch type.

The important conclusion of this research is the long history of the construction of spiral staircases in Iran compared to Western types. As mentioned in the introduction, in many sources, the staircase of the Temple of Selinunte in Italy, dated 480 BC, is considered as the first spiral staircase, and with a long-time interval, the staircase of the Trajan's Column, dated 113 AD, is built. This is while the Iranian examples date back to about a thousand years before

this date. The Roman examples can only be considered the first examples of spiral staircases with a circular plan, which most likely have their roots in examples with a square plan.

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