HERITAGE OF SOUTHWEST ASIA
Vol. 2, Issue 2
https://www.hsaj.ir

Research Article

Comparative Analysis of Spatial–Architectural Patterns in Vaulted Tombs of the Parthian and Elymaean Periods in Khuzestan

Hani Zarei
Assistant Professor, conservation of historical architecture, Jundi-shapur University of Technology, Dezful, Iran.

Abstract: Vaulted subterranean tombs in southwestern Iran, particularly in Khuzestan Province, represent some of the most significant funerary architectural remains of the Parthian and Elymaean periods and reflect the transformation of spatial organization, circulation patterns, and burial rituals during these eras. This study adopts a historical–interpretative approach based on library research and field investigations to conduct a comparative analysis of the spatial–architectural characteristics and access systems of these tombs. Six Parthian and four Elymaean vaulted tombs were selected and analyzed using archaeological reports and field observations. Archaeological documents, plans, and excavation reports were examined, followed by the analysis of architectural evidence, spatial proportions, and movement patterns observed on site. The main objective of the research is to identify the similarities and differences between the funerary architecture of these two periods and to clarify the evolution of burial patterns, chronological indicators, and the role of local traditions in shaping these spaces. The principal research question focuses on the similarities and differences in spatial organization, access hierarchy, and vault forms between Parthian and Elymaean tombs. The findings indicate that both periods shared a continuous architectural tradition characterized by rectangular plans, brick barrel vaults, and subterranean burial patterns. Nevertheless, notable differences can be observed in spatial proportions and circulation systems. The average length-to-width ratio in Parthian tombs is approximately 1:30, whereas in Elymaean tombs it reaches about 1:52, indicating a transformation in spatial proportions. In addition, Parthian tombs exhibit more diverse three-part spatial organizations, the presence of vestibules or dromoi, and more complex circulation patterns, suggesting a multilayered funerary structure. In contrast, Elymaean tombs tend toward simpler two-part organizations and more direct linear access to the burial chamber. These architectural changes demonstrate a gradual transformation rather than a cultural rupture and reflect evolving spatial concepts and funerary beliefs in Khuzestan. The identified patterns may serve as reliable analytical indicators for architectural chronology, archaeological interpretation, and conservation studies.

https://doi.org/10.22034/hsaj.2026.568784.1040

Keywords:
Funerary architecture
Comparative analysis
Spatial–architectural organization
Parthian and Elymaean periods
Khuzestan

Received: August 06, 2025
Accepted: December 15, 2025
Published: December 21, 2025

1. Introduction

Vaulted tombs of southwestern Iran, particularly those located in Khuzestan Province, represent some of the most significant examples of funerary architecture from the Parthian and Elymaean periods. Beyond reflecting burial practices and religious beliefs, these structures provide valuable evidence regarding construction technology, social organization, and spatial planning in ancient societies. Consequently, the study of spatial organization and hierarchical arrangements within these tombs can contribute to a better understanding of regional funerary architecture and provide useful criteria for architectural periodization in Khuzestan (Mohammadi Far, 2014: 240–244).

Parthian tombs are generally characterized by a regular geometric layout and a predominantly linear spatial organization. In these structures, the entrance, transitional spaces, and burial chamber are arranged in a clearly defined sequence. Archaeological investigations indicate that Parthian vaulted tombs in Khuzestan exhibit a high degree of spatial coherence, with the burial chamber serving as the principal architectural focus (Sarfaraz & Firouzmandi, 2010: 320–323; Mohammadi Far, 2014: 275–279). Typological studies further suggest that, compared with Parthian funerary architecture in central and eastern Iran, the tombs of Khuzestan tend to follow simpler and more linear spatial configurations (Sobhani & Rezaei-Nia, 2021: 19–24).

In contrast, Elymaean tombs appear to preserve certain architectural traditions inherited from ancient Elam. Archaeological excavations at Golalak, near Shushtar, reveal that some Elymaean burial structures were organized as multi-component complexes in which burial chambers, subsidiary spaces, and circulation routes formed an integrated spatial system (Rahbar, 1994: 266–268; Rahbar, 1999; 2013). These characteristics suggest notable differences between the two periods in terms of spatial organization and access patterns to the burial spaces.

Previous studies have primarily focused on the description and documentation of these tombs. Research conducted by Rahbar identified general architectural characteristics of several Elymaean burial complexes; however, important questions concerning the number, function, arrangement, and interrelationship of spaces remain unresolved. Likewise, Boucharlat and Haerinck (2011), based on Ghirshman's unpublished reports, documented the architectural components of Parthian tombs at Susa but did not examine the spatial relationships, organizational logic, or hierarchical structure of these spaces. As a result, a systematic comparative analysis of spatial organization and spatial hierarchy in Parthian and Elymaean vaulted tombs of Khuzestan has yet to be undertaken.

Given that several scholars regard the Elymaeans as descendants of the Elamites, or as communities strongly influenced by Elamite cultural traditions (Mohammadi Far & Khounai, 2017: 54; Rahbar, 1994; Sarfaraz and Firouzmandi, 2010), a comparative investigation of funerary architecture from these two periods provides an important opportunity to explore architectural continuity and transformation in southwestern Iran. This study is based on the assumption that, despite sharing a common tradition of barrel-vault construction, Parthian and Elymaean tombs display distinct patterns of spatial organization, circulation, and geometric proportion that may serve as reliable chronological and cultural indicators. The primary distinction between the two traditions lies not in structural elements, but rather in the organization of space and the proportional relationships governing architectural layouts.

Accordingly, this study employs a comparative and spatial analytical approach to address the following question: What are the principal similarities and differences in the spatial organization and hierarchical structure of Parthian and Elymaean vaulted tombs, and how can these characteristics contribute to a more precise identification and differentiation of these two historical periods? Rather than seeking statistically definitive patterns, the study aims to identify recurring spatial and architectural tendencies within a representative sample of tombs and to establish an analytical framework for future research on the funerary architecture of Khuzestan.

2. Research Methodology

This study employs a historical–interpretive approach combined with spatial analysis to investigate the architectural characteristics and spatial organization of vaulted tombs dating to the Parthian and Elymaean periods (Memarian, 2014). Research data were collected through both documentary and field-based investigations. Relevant information was gathered from published sources, archaeological excavation reports, architectural documentation, and the physical remains of the selected tombs, and subsequently classified and analyzed.

Case studies were selected through purposive sampling based on three principal criteria: (1) relatively secure chronological attribution supported by archaeological evidence; (2) the availability of reliable architectural documentation and legible plans; and (3) the possibility of

conducting spatial and accessibility analyses of the funerary structures. Accordingly, six tombs attributed to the Parthian period (Boucharlat & Haerinck, 2011) and four tombs attributed to the Elymaean period (Rahbar, 1994; 2013) were selected for analysis.

Length-to-width ratios were calculated through measurements of the principal spaces identified in published plans and field documentation. Mean values were subsequently determined for each chronological group. Given the limited number of preserved and analyzable examples, the results are interpreted primarily within a comparative and analytical framework. Consequently, the calculated geometric ratios should be regarded as analytical indicators derived from the selected case studies rather than statistically representative values applicable to all Parthian or Elymaean tombs.

The spatial analysis was conducted using the following operational indicators:

- Spatial hierarchy: sequence of spatial access, relationships between chambers and circulation routes, and degrees of spatial segregation.
- Circulation patterns: movement paths, the presence of intermediary spaces such as dromoi, stairways, and direct or indirect access to burial chambers.
- Geometric proportions: length-to-width ratios and overall plan proportions.
- Spatial configuration: the arrangement of spaces in relation to the principal architectural axis and their functional interrelationships.

Historical and architectural data were interpreted qualitatively, while spatial indicators were examined through semi-quantitative measurements of organizational, functional, and geometric relationships. The final stage of analysis consisted of a comparative assessment of the architectural and spatial characteristics of the two periods to identify patterns of similarity and difference and to evaluate changes in funerary spatial organization between the Parthian and Elymaean periods.

3. Literature Review

Research on barrel-vault construction in pre-Islamic Iranian architecture, particularly in Khuzestan, has primarily focused on construction techniques, building materials, and general structural forms. Despite the significance of Parthian and Elymaean vaulted tombs in the continuity of regional vaulting traditions, relatively few studies have specifically examined their architectural characteristics, and even fewer have addressed their spatial organization in a systematic manner.

a. Typology and General Architectural Characteristics of the Tombs:

Among the earliest studies, Chaychi and Saeedi (2002), and Rahbar (1994) introduced and documented Parthian and Elymaean tombs in Khuzestan. Rahbar's investigations examined aspects such as the orientation of the Golalak and Saleh-Davoud tombs, construction materials, and vaulting techniques. His work identified several vault-construction methods, including composite, pitched-brick, and Roman-type arrangements within Elymaean funerary architecture. Nevertheless, these studies remained largely descriptive in nature and did not address the geometric characteristics of the structures or the spatial relationships between their architectural components.

The study conducted by Sobhani and Rezaei-Nia (2021), focusing on the typology of Parthian funerary architecture, demonstrated considerable diversity in plan configuration, structural systems, and architectural ornamentation. Although this research provides a comprehensive overview of typological variation and identifies simple, linear spatial hierarchies as a defining characteristic of Parthian tombs, internal spatial organization and accessibility hierarchy were not examined as primary analytical variables.

b. Structural and Constructional Studies:

Mehrkian and Messina (2019) investigated the corbel-vaulted tombs of the Shami region in Khuzestan and examined the methods employed for roofing rectangular spaces through corbelled

stone construction. Similarly, Mohammadi Far (2014) addressed several structural characteristics of Parthian architecture. However, the principal focus of these studies was on constructional and structural aspects, while the relationship between structural systems and the spatial organization of funerary architecture remained largely unexplored.

Overall, previous scholarship has contributed substantially to the documentation, typological classification, and structural analysis of Parthian and Elymaean tombs. Nevertheless, a significant research gap remains concerning the systematic investigation of spatial organization, accessibility hierarchy, and the comparative analysis of funerary space in these two successive cultural periods. The present study seeks to address this gap through a comparative spatial analysis of vaulted tombs in Khuzestan.

c. Archaeological Reports and Spatial Descriptions:

Boucharlat and Haerinck (2011) were the first scholars to publish and analyze Ghirshman's previously unpublished report (M.D.P. 35) on the Parthian tombs of Susa. Their study presents architectural descriptions of six tombs and provides valuable information regarding geometric proportions, vault rise-to-span relationships, and access sequences leading to the burial chambers. The authors also identify the presence of a dromos as an intermediary space preceding the burial chamber in these Parthian tombs. Despite the significance of this publication as a primary source for documenting the architectural characteristics of the monuments, the spatial relationships between architectural components, the logic underlying spatial organization, and the hierarchy of access were not systematically examined.

Moghadam (2015; 2018; 2025) investigated the tombs of Chega Sofla and documented their principal architectural characteristics. However, these studies remained largely descriptive, focusing primarily on the introduction of individual examples, construction techniques, and general architectural features. Likewise, Mohammadi Far et al. (2023) examined Elymaean tombs from an environmental perspective and classified them into two major categories, mountainous and lowland tombs. While this classification contributes to understanding the geographical distribution of Elymaean funerary architecture, little attention was devoted to the internal spatial organization and architectural configuration of these structures.

d. Research Gap and Contribution of the Present Study:

A critical review of previous scholarship demonstrates that existing studies have primarily concentrated on historical documentation, construction materials, building techniques, and general typological classifications of funerary monuments. In contrast, comparatively little attention has been paid to the analysis of spatial organization, accessibility hierarchies, and the relationships between architectural components within Parthian and Elymaean vaulted tombs. More importantly, no comparative study has yet systematically examined these two successive periods from the perspective of funerary spatial structure and the degree of continuity or transformation in architectural patterns.

The present study seeks to address this gap through a comparative investigation of spatial characteristics, spatial configuration, accessibility hierarchies, and the role of intermediary spaces such as the dromos within Parthian and Elymaean vaulted tombs. By focusing on the organization of architectural space rather than solely on constructional or chronological aspects, this research aims to identify distinctive spatial indicators for each period and to clarify patterns of continuity and change within the funerary architecture of Khuzestan. In doing so, it contributes to a more nuanced understanding of the development of funerary architecture in southwestern Iran and provides a methodological framework for future studies concerned with architectural periodization and spatial analysis.

4. Study Area and Selected Tombs

Khuzestan Province, located in southwestern Iran within the southern sector of the Zagros Fold Belt, has long served as one of the most important centers of cultural interaction and architectural

development in the Iranian Plateau. Owing to its strategic geographical position and rich historical background, the region contains numerous archaeological remains representing different periods of Iranian history. Among these remains, vaulted structures occupy a significant place, documenting the development and continuity of vault-building traditions over time (Fig. 1).

One of the most influential local polities in this region was the Elymaean kingdom, whose territory extended across substantial parts of Khuzestan and neighboring areas. Situated within the broader cultural landscape of ancient Elam, the Elymaeans appear to have preserved certain indigenous architectural traditions that had developed during earlier periods (Sarfaraz and Firouzmandi, 2010: 237). Several scholars have considered the Elymaeans descendants of the Elamites or communities strongly influenced by Elamite cultural traditions (Mohammadi Far & Khounai, 2017: 154). During the Elymaean period, Shushtar and the nearby city of Dastva constituted important political and cultural centers. Archaeological evidence suggests that Dastva served as a regional capital during the late Seleucid and early Parthian periods and remained occupied until the end of the Parthian era (Rahbar, 1994; Mohammadi Far, 2014: 143).

Given the cultural and historical connections between Elymaean and Parthian architectural traditions, as well as the apparent continuity of indigenous vault-building techniques, the present study focuses on a comparative analysis of vaulted funerary architecture from these two periods within the geographical boundaries of modern Khuzestan Province. Limiting the investigation to a single geographical region allows a more reliable comparison while minimizing uncertainties associated with the fluctuating territorial boundaries of the Elymaean and Parthian domains.

Elymaean lowland tombs can generally be divided into two principal categories: subterranean (crypt-like) tombs and semi-subterranean tombs. Their architectural forms appear to have been influenced by local traditions originating in Elam and Mesopotamia (Mohammadi Far et al., 2023: 101). These tombs are predominantly covered by vaults, with subterranean examples identified at Dastva, Golalak, Saleh Davoud, and Susa, while semi-subterranean examples have been documented at Golalak (Mohammadi Far et al., 2023: 104). The present study concentrates specifically on subterranean brick-built vaulted tombs, which constitute the primary sample set for spatial and architectural analysis (Fig. 1; Table 1).

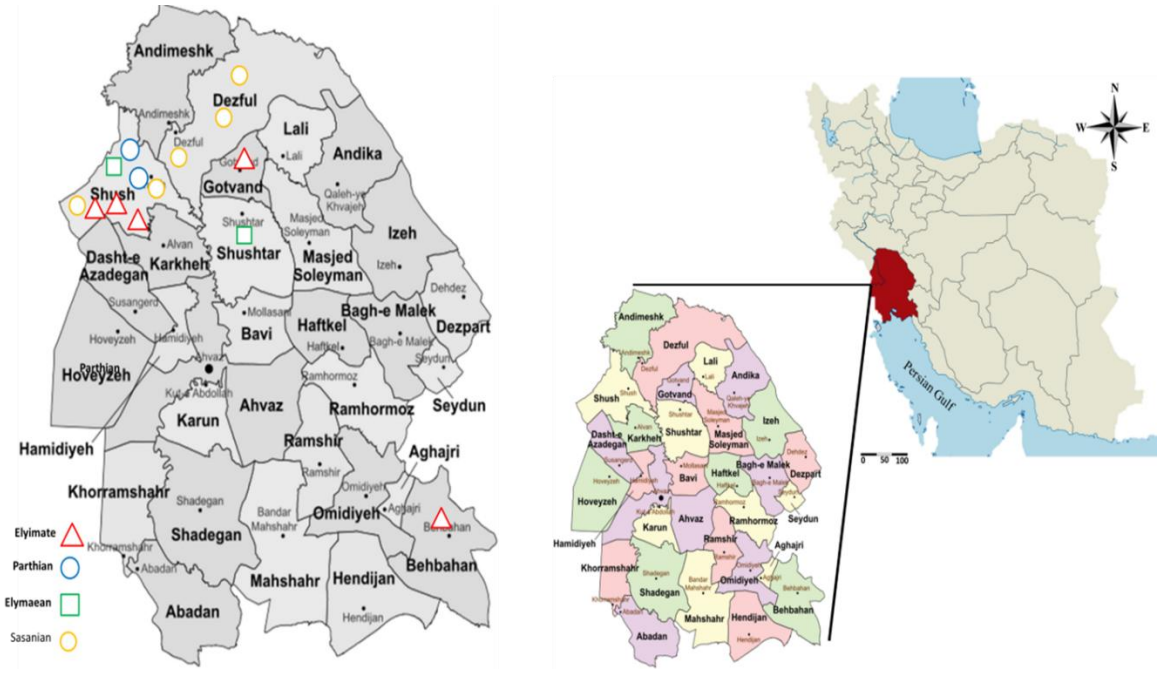
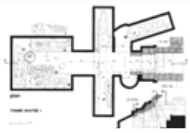
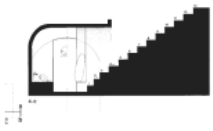
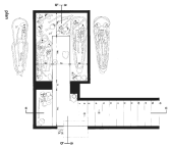
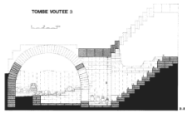
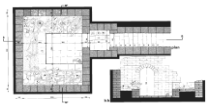
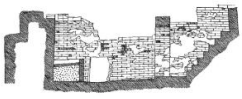
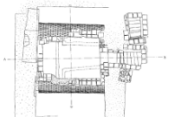
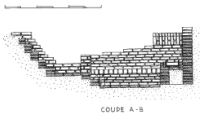
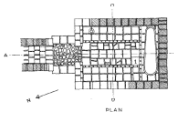
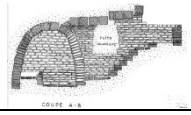
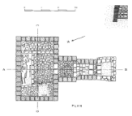
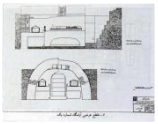
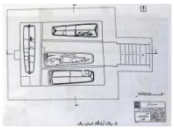
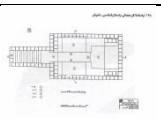
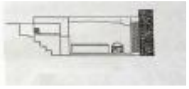


Figure 1. Right: Geographic location of Khuzestan Province within Iran and the studied sites of Shushtar and Susa (ostan-khz.ir, nd). Left: Distribution map of the investigated mudbrick and brick vaulted structures in Khuzestan based on their historical periods.

Table 1. Parthian vaulted tombs investigated at the Susa site and Elymaean vaulted tombs from the Galalak (Shushtar) and Saleh Davoud sites

	Structure Name	Photograph	Section	Plan	Era
1	Susa Tomb 1				Parthian
		(Boucharlat & Haerinck, 2011: pl.12)			
2	Susa Tomb 2 Artisans' Quarter, Tomb 2B (Late Parthian Period)				
		(Boucharlat & Haerinck, 2011: 77, pl. 13)			
3	Susa Tomb 3	 			
		(Boucharlat & Haerinck, 2011: pl.12)			
4	Susa Tomb 4 Artisans' Quarter, Tomb 2/2P (1951)				
		(Boucharlat & Haerinck, 2011: pls. 20, 25a)			
5	Susa Tomb 5 Artisans' Quarter, Tomb 9 (1952)	 			
		(Boucharlat & Haerinck, 2011: pls.26, 30:a-c)			
6	Susa Tomb 6 Artisans' Quarter, Tomb 9 (1952)				
		(Boucharlat & Haerinck, 2011: pl. 34)			
7	Shushtar Tomb 1 Galalak				Elymaean
		(Zarei et al., 2024b; Rahbar, 1994: 193–194)			
8	Shushtar Tomb 2 Galalak				
		(Zarei et al., 2024b; Rahbar, 1994: 198)			
9	Shushtar Tomb 3 Galalak	 			
		(Zarei et al., 2024b; Rahbar, 1994: 200)			
10	Saleh Davoud Tomb Susa				
		(Rahbar, 2013: 300–301)			

4.1. Sample Selection Criteria

This section examines the architectural characteristics, construction techniques, and spatial–physical features of the selected tombs. As noted previously, the study sample consists of ten vaulted tombs, including six tombs attributed to the Parthian period (Boucharlat & Haerinck, 2011) and four tombs attributed to the Elymaean period (Rahbar, 1994; 2013) (Table 1). Given the limited number of identified and sufficiently documented vaulted tombs in Khuzestan Province, the research samples were selected purposively based on their direct relevance to the research questions. The principal criterion for selection was the definite or probable attribution of the tombs to either the Parthian or Elymaean periods, as established through archaeological excavations, associated cultural materials, published excavation reports, and the interpretations of previous scholars.

Among the various known funerary structures, only subterranean (crypt-type) tombs constructed with brick masonry and covered by vaulted roofs were included in the study. This restriction was adopted to facilitate comparison among examples with similar architectural and structural characteristics and to minimize the influence of variables related to construction type, building materials, or construction techniques. Consequently, semi-subterranean tombs, structures lacking vaulted roofing, and examples with incomplete or unreliable architectural documentation were excluded from the study.

Furthermore, despite the extensive political and cultural territory of the Elymaeans and the uncertainty surrounding its exact geographical boundaries during different periods, the geographical scope of the present research was limited to Khuzestan Province. This approach ensured that all selected examples were examined within a relatively homogeneous geographical context. Such a framework allows for a more accurate comparison of the spatial and physical characteristics of the tombs from the two periods and helps control contextual factors, including environmental, climatic, and regional conditions, which may influence not only the physical setting but also patterns of social behavior and cultural development (Shaikh Baikloo Islam, 2025: 5).

Accordingly, the selected case studies comprise subterranean vaulted tombs attributed to the Parthian and Elymaean periods from the archaeological sites of Susa, Dasht-e Mishan (Dastva), Golalak, and Saleh Davoud. These examples represent the most suitable available dataset for comparative analysis due to the quality of their architectural documentation, the clear identification of their spatial components, and their suitability for spatial analysis.

Given the limited number of well-preserved and adequately documented examples, the objective of this study is not to produce statistically generalizable results. Rather, it seeks to identify recurring spatial patterns and architectural tendencies among representative tombs of the Parthian and Elymaean periods.

5. Case Studies

5.1. Architectural Characteristics and Construction Techniques of the Parthian Tombs at Susa

The historical origins of the Parthians remain only partially understood, as ancient sources provide limited information regarding their ethnic background. Nevertheless, the Parthians constituted one of the major Iranian peoples and are generally believed to have originated in the region of Khorasan (Sarfaraz and Firouzmandi, 2010: 189). The extensive political and cultural sphere of the Parthian Empire, stretching from Parthia to Khuzestan, Media, Azerbaijan, Armenia, Babylonia, and adjacent territories, provided a significant context for the development and dissemination of Parthian architectural traditions (Sarfaraz and Firouzmandi, 2010: 203).

Within the Parthian realm, Khuzestan, and particularly Susa, represented one of the principal cultural and population centers. Numerous cemeteries discovered at Susa and its surrounding areas, including the Andimeshk–Ahvaz region and Tepeh Hossein-Abad with its stone sarcophagi, testify not only to population density but also to the funerary customs and mortuary practices of the period (Kaboli, 1994: 131). These archaeological data demonstrate that funerary architecture

in Khuzestan constitutes an important source for understanding Parthian vault-construction techniques and subterranean burial architecture.

During the Parthian period, and continuing into the Sasanian era, gypsum mortar was widely employed as the principal bonding material in both brick and stone architecture, playing a crucial role in the advancement of construction technology (Memarian, 1988: 20). This characteristic was particularly important in the construction of barrel vaults, as the rapid setting properties of gypsum mortar, especially in regions with limited timber resources such as Khuzestan and Mesopotamia, facilitated the construction of vaults with little or no reliance on extensive wooden centering. Comparable techniques were later employed in large-scale Parthian and Sasanian monuments as well as in the construction of inclined pitched-brick vaults in Egypt (Lancaster, 2009b: 372, 375).

The Parthian period, often regarded as a transitional phase between Achaemenid and Sasanian architecture, witnessed the development of innovative building techniques, among which advances in vault construction were particularly significant (Memarian, 1988: 20; Lancaster, 2009a; 2009b). Barrel vaults constructed using large baked bricks and gypsum mortar could be erected without temporary centering while maintaining considerable structural stability (Kawami, 1982: 61). The widespread use of standardized square bricks and the combination of pitched-brick and Roman-type masonry arrangements became characteristic features of Parthian vault construction (Lancaster, 2009a: 459–464).

Among the major Parthian centers in Khuzestan, Susa occupies a prominent position owing to the discovery of numerous archaeological remains, including cemeteries and vaulted funerary structures (Kaboli, 1994: 131; Sarfaraz and Firouzmandi, 2010: 197–203). The present study examines six Parthian tombs excavated at Susa and documented by Ghirshman (Boucharlat & Haerinck, 2011), which share a number of common architectural and spatial characteristics. Previous investigations indicate that most Parthian tombs in Khuzestan, particularly those at Susa, were subterranean structures constructed of fired brick, with internal heights generally exceeding two meters (Boucharlat & Haerinck, 2011: 64) (Table 1). Lowland funerary architecture in Khuzestan, encompassing both Parthian and Elymaean examples, is generally characterized by extensive use of brick masonry and predominantly vaulted roofing systems. Based on their relationship to ground level, these monuments can be classified into subterranean (crypt-type) and semi-subterranean tombs (Mohammadi Far et al., 2023: 101). Subterranean Parthian examples have been identified in the cemetery of Tepeh, or the so-called “City of Artisans,” located east of the Susa archaeological complex (Mohammadi Far et al., 2023: 104–105, Fig. 1:1 & 4,112) ;(Ghirshman, 1952: 14; Boucharlat & Haerinck, 2011: Pls. 6, 12, 13, 17, 20, 26, 34), while comparable Elymaean examples have been documented at Dashtova (Golalak) and Saleh-Davoud near Shushtar (Rahbar, 1994; 2013).

The subterranean or crypt-type tombs examined in this study, which generally accommodated multiple burials belonging to family groups, formed an established funerary tradition within the Parthian realm (College, 2001: 97), particularly in southwestern Iran. The origins of this burial practice can be traced to Middle and Neo-Elamite traditions and, more broadly, to Mesopotamian funerary customs from the third millennium BCE onward, especially during the Old, Middle, and Neo-Assyrian periods (Mohammadi Far et al., 2023: 101–102, 109). Although this tradition appears to have declined during the Achaemenid period, it re-emerged within Seleucid and Parthian territories (Chaychi-Amirkhiz & Saeedi-Harsini, 2002: 87–91; Mohammadi Far, 2014: 148; Negahban, 1996: 370) and subsequently continued among Elymaean communities (Rahbar, 1994; 2013). Comparable examples of subterranean funerary architecture are known from the Royal Tombs of the Third Dynasty of Ur (third millennium BCE) and the tombs of Nimrud (first millennium BCE), both of which represent notable Mesopotamian precedents for this architectural tradition (Moortgat, 1998: 116–119; Hussein & Suleiman, 2000).

5.2. Elymaean Tombs of Shushtar and Saleh-Davoud

As presented in Table 1, five tombs excavated at Golalak (Shushtar) have been attributed to the Elymaean period. Among these, three examples (Tombs 1, 2, and 3) are covered by vaulted roofs. These tombs exhibit a distinctly local architectural tradition and demonstrate strong continuities with earlier Elamite architectural practices. As noted by Rahbar (1994), their architectural characteristics reveal the persistence of indigenous building traditions from the Middle Elamite period through the Elymaean era. Such continuity is reflected not only in construction techniques but also in burial practices and associated funerary traditions, particularly in the archaeological site of Saleh-Davoud, which dates to the Parthian–Elymaean period (Agha-Ali-Gol, 2019: 146).

Archaeological investigations indicate that all of the Golalak tombs were constructed as subterranean funerary structures and roofed with brick barrel vaults. Both the walls and vaults were built using fired square bricks bonded with gypsum mortar (Table 2). These characteristics closely associate the monuments with the long-standing vaulted funerary tradition of southwestern Iran.

From a spatial perspective, all examined tombs are equipped with stairways positioned along the longitudinal axis of the monument, providing access to the burial chamber. In this respect, they share an important characteristic with earlier subterranean funerary traditions. In the Dashtova (Golalak) examples, the stairway and burial chamber are aligned along a common longitudinal axis, creating a direct and clearly defined circulation route.

The burial chambers of all vaulted examples are rectangular in plan and covered by barrel vaults. The length-to-width ratios of the burial chambers in Tombs 1 and 2 are approximately 1.26, while Tomb 3 exhibits a ratio of 1.73. The corresponding ratio for the Saleh-Davoud tomb is 1.82. Significantly, all measured examples display ratios below 2.0 (Tables 2). These values indicate a tendency toward relatively compact rectangular plans and suggest a degree of consistency in the geometric design of Elymaean funerary architecture. The vault heights recorded in the Shushtar and Saleh-Davoud tombs are also remarkably similar. This correspondence may indicate the existence of relatively standardized architectural practices and dimensional conventions during the Elymaean period. As Rahbar (1999: 45) has observed, the close similarity of proportions and construction methods among these monuments suggests the persistence of a well-established architectural tradition over an extended period.

5.3. Spatial and Architectural Characteristics of the Parthian and Elymaean Vaulted Tombs

5.3.1. Spatial and Architectural Characteristics of the Parthian Tombs at Susa

The Parthian tombs examined at Susa display a series of shared spatial and architectural features that distinguish them as a coherent group of subterranean funerary monuments. Overall, the principal characteristics of these tombs may be summarized as follows:

All tombs are subterranean structures, with both the burial chamber and its vaulted roofing system constructed entirely below ground level.

The burial chambers are rectangular in plan and covered by barrel vaults. The length-to-width ratios of the chambers are as follows: Tomb 1 (1.18), Tomb 2 (1.31), Tomb 3 (1.25), Tomb 4 (1.04), Tomb 5 (1.33), and Tomb 6 (1.71). These values indicate a preference for relatively compact rectangular spaces, with all examples exhibiting ratios below 2:1.

Access to the tombs is provided by stairways consisting of between six and fourteen steps. In Tombs 2, 3, 4, and 6, the stairway axis is perpendicular to the longitudinal axis of the burial chamber. In contrast, Tombs 1 and 5 exhibit a direct alignment between the stairway and the chamber axis.

The stairways were either cut directly into the ground or constructed of fired brick, as observed in Tombs 3, 5, and 6.

At the entrance of each tomb, a small vestibule of approximately square plan is present, with the exception of Tomb 1, which contains only a deep access passage.
All burial chambers contain three funerary benches positioned along the side and rear walls. These benches served as designated locations for the placement of coffins or human remains and are arranged opposite the entrance and stairway access.

In tombs with L-shaped spatial configurations, adjacent vaulted spaces are completely separated by masonry walls, and no direct internal connection exists between them.
The constructional characteristics of the walls and vaults may be summarized as follows:
Both the walls and the vaults were predominantly constructed of fired brick. An exception is Tomb 1, where the burial chamber itself is formed entirely of vaulted fired-brick masonry.
The walls supporting the vaults generally have a thickness equivalent to a single square brick, suggesting the use of a relatively standardized construction module throughout the examined examples.

Taken together, these characteristics demonstrate a notable degree of consistency in the architectural design of the Parthian tombs at Susa. Similarities in spatial organization, circulation patterns, chamber proportions, funerary arrangements, and construction techniques indicate adherence to a well-established funerary architectural tradition within the region.

5.3.2. Spatial and Architectural Characteristics of the Elymaean Vaulted Tombs at Shushtar and Ṣāliḥ Dāwūd

In general, the spatial and architectural characteristics of the Elymaean vaulted tombs can be summarized as follows:

- All examined tombs are subterranean structures and are roofed with barrel vaults.
- The vaulted burial chambers are rectangular in plan. The length-to-width ratios of Tombs 1 and 2 are 1.26, while Tomb 3 has a ratio of 1.73 and the Ṣāliḥ Dāwūd tomb a ratio of 1.82. In all cases, the ratio remains below 2:1.
- All tombs are provided with stairways aligned with the principal access route to the burial chamber.
- The entrance stairways were constructed of fired bricks, with treads measuring approximately 14–15 cm and risers corresponding to brick thickness.
- In the Dastwā tombs, the stairway axis is aligned with the longitudinal axis of the burial chamber, whereas in the Ṣāliḥ Dāwūd tomb, the two axes are perpendicular.
- The walls and vaults were constructed of fired bricks measuring approximately 26 × 26 × 6–7 cm.
- All burial chambers contain three funerary benches positioned along the side and rear walls, facing the stairway entrance.

As discussed previously, the present study aims to analyse the spatial characteristics of brick-vaulted tombs belonging to the Parthian and Elymaean periods in Khuzestan. Although these monuments share common constructional traditions, particularly in the use of brick barrel vaulting, they exhibit significant differences in geometric proportions and spatial hierarchy that may serve as chronological indicators.

The results indicate that all examined examples were designed according to a highly regular geometric scheme. This consistency reflects the persistence of a regional funerary architectural tradition in Khuzestan and the continued use of geometries well suited to structural stability, load transfer, and the constructional requirements of mudbrick and fired-brick architecture. While the overall spatial framework follows a consistent geometric order, the functional space beneath the vault is invariably rectangular. In this arrangement, the geometric framework provides structural stability, whereas the elongated burial chamber accommodates funerary activities, circulation, and the principal ceremonial focus of the monument. This square–rectangular relationship

appears to reflect a deliberate architectural strategy rather than an arbitrary design choice, facilitating both vault construction and the organization of movement within the tomb.

The most significant difference between the Parthian and Elymaean tombs is observed in the length-to-width ratios of the vaulted chambers. Among the Parthian examples, the lowest ratio is 1.04 (Tomb 4), and the highest is 1.71 (Tomb 6), producing an average ratio of approximately 1.30. These values indicate spaces that are relatively compact and geometrically balanced. Such proportions are likely associated with simpler funerary arrangements, single-axis spatial organization, and efficient structural control.

Table 2. Comparative analysis of the architectural and spatial characteristics of the Parthian tombs of Susa and the Elymaean tombs of Shushtar (Dastova) and Saleh Davoud.

No	Chronology	Location	Geometric Shape of Materials	Geometric Shape of the Vaulted Space	Length-to-Width Ratio	Dimensions of Building Materials (CM)	Dimensions of the Main Vaulted Space(M)		
							Length	Width	Height
1	**Parthian**	Susa Tomb 1	Square	Rectangular	1-1.18	–	2.96	2.5	2
2		Susa Tomb 2	Square	Rectangular	1-1.31	–	2.5	1.9	1.5
3		Susa Tomb 3	Square	Rectangular	1-1.25	32*32	3.26	2.9	2.21
4		Susa Tomb 4	Square	Rectangular	1-1.04		3.5	3.25	2.5
5		Susa Tomb 5	Square	Rectangular	1-1.33	27*27-28	2.8	2.1	2.5
6		Susa Tomb 6	Square	Rectangular	1-1.71	32*32	3.25	1.9	2
7	**Elymaean**	Shushtar Tomb 1	Square	Rectangular	1-1.26	26-27*27-26*6	3.6	2.85	2.2
7		Shushtar Tomb 2	Square	Rectangular	1-1.26	29*29*7 26*26*6-7	4.2	3.34	2.2
9		Shushtar Tomb 3	Square	Rectangular	1-1.73	26*26*6-7	3.82	2.2	1.74
10		Saleh Davoud Tomb	Square	Rectangular	1-1.82	32*32*7 31*31*6	4.2	2.3	2.2

In contrast, the Elymaean tombs exhibit an average length-to-width ratio of approximately 1.52, indicating a tendency toward more elongated burial chambers and greater spatial depth. The Ṣāliḥ Dāwūd tomb, with a ratio of 1.82, represents the most elongated example among both the Parthian and Elymaean groups. This increased spatial depth suggests a shift from compact funerary spaces toward more processional and ceremonially articulated environments, where movement, access, and spatial experience acquired greater significance. Given the consistency of these proportional differences, the length-to-width ratio may be regarded as an independent analytical criterion for distinguishing between the two periods. The evidence suggests that the evolution of funerary architecture involved not merely changes in vault construction, but also transformations in spatial organization and the manner in which individuals experienced and moved through the funerary environment. The comparative analysis of geometric proportions, spatial organization, and architectural configuration demonstrates that the continued use of regular geometric planning and rectangular vaulted chambers reflects a long-standing funerary tradition in Khuzestan. At the same time, changes in proportional relationships provide a valuable indicator for identifying

chronological developments and shifts in funerary practices. While the Parthian tombs tend toward compact and spatially balanced configurations, the Elymaean examples display greater elongation and spatial depth, suggesting increased emphasis on processional movement and the experiential dimension of funerary architecture. These findings contribute to a better understanding of the development of funerary architecture in southwestern Iran and provide a set of analytical criteria for architectural periodization based on spatial analysis.

6. Discussion

This section presents a comparative analysis of the Parthian and Elymaean vaulted tombs based on two principal dimensions: (1) their spatial and architectural characteristics, including wall and vault construction, and (2) the hierarchy of access and circulation within the funerary complexes. The discussion begins with the Parthian tombs of Susa, examining their spatial organization, geometric proportions, and the configuration of vaulted burial chambers to identify recurring architectural patterns and organizational principles. Subsequently, the Elymaean tombs of Shushtar and Ṣāliḥ Dāwūd are analysed to clarify differences in design approaches, construction techniques, and roofing systems, as well as their relationship to the period's cultural and functional contexts.

Particular attention is given to the access hierarchy as a key component in interpreting funerary architecture, since the arrangement of entrances, stairways, intermediate spaces, and burial chambers reflects broader principles of spatial organization and ritual movement. Finally, the discussion synthesizes the principal spatial and architectural patterns identified in the Parthian and Elymaean tombs and evaluates their significance for understanding continuity and change in funerary traditions.

Through the comparative examination of these architectural and spatial variables, it becomes possible to identify fundamental differences between the two periods and to demonstrate how functional requirements, construction technology, and spatial concepts contributed to the transformation of funerary architecture in southwestern Iran.

6.1. Analysis of the Architectural Characteristics of the Parthian Tombs at Susa

The architectural and spatial characteristics of the Parthian tombs at Susa reveal a relatively coherent funerary tradition while also exhibiting variations in the organization and configuration of individual monuments. Although all vaulted burial chambers share a rectangular plan, subtle differences in their length-to-width ratios can be observed. These variations may reflect specific functional requirements, constructional considerations, or localized adaptations within a common architectural framework.

The stairways, which constitute a principal element of access to the burial chambers, display two distinct configurations: stepped and inclined-flat forms. Such differences may be related to varying access requirements, site conditions, or construction solutions adopted by the builders. The organization of the burial chambers also demonstrates careful spatial planning, particularly in the arrangement of the three funerary benches and the provision of access to the burial space. Similar spatial arrangements have likewise been documented in the Elymaean tombs of Khuzestan (Rahbar, 1994).

Vestibules and access passages constitute important transitional elements within the funerary complexes, mediating movement between the exterior and the burial chamber. In some examples, separating walls were employed to define and compartmentalize spatial units, indicating a deliberate approach to the organization of circulation and internal spatial hierarchy.

Overall, these characteristics illustrate the adaptability of Parthian funerary architecture to functional, technical, and cultural requirements while maintaining a consistent architectural vocabulary. The examined tombs demonstrate a well-developed understanding of spatial organization, circulation, and structural design, reflecting the integration of practical constructional considerations with established funerary traditions (Zarei, 2024a: 165).

6.2. Analysis of the Architectural Characteristics of the Elymaean Tombs

The architectural characteristics of the Elymaean tombs at Shushtar and Ṣāliḥ Dāwūd indicate a highly consistent funerary tradition in terms of overall form and construction. All examined examples are subterranean monuments roofed with brick barrel vaults and are characterized by rectangular burial chambers. Despite this general uniformity, variations in chamber proportions can be observed.

The length-to-width ratios of the burial chambers are 1.26 for Tombs 1 and 2, 1.73 for Tomb 3, and 1.82 for the Ṣāliḥ Dāwūd tomb. In all cases, the ratio remains below 2:1. These proportions differ from those documented in the Elamite period, where the length of vaulted chambers commonly exceeded twice their width. The Elymaean examples, therefore, appear to represent a distinct proportional system characterized by more compact spatial configurations (Zarei et al., 2024b: 104).

The consistency observed in the use of rectangular plans, subterranean construction, and brick barrel vaulting suggests the continuation of established regional building traditions. At the same time, the modification of spatial proportions compared with earlier Elamite examples indicates that architectural continuity was accompanied by gradual changes in the organization and perception of funerary space. These developments may reflect evolving functional requirements and changing approaches to the design of burial environments while maintaining the fundamental principles of the local architectural tradition.

6.3. Analysis of Spatial Hierarchy and Access Patterns

As discussed earlier, one of the aspects demonstrating the continuity of architectural tradition between the Parthian and Elymaean periods is the geometric order of the plans and the arrangement of spaces associated with funerary practices in the burial architecture of these two periods. Within this context, spatial hierarchy—namely, the sequence of spaces through which one moves in order to reach the principal burial chamber—constitutes one of the three main criteria used for the architectural differentiation of these two historical periods.

In addition to spatial organization (the number and arrangement of spaces), access hierarchy (circulation pattern) represents another key criterion examined in this study. Accordingly, the spatial organization and access hierarchy of the Parthian and Elymaean tombs are analyzed in the following sections to identify similarities, differences, and patterns of continuity in their funerary architectural traditions.

6.3.1. Access Hierarchy in the Parthian Tombs

An examination of the entrance system and access organization of the Parthian tombs at Susa indicates the presence of a deliberately structured spatial hierarchy extending from the exterior environment to the burial chamber. The burial chamber was arranged either longitudinally or transversely in relation to the access axis. The access sequence generally consisted of an upper entrance, a stairway, and a small square-shaped dromos (entrance corridor or vestibule leading to the burial chamber) connected to the funerary space (Boucharlat & Haerinck, 2011: 131).

In most examples, the vestibule or dromos, with its approximately square plan, constitutes the first transitional space between the exterior and the burial chamber. Functionally, this space acted as an intermediate zone separating the burial chamber from the outside environment and forming an initial stage within the access sequence. It should be noted that, in their discussion of the Elamite tombs at Susa, Ghirshman and Stève referred to the existence of vertical access shafts in certain high-status burials. These shafts, which served as tomb entrances, were constructed as deep and narrow circular openings lined with masonry and extending down to the subterranean chamber. They were typically sealed with one or two bricks through a very small opening (Ghirshman & Stève, 1966: 8).

Among the Parthian tombs of Susa, only Tomb 1 lacks such an intermediate space and instead exhibits a direct and deep access passage leading to the burial chamber. This feature may indicate a different functional arrangement, a distinct social status of the deceased, or a chronological variation in burial practices.

The stairway represents the second stage of access. In most cases, the steps were cut directly into the natural ground, reflecting a simple and practical construction technique adapted to local conditions. In Tombs 3, 5, and 6, however, the stairways were constructed using fired bricks. This difference may reflect a higher level of constructional investment and technical expertise, while also suggesting an effort to improve the durability of the most frequently used part of the monument.

Axial orientation also plays a significant role in the spatial organization of these tombs. In Tombs 2, 3, 4, and 6, the stairway axis is perpendicular to the axis of the burial chamber. Such an arrangement creates an indirect route of access and interrupts a direct visual and spatial connection between the exterior and the burial space. In contrast, Tombs 1 and 5 display an alignment between the entrance axis and the longitudinal axis of the burial chamber, resulting in a more direct access pattern that may reflect either earlier architectural traditions or specific functional requirements.

A further shared characteristic is the subterranean nature of all the tombs. Besides providing environmental and structural advantages, including thermal stability and protection from erosion, this arrangement reflects a long-standing funerary tradition in southwestern Iran.

Finally, the number of steps, ranging from six to fourteen, reflects variations in burial depth and in the spatial separation between ground level and the burial chamber. Consequently, three principal stages of access can be identified: the dromos or vestibule as an intermediate threshold space, the stairway as the transitional route between levels, and the burial chamber as the final destination within the funerary complex.

Overall, the access system of the Parthian tombs at Susa demonstrates a carefully organized spatial sequence in which axial orientation, stairway construction, burial depth, and the presence or absence of intermediary spaces collectively contribute to the architectural organization of the funerary environment (Fig. 2).

Figure 2. Spatial configuration and access patterns of the Parthian tombs at Susa, emphasizing the intermediary dromos space and its relationship to the burial chamber.

6.3.2. Access Hierarchy in the Elymaean Tombs

In most Elymaean tombs, the stairways are aligned with the longitudinal axis of the monument and provide direct access to the burial chamber. In the Ṣāliḥ Dāwūd tomb, however, the stairway is arranged perpendicular to the longitudinal axis. The location of the stairway in most Elymaean

tombs, similar to earlier Elamite examples, is generally positioned along the width of the tomb. The unique case of the Ṣāliḥ Dāwūd tomb, where the stairway is constructed within the longitudinal wall, resembles Tomb No. 4 of the "Palace of the Dead" at Chogha Zanbil, dating to the Middle Elamite period (Mohammadi Far et al., 2023: 109; Ghirshman, 1968: 141).

All of the tombs are equipped with funerary benches located along the sides and rear of the burial chamber, facing the entrance stairway. The spatial organization is generally arranged so that the stairway and burial chamber are aligned, providing a clear and orderly route of access to the funerary space. These characteristics reflect careful planning of the internal layout and the application of architectural principles to facilitate circulation and access within the tomb complex (Fig. 3).

The examined examples also exhibit similarities to Mesopotamian and Elamite funerary architecture, particularly the subterranean tombs of Chogha Zanbil and Haft Tappeh, in terms of stairway construction, chamber roofing systems, burial-chamber configuration, and the use of funerary benches (Mohammadi Far et al., 2023: 113).

A distinctive feature of the subterranean tomb at Ṣāliḥ Dāwūd is the presence of an intermediate space located beyond the stairway, which is absent from the tombs of Galalak and Dastova at Shushtar. Rahbar identifies this space as a threshold area (āstāneh). It was a roofed chamber covered by a vault, measuring approximately 220 × 225 cm and having an almost square plan, connected directly to the entrance of the burial chamber (Rahbar, 2013: 300). This space is comparable to the dromos or access vestibule documented in the Parthian tombs of Susa and may indicate the influence of a similar spatial model.

Another notable characteristic is the narrow width of the stairways in the Galalak–Dastova, Susa, and Ṣāliḥ Dāwūd tombs. A comparable feature is also observed in the Elamite tombs of Chogha Zanbil. According to Rahbar (2013: 300), the restricted width of the steps would have required individuals to enter sideways rather than facing directly toward the next space. From an architectural perspective, this narrow width creates a physical constraint on movement and access. It may also reflect the continuation of an older funerary tradition. The similarities between these Elymaean tombs and earlier Elamite examples suggest that Elamite funerary architecture may have served as an important model for the development of Elymaean burial monuments.

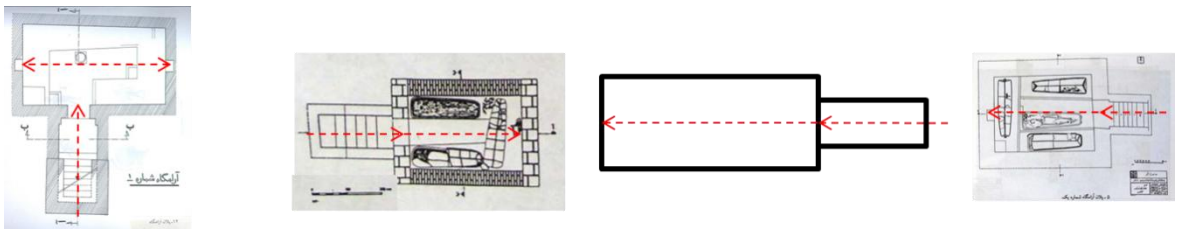


Figure 3. Access patterns and spatial arrangement of the Elymaean tombs of Shushtar (the three tombs shown on the right) and Saleh Davoud (the tomb shown on the far left) (after Rahbar, 1994).

6.4. Spatial–Circulation Patterns Identified in the Parthian and Elymaean Tombs

The analysis of circulation organization within vaulted tombs represents one of the most important approaches for understanding the spatial logic of funerary architecture during the Parthian and Elymaean periods. The entrance sequence, the placement of the dromos (vestibule), the orientation of stairways, and their relationship to the burial chamber not only define the physical structure of the monument but also reflect patterns of movement, access control, and the organization of funerary space.

The examined examples indicate that the tombs of both periods follow a number of recognizable circulation patterns. These patterns can be classified according to the orientation of movement, the degree of directional change within the circulation route, and the relationship between intermediary and principal spaces. Three general spatial configurations were identified, which can ultimately be grouped into two broader organizational models. While a greater diversity of

circulation patterns is evident in the Parthian examples, the Elymaean tombs display a tendency toward reduced spatial complexity and a stronger emphasis on the burial chamber itself. The analysis of these patterns provides valuable insight into structural distinctions, spatial development, and changing architectural preferences within the funerary architecture of southwestern Iran (Table 3).

Pattern I

This pattern includes two subtypes:

Type I-A consists of three successive components arranged along a common axis: a dromos (access corridor or vestibule), the principal burial chamber, and a stairway. Movement follows a linear and uninterrupted route, allowing access to the burial chamber with minimal directional change.

Type I-B consists of a dromos and a principal chamber aligned on the same axis, with the stairway also positioned along the circulation axis. The most significant characteristic of this arrangement is the reduction of travel distance and the simplification of access to the burial chamber.

Both sub-types are present in the Parthian tombs, whereas only Type I-B has been identified among the Elymaean examples.

Pattern II

This pattern is exclusive to the Parthian tombs. In this arrangement, the dromos and the principal chamber are connected through an L-shaped stairway. The change in direction along the access route introduces a spatial interruption within the circulation sequence and diverts movement away from a direct path.

From a spatial perspective, this configuration may be interpreted as a means of controlling access to the burial chamber by requiring a change of direction before entry. As a result, the circulation route becomes more structured and segmented. No comparable example of this pattern has been identified among the Elymaean tombs, a difference that may indicate a transformation in spatial organization between the two periods (Table 3).

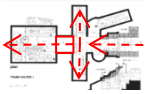
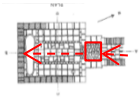
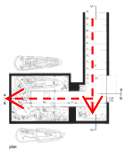
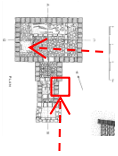
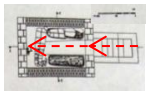
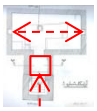
Pattern III

In this configuration, the dromos and the principal chamber are organized in relation to a stairway positioned perpendicular to them. In the Parthian examples, the stairway is arranged perpendicular to both the dromos and the burial chamber, creating a clearly defined and controlled circulation route that separates the exterior approach from the funerary space and directs movement toward the principal chamber.

A comparable arrangement is also observed in the Elymaean tomb of Ṣāliḥ Dāwūd. However, in this example, the stairway is positioned directly perpendicular to the burial chamber rather than to the dromos. This modification reduces the role of the intermediary space in directing circulation and creates a more direct connection between the entrance route and the burial chamber.

Accordingly, Pattern III in the Elymaean period appears to place greater emphasis on the centrality of the burial chamber while reducing the importance of intermediary stages within the circulation sequence (Table 3).

Table 3. Architectural–spatial characteristics and spatial-circulation patterns of the Parthian tombs of Susa and the Elymaean tombs of Shushtar and Saleh Davoud.

Historical Period	Plan Geometry	Plan Proportions	Pattern I		Pattern II	Pattern III
			Type 1	Type 2		
Parthian	Rectangular	1.2-1.3				
			Staircase aligned with the axis of the burial chamber + two lateral spaces + dromos (vestibule) + burial chamber	Staircase aligned with the burial space + dromos (access space or vestibule) + burial chamber	L-shaped staircase + dromos (vestibule) + burial chamber	Entrance + dromos (vestibule) + staircase perpendicular to the burial chamber
			Broken orientation (combination of linear and perpendicular (axes	Linear orientation, direct three-space configuration	Linear orientation perpendicular to the main axis, three-space configuration	Linear orientation perpendicular to the main axis, three-space configuration
Elymaean	Rectangular	Less than 2				
				Staircase aligned with the burial chamber + burial chamber		Staircase perpendicular to the main space + dromos (vestibule) + burial chamber
				Direct orientation, two-space configuration		Linear orientation perpendicular to the main axis, three-space configuration

6.5. Refined Comparative Interpretation of Parthian and Elymaean Vaulted Tombs

The comparative analysis of the Parthian and Elymaean vaulted tombs reveals a substantial degree of continuity in the funerary architectural tradition of Khuzestan. In both periods, all tombs were constructed as subterranean structures and employed barrel-vaulted roofing systems. The burial chambers are rectangular in plan, with length-to-width ratios consistently below 2.0. Furthermore,

all examined examples are equipped with access stairways and contain three burial platforms positioned along the lateral and rear sides of the chamber facing the entrance. These shared characteristics indicate the persistence of a well-established regional funerary tradition based on underground burial, brick vault construction, and a standardized spatial organization.

Despite these similarities, several significant differences distinguish the two chronological groups. One of the most important is the presence of an intermediate transitional space, commonly referred to as a dromos or vestibule. In the Parthian tombs of Susa, a square or nearly square dromos occurs in most examples and functions as an intermediate threshold between the exterior and the burial chamber. By contrast, Elymaean tombs generally lack such a space, with the notable exception of the tomb of Ṣāliḥ Dāwūd, where a vaulted square antechamber appears to have been influenced by Parthian funerary models.

Differences are also evident in the organization of circulation and access. Several Parthian tombs exhibit a complex arrangement in which the stairway axis and burial chamber axis are either aligned or arranged perpendicularly, creating multiple movement patterns and a more elaborate spatial sequence. Elymaean tombs, however, generally employ a more direct and simplified access system, in which the stairway is aligned with the longitudinal axis of the burial chamber. The only exception is the Ṣāliḥ Dāwūd tomb, where the stairway is perpendicular to the chamber axis.

Another distinction concerns spatial proportions. Although the burial chambers of both periods are rectangular, their geometric ratios differ significantly. The average length-to-width ratio of the Parthian tombs is approximately 1:1.30, indicating relatively compact and balanced spaces that approach a square configuration. In contrast, Elymaean tombs display an average ratio of approximately 1:1.52, reflecting a tendency toward more elongated chambers with greater spatial depth. The burial chamber of Ṣāliḥ Dāwūd, with a ratio of 1:1.82, represents the most elongated example among the examined tombs.

The persistence of rectangular chamber geometry in both periods demonstrates that practical and structural considerations governed funerary design. Rectangular spaces provided suitable conditions for the construction of brick barrel vaults, efficient load transfer to the side walls, and compatibility with local building materials such as baked brick and mud brick. Consequently, the principal distinction between the two periods lies not in the basic geometry of the chamber but in its proportions and spatial organization.

From a spatial perspective, Parthian tombs exhibit a preference for compact, balanced layouts characterized by moderate proportions and a more articulated sequence of access spaces. Elymaean tombs, by contrast, display a tendency toward elongated chambers and extended movement paths, suggesting a greater emphasis on processional movement and the experiential dimension of funerary space. These differences in proportion and circulation patterns may therefore serve as reliable chronological indicators for distinguishing between the two periods.

Analysis of circulation systems further demonstrates that two principal spatial-access models can be identified. The Parthian examples generally follow a three-part sequence consisting of an entrance stairway, a dromos or vestibule, and the burial chamber.
This arrangement creates a hierarchical progression from the exterior world to the funerary space and reflects a more complex spatial organization. Elymaean tombs, on the other hand, predominantly employ a simplified two-part sequence composed of a stairway and a burial chamber, with direct access to the funerary space and reduced emphasis on transitional zones.

An important observation is that although Elymaean tombs reduce the number of intermediary spaces, the burial chambers themselves become more elongated, resulting in a longer spatial journey from entrance to burial area. Thus, the simplification of spatial hierarchy is accompanied by an increase in spatial depth. This phenomenon suggests a transformation rather than a rupture in the regional funerary tradition.

Overall, the study demonstrates that continuity is clearly evident in the shared use of underground burial, rectangular chamber plans, and brick barrel-vault construction. Nevertheless,

chronological differentiation can be established through two principal criteria: geometric proportions and spatial organization. The transition from the Parthian three-space arrangement incorporating a dromos to the predominantly two-space Elymaean configuration, together with the shift from compact chambers (average ratio 1:1.30) to more elongated spaces (average ratio 1:1.52), represents the most significant architectural transformation identified in the examined corpus.

These findings indicate that the most reliable indicators for distinguishing Parthian and Elymaean funerary architecture are not construction materials or vaulting techniques—which remained largely unchanged—but rather the organization of space, patterns of movement, and geometric proportions. The evolution observed in these elements reflects an internal development of a long-standing architectural tradition in southwestern Iran and provides a valuable framework for future chronological and typological studies of funerary architecture in Khuzestan.

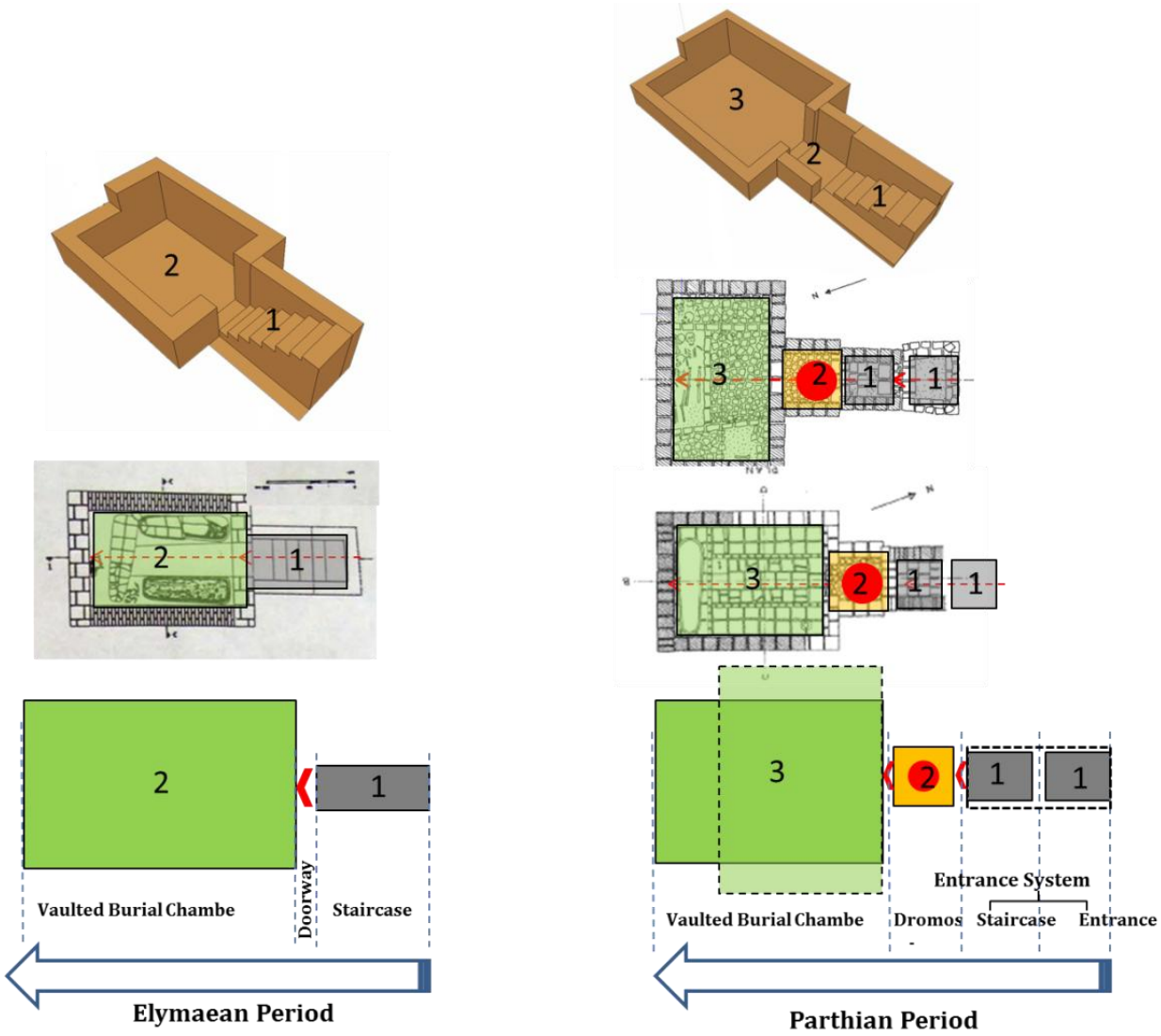


Figure 4. Circulation patterns and spatial hierarchy of the two principal tomb layouts identified in the study. Parthian tombs (right): a three-space configuration consisting of the entrance and staircase (grey), the dromos/vestibule or entrance antechamber (orange), and the burial chamber (green). Elymaean tombs (left): a two-space configuration consisting of the staircase (grey) and the burial chamber (green).

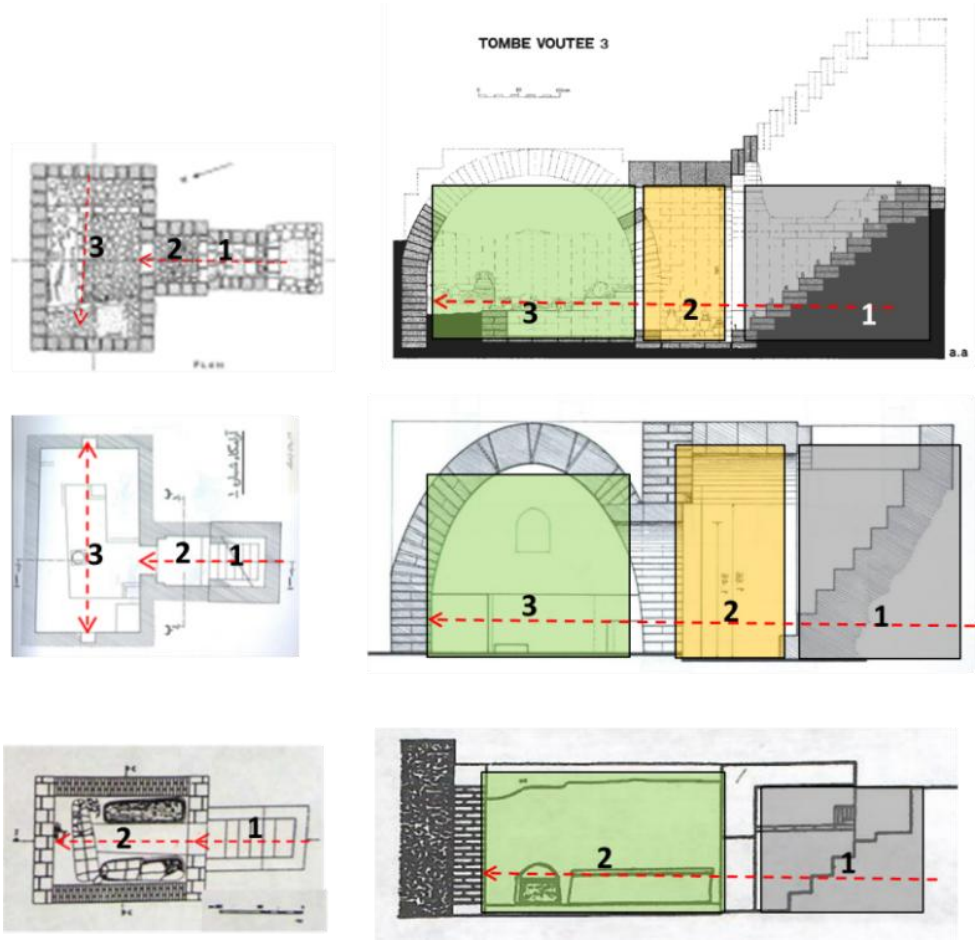


Figure 5. Circulation and spatial hierarchy in the tombs studied.
Parthian tombs (top): a three-space arrangement comprising the entrance and staircase (grey), the dromos/vestibule or entrance antechamber (orange), and the burial chamber (green) (after Boucharlat & Haerinck, 2011). Elymaean tombs: the Saleh Davoud tomb (centre) exhibits a three-space arrangement, whereas Tomb No. 3 at Dastova (bottom) represents a two-space configuration consisting of the staircase (grey) and the burial chamber (green) (after Rahbar, 1994; 2013).

7. Conclusion

The findings of this study demonstrate that the vaulted tombs of the Parthian and Elymaean periods in Khuzestan, despite sharing several fundamental characteristics—including subterranean construction, rectangular chamber plans, brick barrel-vaulted roofing systems, access stairways, and burial platforms—display significant differences in spatial organization, geometric proportions, and circulation patterns. These distinctions can be interpreted as reliable chronological and cultural indicators for differentiating between the two periods.

Comparative analysis revealed that the rectangular form of the vaulted burial chamber represents the continuation of a long-standing indigenous architectural tradition in Khuzestan. Architectural transformations did not occur in the basic geometry of the funerary space itself, but rather in spatial proportions, movement depth, and hierarchical access systems. The average length-to-width ratio of Parthian tomb chambers (approximately 1:1.30) reflects relatively compact and spatially balanced layouts. In contrast, Elymaean tombs exhibit a greater degree of elongation (average ratio of approximately 1:1.52), creating deeper spatial sequences and emphasizing the ritual progression of entrance–movement–burial. As a measurable architectural variable, this proportional shift constitutes a valuable quantitative criterion for distinguishing between the two periods.

From the perspective of spatial organization, the study identifies the dromos, or transitional intermediary space, as one of the principal elements differentiating Parthian and Elymaean

funerary architecture. The predominance of a three-part spatial sequence in Parthian tombs—consisting of an entrance stairway, a dromos (transitional space), and a burial chamber—contrasts with the predominantly two-part arrangement found in Elymaean examples, composed simply of a stairway and a burial chamber. This distinction reflects different levels of spatial control, ritual pause, and architectural articulation of threshold spaces. Likewise, the diversity of circulation patterns observed in Parthian tombs, including linear, angular, and perpendicular access arrangements, contrasts with the simplified and more focused spatial organization characteristic of Elymaean funerary structures.

From a theoretical perspective, this research demonstrates that funerary architecture should not be understood merely as a physical structure but rather as a meaningful system of movement, pause, orientation, and spatial hierarchy. Such an approach opens new avenues for the archaeological study of architecture in Iran by introducing spatial proportions, circulation patterns, and access systems as independent and measurable analytical variables in chronological investigations.

From a practical standpoint, the results have direct implications for the conservation and management of archaeological funerary monuments. A precise understanding of spatial hierarchy, the location and function of the dromos, burial depth, and geometric proportions provides a scientific basis for restoration planning, visitor management, and the prevention of inappropriate interventions. Furthermore, the spatial patterns identified in this study may serve as diagnostic tools for determining the chronological attribution of tombs lacking direct historical or archaeological evidence.

Overall, the differences between Parthian and Elymaean tombs in Khuzestan should not be interpreted as evidence of architectural discontinuity, but rather as the result of a gradual transformation in spatial logic, funerary practices, and cultural perceptions of death. This transformation is reflected in changes in geometric proportions, the reduction or elimination of intermediary spaces, and the simplification of circulation routes. The findings, therefore, provide a framework for broader comparative studies of funerary architecture across Khuzestan, Mesopotamia, and the Iranian Plateau.

The architectural differentiation identified in this study is based upon three principal criteria. First, spatial organization, reflected in the contrast between the relatively simple two-space arrangements of Elymaean tombs and the more complex multi-space configurations characteristic of Parthian examples. Second, access hierarchy, expressed through changes in circulation patterns and the presence or absence of threshold spaces such as vestibules or dromoi. Third, geometric proportions, particularly the significant differences in length-to-width ratios that indicate a transition from compact and balanced spaces toward more elongated spatial configurations. Together, these criteria provide a robust framework for distinguishing chronological phases while simultaneously demonstrating the continuity of regional construction traditions, especially the persistent use of brick barrel-vault technology.

Acknowledgements

The author would like to express their sincere gratitude to Dr. Arman Shishegar, Dr. Mehdi Rahbar, Mr. Mohammad Sheikh, and the Susa World Heritage Base for their valuable assistance and support during this research.

Author Contributions

The first author was responsible for all stages of the study, including data collection, analysis, and preparation of the manuscript.

Conflict of Interest

The author declares no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability Statement

The data supporting the findings of this study were derived from published sources cited in the reference list.

References

Agha-Aligol, D., Sodaei, B., Khosravi, L., & Karimi, M. (2019). *Investigation and Study of Glass Artifacts of the Sassanid Period; Case Study: Jahangir Dome and Gouriyeh Glasses in Ilam Province using Micro-PIXE Technique*. *JRA*. *5*(2), 47-70. https://doi.org/10.29252/jra.5.2.47
Boucharlat, R., & Haerinck, E. (2011). *Tombes d'époque parthe (Chantiers de la Ville des Artisans), Mémoires de la Délégation Archéologique en Iran*, Tome 35. Mission de Susiane. Brill. Leiden/Boston

Chaychi-Amirkhiz, A., & Saeedi-Harsini, A. (2002). *Tadfin-e Tabuti dar Iran-e Bastan [Coffin Burials in Ancient Iran]*. Tehran: Samira. (In Persian).

Colledge, M. A. R. (2001). *Ashkanian (Partian) [The Parthians]*. (M. Rajabnia, Trans.). Tehran: Hirmand. (In Persian).

Ghirshman, R. (1968). *Chogha Zanbil, Vol. II: Temenos, Temples, Palaces, Tombs* (A. Karimi, Trans., 1996). Tehran: Iranian Cultural Heritage Organization.

Ghirshman R., & Stève M.-J. (1966). Suse. Campagne de l'hiver 1964-65. Rapport préliminaire. In: *Arts asiatiques*, tome 13. pp. 3-32. https://doi.org/10.3406/arasi.1966.945

Ghirshman, R. (1952). Cinq Campagnes De Foulesses a Suse (1946 – 1951). *Revue d'Assyriologie et d'archéologie orientale, 46* (1), 1-18.

Hussein, M. M., & Suleiman, A. (2000). *Nimrud: A City of Golden Treasures. Baghdad: Ministry of Culture and Information*.

Kaboli, M. A. (1994). Susa and the Archaeological Heritage of the Susiana Plain [Shush va Mirath-e Bastani-ye Dasht-e Shushan]. *Mirath-e Farhangi, 12*, 119–138. (In Persian).

Kawami, T. S. (1982). Parthian Brick Vaults in Mesopotamia, Their Antecedents and Descendants. *Journal of the Ancient Near Eastern Society,14*, 61-67.

Lancaster, L. C. (2009a), *Parthian Influence on Vaulting in Roman Greece? An Inquiry into Technological Exchange Under Hadrian*, American Journal of Archaeology, *114*(3), 447-472. https://doi.org/10.3764/aja.114.3.447.

Lancaster, L. C. (2009b). *Early Examples of So–Called Pitched Brick Barrel Vaulting in Roman Greece and Asia Minor: A Question of Origin and Intention*, Internationale Konferenz-13.-16. Juni *2007 in Istanbul BYZAS, 9, 371-391*.

Mehr Kian, J. & Messina, V. (2019). Preliminary Report on the Iranian-Italian Joint Expedition into Khuzestan: Kal-e Chendar; Shami (2013-2016). *Archaeology Journal, 3*(4), 49-78. http://archj.richt.ir/article-10-291-fa.html

Memarian, G. H. (1988). *Structural Design of Vaulted Constructions in Iranian Islamic Architecture [Niarash-e Sazehhaye Taqi dar Memari-ye Eslami-ye Iran]*. Tehran: Academic Jihad Press. (In Persian).

Memarian, G. H. (2014). *A Survey of Theoretical Foundations of Architecture [Seyri dar Mabani-ye Nazari-ye Memari (9th ed.)]*. Tehran: Simaye Danesh. (In Persian).

Moghadam, A. (2015). *The Zohreh Prehistoric Project: The Six-Thousand-Year-Old Cemetery of Choghasefli [Projeh-ye Pish az Tarikhi-ye Zohreh: Gurestan-e Shesh Hezarsaleh-ye Tal-e Choghasefli]*. Tehran: Research Institute of Cultural Heritage and Tourism. (In Persian).

Moghadam, A. (2018). *Gurestan-e Shesh Hezarsaleh-ye Tal-e Choghasefli [The Six-Thousand-Year-Old Cemetery of Choghasefli]*. Tehran: Research Institute of Cultural Heritage and Tourism. (In Persian).

Moghadam, A. (2025). Khatun and Other Elite Women in the Choghasefla Cemetery [Khatun va Digar Zanan-e Momtaz dar Gurestan-e Choghasefla]. *Pazhuheshhaye Bastanshenasi-ye Iran, 15*(44), 41–74. (In Persian). https://doi.org/10.22084/nb.2023.27504.2566

Mohammadi Far, Y. (2014). *Parthian Archaeology and Art [Bastanshenasi va Honar-e Ashkani (4th ed.)]*. Tehran: SAMT. (In Persian).

Mohammadi Far, Y., & Khounai, A. (2017). Moruri bar Motale'at-e Elymaei [A Review of Elymaean Studies]. *Pazhuheshhaye Bastanshenasi-ye Iran, 7*(12), 151–174. (In Persian). .https://doi.org/10.22084/nbsh.2017.7876.1535

Mohammadi Far, Y., Rouhani Rankouhi, M., Mehrkian, J., & Messina, V. (2023). Typology of Elymaean Tomb Architecture [Guneh-Shenasi-ye Memari-ye Aramgahhaye Elymaei]. *Motale'at-e Bastanshenasi-ye Parseh, 26*(7), 101–118. (In Persian). http://dx.doi.org/10.22034/PJAS.7.26.97

Moortgat, A. (1998). *Honar-e Beyn al-Nahrayn-e Bastan: Honar-e Classic-e Khavar-e Nazdik [The Art of Ancient Mesopotamia: Classical Art of the Ancient Near East]*. (Z. Basti & M. R. Sarraf, Trans.). Tehran: SAMT. (In Persian).

Negahban, E. O. (1996). *Shush ya Kohan-Tarin Markaz-e Shahrneshini-ye Jahan [Susa: The Oldest Urban Center in the World]*. Tehran: Iranian Cultural Heritage Organization. (In Persian).

Rahbar, M. (1994). Kavosh-e Bastanshenasi dar Golalak-e Shushtar [Archaeological Excavations at Golalak, Shushtar]. In *Yadnameh-ye Gardehamaei-ye Bastanshenasi-ye Shush* (pp. 175–208). Tehran: Cultural Heritage Organization. (In Persian).

Rahbar, M. (1999). *Fasl-e Avval-e Kavoshhaye Bastanshenasi-ye Saleh Davud [First Season of Archaeological Excavations at Saleh Davud]*. Tehran: Archaeological Research Institute. (In Persian).

Rahbar, M. (2013). Aramgah-e Zirzamini-ye Elymaei dar Saleh Davud [An Elymaean Underground Tomb at Saleh Davud]. In H. Fahimi & K. Alizadeh (Eds.), *Namvarnameh: Maqalehhaei dar Pasdasht-e Yad-e Masoud Azarnoush* (pp. 289–314). Tehran. (In Persian).

Sarfaraz, A. A., & Firouzmandi, B. (2010). *Bastanshenasi va Honar-e Doran-e Tarikhi: Mad, Hakhamanshi, Ashkani, Sasani (6th ed.) [Archaeology and Art of the Historical Periods: Median, Achaemenid, Parthian and Sasanian]*. Tehran: Marlik Publications. (In Persian).

Shaikh Baikloo Islam, B. (2025). Payamadha-ye Taghyir-e Eqlim az Gozashte ta Hal: Ahammiyat-e Pazhuheshhaye Dirin-Eqlim dar Motale'at-e Bastanshenasi [Climate Change Impacts from Past to Present: The Importance of Paleoclimate Research in Archaeological Studies]. *Mirath-e Jonub-e Gharbi-ye Asia, 1*(2), Article 5. (In Persian).https://doi.org/10.22034/hsaj.2025.558717.1024

Sobhani, F., & Rezaei-Nia, A. (2021). Typology of funerary architecture in the Parthian period. *Cultural-Historical Studies*, *12*(47), 1–37.

Zarei, H., Nasakhiyan, S., & Taleban, M. H. (2024a). Technical Analysis and Stability Measures in Barrel-Vaulted Buildings of Khuzestan from the Elamite to the End of the Sasanian Period. *Motale'at-e Bastanshenasi-ye Parseh, 34*(9), 145–183. (In Persian).110.http://dx.doi.org/10.61882/jra.10.2.448

Zarei, H., Nasakhiyan, S., & Taleban, M. H. (2024b). Investigating Influential Factors in the Construction Technology of Barrel-Vaulted Tombs of Elamite and Elymaean Khuzestan. *JRA, 10*(2), 85–110. (In Persian).http://dx.doi.org/10.61882/PJAS.1290.902.1

Zarei, H. (2025). Comparative Analysis of Spatial–Architectural Patterns in Vaulted Tombs of the Parthian and Elymaean Periods in Khuzestan. *Heritage of Southwest Asia, 2*(2), ID2. https://doi.org/10.22034/hsaj.2026.568784.1040