Research

Typology, Chronology, and Spatial Distribution Pattern of the Rock-Cut Castles of Bijar-e Garrus, Kurdistan

Zarrīn Fām
Museum Studies Biannual
Volume 3, Issue 5
Fall 2025 and Winter 2026
Print ISSN: 2980 – X924
Online ISSN: 2980 – 9541

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Received: 22 Nov. 2025 **Accepted:** 17 Feb. 2026 **Published:** 20 Feb. 2026

Abstract
Despite the abundance of rock-cut architecture in Iran, comprehensive chronological and typological studies regarding this group of civilizational evidence have not yet been conducted, nor is there a map defining their spatial distribution. This research examines and analyzes five historical fortresses in Bijar County (Qamchogha, Qalāqourh, Dans-Qala, Dokhtar Zeynal, and Bashqurtaran), which represent prominent examples of hybrid defensive architecture (rock-cut and masonry) in the Central Zagros region. The primary objective of this study is to conduct a typology, chronology, and spatial analysis of these fortresses, emphasizing the factors influencing their formation, design, and spatial distribution. The central research question is: how have environmental (geological and climatic), defensive-security, and socio-political factors influenced the formation, typology, and spatial distribution of these rock-cut fortresses in Bijar? The research methodology is descriptive-analytical, utilizing a combination of library studies, field investigations (documentation via GPS and aerial photography), and interviews with local inhabitants. The findings reveal that these structures, primarily constructed during the Sassanid era and utilized throughout the medieval Islamic period, were shaped by the region's geological characteristics (limestone and karst substrates) and geopolitical and defensive necessities. The results indicate that these fortresses, through the utilization of advanced systems such as rock-cut water cisterns lined with saruj (traditional hydraulic mortar) and strategic exit tunnels, demonstrate the high level of engineering knowledge possessed by their builders and reflect a sophisticated interaction between humans and nature in this climate. This study not only contributes to the chronology and typology of rock-cut architecture but also highlights the urgent need for the conservation and restoration of this civilizational heritage.

Keywords: Tehran-Semnan, Khorasan, late Islamic centuries, historical texts, archaeological evidence.

Citation: Amanollahi, H., Karimian, H., & Sheikh Ahmadi, F. (2026). Typology, Chronology, and Spatial Distribution Pattern of the Rock-Cut Castles of Bijar-e Garrus, Kurdistan. *Zarrīn Fām*, *3*(5), 103-142 (in Persian). https://doi.org/10.30481/museum.2026.587870.1084

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1. Introduction

Rock-cut architecture represents one of the most remarkable forms of human adaptation to natural environments, particularly in mountainous regions where geological conditions have facilitated the creation of defensive and residential spaces through negative-space excavation. Despite the abundance of such architectural evidence throughout Iran, comprehensive chronological and typological studies have remained scarce, and no systematic spatial distribution map has been established for these significant remains of civilization. The present research addresses this gap by examining five historical fortresses in Bijar County, Kurdistan Province, located in the Central Zagros region of western Iran. These fortresses—Qamchogha, Qalaqoura, Dans-Qala (Tanez), Dokhtar Zeynal, and Bashqurtaran—represent outstanding examples of hybrid defensive architecture that combines rock-cut techniques with masonry construction.

The Bijar region, known as the "Roof of Iran" due to its elevation of approximately 1,980 meters above sea level, possesses unique geological and climatic characteristics that have made it particularly suitable for the development of rock-cut architecture. The limestone and karst substrates of the area have provided ideal conditions for excavation, while the region's strategic geopolitical position along historical communication corridors between Azerbaijan, Kurdistan, and Hamadan has necessitated the construction of formidable defensive structures. These fortresses, primarily constructed during the Sassanid era and subsequently utilized throughout the medieval Islamic period, demonstrate sophisticated engineering knowledge and reflect a complex interaction between human communities and their natural environment.

The central research question guiding this investigation examines how environmental (geological and climatic), defensive-security, and socio-political factors have influenced the formation, typology, and spatial distribution of these rock-cut fortresses. The study aims to contribute not only to the chronology and typology of rock-cut architecture in Iran but also to highlight the urgent need for conservation and restoration of this invaluable civilizational heritage, which faces increasing threats from natural erosion and human activities.

2. Research Methodology

This research employs a descriptive-analytical methodology that integrates multiple data collection and analysis techniques to provide a comprehensive understanding of the five fortresses under investigation. The methodological framework combines library studies, extensive field investigations, and ethnographic interviews with local inhabitants.

The library research component involved a systematic review of historical texts, archaeological reports, and scientific literature pertaining to rock-cut architecture in Iran and comparable international contexts. This provided the necessary theoretical foundation and contextual background for understanding the cultural and historical significance of the Bijar fortresses.

Field investigations constituted the core of the research methodology. Systematic documentation was conducted using GPS technology for precise spatial positioning, aerial photography for comprehensive site overviews, and architectural drawing with AutoCAD software for detailed recording of structural features. The field surveys included careful examination of defensive walls, rock-cut water cisterns, tunnels, staircases, and other architectural elements, with particular attention to construction techniques, materials, and spatial organization.

Ethnographic interviews with local inhabitants and cultural heritage enthusiasts provided valuable oral histories and traditional knowledge regarding the fortresses' names, functions, and historical significance. These interviews, conducted during June 2024, offered insights that complemented the archaeological and architectural evidence.

The data analysis was conducted qualitatively within a descriptive-analytical framework, comparing architectural elements, evaluating factors influencing formation and function, and assessing spatial distribution patterns across the region. Ceramic analysis played a crucial role in establishing chronological frameworks, with pottery samples classified based on fabric, decoration, and manufacturing techniques.

3. Discussion

3.1. Typological Classification of the Bijar Fortresses

The five fortresses examined in this study represent a distinctive category of defensive architecture that can be classified as "hybrid rock-cut and masonry structures" or "rock-foundation defense architecture." Unlike purely rock-cut structures such as the underground settlements of Kandovan or Meymand, these fortresses

integrate two complementary construction approaches: excavated spaces within the natural rock substrate and built structures using locally sourced materials.

3.1.1. Classification Based on Spatial Relationship with Terrain

The fortresses demonstrate varying relationships with their geological contexts. Qamchogha and Qalaqoura are situated on isolated limestone outcrops with steep precipices on multiple sides, making them virtually impregnable from most directions. Dans-Qala occupies a narrow ridge formation with limited access points, while Dokhtar Zeynal and Bashqurtaran are positioned on mountain slopes with strategic views over surrounding valleys and plains. This diversity reflects the builders' sophisticated understanding of defensive principles and topographical advantages.

3.1.2. Classification Based on Construction Techniques

The architectural analysis reveals three distinct construction approaches integrated within each fortress:
Horizontal rock-cut elements include tunnels, water cisterns, and storage spaces excavated into the rock face. These spaces demonstrate careful engineering in terms of structural stability, water management, and thermal insulation. The tunnels, particularly the 23-meter escape passage at Qamchogha, exhibit precise cutting techniques with visible tool marks that indicate systematic excavation methods.
Vertical rock-cut elements encompass staircases, shafts, and access passages that connect different levels of the fortresses. The 47 steps within the Qamchogha tunnel, with varying dimensions and gradients, exemplify the sophisticated vertical circulation systems integrated into these structures.
Masonry construction includes defensive walls, towers, and built structures using rubble stone and gypsum mortar. The walls at Qamchogha, reaching lengths of approximately 1,000 meters and heights of 15-20 meters, demonstrate the massive scale of these defensive systems.

3.2. Architectural Features and Engineering Systems

3.2.1. Defensive Systems and Fortifications

The defensive architecture of the Bijar fortresses reveals sophisticated military engineering principles. The fortifications were strategically designed to maximize natural advantages while compensating for vulnerabilities. At Qamchogha, natural precipices reaching 200 meters in height on multiple sides reduced the need for extensive fortifications, while the more accessible northwestern approach was protected by massive walls with semi-cylindrical towers. The construction technique employed double-shell walls with rubble cores and dressed stone facades, a characteristic feature of Sassanian military architecture also observed at Takht-e Soleyman.
The defensive walls demonstrate careful attention to structural stability, with thickness variations to accommodate different loads and stresses. The use of semi-calcined gypsum mortar, which sets firmly while maintaining some flexibility, provided both strength and resilience against seismic activity and thermal expansion. The masonry technique, featuring precisely cut square stones in the exterior facade, represents a high-quality construction approach reserved for important buildings of the Sassanian period.

3.2.2. Water Management Systems

The water cisterns represent one of the most sophisticated aspects of the Bijar fortresses' engineering. Qamchogha alone contains ten rock-cut cisterns of varying dimensions, with the largest measuring 7 meters in diameter and the smallest approximately 4 meters. These cisterns were carefully excavated into the limestone substrate and lined with *saruj* (traditional hydraulic mortar) to prevent leakage. The cisterns demonstrate systematic water management through overflow channels directing water from upper to lower reservoirs, indicating advanced understanding of hydraulic principles.
The cisterns served multiple functions: collecting surface runoff during precipitation events, storing water for extended periods of siege, and providing drinking water for inhabitants. The presence of brick lining in one cistern (number 4) suggests modifications during the Ilkhanid period, demonstrating continued maintenance and adaptation of these vital systems.

3.2.3. Escape Tunnels and Strategic Passages

The escape tunnels discovered at Qamchogha represent particularly sophisticated engineering achievements. Originating from the floor of cistern number 10 and extending approximately 23 meters eastward, these passages provided emergency exit routes during siege conditions. The tunnel, with its steep gradient and varying dimensions, demonstrates careful planning for rapid evacuation while maintaining

concealment. The presence of 47 observable steps with widths ranging from 67 to 100 centimeters and heights between 22 and 50 centimeters indicates systematic construction.
The comparative analysis reveals that such escape tunnels, while rare, are documented in other significant Iranian fortresses including Alamut Castle, Lambesar Castle, and the Dokhtar Castle on the Kerman-Zarand road. This suggests a broader tradition of incorporating emergency escape routes into major defensive structures.

3.3. Spatial Distribution and Geopolitical Context

3.3.1. Regional Settlement Pattern

The spatial distribution of the five fortresses reveals a coherent defensive network spanning the Garrus region. Qamchogha and Qalaqoura occupy northern positions, Dans-Qala is centrally located near Bijar city, while Dokhtar Zeynal and Bashqurtaran extend to the south and southwest. This linear distribution follows the natural communication corridors connecting Azerbaijan, Kurdistan, and Hamadan, indicating the fortresses' role in controlling strategic routes.
The intervisibility among these fortresses demonstrates sophisticated military planning. Dokhtar Zeynal, despite its modest dimensions (20×20 meters), provides commanding views over both Bashqurtaran to the southeast and Qalaqoura to the northwest. This visual communication network enabled rapid transmission of warnings and messages through optical signals such as fire or smoke, representing an integrated early warning system.

3.3.2. Geopolitical Significance

The Garrus region's strategic position as a buffer zone and defensive corridor in western Iran is reflected in the density and organization of these fortifications. Historical sources indicate that during the Sassanian period, this region served as an important frontier zone, while in the Islamic period it remained strategically significant for successive dynasties including the Buyids, Seljuks, and Ilkhanids.
The fortresses' locations on isolated outcrops and mountain ridges demonstrate careful selection based on military criteria: commanding views, natural defenses, control of routes, and proximity to water sources. The concentration of these structures in the Bijar area suggests a deliberate policy of defensive consolidation, creating a layered system of protection that could respond to threats at multiple levels.

3.4. Chronology and Historical Development

3.4.1. Sassanian Foundation Period

The architectural evidence strongly indicates Sassanian origins for the main defensive systems. The masonry technique featuring dressed cubic stones with semi-calcined gypsum mortar closely parallels construction methods documented at Takht-e Soleyman, a major Sassanian religious and administrative center. The presence of precise stone cutting, massive wall construction, and sophisticated defensive planning aligns with Sassanian military architectural traditions.
The rock-cut elements, including cisterns, tunnels, and staircases, exhibit technical characteristics consistent with Sassanian engineering practices. The integration of rock-cut and masonry construction, while continuing earlier traditions, was refined during this period to create particularly effective defensive systems.

3.4.2. Islamic Period Occupation and Modifications

Ceramic analysis confirms continued occupation and modification during the Islamic period, particularly during the Seljuk and Ilkhanid eras. The pottery assemblage includes both unglazed wares with applied and incised decorations characteristic of the 3rd to 7th centuries AH, and glazed wares including sgraffiato and lustreware typical of the 6th to 8th centuries AH. The presence of high-quality ceramics including lustreware with Chinese-influenced paste indicates prosperity and connections to major ceramic production centers such as Kashan and Ray.
During the Ilkhanid period, significant modifications were made to some fortresses, including the construction of a rock-cut school (maktab-khaneh) at Qamchogha and the brick lining of cisterns. This pattern of reuse and modification, known as "atragh" (encampment on ancient remains), was a characteristic Ilkhanid practice that allowed them to benefit from established defensive positions.

4. Conclusion

This comprehensive study of the five rock-cut fortresses of Bijar County demonstrates that these structures represent outstanding examples of hybrid defensive architecture that successfully integrated natural

geological features with sophisticated construction techniques. The research confirms that the fortresses were primarily constructed during the Sassanian period, with continued use and modification throughout the medieval Islamic period, particularly during the Seljuk and Ilkhanid eras.

The findings establish that three principal factors shaped the formation and design of these fortresses: geological conditions providing suitable limestone and karst substrates for excavation; defensive-security requirements dictating strategic locations and defensive systems; and socio-political factors determining the fortresses' roles within regional networks of control and communication. The sophisticated water management systems, strategic escape tunnels, and intervisible communication networks demonstrate advanced engineering knowledge and integrated defensive planning.

The typological classification reveals a distinctive category of "hybrid rock-cut and masonry defensive architecture" that represents a significant achievement of Iranian military engineering. These fortresses functioned not merely as isolated military outposts but as integrated components of a regional defensive system controlling strategic corridors and facilitating communication and response to threats.

The significance of this study extends beyond chronological and typological contributions to highlight the urgent need for conservation and restoration of these endangered cultural heritage sites. Natural erosion, limited awareness, and insufficient protective measures threaten these invaluable witnesses to Iran's architectural and military heritage. Future research should focus on detailed excavations, structural assessments, and development of conservation strategies to preserve these remarkable monuments for future generations. The fortresses of Bijar, with their unique synthesis of natural and constructed elements, deserve recognition as outstanding examples of human adaptation and engineering achievement in challenging mountainous environments.