



An Analysis of Spatial Configuration at Qal'eh Dokhtar, Kerman Using the Space Syntax Technique

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Abstract

Forts are among the evidences that are central to understanding administrative-political sovereignty. Qal'eh Dokhtar is a fort with a special position in Kerman's history thanks to the measures its builders had taken regarding its approach and security. The present contribution aimed to analyze and expound upon the spatial relationships in Qal'eh Dokhtar's architecture using the space syntax technique. The dataset deriving from the field surveys and historical texts was analyzed in Depthmap software. The results showed that the so-called "ruler's residence" had the highest spatial depth, and its difficult access furnished the security inherent in such a residence. Furthermore, in light of the parameters of control and entropy, the eastern quarter of the fort was found to exhibit the lowest level of both access and control across the fort. In terms of connectivity, Court I enjoyed the highest level of accessibility, continuity, and spatial coherence with the remaining spaces at the complex as they all clustered around this central courtyard. Court II showed the highest degree of integration. It was probably home to the administrative body, and perhaps also supplied the services to other quarters, as suggested by the passageways linking it to the different parts of the fort.

Keywords: Qal'eh Dokhtar, Kerman, Spatial Analysis, Space Syntax, Security.

Article Type: Research Article

Introduction

Forts were strongholds erected on natural heights, rocky outcrops and sometimes on artificial embankments and hills, and were occasionally framed by a rampart or a system of defensive walls studded by towers at certain intervals. Such structures were often localized in spots where a moat or a river confined them (Diakonov, 1978: 176–177). They served an array of different functions, and individual forts differed from each other in many aspects, including the amount of money spent, the expected function, the local terrain, the level of architectural knowledge, the accessibility of raw materials, rushed or unrushed construction, and the popular regional architectural styles (Stokstad, 2005: XLVI). Yet, the safety of local residents in times of warfare and

foreign invasion was a principle reason behind their construction. On the other hand, certain forts were meant to serve functions like monitoring roads as well as accommodating rebellious and insurgent groups. The importance and special position of forts stem from their significant role in the life of human groups and the structure of social, cultural, and economic developments of the past societies (Nourzadeh, 2016: 2). Accordingly, the practice of fort construction unflinchingly persisted throughout history, and forts continued to play an effective role in protecting the lives and properties of communities (Qalavand, 2013: 2).

Certain fortresses have gained a special significance. A case in point is Qal'eh Dokhtar in Kerman. This fort is crucial to regional studies for various reasons, among them being its role in



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political events and in the protection of the city of Kerman and the regional lines of communication, and as the seat of local rulers in maintaining the security of the regional administrative centers and in economic prosperity (see Afzal al-Din Kermani, 1977: 124; Vaziri, 2017: 102; Monshi Kermani, 1949: 62; Sykes, 1984: 80).

The present paper aims to analyze and explicate Qal'eh Dokhtar's spatial configuration using the space syntax technique. To this end, an attempt is made to answer the following questions: Based on the space syntax technique, what was the spatial configuration of the Qal'eh Dokhtar, Kerman? What measures were taken with regard to the fort's approach and security in its architectural design? To answer these questions, the authors will draw on the results of their surveys of Qal'eh Dokhtar, carried out in two seasons in 2018 and 2019. The space syntax approach will be then applied to the generated dataset.

Theoretical Framework and Methodology

According to the space syntax method, apart from physical elements, the spatial configuration is an equally important factor in shaping an architectural space, affecting the social structures. This method analyzes the sequential relation and arrangement of all spaces with respect to each other, and views the arrangement of the spaces together as having a direct bearing on the way the spaces function (Abbas Zadegan, 2002: 64).

Therefore, space syntax furnishes at present the leading method regarding the morphology of space. It also emphasizes the influence of architectural configuration on cultural and social structures (Hillier & Hanson, 1984: 44). In this theory, the relation between the activity of the space is more than it can be defined individually by the characteristics of the space; rather it should be defined and understood by the communication between spaces or spatial organization as well as communication between audiences and social interactions (Siadatan *et al.*, 2013: 29). In other words, this theory and method views space and human activity not as two discrete concepts but rather as a single, unified concept, manifested in individuals and their movement and visual characteristics (Falakian *et al.*, 2021: 258). Therefore, in every application of the technique to architectural spaces, one should never overlook individuals and their needs and roles.

Like other scholars, archaeologists use this theory to analyze the impact of social structure on the shape and composition of public and private architectural spaces (Dawson, 2002: 464).

The present analysis of the architecture of Qal'eh Dokhtar by the space syntax technique actually started with the survey of the site in 2018 and recording the required data. A review of the pertaining historical texts has been done to complement the dataset. Then, in order to analyze the accessibility level and spatial security of the site, its plan has been processed and analyzed in Depthmap software (Table. 1), which has likewise been used to process and simulate the data. In so doing, the diagrams of "depth," "integration," "entropy," "control," and "connectivity" have been extracted for different spaces of Qal'eh Dokhtar. These visualizations helped us examine and understand the social structures and the role of humans in the formation and development of the architecture at the site, as well as the effect of its architecture on increasing interactive behaviors or social relationships or preserving individuals' privacy and boosting personal and social security. Furthermore, in light of the mathematical relations of space syntax, the parameters of space syntax have been analyzed (Table. 2).

Depth, an important factor in the space syntax technique, means the number of steps that a person must go through to reach a certain space in a given site. The greater the spatial depth, the higher the degree of privacy of a space (Mustafa & Hassan, 2010: 160). Integration is the main concept in space syntax and is the average number of lines or intermediate spaces that can be reached from a given point. Thus, integration is not a distance or metric concept, but a one related to communication (Abbas Zadegan, 2002: 68). It shows the average number of lines and interstitial spaces that facilitate the connection between different spaces.

Entropy analysis means the distribution of points based on their visual depth from a point. It shows the availability and accessibility of a space. The higher the entropy index, the more difficult it will be for individuals to access other spaces from that point and vice versa (Turner, 2004: 15). Control is a factor that determines the degree of authority of a point over other connected points (Soheili and Rasouli, 2016: 49). Connectivity means spatial connection and indicates the degree of connection

between nodes and axes with other nodes of their neighboring unit (Yazdanfar *et al*, 2008: 62). Its practical concept can be seen as the access leading to the desired space (Roshani & Saghafi, 2017: 61).

In this research, after processing and simulating the data in terms of the parameters outlined above, two types of analysis will be performed in the software in graphical and mathematical forms before the research findings are presented and discussed.

Table. 1: Structural analysis of Qal'eh Dokhtar using Depthmap software


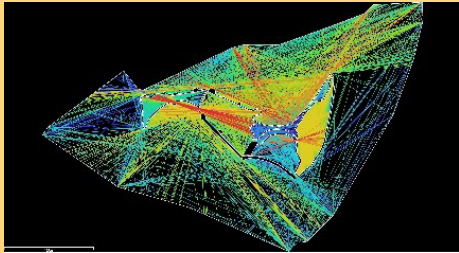
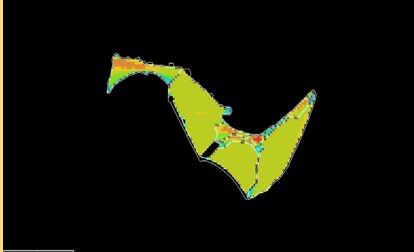
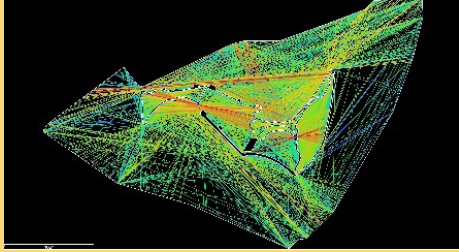
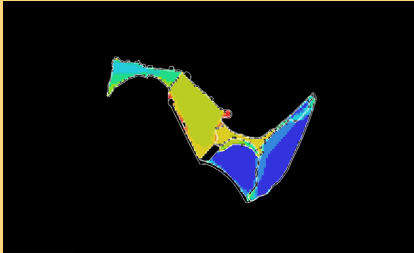
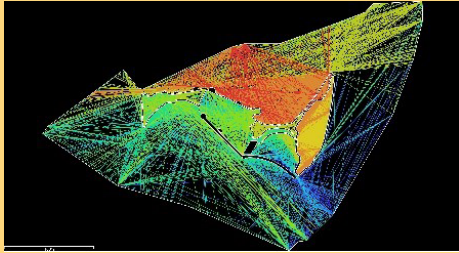
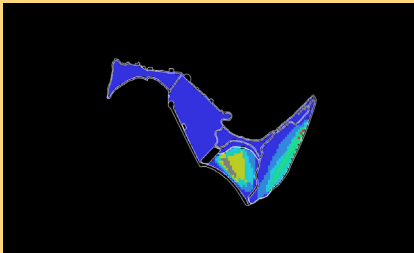
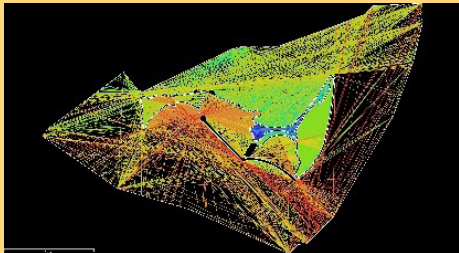

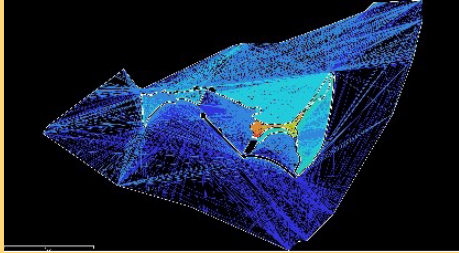
The indicators examined in the Deptmap software	A visual survey of the configuration of the spaces of Kerman's Qal'eh Dokhtar	A visual survey of the configuration of the spaces of Kerman's Qal'eh Dokhtar in the castle ground
connectivity		
control		
entropy		
integration		
depth		

Table. 2: Numerical analysis of the configuration of Qal'eh Dokhtar using Depthmap software

Spatial Occupancy Class	Connectivity	Control	Entropy	Integration	Depth
Western area	224	1.4	2.3	3.9	3.5
The first open area	737	2.2	2.2	4.7	2.9
The second open area	698	2	2	5.2	3.3
Residence 1 Or ruler's residence	85	1.7	2.4	1.4	7.4
The third open area	430	0.9	2.5	3.5	3.6
Eastern area	123	0.8	2.6	2.7	4.4

History of Research

The space syntax has been a popular approach in England since the early seventies. First advanced by Steadman, Bill Hillier and Julian Hansen, the approach marked a turning point in architectural morphological studies, and its current form has evolved from the development of the theory in the course of over three decades, on the one hand, and the development of spatial analysis methods and techniques, on the other (Mazaheri *et al*, 2018:99). In Iran, a multitude of investigations have adopted the method in the fields of urban planning and architecture. With regard to urban planning, Abbas Zadegan (2002) examined the process of urban design as seen from the city of Yazd, and analyzed the sequential features of the city's spaces in three stages of its historical evolution. Yazdanfar, Mousavi, and Zargar Daghigh (2008) analyzed the spatial structure of the city of Tabriz, employing the space syntax as a logical and systematic approach to studying and analyzing urban structures. They noticed a marked difference in the accessibility and functional importance of the "organic district of the city in the past" and "the new district of the city," in a way that has resulted in a disrupted spatial balance and a decreased efficiency of the space. Rismanchian and Bell (2010) in the paper "The Application of Space Syntax in Studying the Structure of the Cities" described space syntax as a technical method for the quantitative analysis of the city's qualitative factors. Having explained the basic elements of this approach, they presented an actual example of its application and the obtained maps and values such as the degree of integration in the structure of the city of Tehran. In another work underpinned by the same approach, these authors (Rismanchian & Bell 2011) investigated the spatial separation of the historical texture again in the

structure of Tehran, and as a contribution to a project named Special Plan for Renovation, they examined the spatial attributes of the historical texture based on the theory of natural movement.

In the field of architecture, Kamalipour *et al*, (2012) studied the morphological composition and spatial configuration of native houses with a focus on the guest space in the traditional houses of Kerman via the space syntax method. Siadatian and Pourjafar (2014) examined the Rasoulian House in Yazd and a house in Masuleh using the justification graph application test and the space syntax method, and evaluated the effect of the spatial organization of the houses with the degree of privacy of the spaces. Considering the values of integration as an independent variable and the degree of privacy of the space as a dependent variable, they detected a meaningful relationship between them. They described the spaces with the highest depth and the lowest integration as being the private arenas at the house. Bemanian, Jelvani, and Arjmandi (2016) explored the relationship between spatial configuration and wisdom in Islamic architecture, focusing on the mosques of the Isfahan school. Their cases included the Agha Noor, Imam, and Sheikh Lotfollah mosques as urban landmarks and a link in the relationship between urban elements. They concluded that the degree of permeability, spatial configuration, as well as the placement of each space in the depth of the mosque building correlate directly with the well-known components of wisdom in Islamic architecture, including the arrangement of spaces. Soheili and Rasouli (2016) in an article entitled "Comparative Study of the Architectural Space Syntax of the Qajar Caravanserais (The Case of Qazvin and Kashan Caravanserais)" looked at the two factors of "security" and "access" in the space of caravanserais, drawing comparisons between

the cells, warehouses, and the courtyards, and discussing their connections with the other spaces. Mehrabiyan, Safari, and Soheili (2021) scrutinized the Dar al-Fonoon school from the perspective of morphology, using the space Syntax method to analyze the relationship between the spatial organization and parameters of integration, depth, connectivity (permeability), visual connectivity (transparency), and clarity in the shape pattern. Mokhtari and Esfandiari Fard (2022) investigated the configuration of the spatial structure of the caravanserai of Shah Abbasi in Karaj using the same method. Having considered the transformation of the caravanserai to a school during the Qajar period, they examined the degree of adaptation of the new function to the spatial relations of the building.

As is readily discernible from the above outline, the architecture of Iranian historical forts still awaits consideration by the space syntax approach to fill the existing gap in the study of their spatial organization. Previous studies on the building of the forts have for the most part simply concentrated on the material culture (ceramics, tiles, metals, glasses) and the description of their architecture. With Qal'eh Dokhtar of Kerman not being an exception, the previous scholarship has considered its corpuses of pottery (Fehervari, 2000: 277; Sajjadi 2019; Tahmasbi Zadeh *et al*, 2022a) and tiles (Riahiyan 2019; Amirhajloo *et al*, 2020). Bastani Parizi went merely one step further to give a general description of the fort and point out that among all the qal'eh dokhtars across Iran, the one in Kerman is the sole example to be used for military purposes for the most part of its lifespan (Bastani Parizi, 1989: 156–164, 194). The report released about the conservation plan of Qal'eh Dokhtar in 2008 also gave a description of the fort's structure and an outline of the intended solutions for its preservation and restoration (Stonavand Afraz 2009).

None of the studies and publications chronicled above gives a detailed picture of the spatial arrangement of Qal'eh Dokhtar. Therefore, our study of this fort using the spatial syntax technique will provide an enhanced picture of the factors affecting its spatial arrangement, and is central to clarifying the nature, use, and methods of securing and accessing this cultural heritage.

Study Area

With a total area of ca. 10 hectares, Qal'eh Dokhtar represents a major historical site on the eastern fringes of the city of Kerman. The fort

perches on an isolated low rocky outcrop that runs a length of about 720 m east-west, and dominates the city (Figure. 1). It is situated at latitude 30°17'27", longitude 57°05'40", with an elevation above mean sea level of 1765 m. The highest extant point of the fort rises about 60 m above the surface of the surrounding lands.

Historical Background of Qal'eh Dokhtar

The fort is discussed in historical texts as a setting for political and social events related to the city of Kerman. Historians and geographers have described it as the residence of rulers and their families (Afzal al-Din Kermani, 1977: 124), a safe haven against besiegers (Hafez Abru, 1996: 52-53, 82; Monshi Kermani, 1949: 23, 71; Katabi, 1985: 43; Yazdi, 1947: 19-22), a place for safekeeping royal treasures (Hafez Abru, 1996: 49, 157; Afzal al-Din Kermani, 1977: 124; Ghazi Ibn al-Zubayr, 1984: 187-188; Katabi, 1985: 100), and a place of refuge for outlaws and political agitators (Hafez Abru, 1996: 53-52; Monshi Kermani, 1949: 23). It also served as a place to detain political prisoners during the historical period. For instance, Abu Ali ibn Ilyas reportedly imprisoned his son Yasa (Elisha) at this fort (Hafez Abru, 1996: 20; Monshi Kermani, 1949: 15). During the Seljuq era, Arslanshah was incarcerated here for three years (Afzal al-Din Kermani, 1947: 23; Khabisi, 1994: 28), as was Mawlānā Shahab al-Din during the Qara Khitai rule (Monshi Kermani, 1949: 43). Sharaf al-Din Ali Yazdi reports the fort to be a place of confinement during the Timurid period (Yazdi, 1947: 132).

The surface assemblages (pottery and tiles) collected from the fort during the two seasons of surveys by the authors in 2018 and 2019 suggest that it flourished possibly as early as the Parthian or Sassanid period and undeniably from the early Islamic centuries up to the 16th century AD (Tahmasbi Zadeh *et al*, 2022a: 310).

Architectural Features of Qal'eh Dokhtar

Based on the first author's survey of 2019 and the surveys by the other authors in 2018, the architecture of Qal'eh Dokhtar follows the contour of the underlying rocky outcrop. Certain structures were built on large boulders, while in other cases, the bedrock was cut or a platform was prepared to make way for structures made of clay, crushed stone, mortar, plaster, and lime. Attested structures from west to east are as follows:



Figure 1. Satellite photo of Kerman and the location of Qal'eh Dokhtar (After: Google Earth, 2022)

Western Quarter

In the northwest quadrant, a gateway protected by two semi-circular towers seems to have been a pedestrian gate, as its height and width were too small to afford the movement of the cavalry. The

towers are equipped with beams and crenation/loopholes (Figure. 2a). Also present was a second, now demolished, gate. Another pedestrian gate occurs to the south, beyond which lie the remains of a building (Figure. 2b).



Figure 2: A: Qal'eh Dokhtar: The northern gate of the western quarter , B:Qal'eh Dokhtar: The southern gate of the western quarter

Central Quarter

In the southwestern central fort, the main elements on both sides of a gate are discernible (Figure. 3a). For two reasons, this was perhaps the only cavalry gate at Qal'eh Dokhtar. The first reason concerns its large dimensions. The second is the presence at a close distance of a smaller gate, which probably controlled foot traffic. To the right of the cavalry gate, there is a solid tower. As with Qal'eh Iraj of Varamin (Mosavinia & Nemati, 2016: 194), the original tower was probably higher, and its hollow top originally contained loopholes, though it was intentionally filled with clay in later periods (Figure. 3b). Therefore, this tower served a double function: a watch tower, and a buttress to strengthen the gate. The gate is flanked on the left side by a further pedestrian gate, presumably reserved for the guards (Figure. 3c).

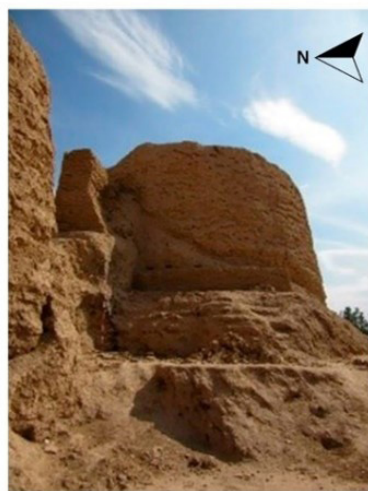
Court I is on the west side of the central quarter. To the north lies Residence 1, and to the east are

the structures of the central quarter. There are no constructions in this part (Figure. 4a). To the east of this court occurs Court II, similarly lacking in any structures (Figure. 4b). Below these two courts one finds structures that were most likely a place for the deployment of security forces, as they support the structures lying above them (Figure. 4c). Here, there is a saruj-lined water basin as well as two lines of 4 cm diameter clay pipes, tentatively interpreted as representing a bathhouse (Figure. 4d).

Another gate sits admits Court II of the central quarter and a third court in the southeast quadrant of the fort (Figure. 5a), as well as a watchtower in the southern central quarter (Figure. 5b). The highest part of court II is occupied by the structures forming Residence 1 (ruler's residence?) (Figure. 5c). This part is enclosed by the three courts and the northern quarter. Architecture of Residence 1 was aligned to the contours of the bedrock, mitigated at points with clay layers. This quarter tapers off considerably at the eastern end, falling down rather steeply.



A



B



C

Figure. 3: A: Qal'eh Dokhtar: The southwestern gate ,B: Qal'eh Dokhtar: Solid tower next to the cavalry gate in the central quarter , C: Qal'eh Dokhtar: The pedestrian gate at the southern end of the western quarter



Figure 4: A: Qal'eh Dokhtar: Court I to the west of the central quarter, B: Qal'eh Dokhtar: Court II to the east of the central quarter, C: Qal'eh Dokhtar: Constructions below Court I in the western central quarter, D: Qal'eh Dokhtar: The location of the clay pipes below Court I

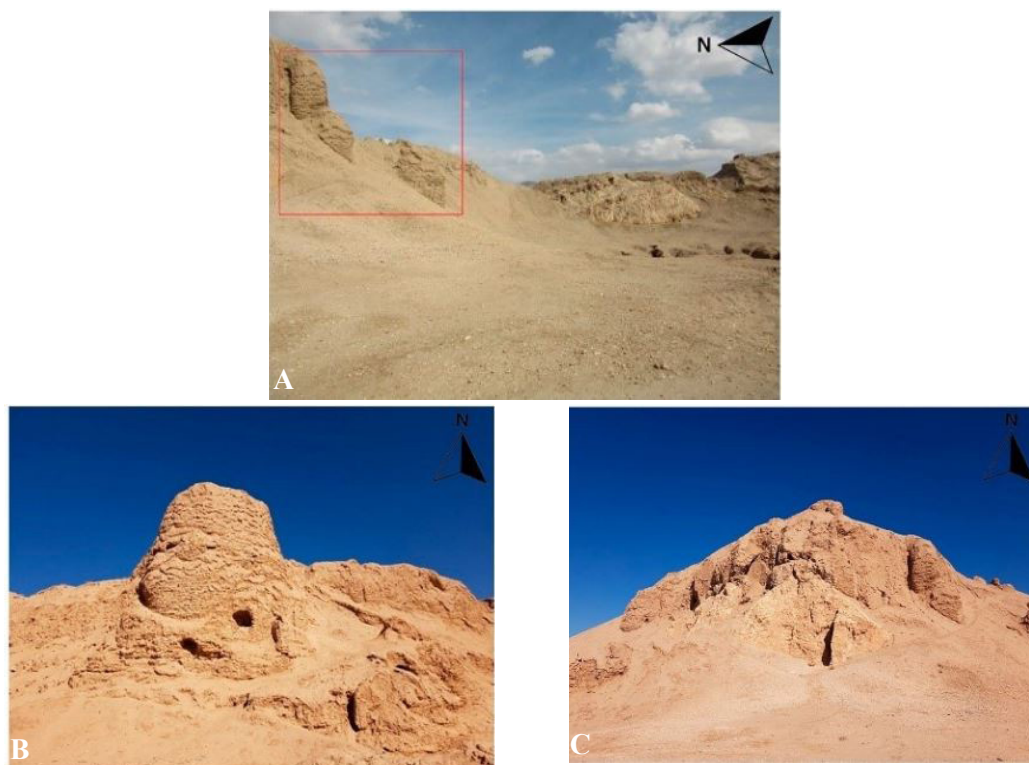


Figure 5: A: Qal'eh Dokhtar: Remains of the gate in the central quarter, B: Qal'eh Dokhtar: Southern tower of the central quarter (After: Tahmasbi Zadeh et al, 2022b:145), C: Qal'eh Dokhtar: Remaining structures of Residence I or the ruler's residence

Eastern Quarter

Most of the eastern quarter is covered by an open space (Court III) (Figure. 6a). Here, there is an entrance gate with limited width and height, affording only a single person in a bent position, located near the eastern end of the northern rampart (Figure. 6b). There are no signs of collapse in this part, as the rocky floor contains no visible layers of debris. If any debris had fallen onto this sloping rocky floor, it would have gradually moved down the slope. Therefore, this gate was not very high at the time of its construction and use.

In the northeastern quadrant of the complex, two- and three-story buildings are attested (Figure. 6c). They were seemingly built and renovated during several different periods, because certain arches are of the upright elliptical type while others represent pointed arches. At the southern end of the eastern quarter, there is a huge rock, as is a defense tower with loopholes. The loopholes are a set of arrow-like embrasures, with the "arrowheads" formed from two slanting bricks (Figure. 6d).



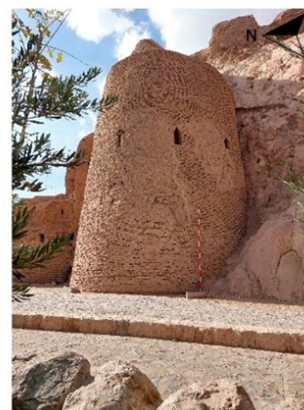
A



B



C



D

Figure. 6: A: Qal'eh Dokhtar: Court III to the south of the eastern quarter , B: Qal'eh Dokhtar: The northern entrance of the eastern quarter; C: Qal'eh Dokhtar: The two- to three-story structures of the eastern quarter; view from east (After: Tahmasbi Zadeh et al, 2022b: 145), D: Qal'eh Dokhtar: Watchtower in the southeast quadrant

Discussion

Drawing on the results from Tables 1 and 2, the space syntax in the architecture of Qal'eh Dokhtar in Kerman (Figure. 7), in terms of the factors of connectivity, control, entropy, integration, and depth, is as follows:

Connectivity: According to Tables 1 and 2, both in the internal fort and the immediate surroundings, the highest amount of connectivity relates to the area of Court I at 737 (maximal connectivity is shown in red and minimal in blue), an observation that evinces its high accessibility to both insiders and outsiders, specifying it as a public space. In such a public place, interactive behaviors or social relationships between individuals are bolstered, and thus social relationships between users are defined and facilitated. The lowest connection rate was recorded for Residence 1, tentatively identified here as the ruler's residence, at the minimal value of 85 (Figure. 8). This very low connectivity indicates a completely private and exclusive residence, because the lower the degree of connectivity of a space, the lower its permeability and the higher the degree

of its privacy and confidentiality (Kamalipour *et al*, 2012). So, individual privacy would be preserved in this space better than any other considered points, and this part can be considered the ruler’s residence, a hypothetical belief also shared by the local people. As mentioned earlier, certain historical and geographical sources have described Qal’eh Dokhtar as the residence of rulers and their families (Afzal al-Din Kermani, 1977: 124).

Control: The software analyses credit the highest level of control to Court I at 2.2 and the lowest level to the eastern quarter at 0.8. Therefore, Court I was the most strictly controlled area across the entire fort (Figure. 9). Generally, higher control evinces more choice and more availability or accessibility.

Put it simply, the lower the degree of selection of a certain space by individuals, the lower the amount of control individuals or users will have over it (Chegeni *et al*, 2020: 172). Therefore, Court I, exhibiting the highest control, was the most chosen by and the most available to the users. But the eastern quarter was probably a more private place, and for this reason features the least selectivity and accessibility, a fact that reduces the level of control. For these reasons, i.e. less selectivity and accessibility and higher security level, the eastern quarter seems rather suited for locating prisons or royal treasuries, as historical sources also contain pertaining allusions (Hafez Abru, 1996: 20, 49, 157; Afzal al-Din Kermani, 1977: 124; Ghazi Ibn al-



Figure. 7: Spatial organization at Qal’eh Dokhtar (After: Stonavand Afraz Consulting Engineers, 2009: 68; Redrawn by Authors, 2022)

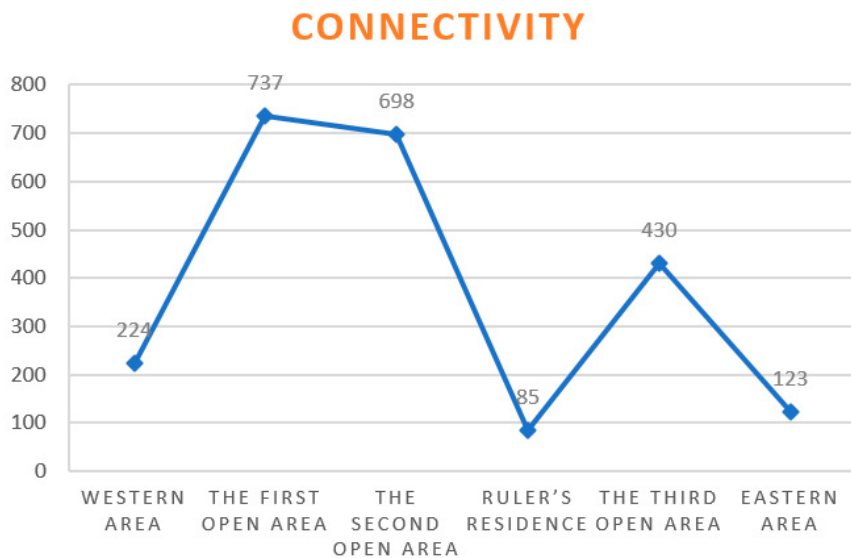


Figure. 8: Connectivity of the spaces at Qal’eh Dokhtar

Zubayr, 1984: 187–188; Katabi, 1985: 100; Monshi Kermani, 1949: 15, 43; Afzal al-Din Kermani, 1947: 23; Yazdi, 1947: 132). As is clearly seen in the respective diagram, in the level of control the ruler's residence outdoes the eastern and western quarters, but falls behind Courts I and II. It is thus characterized by an average level of control. Therefore, while there was adequate control over the ruler's residence, the odds of gaining access to it was still good.

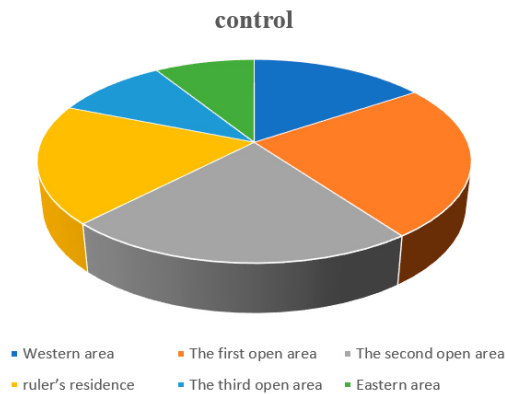


Figure 9: Parameter of the control in the spaces of Qal'eh Dokhtar

Entropy: The software analysis determined the highest amount of entropy for the eastern quarter of the fort at a rate of 2.6. This indicates that the related spaces had the least access. And inversely, other spaces, including Courts I and II, featured a higher degree of access to other parts of the site (Figure. 10). The claim is justified by the fact that the higher the entropy index, the more difficult it will be for individuals or users to access other spaces and vice versa (Turner, 2004: 15). The location of the gates of Qal'eh Dokhtar is indicative of a less accessibility for the eastern quarter, attributing high privacy to it. While there are two gates in the western as well as the central quarter, the eastern quarter housed only a small pedestrian gate. Also, if we consider the location of Qal'eh Dokhtar with respect to the core of the city of Kerman during the Islamic era, its eastern side will be the farthest from the city. Those approaching Qal'eh Dokhtar from Kerman first entered the western and then the central quarter. Therefore, the eastern section of the fort was typified by more entropy, less accessibility, less selectivity, and more privacy. This observation again makes it more suiting for functions like prison and state treasury, mentioned earlier when discussing the control factor.

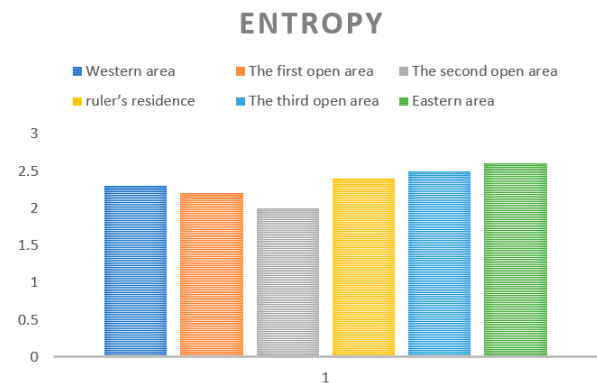


Figure 10: Parameter of the entropy in the spaces of Qal'eh Dokhtar

Integration: Judging on the conducted software analysis, integration as a parameter has a direct relation with accessibility, and high integration is associated with high accessibility. Furthermore, integration is also related to the presence of people in a certain space. The more the attendances in a given space, the higher integration it will have (Roozkhosh *et al*, 2020: 316). Therefore, greater integration in architectural spaces makes them suitable for the presence of individuals of different classes, ages, genders, and with different needs. This means that spaces with greater integration are more public. The highest degree of integration in the plan of the fort is related to Court II at 5.2. This means that this court had more integration and conjunction (or connection) with the other existing spaces, and in all probability the service buildings of the fort lay in this area. As a result, it shows a high degree of cohesion and functional efficiency. While the destruction of the structures in this area makes it difficult to identify other potential service buildings in the absence of excavations, the presence of a bathhouse, water basin, and the guard-rooms in this area is readily evident. The recorded degree of integration makes the existence of other service buildings in this part quite plausible. Furthermore, the lowest integration rate across the fort, 1.4, is related to Residence 1, tentatively identified as the ruler's residence here (Figure. 11). This low rate of integration, as well as the less degree of connectivity explained above, makes this part of Qal'eh Dokhtar an ideal option for a ruler's residence. This part could have well been a perfect safe haven for insurgents, a role actually played by the site during certain periods on the authority of historical sources (Hafez Abreu, 1996: 53–52; Monshi Kermani, 1949: 23). In particular, when a ruler lost his control over

the fort, his residence turned into the refuge of the adversaries. The low integration rate, as well as the lower connectivity and greater security in this space, made it fitting for such a function.

Depth: Table 1 credits the highest amount of depth, at 7.4, to Residence 1 (blue and green colors indicate the lowest depth, and yellow and red colors the highest depth). This means that in order to reach Residence 1, one had to go through more intermediary spaces. This feature lends further support to the identification of this part with a ruler residence. As it is usually easy for users to attend spaces with less spatial depth, they mostly use such spaces (Heidari & Kiaei, 2019: 65); while spaces with more depth are known as private and fewer

attendance occurs there. The connectivity and integration parameters also demonstrated this part of Qal'eh Dokhtar to have been more private and a more suitable accommodation for the ruler and his family. As the seat of the ruler, this part should have naturally had a high degree of character. Furthermore, from the tables it is clear that the degree of integration at Residence 1 is the least among the other parts of the fort, an observation that likewise indicates the lack of easy access to this part and a high level of security. Table 1 relates the lowest amount of depth to Court I at 2.9, pointing to the availability of this space and its close connection with the other spaces (Figure. 12).

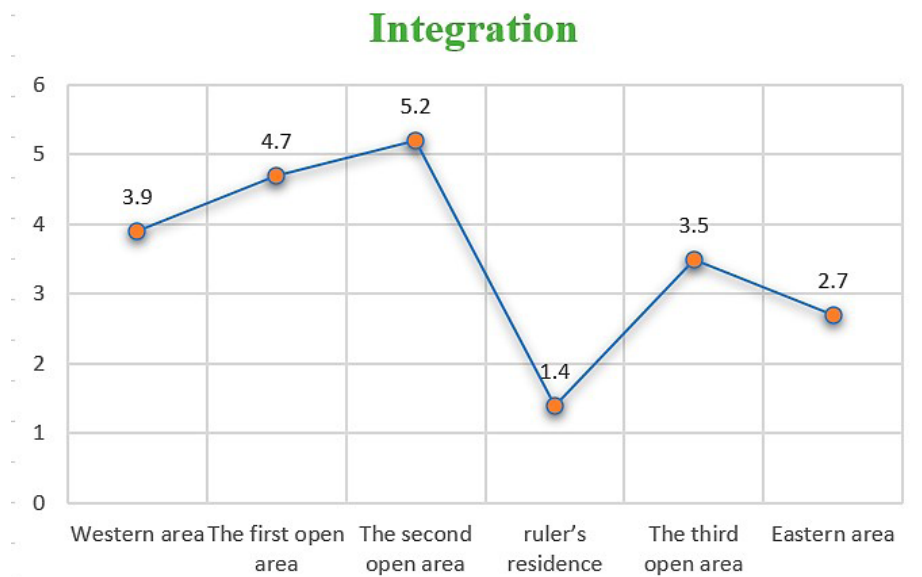


Figure. 11: Parameter of the integration in the spaces of Qal'eh Dokhtar

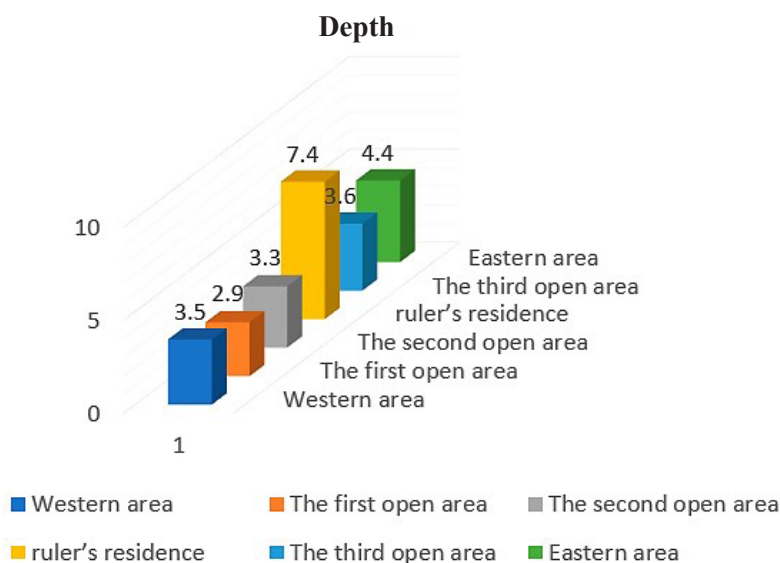


Figure. 12: Parameter of the depth in the spaces of Qal'eh Dokhtar

Conclusions

While archaeological evidence and references in historical sources tentatively trace the history of Qal'eh Dokhtar back to as early as the Sasanian and probably the Parthian period, the fort unequivocally flourished during the early Islamic centuries up until the 16th century AD, serving multiple functions. Therefore, as a versatile complex in eastern Kerman, Qal'eh Dokhtar was integral to the political, social, and cultural events of the city.

The study and analysis of its architecture by the space syntax technique provided new insights about the spatial configuration, the strategies to access and secure the fort, and the meaningful relationships between the quality of access and the security of the site. In this context, the location of the gates, the hierarchy of access to the spaces, and the height level of the structures with respect to the topography of the rock outcrop greatly affected the spatial configuration of the fort. Based on the parameters of space syntax analysis, such as connectivity, integration, entropy, control, and depth, each individual space at the fort displays a varying degree and extent of access, selectivity, privateness or publicness, and security. Therefore, spatial understanding of the architectural space by individuals is contingent upon these factors. As a result, social relations between people were intensified in certain sections, turning them into public spaces. Yet, other spaces enjoyed higher privacy and more security. The analysis of the cited factors using DepthMap software and investigating their effects on the spatial configuration of Qal'eh Dokhtar gave rise to the following observations:

Court I exhibits a high level of connectivity, integration, control, and accessibility, while it is characterized by a lower entropy. The rate of these factors and the short distance of the four gates from Court I suggest that this part was the most public area of Qal'eh Dokhtar, and housed “the servants and guards’ quarters” and “the general public.” In addition to the location of the main gates that facilitated access to Court I, the situation of the city of Kerman to the west of Qal'eh Dokhtar further confirms that the western part represented the most public part of the fort. Such a public area would encourage interactive behaviors or social relationships between people and, thus, define and facilitate social relationships between users. The very low connectivity rate, i.e. 85, recorded for

Residence 1 makes it a completely private place with low penetration and suitable for the residence of a ruler or king. Accordingly, individual privacy is at a higher level here than any other spaces across the whole site.

Court II reveals connectivity, integration, control, and entropy parameters identical Court I. Yet, it was more heavily protected, as only one gate opened directly to it. Therefore, it was seemingly reserved for special individuals, specific classes of society, or certain guilds. However, the degree of integration and consequently the functional efficiency of Court II were much higher than the other parts. The greater the degree of integration, the more the attendances of that space. In other words, greater integration in architectural spaces makes them accessible to individuals of different classes, ages, genders, and interests. Put it simply, spaces with greater integration are more public in character. Therefore, the administrative body of the fort probably occupied this area and provided services for the surrounding parts.

The ruler’s residence had the highest depth and entropy, a favorable level of control, and the lowest connection, access, and selectivity. This part had no gate leading to the outside and, given its location at the highest level, also had no access to the outer world. Thus, it is “the most private” and “the most secure” part of the fort, and “the residence of the ruling class.” This residence is located above the three courts, all of which functioned as intermediaries, blocking direct access to the ruler’s residence.

In the eastern quarter, the parameters of depth, entropy, connectivity, and control tally with those recorded for the ruler’s residence. Therefore, the eastern quarter is a more private space, and for this very reason features a selectivity and accessibility lower than any other parts at the fort. The eastern quarter was the farthest from the central core of the city of Kerman. Yet, the main access to Qal'eh Dokhtar was from the west side (Kerman city), and visitors had to first cross the western and central quarters before reaching the eastern part. Therefore, the eastern quarter had more entropy, less accessibility, less selectivity, and more privacy. However, compared to the ruler’s residence, it enjoyed a wider access, as it had a small gate and lay at a lower elevation. Therefore, in addition to the ruler class, other elites were also able to attend it.

Finally, our analysis of the spatial configuration of Qal'eh Dokhtar corroborates assertions found in historical texts about the different functions of the fort, among them being a residence for rulers and their families, a place for keeping state riches, a refuge for rebellious groups, and a place for detaining political convicts.

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