

## MORPHOLOGICAL STUDY OF URBAN HIERARCHY IN BOSHROOYEH CITY OF IRAN

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### Abstract

City designs in Iran have used the hierarchy principle in all elements of the cities from the components to the whole. The physical cells of tissues in an urban area are clearly related. However, in the development of cities, traces of the network of space communications to the old city centre remain. Instead of composition streets, squares and communication between, the networks contain filled rows with independent buildings. The purpose of this article is to recover the specific relationships between elements of the city and the urban hierarchy with regard to morphological aspects. In this study, urban tissue and typology are used to assess the pattern of urban streets, blocks, squares and islands. The typology of urban tissue based on evaluation of the mentioned patterns is established through field studies, aerial photos and maps of separated lands. We chose the city of Boshrooyeh in eastern Iran as the case study. The historic city core sector has been evaluated in terms of physical characteristics, which provide the morphological typology of the urban tissue. After analysis, data can be investigated in the presence or absence of access hierarchy in different historical periods of the city. The purpose of identifying the morphological typology of the city's historic fabric is to help us determine the hierarchical order and coherence of the city. The result of this study shows the rapid development of the city, including widening streets, and destruction of the urban form (Main

Street and Square). These incidents have led to loss of infrastructure, urban identity, and disorganisation in the urban hierarchy.

### Keywords

Urban Morphology, Hierarchy, Urban Tissue, Morphological Typology, Boshrooyeh.

### Introduction

Urban morphology is the study of city appearance, its gradual formation, and the interaction among components of the tissue that defines specific compounds and urban faces, such as streets, squares, and other public spaces. Urban morphology is divided among several fields of knowledge. Its theoretical aspects are related to urban geography, history, and architecture.

The study of urban morphology seeks to understand the spatial structure and character of a city by identifying the patterns of its components and the process of its development. This study can involve analysing physical structures at different scales. According to Conzen in 1960, land use, building

structures, plot patterns, and street pattern are considered. Analysis of physical forms focuses on street patterns, plot patterns, and building patterns by comparing cartographic sources and historic maps (Carmona, 2003).

### Defining Urban Morphology

Urban morphology is one of the most important physical descriptions of a city. Morphology is a science that investigates the form, shape, external structures, and arrangement of matter (Madanipour, 1996). In 1997, Moudon argued that urban morphology focuses on city studies as a physical environment, but establishes an implicit link between the space elements, material, social, and economic forces of the city.

In 1996, Kropf reported a suitable method for recognising the process character is to study the physical aspects of the city that can be used to build a general character image, because the physical aspects are the most sustainable. Morphological theory describes the historical process of development in the city form and its spatial consequences. This theory tries to present institutions and social forces that give shape to an environment (Rofé, 1995).

### German School of Urban Morphology

As characterised by Larkham, Kristjansdottir, and Rofé's views were influenced by Conzen's view description of the development of the city form. Conzen believes that the historical landscape in cities comprises three divisions: building forms, a city map, and land use. These divisions create a hierarchy frame work, and this hierarchy can be used to create a city map (Ahmadi, 2010).

Moreover, Conzen suggested that these three aspects at the most local level combine to make the smallest homogeneous areas of morphology (urban landscape cells). Urban landscape units arise by putting these cells together. They can be combined at different levels to create a hierarchy inside the city (Larkham, 1997).

### Italian School of Urban Morphology

Koster (2001) hypothesised that the city is a physical embodiment of cultural development, and he used cartography. Cartography has two aspects: a cultural-historical map (typical features of a period) and reconstruction of structures, such as historical houses (Ahmadi, 2010).

Caniggia attempted to understand the building form through the historical process of shaping cities, including elements (buildings), element construction (urban tissue), construction systems (regions and territories), and a system organism (whole the city). These components create a hierarchy of spatial relationships through synthetic elements (Kristjansdóttir, 2001).

The Urban Form System and its Components  
A morphologic system is one form of urban planning. This system can be divided into three important sections:

- Elements that give shape to the structure (element organisation);
- Elements that are regular (facilities);
- Components (road networks, segmentation, body).

Conzen has identified the system components of the urban form associated with three structures: plan, frame and land use. These components can be classified into five

sections:

- A plan or map shows the general forms of an urban complex or macro form;
- A plot pattern is associated with the ground separated into small and large pieces for allocation or a specific user;
- The frame or building textures is composed of buildings, including their antiquity, style, height, and whether they are in empty urban spaces or public spaces;
- Land uses determine the performance of different parts of urban land. Compared with the other key elements, land uses are relatively temporary. Incoming uses often lead to redevelopment and the creation of new buildings, to plot amalgamations and, less often, to subdivisions and changes in the street pattern (Carmona, 2003);
- The site is a major component of the form and is determined by studying the status rippling, current water flows, and vegetation.

The structure indicates how the elements organise themselves. Structure can be discrete or continuous. All these conditions determine the density, islands, plots, and different ways for the units to be organised. An urban form is described with different elements such as a map, land uses, content, and concepts.

### Defining the Type and Urban Tissue

Type is known as the special morphological composition that supports internal organisation among the structures and adjacent spaces. Individual buildings, streets, blocks, and total city area may pertain to a specific type (Scheer and Scheer, 1998). Kropf's (1996) method is about urban character that combined Conzen and Caniggia's views. At the most general

level, urban tissue is defined as an arrangement of streets and blocks. A description of urban tissue is included in the study of street and block patterns, the square pattern, the plot pattern, the building pattern, and the architectural style pattern.

After introducing typology, the detection method and type grouping, historical character, and historical tissue, the following are the important factors when defining urban character: 1. the physical background of the city; 2. specific and perspective views of the city; 3. symbolic meaning of the city (Mirmoghtadaee, 2004, 2006).

### Islamic and Iranian City

Islamic city is composed of a special plot, narrow streets and short courtyard houses and organised surrounding areas, which leading to the main mosque. Lynch in 1960 labelled this type of city as an inward city. It is a private and closed city. The city is completely surrounded, even in terms of communication. These ways lead to the smaller local streets, then tight and narrow impasses (blind alley), and finally to private entrances. The tree-shaped network of streets is surrounded by shops, gardens, and houses. These neighbourhoods and the central place are connected by a network of narrow winding streets consisting of public, private and semi-private streets and neighbourhood centres.

Ancient Iranian cities were organised according to axial, geometrical patterns. The walled towns and villages that started to develop in eastern Iran from the middle of the first millennium BC were square-shaped and had an internal axial layout. A main street stretched from a single

gateway, was flanked by courtyard houses, and led to a central square, which was the communal park for the cattle (Madanipour, 1996).

In 2008 Habibi demonstrated that several principles led to evident in Iranian urban planning. This article only mentions some of these principles:

- Hierarchy principle: every urban space or building has an outside and inside. The urban space indicates the hierarchical position of the space or building;
- Community principle: the accumulation of different elements in a specific location gives special meaning to a place, which provides a special identity;
- Continuity principle: urban spaces are a gap that is located between buildings, mass and forms;
- Territory principle: every urban space is owned from the little space to the large space;
- Connection principle: every urban space is looking to connect with other components.

Space relations, forms and activities follow

these principles, which form the basis for the identity and character of the components and elements. These principles can help us read an Iranian city because it is rooted in all elements. They act as a guide to the urban morphology of the city.

### Boshrooyeh City

Boshrooyeh is a city in the South Khorasan province of Iran. It is located on a transit road from the South Khorasan province to the Yazd, Isfahan and Shiraz provinces. The historical urban fabric of this city was registered on the cultural heritage organization list in 2003. The area of the registered historic urban fabric is 22.4 hectares, but the cultural heritage organization of Boshrooyeh is proposing close to 27 hectares of buffer around this fabric (Taniguchi, 2009).

The Boshrooyeh urban texture was formed during the Safavid period, and its greatest historical context has been recorded in Khorasan. It is among the ten historic cities based on its old brick, clay texture, and traditional fabric. Figure 1 shows the character, identity, and physical



Figure 1: Samples of identity, scale, and character of Boshrooyeh city (Source: Authors).

elements of the city. Around the city core are located some indicator buildings, such as the congregational - Jame mosque and a water reservoir; unfortunately, this section has been significantly damaged.

The city has developed to the north, east, and north-west. Development to the south has been limited because it is an agricultural area. The city developed as a harmonious and orderly

city. The initial construction of the city formed a circular shape, and then during recent years, city tissues developed following a checked rhythmic form. Part of the old gate of the city remains, but its basic shape has been destroyed because of the expanding circle through the city. The gate diameter was two kilometres, and its height was about six metres. It had four main gates, which allowed entry from four positions into the city (see figure 2).

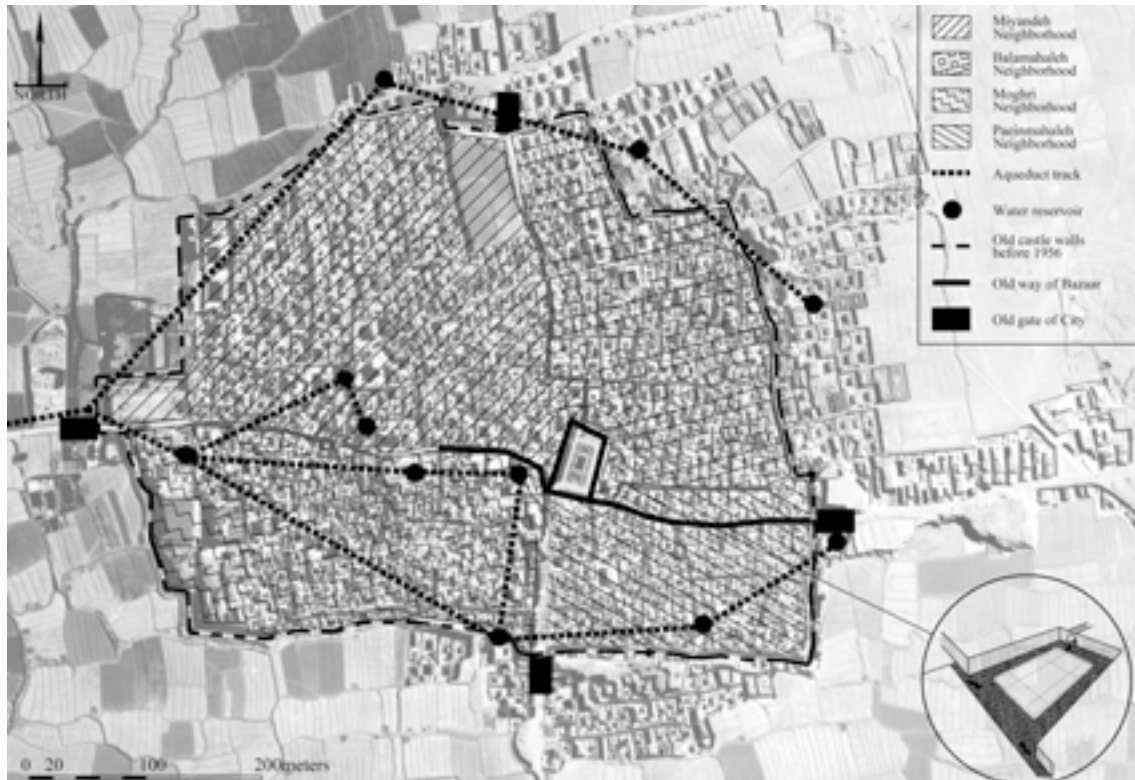


Figure 2: Aerial photo of Boshrooyeh in 1956 and its components (Source: base map by national cartographic centre of Iran and analysed by authors).

Boshrooyeh is composed of four main neighbourhoods. Due to the wind direction from the north and north-west, the wind catcher (Badgir) was placed towards the northwest wind. Markets (Bazaar) are located along the south axis and also in various centres, such as around schools, mosques and Hosseinieh. Hierarchy movement exists from the main square of the city to neighbourhood centres; thus, there are houses. Houses often have introverted architecture. The hierarchical movement is designed according to people, culture and privacy.

The UNESCO mission noted the uncontrolled development pressures, which affect all properties. The pressures mentioned include the demolition of traditional houses in the historical fabric, organising inadequately managed events in the fragile desert ecosystem, building highways through rural gardens, and unplanned installation of infrastructural improvements. If this uncontrolled development and unplanned destruction continue, the whole identity and character of the city risks being irreversibly destroyed.

### Analysis of the urban form

In 2003, Carmona suggested the following components to recognise an urban pattern:

- Island pattern: the number of houses and buildings in an urban area that are defined streets. Different morphological islands classified based on size, form, openness, usage and function;
- Plots: segmentation results in land in small and large pieces that is appropriate for building and urban development. It carries the historical signs and represents the individual property and structure of the social-economics of a specific

period. In traditional centres, the sizes of small pieces can vary significantly;

- The cadastral pattern: the layout of urban blocks and the public space/movement channels or public space network between them. The ground plan of most settlement patterns of streets and spaces has developed over many hundreds of years, and fragments and 'ghosts' of patterns from different eras can be seen in the ground plans of many cities.

Based on these suggestions, we used the following:

- From the description (maps, pictures, and images), the first operation is to study a land status map. A map is considered to be a superior tool. Aerial photos, particularly from a low altitude provide complete details of the tissue of the city.
- The cadastral plane makes the shapes of roads, land plots, and buildings visible. It is the only sustainable source for following changes in urban fabric. Primary land ownership can separate the plane into large and small pieces.
- The three-dimensional display with plane, section, and height on a map offers an overview of the urban form in three dimensions. Three-dimensional modelling makes the size of urban islands and buildings visible.
- The typology is developed from the details of elements, such as islands, plots, buildings, and multi-floor buildings. Then, the typology is classified according to certain criteria.

Urban spaces show the history of past sediment. One of the methods for describing evolution forms is historical mapping. It uses a comparative analysis to identify changes and urban development. Moreover, this method makes it possible to identify land plots and

analyse the road hierarchy. Potential errors may be due to dependence on the estate archive and problems accessing whole documents (Allain, 2009). The perception of urban tissue is required to collected documentation that will be completed with field work. Part of the analysis in this article used historical mapping of the city.

### Hierarchical movement

Urban spaces in historic areas are based on the hierarchical movement from macro to micro. This hierarchy is a movement from public space to private space. Public open spaces are the most fascinating parts of historic cities. Open spaces in historic areas are based on the hierarchical movement from the central part of the city, the main streets, alleys that lead to neighbourhood centres, secondary alleys, 'Hashti' (the traditional entry halls to several houses) of the houses, entry halls and the court yards.

Main access and streets are wider, and alleys, which terminate at houses, are very narrow. In this hierarchical system, the most important urban spaces are the covered semi-private spaces (Sabat) between groups of houses called 'Hashti', and the central square of the neighbourhood (see figure 3). The central space of the neighbourhood is an excellent manifestation of urban design in a certain period of time by the people who used it.

The square (Maidan) is the most distinct element of the urban structure. As a clearly delimited place, it is most easily imaginable and represents a goal for movement. It is the main public space in each neighbourhood. These squares are mostly located in the centre

of the neighbourhoods. Therefore, in Iran gates were separate semi-private and private parts of the network from the public spaces. Impasses and internal alleys lead to passages to other neighbourhood components (Ahmadi, 2009).



Figure 3: Half covered passageway (Sabat) as semi-private space (Source: Authors).

### The square

Many researchers have presented a different typology for the square (Stübben, P. Lavedon,

P. Zucka, and P. Pinon). For instance, in 1924, Stübben divided squares into star, profit, and decor squares. In 1999, P. Pinon identified squares as dedicated, planned, occupational, and organised. According to Lynch (1960), identifying the core of a city includes identifying the square, and communication roads provide a full description of a complex pattern of the town. Finally, square typology can be based on a function, form, orientation, or design type.

Boshrooyeh city have only a main square. Therefore, it acts as multi-functional space with public and commercial square uses. Main square of Boshrooyeh due to close and proximity to the Bazaar, it has a commercial function. The square was constructed at the intersection of the main roads. Roads located on the sides of the square have created four neighbourhoods (see figure 4). The square is a quadrilateral and is surrounded by shops on three sides. The roads are oriented to the north, south-west, and south-

east. The square is a node in the centre of town and is connected to the main roads of the city gate. There was a link between the squares and important urban spaces (see figure 2).

The main road of the city leads to a city gate. Major city centres have been established along the main square and Bazaar (see figure 5). Activities and places around a square are public, for example, the Congregational - Jame Mosque, the Bazaar, and shops. Buildings surrounding the square are related to it.



Figure 4: Type of road and hierarchy movement in Boshrooyeh city (Source: Authors).





Figure 5: Roads map of Boshrooyeh in 1956 (Source: Authors).

The square has changed significantly in recent years. These changes include both its functions and form. Its form changed from rectangular to oval, and it now functions as a roadway. However, it still has public functions and has retained its centrality. Currently, the four main roads enter it.

### Type of roads

Streets and squares form the real faces and façade of cities. Streets and squares form the components of urban tissue and are the key of urban fabric understanding and perception. Street's types include main streets (great old streets), narrow and normal streets, combination streets, boulevards, avenues, and underground streets. Squares, like streets, are a complete

urban form and are irresolvable (Carmona, 2003).

The roads hierarchy changes simultaneously based on the urban size and local culture. Boulevards and wide streets provide the longest distance that creates a general island. Ordinary streets and alleys are patterns for infrastructure (Sultanzade, 2006). Wide streets and main streets link and organise neighbourhoods

together. Neighbourhood alleys belong to their residents more than to other people. In large and medium cities, shops form along these alleys and used for small gatherings. Therefore, internal roads to the district are public for the residence, but have a semi-public aspect (see figure 6).

Based on comparisons of old and new road maps of Boshrooyeh, we found the following



Figure 6: Roads map of Boshrooyeh in 2008 (Source: cultural heritage organization of Boshrooyeh)

changes:

- The four main edge roads were destroyed (north, south, east, and west);
- The streets are wider, and there are more internal roads and internal alleys;
- The city structure was demolished, especially the hierarchy movement from the main centre of town to the neighbourhood centre because streets and alleys were destroyed or widened (see figure 7).



Figure 7: Comparison between the old and new roads (Source: Authors).

### Type of Island

Islands are classified based on the number of houses and buildings in an urban setting that define its street limit. Islands have a different morphological pattern and are classified and divided base on size, form, openness, usage and function. The greatest change

and deformations are visible in the main roads and islands (south-east, north-east, and north-west). Usage and function in southern part of north-east Island changed from residential to commercial (see figure 8).

Blocks in terms of form are separable into geometric blocks (trilateral, quadrilateral, and polygon) and non-geometric blocks (polygon with indirect lines). In this section, we only identify general changes in form of the blocks.

## Results and Discussion

The physical organisation in an ancient Iranian city is based on the correlation between urban elements, such as squares, main streets and subsidiaries, and neighbourhood centres.

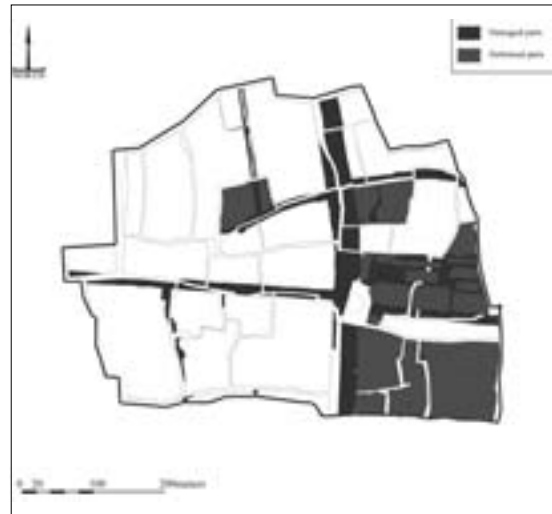


Figure 8: Comparison between the old and new islands (Source: Authors).



Figure 9: Part of the old and new Bazaar (Source: Authors).

Spatial coherence, which is obvious in traditional tissues, is integral to desert cities. New blocks in the city were built without any continuity of form and hierarchy with the traditional part of the city. New islands are amorphous and irrelevant because of their surrounding space. The coordinated system of the town has been destroyed in Boshrooyeh due to disintegrating urban fabric, i.e., the main square, islands and streets. Any interference in the urban tissue requires knowledge of all factors that affect the city.

Briefly, the results of this typology study show the following:

- The main structure of the Bazaar has changed.



Figure 10: Congregational - Jame Mosque and hierarchy movement that remains (Source: Authors).

Part of the Bazaar remains in the old way of Bazaar. The old Bazaar had most proximity with neighbourhoods in compare with new Bazaar. New Bazaar has not connection and closeness to neighbourhoods, and people have come long way to provide their daily need (see figure 9).

- The Congregational - Jame Mosque remains with minor changes, due to the significance of religion in people opinions religious buildings have the least modify in urban change or development (see figure 10).
- Hierarchy movement and networks have

changed the most and are very different from the traditional pattern (see figure 10). Nevertheless, the current network structure is along the old city passages. Hierarchy movement is the most important unifying factor in Boshrooyeh.

- The main roads were destroyed and have been wider during the changes of the street and alleys (see figure 11). Movement from outside to inside does not follow traditional urban planning (hierarchy principles).
- The new square has been transformed



Figure 11: Wide road, block destroyed, new main square in the city (Source: Authors).

completely because of moving vehicles and wider streets (see figure 11). The main square of the city has changed from the square shape to the ellipse.

- Gradually, the organic form has become a reticular form in the city structure. Traditional structure of the city was destroyed over the time (see figure 11). New building was constructed without attention to the old pattern and inconsistent with its around fabric.
- Street and block patterns are gradually changing. Non-combinative, non-coordinated, and split urban blocks have been created to allow cars into the tissue.
- Block sizes have been gradually reduced and have been smaller.
- The overall continuation of old patterns (streets, hierarchy movements, islands, and blocks) is not seen in the physical urban fabric, discontinuity happened due changes of old

to contemporary pattern inside the traditional part of the city.

### Conclusion

New cities form rapidly and usually follow many unconnected concepts that cause confusion in urban spaces, while historical cities formed gradually according to accepted patterns and rules. Many non-local agents influence the form of new cities, while the form of traditional urban spaces depends on the morphology of the site, the historical background and the culture of the local people.

The traditional design system of historic cities in Iran has never allowed direct connections between private and public spaces. A lack of this hierarchical system and damage in the pedestrian network resulting from the



Figure 12: Block in 1956 and block fragmented in 2003 (Source: national cartographic center of Iran).

establishment of new streets has affected historic relationships and traditional social links. Any kind of interference with existing open spaces or the development of new ones should happen in view of the climatic dimensions and architectural criteria (Ahmadi, 2009).

The aim of this study was to assess the physical character of a city based on morphological analysis of urban tissue. According to morphological analysis in this research, we argue that the fundamental city characteristics and its components are going to be destroyed. The city is suddenly fragmented (see figure 12). The results show that quick development, widening streets, and demolition of the city structure may annihilate the infrastructure and identity of the city. These changes also disrupt the hierarchy of a town.

The process of analysis of urban form in the traditional cities had resulted in an approach that could be used in contemporary planning for propose the pattern of the land or region. This included knowledge of space hierarchy that was based on the physical analysis of space and its interconnection and continuity of traditional pattern. The benefit of this approach is assessment of the existing elements in traditional urban pattern. These elements will organize sustainable structure for urban pattern in continuity with the past.

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