MORPHOLOGICAL COMPARISON OF TWO HISTORICAL ANATOLIAN TOWNS

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Mehmet Topçu
Faculty of Engineering&Architecture, Selcuk University
Ayse Sema Kubat
Faculty of Architecture, ITU

Mehmet TOPÇU
Department of Urban and Regional Planning, Faculty of Engineering&Architecture, Selcuk University, 42075 Campus, Konya/TURKEY, +90 (332) 241 00 41/2152, topcu@selcuk.edu.tr
Ayşe Sema Kubat
Faculty of Architecture, Istanbul Technical University, Taskisla, 34437, Taksim, Istanbul, Turkey +90 212 2931300 kubat@itu.edu.tr

Abstract

In this paper a study of the morphological characteristics of two historical towns both of which are located in Anatolia, is presented. These towns have been selected as sample areas because of having distinct urban patterns derived from Roman, Byzantine, Arabic, and Turkish traditions and still reflect the characteristics and segmented labyrinthine urban texture that bear the marks of the Ottoman period. The reason for the selection of the case studies, each of which form a fascinating body of data, is that to date no study has been carried out of these towns which have significant individual characteristics in relation to their immensely rich historical and cultural background. Therefore it is believed that they deserve to be made known to a wider audience as examples of the type of city not often discussed in relevant literature. It is also believed that the morphological analyses which they are subjected to in this paper will contribute to the growing body of numerical data on such towns (Kubat 1997).

The aim of the study is to analyze the morphology of these towns in the light of 'space syntax', which is a method used to give quantitative descriptions of built space in a comparative way. The numerical interpretation of the terminology, however, is specific to this study. The selected towns reflect the richness and density of their social, economic, and cultural environment. It is intended that the examination of the typological variety of the urban layouts and the identification of the specific and distinctive characteristics of these towns will contribute considerably to present-day knowledge of urban design. In this study each town pattern and morphogenetic structure have been analyzed and compared by visual analysis and using the method of space syntax in terms of logical examination and the order of urban structure, complexities present in the urban structure and the reasons for their presence. As a result, in this work the pedestrian-oriented patterns of historical Anatolian towns will be evaluated through quantitative methods (Topçu 2003).

Introduction

As a result of industrialization and rapid urbanization, the existing settlements have lost their historical and cultural values as well as their historical identity which made them unique, none of which can be replaced. Defining the cultural, historical, and psychological mosaic and putting forward the underlying facts of the morphogenetic structures of settlements in current urban planning is of vital

importance that the basic criteria and principles be achieved by determination and interpretation of the positive values of traditional and historical environments (Kubat 1996).

Analysis of the characteristics and structures of local settlements obtained through the continuity of cultural and social values, evaluation of the historical values, and creation of a social conscience for the conservation of these areas are believed to lead to the preservation of present settlements through assigning them up-to-date functions. This will also be an inspiration for modern and contemporary designs.

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For this reason Antakya and Konya which have rich cultural and historical background have been chosen as case studies. The boundaries of the sample towns were shown below (Figure 1). Area boundaries were decided according to the boundaries of the historical district. In this study the pedestrian-oriented patterns of these historical towns evaluated through quantitative methods. The pattern and morphogenetic structure of both were analyzed to give a comparative interpretation by using a mathematical method called 'Space Syntax'. This method has been applied in order to make the morphological analysis of the settlements (Konya and Antakya) possible.

The basic concepts and methods of the Space Syntax which are adopted here were developed at the Unit for Architectural Studies, University College London. Space syntax has been developed not only to evaluate the relations between society, architectural elements, and urban space but also to analyze the physical structure of urban form. The relations which stem from the reasons for generating the settlement pattern and the logical, social, cultural, and historical powers of this pattern which form the spatial pattern are explained through historical data by use of the above-mentioned analytical method.

Figure 1:

The boundaries of research areas of Konya (a) and Antakya (b)

a   b

History of Anatolia

Anatolia is rich in architecture and urban structure not only because of its geographical location but also the influences of several civilizations ranging from the remains of ancient Hittite and Urartean civilizations to the archaeological ruins of the Hellenistic period and the post-Roman period, and the manifest vestiges of the Christian Byzantine age and of the Seljuk and imperial Ottoman periods. Every period of Anatolian history has been influenced by different cultures. During the 9000

years of Anatolian history, several cultures, each having its own language and traditions, were in existence at the same time. Remarkably valuable civilizations affected the urban structure of the area.

Owing to the geographical position of Anatolia between Europe and Asia—it has always been considered as a bridge between the Orient and the Occident. Anatolia has indeed played an intermediary role between East and West and provided efficient trade routes because of her secure and convenient road system constructed in several successive periods.

The eras of the Seljuk Empire and the Ottoman Empire stand out as times of prosperity, in which Anatolia was provided with a convenient road system, with solid and well-designed stone bridges and lordly caravanserais, and with hospitals, schools, and observatories. Seljuk monuments, decorated with fascinating architectural ornamentation, are still numbered among the best works of art found on the Anatolian peninsula (Akurgal 1980).

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The Ottoman Empire, in its years of glory, enjoyed the same prosperity and the same high level of culture and science, combined with a lively commercial activity, as that of the Seljuk period. The Turks of the Ottoman period developed an architecture that was one of the great artistic achievements of humankind and their artistic activity in other spheres produced some of the most admirable monuments of that time.

Methodology

The buildings and the form and shape of the open system of a settlement constitute its spatial individuality. The way in which the buildings are gathered together creates a system of open space and the configuration of the open space structure reinforces the shape of a settlement. Urban open space is the generator of urban form and it should be analyzed by emphasizing its continuous nature. In this study a basic technique called 'Space Syntax' for the representation, analysis, and interpretation of selected sample settlements was used.

Space syntax was developed by Hillier and Hanson at the Unit for Architectural Studies, University College London (Hanson 1989; Hillier 1989, Hillier & Hanson 1984; Hillier et al 1983; 1992; 1993) and is a technique that can be used for morphological analyses of buildings, architectural plans, urban areas, and urban plans. Space syntax is also one of the few theories which allow us to understand how culture and society are embedded in the specific relational patterns constituting architecture and urban design. The aim of the technique is to describe different aspects of relationships between the morphological structure of human-made environments and social structures and events. It is possible to give quantitative descriptions of built spaces. This methodology contributes greatly to the understanding of the physical structure of the cases in this study.

Some definitions of the methodology used in the study;

The *axial map* is the basis of settlement layout analysis. This represents the distance up to which observers can have an uninterrupted impression of visibility and permeability as they move about the town and look in various directions. The map is derived by drawing the fewest and the longest lines of uninterrupted permeability necessary to cover the public open space of an area. The size of a settlement system is measured in terms of the number of lines.

The *convex map* of a settlement is the set of widest spaces that covers the open space structure of that settlement. It is a map of the open space broken up into the widest possible convex spaces. The

convex spaces may be as long as the axial spaces of the system. If the system is regular, many axial lines may pass through a series of convex spaces. From these maps it is easy to see that urban space structures differ from one another according to the degree of axial and convex extensions of their parts and according to the relation between these two forms of extension (Hillier & Hanson 1984).

Measures of Convexity

Convex articulation can be measured by dividing the number of convex spaces by the number of buildings

C*onvex deformation of the grid* can be measured by dividing the number of convex spaces by the number of islands (completely surrounded by an open space).

Grid convexity (Gconveks) of the system is measured by the formula $([(island)^{1/2}+1]^2/Convex\ space)$. It is possible to make a comparison of a convex map with an orthogonal grid in which convex spaces extend across the system in one direction, and in the other direction fit ladder fashion into the intercities.

Measures of Axiality

Axial articulation can be measured by dividing the number of axial lines by the number of buildings.

Axial integration of convex spaces can be measured by dividing the number of axial lines with convex spaces.

The grid axiality (Gaxial) of the system is measured by the formula $([(island)^{1/2}*2]+2/Axial\ line)$. It gives a measure of the comparison of an. orthogonal grid with the number of islands.

Numerical Properties

The ringiness of the convex system (Rconvex) can be measured by the formula (island/([2*convex space]-5). It is the number of the rings in the system as a proportion of the maximum possible planar rings for that number of spaces.

The ringiness of the axial map (Raxial) can be measured by the formula (island/([2*axial line]-5). As the axial map is nonplanar, this value will be higher than the convex value.

From the relation between convexity and axiality in a space, we obtain two kinds of information about the space: through the convex organization we are given complete local information about the space we are in; and through the axial organization we are given partial global information about the spaces we might go to. In urban space we are in effect given information about two scales at once.

Syntactic Measures

The central concept of space syntax is *integration*. The technique allows one to express integration in numerical values. As is the case with many other measures of spatial structure, these values are dependent upon the urban area. The integration of space is a function of the mean number of lines and changes of direction that need to be taken to go from that space to all other spaces in the settlement system. Integration is therefore about syntactic not metric accessibility, and the word 'depth' rather than 'distance' is used to describe how far a space lies. Every line in a settlement layout has a certain depth from every other line. The integration value of a line is a mathematical way of expressing the depth of that line from all other lines in the system. It is assumed that the distribution of integration across an urban area correlates with the movement pattern of an area. Urban areas can be distinguished by and compared in terms of

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different levels of integration. Integration is used us a measure of quality for urban areas. By calculating integrated and segregated parts of a settlement, it is also possible to know whether a new design proposal fits into the existing structure of an area.

The syntactic *intelligibility* of an urban system is defined as the degree of correlation between the connectivity and integration values in the system. The term intelligibility is used because the stronger the correlation, the easier it is to infer the global position of a space from its directly observable local connections (Hillier at al 1983). This makes it possible to capture the way people can learn about large patterns from their experience of small parts or fail to do so when the correlation is weak (Hillier & Hanson 1984).

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Findings of the Study

Konya

Settled life in and around Konya starts from the prehistoric period. Within this period the cultures of Neolithic Calcolithic and early Bronze Era can be seen. Tumuluses, which are the inhabitancy areas of this period, are within the borders of Konya. The findings belonging to the Neolithic Period (7000-5500 BC) came out through the archeological excavations in Çatalhöyük. In Karahöyük, which is within one of the regions of Konya today, inhabitancy of the Hittite is seen. The archeological excavations that have been carried out for many years give us findings that reflect this period. Frigs who gave an end to the sovereignty of Hittite on Anatolia are the sects who have emigrated from Thrace to Anatolia. The findings that were got from Alaaddin Hill, Karapınar, Gıcıkışla and Sızma belong to the seventh century BC. After the Frigians (Phrygians) Konya (Kavania) was invaded by Lydians and Iskender. Later on when the sovereignty of Rome was set Konya kept its existence as Ikonium (25 B.C.).

Hatunsaray Lystra-Derbe, Leodica and Sille were important settlement areas of Byzantines. With the spread of Islam in Anatolia Arabian raids started. The Ommayads and Abbasids raided over Konya. Konya was the capital city in 1076 in Seljuk period. Konya continued its reputation and esteem during the Ottoman period.

In general terms, the typical Anatolian-Seljuk city was comprised of three parts: the fortress, the inner town, and the suburbs. The Seljuk cities of Anatolia lacked geometric order, axiality, and articulated spatial organization, which, in all probability, stems from the amorphous character of pre-Seljuk towns. The Seljuks had little concern for domestic architecture and physical planning at the urban level. On the other hand, a keen sense of planning at the regional level can be observed, for the Seljuks created a vasi communication system in Anatolia which not only revived the historical land routes between Europe and Asia but also linked their cities and towns, encouraging social and economic intercourse and highlighting the Anatolian-Seljuk civilization (Kuran 1980).

Konya was a large city enclosed within walls but it was the exception, as most Anatolian-Seljuk cities sprawled beyond their fortified boundaries (Tanyeli 1987). The spatial structure of Konya can be seen below (Figure 2). This structure was formed during historical periods of Konya especially in Seljuk and Ottoman Period. Konya took its present form -organic characteristics- during the periods of the Seljuk, Ottoman, and Turkish occupations, and the original pattern of the open space structure is still evident. Circulation routes consist of a main west-east spine which is used by vehicles as well as by pedestrian.

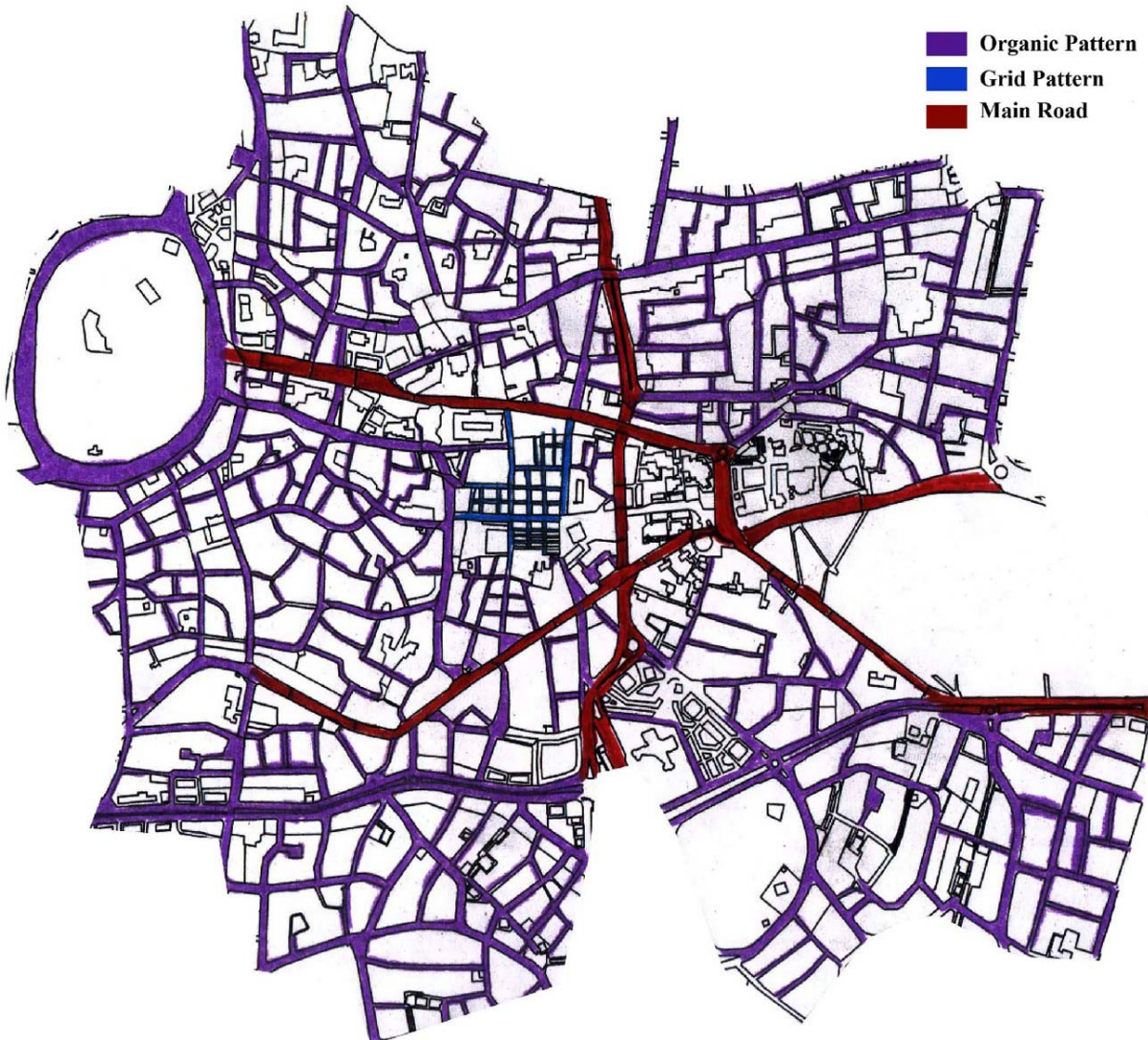**Legend:**
- Organic Pattern
- Grid Pattern
- Main Road

Figure 2:

Spatial structure of Konya

The results of the analysis for Konya;

The values defining the degree of convex articulation are low for Konya. This shows fewer breakups in the open space structure and more synchrony in the urban layout of the city. Convex deformation of grid indicates irregular urban layout. In this situation Konya is irregular. Grid convexity belongs to Konya is low. Thus it can be said that its urban layout is organic. Low axial articulation value indicates a higher degree of axiality. Konya has low axial articulation. High convex and axial ringiness value indicates distributeness of the open space structure. Konya has non distributeness in the open space structure. The form of the integration value gives either urban open space is symmetric or asymmetric. The location of the most integration lines in Konya indicates that it has symmetry (Figure 3).

Antakya

Antakya is one of the oldest settlements in Anatolia. It front earn its importance from Roman Empire. It was the third biggest city in Roman Empire. Its importance came from trade road; it was located in the intersection of these roads. At that time citizen of Roman Empire called Antakya as "The Queen of the East". In 7th century the city was concurred by Arabians and Islamic properties began to show themselves. By the time Antakya lost its luxury that came from Romans. That's because of the privacy needs of Islamic culture.
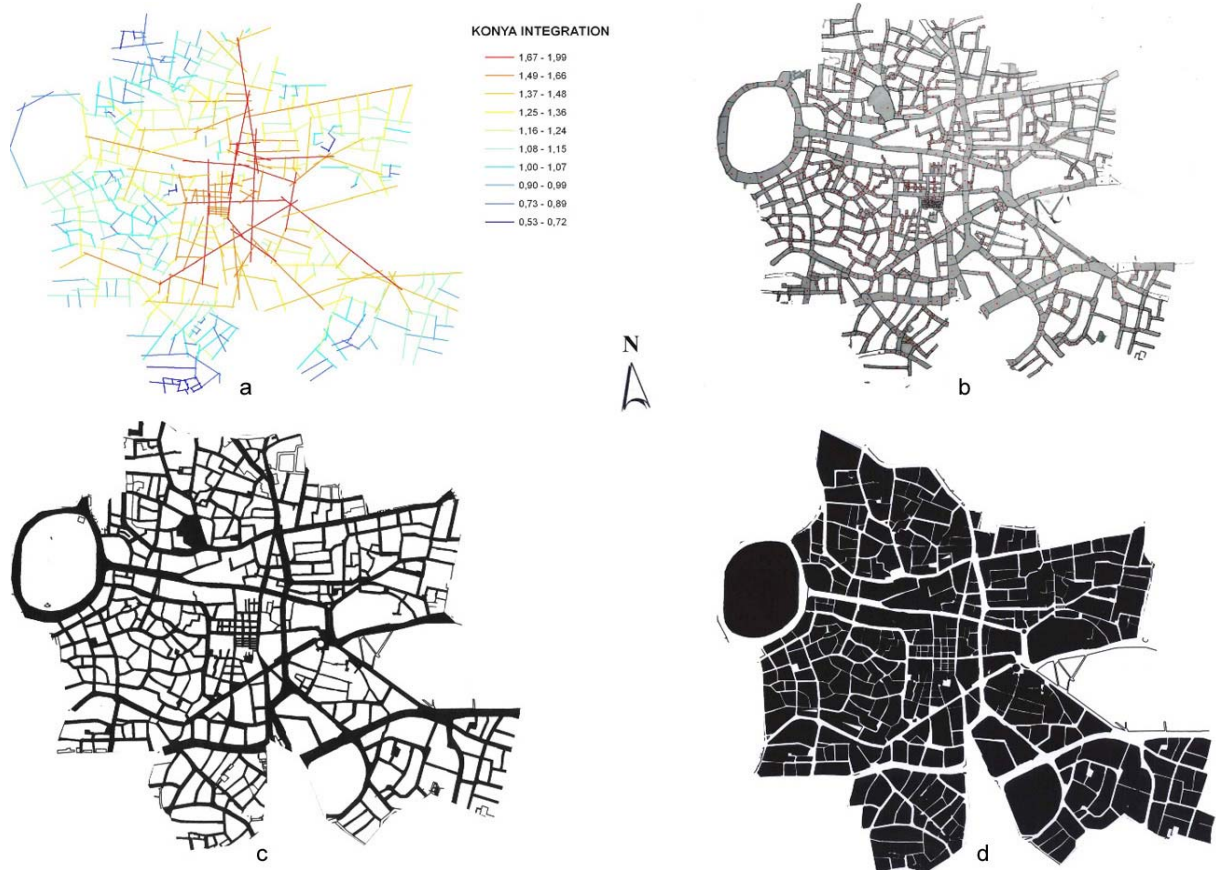
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Figure 3:

Konya: (a) patterns of the integration; (b) the map of convex spaces (c) open spaces map (d) urban block map

After 1516 Ottomans conquered the city but this has not resulted in an important differentiation in its pattern. After that time Antakya still maintained its importance until the new trade roads was discovered. Although it had lost its importance in trade, it hadn't lost the importance in religion in 1963. Antakya was chosen for hac by Pope. At the present time Antakya is a very unique example by its mixed socio-cultural and economic factors. But because of the political and economical reasons it lost its beauty and unique properties (Demir 1996).

Antakya has different social, cultural and physical diversity in its boundaries. There is a combination of religions such as Christian, Muslim and Jew. Turkish, Arabic and Ermenian cultural groups form a mixed culture in Antakya. Social and cultural ethnic groups formed very different and rich physical pattern in the settlement.(Hakim 1986) The spatial structure of Antakya can be seen below (Figure 4). This structure formed during historical periods of Antakya.

The pattern of Antakya still bears the marks of its early Hellenistic and Roman structures, especially in the formation of geometrical grids. The configuration of the streets reinforces Islamic characteristics; cul-de-sacs mean privacy and street structure is narrow (Aysu 1976)

The results of the analysis for Antakya;

The values defining the degree of convex articulation are high for Antakya indicating more breakups and less synchrony in the convex space structure. Convex deformation of grid indicates irregular urban layout. In this situation Antakya is regular. Grid convexity belongs to Antakya is high. Thus it can be said that its urban layout is angular. Low axial articulation value indicates a higher degree of axiality. Antakya shows lower degree of axiality. High convex and axial ringiness value indicates distributeness in the open space structure. Antakya has high convex and axial ringiness value in the open space

Figure 4:

Spatial structure of Antakya

structure. The form of the integration value gives either urban open space is symmetric or asymmetric. The location of the most integration lines in Antakya indicates that it has asymmetry.
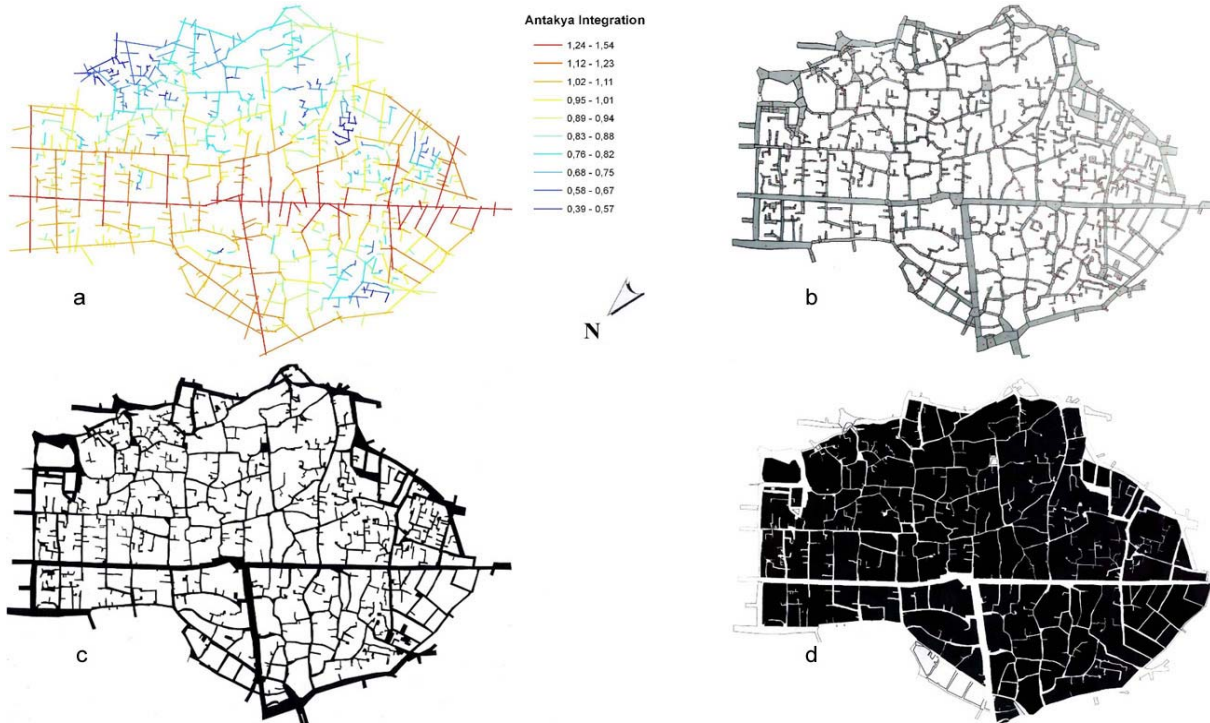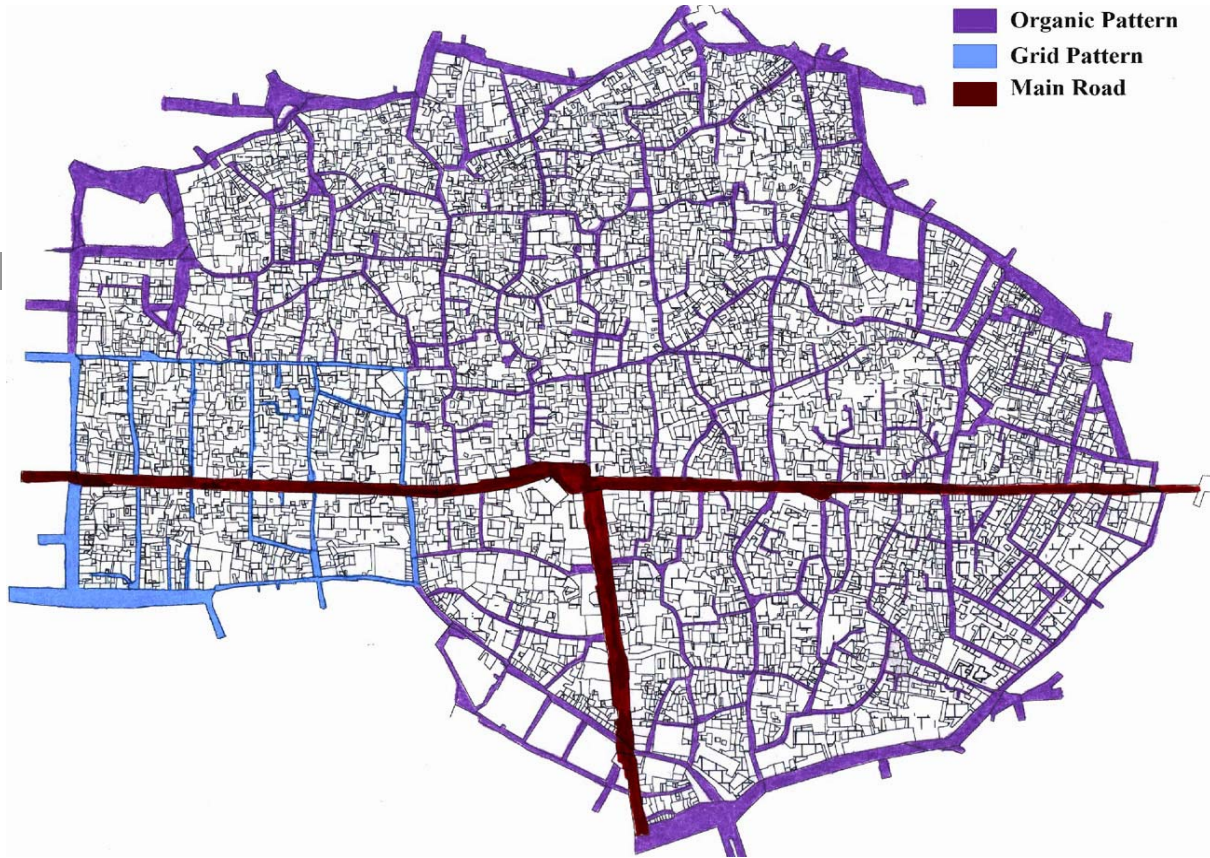

Figure 5

Antakya: (a) patterns of the integration; (b) map of convex spaces (c) open spaces map; (d) urban block map

The Morphological Comparisons of Konya and Antakya by Means of Space Syntax Analysis

The results derived from the comparative space syntax analyses of the samples are as follows. (These results are based on the measurements summarized in Table 1).

SYNTACTIK PROPERTIES	SAMPLES	NAME OF THE TOWNS IN ANATOLIA	
		ANTAKYA	KONYA
C= Convex Space		1224	917
L= Axial Line		888	483
B= Building		1880	3832
I=island		256	116
Measures of *Convexity*	Convex Articulation (No. of C / No. of B)	0,651	0,239
	Convex Def. Of Grid (No. of C / No. of I)	4.781	7.905
	Grid Convexity ([I$^{1/2}$ +1]^{2} /C)	0,236	0,151
	Axial Articulation (No. of L / No. of B)	0,472	0,126
Measures of *Axiality*	Axial integ. Of.C (No. of L / No. of C)	0,726	0,527
	Grid Axiality ([(I$^{1/2}$ x 2) + 2]/ L)	0,038	0,052
	Convex Ringiness (I / [2xC-5])	0,105	0,063
Numerical Properties	Axial Ringiness (I / [2xL-5])	0,145	0,121
Syntactic Measures	Integration	0,885	116.745
	Intelligibility	0,14732	0,312127

Table 1:

Characteristic measures for comparison of the morphology of Antakya and Konya

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Measurements of convexity

By examining the convex map of both settlements, we can calculate to what extent the open space structure is broken up. If the convex articulation values are low, then this will indicate fewer breakups and more synchrony in the convex space of that settlement. The convex articulation values—local variation of the vernacular spaces—for towns can be compared by the use of table 1. This value is lower for Konya (0.239) than for Antakya (0.651). Konya is more synchronous than Antakya.

The degree of convex deformation is higher for Konya (7,905) than Antakya (4,781). This shows that the urban fabric of Konya is irregular and different from that of Antakya which has geometrical grids, regular and reflects characteristics of the Roman occupation. Therefore the urban fabric and the open space structure in sample towns (Konya, Antakya) have different characteristics (Table 1).

High syntax values defining the degree of grid convexity indicate little deformation in the grid structure and angular urban blocks as seen in Antakya (0,236), and low value (Konya-0,151) indicate higher deformation in the grid when compared with Antakya. So it has organic urban block.

Measurements of axiality

A low value of axial articulation indicates a higher degree of axiality. The high axial articulation value 0,472 belongs to Antakya and this value indicates greater breakups and nonaxial developments in the street structure of its urban texture compared with Konya (0,126). It is also informative to calculate the axial integration of convex spaces—making a comparison of the number of axial lines with the number of convex spaces—in which case low values will indicate a higher degree of axial integration in the convex spaces. High value is calculated for Antakya (0.726).

The values of grid axiality allow us to compare an orthogonal grid with the same number of islands in the urban layout. As higher values indicate a stronger approximation of a grid, the urban structure of Konya (0.052) is higher than Antakya (0,038). But in general, values of 0.25 and above indicate a grid-like system whereas values of 0.15

and below denote a more axially deformed system. When we consider this, both of our selected towns show a more axially deformed system

To measure the distributedness of the open system, it is necessary to calculate the values for the ringiness in the convex system. High values of convex ringiness will prove the existence of a grid-like urban texture rather than an organic one, such as Antakya (0,105). The values of axial ringiness are higher than those for convex ringiness and may exceed 1 because the axial map is nonplanar. The values of axial ringiness for Antakya (0,145) are higher than that for Konya (0,121). By analyzing the relation between axiality and convexity, it is possible to derive the characteristic urban pattern of them. Another way of analyzing the patterns of the settlements is through the evolution of the integration values.

Measures of integration

The mean integration values for Antakya (0,885) and Konya (1,167) respectively. Konya has high mean integration value compared with Antakya. The urban layout in Antakya is less integrated and more segregated than Konya. According to the calculations, the town of Konya is the most integrated one. The location of the integrated cores makes it possible to determine the symmetry or asymmetry of the layouts. Antakya has asymmetrical patterns when compared with the other town (Konya).

The most integrated lines constitute the integrated core of the towns, where the core is represented by red lines and the most segregated spaces are represented by the blue lines (figure 3 and 5 see over). The form of the core gives clues as regards the morphological structure of the towns. The most integrated lines are clustered at the centre where the most important activities take place. These disconnected short lines link the centre to the gates with several breakups. The segregated and inaccessible zones are evident on either side of the integrated core.

Measures of intelligibility

The syntactic *intelligibility* of an urban system is defined as the degree of correlation between the connectivity and integration values in the system. The term intelligibility is used because the stronger the correlation, the easier it is to infer the global position of a space from its directly observable local connections (Hillier at al, 1983). This makes it possible to capture the way people can learn about large patterns from their experience of small parts or fail to do so when the correlation is weak. According to the results of syntactic analyses, the spatial structure of Antakya (0,14732) lack structure and are found to be less intelligible compared with Konya which is intelligible (0,31212).

Conclusion

In this study, the pattern of Anatolian settlements shaped under the influence of several cultures is examined comparatively from the point of view of their identity, including their mathematical interpretation. A study of the cultural, historical, and social values and of the architectural heritage of the Anatolian settlements will be helpful in contemporary urban studies, especially for the renovation of the historical and cultural regions of the cities deteriorated and damaged by the effects of industrialization and rapid urbanization processes (Kubat 1997).

The methodology adopted in this study, which makes use of a model for analyzing the morphological structures of the two Anatolian towns and of the findings from the economic, social, and cultural values that make up their urban structures, will be a source of inspiration for urban designers, especially in creating new syntheses which will

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reflect the traditional characteristics of historical settlements.

The following are the main characteristics commonly found in the these towns: the totality of urban functions are within comfortable and pleasant walking distance; the continuity, harmony, and unity of the architectural and urban structures; sensible versions of street planning creating the city; the traditional character and human scale within historical references; sensitive spaces in the formation of the street patterns which no longer exist today because of motorized traffic; organic village designs; economically and aesthetically desirable piecemeal growth; the symbolic richness of the traditional architecture within the city; dialogue of the greatest possible variety in the private and the public uses; and the positive effects of the feelings of unity and the organized lifestyle in the urban spaces.

Analysis and study of the urban spaces which were created by the Romans, Byzantines, Turks, and Ottomans years ago will also inspire designers who are trying to recreate new urban structures and typologies. Conservation and revitalization of these fortified towns by assigning them new functions will make it possible to transfer the urban design criteria created within these settlements to new generations.

In this study the syntactic variables are applied to analyze the morphological structure of Antakya and Konya. The integration and intelligibility values of Konya are higher than Antakya. Thus Konya shows a more symmetric pattern. The spatial structure of Antakya lacks of structure and are found to be less intelligible compared with Konya which is intelligible. The reason for this result is Antakya's having more closed society structure.

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