

Comparing the New and Old Fabrics of Isfahan City Regarding Ecological Criteria

Esmail Shieh^a, Marzie Ghassemi^{b*}

^a Professor of Urban Planning, Faculty of Architecture University of Science and Technology, Tehran, Iran

^b M.S Student, Urban Planning, Qazvin Branch, Islamic Azad University, Qazvin, Iran

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Abstract

The emergence of new neighborhoods in historical cities like Isfahan has been due to rapid population growth regardless of the context circumstances and in an attempt to meet the need for housing. On the other hand, old neighborhoods could not often form suitable environments for life because of incapability to meet the needs and wishes of the residents. Contrary to this situation, new ideas and theories are emerging in the urban world in which the main objective is improving the quality of urban environments. One of the basic concerns of modern urban planning in the world is returning to the nature and reducing the problems caused by automation and endless attack to the natural environment of human life. Hence in this study, we tried to further study and analyze one of the outlined characteristics of these ideas known as "Ecological city" and identify and separate the physical characteristics of an ecological city and also compare the physical criteria of new and old districts of the city in terms of closeness to these criteria. The main objectives of this study can be summarized as: 1. recognizing the physical criteria of the ecological city 2. studying the status of ancient and contemporary urban fabrics in compliance with these criteria. To investigate, two study samples were selected from Isfahan neighborhoods; one from traditional districts (Charkhab) and the other from contemporary districts (Mardavij). Then, these two areas were analyzed based on physical characteristics using Analytical Hierarchy Process and the results of this analysis were shown by GIS. The results of this analysis indicated superiority of the traditional fabrics to the contemporary one. This represents the human-oriented and sustainable urbanism of the country's past which is neglected and forgotten today. The necessity of analysis of the past urbanism and contemporizing its criteria and indicators concerned with what is known today as the modern urbanism science can be considered as the most important result of this study.

Keywords: Space Ecological City, Urban Contemporary Fabrics, Old Urban Fabrics, Physical Indexes

1. Introduction

For each individual, environment is very important because her survival and development depends on a suitable environment (Song 2011: 142). On the other hand, cities are now home to the human settlement such that more than half of the world's population are living in cities today. Currently, cities play an important role in economic and social activities, however, they have weaknesses in terms of environmental protection as well. In fact, following development of urbanization and activities such as land conversion and depletion of natural resources, greenhouse gas emissions and waste creation, a series of problems in the urban environment have become very serious (Kang & XU 2010: 1692). These problems have caused issues such as sustainability and environmental protection to become the today world's main urban planning debate. Concepts of ecological city for dealing with these issues have been raised in recent decades in the field of urban planning.

It is worth noting that developing countries will attract 95% of urban growth in the next two decades and will be the home to almost 4 billion people in 2030 (UN-Habitat 2006: 94). Dealing with environmental issues in these countries is much more important. These countries are

now affected by the speed of industrialization and urbanization. As a result, in a country where economic growth is increasing, the environmental contamination is inevitable but on the other hand, the limits of environmental resources and their irrational use would restrict economic development. Accordingly, much research must be done in order to realize sustainable use of environmental resources and adjust the increasing population pressure on the environment in urban areas. Reflecting on the field, it is understood that the current expansion of urban areas causes more environmental deterioration and is therefore considered as a serious threat to continued survival of human.

Isfahan as one of the major cities of a developing country is no exception. Accordingly, the present study attempts to compare the physical structure in both ancient and contemporary fabric of this city in terms of their compliance with ecological city criteria. For this purpose, Analytical Hierarchy Process (AHP) and GIS features are used. Final goals of this process can be summarized as:

- Understanding the physical criteria of ecological city

*Corresponding author E-mail : marzieghassemi@yahoo.com

and studying the status of fabrics of ancient and modern cities in compliance with these criteria

- Extraction of effective strategies to improve urban fabrics for more closeness of these fabrics to the idea of ecological city.

2. Theoretical Discussions

2.1. Concept of ecological city

There are different approaches to sustainable urban development which partly focus on gradual and brief adjustment of the status quo and somewhat on creation of new solutions. Some of these approaches focus on development of the urban development theories as their performance framework. One of the urban approaches to sustainable development is the theory of ecological city.

Richard Register can be considered as the pioneers of this idea. He defines ecological city as follows:

Ecological city is a city with a healthy environment which is different from existing cities. It is a compact and vibrant city that consumes little land and energy. In integration with nature and environmental conditions of its region, it creates a beautiful landscape. Today, the basic characteristics of this city should be sought in use of clean energies such as solar and wind energies as well as the recycling industry. By planting trees, restoration of streams, and urban green space, we can move further towards such a city. As well, replacement of car riding by walking and bicycle riding is another quite different feature of this city compared with today's cities (Register 1987: 3).

This idea emphasizes on the city as a living organism; and close access, centralizing small scales, true diversity and finally public will are essential to the realization of this city.

2.2. Ecological city indexes

Search in the scientific literature shows that research in the field of ecological city is more focused on finding appropriate indicators rather than search for scientific theories (Fry et al 2009: 933). As mentioned in definition of ecological city, it includes wide dimensions. Hence, the criteria of this city contain a wide range of economic, social, environmental, and physical dimensions. These criteria are summarized as follows:

Economic criteria: One of the main features of ecological city is attention towards economic issues. Here, criteria such as efficiency of existing industries, creation of new industries, job creation level, and amount of wages

will be considered (Gerber 2010: 169). Distinguishing feature of the economic criterion in ecological city is emphasis on economic prosperity based on the use of clean and renewable fuels and attention towards local aspects of economy.

Social criteria: Social issues are also considered in ecological city. The criteria considered in this section include the poverty rate, population distribution (Suzuki et al. 2010: 2), and health status (Fook 2010: 15). As the poverty rate decreases and the population density increases, the social indicator of ecological city is more realized. Regarding health status, issues such as the rate of respiratory and cardiovascular diseases, mortality rate, physical activity, and access to healthy food are studied (Fook 2010: 15).

Environmental criteria: another main criteria of ecological city is the environment issue. The main criterion for assessing the environmental situation is reduced production of greenhouse gases which will be assessed by examining the types of consumed energies (Kenworthy 2011: 5). Ecological city looks for the use of renewable energy sources like wind turbines, solar panels, and so on. As well, the population density and the level of environmental education are the other determining criteria in emission level of greenhouse gases and the environmental status (<http://www.ifc.org>). Level of energy consumption as well as collection and recycling of waste materials are the other environmental indicators of ecological city because the reduction and control of energies such as water, electricity, etc. as well as recycling material and reusing them to reduce the use of raw materials are some other environmental goals of the ecological city (Kenworthy 2011: 5).

Physical indicators: physical indicators are of the ecological criteria considered for assessment of ecological city. Distribution and access are of the issues considered in this section such that by reducing urban fabrics dispersion, access to services becomes easier and therefore the need for car is reduced (<http://www-wds.worldbank.org>). Accordingly, pedestrian traffic in the urban fabric can be considered as the physical indicator of ecological city.

Given that the decision on land use directly affects the amount of greenhouse gas emissions and air quality, studying this in ecological city is of the main indicators. Another criterion examined in this context is the proper distribution of applications because the distance between

the necessary urban services and the workplace and living place of the citizens has a significant impact on energy consumption in transportation (Almec 2011: 56). As well, fitness of application levels and especially uses like green open space has a considerable impact on environmental quality and improving the health of citizens and is therefore one of the main criteria of the agricultural sector (Zhou & Williams 2013: 61).

3. Research spatial domain

Much of a scientific research is composed of examining the hypothesis on a sample and extracting its results. The

hypothesis of this study requires the analysis of two case studies and their comparison with each other. Accordingly, a brief introduction to the spatial domain seems essential which is discussed below.

Intervention area of this research included two neighborhoods of the city of Isfahan, one within the historical old city of Isfahan and the other within the contemporary and modern fabrics of Isfahan that are respectively "Charkhab" and "Mardavij" neighborhoods. It should be noted that these two neighborhoods are located in districts 3 and 6 of Isfahan based on zoning of Isfahan in review of the detailed plan in 2003.



Fig. 1. Location of Charkhab and Mardavij districts in Isfahan

4. Discussion

The analysis is part of the projects and plans for identifying their strengths and weaknesses and putting the results in a logical framework analysis. In fact, it can be said that analysis is one of the key steps in the process of decision-making and offering solution. According to the objective of this study, which is based on comparison, the method used in this sector for analysis of findings is the hierarchical analysis. This method has 5 main stages. In the first stage, the main objectives of the research, intended alternatives (Charkhab and Mardavij districts), and the intended criteria (physical standards of ecological city) are expressed in the research in a hierarchy on a chart known as decision-making tree.

Then, a factor of importance is assigned to the criteria and sub-criteria and the importance factor of each option is defined. In the two final stages, final score of each alternative is specified and compatibility of judgments is studied. The final score of each alternative determines its status in comparison to the criteria intended by the study. It should be noted that during the process of hierarchical analysis (including the final stage), GIS is used for graphic expression of the results

4.1. Analysis of Mardavij and Charkhab districts on the basis of physical criteria of ecological city

As already stated, Analytical Hierarchy Process (AHP) is composed of five stages (Cheng & Wang 2006: 736.):

- Building the hierarchy
- Determining the importance coefficients of the criteria and sub-criteria
- Determining the coefficients of options
- Determining the final score of options
- Checking compatibility of the judgments

4.1.1 Building hierarchies

The most important stage is the stage of building hierarchy because in this stage, we can analyze the complicated issues and convert them into a simple form consistent with the human mind and nature. So, the decision hierarchy is defined as a tree which has multiple levels regarding the problem under review. Specifically, the first level of each tree represents the decision goal; the second level of the tree represents decision-making indicators, and the third level of each tree indicates the options that are compared with each other and are competing with one another for selection (Cheng & Wang 2006: 740).

In this study, the first level as the purpose of decision checks the status of ancient and contemporary fabrics of Isfahan city in compliance with physical criteria of

ecological city. Based on this objective, some criteria are also specified and presented in

Table 1
Indices and sub-indices studied

	Index	Sub-index		The importance of the issue
1	Land use	Uniform distribution of land use	Education	The more applications cover a greater level of district based on the radius of their performance and the more their areas are closer to the desirable capita
			Health	
			Commercial	
			green space	
		Appropriateness of land use areas	Education	
			Health	
			Commercial	
			green space	
2	Dispersion	Building gross density	-	The higher is the gross building density and net residential density
		Gross density of residential units		
3	Access	Access to educational services	-	The easier the access and the less is the distance to the intended services
		Access to commercial services		
		Access to green space		
		Access to health care		
		Access to public transportation		
4	Pedestrian traffic	Continuity of pedestrian paths	-	The more is the continuity of the pedestrian path preserved and not cut by the roadways and the higher are the application varieties and the level of greenery.

It should be noted that the last level of the research hierarchy is the options compared with each other based on the last two levels and includes two districts of Isfahan city (Mardavij and Charkhab districts). Based on

the intended objective, Charkhab district is selected from the traditional fabric and the other is selected from the contemporary fabric.

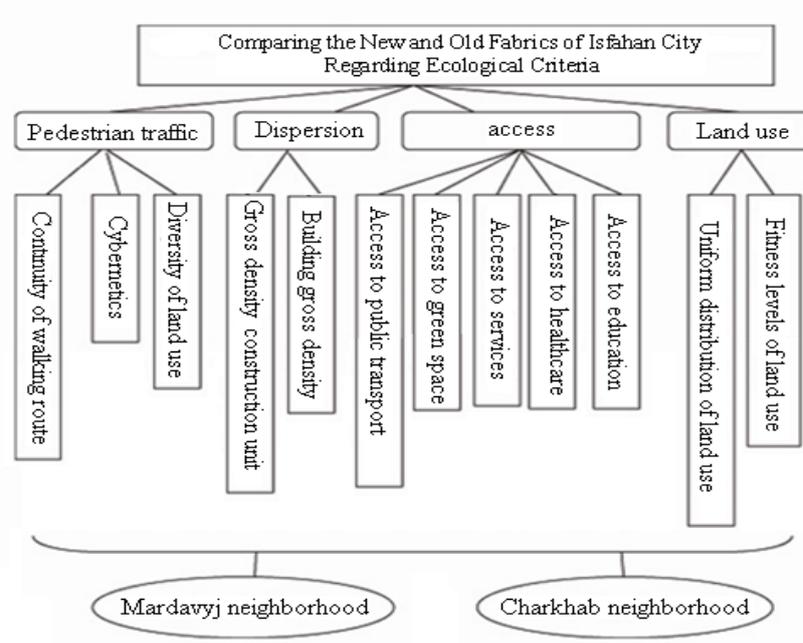


Fig. 2. Hierarchy building stages

4.2.2 Explaining the importance of criteria and sub-criteria

To determine the importance factor of the criteria and sub-criteria, there are several ways whose most common is the dual comparison. In this method, the criteria are mutually compared with each other and the importance degree of

each criterion is defined versus the other one. To do this, we can use a standard method provided by Sa'ati. It functions as follows: a number from 1 to 9 is assigned to each dual comparison. In Table 2, meaning of each number is specified (cimren / 2007/368)

Table 2
Nine-quantity comparison of Sa'ati for dual comparison of the criteria

Level of importance in dual comparison	Score
The same preference	1
Identical to relatively preferred	2
Relatively preferred	3
Moderately to strongly preferred	4
Strongly preferred	5
Strong to very strong preferred	6
Very strong preference	7
Very to infinitely preferred	8
Infinitely preferred	9

First, the main layer criteria are compared with each other. Table 3 shows the paired comparison of the main layer criteria. In this table, displayed numbers are based

on the importance of the criterion of horizontal row versus the vertical row criterion. The value of each number is defined with respect to the values of Table 2.

Table 3 Dual comparison of the criteria

Compliance factor	Weight	Indexes	Land use	Access	Pedestrian traffic	Dispersion
0.0845	0.5437	Land use	1	3	5	7
	0.3109	Access	0.33	1	5	7
	0.0975	Pedestrian traffic	0.2	0.2	1	3
		Dispersion	0.14	0.14	0.33	1

4.2.3. Defining the importance ratio of options

After weighting decision measures, we should weight the alternatives. Weighing of alternatives means determining the priority level of each site according to each of the four criteria. For this purpose, the judgment matrix of each ground(site) should be made with respect to the first criterion and then, the weight judgment matrix of each site

must be made regarding the second criterion. Then it should continue so that there are judgment matrixes of sites to the number of criteria. Importance of the sites differs regarding the criteria. For example, if the only criterion for decision-making and choice is access, the analyst must choose site no. 1 as the best option while the pedestrian traffic measure shows that the best site is no. 2.

Table 4

Scores of the Charkhab and Mardavij districts based on land-use criteria

	Mardavij score	Charkhab score
Uniform distribution of land use	0.049	0.44
Proportion of land use	2.49	1.00
Total	0.12	1.00

Table 5

Score of the Mardavij and Charkhab district based on pedestrian traffic criterion

	Mardavij score	Charkhab score
Greenery	0.17	0.02
Diversity of land use	0.43	0.31
Continuity of walking path	0.07	0.05
Total	0.005	0.003

Table 6
Score of Mardavij and Charkhab districts used on dispersion criteria

	Mardavij score	Charkhab score
Gross residential density	0.23	0.40
Net residential density	0.32	0.44
Total	0.07	0.18

As shown in Table (4), (5), and (6), Charkhab obtained higher scores regarding two indicators of land use and distribution and Mardavij district gained higher scores regarding pedestrian traffic. But as already mentioned, for an overall conclusion of these two districts, we need to analyze and determine the final score of all four indicators. Therefore, we study the status of the other indicator, *i.e.* access.

It should be noted that in review and determination of the superior district regarding this index, categorizations are made based on the scores given in previous stages; and the level of each district dedicated to each category is expressed and thereby, the superior district is selected:

Table 7
Scores of Mardavij and Charkhab districts based on access criterion

Mardavij		Charkhab		Score
Area (square meter)	Percent	Area (square meter)	Percent	
3808	0.16	60662	0.11	0.015_0.733
240224	10.21	154312	16.25	0.733_1.321
1270304	24.03	271249	36.41	1.321_1.851
836410	35.58	333941	47.21	1.851_2.70
2150748	100.00	820164	100.00	Total

As the table (7) shows, Charkhab district is rated higher in terms of access to educational, health care, commercial, green space and public transport services. Accordingly, Charkhab can be regarded as the superior district regarding access and it has higher scores in final conclusion.

4.2.4. Determining the final score of options

At this stage, some calculations called as "the principle of hierarchical composition" are used. The result of these calculations is a "priority vector" which entails all

judgments of all levels of the hierarchy (Zebardast, 1380: 4). After determining the factors effective in physical characteristics of an ecological city and providing all informational layers through analytic functions of GIS and determining the weights of criteria effective in the body of an ecological city based on AHP, features of GIS software were used for integration and overlap of maps. Finally, the map related to the compliance of the characteristics of each neighborhood were prepared based on ecological city criteria. The resulting map is classified in five categories

Table 8
Features of the map assessing conformity of the physical features of Charkhab district with the ecological city

Charkhab		
Classification	Area (Square meter)	Percent
1	48662.39	0.11
2	88616.08	7.00
3	178364.2	22.47
4	<u>268117.6</u>	<u>37.94</u>
5	<u>236406.4</u>	<u>32.47</u>
Sum	820166.6	100.00

Table 9. Features of the map assessing conformity of the physical features of Mardavij district with ecological city

Mardavij		
Classification	Area (Square meter)	Percent
1	3564.85	0.15
2	184800.86	7.86
3	1001295.53	42.59
4	<u>677452.04</u>	<u>28.82</u>
5	<u>483635.03</u>	<u>20.57</u>
Sum	2150748.32	100.00

As the tables (8) and (9) show, a greater level of Charkhab district is placed in classes 4 and 5 (optimal situation) compared to the Mardavij district which determines

superiority of Charkhab district in this comparison. As previously stated, the analysis map of this comparison is prepared in GIS software which is provided below

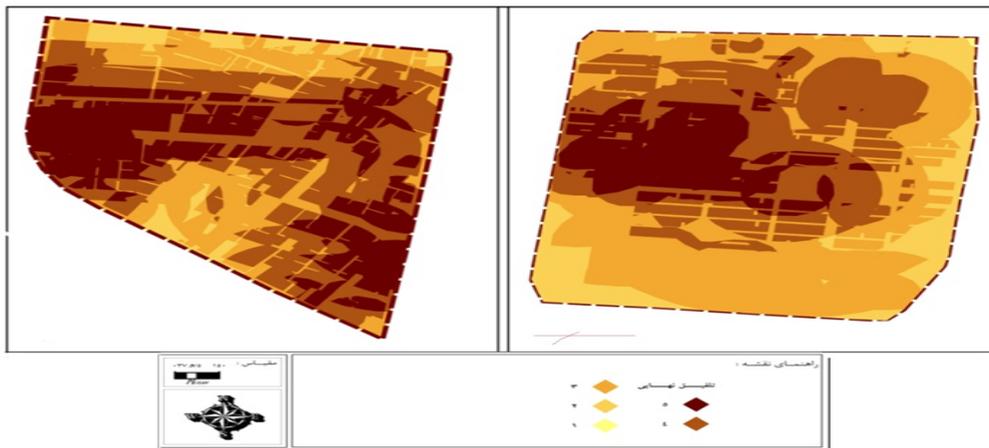


Fig. 2. The process of making hierarchy

4.2.5. Checking compatibility in judgment

The importance of AHP, in addition to incorporating various levels of decision hierarchy and considering multiple factors, is in calculating the compliance rate (CR). Compliance rate is a mechanism that determines the compatibility of comparisons.

This mechanism shows how much we can trust the priorities of the group members or priorities of the combined tables. Based on experience, if compliance rate (CR) is 0.1 or less, judgments and weights can be considered good and reliable. Otherwise, the analyst

should go back to previous processes and re-review the judgments (Dey2000: 27). In the present study, all proposed compliance rates are less than 0.1 indicating the reliability of results and processes carried out in this study.

5. Conclusion

As observed, analysis of both contemporary and traditional fabrics of Isfahan city regarding closeness of their physical criteria to the features of an ecological city

reached no conclusion but superiority of the traditional fabric represented by Charkhab district in this study.

This finally brings us to the conclusion that the traditional fabrics and the past urban development were more focused on indicators of sustainable and nature-oriented city and the urbanism of the last few decades in our country has moved towards modernist ideas like mass building and segregation of applications which eventually leads to prioritizing quantities rather than qualities of the urban environment. This has separated this science from its origins and has made it obsolete in achieving the macro urbanism goals in the world. Accordingly, the shortest and least expensive way to improve the country's urban development is a retrospective view and mining ideas and their high aspirations as well as mixing and updating them by new urbanism ideas. In fact, this research is a view towards two different approaches to city and urban planning and then examining each of them based on a new idea of ecological city. According to the mentioned facts, this type of view can offer a solution for getting out of the impasse confronted by the modern urban development in Iran.

Based on the discussions carried out in this study and its results, it can be stated that in current urban fabrics in general, and contemporary fabrics in particular, there are several problems. This research focused on physical issues, and the offered proposals are consequently around it.

As the analysis carried out on two case studies showed, physical structure of the contemporary urban fabric is largely fragmented and based on the principle of roadway access. Such features have adverse impacts on uniform distribution of applications and disrupt pedestrian access to services.

On the other hand, in traditional fabrics of Isfahan city, because of their current climate and culture, open and green public spaces are not much observed. Accordingly, it can be stated that these fabrics have not been updated in this area and are weak.

Charkhab:

- Protecting Niasarm Madi as a natural element in the physical structure of the district
- Assigning bike paths
- Minimizing the mixed movement of mounted and dismounted

- In fact, both fabrics have some weaknesses. Based on the criteria of ecological city, the following suggestions are presented to solve these weaknesses and problems:
- Expanding open green public spaces in the area
- Transferring uses of production lands to the edge of the area and close to public transport stations
- Preserving gardens of the area and preventing separation and construction in them
- Developing general diverse applications in the district, particularly along the Niasarm Madi path
- Addressing deficiency of per capita land use with defined standards in outreach projects or world standards

Mardavij:

- Splitting land use levels into smaller pieces to facilitate access
- Attention towards land features in design of new roads
- Mixing residential use and other appropriate land uses including small business, green spaces, etc.
- Expansion of public transport in the area
- Increasing building density in order to prevent the horizontal spread of district and minimize use of land
- Use of natural elements such as greenery and water in public spaces as identity element of such locations
- Use of natural elements such as greenery and water in public spaces as identity element of such locations
- Providing specific paths for movement of bikes and pedestrians

In fact, a comparison of these two fabrics in this study proved that if healthy, varied and lively urban fabrics have been built in the past, today we can also convert the urban fabrics built with millions of hectares of concrete and iron and metal, thousands of skyscrapers, and a complex network of highways into human and habitable environments using new urbanism trainings like the idea of ecological city, etc.

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