THE EFFECT OF URBAN DESIGN ON URBAN ENVIRONMENT QUALITY USING GEOGRAPHIC INFORMATION SYSTEMS (CASE STUDY: GHAEMSHAHR CITY)

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ABSTRACT:
Since the beginning of urbanism and following his nature, human being has aimed at his tendency to establish order. Urban design is also developed in the framework of the same general need to order and in response to the special demands of the society. Cities – or if put it more properly – biological communities are created to provide certain objectives for their residents. In design and planning, quantitative methods and analysis are replaced with artistic creativity. And, due to the nature of the issues, a kind of new urban design known as intellectual design appears for artistic design. This study describes the method of evaluating the aspects of urban design in the context of Geographical Information System (GIS). The relationship between construction environment and urban design is examined using questionnaires structured based on urban design aspects in terms of four entrance spaces, knot, path, dead alley, and in Ghaemshahr neighborhood scale where the number of neighborhoods were 36 with totally different uses. Samples were chosen in random systematic way. The content of the questionnaires were coded, quantified, and entered into EXCEL software. Upon being classified and after elementary analysis, they were transferred to GIS so as to be scored based on the aspects mentioned. To zone the quantified qualitative indices, the weight percent of responses and scores was applied. Quantitative zoning of the indices can be used to predict their aspects in gap points. And, by a quantitative integration of indices and with respect to the essence of citizens' mental image, it is possible to take action to reach a classified plot of the quality of urban environment.

KEYWORDS:
Ghaemshahr, Geographical Information System, Urban Design, Urban Quality

INTRODUCTION

The significance of urban design owes to the evolutions of the two recent decades in different technological, social, and environmental areas led to the revival of urban design, in one hand, and the failure of urban designers in creating desirable human spaces and increasingly reducing the quality of life in the present cities, on the other. If creating such spaces be considered as the product of urban design, then definitely the main reason underlying the failure must be south for in the decision making technique and (or) urban design process. The complete example of the claim can be seen clearly in the formation of cities in our country during the last few decades. That is the urban design issues of the country are emanated from several factors which totally form the framework and decision making system of the urban design and ignoring them in designing due to the lack process thinking have brought about undesirable and unsuccessful consequences.

Using urban design principles in the study of artificial environment effects on the quality of urban environment have drawn significant attention.

Contemporary researchers have been successful to evaluate the effect of classical urban design on the physical activities completely via the beauty and attraction of the neighborhoods. Several kinds of neighborhood qualities have been examined and evaluated by different researchers such as green space like parks or natural landscapes, conflicts like noise pollution, air pollution, or structural abnormalities, and attractive architecture or urban design. Studies on the quality of urban environment in urban design have encountered executive obstacles due to not being able to implement integrated field observations and controlling extensive areas as well as the lack of valid measurement tools in urban design.

This study is aimed to promote the relationship between urban design and quality of urban environment. We make attempt to help future researchers to avoid the constraints and obstacles of surveys and conceptual and practical observations by the advent of GIS which is a method for direct measurement of urban design toll. Namely, the method is conceptually grounded in scientific studies of urban design and it is possible to extend

its scale over urban areas. of the objectives of the design, we can imply the followings: quantifying sextet aspects of urban design to have their influence on the quality of urban design in GIS context, quantitative zoning of each aspect and presenting complete plot for the whole city, quantitatively predicting the sextet aspects of urban design in gap and non-sampled areas, integrating all sex aspects in GIS to accomplish the objective of the classified plot of urban environment quality based on the indices.

MATERIALS AND METHOD

Urban Design

Urban design is defined as the intentional and aware tridimensional interpretation of planning decisions. It is a part of the strategic connections of urban design and planning and an armature to which the whole city gets connected. Urban design includes the activities, operations, and processes aimed to superficial and practically systematize urban structure.

In urban design, objectives related to the beauty and appearances of the city are placed in parallel with the functional objectives. Urban design principally deals with the structural and spatial aspects of the environment [1]. Yet, boundary between the shape and space of the city is blurred. Accordingly, the constituents of urban design include three factors: urban activities, urban spaces, and urban form. The first is the content and the two others are the container of urban design. The domain of activity for urban design – whether done by public (governmental) sector or private sector – is the public spaces of the city. Time framework of these activities mostly has unfinished and limited result as opposed to architecture which has finished and complete results in a long run. Urban design provides the possibility of making changes in the environment, while architecture provides the tools for making changes. Unlike architecture dealing with each of the buildings, urban design is as much focused on the design product as focused on the process and stages of design development and presentation. Teaching urban design firstly requires the skill of 3D design and then knowledge of social sciences, law, economy and management. In comparison with urban planning, it is the art of forming and directing the natural growth of the city; an issue based on which different buildings and environments are constructed to satisfy different needs; for instance, providing citizens' welfare via creating better and scientific environment where the way to physically develop the city, how to use urban lands, housing, traffic and are studied in relation to population and function of the city [2].

Urban design includes the trend of organizing the physical elements of urban environment with respect to planning decisions so as to develop a framework of transportation system, open spaces, and buildings in order for facilitating the accomplishment of social, economic, and aesthetic objectives of the society. The shape of city considered to be the main basis of urban design is in fact a container which males the urban activities possible. We can name street which is the most important component of the city shape and undertakes several roles; vehicles traffic, pedestrian passage [3]. The main public places of a city, a place for economic and social activities, and the establishment of composition and frame of a city. By urban activities, we mean not only different activities happening in the daily life in each city but also the distribution of those activities in the spaces. Two other principles of urban design are procedural factors. Using these methods, urban elements (shape of the city and urban performances) can be systematized.

Urban design and culture: Urban design is the most visible activity which can realize the values, demands and objectives of a society and get mind close to practices and thoughts to the realities by crystallizing them [4].

Urban design and geographical values in planning: Regarding natural, geographical and environmental factors are significant. This is because they form the main context and status of the city and can affect all the elements and components of urban design such as place, shape, structure and texture of the city, vegetative coverage, building types, indigenous materials and the like [5].

Urban design and human values: A successful urban design requires the satisfaction of human behavioral values. The analysis of values in urban design includes the followings:

- What people see; that is the ability to really understand the environment
- What people adore; which means the ability to adore, understand and use urban environment
- What people can use: that is the real access to urban spaces during daily activities
- What people remember; that is to remember the experiences of the past good memories from urban spaces
- What people associate; which is related to symbolic, cultural, historical, and spiritual aspects in urban spaces [6].

Measuring Quality of Life

The contribution of urban design to the promotion of quality and conditions of life in biological complexes depends on practicing the concept of quality of life. Aside from the natural factors such as climate [5], topography, geology, plan coverage, view and landscape, what is important here is the definition and evaluation of the elements and factors such as identity, characteristics, and qualities of neighborhood and Hence, rather than using imaginary thoughts on the identification and measurement of the factors, it will be possible to present the quantitative and measurable

requirements. A comparison between urban patterns must clarify how the shape of city affects the citizens' quality of life. Individuals' physical access to urban facilities such as employment, services and recreational center are effective factors in improving the quality of the environment. Accordingly, it is required to measure the spatial facilities of different cities [6].

View Corridors: are direct lines which establish visual connection between two relatively far points via a visual connection channel of at least a significant element.

Privacy: is a complex and culture-dependent concept that can be defined as a personal right in that he transfers what information and under which conditions to others.

Symbols: have been commonly used to transfer meaning in all ages and cultures.

The aesthetic aspects of the environment: Elements and factors are found in urban environments whose appearance will also affect the audience as well as having certain performance; for instance, light, signs, afforesting and green space, colors, urban furniture, views, and elements with historical value [7].

Qualitative factors must also be determined by experts (i.e. designers and people) and then a fusion of the two groups of factors must be gained. They shall not be specific to an area of the city. This is because elements just significant in a certain area of the city cannot be good and proper criteria for the whole city. Their effect must be considered at public spaces area. Accordingly, private spaces can be significant and valuable just when they are considerably visible and (or) significantly used. In studying and controlling qualitative factors, the factors must be regarded for which we can use a certain mechanism.

Characteristics of the Setting

Ghaemshar is one of Mazandaran Province cities with 458.5 square areas (%1.93 of total province area). The city is the southern neighbor of Savadakouh, northern neighbor of Jouibar, eastern neighbor of Sari, and western neighbor of Babol. This is also one of the central cities of Mazandaran with 51.2m height from sea. Ghaemshar is located 260km from Tehran. Population of the city is 320741 based on the individual and housing statistics of 2011 of total population, 203741 live in urban areas and 117000 in rural area. Based on the studies of detailed plan approved for Ghaemshar, about 1062.7 hectare of the city area has housing use which has allocated %39.5 of the area to itself with a per capita about 67.84 square areas. About 26hectare of the city area has public, higher education and technical and occupational use including %0.57 of the city area. Total use area for public welfare services (including park and green space, commercial, sport, official, military and disciplinary, health and well-being, medical, cultural, religious, touristic, and dining areas) includes about 120hectare with a per capita of about 7.7 m². Respective uses are allocated only %4.1 of the city area. Map of Ghaemshahr geographical status has been illustrated in figure 1.

Fig 1: Map of Ghaemshahr geographical status in town, province and country

Literature Review

In a study by Papas et al (2007), the method of evaluating five dimensions of urban design –view and landscape, frontage, human criterion, transparency, and complexity – is described in GIS context. In the study, the relationship between construction environment and urban design is emanated from measuring criteria such as residential density, mixed land use, street doweling, estimation of human activity resources, and access to public transportation of the city. For the sake of more accurate design, the characteristics of constructed space were examined as a complementary criterion. Contemporary researcher ssucceeded to completely evaluate the effect of classical urban design on physical activity via aesthetic and attractiveness of the neighbors. Some of the qualities of neighborhoods such as the green space of parks or natural arena, frictions like noise pollution, air pollution, or structural and architectural abnormalities or urban design attractions are examined and measured [8].

Eknik et al founded a study that examines the spatial facilities of the city and applied fourteen spatial indices to compare between the activities of the organization and land use in four new towns. The indices examine the characteristics of spatial construction in terms of density and access from the consumer's point of view (residents, employer, employees, services and travelers) and producer (cost). the indices include: social contact, employment situations, access to services, distance from open space, concentration of employment centers, access of employment centers to services, concentration of services, distance from city center, reaching workplace, reaching services, residential density, employment density, land cost, road maintenance cost.

The study founded a framework for the total comparison of land use patterns and the patterns of

activities place which are considerably applicable for spatially comparing between cities and neighborhoods.

Theoretical Principles

This study describes the evaluation of six aspects of urban design – conversion, permeability, acceptability, readability, accumulation, and human criterion – in GIS context. The study examines the relationship between the construction environment and urban design which is in urban pattern from the evaluation of criteria such as residential density, mixed land use, street connection, estimating human activity resources, and access to public transportation in Ghaemshahr. For the sake of more accurate design, the characteristics of constructed space were taken to be the criterion. Urban design in the context of this study which is a reflection of city shape at the highest level of transparency and distinction of street components or blocks view; descriptive evaluation methods (mostly subjective and non-objective ones) are defined and determined. The term urban design is also a reflection of order and coordination identifying the way to furnish and how to place natural and synthetic elements in the space. Urban designers are interested in knowing how to observe construction and landscape elements and react to them. They make attempt to create live, desirable, attractive and interesting streets. Executive directors and academic researchers of urban design and landscape architecture have described a quality which has made the construction space desirable, attractive and (or) even encouraged to walk in this space.

Dimensions of Urban Design

Conversion is to induct the concept that a person passing through an entrance and moving from private arena to public one feels openness. The openness can be associated with the structure of the space. At the same time, the openness of the visual corridor and the extension of the view range from privacy to public area can be significantly effective. However, the index and concept have conceptual transparency. Gradually flowing from privacy to public area is also another trick to feel the feasibility of the movement further [9, 10].

Permeability is established based on the principle that the arenas of both sides are not distinguished from each other at all and can permeate into each other a bit. Hence, in mental image of most citizens, the arenas turn into each other softly. Permanence of activities and structural elements from an arena to another, their gradual change and the existence of epitomes of both entrance arenas make great contribution in the same regard [11].

Acceptability describes the concept that the presence of the space natural elements is desirable and makes the gradual change of natural space into synthetic space possible. Maintaining and promoting landscapes and plant coverage define the entrance area of the neighborhood as a special place and helps the movement hierarchy. Reinforcing views and landscapes play a key role in encouraging the cheerfulness of the entrances area. As a result, it must be noted that views not be closed by structural elements and volumes.

Readability is the individuals' navigation tool. Namely, when entering, the significant signs of city index – whether natural or synthetic – must be visible so that the individual can locate his situation. In the same regard, the individual must get aware of approaching decision making point. The index can also be examined in the same regard with the concept of view and landscape discussed in the classical image of the city [12]. View and landscape is the space quality of the place which makes it live and durable. Image making places can specify building or landscape figure tolls as clear as an integrated and transparent organization. Another factor contributing to the readability of the place is order. Establishing relative symmetry on both sides and equal enclosure at the entrance contributes to the organization of this part.

Accumulation in a place – despite all different activities – is related to the space which has resulted in the gathering of people and reinforces its accumulation quality. Time activities also establish accumulation in space and provide opportunities for individuals to get involved in different activities existing in the space. Then, the individual can choose among them and in fact have the possibility to select suitable activity with respect to his own interest or needs.

Human scale is usually considered as the height of the building or width of the street. However, the façade of the buildings and urban furniture can also be effective in understanding human scale. That is the dimensions of a local square must have harmony with human's esthetic abilities regarding the space perception. In this square, social interactions exist at interpersonal level. In addition, the structure of the space must also be so as to provide pause spaces required for fulfilling the above activities. Accordingly, the interface between paths or the square (the width of the path and the angle of its encounter with the square must be designed so as to not to ruin the pause space of the square [13].

Questions, Method, Sample, and Instrument of the Study

Research questions are:

- To what extent can the subjective and non-scientific observations be used in urban planning? Is there any significant relationship between construction environment and urban design?
- Which one of the urban pattern criteria is effective in Ghaemshahr urban design?

In this study, some urban design aspects (such as conversion, permeability, acceptability, readability, distinction, inducting home-sickness,

uniqueness, stillness, accumulation, integrity, freshness, flexibility, peace, friendliness, homeyness, spectacular, discipline, fluency, differentiation, safety, presence, dynamicity, and memorability) were examined in terms of questionnaires on entrance spaces, knot, path and dead alley. First, questionnaires were developed based on the aspects of urban design on entrance spaces, knot, path and dead alley. In fact, the qualitative indices of urban design are embedded in the questions. All the existing residential and non-residential polygons in the city are statistical. Sample of the study was chosen randomly and systematically.

For each neighborhood, a questionnaire was surveyed. The sample of the study consisted of neighborhoods existing in Ghaemshahr (n=36) [11] and were different in terms of use. The sample size was 384 done by Arc GIS software. When all questionnaires were filled out, the content of them was codified and transformed into numerical data from descriptive nominal data. Then, data was entered EXCEL software.

Upon being classified and after elementary analysis, they were transferred to GIS so as to be zoned and scored based on the aspects mentioned. Since the number of questions was not equal for the spaces and since some of the questions were omitted based on the validity test by Cronbach's alpha, the weight percent of scores and responses was applied to zone the quantified qualitative indices. This technique provides the possibility to understand better and compare easier. The plot of Ghaemshahr was prepared based on dividing zone, area, and neighborhood. The plot was used as the basis for field works.

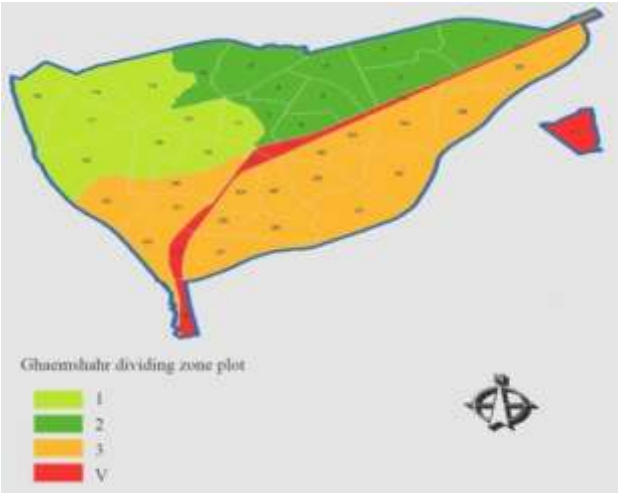

Fig. 2: Ghaemshahr dividing zone, area, and neighbourhood plot [14]

RESULTS

The main question of the study was concerning the exploitation of subjective and non-scientific observations in urban planning and the evaluation resulted from the observations. And, the significant relationship between the construction environment and urban design was the subject of another question. Since a successful urban design requires the satisfaction of human behavior and the analysis of human behavior values in urban design (that is the ability to really understand the environment, the ability to adore, understand and use urban environment, the real access to urban spaces during daily activities, remembering the good experiences of the past of urban spaces and the symbolic aspects in the urban spaces), and since urban design indices have qualitative essence and tend to the mental image of citizens in time and place which include the environment of urban constructions and in fact elementary scientific definitions are developed based on observations and subjectivities.

Zoning plots produced and weight percent tables if urban design qualitative indices which describe the hierarchy of urban environment quality can justify the application of observation technique in the qualitative evaluation of urban design and in urban planning.

In conclusion, we can direct the urban design discussion to a quantitative and statistical issue and take action for the adjustment and (or) replacement of the factors based on the existing structural status and the quantified plot of urban design aspects before designing. Among the actions are:

- Quantifying sextet aspects of urban design to enhance their influence on the quality of urban environment in GIS context.
- Quantitative zoning each of the aspects and developing a complete plot for the city
- Quantitative anticipation of all aspects in gap and non-sampled areas
- Integrating all aspects in GIS to achieve a classified plot of the quality of urban environment based on the indices

Another question is: which urban pattern has been effective in examining the aspects of urban design in Ghaemshar? With a glance at different areas of the city and comparison between the resident population as well as the dispersion of welfare, cultural, educational and etc. facilities, we can consider a checked pattern for the city. In the same regard, it can be noted that it is a non-central system where there are many knots or junctions. All the points are covered by network and the development of the network is (theoretically) ongoing. In central and (or) commercial areas, there are several paths for come-and-go and transverse streets are used for shortening ways and long trips. The zoning plots and weight percent tables of the qualitative indices of urban design which describe the hierarchy of urban environment quality can justify observation method in evaluating urban design and used in urban planning [3].

Permeability index plot begins from class %40 and continues till class %100. Maximum area is allocated to class %60-80. Permeability index plot has been illustrated in figure 3.

Conversion index plot begins from class %40 and continues till class %100. Maximum area is

allocated to class %60-80. Conversion index plot has been illustrated in figure 4.

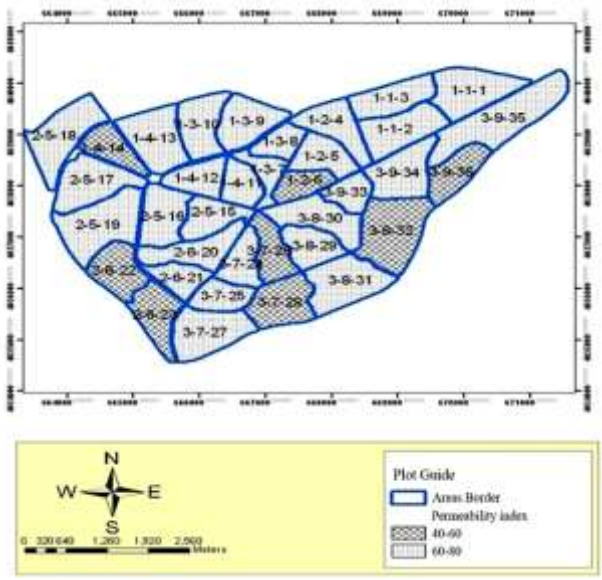

Fig. 3: Permeability index plot [14]

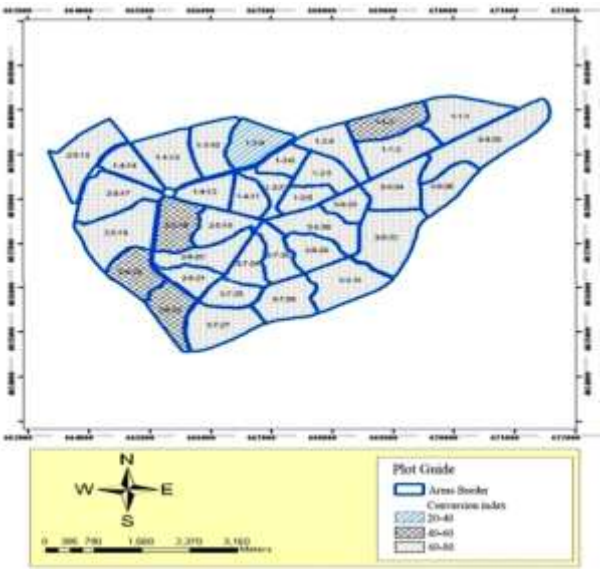

Fig 4: Conversion index plot [14]

Accumulation index plot begins from class %40 and continues till class %100. Maximum area is allocated to class %60-80. Accumulation index plot has been illustrated in figure 5.

Acceptability index plot begins from class %40 and continues till class %100. Maximum area is allocated to class %60-80. Yet, reviewing the plot indicates the significant difference between areas with lower acceptable and areas with lower accumulation and permeability. Acceptability index plot has been illustrated in figure 6.

In readability index plot which begins from class %40 and continues till class %100, maximum area is allocated to class %60-80. The index merely grows dispersedly in a few special areas. Readability index plot has been shown in figure 7.

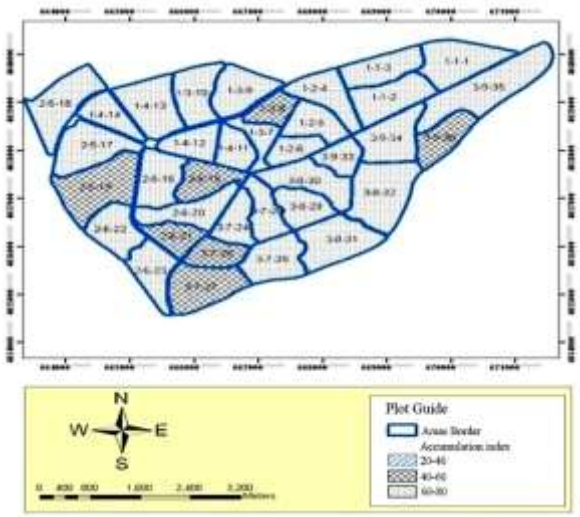

Fig. 5: Accumulation index plot [14]

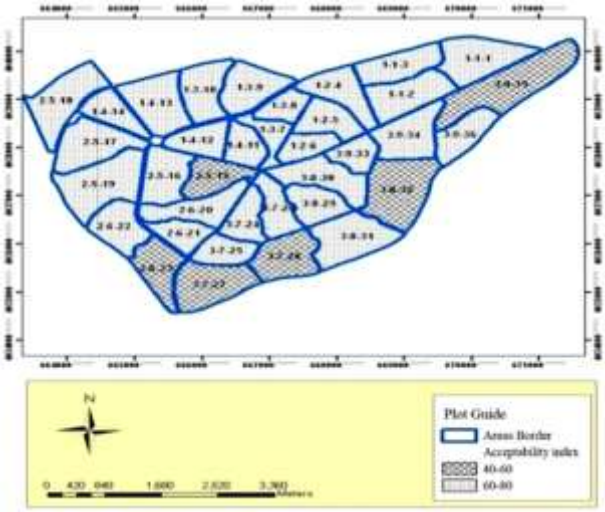

Fig 6: Acceptability index plot [14]

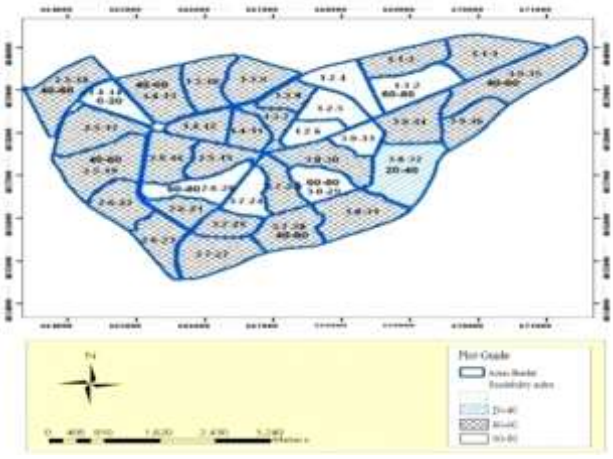

Fig 7: Readability index plot [14]

Human scale index plot begins from class %40 and continues till class %100. Maximum area is allocated to class %60-80. Human scale plot has been shown in figure 8.

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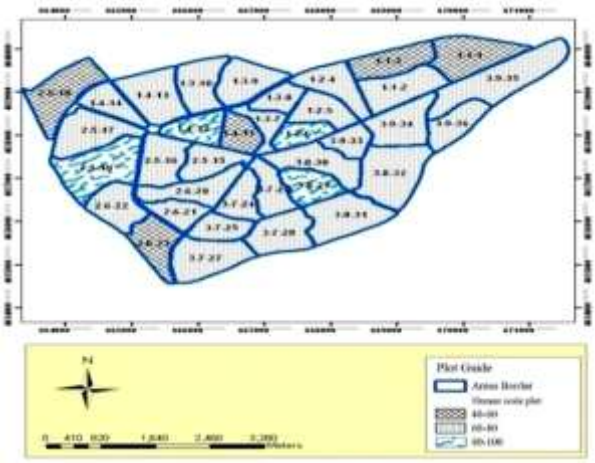

Fig 8: Human scale plot [14]

CONCLUSION

Zoning plots produced and weight percent tables of the qualitative indices of urban design which describe the hierarchy of urban environment quality can be used in urban planning. So, it is possible to take action to modify and (or) replace factors before designing and based on the existing structural status and the quantified plot of the present urban design dimensions.

As seen, maximum square area of the abovementioned classes in Ghaemshahr neighborhoods has almost medium efficiency in a range between %40 and %60 which are consistently dispersed. at the same time, minimum square area is almost in cluster form in a range between <%20 and >%80. To reach a dominant point of view in this regard, we use is potential plots. The plots show in which ranges all or a part of classes are at the same level. Reviewing the readability plots and human scale indicates that most areas of Ghaemshahr are not at the same level of efficiency with respect to the classes and, this shows the low efficiency level of readability index across city. Studying the quantified indices of urban design of the level of conversion, permeability, accumulation, acceptability, and human scale are evaluated as being at the same level of efficiency and the extent of individual's satisfaction of the neighborhood aside from economic and social factors (i.e. The ability to really understand the environment, the ability to adore, understand and use urban environment, the existence and real access to urban spaces during daily activities, remembering the experiences of past good memories and symbolic aspects in urban spaces) at a good level. Among the indices, again conversion, permeability, and acceptability are of the aspects of urban development and increase with the development of the neighborhood. They have better harmony and adaptability with each other. Also, the accumulation and human scale which promote many qualities of neighborhood fit each other further. Readability index has lower efficiency level in most areas regarding the individuals' satisfaction in using urban environment. of course, no significant difference is seen between the level of the index in different areas and it has just gained further class area in some consistent zones. Zoning plots which create appropriate adjustment between neighboring areas with different classes increasingly emphasize on partial balance of design aspects at city level. In the same regard and concerning the satisfaction level of different citizens of various urban spaces – while they can be considered at the same class of designing in terms of the urban aspects – it is possible to imply congruent urban development by different weighing each index. Hence, it is proposed that different areas in city all be considered in urban development and the quantitative plot of each index be highlighted and comparative evaluation of the indices be employed rather than using total neighborhood indices produced from the overlap of sextet aspects and hiding full and empty spaces. Again, based on the comparison between different aspects of indices influence, it is better to allocate various weights to different aspects of urban design and (or) employ the following indices, if possible.

Suggestions

Regarding the zoning plots and the statistical and quantitative diagrams, the followings are suggested:

- Regarding slope and indices drop diagram in different neighborhoods to evaluate adaptability and conflict of indices
- Paying significant attention to minimum and maximum areas in each index
- Reevaluating indices, replacing or modifying and(or) using sub-index, if necessary
- Different weighing the indices by urban designer based on the development of the neighborhood
- Having more specialized look into urban issues and promoting the relationship between urban planning, urban design, and architecture and the formation of return cycle to set the index.

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