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Enhancing Citizens' Visual Comfort by Focusing on Skyline Native Models in Urban Landscape Using AHP Method (Case Study: Imam Khomeini St. of Mashhad)

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I. ***Abstract***
Considering skyline in urban landscape has many dimensions which recognizing and presenting solutions to modify it can have a significant role in improving environment status. Ignoring this important issue has led to visual disturbances and various problems in cities. The purpose of this article is to investigate factors related to skyline in urban landscape in order to enhance visual comfort of urban citizens through them. In this respect, the present study considers the status of tall buildings in urban landscape with the purpose of clarifying dimensions of this issue. How to set skyline in cities can be studied from different aspects. Qualitative methods including observation, interview, and questionnaire are used to collect data, and quantitative analyses of Crosstab (Phi and Cramer's V) and Frequency are used to analyse them. AHP method is also applied to evaluate the proposed scenarios. Finally, the paper presents solutions to shaping an appropriate skyline and a cohesive whole in the first part of Imam Khomeini Street of Mashhad, which can be effective in enhancing physical quality and visual comfort of this street.

Key words: Visual comfort; Visual disturbance; Skyline; Urban landscape;Street

II. Introduction

Skyline and buildings height in modern cities are important factors which require special attention. Sometimes, high altitudes of buildings cause a sense of confinedness in people and sometimes, their low altitude causes a sense of insecurity. For this reason, appropriate and desirable height of buildings is of much importance so as it brings none of the two senses. Employed individuals or residents will be gradually influenced by their surrounding environment; this effect will be reflected in their behaviours. For this purpose, a wall from the first part of Imam Khomeini St. has been chosen in order to measure the height of its buildings and to propose modifications,if necessary. People who do not feel good about an environment prefer not to take that path. This will cause a street or place to lose its value, and people will use it only for their transits. Order, beauty, and scale are created by designing: *order* is based on logical and perceivable arrangement of independent elements, which encompasses the order and relationship between elements; *beauty* is in fact the very quality of sublimity of emotions and the brilliance of mind, which has with itself the sense of aesthetics and external visual effects; *scale* is to proportionate it [1]. Therefore, this paper attempts to have a closer look and clarify dimensions of the effect of constructing tall buildings, setting the skyline, and making models so as to prepare a suitable design for urban landscape.

III. Problem statement

In the studied area, buildings have different altitudes and this has made the vision of the environment undesirable. In this paper, attempts have been made to minimize this height difference so that the axis can have a better vision and a more desirable skyline is set.Buildings height has a special effect on people's behaviours and moods; the importance of this issue has, therefore, made us to
review buildings height. Among benefits of applying this method, we can refer to having access to a suitable height, setting a desirable and ordered skyline as well as creating an attractive and pleasant environment.

IV. Theoretical fundamentals

A. Urban landscape

Urban landscape is one of the most important topics in which architects, urban designers, urban planners, landscape architects, environment designers, and environment psychologists are interested. Urban landscape is something beyond urban planning and designing, and currently, orientation of urban designing and planning in different areas including urban landscape is on its way to stable development. The most important feature of stable urban landscape is that it is introduced as a stable spatial and social structure. The paradigm of stable place can be considered as the general frame of the idea of landscape urbanization in which four elements of "framework", "activity", "imaginations", and "ecosystem" contribute coordinately in conditioning and shaping urban landscape. Landscape of an urban environment is a set of (natural and made) environmental stimuli, the formation of which depends on political, economic, and cultural structures of the society as well as models and dominant norms of that society. Urban landscape can be considered from three dimensions of function, identity, and aesthetics. Aesthetic dimensions of urban landscape can be considered according to two dimensions of framework and perception. Urban landscape with three emotional, cultural, and ecologic dimensions is a new type of fluid identity of city which has a direct relationship with citizens' perceptions [2]. In the modern world, landscape is a vivid and dynamic identity which is on one hand, influenced by humans and their relationship with environment, and on the other hand, influences humans' relationship with environment through associations that have occurred during several years and subsequently changed people's culture and civilization. On one hand, landscape cannot be summarized in a framework because it further encompasses quality and meaning; on the other hand, it cannot be considered an abstract concept since we perceive it through framework and senses. Landscape is,

therefore, a phenomenon which is formed by our perception of environment and intellectual interpretations; in fact, landscape is an objective-subjective phenomenon [3].

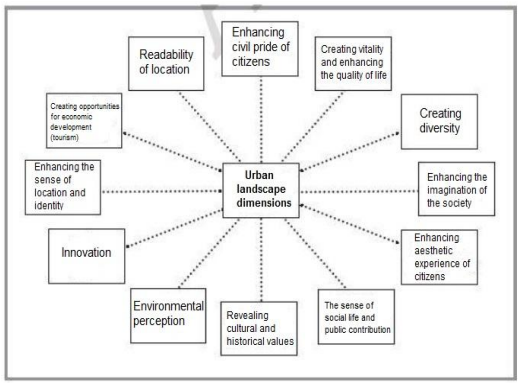

Figure 1: influencing dimensions of urban landscape in spaces

B.The concept of urban landscape quality

In sum, there are three theories about the quality of urban landscape: considering urban landscape as a feature which is inherent to the city framework and is independent of humans as observers and witnesses; considering urban landscape as a fully subjective concept which is formed by the observer and is not related to structure and properties of the physical environment; considering urban landscape as a phenomenon or event which is formed during exchanges between physical and tangible properties of the environment on one hand, and models, cultural symbols, and mental capabilities of the observer on the other[4]. In whatever urban environment they are placed, urban landmarks including tall buildings present important and key information about the relationship of places, elements and different paths, and are used for navigating and routing. Using urban landmarks for environment evaluation and recognition allows individuals to specify their direction in urban spaces, to get familiar with new paths, and to distinguish features of an area or district [5]

C. Definition of high-rise buildings

Although high-rise buildings in Iran refer to buildings having more than 6 floorsaccording to the regulations of Architecture and Urbanization High Council of Iran, approved in 1998, this definition applies to buildings having more than 12 floors according to Tehran Comprehensive Plan, approved in 2007 [6]. Definition of tall buildings in relation to urban issues can be a combination of quantitative and qualitative variables. For example, in some regions of England, tall buildings are defined based on their height, their influence on the surrounding environment, or their major impact on skyline. If a building has one of these features, it will be considered a high-rise building. For instance, according to these conditions, a building with medium height can be function to heightening criteria provided that it affects the skyline or the surrounding environment. Therefore, in this paper, by high-rise building we mean a building which has a major impact on the skyline due to its height [7].

D. Performance of tall buildings in urban landscape

Lynch believes that if public buildings which create more communication between people have more visible vision, they may be paid more attention and people will use them more; otherwise they will be ignored. Therefore, performance of these buildings in urban landscape is of much importance. If this potential is exploited efficiently, it can be expected that the personality of a city is enhanced. Generally, performance in urban landscape includes making the environment readable, making the environment calm, navigating in urban space, being proportionate, accessibility, visual aspects and so on; however, performance of tall buildings in urban landscape in particular includes readability, setting the skyline, and its potential in reinforcing strategic perspectives (if these buildings are used efficiently). As was stated in the section related to the connection of tall buildings to the base, even the performance of these buildings in ground floor and roof can have a significant impact on creating vitality and contributing in public spaces. In terms of performance, tall buildings can have both positive and negative impacts on urban landscape. One of the factors that determines the role of these buildings in urban landscape is the way they are placed and the way the skyline is set, which will be studied regarding their design [7].

E. Skyline

Skyline, which is created based on the building roofs, not only increases visual attraction, but also inducesto our mind some special activities (such as churches or town centers) and usage foci (such as a group of offices or commercial units)[8]. Skyline is an imaginary line which is plotted on the upper border of the height of all buildings and is created by putting built units and the spaces between thembeside each other. The most important effect that skyline has on the spatial perception is through confining the space by buildings altitude. Generally, spatial confinedness has direct relationship with parameters such as shape, size, height, continuity, floor, and space architecture. There are two types of skyline: regular skyline, and continuous and discontinuous irregular skyline[9]. Components of skyline consist of base line and combined line. Base line is a line at which the flat wall is terminated to its roof. Combined line is a line which specifies the end border of street walls or roofs or others. These physical elements include the total volumes that either exist in the composition of building roofs or can be seen in combination with taller buildings behind the wall. The most important effect that skyline has on the spatial perception is through confining the space by buildings altitude. Generally, spatial confinedness has direct relationship with parameters such as shape, size, height, continuity, floor, and space architecture. However, the extent of confinedness varies. Based on the previous studies, in the old texture of Iran, if the ratio of body height to width is 1 (a=45, the angle between horizontal and sight line or the upper edge of the body), the sense of complete confinedness will be felt; if this angle is 18 degrees (ratio=1:3), the minimum sense of confinedness is felt; and if this ratio is reduced to 1:4, space will not be considered confined [10]

F. The effect of different lines on individuals

Unlike a curved line, a straight line will have an obvious and inflexible effect on the mind. Straight line do not need to be visible along its length. Most of the important points are connected through lines in our mind and imagination. Urban elements, specially the important buildings, will create a space in our minds through several lines which make an axis. These straight lines have different implications for us. They either show an orientation or separate two sections. Unlike

horizontal and vertical straight line, oblique straight line has a kind of movement. This line moves from the left bottom side to the right top side, or it moves from the left top side to the right bottom side. In terms of spatial form, any architectural style indicates a subjective concept. In an architectural design, the usage of horizontal and vertical lines varies according to what the building is to indicate. Our judgment about an oblique line always depends on horizontal and vertical lines. An oblique line which moves from the left bottom side to the right top side makes a sense of ascendance, and conversely, a line that moves from the left top side to the right bottom side makes a sense of descendance in our minds.In contrast to straight line, curved line always shows a kind of movement. Among curved lines, two curvatures can be distinguished: regular curved line like a parabola, and irregular curved line. Information redundancy will be continuously decreased [10].

G. Visual comfort

Visual comfort of cities is one of the important and essential components of man-made safe environments for habitancy and living because it is like a large house; and as a house must have features and benefits that make living more desirable and comfortable, a city must also have properties and qualities to provide comfort, convenience, and security. Moreover, a city must be a warm, intimate, and pleasant place like a home so that a desirable life quality is provided [9]. The results of different inspections indicate that there is a statistical correlation between the frequency of behavioural abnormalities with various visual and environmental pollutions. The hypothesis of this paper is that behavioural pollutions tend to have spatial and temporal adhesion of environmental pollutions (including visual pollution). Conversely, visual comfort can be defined for places which provide better qualities and quantities of information and conditions so that they can be used in a sounder, safer, and more desirable way; therefore, they require more official and/or social inspections. Intended index components include four axes: pollution related to symbols (environmental information and readability), pollution related to colours (using colours inappropriately in urban spaces), pollution related to lights (darkness), and visual pollution (visual disturbance)[11].

H. Visual disturbance (visual pollution) and lack of comfort for citizens

Effects and consequences of visual pollution increase over time, and there is no warning sign in main squares of cities to inform people of the level of this pollution. Many of metropolises of our country are not beautiful visually – deformed buildings beside those streets that are full of cars and crowd. Visual and auditory pollutions in cities are one of the main reasons for the decrease of work efficiency of citizens. In other words, many of the conflicts and disputes that occur in cities are influenced by the negative effect of urban pollutions, specially visual and auditory ones. The way urban textures are established; the form of urban spaces, squares, and parks; exterior view of allies, streets, and buildings; design of cities signs; design of communication networks; design of subway and bus stations, and finally urban graphics can all be designed and studied in the form of art and artistic activities. Art is related to structure and frameworkof cities, and ignoring it can cause visual abnormalities. Undesirable and abnormal physical structures and frameworks play an important role in causing behavioural abnormalities among people. The reason is that space and environment influence behaviour of residents; environment and framework impose some behavioural patterns and new social roles on residents;and they reinforce some existing behaviours and weaken some others[12].

V.Methodology

In this paper, maps, information, and visual documents have been collected from information banks and computer networks. Methods of structured observation, interview with regular questions, and questionnaire with multiple questions have been used in this research. Sample size of the studied statistical population was determined as 100 persons based on Cochran's formula. Due to nominal variables, the analysis has been based on quantitative information processing using Phi and Cramer's analysis. Consideration of options has been done by AHP method using Expert Choice software. Experimental field of the present paper is Imam Khomeini Street of Mashhad.

VI.Findings

A. Considering skyline of the studied area

As can be seen in the figure below, skyline is not much high, except the first building from the left which has a higher altitude compared to other buildings. For other constructs, skyline has the minimum possible height, and this has a direct influence on the sense of un-confinedness. Combined skyline has higher altitude in relation to base skyline, and this is due to two residential buildings which are located in the second layer of the body. On the other hand, it should be noted that in the spring and summer, trees on the curbs affect the skyline combined with trees, because they have many branches and leaves. In some parts of the body, height of the skyline combined with trees is higher than that of the base skyline. Generally, we almost observe a uniform skyline and a kind of non-uniformity and asymmetry in the body.

Figure 2: skyline of the studied area

B.Results obtained from questionnaires

In this paper, questionnaire has been used to elicitindividuals' opinions about the studied area and the altitude of existing buildings. The purpose is to find out how much are individuals affected by their surrounding environment and what effect does it have on their minds and behaviours. This section also aims at modifying the altitude of buildings based on the individuals' opinions. According to the conducted surveys, the following results have been extracted from questionnaires.

View: according to the question about a building with a different view, 66% confirmed the existence of a building with different view, and 34% rejected it. **Contradictory altitude:** 52% of individuals believed that there is a building which has contradictory altitude compared to other buildings. By contradictory altitude, we mean the existence of a building which has different altitude from others. **Appropriate altitude:** in this question, the picture of two buildings in the

studied area was shown to individuals so that they express their opinion about the altitude of the two. 56% believed that the building has an appropriate height. **Equal altitude:** equal altitude in a region makes a constant skyline. 42% believed that the buildings of the studied area have equal heights, and 58% rejected it. According to the obtained percentages, it is concluded that more than half of the individuals believed that buildings do not have equal altitude and it is constantly changing.**Disturbance:** 52% of the individuals did not consider different altitudes the cause of visual disturbance and considered them appropriate for buildings. **Balance:** there is no balance between buildings altitude, and each has a unique altitude which causes visual disturbance. **Congruence:** by congruence, we mean buildings dimensions and whether they are congruent in terms of size. 56% (28 individuals) stated that there is congruency between buildings dimensions. **Eliminating buildings:** the purpose of this question was to find out whether eliminating a building with contradictory altitude sounds good to people. 62% disagreed. They believed that it is better to modify its height or if possible, match its altitude with other buildings. **Rhythm:** most of the buildings of this area do not have any special rhythm regarding their height; this will lead to an irregular skyline and lack of consistency in height. **Beauty of the environment:** half of the individuals considered similarity of buildings heights as a factor of environmental beauty, and the other half considered it an unimportant factor which does not contribute in environmental beauty. **Confinedness:** sometimes, high-rise buildings induce a sense of confinedness in people, which is pleasant to some and unpleasant to others. 58% of individuals do not consider high-rise buildings as a confining factor for the environment, and these tall buildings seem normal to them. **Desirability:** in this question, picture of two skylines was presented so that individuals could choose their desirable skyline. 62% chose Figure 1 which showed a uniform skyline. It can be concluded that most people prefer a regular and uniform skyline. **Order:** in individuals' viewpoint, there is no order in buildings, and they do not follow any specific regulation in their construction.

C.Presenting proposed scenarios and evaluating them

In order to realize the objectives of this study, three scenarios were suggested: minimum scenario –in which we are slightly allowed to interfere and are limited. It is better to use plant covering to reduce buildings altitude difference. Since in this scenario we do not intend to change buildings so much, we can create tall plant covering (up to the skyline border) so that it not only makes diversity, but also a continuous skyline. Moderate scenario –in which we cannot make many changes, but we are neither that much limited. It is better to use a vacant land or a building that needs restoration or elimination, of course provided that its skyline is problematic. If there is such a building, we can reconstruct it and modify its altitude. Another solution is to get those buildings behind the main body to have an altitude equal to that of the tall buildings of the body so that skyline breaks are removed (in low-height places of the body). Maximum scenario –in which we are fully allowed to make any changes and do anything that can help reduce height difference. However, this method is not economical. For this scenario, it is suggested that we modify the view of buildings which have great difference with others, and increase the height of those buildings which are lower than others using a suitable plan.The scenarios are evaluated by AHP method and by considering implementation, social, physical, accessibility, economic, and environmental criteria in which coordination, fitness, readability, making the environment calm, visual comfort, visual pollution, visual aspect, enhancing strategic views, being significant, and wall integrity are among the most important sub-criteria. After considering the mentioned scenarios using Expert Choice software, it is observed that the maximum scenario devotes the highest score to itself.

VII. Conclusion

In the present study, criteria of a desirable skyline in urban spaces and different skylines as well as the status quo of the skyline of the studied area (Imam Khomeini St.) were investigated. Skyline is a component of city framework, which affects people and their relations and behaviours. Skyline is defined based on altitudinal levelling of buildings. A regular skyline induces a sense of calmness to people. When analysing skyline, two issues must be considered: on one hand, uniformity and break of the skyline, and on the other, the ideal position of skyline on diversity-to-uniformity spectrum. Ideally, skyline should be broken hierarchically, i.e. if a low-height skyline is desired, it should decrease gradually and hierarchically. Altitudinal levelling of buildings should be analysed according to other components. In an axis that has a tree-planted visual corridor, we should not provide a situation to have extreme shadowing, to induce the sense of confinedness, and to neglect human scale by increasing buildings altitude. As much as skyline uniformity can bore and tire observer's eyes, enormous changes in buildings height in a continuous manner can also cause landscape disturbance. Therefore, maintaining skyline quality and using spatial desirability criteria can contribute significantly in improving urban landscape quality and subsequently citizens' visual comfort.

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