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Recreating and Improving the Quality of Large Urban Buildings by using Dot-Matrix Displays and Lighting Systems at Night: A Case Study of Metro Building at Shahidan Dehbozorgi Intersection – Shiraz

Karim Zohrabi *

Municipality Employee of Shiraz, Shiraz, Iran.

Abstract

What is imprinted in the minds of citizens about the city and urban spaces is often related to the image they receive of their city during the day. Proper lighting of the city and its spaces will not only help people to better understand the environment, but also create a clear and appropriate mental image of the city at night. Proper lighting can be considered as one of the factors that strengthens the identity of a place and enhances its special personality. With proper lighting, the attractiveness and consequently the vitality of the city or the tranquility of its spaces can be increased and the presence of citizens in the space can be strengthened. Signs are part of urban equipment that are placed outside closed spaces, and their main function is to convey a message from a person, group, or institution to other citizens whether written or visual. A 3D element has been implemented on the Shiraz Municipality Metro building (Shiraz Metro) that has the ability to display images at night in 3D. The viewer will see a different image of this building at night and during the day. Accordingly, the main goal of this article is to study the quality of the environment around the Shiraz Municipality Metro building at night through lighting. The research method is descriptive and analytical, and the required data was collected through field studies and observations, and the questionnaire was completed randomly. The results of the study indicate that the lighting of the abovementioned building has been favorable in terms of environmental quality and has enhanced the character of this building.

Keywords: urban spaces, lighting, environmental quality, metro, Shiraz Municipality

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* Corresponding Author: zohrabi.karim1396@gmail.com

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بازآفرینی و بهبود کیفیت ساختمان‌های بزرگ شهری با استفاده از نمایشگرهای نقطه‌ای و سیستم‌های روشنایی در شب: مطالعه موردی ساختمان مترو در تقاطع شهیدان دهبزرگی – شیراز

کریم ظهرابی* کارمند شهرداری شیراز، شیراز، ایران.

چکیده

آنچه در ذهن شهروندان از شهر و فضاهای شهری نقش می‌بندد، اغلب به تصاویری که در طول روز از شهر خود دریافت می‌کنند مرتبط است. نورپردازی مناسب شهر و فضاهای آن نه‌تنها به درک بهتر محیط کمک می‌کند، بلکه تصویر ذهنی روشن و مناسبی از شهر در شب ایجاد می‌کند. نورپردازی مطلوب را می‌توان یکی از عواملی دانست که به تقویت هویت مکان و افزایش شخصیت ویژه آن کمک می‌کند. با استفاده از نورپردازی مناسب، می‌توان جذابیت و در نتیجه پویایی شهر یا آرامش فضاهای آن را افزایش داد و حضور شهروندان را در این محیط‌ها تقویت کرد. علائم، بخشی از تجهیزات شهری محسوب می‌شوند که در فضاهای باز نصب می‌شوند و وظیفه اصلی آن‌ها انتقال پیام از سوی یک فرد، گروه یا نهاد به سایر شهروندان، به‌صورت نوشتاری یا تصویری است. در ساختمان متروی شهرداری شیراز، یک عنصر سه‌بعدی اجرا شده است که قابلیت نمایش تصاویر سه‌بعدی را در شب دارد. بنابراین، بیننده در شب تصویری متفاوت از این ساختمان نسبت به روز مشاهده خواهد کرد. بر این اساس، هدف اصلی این مقاله بررسی کیفیت محیط اطراف ساختمان متروی شهرداری شیراز در شب از منظر نورپردازی است. روش پژوهش، توصیفی-تحلیلی بوده و داده‌های مورد نیاز از طریق مطالعات میدانی، مشاهدات و تکمیل پرسشنامه به‌صورت تصادفی جمع‌آوری شده است. نتایج پژوهش نشان می‌دهد که نورپردازی این ساختمان از نظر کیفیت محیطی مطلوب بوده و به تقویت هویت آن کمک کرده است.

کلیدواژه‌ها: فضاهای شهری، نورپردازی، کیفیت محیطی، مترو، شهرداری شیراز

* نویسندهٔ مسئول: zohrabi.karim1396@gmail.com

Introduction

The human environment is essentially a visual world, and he obtains information about the surrounding environment primarily through his eyes. The eye is the most important sensory organ, and about eighty percent of all information is received through it. Light is the medium that enables visual perception and not only enables humans to see, but also affects human states and their sense of health and comfort. The absence or insufficiency of light causes a sense of insecurity and causes humans to lack the necessary information and lack of awareness of their situation and status. Artificial lighting also creates a sense of safety for humans during darkness (Parhizgar, 2021).

About three hundred thousand years ago, humans began to use fire as a source of heat and light. Flames enabled humans to live in caves. The use of firewood, wooden torches, oil lamps, and tallow lamps brought about decisive changes in the way prehistoric humans lived. In ancient times, artificial light was created not only in indoor spaces, but also in outdoor spaces. The Lighthouse of Alexandria, which was used in the third century BC, is a testament to this. There is evidence from one thousand six hundred years ago that it provided nighttime lighting for the streets of the city of Antioch in Syria. Later, with the progress of humans in all scientific fields, lamps were made that worked using gas extracted from coal. Street lighting in cities of industrialized countries was provided using these lamps in the nineteenth century. The turning point in the development of artificial lighting was the success that resulted from the economic production of electricity and the construction of the first incandescent electric light bulb by Edison. Electric bulbs were the first sources of light whose illumination was free from undesirable side effects such as smoke, unpleasant odors, and were very easy to use. Since the construction of the first electric bulb, many advances have been made in this field, so that now many manufacturing companies are researching and producing various types of street lamps and lighting (Adel, 2022).

Humans always need light. Without light, humans are unable to clearly understand their surroundings. Without light, they will not be able to understand color, depth, space, and volume. Darkness has always been a confusing issue for humans, to the extent that it is used to describe ambiguous and complex issues. Darkness always acts as an anti-space for humans. Therefore, humans always try to escape from darkness as much as possible or somehow illuminate the space for themselves, for example by using moonlight or a lamp.

What is imprinted in the minds of citizens about the city and urban spaces is often related to the image they receive of their city during the day. With proper lighting of the city and its spaces, it will not only help people to read more, but also to create a proper and clear mental image of the city at night. Proper lighting can be considered one of the factors that strengthen the identity of a place and enhance its special personality. With proper lighting, it is possible to increase the attractiveness and, as a result, the vitality of the city or the tranquility of its spaces and strengthen the presence of citizens in the space (Omidi & Shahbazi, 2020).

The history of the emergence of the concept of quality of life dates back to the time of Aristotle in 385 BC. In this era, Aristotle considered living well or doing things well to mean being happy. Research on quality of life has been raised as a new topic in sociological, economic, geographical and health studies in many countries during the last four decades of the twentieth century. In this regard, by studying and evaluating the concept of quality of life, the field of cultural, social and economic planning is increasingly provided, and thus society can more and more quickly coordinate and align itself with the required conditions. One of the dimensions of this concept is environmental quality. Environmental quality itself is evaluated in the form of two dimensions of physical and environmental quality. The physical environment is examined in order to raise the quality level of citizens' living space, including: attention to the architecture of buildings, homogeneity, proximity, interconnection, walls, coverings, quality of structures, skyline, etc. Environmental quality also emphasizes the quality of the urban environment and the health of citizens. Urban space, as a space where people spend a large part of their time, should create a sense of peace, safety, and beauty in citizens and ultimately lead to their health level. One of the

main factors in this regard is paying attention to the physical and functional quality of urban space, especially in the central parts of cities (Falahat, 2019).

Shiraz, as the capital of Fars Province, plays a significant role in providing services to its citizens and other cities in the province, as well as neighboring provinces. With a population of 1,995,500, this city is the fifth most populous city in Iran and the most populous city in the south of the country. Khobarnagar Street is one of the busiest places in the city due to its proximity to Shahid Avini Metro Station, Chamran Boulevard and Namazi Square. Therefore, the study of the lighting of the metro building and its impact on the urban environment has been evaluated in this study.

Environmental Quality, Lighting, Concepts and Definitions

Cities have always been centers for innovation and creativity. According to Mumford, the city is the manifestation of civilization, which has produced many innovations over the centuries. Creativity is the mental and rational activity to create a new and original idea. Creativity involves thinking about a subject anew, based on first principles, based on experience, radically, having the capacity to rewrite rules, going beyond constraints and conventions, finding common thematic strands among those that are apparently separate from each other, and being flexible in view of marginal situations. And in the case of buildings that are used in a way during the day and in a different design and shape at night, and are used for a purpose other than what they have during the day, it is an idea that has been considered in recent years (Asadi et al., 2019).

The interrelation and impact of the quality of the urban environment on the quality of life of city residents has been emphasized by Quinn Lynch. He says: If urban design is to be useful, it must be able to help improve the quality of human life by improving the quality of the physical environment. When it comes to environmental quality, the main attention and emphasis is still on the physical structure and form. The issue that has been most concerned in studies related to environmental quality has been the construction of the city and the legibility of its form. These studies include elements and factors such as identity, neighborhood characteristics and characteristics, expressiveness and clarity of street patterns, etc. Simultaneously with the emergence of environmental crises, environmental quality was recognized as part of the general concept of quality of life. This concept has been assumed to be a comprehensive reflection of a person's sense of health, including all factors that contribute to human satisfaction, and environmental quality has been used as an indicator to measure the degree to which the environment is suitable for human living. The concept of urban environmental quality can be defined as the degree to which the entire environment or some elements of the environment at the city scale, such as the atmosphere and water, are suitable for human living, the urban economy, and the social environment (Shiraz and Suburbs Urban Train Organization, 2014).

Attempting to establish a comprehensive and restrictive definition of urban environment quality that is rooted in superficiality will not be fruitful. And it will even be harmful because the quality of the urban environment is the result of a complex combination of the shape of the physical elements of the city and the existence of urban activities and elements of the natural environment. Such a definition summarizes the achievement of quality or the improvement of the existing quality in the city in the approval of a few criteria and the implementation of a few simplistic directives. Meanwhile, the thinkers of the city school from the distant past, namely Greece, China and ancient India, and the researchers of the contemporary era since the beginning of this century have focused all their efforts on the symbols, elements and values of a quality city, and with the aim of being concise and useful for decision-makers, the concept of urban environment quality should be sought in two issues (Basiri, 2019):

1) Physical elements
2) Activities through which the city becomes a city

According to the definition of lighting in the book Concepts and Keywords of Urban Beautification written by Mr. Samad Jafarpour, in the Night Identity of the City; light is one of the most important qualitative and symbolic factors and has a special place in terms of

function in architecture and urban planning. The main function of light, whether natural or artificial, is to illuminate spaces and building forms, which we call illumination. However, light can be created using architectural ingenuity and paying attention to three factors:

1) Aesthetic
2) Conceptual and semantic
3) Symbolic

It is used to redefine urban spaces. Signs are part of urban equipment that are placed outside closed spaces and their main function is to transmit a message from a person, group or institution to other citizens in the form of signs, whether written or visual.

Studying and investigating in order to formulate physical criteria for the quality of the urban environment and improve these indicators requires a comprehensive approach, planning, and field observations. The research method in this study is applied in terms of purpose and is descriptive-analytical in methodology. In coordination with university professors, a practical test was designed to examine this impact, which was prepared through a questionnaire and given to respondents with different visual literacy levels, and was used qualitatively by scoring. Finally, using SPSS software, qualitative data was analyzed and converted into quantitative data to measure the impact of lighting on the beauty of the urban train building. For this study, a statistical population of 50 people consisting of 5 university professors, 10 urban design students, 10 architecture students, and 25 ordinary people with different levels of knowledge was used. Given that these three selected groups have different visual literacy and each group has different criteria for expressing lighting and quality of life, therefore, selecting this statistical population can provide the basis for measuring the impact of light (natural and artificial) on the quality of life at night (Vakili, 2019).

Study Area

Shiraz is the capital of Fars Province and the largest population center in the southern half of the country, covering an area of 10,479 square kilometers, The study area is the central building of the Shiraz Metro, located in District 1 of Shiraz Municipality, on Khobarnegar Street, Shahid Avini Street, opposite the Shahidan Deh Bozorghi Bridge. In the vicinity of this building, there are the Shahid Avini Metro Station, Shahid Dastgheib High School, and the crossing point to Namazi Square and Chamran Boulevard, two busy points in the city. Given that the Shiraz and Suburbs Urban Train Organization is responsible for the construction and operation of the Shiraz Metropolitan Metro, and the adjacent buildings are places where people travel, it should have some visual characteristics.

Figure 1. Location of the central building of Shiraz Metro

The building in question, enclosed in metal on one side and a stone wall on the other, attracts attention, impressing every viewer with its cold and monotonous atmosphere, so that the next time they do not pay attention to this building, and behind this structure at night, another image attracts attention, as if there was no mention of the structure that was visible during the day.

Figure 2. Aerial view of the central building of Shiraz Metro

Figure 3. View of the central building of Shiraz Metro at night

This three-dimensional element, which is being implemented for the first time in Shiraz with a new design, consists of metal parts with different angles that present the image according to the light radiation in different parts and angles. (The role of the artistic image of Shahid Doran) can also be seen from a distance due to the dimensions of the image. This three-dimensional element has been displayed on the facade of the Shiraz Metro office building. It is able to occupy the mind of every viewer with interesting and spectacular images on various occasions and, in terms of informing passers-by, it can use advertising

and citizenship messages if needed. Considering the location of the building, the above sign can be used in many ways to increase citizenship culture and introduce the city's celebrities.

One of the sets presented regarding urban design qualities is Green's set of criteria. In an article titled The Shape of the City published in 1992, Green identifies four main components for urban design quality, each of which consists of several elements as follows:

a) Function: includes connectivity, security, climate comfort, and diversity.

b) Order: includes coherence, clarity, continuity, and balance.

c) Identity: includes focal formation, unity, personality, and uniqueness.

d) Attractiveness: includes scale, visual and functional alternation, vitality, and harmony.

Brian Goody, a prominent urban theorist, lists the desirable environmental qualities in the following order in his 1993 article (Two Gentlemen in Verona: The Qualities of Urban Design) (Shiraz and Suburbs Urban Train Organization, 2014).

Vitality, harmony with the existing context, diversity, human scale, permeability, possibility of personalizing the place, legibility, flexibility, measured and controlled evolution.

In this regard, preventing behavioral abnormalities through appropriate design and optimal use of the built environment is essential. Since urban design is an activity to improve environmental qualities, paying attention to these qualities at night is also considered one of the duties of urban designers. Providing guidelines for lighting urban spaces is one of the most important measures in this regard.

In an article presented at the North American Society of Lighting Engineers, the organizers of these conferences were concerned with discussing the goals of lighting. Therefore, one of the most basic and main goals expected from lighting urban spaces is to create a sense of safety and security, and yet the relationship between lighting and security is very complex. The term security in the concept of lighting design is often used with the aim that lighting provides a sense of calm and freedom from fear in people to use areas.

Moayedi, in a study using a descriptive-analytical method, has examined the effect of lighting on creating a sense of vitality and dynamism of urban public spaces at night, and also analyzed the role of the vitality of urban public spaces in increasing the level of citizen presence and creating nightlife in the city. The results of his studies show that the vitality factor, including components such as diversity, activities, safety, security, accessibility, comfort, cleanliness, identity, participation, aesthetics, readability, sense of belonging, and efficiency, prepares urban public spaces for the presence of citizens. Also, Motavasli and Bidsheki have analyzed the role of light pollution on the quality of urban spaces and furniture from the perspective of passers-by on Farrokhi Street in Yazd. This article uses a descriptive-analytical and field research method in terms of study method, and documentary and survey methods have been used to collect information. The purpose of this article was to examine the lack of a common and uniform pattern of lighting, the lack of attention to the visualization of passers-by, the predominance of commercial motives and economic profit over urban development rules and regulations, inadequate supervision of construction and high-rise buildings, and the continuous consumption of energy, and the installation of inappropriate lights with a direct angle of radiation without protection and at a high height. Considering the above-mentioned issues, the research findings show that from the perspective of passers-by, light pollution has had an increasing impact on the quality of urban space and furniture.

The main objective of this research is to investigate the environmental quality in the central building of Shiraz urban train and its lighting. Appropriate lighting can be considered one of the factors that strengthen the identity of a place and enhance its special personality. With appropriate lighting, the attractiveness and, consequently, the life of the city or the tranquility of its spaces can be increased and the presence of citizens in the space can be strengthened. With an emphasis on physical and functional indicators; in recent years, the use of indicators and criteria for the quality of the living environment has become common in various countries, both developed and developing.

Physical Components of Urban Environmental Quality

In research on urban indicators, one of the fields of the social indicators movement, founded in the late 1960s by Raymond Bauer, urban indicators are defined as: statistical series or any other evidence that allows us to assess the current and future situation based on our goals and values, as well as to evaluate specific plans and programs and determine their effects. These indicators include:

Sensory richness: It can affect the consistency of options related to people's sensory experiences, a quality called (sensory richness).

Legibility: It can affect how and how easily people perceive the opportunities and situations that the environment presents them, a quality called legibility.

Durability: It means lasting, that is, that which has the power of life and life in it and will survive. In the definition of durability, the first thing that comes to mind is the concept of staying over a long time.

Sustainability: Sustainability means stable, durable, that is, something that remains fixed and established and the stability of stable phenomena.

Lighting: Lighting is an interdisciplinary concept that deals with complex concepts and areas from a variety of humanities and art disciplines. It can be said that this concept is the qualitative and artistic lighting design of a building or space that depends more on qualitative, emotional, and aesthetic aspects than on standards and measurements of lighting levels. However, the two concepts of lighting and illumination are closely related to each other, and in practice, their separation is not possible or desirable in many cases.

Findings of the Study

Based on the observations and studies conducted in the physical assessment of the quality of the environment in the area, there are weaknesses and strengths that indicate the level of environmental quality in this building, and each of these effective components has been examined, including: durability, stability, sensory richness, readability, and lighting.

1) Sensory richness: In order to examine the sensory richness component, indicators such as color status, sense of calm, symbols, and color pleasantness have been used. Based on the studies conducted, the sensory richness criterion in the building in question is in an average and desirable state with an average of 3.
2) Readability: In order to examine the readability component, indicators such as pedestrian guidance and guidance, new construction with old construction, and separation of sidewalks from the street have been used. According to the studies conducted in the present study, it is in an average state with an average of 2.92.
3) Durability: In order to examine the durability component, several indicators (images of the sign, staying in the mind, its effect on the passersby) have been evaluated. Based on the researcher's observations, the durability component in the building under study is in a moderate to low and somewhat undesirable condition with an average of 2.75.
4) Sustainability: In order to examine the sustainability component; the indicators of environmental compatibility and public space compatibility have been evaluated, which, like the durability component, are in an above average and somewhat desirable state with an average of 3.09.
5) Lighting: In order to examine the lighting component, according to the studies conducted, the lighting criterion in the building in question is in an above average and desirable state with an average of 3.27.

Table 1. SPSS Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
حسي غناي	93.915	49	.000	3.00000	2.9358	3.0642
خوانايي	108.479	49	.000	2.92500	2.8708	2.9792
ماندگاري	119.086	49	.000	2.75500	2.7085	2.8015
بابداري	76.762	49	.000	3.09000	3.0091	3.1709
نوربردازي	104.502	49	.000	3.27500	3.2120	3.3380

Priority of Components

Based on the observations and information obtained and the results of the Friedman test, the prioritization of components and the main hypothesis of the research, which is the environmental quality and the improvement of the character of the Shiraz and Suburbs Urban Train Building, it shows that the use of the above building at night and its use as a signboard in the dark of night is in a desirable and satisfactory condition. Thus, the above building competes with other buildings in the view of citizens and this building has a desirable visual environment.

Conclusion

In order for a city to be ready for people to live and create a platform for citizens to be happy and cheerful, various activities, from hard to soft, must be carried out in it. Developing cities and transforming them into metropolises requires new activities, and on the other hand, city managers must also provide the necessary facilities to increase citizens' satisfaction. In order to increase satisfaction and also create a platform for citizens' happiness and cheerfulness, in addition to building infrastructure, attention should also be paid to the visual beauty of the city. Due to the lack of a common and uniform pattern and lighting, lack of attention to the visualization of passers-by, the predominance of commercial motives and economic profit over urban development rules and regulations, inadequate supervision of constructions, etc., the appearance and landscape of current cities have faced serious problems. This great mission is the responsibility of city administrators (mayors, city councils, etc.) who can work on developing urban regulations and guidelines. For example, it is good to first localize the design and provide local solutions as a basis for planning and decision-making in order to get rid of the problems of plans and their incomplete implementation. Therefore, by considering the limitations and considering the existing capacities and potentials, designers can benefit from the future of the city and improve the situation and increase the level of environmental quality, and by giving personality to buildings with large facades, they can strive to improve their environmental quality.

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