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The impact of lighting and illumination on safety of the parks

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A R T I C L E   I N F O

A B S T R A C T

This study attempts to investigate the role of park lighting in providing security and its role in deterring crime and corruption while emphasizing the need for light as one of the most important elements of urban landscapes. Park lighting is not a matter of decoration. It is rather a way to respond to our search for an advanced method of better provision of safety and comfort of an environment. Today, lighting defines the identity and the nighttime landscape of parks and the lack of light or darkness at night results in problems such as increased incidents, accidents, crime and delinquency and reduces social security. Humans are susceptible to conditions. An important part of these conditions are imposed on them in the form of environmental conditions. The five senses form their most important links with the surrounding environment and of the five senses, sight is of utmost importance. The major information and data around us includes things that we see. From a psychological point of view, the method of lightning in an environment has a very decisive role in how we act and react. Therefore, the knowledge of light and its effect on individuals can lead to a conscious attitude towards the design of human environment. Light is the clearest, softest and easiest existing structural material which determines the quality of the human environment. It enhances the safety of parks and increases the park users at night.

1. Introduction

Different theories have been proposed to detect the causes of the creation of cities and human societies, one of which considers the issue of security and safety effective in this field. In many cases, the design type of physical spaces has certain roles that make an area or space unsafe or secure. Of course, the fact that parks and gardens play an important role not as utilization but as an urban green infrastructure should be considered at the highest – metropolitan- level of design policymaking. If we divide the available spaces into two under-roof and outdoor spaces, the interior or the so-called under-roof spaces should have some characteristics such as the protection of privacy. On the contrary, the outdoor spaces or the spaces in the open air should be a place for social interactions, being subject to the public, and should be experience able and equal spaces for all in order to have a healthy life. Indeed, as a house and all its interior spaces provides a safe shelter for family and guests, a city and its spaces should provide safety and security for all residents

and administrators equally (Lubuva and Mtani, 2004). Some call safe spaces "defensible spaces ".In fact, they are spaces in which people are more active, feel more secured and there is fewer incidences of criminal activities.

1.1. Literature Survey

Bova (1988) investigated the different aspects of the impact of light on human life and the environment and has highlighted the different usages of light in different industries and arts. The book "Daylight in Architecture" by Benjamin Evans in the field of utilization of natural light in processing and its practical applications in architecture has proposed many issues and examples. Steffy (2002) in the book "Architectural Lighting Design" referred to the principles, methods and artistic and technological aspects of architecture lightning through artificial light and comprehensively take into account the cycle of a lightning project in monuments and buildings from the beginning to the end. The lighting research project of urban parks (Prelovšek et al., 2012) has investigated two urban parks in Slovenia and presented some guidelines to improve the quality of park spaces at night which

can also be generalized to other similar urban spaces (Herbert and Davidson, 1994). In their joint article, they considered the role of street lighting in reducing crime and corruption and evaluated the effects of street lighting in this field with a very significant positive correlation. The article by Knez (1995) examined the effect of lighting on human's temperament and investigates the effect of interior lighting of buildings on human with different intensities and colors and regards it as one of the factors effective in human performance in the workplace and life and has shown that its effect on men and women is different. Seitinger (2007) focused her research on urban screens (urban television) and pointed out that urban lighting is an issue that still has a potential capacity for study and research. In this regard, she emphasized the existence of a different expertise for a comprehensive lighting design. In Iran, while considering the general principles of lighting of urban parks, Adibi et al. (2006) point out that in their paper that night landscape should be taken into consideration by designers as an integral part in the design of parks and gardens simultaneously with other sectors. This article regards park lighting effective in the readability of signs, pathways, provision of facilitation and security and encouraging citizens to the use the parks at night. Today, in many major cities around the world, urban managers try to establish a connection between people, lighting and urban environment by using lighting consultants and implementing different plans and hold a social approach to urban lighting. Urban lighting is a functional field that despite its progress still has important and effective capabilities that must be taken into consideration. In this study, we seek to look at lighting from the viewpoint of its effectiveness in increasing the security of urban parks.

1.2. Statement of problem

Urban lighting design especially park lightning is not a matter of decoration. It is, rather, a way to respond to our search for an advanced method of better provision of safety, comfort of an environment. Today, lighting defines the identity and nighttime landscape of parks and the lack of light or darkness at night result in problems such as increased incidents, accidents, crime and delinquency and reduces social security. In architecture, urbanism and green area deal with a functional lighting beyond brightening the space and designers consider it as one of the major components. Today, urban life has caused the range of citizen activities to continue into the night.Accordingly, the night life has become a part of urban life. As a result, in order to create a suitable and secure ground for urban nightlife and to improve the visual quality, lighting design in parks and urban spaces is of interest to designers. Park landscape both in daylight and at night should have form and content. Light in urban design has different

qualities and characteristics such as being a tool for notification, identification in the areas and enhancement of identity and security of centers, representation of a symbols, cultural and natural heritage and urban spaces such as sidewalks, squares and parks. Providing security, making park spaces pleasant and having a positive impact on the psyche of the citizens can be referred to as the factors contributing to the importance of the park lightning and it can be stated that light is an architectural element of environment design and citizens have realized the importance of urban lighting, it can also be declared that light and has a high potential to increase the efficiency and performance of individuals. In addition, it can redesign urban and architectural spaces of an environment and make them beautiful and secure at night.

1.3. The importance and necessity of research

Today, although the functional role of lighting in Iran has been to some extent considered as one of the methods of enhancing and shaping urban spaces at night, less attention has still been given to its capacity as an effective factor in attracting visitors and enhancing the security in parks. The present study is important since in addition to evaluating the role of lighting as an important and effective factor in increasing in the number of visitors, it investigates and improves parks safety.

2. Research methodology

This research is a kind of descriptive and documentation study. The required data has been collected by studies of library documents and field visits and observations .Maps and satellite images in the study area have been used in order to organize field data. Furthermore, after investigating the lightning of the site, a set of suggestions were made for lamp bases and lighting at Laleh Park.

2.1. The theoretical literature of definitions and terminology

2.1.1. Lighting

Lightening is a combination of science and art and it is an issue about how people illuminate their surrounding environment, how they feel the light and what their reaction to it is. Lighting is an issue in the field of biology and physiology as it is related to psychology. Good lighting in any context (urban, architectural, green space) depends on the accurate understanding of the features of the lighting case. This is perhaps the most important stage of the set of procedures in lighting process. Answers to some questions such as "what kind of lighting do people need in order to implement their plans properly?" or "what lighting method provide more comfort for them?" are among the important issues that require

full attention by a lighting designer in lighting. What the eyes see from the environment and what our brain perceives are influenced by the amount of light reflected from various surfaces. Therefore, knowing the properties of materials and their surfaces and paying attention to the amount of light reflected from them are other principles of successful lighting. Lighting can sometimes limit and expand the extent of human sight. In addition to its functional tasks, lighting can also carry out other tasks. In his book "Daylight in Architecture", Benjamin Evans describes those tasks as follows: a symbolic, common, pleasing, simple, natural and at the same ambiguous use of light to open the window of human imagination is biggest task of lighting in our time.

2.1.2. Park lighting

Park lighting is in fact a combination of lighting of accessories, park buildings, furniture, lamps and lighting bases, symbols and sculptures, plant lighting, etc. that in addition to providing the conditions for continuing activities and functions of the park at night, it plays an important role in the establishment of security and comfort and attractiveness of parking spaces. Today, in order to improve the lighting, the role of some organizations such as Lighting Urban Community International (LUCI), lighting program, people and the city as well as lighting festivals and workshops cannot be ignored. Inspired by lighting workshops and festivals, lighting designers, urban designers, urban planners, green space engineers, architects, public organizations and urban managers can investigate the lighting method of urban environments especially parks , and explore how they affect the citizens (Fig. 1).

Fig. 1: lightening

2.1.3. Social security

Social security is the tranquility and peace of mind that should be provided by any society in economic, social, political and judicial fields for the society and its members. Therefore, social security is nothing but a state of peace of mind from fear, threat and anxiety and protection of life, property, honor, identity and beliefs from any threats and attacks.

2.1.4. The importance of urban lighting and its role in providing security

City is an environment with much diversity, with less or more facilities, parks and gardens, wide and narrow neighborhoods and with different streets and pathways that links together social spaces. Urban spaces establish the closest relationship with people and environment and thus play a significant role in giving identity and a sense of relief to citizens. Beauty, neatness, cleanliness and consistency are the important characteristics and criteria for the evaluation a peaceful city. All new facilities in today's cities as in the past are not capable of providing peace and security for citizens. Due to the high concentration of population and activities outside the human scale and profusion of vehicles, they gradually distanced themselves from the parameters of peace and security of urban space.

The factors that destroy urban security, threaten and decrease the security of big cities are numerous. Some urban areas are one of the main factors that threaten the security of cities. These spaces are usually invisible that is why they are considered as cozy and safe for unauthorized and abnormal activities. Urban under stairs, inside the underpasses, overpasses, pitted grounds and holes are some examples of indefensible spaces in cities. This is where the importance of lighting as one of the main factors in providing the security of urban environment is revealed.

Lighting and light design belong to art and science and they require proper understanding of the function of light sources as technical and artistic tools. Lightings should be completely evaluated in different sizes. By proposing good ideas in architectural design and landscape architecture, lighting becomes an element more important than a merely decorative tool. Another advantage of outdoor lighting is that it lets you walk easier during the night and darkness. Moreover, it prevents crime in the vicinity of your neighborhood.

2.1.5. Social security and the role of lighting in deterring crime in parks

Social security and security in general are directly related to space and components of parks. A suitable parking space to a large extent provides security and inappropriate space destroys that security and provides the context for all kinds of social problems and predicaments; inappropriate urban spaces, defenseless spaces, insecure parks, cities with architecture merely for men are all factors threatening urban and social security. One of the important principles in reforming these spaces is using good lighting and lighting design. Nowadays, security is one of the indicators of life quality in cities and social problems are considered the most important different consequences security. Parks are

one of the components where social abnormalities occur. Currently, when women go to park from every class with every kind of cloth and makeup, encounter problems in leisure and recreation there. For example, lack of good lighting at night between 6 and 10 pm is an important factor that prevents peace and security especially for women. Some technical conditions in urban areas, especially in parks can be directly linked to the increase or decrease in criminal offenses. The existence of some mechanisms also prevents crime. Studies show that dark and poorly lit spaces are sometimes good places for financial and sexual assaults.

2.1.6. Park lighting, providing security and comfort and increasing visitors at night

Providing security in parks for having comfort during nighttime visits and activities are one of the important factors in park lighting. Security has always been of great importance in order to attract visitors and according to the survey conducted in 1994, 66 percent of visitors stated that when choosing a place or a park, the issue of security is their first priority. Several studies have shown that the increase in the intensity of light is accompanied by a sharp reduction in nocturnal crimes. These studies emphasize that higher brightness level induces a more secure feeling in visitors and improves the quality of life.

2.1.7. The role of light in providing the security of green spaces and parks

In the design of urban landscapes, one-dimensional view of green space or other urban factors will be a wrong and futile approach. In fact, in order to improve the quality of an urban landscape, all the factors effective in it should be taken into account. Intangible aspects of civil life, such as poverty and richness, dominance of certain institutions and values, aesthetic tastes of subcultures, historical depth of a city, the level of safety and security of the society, society's respect for social conventions and other factors via a system of "signs" made external manifestation and positive or negative evaluation possible. Light is one of these signs, it forms and is formed. Soul creates a place and when its elements are created, they emerge from them and change by the passage of time without changing the structure. Currently, one of the challenges in security and safety of parks is paying attention to cooperative management and involvement of all institutions related to these two concepts in the design of strategies, construction and macro management of parks. In fact, relying only on the missionary and operational presence of each of the institutions related to the concept of security and safety and their lack of involvement in the areas of macro management are resulted only in an insular structure.

3. Analysis of important areas for park lighting

3.1. Entrance

The main entrance is generally the introductory spaces of the complex, therefore, their visibility and recognisability of the surrounding space should be easy. Thus, for lighting of this section the bright lights and searchlights are to be mainly used. Using the proper radiation angle in a way that does not cause glare in people's eyes and it is also effective in making the entrance beautiful are some of the lighting features of this section.

3.2. Green spaces

Lightening of bulk of shrubbery and plants can affect the establishment of public visual features and better access to these spaces and dominance over them and the clarity of vegetation can be effective. It should be noted that different flowers, grass, trees and plants manifest themselves in various colors and each of them is beautiful in special lights. Therefore, different methods should be used for their lightening. Many plants that are not noticeable during the day with natural light create an interesting landscape when they are lightened in a dark background. Trees are the main and dominant component of green space so they can be used as optical elements and be considered as surfaces that create the conception of dimension.

3.3. The surface of lakes

Light should not be reflected directly on stagnant water. Instead, by using mirrors and glass, light direction should be shifted and reflected on water so that the image of trees and other objects will be reflected in it. The dancing water fountains cannot be clearly lit because the light should be passed through water powder. Therefore, the lamps can be installed below the water surface.

3.4. Bowers and picnics

Lighting design in sitting places should also be psychologically carried out so that people can feel relaxed and secure while sitting in a place that has good lighting and protects people's privacy. On the one hand, these places should not be surrounded by bright floodlights and lights and on the other hand, they should be dark or be designed light by poor lighting.

4. The important principles in the design of park lighting

- Lighting in parks should be distinguished individually and a specific lighting design cannot be applied to all parks.
- Street lights adjacent to parks should be taken into consideration.

- The lightning should not irritate adjacent neighborhoods.
- Special attention should be given to the maintenance.
- Adequate light should be provided according to the function of the environment.
- It is necessary that lights and bases be coordinated with park furniture.
- The appearance and structure should be aesthetically of particular importance given
- Electrical energy consumption is to be optimal.
- For the security purposes, it should be possible to identify people's faces from a distance of at least 4 meters.
- It is better that barriers, stairs and downhill be visible.
- Signs, signposts and directions should be detectable.

5. A Case Study: Lighting of Laleh Park in Tehran

5.1. History

Laleh Park with 280 thousand square meters is located in district two of Tehran (Fig. 2). Over the past years, the land of Laleh Park belonged to the Army. This land was known as Jalalieh hippodrome and was used for parades. The army transferred the related land to the Ministry of Finance, at the request of this Ministry. The Ministry of Development and Housing at that time had a mission to develop a plan for this area. The northern part of the park was allocated for public cultural facilities and the southern part was considered solely for the park. It was designed by the famous French designer "Zhufeh" and other Iranian park designers. Other executive operations were carried out by the Municipality. The Municipality continued the operations according to the plan until Farah Park was finally established in 1967. After the victory of the Islamic Revolution on Bahman 1979, the name changed into Laleh Park. Currently, the park is located in District 6 of Tehran and from the north it ends in Dr. Fatemi Street, from the south it ends in Keshavarz Blvd, from the West in Kargar Street and from the East it ends in Hijab Street. The Museum of Contemporary Arts, Carpet Museum of Iran and Laleh Hotel are located in the vicinity of the park.

Fig. 2: Location of Laleh Park in Tehran

In park lighting, the graded values in standard EN 13201 are observed to enhance the security and according to field studies conducted on the park, most spaces met the standard. To enhance the security in the site, all spaces should meet this standard.

5.2. Pedestrians' passages

- The average intensity of horizontal lightning: 3 to 20 lux
- Minimum intensity of horizontal lightning: 0.6 to 8 lux
- Semi- cylindrical intensity of lightning: 0.5 to 5 lux

5.3. Cyclists

- The average intensity of horizontal lightning: 2 to 15 lux
- Minimum intensity of horizontal lightning: 0.6 to 5 lux
- Semi- cylindrical intensity of lightning: 0.5 to 3 lux

5.4. Stairs and slopes

- The average intensity of vertical lightning of stairs' height: less than 20 lux
- The average intensity of horizontal lightning at the bottom of the stairs and slopes: More than 40 lux

Typically, lighting a site is carried out based on its spatial divisions into different functions, for example, the square in front of a shelter which each requires its own special lighting. It is expected that the central square of a site which is the place for gathering different groups and social activities together be bright enough and a shelter or small bower which is to provide a private space and not to attract the attention of others be less bright. Accordingly, few major areas can be conceived for Tehran's Laleh Park.

1. Entrance space and Main Square: this part begins from the South West of the park through an entrance square and after passing through a wide path with cypress trees; it reaches the main square and a large pond of the park. This space which is a place for social interaction is always the most crowded and busiest site of the park and various activities are carried out there. Tall standing lamps are suitable for this space. Medium light bases can also highlight the spatial divisions in the path between the entrance and the main square.

2. The route around the park: this space that starts from the peripheral entrance of the Museum of Contemporary Arts is another crowded space in the park. On holidays, this route is usually used for various sports activities such as football, volleyball and badminton and sports fields of the complex are also built along the same path. Tall standing lamps with strong light are suitable for illuminating this space.

Public green space: The remaining area of the park can be classified under this title. These areas are typically the places for parks and planting with different plant densities and provide more specific facilities for the citizens. The lamps with average height are suitable for these spaces. Combined with

average lamp size, lamps with short bases in some cases can create fantastic and different spaces. Some suggestions in this regard have been given (Figs. 3 to 6).
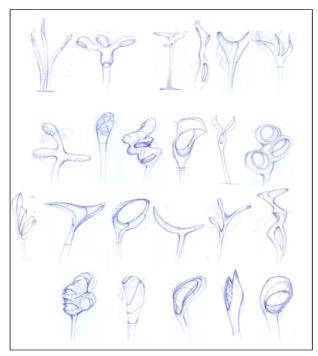

Fig. 3: Axis and suggested lighting designs

Suggestion 1: a two -way average height light has been designed which is inspired by flowers' petals, has two light sources and reflectors and a large extent can provide brightness in both directions.in this lamp, the light source is embedded at the bottom of stem that is vertically reflected in the reflection screen and thereby the light is spread through the surrounding environment (Fig. 4).

Fig. 4: The first suggested lamp base for Lighting

The second design is a tall lamp and is composed by a combination of three lamps with different heights. This lamp is designed for the sections of entrance and the main square and due to its highness and a sufficient level of light sources can provide adequate amount of lighting for this space. The division of the light source into smaller diamond-shaped constituent units causes the overall light created by the accumulation of bright spots that

in addition to giving it a special look, it makes the repair and replacement easier (Fig. 5).

Fig. 5: The second suggested lamp base for Lighting

The next suggested design is a lamp base with average height which is simple and innovative design. This lamp is made of an angled crescent which is smoothly combined with the base and due to having an expansive brightness can be used to illuminate the wide places and spaces with an average width. Due to a better function and aesthetic symmetries, this lamp is designed to be double-sided. Therefore, the light of rear section is less bright and is effective for the surrounding lightning edges. This lamps has a very slight angle and is designed to increase the visual movement of the form and strengthen the upside movement of the light (Fig. 6).

Fig. 6: The third suggested lamp base for Lighting

The propagation of these attitudes in the city that are new vision angles around us must follow a long-term plan that slowly create related values in the mind of the audience and strengthen and enhance social environment and their visual perception of the environment. The unique design of the park lighting can be a good starting point for such a program that brings about effective feedbacks for the improvement of the process in future projects.

6. Discussion and conclusion

The main strategy to achieve the goals in the field of lighting is in the first place changing the attitude of authorities and institutions associated with urban issues toward lighting. The approach to park

lightning as a minor, decorative and expensive activity should change. The urban authorities and institutions should be aware that nowadays park lighting can improve places and the quality of urban environments and enhance security. As previously mentioned, park spaces should be centers for people's gathering and social interaction. Undoubtedly, the quality level of park landscapes is of great importance in attracting people to these places. The enhancement of the quality of park landscapes is beyond a one-dimensional approach to the elements of the urban landscape. In other words, in landscape design of parks, all the physical and human factors must be simultaneously considered. There are many designed spaces in which only physical factors such as vegetation, furniture and other physical factors have been taken into consideration and are considered as failed plans due to lack of attention to the human needs and the privacy of human activities. One of these human needs is lighting and it's the consequence is having safety in parks. Today, we should put an end to the trial and error method in our park designs and offer a comprehensive plan for our park landscapes by a careful look at current experiences and by taking into account human rights in park spaces.

Exterior lighting creates security and peace, and if the lights are used properly, they can make tremendous changes in the beauty and security of the environment without huge spending. In addition to providing lighting and security in the environment, lighting elements are also used as design elements. Lighting is part of the design of parks and gardens for nighttime that should be simultaneously considered in the design and be in accordance with the dominant style and spirit of the environment. If designed properly, lighting elements can also be used as architectural elements in daylight. Otherwise, it should be invisible or hidden in the environment. Each environment has some features therefore the lighting design should be carried out to enhance them. The use of lighting techniques and proper understanding of lighting features make a significant contribution to the good nighttime landscape design.

It is hoped that this study will bring about effective practical results for the improvement of urban lighting condition and social security through a proper urban lighting design.

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