

The Livability of Open Public Spaces during Nighttime

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The transformations of contemporary life are reflected not only in the way people use open public spaces but also in the time people use them—nighttime activities are becoming more frequent. High daytime temperatures in certain periods of the year, during the summer and other seasons, discourage the development of outdoor activities in open public spaces during daytime. The urban heat island impact of pollution has significantly reduced the quality of living conditions in cities for daily outdoor activities. On the other hand, the hectic contemporary lifestyle in an urban context creates a lack of free time during the day, because leisure is compatible with working hours, where the focus on working during the day reduces the possibility of free time . These restrictions have changed the patterns of human behavior in urban environments, shifting the focus of free time to nighttime. The livability of open public spaces in an urban context is determined by usage and the frequency, duration, and activities of users. People's activities in public spaces, according to Jan Gehl, can be divided into three types: necessary, optional, and social behaviors. According to him, the physical environment and spatial features of the area play an important role when engaging in outdoor activities, except for the necessary behaviors (including going to school, going to work, shopping, etc.).

urban outdoor lighting

artificial lighting quality

open public space usage

contemporary lifestyle

livability

nighttime outdoor activities

1. Usage and Perception of Contemporary Open Public Spaces

The importance of open public spaces in everyday life is manifested in the form of social benefits. According to UN-Habitat, they are a “vital ingredient of successful cities”, and places that create a sense of community, culture, and social capital ^[1] from the aspect of ecological urbanism ^{[2][3]}. They are key places to create a sense of community, and thus civic identity and urban culture ^[4]. The identity of a place is a matter of socio-environmental values ^[5].

The relevance of this research topic reflects the need to improve the design of open public spaces in order to enable their usage for leisure and recreational activities ^{[6][7][8][9][10]}. The focus of previous research in the domain of nighttime usage of open public areas is mainly focused on urban safety, not on leisure and recreational activities ^{[11][12][13][14]}. Therefore, the contribution of this research is in examining the frequency, duration, and type of outdoor activities in open public spaces during nighttime.

The relationship between people and spaces is a rather complex one, and has been deeply researched using theories such as environmental psychology, and by many researchers from Lefebvre [15] and Kevin Lynch [16] to more contemporary ones [16][17]. The theory of cognitive maps, in Lynch's view, explains users' perception of urban form based on five types of spatial elements: paths, edges, districts, nodes, and landmarks.

The users' spatial impressions are based on their experience and their image of the space [4]. On the other hand, the potential for preserving open public areas for a certain activity is determined by the layers of visual identifications [18][19][20], which emphasizes the importance of the way space is perceived. In addition to the existence of three inseparable dimensions of space—mental, physical, and social, Lefebvre also notices the existence of the fourth dimension that includes time, i.e., movement [18][21]. In this research, the comprehension of open public space is defined both by the movement of users and by the relationship between users and the urban environment—their spatial distribution [22][23]. The scope (limits/boundaries) of a certain space is conditioned by specific features like edges, whereas the flow or movement (the paths) is the most important characteristic in the perception of the environment [16][17][24][25].

The characteristics of pedestrian movement (the slower motion) influence the perception of spatial characteristics [26]. In pedestrian areas, movement speed enables the comprehensive sensory experience of spatial characteristics and a more articulated interpretation of the environment. The kinetic experience of the environment is defined by the dynamics of outdoor recreational activities [27].

The lighting in a space influences people's perception and people's urban experience [28], as well as the usage, activities, and spatial distribution of users in space [29].

2. Nighttime Usage, Safety, and Quality of Artificial Lighting in Open Public Spaces

The most obvious transformation of space in terms of visibility occurs in a shift between daytime and nighttime, when replacing daylight with artificial lighting affects perception and the possibility of performing outdoor activities. Nighttime is the part of the day when visibility deteriorates and perceiving environmental characteristics is possible only under the effect of artificial lighting. In that sense, lighting could represent a useful design tool for shaping both urban spaces and user behavior [27][28][30][31].

Daytime usage of open public space is determined rather equally by several environmental, social, cultural, and spatial factors [32], while during nighttime one of the main factors that influence usage is the personal sense of safety [14]. In her famous work, "The life and death of the great American cities", Jane Jacobs argues that the constant flow of people makes a place more livable, and how active usage of open public space throughout the whole day is one of the main factors of livability [33]. Further, Jacobs stated that the safety aspect is an important part of a livable urban environment. According to Marcus and Francis [34], safety refers to the personal security of open public space users, and it can be perceived as an objective and subjective measure. In this research, the researchers deal with the perceived feeling of personal safety as opposed to objective safety, which includes actual

incidents or crime [35]. Increasing urban safety and security is one of the major principles addressed by UN-Habitat in their sustainable development goal number 11. Therefore, to create an inclusive public space, it is important that different categories of users can freely participate in society [14]. Design elements that improve safety and reduce general fear include lighting, surveillance, improved sightlines and visibility, clearer access points, and pedestrian routes through spaces and services, including ablutions and sanitation [11][13][14]. In several crime-prevention studies street lighting was recognized as an important part of the physical features that help in feeling safe in public spaces and influence overall crime reduction [36][37], while according to Rezvani and Sadra, lighting and visual accessibility of public places leads to strengthening the sense of feeling safe in neighborhoods, because they allow the person to detect possible threats [12][13]. In addition, there may exist an intuitive or learned association between lighting and safety [38]. The quality of visual information is of great significance for memorizing the environment and artificial night light makes the urban environment more comfortable for users and visitors [28][30][39][40].

This research presents an extension of wider research regarding the lighting quality of different types of open public pedestrian areas [26][27][30][31][41]. The research is based on previous studies [27][30] which include the analysis of existing outdoor lightning standards in two types of open public spaces in residential areas. These two areas represent city districts, the examples used are residential neighborhoods designed under the socialist paradigm in Belgrade, Serbia in the mid-20th century. The results of the case study of the Danube waterfront within the open-formed residential blocks of Dorćol showed the influence of standard lighting design practices for residential areas on the overall lighting quality and creation of dark, unsafe areas in the open public spaces of the neighborhood [30]. The dominant usage of the pedestrian area (a plateau elevated from the approach street and bordered on two sides by residential buildings) is as access paths to housing, framed by relaxation areas of greenery. In this research, the lighting quality transformation under the influence of the environment is presented through the comparative analysis of in-field measured illuminance level and designed values in accordance with standards and recommendations in the open public pedestrian area. The case study of the Eastern City Gate of Belgrade housing complex showed the relationship between outdoor leisure activities and artificial lighting quality in open public spaces based on the kinetic experience of users [27]. The complex, spatially defined by an elevated, circular, car-free forecourt surrounded by an access road, is designed as an open-formed modernist block with open public space for outdoor recreational activities and three identical skyscrapers placed radially from the center of a main-access pedestrian path. This research showed that the contemporary context, along with new forms of time consumption, transforms the dynamics of open public space usage, and the in-field analysis showed that the decrease in the level of activities at nighttime is a consequence of the lighting quality. The presented methodology in this research offers tools for the analysis of recreational usage of open public spaces in relationship to lighting quality parameters.

Furthermore, several previous research studies dealt with questions regarding how people experience lighting and ambience as they move through an urban context [28], as well as lighting and perception of safety during nighttime [11]. The research from 2021 dealt with the issue of perceived safety, exploring how the presence of different design interventions impacts the perceptions of safety in public spaces. The research was focused on women's experiences in particular [42]. The results of this research suggested the overall importance of evidence-based design in open public spaces and the need to integrate a gender perspective. In a study from 2012, nighttime open

public space usage was researched by gender and age group (seniors above 60 years old, adults from 20 to 59 years old, teenagers from 13 to 19 years old, and children), as well as the location of outdoor leisure activity and type of activity (sedentary, moderate, and vigorous) [35]. In this research, the authors showed that, in every age group except the seniors, the male population used open public spaces more frequently during nighttime. This research also showed that the most prevalent type of outdoor activity was moderate (social gathering), while sedentary (electronic device usage) and vigorous (sports) were equally performed. Additionally, the most-used area of open public space at night was a grassy area. Moreover, this research questioned the issue of uniform lighting design by considering how designers translate lighting codes in the design and planning process [43]. This research argues that lighting design should include the specificity of local culture or geographical context and an individual approach in the lighting process.

Lighting design for open public spaces relies on the standards and recommendations defined by the Illuminating Engineering Society (IESNA) [44], the International Commission on Illumination (CIE) standard [45], and the British Standards Institution (BS EN) standard [46]. Regarding open public pedestrian areas, outdoor urban lighting design is based on the fulfillment of functional lighting features as the top priority to achieve adequate visibility according to the users' needs, as well as to meet all the safety and security requirements in an open public space. The IESNA standards categorize adequate illumination according to the space usage at nighttime as very active (commercial zone), moderately active (intermediate zone), and less active space (residential zone) [44]. The CIE standards categorize the influence of the luminosity of the surroundings, the boundary area (edges of open public space), in three categories—high, moderate, and low [45], while the BS EN standards categorize the level of urbanity as rural, urban, and city center [46]. For the various types of open public spaces (streets, parking places, pedestrian areas) the types of lighting situations are defined by the lighting technical class [45][46] and the specific sets of parameters, based on the category of the existing type of traffic in space, users' motion speed, and the roughly denoted dominant space usage. In the Serbian context, the Lighting Committee makes decisions based only on the CIE standard. The lighting design practice in the country is based on a rather formal and rigid approach and interpretation of lighting policies and regulations. Therefore, this research explores all mentioned standards and regulations in order to determine differences between the planned design of lighting in open public spaces and real everyday situations. In addition to previous research, the added value of this research is the users' perspective on the nighttime dynamic of space through the relationship between qualitative and quantitative results of overall lighting quality.

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