

Research Article:**The Effect of Night-Lighting on Urban Space Vibrancy: Sara Square, Sulaimani City as a Case Study****Hawar Shawkat Karim** ^{1,a}**Raz Saeed Faraj** ^{2,a,*}^a Architecture Engineering Department, College of Engineering University of Sulaimani, KR, Iraq**Article Information****Article History:**Received: January 26th, 2026

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Abstract

Nowadays, lighting is not just a need from the engineering point of view, but rather a strategic measure for increasing safety, establishing the cultural identity of the place, and improving nightscape usability of public spaces. The Sara Square in Sulaimani city is one of the main heritage landmarks and due to the lack of proper lighting conditions, the utilization of the square is reduced during nighttime, decreasing its attractiveness as a public space. Thus, the aim of the current research is to explore how nightscapes with strategic lighting may increase residents' satisfaction, enhance the sense of safety, decrease avoidance behavior, and develop the appreciation of heritage in local historic urban area. To achieve these objectives, the current study explores lighting conditions in Sara Square, identifies public perceptions and preferences, and provides some suggestions for developing context-appropriate night scaping based on international case studies and related sustainable development goals. The research design consisted of using international cases lighting usage and conducting the comparative field observation (N=128). The findings revealed a high degree of dissatisfaction with the current lighting conditions, which was found to be significantly associated with avoidance behavior. More than 40 percent of participants stated that usually they avoid visiting the square during the evening time, since the lighting does not create a positive atmosphere for them. The close connection of the participants to the location and their definite preference for lighting that emphasizes the historical character of the square were revealed among the participants. As a result of statistical analysis, the significant positive relationships were found between better perception of illumination, improved safety, avoidance decrease, and place identity. Thus, the study concludes that Sara Square could become an active, cultural, and sustainable destination for people by applying the layered lighting strategy, including accent lighting of heritage, social lighting, and pedestrian safety.

1. Introduction

The current lifestyles trends have changed the scope and meaning of activities in the open public spaces with the emphasis not on the day but the night. In such circumstances, the functionality of such spaces and their ability to adapt to address this change relies on the physical constraints that they have [1]. In this context, lighting plays a crucial role in maintaining the benefits of urban parks during nighttime hours [2]. The concept of the nightscape is inherently complex, encompassing elements of aesthetics, sense of place, urban design, planning, economics, psychology, engineering, and ecology. Nightscape lighting helps define a city's character and contributes to shaping its

visual identity through informed design strategies [3]. Traditionally, cities were designed primarily for daytime activities, while nighttime design was often an afterthought. Such a daytime bias can be based on the historical process of the evolution of human life and the artificial light creation. Nevertheless, lighting affects moods, feelings of security and general wellbeing. It should thus not be viewed as just a functional or decorative element but as an essential part of city life one that has the potential to improve the quality of life of people who live in it. When thoughtfully integrated, lighting can impact the "total architecture" of a space, encouraging social

interaction, enriching cultural experience, and reinforcing urban design principles [4][5]. The Public Lighting Environment (PLE), in particular, plays a vital role in shaping visual and emotional responses. Since light influences both perception and feeling, the design of lighting systems must reconcile physical, physiological, and psychological needs. An appropriate PLE enhances visibility, comfort, and safety, supports crime prevention, and fosters a sense of security among citizens [6]. The development of technologies has promoted the efficiency, low cost, and satisfaction of urban lighting [2]. The Eco-Metropolis Strategy of the City of Copenhagen (2007), that is targeted at transforming it into the livable and most sustainable city in the world by 2015 that focuses on the use of illumination as an important tool to make urban areas livable during the day and night. In this respect, light is turned into a medium where the cities are staged [5]. The 2030 Agenda on Sustainable Development that was passed by all the United Nations Member States in 2015 focuses on the 17 Sustainable Development Goals (SDGs) as a global call to action. The nightscape as well as lighting design approach is consistent with some of these objectives: SDG 11 (Sustainable Cities), lighting can make urban environment safer, inclusive and more livable; SDG 8 (Economic Growth), by enhancing the night economy through tourism and prolonged business presence; SDG 9 (Innovation), through the reinventing of infrastructure as a source of social and economic development rather than a technical one [7]. Other than being functional, lighting is a cultural and historical statement of a city. The aesthetic decisions taken in the architectural illumination serve as visual discourse that conveys heritage and traditions of a city. The lighting of landmarks and monuments does not only increase visual beauty but also depicts culture. In the modern day urban areas like Tokyo and Seoul, there is the use of dynamic and colorful light on the skyscrapers and billboards creating a feeling of modernity and innovation. Such high-tech lighting displays go beyond the decorations by conveying the progressive spirit of a city. Lighting design can articulate cultural values and aspirations through the choice of color, intensity and pattern, which in turn affects the perceptions of urban identity by inhabitants and visitors [8]. The contemporary lighting practices are also sustainable as they include energy efficient technologies and smart systems which make real time changes to illumination. Adaptive LED lighting like the one used in Copenhagen automatically changes brightness depending on the presence of pedestrians or vehicles, and maximizes the use of safety and energy. These systems allow cities to automatically adjust illumination to seasonal variations, occurrences or even time of day without user intervention [9] [10].

Finally, it is light which enables spatial perception to happen [5]. However, there are still some questions: does urban lighting affect human behavior and perception? The answers to this knowledge gap will enable the formulation of the framework that will quantify the overall effect of lighting economic, technical, aesthetic, and sustainable to aid more informed and humanistic decision-making in urban lighting design.

Definition of key terms

Nightscape: the way that artificial and natural light shape the visual and sensory nature of urban space at night [3].

Lighting: electrically powered lighting that is placed in public areas for aesthetic, practical, or safety reasons [6].

Urban space vibrancy: the level of social interaction and human activity in a public area [41], [15].

Heritage urban space: a public area with structures or monuments of acknowledged historical significance [44].

2. Research Problem, Aim and Hypotheses

Sulaimani, the main historic and central part of Iraq, Sara Square, is a location that is being poorly lit and neglected. It is not a place of gathering or interaction at night, but a transitional place and thus low user engagement. The square has not yet been exploited as a vibrant public space even though it boasts of a lot of cultural and historical importance. On the contrary, related spaces like square Mzgawte Gawra and street Orzde are better places to be, as the lighting conditions are better, the level of security is higher, and the social activity is more active. These disparities demonstrate the critical importance of lighting as a factor in creating perceptions of safety, comfort, and attractiveness in the city. This research paper, thus, explores the way in which strategic lighting interventions especially those that focus on historic architectural features can make Sara Square a place with vital activities, safe and expressive of its cultural character. The study is based on the global best practice in nightscape design but foundations of the recommendation are based on the socio-cultural and spatial setting of Sulaimani. Research Aim: to find out and create effective lighting plans that will re-energize Sara Square to make this area a vibrant, secure, and socialized community. The research is expected to combine the experience of the successful international precedents with the experience of the perception of the local users in order to have the global relevance and the local authenticity at the same time.

Research Hypotheses:

The Sara Square illumination condition greatly reduces the use of this space at night as opposed to the utilization of adjacent areas.

- Conceptual Lighting design will increase the visibility of historic features of the square thus strengthening cultural identity of the locality.
- The right lighting solutions in combination with social activation initiatives will make Sara Square much more attractive and make it a social meeting venue.

3. Literature Review

Nightscape in urban areas have been examined on a significant scale and most of the studies have centered on the effects of night lighting on visual perception and regeneration of the public space. Nevertheless, the city of Sulaimani has not been studied in this light (according to existing literature). Thus, it is necessary to use previous works on similar situations to prove the scholarly value of the current research, as well as to accentuate the absence of specific study on the role of lights in the night in the renewal of urban areas in the nightscape of Sulaimani. Stone, T. (2019) proposes the new framework of the discussion of light-pollution, which focuses on designing to live in the dark instead of the old model of light. It suggests that the decrease in the use of artificial light can be viewed as the ecological restoration of urban environment, and also covers the ethical aspects of such a method and how it can redefine the concept of nightscapes in urban areas [11]. This study offers a valuable conceptual reframing for illumination designing for darkness but with no empirical testing just remains a theoretical. Houell, N. et al. (2019) examine the views of the people on a smart lighting system in Nantes, paying attention to the reaction of the inhabitants on the technological solutions in the domain of illumination and their consequences in terms of safety and energy savings [12]. It's a good data for perception of citizen, but western single case. Zielinska-Dabkowska, K.M. and Xavia, K. (2019) focus on the light pollution by media architecture and dynamic LED lights in Zurich, Switzerland. They disclose that this type of lighting that is usually meant to draw people attention does not place much emphasis on the well being of humans and circadian health. The authors suggest the strategies to reduce this new light pollution worldwide [13]. This study focus on light pollution, but different lighting type not heritage architecture. Zhang, R. et al. (2022) research sustainable development of the urban night tourism economy of Shenzhen, China, examining the tourism trends of the city among the years 2011 to 2021 and emphasizing the importance of properly designed nocturnal environment in the economic aspect of the city [14]. This study is evidence on strong economy, but for modern city not heritage square. Rakonjac, I. et al. (2022) highlight the importance of lighting in the context of increasing the livability of open public spaces, especially waterfronts. Their study proves that the uniformity of lighting is a major factor that

determines the impression of safety and comfort by the users [1]. This study focused on lighting uniformity and safety, but in waterfront urban space. Elshater, A. and A. Abusaada, H (2022) discuss the way that nightlife activities alter the urban form and use, and they offer a conceptual framework of understanding how stakeholders can respond to nighttime urban processes, through the use of Cairo as a case study [15]. This study is just a descriptive nightlife framework. The article by Castilla, N. et al. (2024) focuses on the influence of the public lighting environment (PLE) on the subjective ratings of residents towards the surrounding environment by using surveys in various urban settings to assess the impact of lighting on the perception of the community [6]. In addition to these examples, lighting technology has also been demonstrated to create significant improvement in architectural development and sustainability especially in cultural heritage buildings like the Al-Mutanabbi Street in Baghdad. The study recognized evaluation technique, however, it lacks a cultural identification component. It is shown in the academic literature that strategic lighting not only highlights the architectural detail and adds aesthetic value but also aids energy saving and reduction of carbon emissions through using the environment-friendly technology, such as LEDs. In addition, the use of effective lighting will bring about a sense of security, increase night time activities, revive local economies and encourage interaction among communities that will prove that lighting is a very potent stimulus to a holistic regeneration of the urban areas [16]. This study highlights a heritage place, but it is not generalizable; it is just single case.

3.1 Nightscape and Urban Illumination

Nightscape has no generally accepted definition, but a number of interpretations have been offered. Nightscape may be viewed as the recreation or redefinition of the landscape of the day into the urban areas. The fundamental difference between the day and night landscapes is the contrast between the natural light and the artificial light that create the perception and the experience of the urban settings in various times of the day [3]. According to Yuan, the nightscape is a subdivision of study of landscape. Like the traditional landscape, it includes natural landscapes the ones that the environmental conditions influence mainly, and cultural landscapes the ones that were shaped by human actions and interventions. Nightscape, in this case, is the ornamentation of the city objects in both natural and artificial light sources, i.e., moonlight or artificial illumination. Nightscape design aims at making night scenes both aesthetically interesting and attractive to the city or a particular area through various lighting strategies to modify the appearance of the space and produce an emotional or psychological impact on the viewers [3]. A good

lighting system in the streets can change the city during the night. Well-planned lighting enhances city visibility enabling citizens to have an enjoyable and safer nighttime view and travel the city. Individuals who go out at night need to have a feeling of protection and visual assurance, as well as spatial orientation [18]. Moreover, the lighting is crucial in restoring major landmarks and by making the city night brighter. Lighting of buildings that are historical or architecturally important helps a lot in terms of their appeal to visitors and the character of a city [19]. Within the last ten years, a culture of light art has come into being in most cities and transformed the street and urban areas into outdoor theatres or show rooms. Although the aesthetic and experiential utilization of artificial light is an old idea, in recent years, the incorporation of artificial light in urban regeneration and planning policies has been becoming more conscious and aimed at [5]. Geographers and other social scientists have also explored the cultural aspects of illumination by street commercial billboards and decorative facades to such lighting of festivities and culturally specific light uses. These novel lighting types are becoming widely used as local regeneration measures, and they are all known as urban illuminations. It does not just encompass the light design or light art but a type of illumination of enhancing the beauty and livability of the city. The perspective of how these new lighting mechanisms affect the experiences that people go through in the urban environment has come to play a critical role in the study of the contemporary city life [5].

3.2 The Perception of Nightscape Lighting and Human Behaviour

Lighting design assists in making a social area more understandable to the users and emphasizing architectural aspects, walks, landmarks, and collection areas so that the area becomes more comprehensible and usable. Designers must learn to perceive and interpret social spaces, create their own mental maps or images of them, in a way that different users perceive and interpret them. Joanna Entwisted [20]. Legibility of space mediates the relationship between space and the way human beings behave. This concept is the degree to which individuals are able to understand spatial arrangement and formations and then build mental imagery pertaining to the world around them. Similarly, the readability of the nightscape in a city leads to people creating mental maps of their city at night. In line with these, the illumination design must be wisely used on the basic spatial elements nodes, edges, paths, districts and landmarks with the assurance of cohesiveness and understandability. Light plays a direct role in determining spatial perception. Light, space, and the observer are interrelated in such a way that what we perceive, experience, and understand about the spatial

elements around us [21]. Hence, an illuminated environment has to be designed taking into account a profound knowledge of the human perceptual requirements on the context of visual and psychological experiences [22].

3.3 Night Lighting Satisfaction and Place Attachment

Night lighting Nighttime lighting is central to increasing the level of satisfaction people have of their urban settings in terms of place attachment an attachment of profound emotional connection of the people to their environments. Such association is formed based on the impression of comfort, security as well as attractiveness in the nighttime hours [23], [4]. Emotional attachment is the topophilia, which is the affection of people to place and an emotional attachment to place, which significantly impacts the experience of urban nightscapes and appreciation [24], [25]. The physical properties of lighting, e.g. warm, homogenous, and spatial readable, not only satisfy functional requirements, but also develop a sense of belonging and identity, which strengthens collective memory and place meaning [26], [27]. According to the recent studies in urban lighting, it is emphasized that it has a transformative potential in terms of more than just lighting, which also includes smart lighting systems, including IoT-based adaptable systems, and AI-driven adaptations of brightness and color temperature that respond dynamically to human presence and environmental factors. These inventions can increase visual comfort, safety, and emotional involvement [28], [29]. Balanced and homogeneous light helps create a safe and friendly environment, promote socialization and extend the nighttime stay [30], [31]. Planned architectural and landscape lighting contributes to the directional functions and to the renewal of the public space, the support of the cultural identity and spatial integrity [26], [27]. Moreover, the application of warm and neutral color schemes and layered illumination also creates the atmosphere of restorative environments and reinforces social relationships, especially when integrated with artistic or interactive illumination interventions [4], [30], [32]. Modern research confirms that well-designed nightscapes contribute greatly to the livability of a city and promote comfort, security, cultural identities, and a dynamic night economy and do not undermine the principle of sustainability and human-centered design, which minimizes ecological footprint and facilitates inclusiveness and sense of well-being [33], [34]. An interesting case in point is the project of Lighting of Genoa, and it proves that the careful use of lighting can restore the sense of pride and attachment to the community because it turns the historic urban squares into the luminous lanterns they used to be and invites people to social get-together, cultural exchange and

contemplation and strike a balance between preserving a historical heritage, safety and environmental protection [35]. Simultaneously, spatial video imagery (SVI) and AI-powered analysis have been used in empirical studies that increased knowledge of how artificial light response engages human behavior and the quality of the environment in the atypical light context of urban environments [36]. The connection between place attachment and night lighting is quite complicated in nature. Lighting also contributes significantly to the identity of a place in the dark and to its emotional appeal [37]. It also guides behavior—people instinctively follow the brightest paths, while vertical and horizontal contrasts enhance orientation and visual focus [38]. Artificial lighting enriches the aesthetic appeal of cities, emphasizing their symbolic landmarks and fostering emotional connection. Place attachment this emotional and psychological tie to location—is strongly affected by perceptions of safety, functionality, and aesthetic pleasure after dark [39]. Proper lighting design results in a sense of safety and security and makes people utilize the spaces of the night and the relationship of people and space [39], [40]. Lighting in addition to safety and functionality also strengthens place identity which is the defining the unique character of a space. The ordinary urban environment could be turned into a memorable place with the help of effective lighting of the architectural elements and the establishment of specific atmosphere [41]. The brightest example of such a characteristic is the Eiffel Tower, whose iconic light contributes to the reinvention of the image of Paris in terms of culture, image, and functionality on aesthetic, emotional, and functional levels [42].

3.4 Illumination in Urban Space

The urban Public spaces are very essential in improving the quality of the urban as a whole. The open areas and town squares are unique elements of the city that should have a sense of liveliness, warmth, and comfort particularly at night. Through careful and contextual illumination techniques, lighting can lead to the aspect of comfort, safety, security, and well-being. These attitudes are the base of the community responding to the feeling of belonging and place attachment [43]. The lighting must create a sense of invitation and belonging in the city. The impression of a public space created at night depends mostly on what is lit up. Art and light can be a great tool in the creation of spatial atmospheres and they have a very strong impact on how individuals feel and experience the environment around them [4]. Urban lighting in most situations follows practical designs that seek to make the environment convenient and safe to the pedestrians. The lighting can be low-height lamps or embedded lamps within the walkways, grass and ground surfaces that have a soft, glare-free lighting

source. The contrast lighting can be used in some important nodes or landscape features to make the focal elements in contrast with the background, and it gives a visual depth to the objects and improves the overall aesthetic value of the objects. Moreover, artistic lights arrangements may convey the identity or thematic nature of a square and make it aesthetically interesting and contextually relevant [3]. Urban landscapes of historic buildings and monuments are commonly perceived as immobile objects that provide architectural stability to the dynamic urban landscape. These structures retain their space and history, although cities are constantly changing in all their forms. Lighting serves as a mediating factor between this urban dynamism and the permanence of the architectural heritage, which guarantees consistency between the changing use of the public space and its history [44].

3.5 Urban Spaces Lighting Strategy and Function

Most cities develop an overall lighting scheme that defines the theme of the space as well as gives a detailed lighting design. Care is also given in these design practices to the landscape and architectural features around to ensure that there are a visual harmony and relevance to the context [45]. As Yuan explains, special structure lighting, square lighting, an advertisement lighting and sign lighting are some of the important elements of urban lighting which are common features of city squares, usually working during the night. Also, some lighting at festivals at times beautifies the urban night, and contributes a festal or more cultural element to the nightscape [3]. The space arrangement of nightscape in a metropolis particularly in the squares and other areas that are open to people are expected to concur with the functionality nature of the place. The overall perception of the space by night, which comprises landscape and lighting installations, should be aligned to the thematic identity and the activities that are to be undertaken in the space. Their lighting must respond to some visual and perceptual needs due to the functions and experiences that could be done in outdoor environment [46].

a. Light Carpet

This technique of lighting is commonly known as a light carpet in which the ground plane will have a distributed lighting throughout the plane with a series of light sources. This is aimed at highlighting the spatial extent and civic role of the square as opposed to lighting historic buildings or monuments.

The source of light is usually placed on higher levels, and they will still be invisible in order to make the public space of people to be the object of visual focus [46], [47]. As an example, Figure 1 shows light carpet effect in Piazza del Popolo, Rome, which is a huge recreational square surrounded by vehicular traffic.

Although the amount of fixtures is minimal, the design manages to provide the homogeneous lighting of the entire space and the neighboring facades [48].

b. Light Zone

Light zone strategy is used on the areas that are planned as meeting or gathering centres. In this case, the sources of light are switched on in areas where there is concentration of people whereas other parts of the square are dim. Color, intensity or hue differences contribute to the definition of these zones, giving priority to social activity and visual attention. The sources of light in such a design will be made to be of human proportions, and positioned at lower levels to create an impression of being intimate and connected such that people can sit in well-lit areas [49]. Figure 2 shows even effect of lighting that was realized using this technique.

c. Island Light

Lighting in an island is commonly used when a social area encompasses or surrounds architecturally or historically significant buildings. These important elements are lit up during nighttime to be set contrasts with a darker background context [49]. We can take an example in Figure 3 which represents the Market Square in Dessau, Germany. In this case, the light poles are utilized to define the regions of market and recreational zones and highlight the prominent architectural objects [47]. Such selective lighting technique strikes a balance between the practical and aesthetic, balancing the practical visibility with aesthetic highlighting of key cultural features in the urban nightscape.

3.6 Paths

Pathway illumination in urban spaces generally does not require high brightness levels. The objective is to provide sufficient ground lighting, particularly in low-density areas, to ensure that pedestrians can clearly perceive surface conditions and navigate safely. Pedestrian zones are best served by low-luminance ground lights, which offer gentle illumination without producing glare or visual discomfort, as illustrated in Figure 4 [3]. Building illumination is often achieved through facade-mounted lighting, while integrated design features such as spouting water combined with floor lighting contribute to visual appeal without disturbing users or overpowering the environment.

3.7 Special structure lighting

In most urban spaces, there are statues or other landscape elements set to be landscape nodes. Usually, these special structures are on a small scale and set among plants. The plants work as the background of the special structures. The lighting design of the structures should include accent lighting on the main landscape elements; for the main elements, small floodlights can be used to emphasize them. And the lights for the background plants can be in lower luminance. The waterscape is usually

designed to be the visual center of the whole square. Floodlights are usually used for fountain lighting to provide hide lamps[3].as shown in the (figure 5).

3.8 Buildings

Because Civic Place encompasses a wide range of architectural characteristics and typologies, the lighting strategies proposed for it must vary accordingly. In general, building illumination should remain moderate to preserve harmony with the surrounding environment. For modern illuminated structures, achieving coherence between the building's lighting and its context is essential to ensure both visual balance and aesthetic satisfaction [50]. The illumination of objects, monuments, and other points of interest forms an integral component of the fixed urban scene, animating the nighttime landscape and assisting users in orienting themselves. Good lighting enables whole buildings to harmonise with the immediate environment [48]. Lighting can be commercial, social or historical in nature according to the location. Nevertheless, not all the structures should be illuminated, but it is better to focus on such architectural features that should be given attention and emphasize some important details and space [48]. Figures (6, 7) provide examples of how buildings are handled depending on their location and how lighting can be applied at an individual and contextual level to provide a visual harmony with the surrounding environment. Most monuments in Paris, e.g., have domes which seem to be similar during the day, however, at night they distinguish themselves by different forms of lighting. Some of the ways of illumination instantly identify these landmarks as depicted in Figure 6 (right) whereas in Figure 6 (left) and Figure 6 (middle), there is a soft even lighting that gives the view of a single nighttime image. During the Festival of Lights at the Gendarmenmarkt Square in Berlin (Figure 7), buildings and structures are lit to form the center of a light composition of a city. This practice is an attempt to reinvent architecture as one of the primary components of night urban nature. In most typical situations, however, the lighting strategy of the square is based on the key architectural features to provide illumination of the open space [48].

3.9 Research Gap

These studies on nighttime lighting mostly are descriptive, single-case, and mostly focused on cities in Western and East Asia. Lighting-place attachment linkages are based on theory rather than empirical data, and the lighting typology is described separately but never validated as a single framework. Through survey-based testing of the layered framework in Sara square, Sulaimani, this study tries to close a gap in the literature by examining a heritage square in Iraq or Middle East.

4 Research Methodology

4.1 Research Design

The research methodology used in this study is a mixed-methods approach that incorporates field observations of the structured field work, questionnaire survey, and comparative case analysis. The aim of such an approach is to fully evaluate the impact of lighting conditions in the city during the night on the satisfaction of the population, their attitude to safety, cultural identity, and spatial vitality in the Sara Square, Sulaimani. The combination of quantitative and qualitative data also implies that the research is expected to produce a comprehensive picture of the experiences of the users and their spatial behaviors. Moreover, the aim of the research is to find the evidence-based lighting strategies including the support of the international best practices of historical public squares revitalization, so that the offered interventions become contextual, sustainable, and human-centered.

4.2 Case Study Selection

The city of Sara Square was chosen to be the main case study of the current research because it has cultural, geographical, and major gaps in terms of lighting at night (as it is reported in Table 1). All these reasons make it a good topic to study the role of lighting that affects the perception of users, safety, and interaction with historic urban environments. Three globally acknowledged heritage squares that have been successfully revitalized in terms of lighting were selected to offer some form of contextual benchmarking and allow comparison:

Pariser Platz / Brandenburg gate (Berlin) Table (2), Heritage Leicester square (London, UK) Table (3), Trafalgar Square (London, UK) Table (4). The selection of these reference sites was due to their excellent incorporation of heritage-sensitive lighting, further strengthening the ease of pedestrian comfort, and strengthening the place image. Together, they establish a comparative framework, which will be used to inform the theoretical base of this research and determine how the state of Sara Square can be improved. This comparative analysis is summarized and given in Table 6, which provides a final analysis of the global best practices that are related to the challenges and needs of Sara Square.

4.3 Field Observation and Nighttime

Assessment

Extensive night site observations were done to determine the current state of lighting in Sara Square. The assessment also encompassed illuminance levels, distribution of the lights, glare, the visibility of the pathways as well as the lighting of historic structures like the Sara Building. Spatial use patterns, pedestrian behavior, the density of the crowd, and perceived comfort were also reported by observations. Urban Nightscape Assessment Guidelines Checklist was

used to collect photographs and detailed structured notes, as shown in Table 5. This methodological approach allowed creating a contextual insight into the impact of lighting on spatial performance and user experience.

4.4 Questionnaire Survey

The level of satisfaction with the night was analyzed based on a structured questionnaire, which aimed to establish the level of primary and secondary sources of nightscape satisfaction as presented in the theoretical framework (Table 6). A convenience sampling method technique was used, the survey was conducted in two formats, online using Google form to broaden reach and Hardcopy (on-site), varied days and times that were given on site to get the responses of as many users as possible. The sample was inherently skewed toward local and frequent users, who are the main stakeholders in the spaces nighttime regeneration.

The questionnaire was designed in seven parts, including the following aspects: The demographic profiles of the respondents and their connection with Sara Square; The frequency of visits in the evening and the activities performed there; The comparative assessment of the spaces with the light infrastructure nearby (Grand Mosque Square and Orzde Street); The perception of the quality of lighting (brightness, glare, pathway visibility, and general atmosphere); The aspects of safety and comfort of visiting the areas; The cultural and heritage identity as affected by the light infrastructure; The acceptance of intelligent and sustainable lighting technologies. A 5 point-likert scale was used on all perceptual items, to guarantee internal consistency and comparability of responses. The questions used in the surveys were based on validated measures in the fields of environmental psychology, urban lighting and research on public spaces, thus, the survey questions were reliable and had a content validity.

4.5 Measurement of Variables

The important variables were operationalized to enable a quantitative analysis of the variables of nighttime lighting and the satisfaction of the population. The variables were perceived safety, visual comfort, aesthetic quality, heritage identity, potential of social interaction and the general satisfaction. All of these constructs were modeled by a variety of indicators, which is in line with the best-practice frameworks of lighting design and urban placemaking, summarized in Table (6).

4.6 Data Analysis

Processing and analysis of survey data were done through the use of SPSS software. Descriptive statistics were used to generalize demographics of the respondents and determine the overall trends in perceptions. Non-parametric statistical tests (including t-tests) were conducted to analyze the

differences between demographics as well as the frequency of visits. Triangulation of the field observation data with the survey findings were done to identify valid interpretations and improve the strength of the conclusion. This combined study offered a solid empirical basis of the evaluation of the effects of the lighting condition on the population satisfaction and the utilization rate of the space.

5. Results and Discussion

This research used a mixed-methodology to assess how the nightscape lighting affects the level of public satisfaction, safety and cultural identity in Sara square, Sulaimani. One hundred and twenty-eight night-time users were included in the questionnaire survey. The software Jamovi (version 2.7.13) was used to analyze the raw data and provide the descriptive statistics, which were supported by the observations provided by the structured field observations. Collectively, these datasets create a comprehensive analytical framework that allows the testing of the hypotheses of the present study and can offer practical information to revitalize historic urban environments with the help of lighting design.

5.1. Demographic and Behavioral Profile of Respondents

The sample surveyed was a wide range of Sara Square users, the representative of the local population. Most of the participants were locally based and long-term residents (94%, $M = 4.82$, $SD = 0.65$) and thus familiar with the area and the night conditions. The majority of them were young adults (18-24 years) (56.3%, $M = 1.83$, $SD = 1.14$) and were mostly male (69.5%, $M = 1.30$, $SD = 0.46$). As regards to educational level, the highest proportion was represented by bachelor degree graduates (60.9%, $M = 3.38$, $SD = 0.99$). Almost all the respondents (94.5% of them) indicated they had been to Sara Square before, which would have indicated that the sample used in the study were experienced users who were already acquainted with the space and lighting requirements of this location. Full demographic characteristics are presented in Table 7. Visitation analysis showed that there was a significant tendency, i.e. the majority of the users visited on a regular basis, but their time of stay was short, 84.4% stayed less than 15 minutes. Table 8 also indicates the prevalence of transit (49.2%), and social interaction (9.4%) as the main reason of visitation. The outcomes bring out a crucial spatial behavior pattern. Sara Square is now being used as a transition route as opposed to a recreational or social destination. The given behavioral outcome proves the initial hypothesis of the research, which states that the lack of lighting and the feeling of safety considerably diminishes the ability of the square to become a dynamic and meaningful space of the community.

5.2. Comparative Evaluation with Neighboring Areas

Finding that there is a significant difference in perception as seen in Tables 9–10. Sara Square was the lowest rated on almost all the dimensions that were measured especially the quality of lighting, the safety, and the social activity. Conversely, Orzde Street scored much better in terms of assessments, particularly concerning the beauty of the place, social vibrancy, and makes it a more preferable and interesting place to be during the night. Such a relative deficiency supports the initial research hypothesis which states that the perception of inadequate lighting and safety suppresses the public use and vitality of Sara Square. The statistical outcomes indicate that Sara Square received a considerably low score as compared to its adjacent spaces in 5-point comparative scales (1 = much worse, 5 = much better):

Lighting: $M = 1.51$, $SD = 1.03$, Safety: $M = 1.67$, $SD = 1.02$, Social vibrancy: $M = 1.59$, $SD = 1.05$, Overall perception: $M = 1.82$, $SD = 1.10$, Access: $M = 3.13$, Aesthetics: $M = 3.12$. The levels of engagement also highlight this divide: 52.3% of participants stated that they rarely or never visited Sara Square, and 55.5% of participants stated that they regularly or frequently visited Orzde Street. The results presented in Tables 9 -10) and Figure (10) have made very clear that Sara Square is comparatively disadvantaged in the city network of nightscapes, mainly due to lack of sufficient lighting quality and its perceived low level of safety.

5.3. Perception of Lighting Quality, Safety, and Comfort

The key element of the survey was to determine the impressions of the users regarding the current lighting situation in the Sara Square and confirmed a strong degree of discontentment in society. According to the findings shown in Table 10, the current lighting used in the square does not appeal to the functionality or aesthetic requirements. On 5-point Likert scales (1 = strongly disagree, 5 = strongly agree), the respondents strongly disagreed that the lighting part helped create a welcoming atmosphere, with 80.5% giving the aspect a rating between 1 and 2 ($M = 1.84$). In the same way, 86.7% of people did not agree that the lighting was used to show historic features ($M = 1.45$) and 85.9% did not agree that the illumination was sufficient (M not presented). Problems with lighting were also common (60.2% and 38.3%), with dark or dark-light areas and glare problems, respectively, being the problems that interfere with visual comfort and orientation. Table 10 presents the results of these findings and Figure 11 illustrates them.

Negative Perceptions and Behavioral Implications

Negative perceptions prevailed in almost all the survey items. A large percentage of the respondents

said that Sara Square was a hostile, unsafe, and unfriendly place to hang out late at night. Most importantly, 86.7% believed that the lighting did not highlight historic and cultural aspects of the square, which compromised the fact that it was a heritage space. This dissatisfaction also translated into behavioral avoidance. A good percentage of the participants stated that they tend to shun the square at night due to lack of good lighting. Upon enquiring them on what would best enhance their feeling of security, the most common element mentioned was the improvement of the light in the streets and the neighborhood. In general, most of the respondents described the lighting of Sara Square as low. Dark spots and glare indicates are indicators of bad lighting design and unequal distribution which makes the environment look and feel fragmented and uncomfortable. Altogether, these results prove that the existing lighting is not conducive to safety, comfort, or cultural values, and the essential change is to redesign the lighting of Sara Square to increase visual clarity and the usability of the feature by people during the night.

5.4. Cultural Identity and Place Attachment (Cultural Attachment as a Foundation for Revitalization)

In spite of the negative perception regarding the quality of lighting, the data show that the place attachment is high and the perception of cultural and historical value of Sara Square is deep. A resounding majority of the respondents rated the cultural and historical significance of the square as high or extremely high ($M = 4.34 / 5$) indicating that the community members have had a longstanding emotional and symbolic attachment to the location. When respondents were requested to provide the type of lighting style that would best identify the square, the most favored one was the one that would reflect the identity of a square as to a Historical one ($M = 4.10^*$), then the one to reflect Local Culture came on the second ($M = 3.83^*$). The results on the issue greatly justify the second research hypothesis (H2) the finding that the community wants lighting that adds to the heritage character of Sara Square but not hides it. It was also agreed by the respondents that the better lighting along with the underlining of the architectural features of the Sara Building ($M = 3.73$ and $M = 3.98$ respectively) and the lightening of the historic monument were strongly accepted though there was a slight variation in opinion on the latter. As the results summarized in Table (11) and presented in Figure (12) make it evident, one of the primaries focuses of lighting interventions must be ensuring that the articulation of the main heritage elements is prioritized.

Correlation Between Cultural Value and Navigation Perception:

One of the most eye-opening discoveries is that there is a strong positive relationship (as indicated in Table (13)) between the ability of the respondents to identify the cultural value of Sara Square and their sense of incompetency in night time navigation. This association implies that the most concerned about the square heritage is also the most vulnerable to the existing shortcomings primarily, the lack of light and space readability. This observation highlights the underlying community need to do better, which is a strong supposition of the third hypothesis (H3): that proper lighting and design interventions would make the square used significantly by the community by fulfilling the unmet need to engage with well-lit and celebrated heritage space.

Synthesis of Hypotheses and Broader Implications

The results all support the three hypotheses of the research: H1 – Lighting and Safety Perceptions: As it is evident, inadequate lighting and safety perceptions are the key factors that decrease the use of Sara Square during the night. The square is currently used primarily as a transitional one since lots of users prefer not to spend their time there at night and prefer places with more illumination like Orzde Street.

H2 – Cultural Identity and Visibility:

The community is of the solid belief that light improvements would bring more visibility to the historic features and strengthen cultural identity. The place attachment and desire to use heritage sensitive lighting designs point to a social willingness to adopt a lighting approach that glorifies and not ignore the cultural story of the square. The lack of proper lighting of the Sara Building and monuments is yet another opportunity that was missed to create civic pride and historical continuity.

H3 – Lighting Quality and Social Activation:

The good associations of the quality of lighting, the aspect of perceived safety, ease of navigation, and avoidance behavior prove that strategic lighting interventions may have a significant positive impact on the usability of the square. The carefully designed lighting scheme can trigger socialization and turn the square into a not pass through area but rather an engaging social space, by increasing visual comfort and spatial readability.

Alignment with International Best Practices:

These results agree with the global best practices that were noted in the literature review. The lack of general ambient lighting systems, the lack of social congregation lighting systems, and the lack of heritage landmark lighting systems (called Light Carpets, Light Zones and Island Lighting respectively in Table 5 of the manuscript) are considered the direct cause of poor performance of Sara Square in thematic assessment. Comparative case studies, e.g., Trafalgar

Square and Pariser Platz, indicate that hierarchical approach in terms of lights, i.e. distinguishing between pathways, social space and monuments, is key to the development of a legible, safe, and dynamic nightscape. Application of a comparable stratification of lighting structures in Sara Square would not only improve the functional clarity of the location and the quality of lighting to be there, but also revive its own identity as a cultural and civic phenomenon in the city landscape of Sulaimani.

5.5. Synthesis: Towards a Strategic Lighting Framework

The findings all confirm that the process of revitalization of Sara Square requires the overall redesign of nightscape, with references to the evidence-based concepts of urban lighting and cultural identity. The lack of the stratification of the lighting strategies discovered in the literature is the direct reason of the current underuse and neglect of the square. The responses given by the public clearly states the need to have greater safety, better wayfinding and greater exposure of heritage features and this forms a direct basis on which context-sensitive lighting interventions can be implemented. An effective approach to lighting in Sara Square should thus take a multi-scalar and humanistic approach that considers functional, social and symbolic aspects of the approach at the same time:

Functional Layer – “Light Carpet”

Use standardized pathway lighting to get rid of the dark areas and provide safe pedestrian navigation. This infrastructure underpinning directly counters the major causes of avoidance revealed in the survey and improves the perception of safety and the comfort of movement.

Social Layer – “Light Zones”

Use warmer and lower-level lighting to establish zones of sitting, meeting, and socializing. These areas will create dynamism and accommodation, which can be likened to the liveliness of nighttime that is witnessed in adjacent areas like Orzde Street.

Identity Layer – “Island Lighting”

Use focused accent lighting to emphasize the Sara Building and other significant monuments, and turn them into focal points of illumination, which will help promote the sense of cultural identity and continuity. This stratum serves the need of the community that has demanded lighting reflecting the rich locally cultural heritage and boosting the civic pride.

Transformative Vision:

This is an integrated approach that reposition lighting as something beyond a technical requirement it makes it a revitalization tool. Through the superimposition of light to achieve functional, social and symbolic ends, Sara Square can transform into a forgotten transitory area into a thriving, secure, and culturally resonant urban landmark. Not only would such transformation

increase the livability and inclusivity of the nighttime, but also be in line with the larger goals of sustainable urban development in general and Sustainable Development Goals in particular to make the cities inclusive, safe, resilient, and sustainable. Sara Square can be the enlightened core of Sulaimani, a type of the connection between its rich past and an active modern present through the sensitive and deliberate use of light.

6. Conclusion

This study aimed to assess the current situation of Sara Square nightscape lighting, highlight preferences and perceptions of residents, and propose context-sensitive lighting strategies. The results support all three research hypotheses. In line with H1, that the underuse of the square is directly caused by the insufficient lighting which sets the feeling of insecurity: more than 40% of respondents reported usually avoiding the square after dark, and Sara Square was consistently rated lower than the neighboring street on lighting, safety, and vibrancy. Consistent with H2, users respond showed a strong, long-lasting sense of place attachment ($M=4.34$) and a clear preference for lighting that reflects the squares historical character ($M=4.10$), which are good indications that the improved illumination of heritage features is likely to reinforce, not compromise, cultural identity. Behavioral data in support of H3, show that Sara Square currently at night functions as passage rather than a destination, with the absence of the social-activation and gathering-oriented lighting associated with a well-used heritage square. Furthermore, the results answer the research problem since they validate, in a previously untouched heritage context in the Middle East, three worldwide acknowledged yet locally untackled lighting levels; namely Light Carpet, Light Zones, and Island lighting. The long-standing correlations established between these levels and lighting quality, safety perception, and avoidance behavior have validated their importance beyond the global case studies in which they were driven. A human-centered stratified lighting design including pathway lighting, gathering areas lighting, and highlighting lighting for the Sara Building and its landmarks is suggested as a research-based approach that would make Sara Square safe, socially active, and meaningful at night. Since the sample was drawn from one location, and convenience sampling was employed to select the sample from a particular place, the study is biased concerning demographics. Future research should consider testing this concept through before -and - after treatments in other historic squares. Under these limitations, the study provides support for the fact that lighting strategies could contribute to more sustainable historic urban settings.

Practical and Regional Significance:

As it is, the poor lighting during the night has turned Sara Square from a cultural landmark into underused transit hub. Inadequate lighting consistency,

direction, and heritage are directly proportional to avoidance pattern and lack of social vitality. Using layered lighting plans (such as pathway light carpets, architectural accent lighting on the Sara Building and intelligent zoning of social lighting) holds the promise of measurable increases in the usage and perception of the public, as indicated by international best practices. The interventions also pursue the objectives of Sustainable Development Goals to support inclusive, resilient, and culturally oriented cities by using LED technologies that consume less energy and principles of human-centered design. To the urban planners and policymakers in Sulaimani, this paper presents evidence-based design advice in promoting inclusive, identity-based nightscapes. In addition, it bridges a serious gap in research in the Middle East city designed to address the problem of urban regeneration, which is a major element of sustainable cultural regeneration in the modern city.

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أثر الإضاءة الليلية على حيوية الفضاء الحضري: ساحة السراي في مدينة السليمانية-حالة دراسية

المستخلص

لم تعد الإضاءة مجرد ضرورة تقنية، بل أصبحت أداة استراتيجية لتحسين السلامة، ودعم الهوية الثقافية، وتعزيز استخدام الأماكن العامة ليلاً. في ساحة السراي، أحد أبرز المعالم التراثية في السليمانية، يُحدّد نقص الإضاءة الليلية من استخدامها بعد حلول الظلام، ويُقلّل من إمكاناتها كمكان حيويّ. تتناول هذه الدراسة كيف يُمكن للإضاءة الليلية الاستراتيجية أن تحسّن رضا السكان، وشعورهم بالأمان، وسلوكهم في تجنّب الأماكن، وتقديرهم للتراث في سياق حضري تاريخي محلي. تهدف الدراسة إلى تقييم ظروف الإضاءة الحالية، وتحديد تصورات الجمهور وتفضيلاته، واقتراح استراتيجيات إضاءة مُراعية للسباق، تستند إلى أفضل الممارسات العالمية وأهداف التنمية المستدامة ذات الصلة. شمل منهج البحث الرجوع إلى معايير الإضاءة العالمية، والملاحظات الميدانية المُقارنة (عدد المشاركين = ١٢٨). تُشير النتائج إلى مستوى عالٍ من عدم الرضا عن إعدادات الإضاءة الحالية، وهو ما يرتبط ارتباطاً وثيقاً بسلوك تجنّب الأماكن. أفاد أكثر من ٤٠٪ من المُستجيبين أنهم يتجذبون الساحة عادةً في الليل لأن الإضاءة لا تُوفّر بيئة مُريحة أو مُريحة. وقد أظهر المُستجيبون ارتباطاً وثيقاً بالموقع، وتفضيلاً واضحاً للإضاءة التي تُبرز طابعه التاريخي. يكشف التحليل الإحصائي عن وجود روابط إيجابية هامة بين تحسين إدراك الإضاءة، وتعزيز الشعور بالأمان، وتقليل النفور من المكان، وترسيخ الهوية المكانية. وتخلص الدراسة إلى إمكانية تحويل ساحة السراي إلى وجهة ليلية نابضة بالحياة، ذات أهمية ثقافية، ومستدامة، وذلك من خلال تطبيق استراتيجيات إضاءة متعددة الطبقات تركز على الإنسان، وتجمع بين إضاءة مميزة للمعالم التراثية، وإضاءة اجتماعية للتجمعات، وإضاءة وظيفية لضمان سلامة المشاة. ويُظهر هذا كيف يمكن لتحسينات الإضاءة المحلية أن تعزز الرفاهية، وكفاءة استهلاك الطاقة، ومدناً أكثر شمولاً واستدامة، مما يدعم أهداف التنمية المستدامة

الكلمات المفتاحية:

المشهد الليلي؛ إضاءة المشهد الليلي؛ إضاءة الفضاءات الحضرية التاريخية؛ الرضا

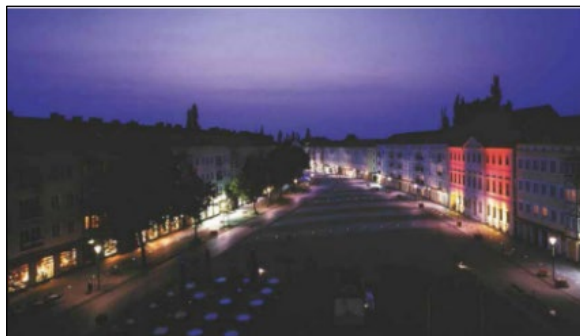
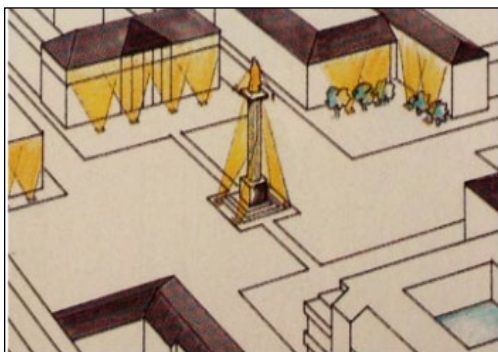


Figure 1: Carpet of light (right), Piazza del Popolo, Rome(left) [47].

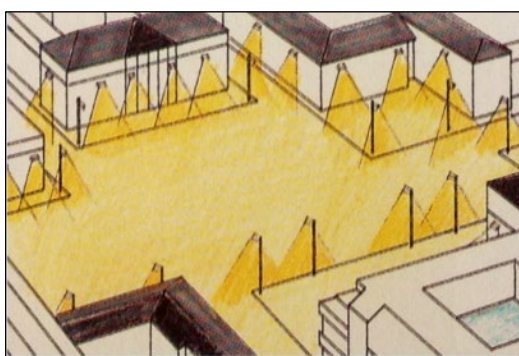


Figure 2: Lighting zones [47].

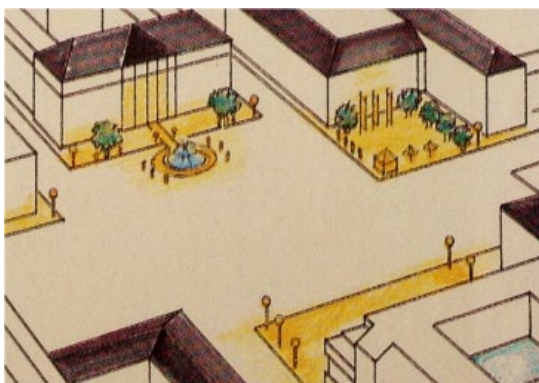


Figure 3: Island light, the Market Square of Dessau, Germany [47].

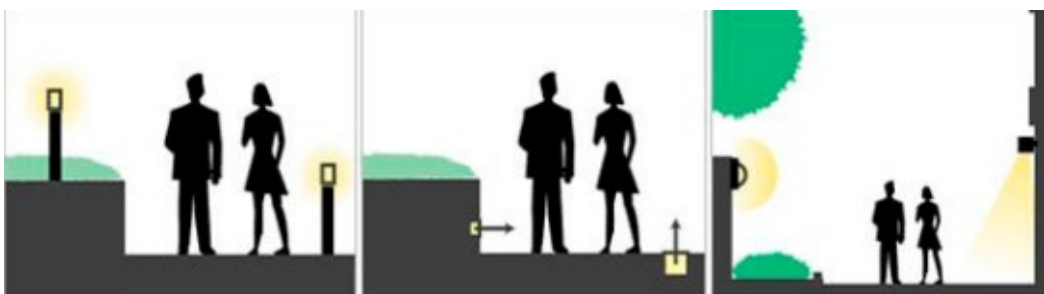


Figure 4: Styles of path lighting for city square [3].

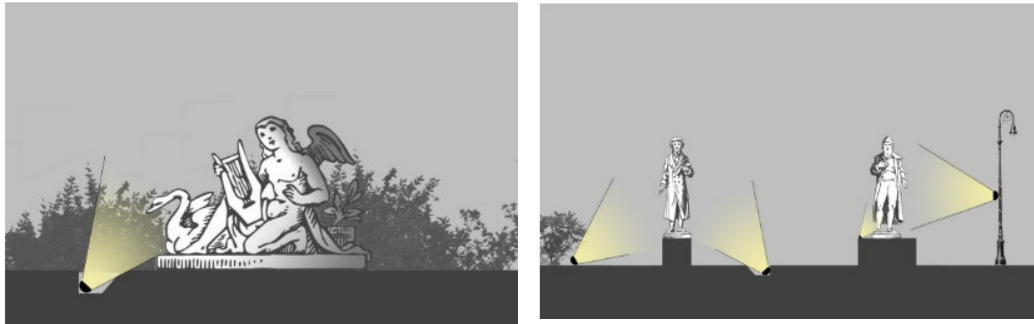


Figure 5: Different ways of lighting for statues, [3].

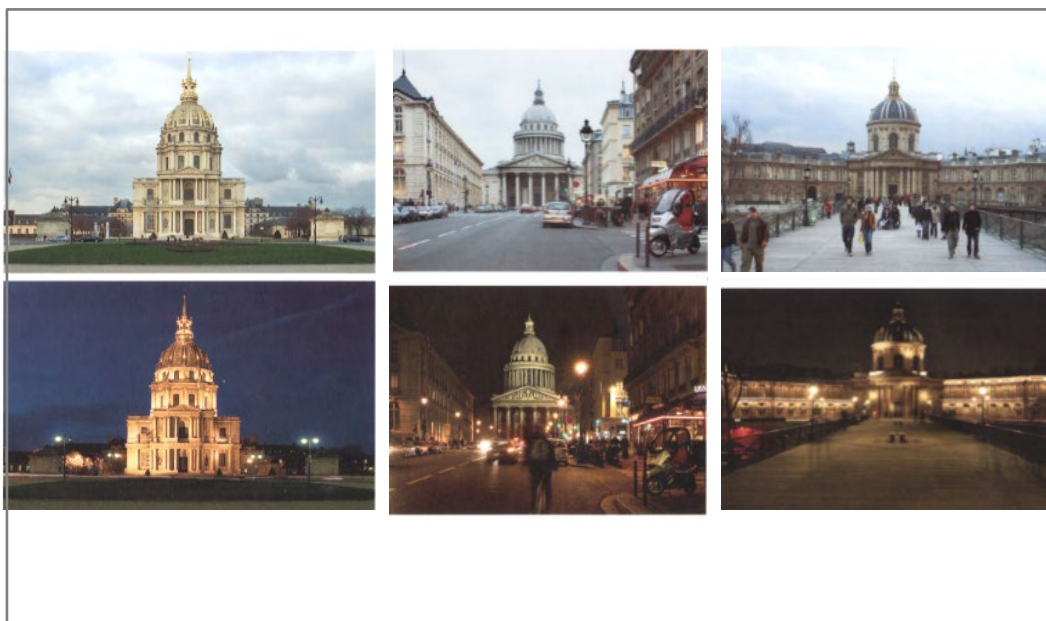


Figure 6: Domes Invalides, The Pantheon, College de France, Conseil d'Etat, Paris, [48]

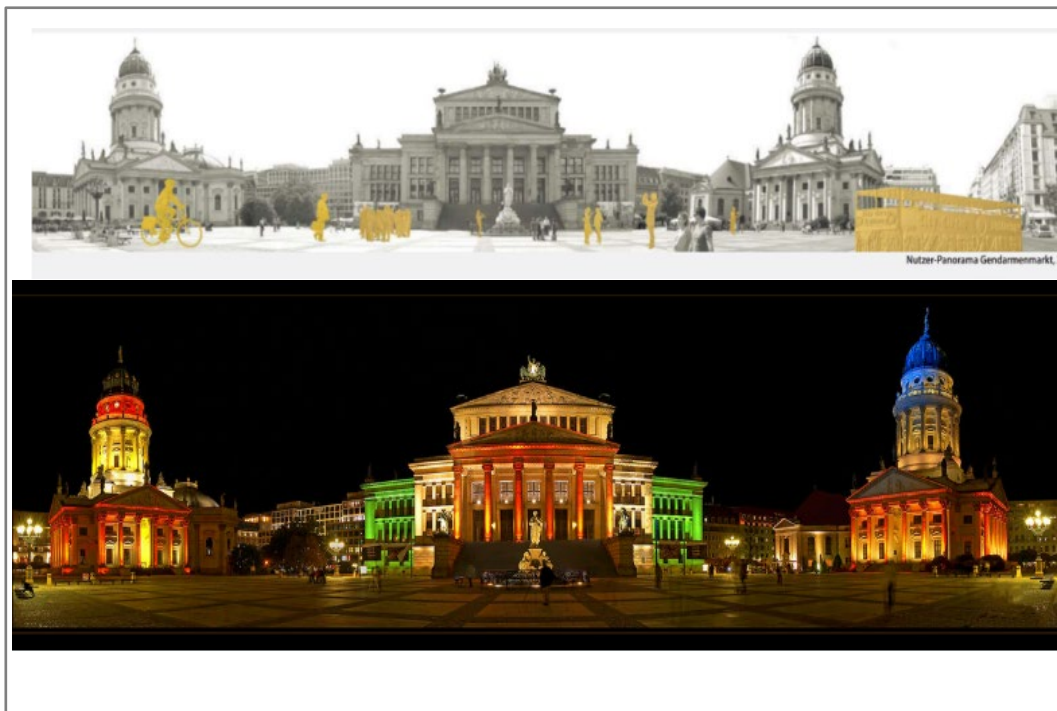


Figure 7: Berlin “Gendarmenmarkt “, Festival of Lights [48]

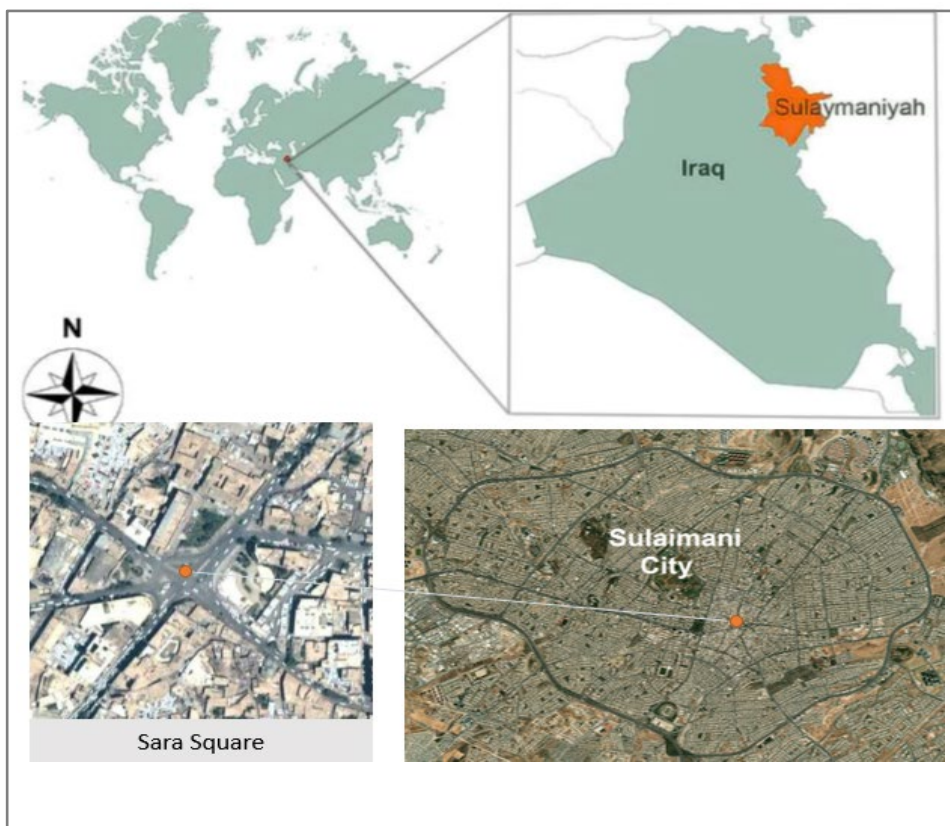


Figure 8: Location of the Sara square in Sulaimani City Satellite image city (Google Earth)

Table (1): Analyze and examine nightscape lighting for historic Sara square (researcher)

Project / Square	Location	Short Description
Sara Square Lighting	Central Sulaimani, Kurdistan Region, Iraq	Sara Square functions as a central urban landmark in Sulaimani, with its a strong heritage identity for the city. The square's existing lighting hierarchy is limited, with no clear differentiation between key architectural elements, circulation paths, and gathering zones. Unlike international best-practice examples—where monuments and focal points receive accent illumination and pedestrian areas are supported by uniform ambient lighting—Sara Square currently lacks a coherent visual strategy at night. Pedestrian movement is often influenced by shadowed areas and uneven light distribution, reducing nighttime comfort and spatial legibility. These issues are further clarified in the comparative analyses presented in Table 5.

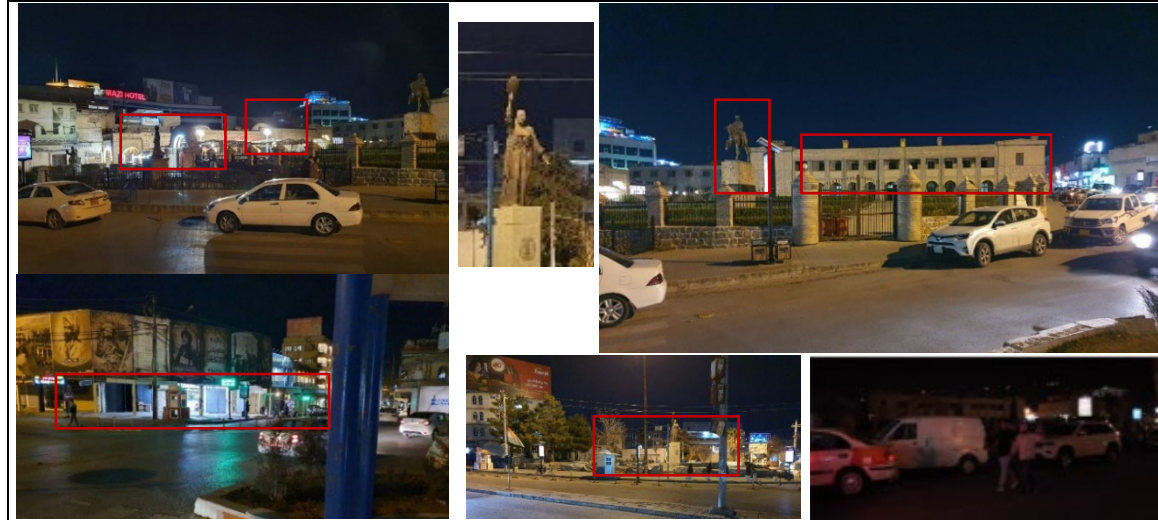


Table (2): Analyze and examine nightscape lighting for Brandenburger Tor Lighting, Berlin (researcher)

Project / Square	Location	Short Description
Brandenburger Tor Lighting	Pariser Platz, Berlin	Conservative and elegant lighting that emphasizes the sandstone material and architectural detail, integrating seamlessly with the historic context without compromising the structure. Focused on uniform, consistent light color and multiple viewing angles.as outlined in the comparative table. The analyses shown in Table 5

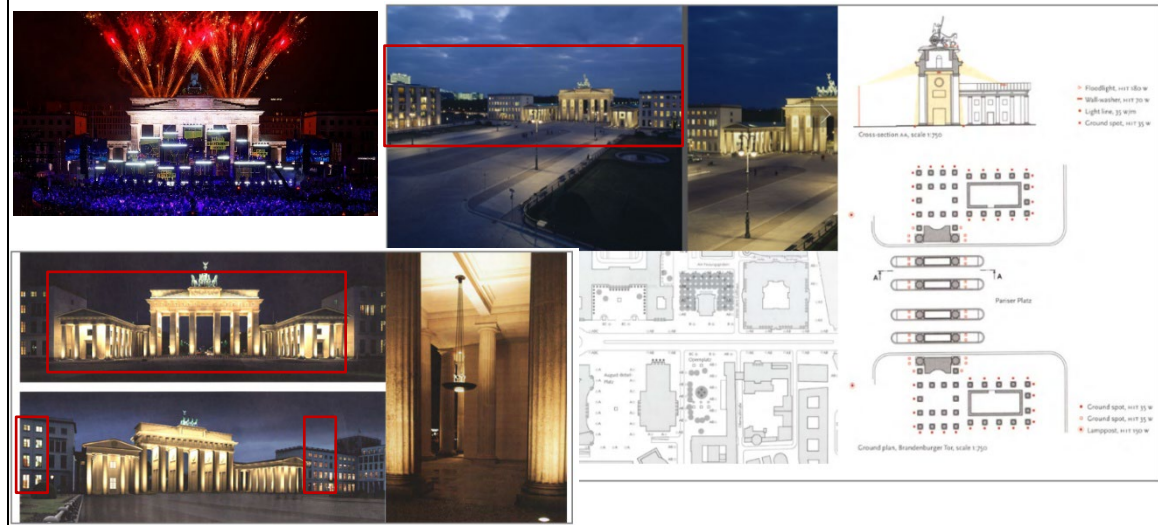


Table (3): Analyze and examine nightscape lighting for Heritage Leicester Square, UK (researcher)

Project / Square	Location	Short Description
Heritage Leicester Square	London, UK	Lighting designed to create security and social vibrancy. Limited light poles with clusters of neutral white LEDs illuminate paved areas, fountains, and the Shakespeare statue. Accent and ambient lighting foster pedestrian usage and visual interest.as outlined in the comparative table. The analyses shown in Table 5



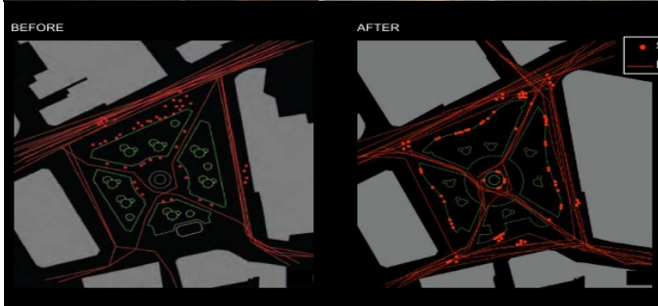
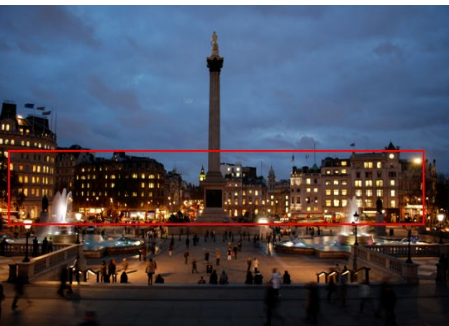
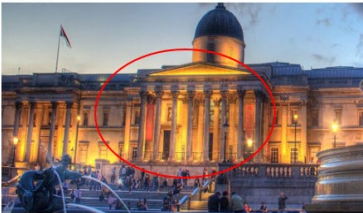




Table (4): Analyze and examine nightscape lighting for Trafalgar Square Lighting, UK (researcher)

Project / Square	Location	Short Description
Trafalgar Square Lighting	Central London, UK	Hierarchy of illumination: key monuments (Nelson's Column, lions, fountains) highlighted with accent lighting; ambient glow for pedestrian movement and social gathering. Pedestrian-friendly redesign with enhanced safety and navigability.as outlined in the comparative table. The analyses shown in Table 5



Uniformness overall illumination by typical architecture or important building elements and the same lighting color.







The surrounding building should have the same light for the interior for the overall uniform

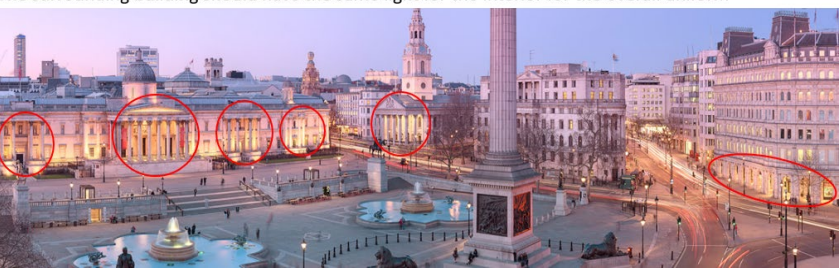


Table (5): Thematic evaluation checklist form for identifying the main indicators of Nightscape lighting assessment for historic square guidelines (researcher)

The main indicators of Square Nightscape lighting Criterion	International Case study			Main case study	Indicator source
	Trafalgar Square (London)	Brandenburger Tor (Berlin)	Heritage Leicester Square (London)	Sara Square/ Observation	
Carpet Lighting Presence	Present: uniform, soft ground illumination	Present; emphasis on uniform ambient lighting	Present: enhanced pedestrian pathways lighting	Absent, lacks essential ambient lighting	[47], [48]
Light Zones	Warm, inviting social zones	Defined social zones with varied lighting	Social areas are lit for safety and social activity	Absent, Social interaction lighting is missing in Sara Square	[48]
Island Lighting	Strong accent lighting on monuments	Accent lighting on landmarks	Lighting highlights historic statues and features	Absent, misses an important landmark illumination	[42], [49]
Pathway Lighting	Well-lit, safe pathways	Directional low luminance pathways	Pathways lit with warm and clear lighting	Poor, Path lighting is inadequate in Sara Square	[18], [31], [23]
Architectural Lighting	Integrated facade lighting with urban context	Selective and subtle facade illumination	Emphasizes heritage buildings with accent lighting	Minimal, Need better cultural and architectural lighting	[16], [21]
Safety Perception	High	Moderate	Improved by well-planned lighting	Low, Lighting upgrades are needed to enhance safety	[2], [6], [39]
Energy Efficiency	High-efficiency LEDs with smart controls	Sustainability-focused LED systems	LED and energy-efficient lighting systems	Normal, Opportunity for smart lighting implementation	[12], [28]
Cultural Integration	Strong cultural narrative	Historical emphasis	Heritage-focused lighting design	Limited, Lighting should reflect local culture and heritage	[24], [26], [44]
Social Interaction Support	High	Moderate	Encourages vibrant night-time social activities	Weak, Light design to support night use is lacking	[15], [41], [43]

Table (6): The main/secondary nightscape satisfaction Measurement indicators of study (researcher)

Main variable	Indicators	Questionnaire items for measures	Indicator source
1. Lighting Quality	Visibility, brightness, glare, architectural highlighting	(navigation, visibility, glare, adequate lighting, highlighting), (illuminate the following historic features)	[6], [18]
2. Safety Perception	Feeling of safety, lighting barriers, safety factors	Safety and comfort Perception	[39], [45]
3. Visual Comfort & Atmosphere	Comfort, mood, desire to stay	(welcoming, comfortable, linger), (atmosphere, nighttime experience)	[2], [5]
4. Aesthetics & Cultural Identity	Aesthetic appearance, heritage visibility, cultural expression	(visual appeal), (cultural character), (the cultural heritage and identity)	[24], [26], [44]
5. Functionality & Wayfinding	Pathfinding, clarity of social spaces, accessibility	(navigate pathways, social interaction areas), (accessibility)	[38]
6. Social Interaction & Vitality	Social activity, vibrancy, reasons for visiting	(supports social interaction), (social vibrancy)	[14], [15], [41]
7. Overall Satisfaction	General evaluation of night-time lighting experience	(adequacy), (overall night-time experience)	[6], [28]
8. Support for Improvements	Acceptance of smart/sustainable lighting technologies	Sustainability and innovation	[12], [28], [29]

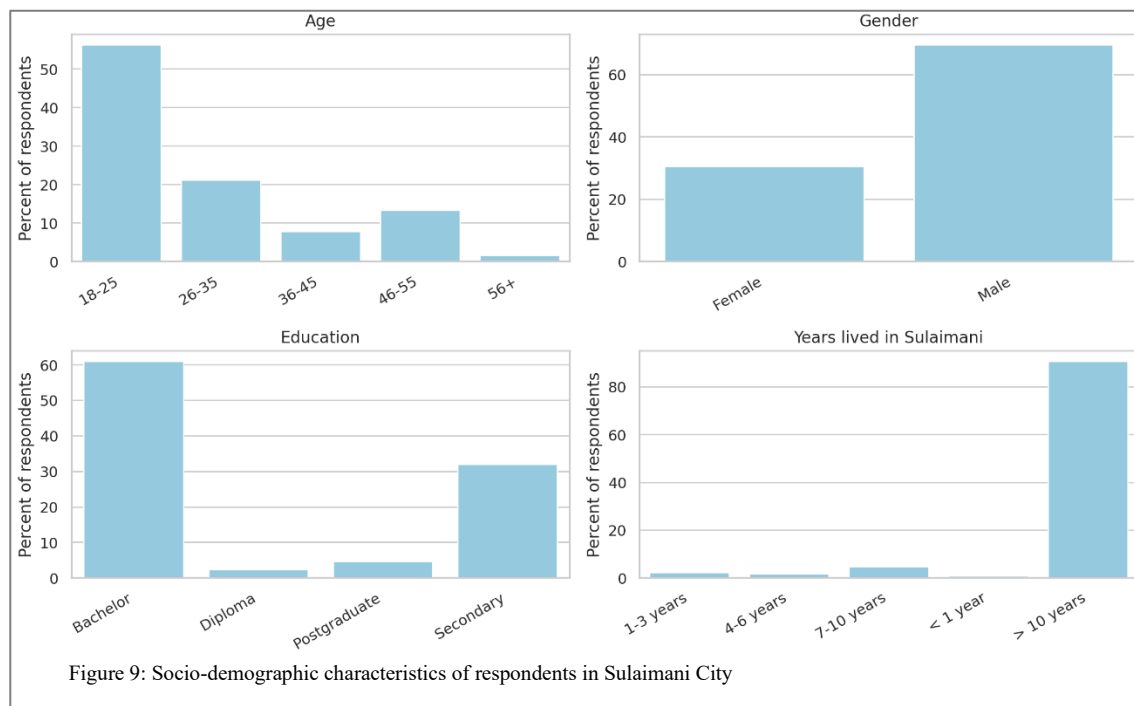


Figure 9: Socio-demographic characteristics of respondents in Sulaimani City

Table (7): Demographic Characteristics of Respondents (N = 128)

Variable	Category	n	%
Visited Sara Square	Yes	121	94.5
	No	7	5.5
Age groups	18-24	72	56.3
	25-34	27	21.1
	35-44	10	7.8
	45-54	17	13.3
	55-64	2	1.6
Gender	M(SD)	1.83 (1.14)	
	Male	89	69.5
	Female	39	30.5
Education	M(SD)	1.30 (0.46)	
	Secondary	41	32.0
	Diploma	3	2.3
	Bachelor's	78	60.9
	Master's+	6	4.7
Lived in Sulaimani	M(SD)	3.38 (0.99)	
	Entire life	~120	~94
	M(SD)	4.82 (0.65)	

Table (8): Comparative Nighttime Visit Frequencies (Nighttime Usage Pattern)

Variable	M	Median	SD	Min	Max
Visit Frequency	3.19	3.00	0.90	2	6
Stay Duration	1.30	1.00	0.79	1	5
Primary Purpose	2.94	2.00	2.36	1	8

Table (9): Sara Square vs. Neighboring Spaces visits (1=Much Worse, 5=Much Better)

Frequency	Sara Square n (%)	Mzgawte Gawra n (%)	Orzde Street n (%)
Never	21 (16.4)	23 (18.0)	10 (7.8)
Rarely	46 (35.9)	10 (7.8)	11 (8.6)
Occasionally	60 (46.9)	52 (40.6)	36 (28.1)
Regularly	1 (0.8)	43 (33.6)	26 (20.3)
Frequently	0 (0.0)	0 (0.0)	45 (35.2)



Figure 10: Comparative Nighttime Condition analysis of Sara Square and neighbors

Table (10): Lighting Quality Assessment (1=Strongly Disagree, 5=Strongly Agree)

Statement	M	Median	SD	% Rating 1-2
Navigation clarity	2.84	3.00	1.64	39.8
Sense of security	2.41	2.00	1.55	58.6
Welcoming atmosphere	1.84	1.00	1.31	80.5
Encourages lingering	1.64	1.00	1.16	77.4
Highlights historic features	1.45	1.00	1.06	86.7
Supports social interaction	1.57	1.00	1.21	82.8
Too much glare	3.02	3.00	1.63	38.3
Areas too dark	2.39	1.00	1.73	60.2
Cultural character	2.42	2.00	1.43	50.8
Current lighting adequate	N/A	N/A	N/A	85.9 disagree

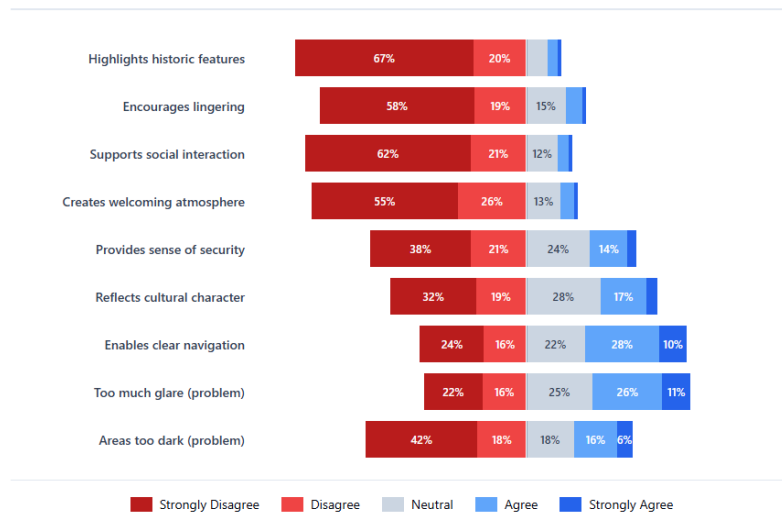


Figure 11: Lighting Quality Assessment: Sara Square (5-point Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree (N = 128))

Table (11): Descriptive Cultural Heritage Importance Assessment

	Cultural Importance	Historical Role	Cultural Priority	Traditional Elements	Modern Technology	Unique Identity	Architectural Details	Sara Building	Monument	Urban Fabric
N	128	128	128	128	128	128	127	95	128	68
Missing	0	0	0	0	0	0	1	33	0	60
Mean	4.34	3.53	3.40	4.10	3.83	2.74	3.73	2.25	3.98	
Median	4.00	4.00	3.00	5.00	4.00	2.00	4	3	5.00	
Standard deviation	0.691	1.22	1.38	1.25	1.08	1.43	1.42	1.27	1.44	
Minimum	2	1	1	1	1	1	1	1	1	
Maximum	5	5	5	5	5	5	5	5	5	

Figure 12: Cultural Heritage Importance Assessment (5-point Scale: 1 = Not Important, 5 = Very Important (N = 128))

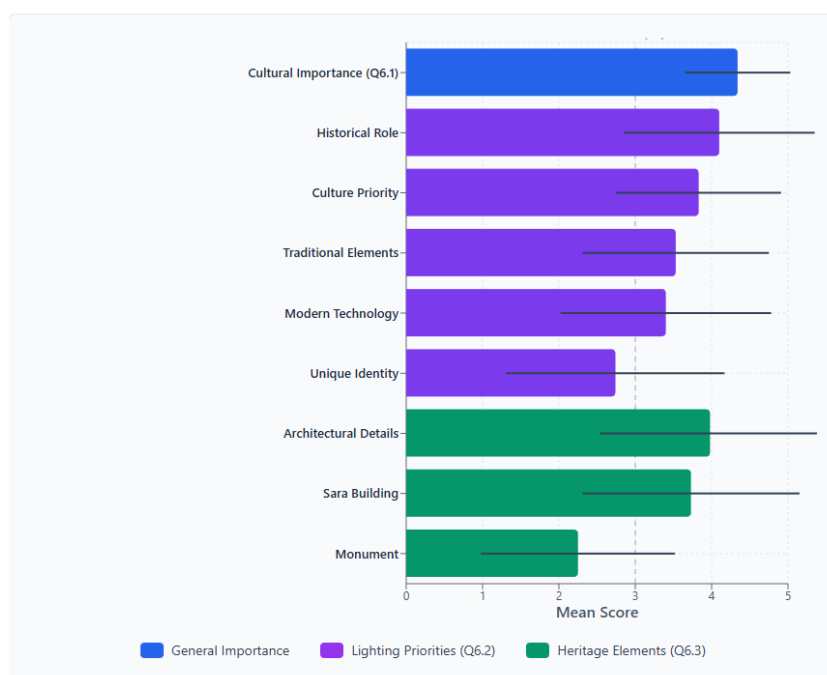


Table (12): Spearman's rank-order correlations among lighting perception variables (N = 128)

		Navigation	_Security	Welcoming	Avoided	Cultural Importance
_Navigation	Spearman's rho	—				
	df	—				
	p-value	—				
Security	Spearman's rho	0.847***	—			
	df	126	—			
	p-value	<.001	—			
_Welcoming	Spearman's rho	0.653***	0.789***	—		
	df	126	126	—		
	p-value	<.001	<.001	—		
_Avoided	Spearman's rho	0.726***	0.739***	0.585***	—	
	df	126	126	126	—	
	p-value	<.001	<.001	<.001	—	
Cultural Importance	Spearman's rho	0.596***	0.644***	0.292***	0.557***	—
	df	126	126	126	126	—
	p-value	<.001	<.001	<.001	<.001	—

SARA SQUARE NIGHTTIME LIGHTING AND URBAN VITALITY SURVEY

Research Study Information

Welcome, and thank you for participating in this academic research questionnaire. This study, conducted by **Asst. Prof. Dr. Raz Saed Faraj** and **Asst. Lecturer Hawar Shawkat Karim** from the **Department of Architecture, Faculty of Engineering, University of Sulaimani**, investigates how nighttime lighting design can revitalize **Sara Square**, a key historic space in Sulaimani, Iraq. The aim is to explore and develop effective lighting strategies that enhance **people's satisfaction, safety, cultural identity, visibility of historic features, and social vibrancy**, transforming Sara Square into an **active, safe, and culturally meaningful 24-hour public space**, informed by local user perceptions and international best practices. Your valuable responses will contribute to **evidence-based urban design research**.

All answers will remain **confidential** and used solely for academic purposes. Participation is **voluntary**.

Please review the following map and images carefully before completing the questionnaire. The map shows the location of Sara Square in relation to **Orzde Street** and the **Grand Mosque square (front space)**, while the images illustrate the **current nighttime atmosphere** of the square. These visual references reflect the **recent updates and spatial layout** of the area and are provided to help you give **accurate and informed responses** regarding the square's overall experience.

By clicking **"Next"**, you confirm your voluntary participation in this study.

Sulaimani City Centre - Sara Square Atmosphere

Next

Clear form

How long have you lived in Sulaimani? *

☐ Less than 1 year
☐ 1-3 years
☐ 4-10 years
☐ More than 10 years
☐ My entire life

What is your relationship to Sara Square? (Select all that apply) *

☐ I live nearby
☐ I work nearby
☐ I regularly pass through
☐ I visit for social/cultural activities
☐ I visit for historic/architectural interest

NIGHTTIME USAGE PATTERNS

How often do you visit Sara Square during evening/nighttime hours (after 6:00 PM)? *

☐ Never
☐ Rarely (1-2 times per year)
☐ Occasionally (Once per month)
☐ Regularly (2-3 times per month)
☐ Frequently (Weekly)
☐ Very frequently (Multiple times per week)

How long do you typically stay during nighttime visits? *

☐ Less than 15 minutes (just passing through)
☐ 15-30 minutes
☐ 30-60 minutes
☐ 1-2 hours
☐ More than 2 hours

What is your primary purpose for visiting Sara Square at night? (Select main reason) *

☐ Passing through/transit route
☐ Socializing with friends/family
☐ Attending cultural events or activities
☐ Appreciating historic architecture
☐ Exercise/walking
☐ Shopping/commerce in nearby areas
☐ Photography
☐ Other: _____

Figure 13: A sample of a (Google Forms and in-person) questionnaire of the Sara Square Nighttime Lighting and Urban Vitality Survey in Sulaimani

ELIGIBILITY & DEMOGRAPHICS

Have you visited or passed through Sara Square during evening or nighttime hours (after 6:00 PM) within the past 12 months? *

☐ Yes

☐ No

Your Age *

☐ 18-24

☐ 25-34

☐ 35-44

☐ 45-54

☐ 55-64

☐ 65 or older

Gender *

☐ Male

☐ Female

Highest education level completed *

☐ Primary school

☐ Secondary school

☐ Diploma/Technical certificate

COMPARATIVE SPACE USAGE (Nighttime)

Comparing NIGHTTIME conditions, rate Sara Square against Grand mosque square(Mzgawte Gawra)/Orzde Street: *

(1=Much worse, 3=Same, 5=Much better)

	1	2	3	4	5
Lighting quality	☐	☐	☐	☐	☐
Perceived safety	☐	☐	☐	☐	☐
Visual appeal/aesthetics	☐	☐	☐	☐	☐
Cleanliness/maintenance	☐	☐	☐	☐	☐
Social atmosphere/vibrancy	☐	☐	☐	☐	☐
Accessibility for pedestrians	☐	☐	☐	☐	☐
Expression of cultural identity	☐	☐	☐	☐	☐
Overall nighttime experience	☐	☐	☐	☐	☐

☐ Cultural significance

☐ Social atmosphere/more people

☐ Better accessibility

If you RARELY or NEVER visit Sara Square at night, how important are the following reasons? *

(Rate each: 1=Not a barrier, 5=Major barrier)

	1	2	3	4	5	N/A
Poor/inadequate lighting	☐	☐	☐	☐	☐	☐
Feel unsafe or uncomfortable	☐	☐	☐	☐	☐	☐
Lack of activities or attractions	☐	☐	☐	☐	☐	☐
Poor maintenance/cleanliness	☐	☐	☐	☐	☐	☐
Difficult to access/poor walkability	☐	☐	☐	☐	☐	☐
Prefer other public spaces	☐	☐	☐	☐	☐	☐
Too crowded	☐	☐	☐	☐	☐	☐
Too empty/isolated	☐	☐	☐	☐	☐	☐
No specific reason to visit	☐	☐	☐	☐	☐	☐

NIGHTTIME LIGHTING QUALITY ASSESSMENT

Rate your agreement with the following statements about Sara Square's nighttime lighting: *

(1=Strongly disagree, 5=Strongly agree)

	1	2	3	4	5
The lighting helps me navigate pathways clearly at night	☐	☐	☐	☐	☐
The lighting makes me feel visible/observed, increasing my sense of security	☐	☐	☐	☐	☐
The lighting creates a welcoming and comfortable atmosphere	☐	☐	☐	☐	☐
The lighting encourages me to linger and spend time in the square	☐	☐	☐	☐	☐
The lighting effectively highlights the square's historic architecture	☐	☐	☐	☐	☐
The lighting supports social interaction and community gathering	☐	☐	☐	☐	☐
There is too much glare or harsh lighting	☐	☐	☐	☐	☐
Some areas are too dark and feel unsafe	☐	☐	☐	☐	☐
The lighting reflects the cultural character of Sulaimani	☐	☐	☐	☐	☐
The current lighting is adequate and needs no improvement	☐	☐	☐	☐	☐

Figure 14: A sample of a (Google Forms and in-person) questionnaire of the Sara Square Nighttime Lighting and Urban Vitality Survey in Sulaimani

CULTURAL HERITAGE & IDENTITY

How important is it that Sara Square's lighting design reflects and celebrates the cultural heritage of Sulaimani? for example like international square case studies

Trafalgar Square-Central London, UK Brandenburger Tor - Pariser Platz, Berlin

☐ Not at all important
☐ Slightly important
☐ Moderately important
☐ Very important
☐ Extremely important

SAFETY & COMFORT PERCEPTIONS

What factors most influence your feeling of safety in Sara Square at night? (Select top 3)

☐ Quality of lighting
☐ Number of other people present
☐ Visibility from surrounding buildings
☐ Police or security presence
☐ Maintenance and cleanliness
☐ Clear sightlines/lack of hiding spots
☐ Familiarity with the area
☐ Nearby active businesses/cafes
☐ Other: _____

Have you ever avoided Sara Square at night due to safety concerns? *

☐ Yes, frequently
☐ Yes, occasionally
☐ Yes, once or twice
☐ No, never

If yes, would improve lighting make you feel comfortable visiting Sara Square at night? *

☐ Yes, definitely
☐ Yes, probably
☐ Maybe
☐ Probably not
☐ Definitely not
☐ N/A - I don't avoid the area

Rate your agreement with the following statements: *

(1=Strongly disagree, 5=Strongly agree)

	1	2	3	4	5
Sara Square's lighting should incorporate traditional Kurdish design elements	☐	☐	☐	☐	☐
Modern lighting technology can complement historic preservation	☐	☐	☐	☐	☐
Lighting should emphasize the square's role in Sulaimani's history	☐	☐	☐	☐	☐
Cultural identity is more important than contemporary design trends	☐	☐	☐	☐	☐
Lighting should create a unique identity distinct from other cities	☐	☐	☐	☐	☐

How important is it to illuminate the following historic features in Sara Square? *

(1=Not important, 5=Extremely important)

	1	2	3	4	5	Unfamiliar with this feature
[Historic Building - Sara Building]	☐	☐	☐	☐	☐	☐
[Monument/Statue]	☐	☐	☐	☐	☐	☐
Architectural details of surrounding buildings	☐	☐	☐	☐	☐	☐
Traditional urban fabric/layout	☐	☐	☐	☐	☐	☐

Untitled Section SUSTAINABILITY & INNOVATION

Would you support the following smart lighting features in Sara Square? *

	Yes	NO	Unsure
Motion-sensor activated lighting for energy savings	☐	☐	☐
Adaptive lighting that adjusts brightness based on activity levels	☐	☐	☐
Color-changing lighting for special events/celebrations	☐	☐	☐
App-controlled lighting for citizen participation	☐	☐	☐
Integration with public safety monitoring systems	☐	☐	☐

Back Next Clear form

THANK YOU FOR YOUR PARTICIPATION! Your insights are invaluable to creating a safer, more vibrant, and culturally meaningful Sara Square for all residents and visitors of Sulaimani.

Back Submit Clear form

Figure 15: A sample of a (Google Forms and in-person) questionnaire of the Sara Square Nighttime Lighting and Urban Vitality Survey in Sulaimani