

Lighting of urban green areas – the case of Grabiszyn Park in Wrocław. Searching for the balance between light and darkness through social and technical issues

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Abstract. Illuminating the urban green spaces could lead to conflicts of spatial, technical and social nature. This relatively new, though already global, problem is expected to grow bigger with the further increase of urban areas artificial brightness. The case of Grabiszyn Park in Wrocław is an example of how difficult it is to find a balance between big-city lights and a natural darkness. The situation is even more difficult if the light is not legally recognized as a significant source of air pollution and direct nuisance at the legal level. The aim of the paper is to recognize the broader perspective of urban greenery lighting issues, global recommendations basis and the local awareness. The authors also made an attempt to analyze and assess the project implementation, as well as to characterize the components of the quality of an urban green areas lighting.

1 Introduction

Illumination of urban area is a field of growing interest not only for designers and researchers, but for its users as well. Defining the components of the high quality of the city's lighting after dark, and consequently creating the proper guidelines, is a very complex and changing process though. Outdoor lighting, as a public good, is expected to be functional, economical and respond to the conditions of places and users' needs within a diversified urban space. However, the situation becomes complicated when not only people are exposed to artificial light but the lively elements of cities' ecosystems, as well as in the case of urban green areas.

1.1 Lighting regulations and recommendations

Current guidelines related to lighting are based on legal regulations and corresponding norms, as well as a lighting culture of the society and the awareness and choices of designers. In Poland, there are no specific requirements dedicated to the lighting of green areas. The existing schematic technical standards refer mainly to roads [1], outdoor work spaces and sports areas [2]. Although some of these elements could be found in urban

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greenery, they are not always applicable. Park lighting in Poland is not a subject to standards as it is in the case of streets, often creating more nuisance than road lighting [3].

Internationally recognized guidelines referring to green areas focus mostly on the prevention of intrusive light, suggesting zoning broken down into, for example, wild nature reserves, villages, suburbs, city's downtowns and centers [4, 5]. Illuminating Engineering Society draws attention to the environmental issue of urban lighting, especially the light pollution, light trespass and glare associated with ill-considered use of lighting techniques [6]. Environmental Zones are also proposed, determining the brightness levels. The more detailed recommendations due to the quality of outdoor lighting refer to the light pollution reduction publications [7, 8]. However, they are often questioned whether they are right for urban areas due to insufficient flexibility and rigorous approach to lighting. This is also connected with the erroneous fear of switching off the city lights, more than with paying attention to their distribution direction and proper parameters.

In the specialist and scientific literature, lighting of green areas is still an unresolved topic, presenting many, often contradictory, approaches. Most publications refer to the impact of light on fauna and flora [9], especially to the blue-rich LED lighting [10], energy efficiency, visuality and lighting engineering [11], aesthetics and a landscape beautification [12, 13]. In the case of parks, the attention is focused on illumination in relation to seasonal changes, plant vegetation periods. A lot of attention is also devoted to digital control and new technologies used in greenery areas lighting, for example, adaptation to moonlight or the number of its users [14]. The difficulty of green areas illumination is also associated with its wild, dynamic character, difficult to measure with parameters. However, the art of illumination of objects differs from the lighting of larger urban green spaces with a specific functional and spatial program. There are also voices raised that the naturalness of the place is important in the perception of space after darkness [15]. In line with such concept, the lighting of the greenery should not be restricted to certain lighting level but to mimic its daytime character. On the other hand, the ecological approach to illumination recommends preserving the darkness due to the harmfulness of exposure to light during the night-time and maintaining its warmest color – low color temperature [16].

1.2 Urban green areas issues

Urban greenery areas vary in terms of the functional sphere or level of development. In the downtown conditions single isolated trees are preferred, but they are treated more as elements of city furniture than living objects. Lighting them is not a biologically beneficial, but extremely popular, seen in many cities' lighting plans [17]. Parks, squares and green areas retain their natural function to a greater extent in the vicinity of the buildings. There are also city green areas that areas that make up extensive ecosystems bordering with agricultural areas. Indeed, all of the presented types of urban greenery are used by residents and tourists. When planning to illuminate it, one should consider whether the space of the park is a typical 24-hour, accessible public space subordinated to people's expectations and global trends. In the conditions of today's permanent brightness of urban areas, the schematic and normative lighting model seems to not work anymore. Urban greeneries are often the last remaining oasis of wild, undeveloped space. On the other hand, they provide an attractive, and deficit, space for outdoor recreation, which result in the desire to adapt it to the users' needs over time.

Currently, the main goals of green area lighting are to increase the sense of safety of the users, create attractive landscape with the light and make people dare to stay out more. The most frequently illuminated elements of green areas are paths and squares, street furniture, buildings and characteristic objects that help to orientate after dark [18]. However, evolutionally every living element of the environment, including people, requires nighttime

darkness conditions, so that circadian rhythm function properly on the psychophysical level [19]. Planning the green spaces lighting is therefore the result of seeking a balance between the natural and urban environment, artificial brightness and the darkness. An example of such process is the lighting of Grabiszyn Park in the city of Wrocław.

2 Methods and material

2.1 The aim and scope of the study

The aim of the paper is to present the issues of urban green areas illumination, which represent an example of spatial conflict associated with artificial light. According to the authors' assessment, in the future there will be more and more of them due to the dynamic increase of brightness in cities and the growing level of knowledge on the negative consequences of excessive or inappropriate lighting.

The analysis of the lighting process of Grabiszyn Park in Wrocław was conducted, which allowed to learn the real arguments for and against brightness in parks. The implemented lighting project was evaluated by the authors in terms of functionality, social and light pollution related issues. The timeframe of the research covers the latest events (last two years) and focuses on the park itself, however, the literature study mainly refers to the last decade. The analysis of sources is the basis for assessing whether it is possible to reach a compromise solution and considerations on the components that constitute to the quality of urban green areas lighting.

2.2 Research hypothesis and methods

An interdisciplinary study of contemporary literature was adopted in the introduction section of the paper, involving fields of lighting engineering, legal issues, composition and visual side of light, ecology and astronomy. A practical part of research is the case study of Grabiszyn Park illumination process. The analysis of documents, formal and press reports as well as interviews and observations have been adopted to examine mentioned issues. For the purpose of the paper, an authorial analysis and assessment of park lighting project implementation were also carried out.

Considering the low social awareness, the authors hypothesized that currently it is not possible to reach a compromise solution regarding the park lighting socially, but it is technically. However it is difficult due to the lack of national and local legal regulations in the field of lighting and light pollution.

3 Grabiszyn Park – the urban greenery lighting case study

The Grabiszyn Park is a vast area of urban greenery (~50 ha) of a natural character, with an extensive network of pedestrian routes. The Ślęza River, the cemetery complex and the allotment gardens that limit the park, affect its indirect isolation in the city tissue. In recent years, along with the multi-family housing development, the Park is gaining attention due to its recreational potential.

3.1 Participation and masterplanning

Lighting of Grabiszyn Park lanes has been the one of the winning projects in 2016 Wrocław Participatory Budget edition. The main aim of the project was a new lighting installation to make jogging and walking safe and accessible after dark. The construction works had

started at the end of 2017. Before then, only about dozen park lamps have been located in the park, situated around the entrance zone from Grabiszyńska Street.

The lighting project was one of the factors leading to protests regarding development and further maintenance of Grabiszyn Park. At the beginning of 2018 people started to protest against the city's maintenance works in park that included cutting down over 500 dead trees. Around the same time a project of Grabiszyn Park Masterplan [20] was presented to the citizens. The public consultation of Masterplan had started the discussion concerning the maintenance of the park and its future development. One of the topics was new lighting of alleys, which was meeting citizens' need of safety but influencing fauna and the trees roots. During the time of discussion, the participatory budget lighting had been installed, and for some of neighborhood citizens it was considered as park devastation. In the meantime 10 lamps were set on fire, and during the next months, from January to July, fastening and control elements had been stolen and cables cut of another lamps located at the main alley (Fig. 1.). Because it had not happened before in any other park in the city, it was assumed to be not a hooligan act, but rather a deliberate action [21].



Fig. 1. Burnt lamps, January 2018, [photography courtesy of Tomasz Pajączek/Onet].

Due to many issues and conflicts it was decided to extend the time of the public consultation till June 2018. In view of such a big change, the residents' reservations and fears seem to be natural, even though the lighting of the park lanes was a bottom-up initiative. The maintenance works interfering with the structure of the park, the Masterplan project and the above events turned out to be so crucial for the local community that the civic committees were established in order to protect the park from changing its natural and forest-like character.

The second, so far suspended, stage of lighting in Masterplan assumed a significant increase in the number of planned lamps and additional illumination. During the consultation, it was possible to learn about arguments for and against artificial brightness [22]. The main „for” arguments were such as: an improvement of security and maintaining the continuity of communication corridors after dark, eliminating the fear of darkness, facilitating access to public transport sites and the possibility of longer activity and recreation in the park. However, far more requests concerned objections to lighting or its significant limitation. It was claimed that lighting at night generates too high costs in relation to a small number of its users, as an expression of excessive 'convenience', that also can encourage pathological behavior. Many considered nature as the primary function of the park and the protection of its wild nature as a priority (mainly protection of trees, plots and nocturnal animal species). It was proposed to completely turn off the lights at night,

beyond the trams running time. There were also votes for the dark-sky protection and the possibilities of amateur astronomical observations. For many citizens, enough would be the use of flashlights at night and repairing the surface of paths for security purposes.

The public consultation resulted in, among other issues, conclusions that the lighting as part of participatory budget has been implemented in a very limited extent in relation to Masterplan (Fig. 2.). It was determined that the fixtures must prevent the upper light emission and recommended to create a lighting curfew. Traffic sensors could not be implemented in order to protect nature.



Fig. 2. The brown dots show existing lamps, orange dots represent winning participatory budget project and the smallest red ones lamps planned in Masterplan [20]. Spatial distribution of the new luminaires is indicated by the blue line [graphic based on ZZM Wrocław data].

3.2 Analysis and assessment of the project implementation

Although not much time has passed since the changes in the park area brightness after dark, the implementation can be assessed on several levels. At the same time, it should be noted that access to the public data and technical parameters of light is still difficult, which limits the assessment methods for observations and simple tools, without specialized measurement being necessary.

Public consultations, protests and the devastation of lamps, led to reduction of the Masterplan version, simultaneously developing the vision from the Participatory project and postponing further plans for the park modernization. In the end, only the main communication park paths were illuminated and by arranging the lamps the bypasses for the roots of nearby trees were included or the works with the use trenchless method were conducted. Energy-efficient LED luminaires have been used with four times less energy consumption than already existing ones, and with an estimated life expectancy of 25 years. Lamps are equipped with a remote control system and the possibility of gradual brightening, which is especially important in the case of such sensitive area and with thoughtful usage can serve as a part of the compromise solution.

From a public space user's point of view, lighting can be evaluated in terms of its functionality and usage comfort. Selected communication routes have been illuminated

continuously, allowing one to walk through the whole area of the park in the most popular directions. The light of the lamps does not affect the housing zones, and its interference with the plant tissue is limited only to the closest surroundings of the paths. However, the discomfort associated with the glare is appreciable. It involves the appearance of excessive brightness or contrast within the visual field [23], which in the case of Grabiszyn park is caused by the choice of luminaires shape. Contrary to the good practice rule, that proper lighting ensures the visibility of light and illuminated space, not its direct source, the flat-lens luminaire exposes strong, unshielded LED diodes. It can disturb the user or limits the ability to recognize objects in space, which also may affect one's sense of security.

The impact of light on the environment is another aspect of assessment. The new full cut-off fixtures do not emit light above the horizon, which minimizes light pollution (Fig. 3.). Although it is visibly bright within the paths, it is possible to recognize the main stellar constellations. Currently, the night-sky quality of the park centre corresponds to 6 "bright suburban sky" in the Bortle scale (with 1 as the darkest and 9 as the brightest) [24]. The park is not big enough to curb the surrounding city lights and an ubiquitous sky glow, but still remains a stargazing potential.

The color temperature of luminaires is 4000 K, which is a neutral-cool light limit. The recommended range for green areas is approximately 1900–2500 K, to reduce glare and insect attraction or to minimize ecological effects and impact to human dark adaptation [4, 6, 7]. Therefore, the color could be more nature-friendly, warmer, especially since with a quality luminaires it is possible to obtain an adequate color rendering index. There are some doubts, as well, regarding the lamp height (5 m) that in some points violates the level of tree crowns, but at the same time it limits the needed lamps quantity.



Fig. 3. New lighting of Grabiszyn Park at night: distinct lack of upward light spill and visible distant visual glare from the luminaires, [A. Łopuszyńska].

3.3 Discussion: a quality lighting

While the applicable procedures, technical standards and the legal situation of outdoor lighting in Poland are regulated by the government, and their possible changes and updates are long-lasting, the bottom-up initiative had influenced local authorities and their actions towards using new, more individualized, solutions. Certainly, this is a factor introducing the diversity of opinions and an element of discussion in the sphere of shaping public space,

and in consequence it may result in faster reactions to globally changing needs. However, it is worth noting that the ‘loudest’ activist groups are not always representing the interests of entire local community; there is a risk of pushing their agenda at the expense of citizens who tend not to participate in public consultations.

It is the quality that could become the platform for a common compromise and the multi-level perception of security after dark. On the one hand, it is to ensure a democratic sense of security for people after dark through public lighting; but also safe for the environment, i.e. minimize the impact on the environment and light pollution as well as safe for the public budget in terms of reducing energy consumption and preserving the environment in the best possible condition, in accordance with the rule of sustainable city. At the same time, only an interdisciplinary approach to the issue could guarantee this. Nowadays, technical-economic and visual premises dominate, such as caring about low lighting maintenance costs, striving to meet the minimum required technical standards and beautify the space after dark. Due to the lack of regulations, it might result in chaos and visual nuisance for its users.

Future changes in lighting regulation are unavoidable considering the need to care for the quality of increasing brightness in cities. It is necessary to adopt an urban lighting zones that will fill the gap between areas of protected darkness and the bright city centers. Currently, the use of globally recognized recommendations is not obligatory, and there are no tools to enforce lighting policy. The current transformation into energy-saving lighting makes perhaps the greatest opportunity to focus on its quality.

4 Conclusion

The devised solution that has not evolved towards lighting most of the Grabiszyn Park alleys, but focused on the main ones is a kind of technical compromise. However, there can be no question of finding a reconciliation of involved social groups. Such reconciliation would require prior determining and social acceptance of the real quality of lighting. Social awareness and general knowledge about the modern possibilities that lighting technologies bring are still too small. After all, a sense of security and recognition in space after dark is possible without major losses for the night landscape and ecosystems. Emphasizing the importance of light pollution issues, it must be said that they are not only related to the night-sky darkness, but thoughtful and functional lighting usage.

It seems right to assume, that the urban greenery, should be considered special, but still a part of a city space. Therefore, green areas, as well as its illumination, should serve the people in contrast to agricultural or protected areas. Shutting off the lights seems to be inappropriate and too radical for urban areas, but this does not mean, however, disrespect for the conditions and surroundings of such a place. It is rational to strengthen the sense of security for park users after dark by lighting: creating its continuity, uniformity and clear communication routes. The same aim is served also by minimizing the light trespass and glare. Pedestrian-bicycle paths and selected squares, as well, could remain the character of a fully-fledged public space, but with keeping the rules of safe lighting. The color and intensity of light should harmonize with the natural circadian rhythm of people, fauna and flora, so it is reasonable to eliminate the blue light. It is worth noting that the use of energy-saving fixtures and fulfillment of color rendering index is not necessarily connected with the ‘cool’ color temperature.

In order to define the criteria for urban greenery high quality lighting design, the individual approach is recommended, meeting the requirements of a specific area and its users. The key is to choose the right parameters of light, depending on the urban functional zoning, as well as the correct selection, assembly and placement of the fixtures. This allows to keep the light within the desired boundaries, so that, for example, the paths will be

illuminated instead of the tree crowns. In case of not yet developed 'culture' of lighting and possible change of needs over time, it is a good solution to use controllable lighting devices, including the intensity (reducers), the usage time of lighting (timers), as well as manipulation of the light direction.

Due to light pollution prevention, that becomes a part of urban planning in many places in the world, limiting the upward light spill is crucial. Minimizing the negative effects of ill-considered and excessive lighting, thus increasing the care for its quality could create the basis for a sustainable lighting environment. The issues presented in the paper are gaining attention, which gives hope for further discussion and a more humanistic approach to artificial brightness.

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