Current Trends in Design of Street Lights

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Abstract. The article considers modern trends in architecture and design of street lighting devices. In the context of light urbanism concept, it is shown that lighting elements are an integral part of architectural image of a city. Street lights create the aesthetics and the "visual rhythm" of day-time city, and in the evening revitalize roads, pedestrian zones, courtyards and recreational areas. The formation of a beautiful image of a city is one of the factors of residential and business attractiveness, as well as the development of tourism. Design innovation of lighting objects expressed through various symbols and forms can convey spiritual values which improves emotional and physical state of people. Based on the analysis of street lighting practices in some cities the author identifies directions in the design of street lamps that create a unique urban image. These are art installations, representation of national symbols, heroes of literary and music, event emblems, bio-tech and high-tech devices. The key aspects of further development of street lighting design are also highlighted: aesthetic, socio-cultural, economic and environmental. Evolution of led-lighting opens up a wide possibilities for futuristic design and energy efficiency of street lights. It is noted that architectural and technological modernization will contribute to the creation of high-tech, creative, smart and eco-friendly devices for street lighting.

1. Introduction

The architectural and lighting appearance of streets is one of the most important factors that shape the image of a city. Visual comfort and possibility of easy orientation on roads and pedestrian zones are significant conditions for safety and attractiveness of residential space. Original design of lighting devices in the context of modern socio-cultural trends allows to create a unique street ensemble and, as a result, increase the value of public areas. Improving the quality of life space is a priority for "day-urban" and "evening light-urban" project. Within the current trends can be identified conceptual design directions that embody historical motives, artistic images, wildlife objects and other interesting forms in architectural lighting forms. Amazing architectural images presented in street lamps become elements of the cultural code of cities.

The purpose of this study is to analyze modern design approaches that are used to make a creative and innovative forms of street lighting devices. The objectives of the study are consideration of functional and aesthetic purposes of street lighting, review of trends in street lamps design that create a unique urban image, identification of key aspects of further development of street lighting design.
2. Materials and methods

The development of urban infrastructure has led to changes in the criteria for assessing the quality of life in the conditions of a city’s activity in evening and stimulated the evolution of outdoor lighting as a prerequisite for safety and comfort. Technological progress in lighting allows the life rhythm of cities to remain active in the dark time. Sufficient quantity and high quality of street light have become integral components of a comfortable urban environment and criteria for designing public spaces [1]. Lighting is the dominant factor in planning decisions and improvement of the most important elements of city: street and road, pedestrian spaces, recreational areas and architectural objects. A special role in the organization of pedestrian zones belongs to the design of lighting poles and lamps that carry the functions of landscaping, forming the perspective and aesthetics of pedestrian spaces.

Streetlights are integral elements of architecture and design of a city, defining aesthetics and artistic appearance of streets and have a great compositional value in shaping the structure of cities. Along with the utilitarian lighting of urban spaces, there is a tendency to increase the role of artistic factors in the formation of the light environment. From a psychological point of view, artificial lighting has especially active emotional properties, so night architecture leaves a bright and memorable impression in people's memory. Currently, such scientific directions as "urban light architecture" and "light urbanism" are being developed [2, 3, 4]. Russian founder of light architecture N. I. Shchepetkov describes the light structure of a city as a system consisting of a light-planning frame and a light-planning fabric [5]. "Frame" is a context consisting of placement, number, height, size and brightness of street lamps. "Fabric" is the shape of lampposts and lighting elements, symbolism and other design specifications. Researchers characterize street lamps as a "rhythm" or as an "engineering painting" on the canvas of urban space [1, 6].

The main goal of creating a harmonious light of a residential space is to achieve a uniform distribution of horizontal illumination, to create an artistically expressive, comfortable and safe environment. Street lamps and other lighting devices are small architectural objects of residential space [7]. They create an urban street style. Design and shaping of street lamps reflects various evolutionary processes: technical, economic, cultural and social. Analysis of the "frame and fabric" of street lighting in a number of cities allowed to identify the following three directions in design of street lights that create a unique urban image.

1. Street lights with national symbols at pillars, lamps and lampshades. An amazing example is the city Ashgabat (Turkmenistan): there is a wide variety of unique street lights with the octagonal Star of Oguz-Khan, crescent moon with stars and horses (figure 1). This means that street lamps perform not only an aesthetic, but also a semantic function.

![Figure 1. Street lamps of Ashgabat with national stylistic elements.](image)

Symbols are a special language in architecture that affects people's feelings through beauty and monumentality [8]. The representation of national symbols in modern lantern structures has a cultural and ethical effect: it forms the resident's mentality and fosters respect for their history and culture.
Especially national symbols and signs are supported in Eastern cultures, which is most clearly expressed in architecture and painting.

2. Lanterns as art installations in the context of city's socio-cultural space. In this aspect, street lamps are represented as objects of living and inanimate nature (people, animals, plants and others). There are examples of unusual expositions are people in different images. In Brest (Belarus) there is an alley of lanterns in the images of heroes from stories of Nikolai Gogol (figures 2). In Nur-Sultan (Kazakhstan) there is an alley of lanterns-musicians (figures 3). Lanterns in form of human figures (athletes) were installed for the Olympic games-2008 in China (figures 4).

The combination of decorative objects and lighting devices increases the originality and aesthetics of streets, parks and residential areas. Such architectural images can embody not only human figures, but also feelings, emotions and humanistic values, which is especially important for the cultural and spiritual development of people in conditions of dynamic life and stress.

3. Street lighting objects in the bio-tech style as a development of the concept of architectural futurism. Futurism is the art of the future, it involves the destruction of stereotypes and offers the idea of the future as an era of technology, industrialism, urbanism, high speeds of life [9]. Development of the bio-tech direction embodies natural forms with the use of technological advances, and the result is a stylish design and energy efficiency (figure 5). In this trend designers also develop original projects of pedestrian zones using LED lighting (figure 6). An innovative invention can be considered a bio-lamp by Hungarian designer Peter Horvath (figure 6). This lamp not only illuminates the street, but also cleanses the air, producing oxygen (algae is hidden inside) [9].
Thus, the evolution of urban light architecture takes place in two directions. First, the refined design of lighting system creates the appearance of streets and highways of city at a high aesthetic level. It can contribute to improving the mood and well-being of citizens. Second, the use of new light technologies can significantly reduce energy consumption. In context of environmental trends, the production of energy-efficient and aesthetic street lamps can be considered as "green" investment projects for bank lending and it can contribute to the decoupling effect [11].

3. Discussion of research results
Improving of human environment and reducing ecological pressure are dominant postulates of sustainable development concept. It requires a favorable living and recreational areas. Researchers assert that visual elements have a huge impact on a person's mental state, which directly affects their psychosomatic health, behavior, intellectual and social development [12, 13]. The use of colour and light in the design of day and night city streets is a global trend that increases the comfort of residential space [14]. Modern megacities "live around the clock", requiring constant lighting, and light architectural as the most flexible structure allows to stage modern processes taking place in "information society" [15].

The aesthetic aspect of street lighting is related to the perception of the architectural environment: lighting objects should not create discomfort for the visual organs. Due to the multiplicity of perception points at high-speed travelling along urban highways, the static perception of objects is lost. In the evening-night time, the impact of dynamic car's headlight creates the illusion of instability, so the human eye needs a stable support – street lighting.

The socio-cultural aspect of the development of urban architectural lighting is that with the help of symbols and designs embodied in street lamps, it is possible to transmit national values, beauty of natural objects to improve the cultural and spiritual state of people. In different cities of the world there are street lamps of unique design: art installations, representation of national symbols, heroes of literary and music, event emblems, futuristic and high-tech devices. Urban management is to be include in territorial development programs items related to increasing the visual attractiveness of illumination infrastructure [16].

The socio-economic aspect of urban space progressing is to increase the attractiveness of territories for living, working and recreation. Financial resources follow the movement of people. So, many cities of the world that attract the masses of tourists have created a festive atmosphere, using night effects of artificial lighting. Creating a beautiful city image is a factor of the development of tourism types: cultural, historical, business, recreational and other [17].

The ecological aspect of street lighting modernization is reflected in the transition to energy-efficient lighting and reduction of energy intensity. The problem of saving electricity in conditions of limited resources and increasing their consumption is extremely urgent. In accordance with global energy saving trends, LED-light sources are the most energy-efficient, economical and safe. Over the past two or three years, new LED lighting technologies have appeared on the global lighting market that surpass the traditional ones in terms of economic, environmental and quality parameters [18]. Also, the advantage of LED is a wide range of controllability in terms of light output power [1].

Summarizing, architectural and technological modernization of lighting elements "activates" streets and residential areas, increases in interest in city as a place of recreation and strengthens the social value of city. It can be assumed that the concept of light urbanism will continue to develop in an interdisciplinary context and lighting facilities of the future will be high-technology, creative, smart and eco-friendly.

4. Conclusion
Review of literature sources and author's analysis allow to conclude that modern urban development is impossible without a light upgrade. Lighting objects perform not only a security function, but also form the aesthetic appearance of streets, courtyards and recreation areas. Original forms and design of lighting
devices complement the "street ensemble", creating a pleasant atmosphere and uniqueness of residential environment.

The design of lamps and lighting poles depends on technological progress, social needs and cultural development. The key trends in street lighting design are national and cultural symbolism, art installations and bio-tech. Architectural and technical development of urban lighting should be considered as a synergy of functional, aesthetic, socio-cultural, economic and environmental aspects. The evolution of street lighting architecture is seen in the direction of design creativity, video ecology, smart light management technologies, which will increase the comfort of human habitat.

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