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Research Paper

Elimination of the blinding effect in landscape luminaires

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Abstract

The article presents one of the possible options for implementing the lighting technology "Flat beam" for landscape lighting purposes. One of the possible ways to control the light distribution of a number of light sources based on LEDs with different radiation patterns is considered. As a secondary optics, it is proposed to use a mirror surface that redistributes the light flux of an LED light source. It is indicated that, depending on the initial type of the light-emitting diodes light curve and the features of mounting the mirror surface, the resulting light distribution can vary widely, depending on the initial task that the designer sets for himself.

Keywords: *Secondary Optics; Light Distribution Diagram; Light Intensity Curve; LED; Flat Mirror Surface; Landscape Lamp*

1. Introduction

Modern urban landscape can not be imagined without night lighting. To date, many lighting devices have been developed, which serve as an excellent element of illumination in the dark.
Currently, for lighting streets, roads, as well as for lighting courtyards and industrial areas, a common lighting system is widely used when lighting fixtures are mounted on a support or suspended on a cable at an altitude of 6-15 m. Under the conditions for ensuring a uniform uniformity in the distribution of road surface brightness, various schemes of the arrangement of supports: one-sided; axial; two-row chess; double row rectangular; double row in the street; Two-row rectangular along the axes of motion [7].
As you know, engineers and designers, in many situations, ordinary street lights - are not the best solution for road lighting. The installation height of the luminaire can be limited by any designs or local regulations. Sometimes a problem can be a blinding light. Very often there is a need to urgently perform maintenance of luminaires, for example, in order to reduce the likelihood of a car accident on sections of a road with intensive traffic, while the time limit for movement during operation should be minimized. In such situations, standard lighting is often imperfect.
Thorn applied its vast experience to solve these problems and developed the Flat Beam® lighting technology, which reduces the mounting height of the luminaires. [8]. As a rule, such a street luminaire is installed at a low altitude (0.9 m) and thanks to the LED lamp it provides indicators above the standardized safety standards for the roadway. Manufacturers also note that comfortable driving is provided by eliminating the glare effect. Also in the luminaire, various lighting control options are realized, from simple dimming to an advanced central control system [6].

2. Methods of increasing the efficiency of a lighting device

The optical part of the device includes a diffuser - a UV-resistant polycarbonate compartment with graffiti protection with additional processing that prevents scratching and an optical system that generates the required light distribution of the luminaire, or a reflector having an aluminum coating with a high reflection coefficient, or secondary optics in the form of special lens.
However, one of the options for implementing the lighting technology "Flat beam" is the use of a mirror surface in place of a complex optical system. On the basis of lighting technology "Flat beam" you can create lighting for landscape lighting, where you can also implement various modes of operation.
The most widely used for landscape lighting are lamps such as a "light column". The light column is used for landscape illumination of squares, gardens, homestead lands, cottage settlements and are installed along pedestrian paths and around flower beds.
The most promising sources of light in the light column are LEDs. LEDs outperform conventional sources of optical radiation in many respects. They are point emitters, the use of secondary optics makes it possible to obtain the necessary diagram of the distribution of the light flux.
The existing nomenclature of LED light intensity curves is determined by the design of the LED itself or by a combination of LED and secondary optics.
In lighting for landscape lighting, a significant disadvantage is the blinding effect that arises from the fact that the light flux from the light source spreads to the upper hemisphere. The axisymmetric shape of the light intensity curve of the overwhelming number of modern LEDs when the surface is illuminated at a small angle creates an elongated shape of the light spot. To limit the extent of the light spot in the design of lighting devices, special screens are used, but in this case, the inefficient use of the light flux is noted, since part of the light flux is absorbed by the screen.
The use of lighting technology "Flat beam" contributes to the elimination of the above disadvantages.
Realize the technology of "flat beam" can be by changing the light distribution of the light-rod in the lighting device with the help of a reflective surface.
One option is to use a flat mirror surface. In addition to redirecting the light flux, for example, from the upper hemisphere to the lower one, it becomes possible to create the required light distribution, depending on the layout of the mirror surface.

Figure 1 shows the light intensity curves of a light-emitting diode with secondary optics, forming a wide light distribution with respect to the optical axis of the LED. Figure 2 shows the light intensity curves of the same LED, but parallel to the optical axis of which is a flat mirror surface. Figure 2

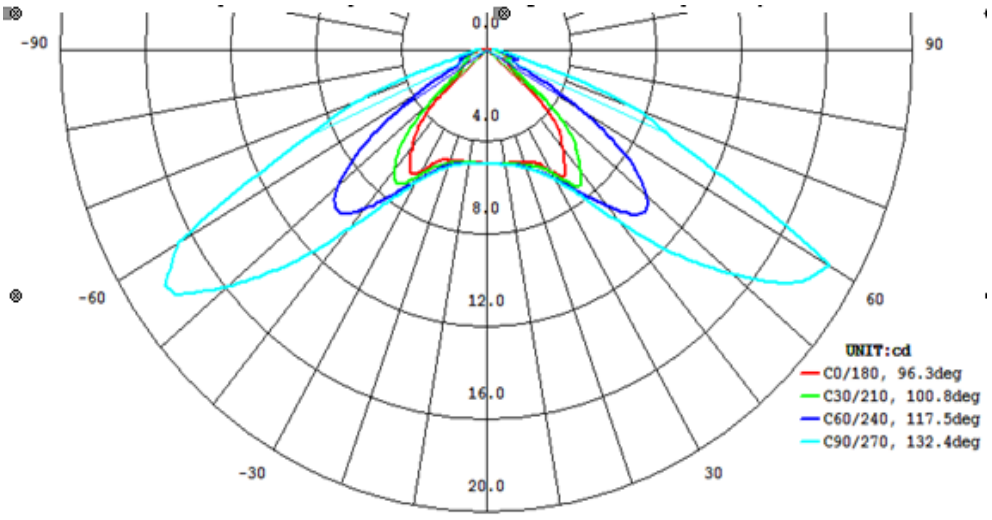

Fig. 1: Curves of Light Intensity of an LED with Secondary Optics Forming a Wide Light Distribution With Respect To the Optical Axis of the LED.

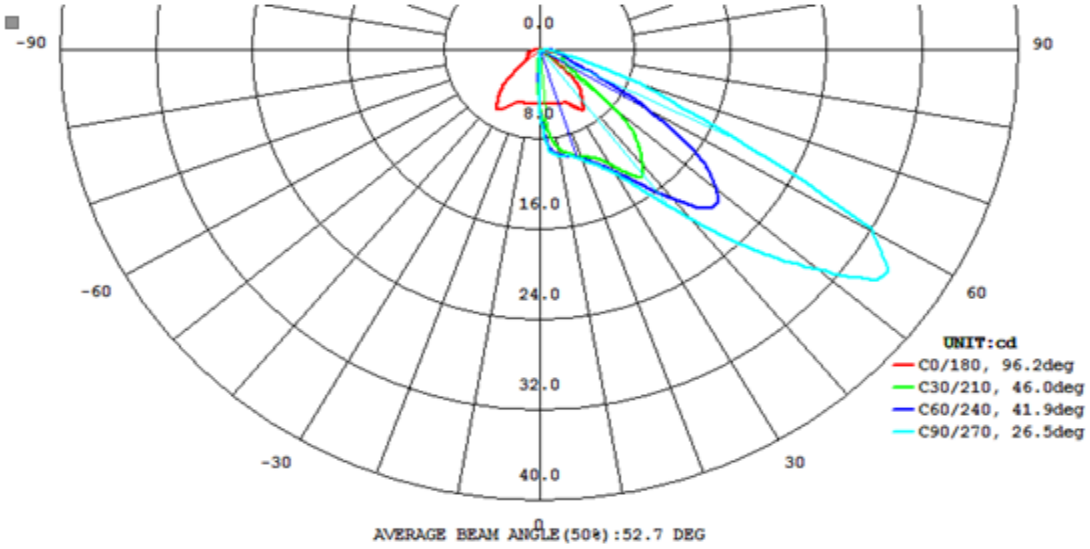

Fig. 2: Curves Of The Light Intensity Of The Same LED (Figure 1), But Parallel to the Optical Axis of Which Is A Flat Mirror Surface.

Shows that the maximum luminous intensity of the lighting device has almost doubled.

The Mirer Or plate can be mounted parallel to the optical axis of the LED or by the orientation at different angles of the plane relative to the optical axis of the LED, depending on the initial shape of the light intensity curve.

The above-described method of forming the LED light distribution allows changing the shape of the light curve of the light-emitting diode in the manner required by the task, thereby eliminating unwanted radiation around the lighting device. Due to this, light pollution decreases with landscape lighting, and the illuminated surface near the light column is doubled. This is because the light flux, which previously either shone into the upper hemisphere, or was absorbed by a protective screen, in this case is directed to the illuminated surface.

3. Conclusion

The conducted researches have shown that the use of a mirror surface for the formation of a light distribution of a lighting device with LEDs makes it possible to significantly expand the "nomenclature" of light intensity curves without using complicated expensive secondary optics of light-emitting diodes.

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