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Computer simulation of a concentrated light curve from LED source

The issue of the concentration of light flux from the LED source is considered. Various ways of obtaining a concentrated light curve are analyzed.

Modelling of a concentrated beam of light rays.

When designing LED light devices, there are problems creating a concentrated parallel beam. For low-power LED sources, a curve of light intensity is characteristic. But the light flux of one light source of low power is not sufficient for lighting problems. In powerful LED sources, for the most part, the curve of light intensity of uniform type. In particular, the light curve of the LED Cree 1507 is shown in Fig. 1.

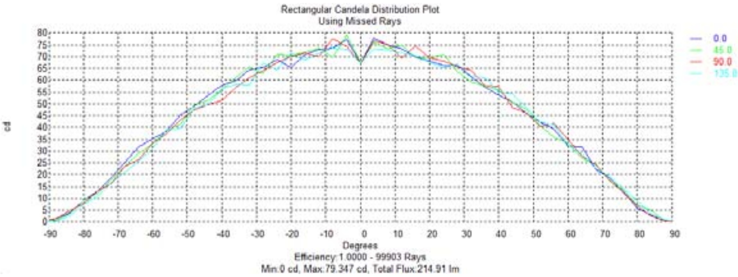


Fig.1. Light curve of the LED Cree 1507

For the formation of a narrow curve of light intensity with a high concentration of light flux, the most suitable reflecting optics. To form a parallel beam of light coming out of the reflector's luminaire, the paraboloid shape of the reflecting surface should be used.

In the course of a scientific study, an approximate problem of passing light rays through an aperture of 5 cm in diameter was solved. As the light rays from the light instrument go out in parallel, the diameter X the light hole is 50 mm (Fig.2).

The rectangular coordinates of the parabola are determined by the equation

$$X^2 = 4fZ \qquad (1)$$

where Z – is the reflector's depth, and f is the focal length.

In this task, the diameter of the light hole X and the diameter of the base hole X0, which is determined by the parameters of the light source, is known. LED Cree 1507 has a size of 15 mm, so the diameter of the base hole will be set to 16 mm (+1 mm reserve).

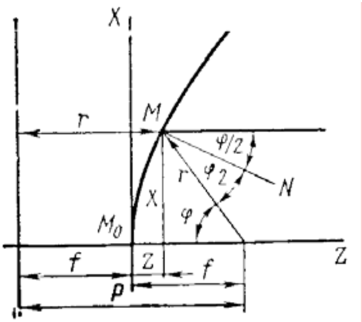
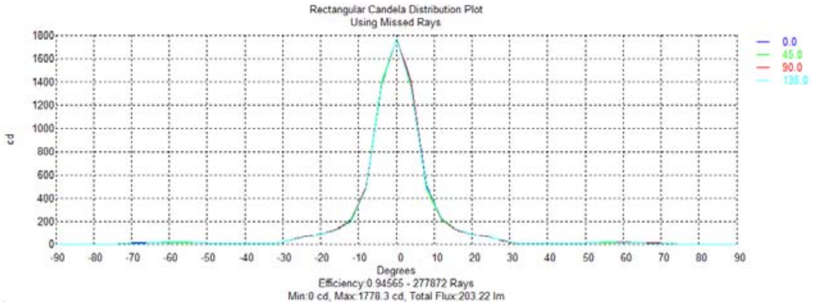
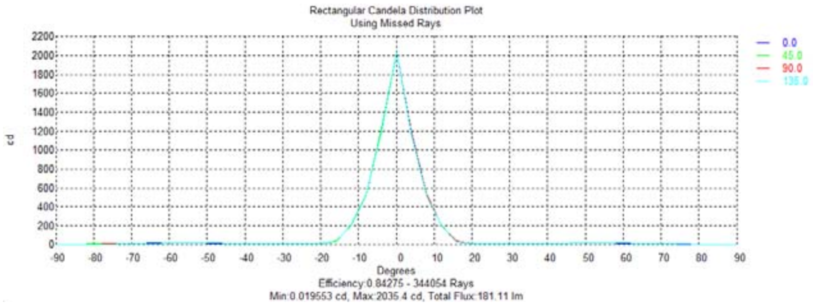


Fig.2. Parabolic parameters

Computer simulation to find the optimal length of the reflector was carried out in the software environment Trace Pro. Three reflector lengths were investigated: 50 mm (Fig. 3 a), 100 mm (Figure 3 b), 150 mm (Fig. 3 c).



a



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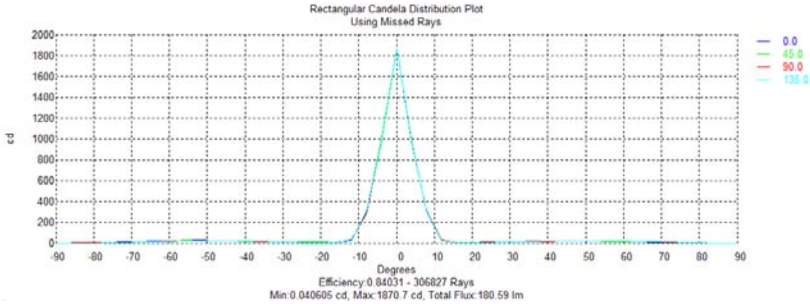

c

Fig. 3. Influence of reflector depth on the shape of the curve of force of light

The simulation results are summarized in the table.

Table 1.

Results of simulation

Reflector length, m	Maximum candle power, Kd	Half-brightness angle, deg
50	1778,3±5%	7
100	2035,4±5%	5
150	1870,7±5%	6

From the results of computer simulations, we can conclude that the optimum depth of the reflector at the initial data is 100 mm. At this depth, the reflector receives the highest maximum power of light and the smallest angle of half brightness. Consequently, with parameters of the width of the reflector 50 mm and a depth of 100 mm, the greatest concentration of light intensity is obtained.

References

1. Зеленков І.А. Застосування програмних засобів для моделювання світлодіодних світлових приладів / І.А. Зеленков, Н.І.Кулик // Електроніка та системи управління. – 2011 р. – № 3(29) – С. 45-49.

2. Квасніков В.П. Моделювання світлодіодного приладу / В.П. Квасніков, Н.І. Кулик // Вісник інженерної академії України. – 2015 р. – № 4– С. 224-226.

3. Natasha Kulik Modeling of Freeform Reflecting Surface for LED Device /N. Kulik// Systems. Control and Information Technology «SCIT 2016» May 20-21, 2016, Warsaw, Poland. – 2016. – P.674-681.

4. Алямовский А.А. SolidWorks 2007/2008. Компьютерное моделирование в инженерной практике. – Санкт-Петербург: БХВ-Петербург, 2008– С. 698 – 699.