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Optical systems of LED airfield fires

Development of designs of LED airfield fires of airfield light signaling systems, namely the selection of an optical system, which will allow the creation of LED airfield devices that would meet the conditions of the ICAO for the formation of a light signal. Therefore, to solve the complex task of selecting the optical system of an airfield LED fire, the developed tool using the MatLab interface is proposed.

Optical systems airfield fires

This tool allows to simulate the passage of an LED beam throughout the selected optical system for the development of the design of LED airfield fires with the appropriate light distribution within the light flux dispersion angles of the LED light signal.

The development of LED technologies contributes the creation of more modern LED airport equipment. Airport fires of subsystems of airfields LED systems must meet the requirements of certification according to the following criteria:

- functionality,
- climatic,
- structural,
- electric,
- lighting and reliability.

The following requirements are imposed on the designs of modern LED airfield fires of light signaling of airfields:

- reduction of electricity costs;
- minimization of the design of airfield lighting devices;
- manufacturability of the design of airfield lighting devices.

The use of LED airfield fires in during construction airport or its modernization requires a modern appearance. Today, the most famous foreign companies that have proven themselves as manufacturers of light signaling equipment are: Lucebit, Transcon, Idman, ADB, Thorn, OCEM. Airfield light signaling systems consist of subsystems of airfield fires.

For each subsystem of airfield fires, there are requirements for the performance of the framework of the light device, its overall dimensions and light technical characteristics. The wide range of functions performed by subsystems of airfield fires leads to the creation of a large number of variants of airfield fires designs, which differ:

- the number of light armature in the assembly,
- radiation direction,
- the location of the light emitting source,
- type of optical element or optical system as a whole and others.

Figure 1 shows some variants of designs of one of the subsystems of the airfield light signaling system - glide path lights. But not all manufacturers of light signaling systems have switched to the production of LED equipment.

а) в) с)

Fig. 1 Gliding airfield fire of manufacturers: a) ADB; в) Idman; с) Thorn.

The Ukrainian Association of Light Engineering Enterprises Vatra Corporation has developed the elements of the airfield LED system, namely the design of LED equipment for the airfield light signaling systems. Design features of LED equipment are related to the scattering angles of the luminous flux of the LED light signal. It is the detection and observation of LED light signals at the airfield that directly affects decision-making when visual contact is set. The light-technical parameters of spatial radiation are normalized in accordance with the recommendations of ICAO [1-3] (Fig. 2) and provide the necessary orientation during convergence.

When developing the designs of LED airfield fires, it is necessary to take into account the asymmetry of spatial radiation. The use of LED modules in the construction of airfield fires has a number of advantages. The most significant advantages of the LED airfield light include: low energy consumption, instant on and off, resistance to vibration, long service life, high quality of light with a color rendering index in the range of 80-95 and an optimal directional pattern with the ability to create directional light. It is possible to solve the asymmetry of spatial radiation due to secondary optics.

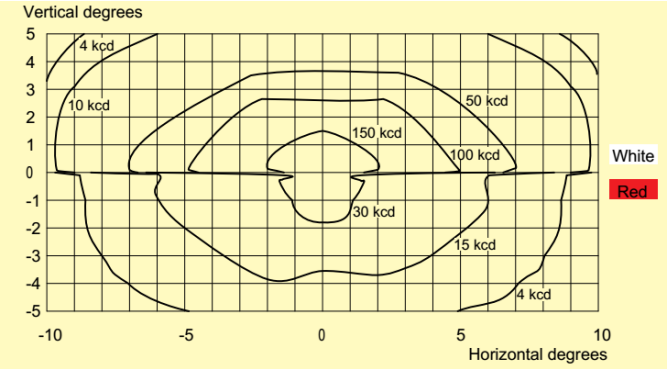

Fig. 2 Normalization of spatial radiation to the system of gliding fires according to ICAO recommendations

Since for each subsystem of light signaling systems there are requirements for the creation of spatial radiation, it is necessary to select secondary optics for the design accordingly. Therefore, it is proposed to solve this problem with the help of the developed tool using the MatLab interface [4-5] (Fig. 3) for modeling the secondary optics of total internal reflection. The tool allows:

- calculate the path of rays through a complex optical system
- calculate the parameters of the equivalent optical system
- get a graphic image of the path of rays through a complex optical system.

Fig.3 Tool using the MATLab interface for modeling secondary optics of total internal reflection.

A graphic representation of the passage of rays through a complex optical system allows to draw conclusions regarding the determination of secondary optics in the development of LED airfield fires (Fig. 4).

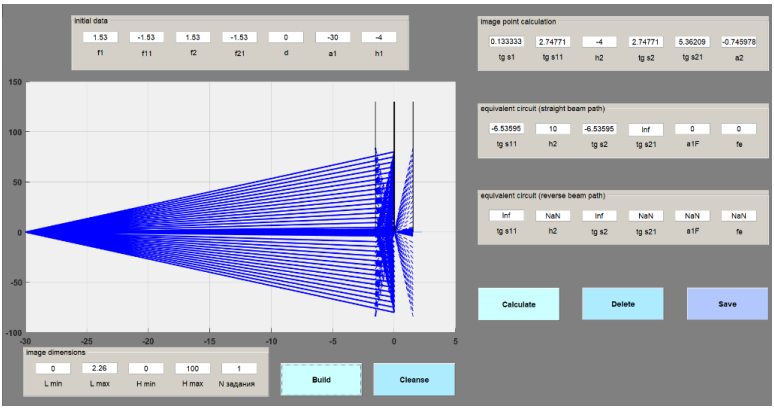

Fig. 4. Graphic representation of the passage of rays
through a complex optical system

Modeling the optical system of airfield fires is much simpler than in natural experiments during the design development of LED airfield fires. In addition, modeling the optical system as a selection of secondary optics for LED aerodrome fires for each subsystem of the aerodrome lighting system will reduce the development time of the aerodrome fires.

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