

Improving the standards and methods to control the lighting of roads



Some problems have been found according to the results of the analysis of the present state of the design engineering and control of the artificial lighting of public roads in Russia; and now the ways to solve them are being elaborated. The priority tasks are: to improve the standards of the lighting of roads and tunnels in order to harmonize them with the international requirements; to conduct a study of the brightness characteristics of modern road surfaces and their further type assignment and standardization, to carry out the research and develop the tools and techniques to measure and control the lighting parameters of the road illumination.

The main purpose of the road lighting is to create safe and comfortable conditions for the drivers in order they could see in the night. Therefore, the main task is to provide standardized indicators of the road lighting. Historically, the evaluation of the road lighting in Russia is divided into the two areas of focus: the lighting of roads and streets (including tunnels) in cities and other settlements and the lighting of public roads and tunnels outside the settlements.

Nowadays the first area is regulated according to the recent standards (Natural and artificial lighting. Revised edition SNiP 23-05-95), the second area is regulated according to the standards for public roads and in accordance with SNiP 32-04-97 for roads and tunnels respectively.

The fundamental difference between these two areas of focus is that as the main standard for the evaluation is the brightness in the first case, while in the second area it is the lighting of the road pavement. It is well-known that if we speak about the approved standards for ensuring the observation conditions (inclination of the line of sight at an angle of 10 to the plane road) there is no direct dependence between the light intensity and brightness since reflection of the road surface is not diffusive and has a clear direction depending on the direction of illumination, and the type and the state of the reflecting surface.

Taking into account the fact that light intensity does not provide clear characteristics of the observation conditions, the road lighting standards are based on the brightness in all the developed countries of the world. And there is no difference in the international and European standards between the lighting in the settlements or outside the settlements. The classification of the objects of illumination in these standards is connected with the specific observation task at this part of the road and depends on the following factors: the separation of the oncoming traffic,

the speed of the traffic and its intensity; the crossroads at the same road level and their density per 1 kilometer of the road; navigation task difficulties; the complexity of the observation site, etc.

We should note that both foreign and domestic standards take into account the specific features of the definition of “the brightness of the pavement”, and in cases where it is incorrect to use this concept (for example, curved road sites in plan and / or in profile, the road sites with non-standard type of surface; roads in regions with a long duration of snow cover), the standards are based on the light intensity.

Recently the professional community has repeatedly pointed out that the technological level of the existing Russian legal instruments in the field of road lighting does not fully meet modern requirements for ensuring the safety and comfort of the traffic. Applicable standards and other regulations for the road lighting shall be updated according to the latest domestic and foreign scientific and technological achievements in this field. First of all, we have to harmonize them with the current Russian standards for the lighting of roads and streets in urban areas and with the international standards. To achieve it we have to solve a number of priority tasks.

The first task is to work out the regulating documents based on the concept of brightness which is used to determine the standards of the lighting of roads and tunnels. We should take into account the specific features of the lighting of the public roads by means of developing a new classification of the lighting objects and connect it with the existing classification of roads and the entire road infrastructure. This stage of improving the regulatory system doesn't involve the full harmonization of the new Russian regulations with the foreign standards, especially in terms of classification of the lighting objects and the structure of regulations. It is due to the established significant differences between foreign and domestic practice of drafting the regulations regarding both the form and the presentation of the material, and due to the geographic and climatic characteristics of Russia. At the same time in terms of the concept issues related to the list of standard parameters and their values the new Russian regulations should be brought in line with the international standards as much as possible.

The second task caused by the approval of the brightness concept of standards is related to the need to conduct a large-scale research of the brightness characteristics of the domestic types of road surfaces that are being used or developed and their further standardization. Nowadays when a lighting fixture is being designed for the lighting installation they use the standardized data on the brightness coefficients for the two types of coating, the so-called fine-grained and rough asphalt coatings, to calculate the brightness of pavement. These standardized data were obtained from the studies conducted by the Russian Lighting Research Institute more than half a century ago. Nowadays we can see the increase in number of vehicles, the introduction of heavy vehicles with an axle load of more than 10 tones and, consequently, the increase in the traffic load on the pavement. That's why the new types of road surfaces have appeared; they are produced on the basis of modern materials and technologies and obviously have values other than those specified for the brightness coefficient. All these factors show that such studies are important. It is not easy to measure the brightness coefficients depending on the direction of the light in the standardized observation conditions. The traditional method of measuring is performed in the laboratory on a fragment of the pavement cut off from the actively exploited section of the road. It is obviously a laborious and inefficient process since it results to the damage of the road coating, and the need to remove these defects arises. In recent years another method has been applied which is based on measuring the brightness coefficient using a special measuring device. This device is installed directly at the chosen point of the road pavement. The benefits of this method are obvious. But to implement this method we will need to develop the relevant tools and measurement techniques.

The third task arises from the need to verify the values of lighting parameters of the real illuminating installation with the standard indicators. The objective is to develop a methodology for measuring and monitoring the standard parameters of road lighting. Nowadays the measurement of the lighting parameters is made using the luxmeter at the control point of the road. It is obvious that the standardization of the brightness will require measuring the brightness characteristics of the installation in the appropriate manner. Determining the brightness at control points of the road is a more time-consuming procedure. When the traditional method of measuring with a photoelectric brightness meter is used it is necessary to stop the traffic on the lane where the measurement is being done for several hours, and often it is necessary to stop the neighboring traffic lanes. This is the reason for using the control of the light intensity instead of the brightness control on the road till the present moment. However, with the introduction of digital measuring technology the situation has changed drastically. The new cameras on the basis of PZS sensor allow to make brightness images of the object (the control point of the road) and evaluate the regulated parameters of the installation quickly: the average brightness of the coating, and the overall and longitudinal uniformity of brightness. The camera can be fixed on a car, and in such manner we can take measurements moving at the speed of the traffic flow.

There is another serious problem connected with measuring the brightness of the pavement. In accordance with the requirements of measuring the brightness of the road surface the control area of the road must be clean and dry without any impurities and other ingredients such as water, snow or ice. It is obvious that due to the climate conditions in Russia the road pavement in many regions is wet or covered with snow most of the time, and therefore the pavement does not meet these requirements. Another important requirement is the usage period of the pavement, i.e. the road must be exploited during the specified period of time. This requirement is due to the fact that over time the road surface is becoming smooth, and the reflection turns out to be more directional. Meanwhile, the total reflection coefficient increases, which significantly affects the real brightness values of the lighting installation. The period necessary to stabilize the reflective properties of the coating ranges from six months to a year depending on the intensity of traffic on this section of road.

It is obvious that the new sections of road with a new coating do not meet the standard requirements for measuring the brightness. To solve this problem another method can be used. The main idea is that measuring the brightness is carried out on the sample of the standard coating similar to the coating of the control section of the road. To make the process easier a luminance meter is fixed on the console of a moving car. Of course, the results of measuring carried out using this method will not be associated with the real state of the pavement. Hence, it is necessary to carry out type assignment of the existing and newly created pavements based the research of brightness characteristics of these coatings which is described above.

The experimental examination carried out in one of the streets of Moscow showed that the difference of the parameters of the road lighting measured directly on the road and using a sample of pavement makes up 15-20 %. The sample was close in characteristics to the road surface of the street, which determines the divergence of the results obtained.

Development and implementation of the equipment and installations, and the standards for measuring the lighting parameters into the usual practice will allow to solve the task of controlling and monitoring the surface of public roads.

Since the specified task are of high importance the Federal State Unitary Enterprise "ROSDORNII" together with the Russian Lighting Research Institute initiated the inclusion of the relevant research topic into the Research and Development Plan of Rosavtodor. The main objective of this topic is to develop recommendations to improve the regulatory framework of

the design engineering and control of artificial lighting of public roads and tunnels. The research work is currently being carried out.

In conclusion, we would like to emphasize that the solution of these problems will help to increase the quality of the road lighting; thus, the road lighting it will comply to the advanced world standards, and it will help to improve the safety and comfort of the road traffic in Russia.

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