THE NECESSITY OF MASS METHODS OPTIMIZATION FOR MEASUREMENT OF PHOTOMETRIC QUANTITIES

Measurement of illuminating intensity demands a lot of time. In a metrology when carrying out checking of the principle of division of metrological certification and current periodic checking which has to provide monitoring of the measurement characteristics earlier is applied long ago. Such principle can completely be extended also to carrying out measurements of photometric characteristics of lighting installations. In work it is offered to take the full-scale measurements provided by the existing normative documents once and further only to control their constancy. The main question at the same time is the choice of size which constancy would allow to guarantee constancy of all or the majority of parameters of lighting installation, measured earlier. For internal irradiating illuminating intensity and a ripple factor of a luminous flux can be such sizes. For external lighting of streets and roads it is possible to fix illuminating intensity or brightness of a paving in the centre of the road, using for this purpose established for the luxmeter (brightness meter) on the moving car. Apparently it is necessary to measure also a coefficient of irregularity. Advantage of such approach consists in reduction of time of measurements.

Keywords: minimum, average, cylindrical illuminating intensity, luxmeter, lighting installations.

Problem statement

Methods of measurement are defined by the objectives, for which the measures are being conducted. In the field of application, as in the obligatory paragraph of measuring technique, the objective is often omitted; as a result application of documents which worked well, leads to undesirable consequences. Of course this is economic irrationality.

Main body

The need to control the lighting in various room areas, especially in health care, preschool and school establishments has been often discussed [1,2]. We shall consider in detail the general part of the problem, more fully described in [3]. In many ways, this work echoes with international standards [4]. In the application area it is indicated that the standard specifies methods for determining the minimum, average and cylindrical illumination, coefficient of natural illumination indoors buildings and workplaces, minimum illumination in places of production work outside of buildings, average illumination of streets, roads, squares and tunnels, which are covered by SNIP 23-05-95 [5] and DBN B.2.5 - 28 - 2006 [9].

Let’s analyze the amount of time required for measurements according to this document for a school premises in which three parallel classes study in one shift, a total of 33 classrooms. Given the other offices, it is about forty rooms. Let the typical room of 5 m to 6 m has 6 fixtures (2 rows of 3 lamps). To measure minimum illumination the control points according to GOST [4] should be placed in the center of the room, under the lamps, between them and their rows. In total 31 point for measurements. To measure the average illumination 16 more measurements will be required. When measuring the cylindrical illumination, the control points must be located under the lamps, between them and along the central longitudinal axis of the room - a total of 15 points. Given that in every point 4 measurements should be conducted, this will total in 60 measurements. A total of 107 measures would be needed for one room. For all schools need 3531 measuring tub. If each of the measurements will be done in one minute, considering that the measuring should be conducted in the dark, that is, no more than 3 hours a day, we have about 20 days of measurements at night, plus the time to process and arrange the results.

The same standard offers to place control points for measuring the average illumination of streets, roads and squares evenly on the section of road coverage, limited by lamps step at a distance of 3-5 meters from each other. For street of width 25 meters and the distance between lights 25 meters this means 25 - 60 points. Such measurements will last about an hour, again measuring done at night. Number of lamps along the roads is difficult to assess, but it is obvious that it is very time-consuming.

Consider another standard [6]. To determine the photometric characteristics of traffic signs, namely the specific factor intensity (cd lx 1m-2) must be measured at an angle of 5 degrees and the angle deviation 20
minutes. This is a reasonable requirement. Whereas it is desirable to react to sign with a distance of about 100 meters, which means that the sign should be at a distance of about 8 meters from the axis of movement of the car, and the distance (perpendicular to the axis of movement) from the driver's eye to the headlights about 0.5 meters. It should be noted that there is no checking scheme that would consider the transmission of such units. If use light bulb with a maximum luminous 1500 cd (SIS 107-1500) and illuminometers with registration threshold of 0.1 lux, that is capable of measuring illuminance of 10 lux with an accuracy of 1% for measurement, it is easy to calculate that the distance from the lamp to the sign should be about two meters. Accordingly, the distance from the lamp to the luxmeter should be just over one centimeter. This means that even in laboratory conditions measurement of specific intensity factor using standard equipment is impossible. For such measurements specially equipped booth is required.

It should be noted that in road signs six colors are used, respectively the number of measurements grows. The number of road signs is difficult to assess, but it is obvious that it is very big. It is clear that under such requirements, measuring of road signs characteristics in place of their operation is impossible.

A similar is the situation for road marking when applying [7]. Deflection angle in this case is 1.5 degrees, is 5 times more, but it does not change much the situation. Additional complication is the angle at which coating of 12 degrees is lighted. With this angle the error of distance becomes comparative to the size of the sample. Time spent on each measure rather difficult to assess, given the need for producing a sample and its adjustment, but given the length of the road, in any case it leads to major time consumption. In reality, these measurements are rare.

There are other measurements that require time-consumption. All requirements are quite reasonable, but a large amount of necessary work in practice leads to their almost total absence due to economic reasons. As a result, suffers health, safety of life and hazardous conditions for road users are create.

It should be noted that in metrology during execution of the calibration (in fact it is the same measurement) long ago have been established the principle of separation of metrological certification or initial verification, which requires a large volume of work, and ongoing periodic testing, which should provide the control of previously measured characteristics. The volume of work at significantly smaller than within metrological certification. This principle is possible to be distributed on to the measurements, namely, there should be once conducted full-scale measurements included in existing regulatory documents and further only monitor their immutability, i.e. the first measurement must be conducted to determine the overall picture, and further one - to control changes.

The main issue here is selection of value, immutability of which would guarantee the immutability of all or majority of parameters measured earlier. It is likely that for this the existing documents would have to be complemented with separate paragraph that would regulate the measurement of this particular value.

For indoors illumination as such values can serve illumination and ripple rate in one control point, for example in the center of the room. With a constant number and type of lamps, constant arrangement of furniture and wall coverings immutability of these values will ensure the immutability of previously measured values with high probability. This will reduce the time spent by two sequences, leading to the possibility of real control over illumination.

For illumination of roads and highways one can record the illumination in the middle of the road, using set on a moving vehicle Illuminometer. It is likely that there will be needed to measure the rate of irregularity as well. Herewith will be possible to efficiently control the quality of lighting in the city and intercity routes.

To control the traffic signs, during their production there should be conducted additional measurement of the reflection rate in a convenient geometry, such as D / 0, and to control it with a simple device directly in the place of installation, using a pattern of the matching color with already known reflection rate for relative measurements. Perhaps, it will be possible to limit oneself to the use of conventional lucimeter and lighter, maximally bringing the illumination geometry / reflection to 0/0.

In the same way for the road markings one should choose a convenient, common for the entire country geometry, not coinciding with the proposed in [7] (eg 45/45 - reverse reflection). Application of lucimeter and a sample of already known reflection rate simplify the procedure. This will allow conduct measurements directly on the road in the daytime. This approach implies the immutability of the spatial distribution of light. For road signs and road surfaces, this means the assumption about diagram constancy the reflected light radiation at a fixed direction of illumination. These are perfectly justified assumptions.

Conclusions

The gain from the proposed approach will be not only in reduce of measurement time, but also in the fact that these measurements will actually take place. This will ensure medical requirements, security requirements and so on. Revision of existing measurement methods will be not needed, as it will be enough to develop techniques for monitoring immutability of relevant parameters. Of course, extensive preliminary discussion
of the proposed approach in each area measurements involving leading experts will be necessary.

References

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