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Designing and floodlighting of objects by the luminance distribution projecting

Abstract. *Floodlighting is the kind of creative work consisting of presenting a similar image of the object as it is by day or its complete change. This change is achieved by creating different luminance distributions on the object pursued by lighting equipment. Equipment selection from the whole range of databases that are currently manufactured by the luminaires companies in order to obtain the desired effect is a very time consuming task and often impossible. Fixtures for implementing specific luminance distribution there may not be produced at all. The new method based on pre-defined desired effect lighting estimates the demand for lighting equipment. Also by the constant use of the method we can light the subject up without the use of classic lighting equipment. The article discusses the course of the design of floodlighting by this method, and it shows the pros and cons while comparing them with classical methods of the design and floodlighting of objects.*

Streszczenie. *Iluminacja obiektów jest dziełem twórczym polegającym na przedstawieniu podobnego obrazu obiektu jak to ma miejsce w porach dziennych lub zupełną jego zmianę. Zmianę tę uzyskuje się przez tworzenie różnych rozkładów luminancji na obiekcie realizowanych sprzętem oświetleniowym. Dobór sprzętu z całego zakresu baz produkowanych obecnie przez firmy opraw oświetleniowych chcąc uzyskać pożądany efekt jest zadaniem bardzo czasochłonnym, często niemożliwym. Oprawy oświetleniowe realizujące konkretny rozkład luminancji mogą w ogóle nie być produkowane. Nowa metoda pozwala na podstawie wcześniej zdefiniowanego zamierzonego efektu oświetleniowego oszacować zapotrzebowanie na sprzęt oświetleniowy lub, przez jej stałe zastosowanie oświetlić obiekt bez użycia klasycznego sprzętu oświetleniowego. Artykuł omawia tok projektowania iluminacji tą metodą. Pokazuje jej wady i zalety zestawiając je z klasycznymi metodami, zarówno projektowania jak i iluminacji obiektów* ***(Projektowanie i iluminacja obiektów metodą projekcji rozkładu luminancji)***.

Keywords: floodlighting, illumination, lighting design
Słowa kluczowe: iluminacja, oświetlenie, projektowanie oświetlenia

Introduction

So far, there are two known methods for designing the floodlighting of objects. First, the classic one is based on field trials using the actual, currently producted lighting equipment. The other method is based on computer visualization of lighting of a virtual 3D model using luminaires photometric files [1 - 6]. Both methods have their advantages and disadvantages [7,8]. The advantage of the first method is mainly the drama of the show. The designer can watch the lighting effect on the actual object in the evening hours.

Figure 1 shows an floodlighting attempt of the building of the Delegation of the Regional Office in Płock (Poland).

The project assumes the mixed method illumination [9]. The central part is assigned to illuminate by flood method while the pilasters side of breaks were emphasized using light lines on the electroluminescent light sources mounted at their bases. The project also involves the illumination of both tympanums using LED light lines.

Fig. 1. The field trial of the object floodlighting

The method, however, has a number of drawbacks and is of limited use. As far as field trials for small objects can be imagined, then for large size ones, where the quantity of lighting equipment is high, the method becomes useless. Also, realizing the concept to emphasize architectural details of high objects by using the accent method, where lighting equipment can be mounted mainly on its facade, it is difficult to imagine its use. The method is applicable to a limited number of variants of floodlighting both in terms of quantity, luminaires types available during the show and the time needed to implement (the power supply, hardware mounting). It is difficult to make decisions during the show, and relying on the analysis of photographic documentation may cause a number of errors [10]. There is also no possibility of analysis based on the concept of lighting fixtures that are in the design phase – for example dedicated to specific floodlighting solutions.

As shown in Figure 1 the field trials carried out were limited only to the flood illumination method of the central part and installation of two light lines, one for pilaster, at their core, and 2 linear luminaires on the tympanum. Selected fixtures, although the standard ones of the well-known manufacturer of lighting equipment had to be ordered because the manufacturer does not have in its extensive database that type. The tests were preceded by several hours makeshift assembly of luminaires and their power and control. Positions of luminaires were not exactly in places assumed by the project for conservation reasons. These were illumination tests, and the Investor, after these consultations, in the presence of the conservator was supposed to decide whether the concept of illumination is suitable for him, so interference with the structure of the object, drilling mounting holes in the facade object were inadvisable.

There are attempts to eliminate these defects by using the other known method - computer visualization of the 3D model. However, it needs a creation of virtual three-dimensional geometric representation of the object (Fig. 2), using materials of which the object is actually made, in order to truly represent the attributed reflection and transmission properties.

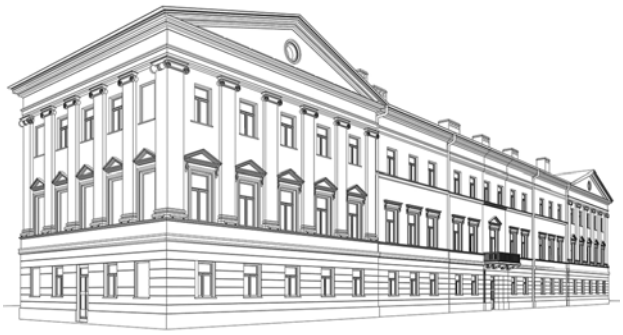

Fig. 2. The virtual three-dimensional geometric representation of the object floodlighting

On the basis of the so-called illumination base lighting designer can analyze his vision of lighting. The advantage of this method is the ability to explore many options and illumination ideas, regardless of the amount of lighting equipment used and the place of the set up in the final lighting design.
For the object of description were provided 3 variants of illumination. They are based both on a flood (Fig. 3) and mixed method emphasizing only pilasters (Fig. 4) and the elevation of the ground floor (Fig. 5). After consultations with the investor for implementation the variant II (Fig. 4) was chosen followed by previously described field tests.

Fig. 3. Floodlighting option I – flood method

Fig. 4. Floodlighting option II - mixed method with emphasis of tympanums and pilasters in the side breaks in walls

The method, however, has its drawbacks. At present time, the creation of the project based on the 3D computer model and depending on its complexity, may take a few dozen to a few hundred hours of work. Often, the barrier is also the cost of the computer application license which is capable to carry out such simulations and the time needed for their understanding and mastery.

Of course one can see the difference between computer simulation and terrain attempts. The burnouts can clearly be seen in a high luminance unevennesse places (Fig. 6). It should be noted, however, that it is an evening illumination photography which had different exposure during the execution than the computer simulations.

Fig. 5. Floodlighting option III – mixed method with emphasis tympanums, pilasters in the side breaks in walls and elevation of the ground floor

Evaluating the floodlighting project on the basis of photographies is associated with a high risk [10]. The only objective comparison of illumination images is lighting simulation with the luminance distribution with simultaneous luminance measurement with matrix meter ILMD during tests. When measuring ILMD one should take into account possible difficulties in obtaining objective luminance value, connected with the correct execution of the measurement, which is not so obvious [11, 12].

Fig. 6. Differences between floodlighting field trials (a) and a computer simulation (b)

Solving the problem – virtual luminance distributions projection on the real object

The downside of the known ways of the objects floodlighting design can be eliminated through the use of the luminance distributions projection which would be carried out by the actual lighting equipment.
Especially it concerns the accent point method as in Option II and III of this project. Pilasters illumination shown in Figure 1 differs from a computer simulation because the assembly is not exact, both because of the place and maximum light fixtures pointing.
Shown in Figure 5, the system needed to use this method of floodlighting design consists of a PC, a computer application S and multimedia projector P. Projector P displays the desired lighting effect in the form of luminance distributions images L, L1, L2, etc. on a real object RO allowing a dynamical change of single light accents L, L1, L2, etc. which are a part of the whole lighting design.
The method allows you to load the photometric data (photometric web file) PW of luminaires produced by all manufacturers to a computer application S and to make the

floodlighting design of the object using luminance distributions images projection L, which in turn are realised by selected lighting equipment.

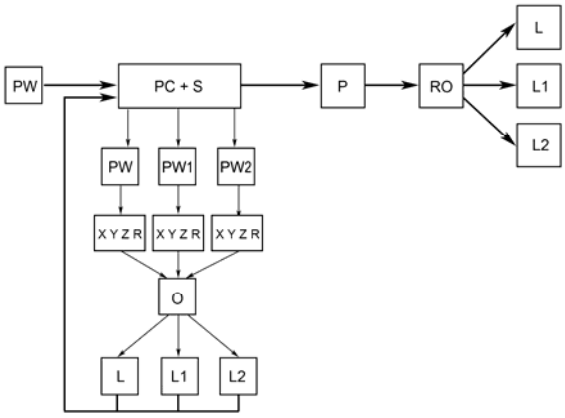

Fig. 5. Luminance distributions system on the real object

Lighting effects are created in real time, allowing for their free conversion and change of both their location X, Y, Z and direction R (Fig. 6).

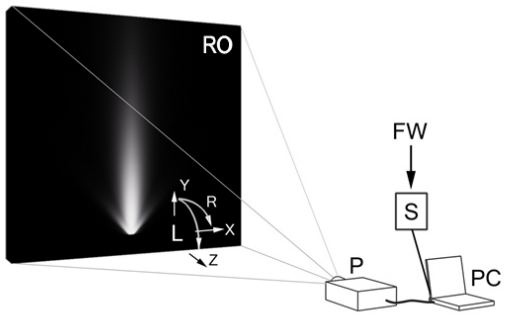

Fig. 6. Lighting effects created in real time on the object after using a photometric file of produced luminare

The computer application allows also the correction of luminance distributions obtained L, in order to redesign the lighting equipment for specific floodlighting solutions L1 (Fig. 7). For example, the redesign could take place by using additional lighting accessories which change the web of the actual photometric luminaire (PW1). You can also search the database of photometric webs in order to find such fixtures, that could realise luminance distributions completely similar to L1. A direct check of the effect of lighting on the object is also possible.

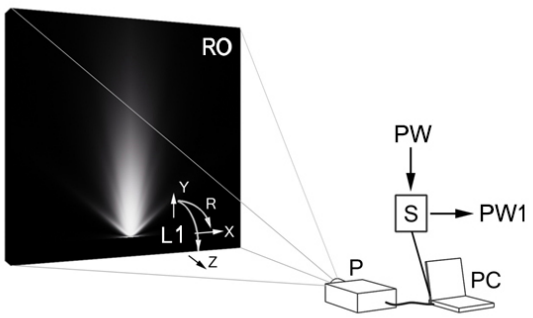

Fig. 7. Lighting effects created in real time on the object after correction of luminance distribution of produced luminare

It is a pretty complicated task to obtain the desired luminance distribution, including how to select the right lighting equipment from a whole range of databases of lighting fixtures that are currently manufactured. It requires knowledge of lighting equipment produced by many companies and lighting effects they produce. It may happen that some luminaires are not presently manufactured. Figure 8 shows a system application where on the basis of predefined desired luminance distribution of single luminance distributions L3 and on the basis of the real position planned X, Y, Z, as well as R direction of the future luminaire with respect to the illuminated plane O - a new photometric files are being created (PW2). These files can form the basis for production of the new lighting equipment.

Objects floodlighting design method based on the described arrangement may be used in the lighting industry and design offices, eliminating the need of possessing in its database a large amount of luminaires needed for field trials.

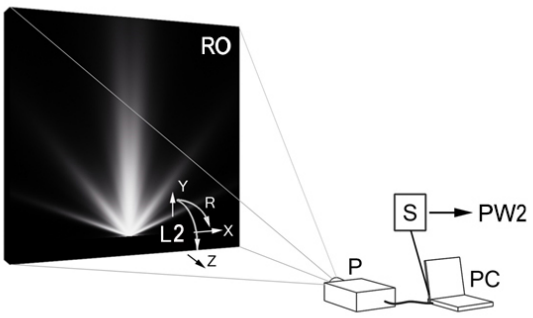

Fig. 8. Lighting effects of virtual luminare created in real time on the object

Object floodlighting by multimedia projector

The virtually generated luminance distribution of the projected image on the real object may also become a common method of floodlighting. So far, there are known three methods of floodlighting of objects [9, 12]:

1. "point" method characterized by the accent lighting formation on the object,
2. planar lighting,
3. mixed method - a method combining point and flood.

The choice of floodlighting method for a particular object is a combination of many factors. The main ones are the point/points and directions of observation of the object. It is believed that if the object is observed mainly from further observation points the flood method is better, since the creation of non-uniform luminance distribution is not recognized. While observing the building at close range, where architectural details and object tectonics is perceived well, a point method point should be considered [9], but it is not always possible.

Floodlighting method using luminance distribution projection is able to achieve similar visual effect as the previously known methods but in addition, it allows for further enlargement of the new effects, often difficult to implement by conventional ways. The floodlighting design can be quite bold, often debatable, as by means of such a system it can be changed at any time without incurring extra costs.

The great advantage of contstant floodlighting of the object by luminance distributions projection method is that it meets the requirements of the certificate BREEM. The total

luminous flux generated by the multimedia projector is "masked" to the geometrical shape of the object. The problem of light pollution of the environment is thus minimized [14 – 19]. Note that there will be the penetration of light into the interior. This method of floodlighting is also energy efficient. The power of the projector is significantly less than the power needed to carry out a similar floodlighting concept using the real lighting equipment.
This method of floodlighting is also practical. System maintenance is limited only to the multimedia projector. Replacing a burned-out light sources is relatively simple.
Another advantage is the absence of interference with the structure of the object. Often the floodlighting object is a monument, where there is no agreement on the installation of lighting fixtures on the facade and the only way to illuminate the object is a planar method. If you use flood lighting, you can also obtain on this object illumination effect similar to the “point” floodlighting method.

Conclusions

So far, floodlighting design of objects have been achieved using two ways: field trial basis and computer visualization of 3D virtual model.
Luminance distributions projection method solves some of the problems which illumination designers are struggling with. It reduces the time required to create multi-variant design concept of floodlighting without restricting the designer in creating of a virtual lighting 3D model computer visualization. It defines and creates the demand for new lighting equipment. It does not require that the designer purchase sophisticated tools and applications, and proficiency in them. Also, it eliminates the need to have in its resources lighting equipment used in real life settings. It can be concluded that the main disadvantages of the known methods of illumination designing of objects have been eliminated.
Application of the method of luminance distributions projection as a constant object floodlighting is currently difficult to implement due to hardware limitations. The continuing problems are the tightness of IP multimedia projectors and their durability. It should be expected that with the development of multimedia equipment, the problem will be resolved quickly, and thus that way of designing and floodlighting of objects will become more and more popular. As a result, the illumination with a projector will not be limited only to show events, often having nothing to do with professional floodlighting of objects.

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