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Influence of the Light Distribution of LED Luminaires on the Energy Consumption for Lighting in Public Premises

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Introduction

- Energy efficient lighting installation is:
- ✓ one that meets the necessary lighting requirement for a particular application,
- ✓ consumes minimum energy,
- ✓ needs minimum maintenance.





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Introduction

- Steps forward efficiency:
- 1. Choice of light source and its drive the most efficient that can meet the desired requirements for the specific application.
- 2. Color appearance and color rendering should be considered. Choosing the most appropriate pattern of white can lead to enhancement of the objects in the roomor ambience of the space. The color rendering requirements for the specific application should be met.
- 3. When light source is chosen its life expectancy should be taken in consideration. The high efficiency of the light source itself does not always lead to efficiency of the luminaire in which it is fitted, so also the LOR (Light Output Ratio) of the luminaires should be considered for maximum efficiency of a lighting system.
- 4. The luminaires at a given space should be arranged in such a way that they provide effective illumination and are accessible at the same time to ensure easy maintenance.
- 5. Another consideration that should be taken into account is the light distribution pattern of the luminaires. For most of the LED luminaires on the market lambertian light distribution is typical, while in office environment usually wide and even light distribution with good uniformity is aimed.

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Approach and Considerations

For investigation of the influence of the light distribution of LED luminaires on the efficiency of the lighting system in an office environment a typical premises has been used. The requirements for office spaces are given in the European standard for indoor lighting EN 464-1/2011 [3]. This document specifies the requirements for lighting solutions for indoor work places and their associated areas in terms of quantity and quality of illumination. According to this standard the task illuminance (quantitative value) in the office considered is set to 300lx, the illuminance of the immediate surroundings is 200lx and the illuminance of the background is set to 50lx. The quality of the lighting system is estimated through discomfort glare (UGR) – set to a value below 19, the requirement for color rendering index (R_a) should be above 80, and the uniformity of lighting (U₀) should be at least 0.4. For evaluation of the efficiency of the luminaires considered, the Lighting Energy Numerical Indicator (LENI) is used [4].







Results from the Investigation

 The office taken in consideration has the following dimensions: length – 19.2m; width – 14.2m; height – 2.8m, area – 273.55m², height of the work plane – 0.8m, the maintenance factor is considered MF – 0.8. The simulation of the premises is shown on fig. 1









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Luminaires and Results

Luminaire type	Model	Light distribution curve	Power, W	Illuminance, E _{av} , lx U0	Number of luminaires	Specific connected load, W/m ² ; LENI, W/m ² per year
Zumtobel 42182944 ML4 EB LED2400- 830 M600Q LDO KA [STD]			25	501 0.4	72	6.58 13.86
Zumtobel 42182945 ML4 EM LED2800- 830 M600Q LDO KA [STD]		0	25	512 0.4	64	5.85
Zumtobel 42182845 ML4 EM LED3000- 840 M600Q LDO KA [STD]			25	553 0.4	63	5.76 12.2
Zumtobel 42182655 ML5 EH LED3000- 840 M600Q LDO TBL [STD]		\bigcirc	25.5	508 0.4	56	5.22 10.97
Zumtobel 42182947 ML4 EM LED2800- 830 M625Q			26	538 0.4	64	6.08 12.77







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Luminaires and Results

	26	538 0.4	64	6.08 12.77
	27	499 0.43	56	5.53 12.9
	27	546 0.5	72	7.11 14.97
3-1	27.6	544 0.4	49	4.94 10.29







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Luminaires and Results

	26.7	544	49	4.78
		0.4		9.95
	29	497	42	4.45
		0.4		9.23
	32	524	56	6.55
		0.4		13.77
	32	530	48	5.62
		0.6		11.83
	35	559	56	7.17
		0.5		14.88







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Luminaires and Results

	35.4	565 0.4	49	6.34 12.73
	35	540 0.5	48	6.14 12.94
	34.9	513 0.6	36	4.59 9.45
	35.4	517 0.6	36	4.66 9.59





Conclusions

- From the results shown in table 1 it is obvious that the batwing light distribution is more effective than the lambertian or cosine. A great influence on the efficiency of the LED luminaires has their optical system. The greatest efficiency is received for luminaires with diffuse light, and again the wider the light distribution, the better the efficiency.
- Energy effective lighting design requires an appreciation of the characteristics of low energy light sources, knowledge of the levels of visual amenity required for different applications and close attention to optical systems and luminous intensity distribution curves of the luminaires.







THANK YOU FOR YOUR ATTENTION!

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