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VISUAL COMFORT ANALYSIS OF LIGHTING ENVIRONMENT FOR INDUSTRIAL BUILDINGS

Annotation: Daylight is a gift of nature and one of most important elements of human life. Good lighting of working places enables us to increase the productivity of work, its safety and quality of production. People working in these buildings spend a substantial part of the day stay in their internal environment. It is therefore necessary to pay attention to the creation and evaluation of industrial buildings. The paper present results of daylighting evaluation and visual comfort in the selected industrial hall. The parameters related to indoor lighting in large industrial hall were analyzed using in situ measurements and computational methods.

Keywords: industrial buildings, indoor environment, daylighting, simulation.

Introduction. Each building creates an artificial environment for a person to serve and is an urban response to the landscape. The energy effects of solar radiation on buildings can be effectively used in a correct and functional solution, which also benefits the return on investments. The energy aspect in characterizing daylighting is an important element in the field of construction, architecture, urbanism and technological development [3]. Daylighting is a method of lighting building interiors with sunlight and diffuse skylight. The constant ratio of indoor to unobstructed outdoor illuminance is usually expressed as a percentage and is known as the daylight factor. Daylight factor is a measure of the daylight illumination at a point expressed as a ratio of the illumination on a given plane and the simultaneous exterior illumination on a horizontal plane in an unobstructed location. The daylight factor at a point within an enclosure is a function of three components, the sky component, externally reflected and internally reflected component [4].

$$DF = \frac{E_{iH}}{E_{eH}} \times 100 = D_S + D_i + D_e \quad (1)$$

where D_S, D_i, D_e are sky, internally reflected, and externally reflected components.

Description of the hall and measurements. Measurements were realized in the hall in Košice. Interior dimensions of hall are 15 m x 60 m x 8.5 m (see Fig. 1a). In the hall there is toplighting and sidelighting. Sidelighting is created by the windows with dimensions 5.6 m x 1.8 m, 3 m x 1.8 m, and toplighting is created by one saddle skylight with dimensions 2.4 m x 48 m x 1.1 m (Fig. 1b). The fenestration systems are created by single wired glass. In the calculation the following coefficients were considered (transmittance coefficient 0.8, maintenance factor of glazing on exterior surface 0.9, maintenance factor of glazing on interior surface 0.85, reflectance factor of ground 0.15 - dark ground). The surface of walls is cream color with reflectance factor 0.4, white ceiling by reflectance factor 0.7. The floor has reflectance factor 0.2. The neighboring objects are in distance, which does not shade the hall [1].

a b

Figure 1: a - Interior view of the hall – model by simulation, b – view on the skylight

Results and discussion. The table 1 shows results of measured values in situ and calculated values by Radiance simulation program.

	D_{min} (%)	D_{max}(%)	$D_{average}$(%)
Measured	2.56	7.69	4.96
Calculated	2.18	6.96	4.83

Table 1: Results of measured and computed values.

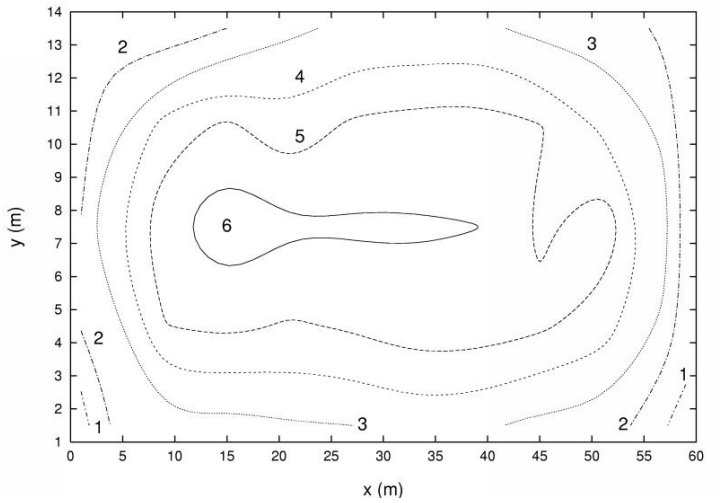

Figure 2: Graph of measured values

The distribution of the daylighting in situ is shown in Figure 2. In the Figure 3 the distribution of the daylighting is calculated by simulation program.

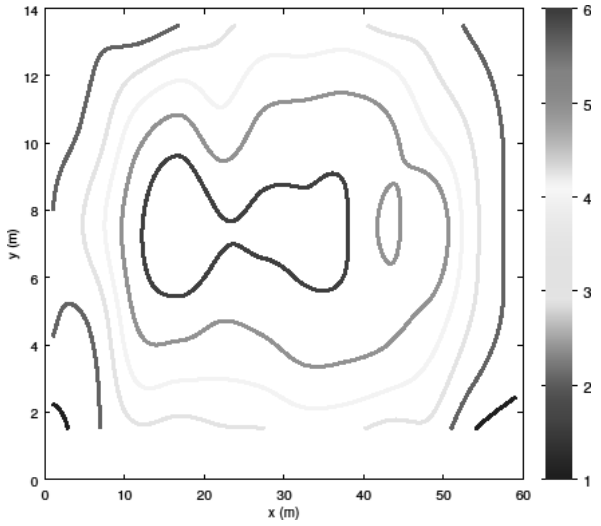

Figure 3: a – Graph of computed values

Figure 4 exhibits the effects of windows and skylight on the brightness obtained from the simulation program.

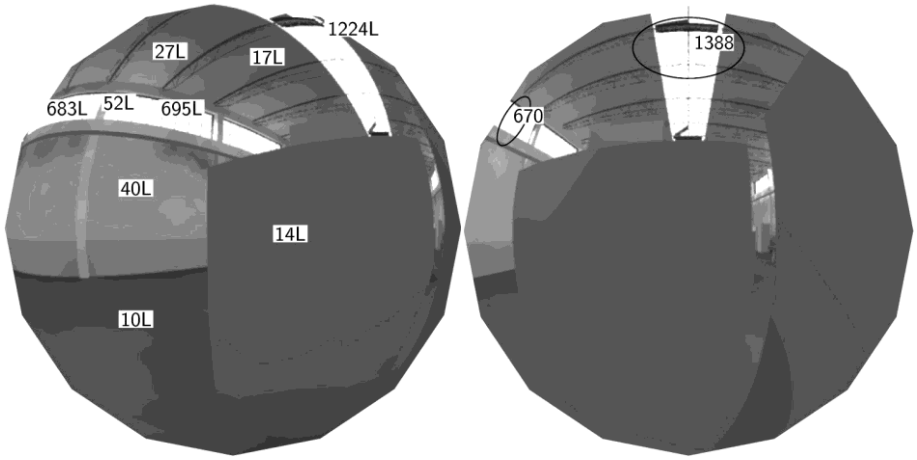

Figure 4: Luminance values calculated by simulation program

Conclusion. The results of daylight factor for measured and computed values shows differences. The differences are due to the fact that every simulation program calculates with limits. According to standard STN EN 12464 – 1 for measured values and computed values by simulation program meet because D_{min} = 1,5 %, $D_{average}$ not meet because $D_{average}$ = 5% [7]. According to standard STN EN 12464 - 1 users in interior spaces must be protected against glare. The visual comfort is affected for relation of illuminances 1:10 and glare for relation 1:100 is occured [7]. Glare for overcast sky is occur. Figure 4 shows the values of glare sources.

Acknowledgements. This paper was elaborated with the financial support of the research project VEGA 1/0674/18 of the Scientific Grant Agency, the Ministry of Education, Science, Research, and Sport of the Slovak Republic and the Slovak Academy of Sciences.

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Анотація:

Денне світло - це дар природи і один з найважливіших елементів людського життя. Гарне освітлення робочих місць дозволяє нам підвищити продуктивність праці, її безпеку та якість продукції. Люди, які працюють в цих будівлях, проводять значну частину дня, залишаючись у своєму внутрішньому середовищі. Тому необхідно звернути увагу на створення та оцінку промислових будівель. У документі представлені результати оцінки денного освітлення та візуального комфорту у вибраній промисловості.

Ключові слова: промислові будівлі, приміщення навколишнього середовища, денне світло, симуляція.

Аннотация:

Дневной свет - это дар природы и один из важнейших элементов человеческой жизни. Хорошее освещение рабочих мест позволяет нам повысить производительность труда, его безопасность и качество продукции. Люди, работающие в этих зданиях, проводят значительную часть дня в своей внутренней среде. Поэтому необходимо обратить внимание на создание и оценку промышленных зданий. В документе представлены результаты оценки дневного освещения и визуального комфорта в выбранных промышленных

Ключевые слова: промисловий корпус, приміщення в приміщенні, денне світло, симуляція.