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Optimizing Lighting for Visual Comfort in a Computerized Work Environment

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Abstract. *The use of computers and digital devices in today's world has a significant impact on the visual comfort of workers. Forced sitting posture and inappropriate lighting lead to visual and musculoskeletal problems, as well as Computer Vision Syndrome (CVS). The aim of the study is to analyze and evaluate the software for the correct design of lighting systems, the standards to be followed and the appropriate color temperature to prevent negative effects on physiological processes, circadian rhythm, visual fatigue and stress. Also, flicker-free lighting types that do not create reflections and glare on screens and eyes will be covered. The task is to review the literature on the subject, to identify the main problems in lighting design and the negative consequences that cause visual disturbances. A measurement of the artificial lighting in an administrative building will be carried out and the influence of the values on the employees and their work tasks will be investigated.*

Keywords: *Circadian rhythms, Smart lighting, Human centric lighting system, Indoor lighting standarts, Computer Vision Syndrome*

Introduction

Over the past decades, numerous studies have shown that the characteristics of the computerized workplace, especially the lighting, can significantly affect the perception of mental fatigue and the behavior of people. Lighting plays a role in both physiological and mental processes, affecting cognitive-biological mechanisms. The quality of lighting is a key factor for people working with computers and digital devices. The brightness, contrast, amount and color temperature of light directly affect visual comfort and work efficiency.

Poor-quality lighting in computerized workplaces can lead to visual problems such as eye strain, itching, redness and pain, headache, fatigue, and Computer Vision Syndrome (CVS) [Zhelyabova M. et al., 2024; Pucker A., 2024]. A properly designed lighting system can reduce visual strain, prevent headaches, as well as neck and back pain, while improving the overall work environment [Dong W., 2024; Stetsky S. et al., July 2024; Zhou D., June 2024].

Different colors of light create different moods and atmospheres that affect the sense of well-being, productivity and maintenance of circadian rhythms [Kazemi R., October 2018; Samani A., 2012]. Many studies have shown that poor window placement (for example, when they are not located to the left or right of the workers) contributes to the deterioration of eye health. As a result, people often change their position to avoid light and glare, leading to musculoskeletal problems such as neck and lower back pain.

Methods and formulas have been developed for calculating the transmission coefficient of direct and diffuse sunlight through smart windows with an optical filter. These windows regulate and adapt light transmission depending on the season and time of day, ensuring a more efficient distribution of light [Zakirullin R. et al., 2024; Zakirullin R. et al., 2023].

Artificial light also matters - light reflected from overhead lighting onto the screen contributes to visual strain. Research has shown that using diffusers on light fixtures prevents these reflections. Indirect lighting aimed at different areas can be adapted to individual needs and improve the feeling of comfort and well-being of users [Gkolompia E., 2024; Kızılörenli E. et al., 2024]. Adjusting the brightness and light settings from the monitor itself can also reduce visual strain [Gkolompia E., 2024].

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There are two main indicators for evaluating ambient light:

Mean room surface emissivity (MRSE), which measures the total density of reflected (non-direct) light.

Mean Indirect Cubic Illuminance (MICI) – used for irregularly shaped rooms where there are significant differences in light distribution [Duff G., 2015; Ekren N., 2007; Boyce PR, 2022].

It is important to pay attention to the colors and reflection coefficients of the surrounding surfaces - ceiling, walls and floor, to ensure visual comfort in the workplace. Increasing the reflectivity of the ceiling has been found to improve the uniform distribution of daylight and reduce energy consumption. Recommended reflectance coefficients are above 50% for floors and work surfaces, and between 70% and 80% for ceilings. Higher reflectances reduce shadows and ensure even lighting, while darker walls create a cozy and focused work environment. Excessive light brightness can lead to visual fatigue due to frequent readaptation of the eyes.

Visual adaptation to different brightness levels is a key process in active visual work. Light adaptation to brighter conditions occurs relatively quickly (within a few minutes), while adaptation to low light levels can take up to 30 minutes. Transitions between different levels of illumination often lead to visual fatigue.

According to the European standard EN 12464, the following useful reflectance ranges are recommended for the main internal surfaces:

- Ceiling: 0.7 to 0.9
- Walls: 0.5 to 0.8
- Sub: 0.2 to 0.4 [Makaremi N., October 2017; Ruck N., June 2000].

According to Ordinance No. 49 on artificial lighting of buildings:

- Light background: reflection coefficient above 0.4
- Medium background: reflectance between 0.2 and 0.4
- Dark background: reflection coefficient below 0.2.

The National Institute for Occupational Safety and Health (NIOSH, 2020) recommends exposure to bright white light during the day to improve alertness and better sleep. White light, which contains the visible spectrum from violet to red, can affect circadian rhythms. Exposure to blue light emitted by LED and fluorescent lights, as well as electronic device screens, can disrupt sleep if it occurs at the wrong time.

The sharpest decline in circadian rhythms of wakefulness occurs between 2 and 6 a.m. and between 2 and 5 p.m., when natural sleepiness is experienced. Taking breaks during this period or changing tasks can reduce fatigue as well as ensure quality sleep each night.

1. Computer programs for Lighting

Daylight is the only source of natural light. In order to model and make its calculation, lighting calculation methods are created. These methods are related to time, days, seasons, geographical location, and are taken into account to make the best and realistic calculation. (Ekren N., 2007)

Visualization is extremely important to understand the changes in illuminance for different materials and properties and to predict the effect of different lighting designs in the real world, also to see the interaction between light and reflection and on surfaces.(AGi32)

Every lighting designer, architect or project manager should have the right tools to better plan their project.

At the beginning of any lighting project, it is important that lighting designers consider each required functional area:

- What corporate-strategic, architectural or functional significance does the room or area of the room have.
- What light can achieve.
- Which office tasks can be supported by lighting to optimize the use of the room.
- What is the ideal lighting solution.
- Which individual lighting strategy and lighting methods are suitable as a basis for lighting design.(ERCO)

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Lighting design software, each with its own specific characteristics, allows to create two- or three-dimensional simulations and representations of the environment and to realistically simulate the effect of light to recreate the emotional and impact on the human factor. (Rossi K., 2023)

By additionally using plug-ins for lighting simulation software such as DIALux, Relux and Autodesk 3ds MAX design, appropriate lighting can be designed for each project. Through the Revit file library, the models that can be used are scalable and can be adjusted according to the needs. (Ekren N., 2023; Philips; Calculux)

Lighting design software

In **Table 2**, a selection of widely used lighting design software is listed, along with their respective key features. The table also includes links to each tool, allowing users quick and easy access to the software. These tools support various advanced functions such as photometric calculations, 3D visualizations, daylight simulations, and energy efficiency evaluations, making them valuable for professionals aiming to design optimized lighting environments that adhere to regulations and ensure efficiency.

Table 2. Lighting design software

Lighting design software	Developer/ Link	Price/ Licence	Main functions / Features
Calculux Indoor 5.0	Philips Lighting design https://calculux-indoor.software.informer.com/ https://electrical-engineering-portal.com/download-center/electrical-software/calculux-area; http://www.electrical-knowhow.com/2013/01/calculux-indoor-software-for-lighting.html https://vdocuments.mx/manual-calculux-indoor.html?page=12	Free	Simulates real lighting situations and analyzes various setups. Uses luminaires from an extensive Philips database; supports importing other formats. Performs lighting calculations (including direct, indirect, total, and average illuminance). Predicts financial implications, including energy, investment, lamp, and maintenance costs. Compiles reports displaying results.
DIALux lighting design program	DIAL GmbH from Lüdenscheid in Germany https://www.dialux.com/en-GB/ https://www.ny-engineers.com/dialux-calculation	Free	Design, calculate, and visualize lighting for indoor spaces. Select from 500,000 real luminaires across 190 brands using the Luminaire Finder. Import images or screenshots (e.g., *.jpg, *.bmp, *.png) from services like Google Maps to create a true-to-scale layout for illumination. Generate 3D computer models to accurately

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			depict the lighting appearance. Gather customer requirements. Adhere to planning data, norms, and standards.
AGi32 lighting program	Lighting Analysts, Inc. http://www.agi32.com/ Rossi K. , 2023 https://lightinganalysts.com/software-products/agi32/overview/ https://www.agi32.com/Docs/PDFs/Software/AGi32/AGI32_datasheet_v18.pdf)	Paid	AGi32 is a professional lighting design, that can calculate: the illumination in the interior (in fc or lux), horizontally, vertically, with a variable direction meter; The light emitted by the surfaces (lm/m2) Lighting power density (W/m2) Uniform glare rating (UGR) The software creates realistic 3D models of spaces
Radiance Lighting program	Greg Ward Larson https://www.radiance-online.org/about https://sourceforge.net/projects/radiance.mirror/ Rfritz, 2019 https://storybox.karmanitalia.it/en/best-lighting-design-software	Free	A suite of programs for the analysis and visualization of lighting in design Input files specify the scene geometry, materials, luminaires, time, date and sky conditions Daylight calculations - include spectral radiance (ie. luminance + color), irradiance (illuminance + color) and glare indices Radiance's key advantage over simpler lighting tools lies in its flexibility, allowing for the simulation of complex geometries and materials with minimal restrictions.
Microlux Lighting program	LuxArt https://microlux.software.informer.com/5.5/	Free	CSreating lighting projects that simulate 2D and 3D projects The program has an awesome set of tools that can use to explore different lighting in any environment

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LightCalc Lighting program	Michael De Luca https://www.lightcalc.com/purchase/purchase.html https://storybox.karmanitalia.it/en/best-lighting-design-software https://www.lightcalc.com/lightcalc/lightcalc.html	Paid	The program works with information the designer has ready access to: ceiling height, room width and length, counter height, color pallette, etc. Determines the overall reflectance in the room Finds the proper footcandle level for general, task, and art lighting Adjust the footcandle level for dark to light rooms and client age Determines the proper spacing needed. Uses both Inverse Square Law and Lumen methods. Suggests a grid layout for general lighting.

2. Lighting standards in computerized office spaces

Lighting standards in computerized office spaces are essential for guiding the design and ergonomics of lighting systems, aiming to ensure visual comfort, prevent eye strain, enhance overall worker well-being, and boost productivity. These standards encompass various factors, including contrast, brightness, illuminance levels, glare control, color temperature, and the color rendering index. Additionally, they address concerns related to blue light exposure, circadian lighting, light distribution, and the adjustability of artificial lighting levels in relation to available daylight. The use of safe and sustainable materials, along with a focus on energy efficiency, is also a critical consideration in the development of effective lighting solutions. Key international standards and recommendations for lighting in computerized workplaces include various guidelines that promote a balanced and health-conscious work environment, thereby fostering improved employee performance and satisfaction.

Main international standards and recommendations for lighting in computerized workplaces:

- Illuminating Engineering Society standards (IES)
- Society of Light and Lighting (SLL)
- International Commission on Illumination (CIE)
- European standard EN 12464-1:2021(CEN)
- Bulgarian version of the European standard - BDS EN 12464-1:2021 (BDS)
- American National Standards Institute C137.4-2021 (ANSI)
- International WELL Building Institute (IWBI)
- International Organization for Standardization - ISO 8995-1:2002 - "Lighting of Indoor Work Places" (ISO)
- Standard ANSI/HFES 100-2007 - "Human Factors Engineering of Computer Workstations" (HFES/ANSI)
- Standard ANSI/IESNA RP-1-20 - "Recommended Practice for Lighting for the Visual Environment"(ANSI/IESNA)

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By following these lighting standards and taking into account the mentioned factors, organizations can develop workspaces that are not only well-lit but also comfortable and conducive to productivity. This approach significantly enhances employee satisfaction and performance.

3. Color temperature for computerized workplaces

Workplace lighting should strike a balance between visual comfort and efficiency. For offices and educational institutions, the optimal average color temperature is 4000 K, categorized as a neutral color. This temperature reduces eye strain and helps prevent headaches . Research shows that for subjective performance, 750 lx at 5000 K or 6500 K is preferred, while 500 lx at 5000 K proves best for preventing fatigue and stress. (Hanui Yu, 2023)

Color temperatures above 5000 K are considered cool (bluish-white), while those in the range of 2700-3000 K are warm (yellowish-white) . Warmer lights (yellow or orange) promote relaxation, whereas cooler lights (blue and white) aid in concentration and alertness. Ideally, lighting should shift throughout the day—cooler in the morning to stimulate focus and warmer in the afternoon to encourage relaxation. (Martin Wan, 2023; Wilson J., 2020; Dovramadjiev, T., Dobreva, D., etc., 2023, pp. 53)

The most suitable color temperature for an office atmosphere, which requires an energetic tone, lies between 4000 K and 5500 K . Color temperature, or Correlated Color Temperature (CCT), refers to the visible color of light measured in Kelvin. Based on the ANSI standard, CCT is divided into warm white - 3000 K, white - 3500 K, cool white - 4000–4500 K, and daylight - 6500 K (ANSI, 2001) (Choudhury, 2014).

According to another source (Creutzfeldt Claire J., 2012.-SLL), Correlated color temperature is divided into:

- Warm light – below 3300 K
- Medium level – 3300-5300 K
- Cold light – over 5300 K

Table 2 presents values of some natural (daylight) and artificial light sources. (Choudhury, 2014; Momov A., 2006; Georgieva S., 2019)

Table 2. Color temperature (CT) and correlated CT

Color temperature (in Kelvin, K)	Light sources
1700 K	Flame from a match stick
1800 K	Candlelight, sunrise/sunset
2700 K	White fluorescent lights
2800 K	An extremely warm white
3000 K	Warm white
3000–3500 K	Neutral white from fluorescent lights
4000 K	Cold white
4100 K	Cold white from fluorescent lights
5000 K	Daylight
5500-6000 K	Vertical daylight, electronic flash
5000-6500 K	Daylight from fluorescent lamps
6500-7500 K	Cloudy daylight
6500–9300 K	LCD or CRT screen
8000-12000 K	Blue sky

4. LED lighting or Fluorescent lighting in the office

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Most computerized workplaces use fluorescent lighting. It's too bright, employees can't focus on tasks. As a result, stress increases, causing eye strain and leading to migraines. Shaking leads to changes in the mood of workers, causes distraction and can cause physiological effects such as headaches. (Wilson J., 2020)

Lighting systems must be designed to avoid flicker and stroboscopic effects. They should be arranged around the workplace in such a way that they are unlikely to cause reflections in the screen. (Creutzfeldt Claire J., 2012)

LED lighting, with its accurate color rendering index and adjustable color temperature, successfully mimics natural sunlight. The warm color temperature of this type of lighting is perceived as more pleasant compared to fluorescent lighting. In addition, LED lighting consumes up to 65% less energy, while providing the necessary level of illumination, correct color rendering and contrast to ensure comfortable work.. (Martin Wan, 2023; Balatova A., 2023)

5. Smart lighting

Smart lighting is personalized lighting for a specific work environment where, through a dedicated smartphone app, workers can control lighting according to personal preference to improve their health and happiness. **Fig. 1** (Smart lighting)

Fig. 1. Smart lighting

Recent research underscores the strong link between lighting and circadian rhythms, often referred to as the "biological clock." These rhythms regulate the sleep-wake and stimulation-relaxation cycles, which can be influenced through spectrally tunable LED lighting and modern control systems.

The contemporary concept of intelligent lighting is built upon three core principles: the use of LED illuminators, advanced control systems, and universal communication interfaces that adhere to global standards. These solutions continue to develop in tandem with the increasing demands of next-generation devices and applications within the growing Internet of Things (IoT) ecosystem.

A smart lighting system is fundamentally designed as an adaptable solution aimed at enhancing both visual comfort and energy efficiency. These systems allow for dynamic adjustments in lighting conditions based on factors such as natural light availability, occupancy, or even user preferences. By utilizing technologies like LED lighting, advanced sensors, and intelligent control mechanisms, smart lighting systems optimize light output while minimizing energy consumption. This adaptability ensures a balance between user comfort and sustainability, making such systems increasingly popular in modern workplaces and residential settings. (Smart lighting; Higuera J. at al., 2018 Wilson J., 2020)

6. Biodynamic lighting (Human Centric Lighting system)

Computer workers spend extensive time in enclosed spaces under artificial lighting, which lacks the natural dynamics and biological effects of daylight. In 2021, American scientist George Brainard discovered a circadian photoreceptor in the retina that detects specific light quality and intensity to adjust

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the biological clock. Research indicates that specific light exposure stimulates the circadian rhythm, which regulates hormone levels, particularly melatonin and cortisol, playing a critical role in physical and mental well-being. Studies also found that nighttime light exposure significantly suppresses melatonin production while simultaneously increasing alertness. (Brainard G. 2001; Lockley S. 2006;)

Biodynamic lighting or a Human Centric Lighting system (HCL) has been created, which uses effects that specifically adapt the color of the light to the needs of the user. It is characterized by dynamics in terms of light direction, color temperature and level to positively influence vitality and relaxation, mood, visual acuity and productivity. The color of light affects many reactions in the human body, for example the ability to concentrate and perform, the level of well-being and the biological rhythm. Intelligent network-based solutions that communicate between multiple input and output devices and signals using one or more central controllers. These devices may include relays, occupancy sensors, switches and touchscreen control panels, as well as signals from other building systems, such as heating, ventilation or air conditioning systems. System setup can be done both locally at the device level and centrally. https://www.trilux.com/en/service/knowledge/human-centric-lighting/; https://stroiteli.bg/tendentsii-v-biodinamichnoto-osvetlenie; https://www.shine.lighting/threads/human-centric-lighting-hcl-systems-and-solutions.927/; https://sushantuniversity.edu.in/blog/biodynamic-lights-and-its-task-performance/#:~:text=Biodynamic%20Light%3A%20Biodynamic%20light%20is%20a%20technical%20method,a%20positive%20impact%20on%20workers%20and%20work%20performance.)

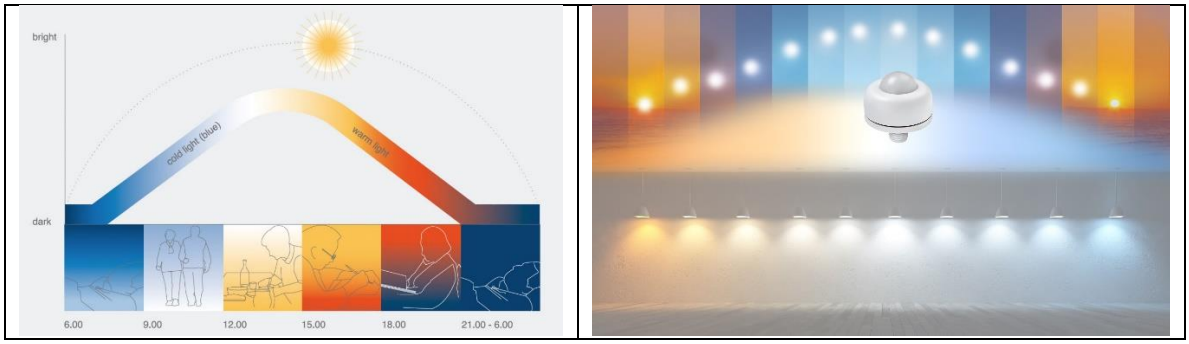

Fig. 3 Biodynamic lighting

The sunlight is warmer in the morning, colder in the afternoon, and warmer again in the evening. Therefore, according to Dr. Pawel Morawski, light expert at Trilux Poland, students/workers should start their day with warm light containing a pleasant combination of tones, including red, which does not stress their bodies after a night's sleep. Around midday, the blue light in the lighting is usually increased, which has an awakening and energizing effect. https://lighting-bulgaria.com/article/2558-kak-biodinamichnoto-osvetlenie-moje-da-spomogne-za-podobriavane-na-obuchenieto-v-uchilishte

7. Study and research about preferred lighting and saturation

Research was done on several Bulgarian and Greek companies and freelancers.

It was established that, depending on the professions, the preference for the lighting in the premises is different. This depends on whether workers only use a computer at work or another source of information, on paper.

Accountants tend to use brighter lighting due to the fact that they use paper documents to process and enter information into computers.

For designers, daylight is preferred (natural light from the sun, radiation from the sky), but when working in indirect sunlight, because of glare on the screen, radiation reflected from surfaces, walls, ceiling, floor, objects, etc. (Dobreva, D., 2011, pp. 68; Dobreva, D., 2017, pp. 1275). Blinds are also used here in the brighter part of the day. Depending on the season and time of day, the intensity of daylight in the room decreases, falls below the permissible level, then mixed lighting is applied.

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IT professionals and web designers often have the lowest light levels at work. They prefer to work only on the light emitted by their video display screens. If necessary, they use the backlight of the keyboard.

50 years ago, the illuminance recommended for offices was 100 lx, since then the figures have increased dramatically, between 500 lx and 2000 lx. Studies have noted that 40% of video display operators prefer levels between 200 and 400 lx and 45% levels between 400 and 600 lx. (Grandjean E., 1987). After research was done, it was found that a very high level of illuminance is often inappropriate and at levels above 1000 lx, the risk of unpleasant reflections, deep shadows and excessive contrasts increases.

In this study, office workers were found to prefer light levels between 400 and 850 lx, which was confirmed by (Nemecek, 1971; Hanui Yu, 2023; Janosik E. at al., 2003; Dobreva, D., 2018, pp. 170)

Two ergonomic issues that require special attention in lighting designed for offices equipped with video displays are investigated:

- sharp lighting - contrasts between the screen and the environment should be avoided
- reflections on the glass surface of the screens must be reduced or eliminated. (Ettiene Grandjean, 1987).

Some psychological effects of colors should also be taken into account and summarized here:

With blue and green coloring of the walls of the rooms - they look slightly larger, the feeling is colder and calmer. (can be used for small rooms to "expand" them optically)

Red and orange create a feeling of approaching the walls, they are warm and quite exciting. (can be used for larger rooms)

With Brown, the feeling of closeness is very great, the rooms look small, they create coziness. (they are suitable for premises where many people work).(Ettiene Grandjean, 1987, 42 pp.)

But in all three cases, pale shades of these colors should be used so as not to create a gloomy mood. With a ceiling painted white, the rest of the room should be colored as follows:

- walls - in pale green; floor - in green with medium saturation; furniture - in gray green and light brown.
- walls - in pale pink; floor - reddish brown (medium saturated); furniture - reddish or light brown.
- walls - in pale blue; floor - gray; furniture - gray, with a gray-blue tint (Georgieva, 2019- 375 pp.); (Momov, 2006 -101 pp.); (Bogatev, 1979)

Color has quantitative and qualitative characteristics:

- quantitative color characteristic: the magnitude of the light flux that is reflected or emitted from the colored surface.
- qualitative characteristic of color: it is called chroma. It is determined by the color tone (the wavelength in mm) and by the color purity (characteristic of the colors obtained by mixing monochromatic and white light). (Georgieva, 2019 – 367 pp.)

8. Research methods

Measurement of artificial lighting in an administrative building **(Table 3)**

Technical means for measuring artificial lighting in buildings: **TESTO 435-2, id. No. 02005895**, with light measuring probe (lux meter)

Normative requirements: **Ordinance No. 49, SG No. 7/1976**

Table 3. Measurement of the artificial lighting in the office building

TYPE OF ROOM /WORK PLACE/	TYPE OF LIGHTING	TYPE AND NUMBER OF WORKING LIGHTING FIXTURES	NORM lx	LIGHTNESS lx
2	3	4	5	6
Floor 4				
Accounting:	-	LED	-	-

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		5x1x6W 3x1x12W		
Work place № 1	Total	-	300	322
Work place № 2	Total	-	300	376
Work place № 3	Total	-	300	412
Logistics:		LED 1x4x12W 1x4x10W		
Work place № 1	Total	-	300	306
Work place № 2	Total	-	300	318
Work place № 3	Total	-	300	342
Work place № 4	Total	-	300	366
Work place № 5	Total	-	300	350
Work place № 6	Total	-	300	332
Work place № 7	Total	-	300	379
Work place № 8	Total	-	300	396
Work place № 9	Total	-	300	385
Work place № 10	Total	-	300	320
Floor 3				
Chief Financial Officer(CFO)	-	LED 9x1x8W	-	-
Work place № 1	Total	-	300	364
Director		LED 9x1x8W		
Work place № 1	-	-	300	340
Floor 2				
Accounting No. 1		Fluorescent light fixture (FLF) 16x2x58W		
Work place № 1	Total	-	300	331
Work place № 2	Total	-	300	346
Work place № 3	Total	-	300	368
Work place № 4	Total	-	300	336
Work place № 5	Total	-	300	380
Work place № 6	Total	-	300	321
Work place № 7	Total	-	300	330
Work place № 8	Total	-	300	447
Work place № 9	Total	-	300	666
Work place № 10	Total	-	300	376
Work place № 11	Total	-	300	341
Work place № 12	Total	-	300	318
Accounting No. 2		FLF 4x2x14W		
Work place № 1	Total	-	300	312
Work place № 2	Total	-	300	330
Work place № 3	Total	-	300	324
Work place № 4	Total	-	300	302
Floor 1				
Supply depart-ment	-	LED 16x2x36W	-	-
Work place № 1			300	749
Work place № 2	Total	-	300	669
Work place № 3	Total	-	300	517

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Work place № 4	Total	-	300	648
Work place № 5	Total	-	300	585
Work place № 6	Total	-	300	620
Work place № 7	Total	-	300	492
Work place № 8	Total	-	300	680
Work place № 9	Total	-	300	635
Work place № 10	Total	-	300	483
Work place № 11	Total	-	300	599
Work place № 12	Total	-	300	562
Work place № 13	Total	-	300	472
Work place № 14	Total	-	300	511
Work place № 15	Total	-	300	528
Import depart-ment		LED 4x2x18W		
Work place № 1	Total	-	300	325
Work place № 2	Total	-	300	310
Work place № 3	Total	-	300	341
Work place № 4	Total	-	300	305
Floor 0				
Advertising department	-	FLF 2x2x36W 2x2x186W	-	-
Work place № 1	Total	-	300	308
Work place № 2	Total	-	300	333
Work place № 3	Total	-	300	316
Work place № 4	Total	-	300	325
Work place № 5	Total	-	300	360
Accounting:		FLF 4x2x18W		
Work place № 1	Total	-	300	338
Work place № 2	Total	-	300	326
Work place № 3	Total	-	300	312
Computer specialist	-	FLF 4x2x18W	-	-
Work place	Total	-	300	356

Conclusion

From the measurement made, it was found that in the Supply Department, the light is increased, it reaches 749 lx, which suggests their work, in addition to video displays, also the use of paper media.

In the Accounting Department, there are places where the light reaches 666 lx, which depends not only on the artificial light, but also on the location of the workplace. It can be near a window and let in daylight, also the amount of reflected light can also be obtained from the materials and colors of the desktop.

In places with fluorescent lighting, eye fatigue occurs faster. LED lighting has an advantage over fluorescent lighting, it prevents the negative effect of flickering fluorescent lighting. With LED lighting, color perception is better, the worker performs his tasks more calmly when working with video displays and with paper media.

There is a need to replace fluorescent lighting with LED lighting, as well as the introduction of lighting control, which can improve visual comfort and worker satisfaction.

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In order to select the correct color temperature to suit the individual preferences of the operator, the use of LED controllers and dimmers is required.

The location of workplaces should be adjusted so that bright light does not fall on the monitor, no glare is reflected that could irritate human vision during work. Also to eliminate the shadows that cause the vision to adjust and refocus and so eye fatigue occurs more quickly.

From a psychological point of view, the spectral composition of artificial lighting should be as close as possible to that of natural light. Warmer light in the morning, colder at noon to activate working capacity, and warmer again at the end of the working day to readjust the body for rest.

A large number of operators turn off part of the lighting or lower the blinds in front of the windows to protect themselves from the irritation of the light sources and the glare received from them.

Designing high-quality lighting is essential to improving the physical, emotional and mental well-being of computer and digital device users. It must be properly distributed in space, be able to be controlled and adjusted from a distance. This can improve workplace comfort and reduce electricity costs.

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