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METHODS FOR TESTING AND EVALUATING ARTIFICIAL LIGHTING PARAMETERS IN ROOMS

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ANNOTATION: This article analyzes methods for assessing and hygienically evaluating artificial lighting parameters in indoor spaces. Lighting is a crucial environmental factor affecting human life and activity. Adequate and properly designed lighting ensures the normal functioning of the visual system, reduces eye strain, and enhances productivity in work and educational settings. The article covers the concept of artificial lighting, its key parameters, types of lighting systems, the methodology for measuring illuminance using a lux meter, the selection of measurement points, and the comparison of results against hygienic standards. Additionally, it discusses the impact of artificial lighting on the health of patients and medical staff in healthcare facilities and offers recommendations for improving lighting conditions.

Keywords: artificial lighting, illuminance, hygiene, luxmeter, light, visual analyzer, medical institution, occupational hygiene, sanitary requirements, workplace.

INTRODUCTION

Many factors of the external environment affect the human body. One such factor is lighting, which is of great importance in a person's daily life, study, work and recreation. A person receives the main part of the information in the environment through the vision analyzer. Therefore, it is important for hygiene to have enough, uniform and eye-friendly lighting in work and living rooms.

Lighting in rooms can be natural or artificial. Natural lighting is provided by sunlight, whereas artificial lighting is supplied by various light sources powered by electricity. In modern buildings—particularly in medical facilities—artificial lighting systems are widely used alongside natural lighting.

The primary purpose of artificial lighting is to create the visual conditions necessary for performing tasks. In rooms with insufficient illumination, the strain on the human eye increases. Prolonged work under such conditions can lead to rapid eye fatigue, reduced concentration, and decreased productivity. Conversely, excessively bright or improperly arranged lighting can cause glare and discomfort.

The issue of lighting in medical facilities is of particular importance. Doctors and other medical personnel require adequate lighting when examining patients, performing various procedures, conducting laboratory tests, and working with medical records. Therefore, the hygienic inspection and assessment of lighting in medical facility premises constitute a key task in the fields of communal and occupational hygiene.

The primary method for the hygienic assessment of illumination involves comparing measured values against the standards and regulatory requirements currently in force.

The required level of illumination varies from room to room, it depends on the room's intended use and the precision of the work performed within it.

For instance, the lighting requirements for a corridor intended simply for movement cannot be the same as those for a laboratory where the inspection of small objects is required.

MATERIALS AND METHODS

The verification of artificial lighting is carried out in several stages.

In the first stage, the function, area, and type of work performed in the room under inspection are determined. For instance, it is noted whether the room is a patient ward, treatment room, laboratory, operating room, lecture hall, or administrative office.

In the second stage, the existing lighting system is inspected. The type, quantity, location, and technical condition of the lighting fixtures are determined. Any soiling or malfunction of the lamps is also noted.

In the third stage, illuminance is measured using a luxmeter. The instrument is placed at specific points on the work surface, and the readings are recorded.

In the fourth stage, the obtained results are compared with the relevant sanitary and hygienic standards.

In the fifth stage, a final hygienic assessment of the room's lighting is conducted. If the illuminance does not meet the required standards, recommendations for improvement are developed.

Artificial illuminance is a physical parameter representing the level of illumination on a specific surface produced by light sources. In the International System of Units, illuminance is measured in lux (lx). One lux is defined as the illuminance produced when a luminous flux of one lumen falls on a surface area of one square meter.

The level of illuminance depends on a number of factors. Specifically, the lamp's power, the type of light source, the number and placement of light fixtures, the dimensions of the room, the light-reflecting properties of the ceiling and walls, and the position of the work surface relative to the light sources all influence illuminance.

The hygienic assessment process focuses on the following indicators: the quantitative level of illumination; the uniformity of illumination; the placement of lighting fixtures; the technical condition of light sources; the potential for glare; the presence of harsh shadows on the work surface; the light-reflecting properties of the room's walls and ceilings; and the positioning of the workstation relative to the light source.

If illumination levels fall below established requirements, it is necessary to identify the cause. Potential causes include insufficient lamp wattage, improper fixture placement, lamp aging or soiling, excessively dark room surfaces, and other factors.

To rectify identified deficiencies, measures such as cleaning fixtures, replacing lamps, installing additional lighting, or reconfiguring the existing lighting system may be taken.

RESULTS

From a hygienic perspective, lighting is evaluated not only by its intensity but also by the uniformity of light distribution, the absence of glare, and the lack of harsh shadows or stark contrasts in brightness.

Adequate lighting facilitates visual tasks. Sufficient illumination is particularly important when distinguishing small objects, reading fine print, operating equipment, and performing precise movements.

Insufficient lighting places a strain on the visual system. The eyes must work harder to see, which can lead to fatigue. Prolonged exposure to such conditions may result in reduced work efficiency.

Furthermore, improper lighting arrangements can impact workplace safety. An inability to clearly see objects in the work area can lead to various errors. This issue is of particular importance for medical professionals, as certain medical procedures require a high degree of precision.

Artificial lighting is classified into several types based on its purpose and arrangement.

General lighting is a system designed to provide uniform or relatively even illumination throughout a room. In this setup, light fixtures are arranged in a specific pattern on the ceiling or other structural elements. General lighting is used in classrooms, corridors, hospital wards, and many other types of rooms.

Local lighting is used to provide additional illumination for a specific workstation or work surface. Examples include a desk lamp, a specialized light used during medical examinations, or supplementary lighting for a laboratory workstation.

Combined lighting involves the simultaneous use of both general and local lighting. This type of system is effective for tasks requiring high precision.

Additionally, emergency and evacuation lighting systems are employed to ensure people's safety during emergencies. Their function is to facilitate the safe movement of people in the event that the main lighting system fails.

Checking and evaluating artificial lighting levels in rooms is a key aspect of communal and occupational hygiene. Properly designed lighting creates favorable conditions for visual activity, reduces excessive eye strain, and facilitates efficient work performance.

A luxmeter is one of the primary instruments used for the objective measurement of artificial lighting. During the assessment, factors such as the type of room, the nature of the work performed, and the placement and technical condition of the lighting fixtures are taken into account. The measured results are compared against relevant hygienic standards to provide a sanitary-hygienic evaluation of the room.

DISCUSSION

An instrumental method is used to verify artificial illumination levels. This method relies on directly measuring illuminance using a specialized instrument known as a luxmeter.

A luxmeter consists of a light-sensing photoelectric element and a measuring unit. When light strikes the photoelectric element, an electrical signal is generated; the instrument converts this signal into an illuminance value and displays the result in lux.

Before measurements begin, the room being tested is set to its standard operating conditions. All necessary lamps within the artificial lighting system must be operational. Conducting measurements with some lights intentionally turned off may not reflect the actual working conditions of the room.

The light-sensing component of the luxmeter is placed on the work surface being tested. Measurement points are determined based on the size of the room, its function, and the nature of the work being performed.

In small rooms, measurements may be taken at a few points. In large rooms, the number of measurement points is increased. This allows for the determination of how illuminance is distributed throughout the room. During measurement, care must be taken to ensure that the shadow of a person's body or other objects does not fall on the light-receiving part of the instrument, as this could artificially lower the measurement result.

The obtained results are recorded in a special table or inspection report. If measurements are taken at multiple points, the average illuminance value is determined where necessary.

The following formula can be used to determine the average illuminance:

$$E_avg = (E_1 + E_2 + E_3 + ... + E_n) / n$$

Here, E_1, E_2, E_3... E_n represent the illuminance values measured at various points, and n is the number of measurements.

This calculation provides an indication of the general level of illumination in the room. However, determining the average value alone is insufficient; the uniformity of the illumination distribution must also be assessed.

The assessment of artificial lighting is carried out in several stages.

In the first stage, the function and area of the room being inspected, as well as the type of work performed there, are determined. For instance, it is noted whether the space is a patient ward, treatment room, laboratory, operating room, classroom, or administrative office.

In the second stage, the existing lighting system is examined. The type, number, placement, and technical condition of the light fixtures are determined. Any soiling or malfunctions of the lamps are also recorded.

In the third stage, the illumination level is measured using a lux meter. The instrument is placed at relevant points on the work surface, and the readings are recorded.

In the fourth stage, the obtained results are compared with the relevant sanitary and hygienic standards.

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