

WHY IT IS NECESSARY TO REVISE THE STANDARDS OF EXHIBITION LIGHTING

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ABSTRACT

In the modern world, one of the main functions of museums is to organize the preservation of pieces of art and arrange their presentation to museum visitors. Since the modern exhibition is based on the artificial lighting, it is necessary to properly arrange this lighting; otherwise, it can negatively affect the safety of museum pieces. The article sets out the views on the criteria of professional lighting of works of art, as it is always a compromise between the custodians and the lighting engineers. The authors also attempt to disclose the processes of organizing museum lighting and give a generalized description of the standards and rules, which serve as a basis to realize this lighting. The main reasons for the need to rethink these standards and rules (and even to revise them), in connection with the emergence of new LED sources, have been outlined.

Keywords: museum, lighting engineering, classification of museum pieces, preservation of museum pieces, lighting standards, museum exhibition lighting, daylighting, artificial lighting, LED sources, exposure to light on exhibits, optimal conditions for the perception of fine art

1. INTRODUCTION

The cultural development of people involves visiting various events, museums, which are open all year round. The museum is the most interesting place in terms of lighting, because here you need to create the correct composition and its lighting so that the visitors would come again and again [1].

The museum lighting involves many details necessary to achieve high-quality lighting of various exhibitions and works of art. However, it should be kept in mind that, one way or another, the modern exhibition is based on artificial lighting.

The museums, regardless of their focus area and specificity, almost always have one single goal: the education. They hold a variety of exhibitions aimed at introducing people to cultural values, as well as demonstrating the achievements in various areas of human activity: from art to archaeology. Therefore, the lighting system is the most important for museums, as it is the means to achieve the desired result: to focus visitors' attention on the elements of the exhibition. Museum lighting is considered to be the most complex of all other types of lighting.

In museums, the light should perform the following functions:

- Fully illuminate the exhibited items;
- Create accent lighting depending on the purpose of the exhibition;
- Provide full lighting of the rooms so that people can freely move through;
- Advantageously emphasize the works of art or other exhibited items against the background of the museum premises.

It is difficult to create high-quality lighting of exhibited items in museums for the following reasons:

- Exhibition rooms in museums should be spacious;
- In one room, the exhibition can be arranged in various ways: along the walls, in the centre, on special showcases and pedestals, or in both versions;

- The lighting installation in each room should be based on certain standards and requirements, which are given in the regulatory documentation;

- It is not always possible to properly arrange daylighting in museum premises due to the specifics of the structural arrangement and in addition, the daylighting changes throughout the year depending on the season and weather conditions;

- For the exhibition lighting to be of high quality, the lighting system in the museum premises should be universal to provide high-quality lighting regardless of the exhibition arrangement;

- In the case of poor-quality engineering and selection of lighting equipment for the installation of lighting systems, the standards of lighting and requirements for the lighting of art pieces may be infringed. When installing the lighting system, it is necessary to comply not only with the requirements and standards, which we will further discuss, but also with the purpose of the exhibitions.

The vast majority of museums around the world, as well as exhibitions and galleries, organize exhibitions of fine arts. For them, the most important is the installation of artistic lighting. In addition, the main goal here is to organize the correct light image of the exhibited items to provide a powerful emotional and psychological impact on visitors. In such a situation, museum lighting is to seek a compromise between the poles apart: ensuring the preservation of exhibition items (for example, paintings with certain dose limits¹, which, as a result of prolonged light exposure, can be discoloured and destroyed), on the one hand, and the need to adequately demonstrate masterpieces, on the other hand [1].

Improper lighting (strong, bright, containing infrared and ultraviolet radiation) has a devastating effect on exhibited items with low light resistance. In order to avoid such negative developments, there are certain requirements for the organization of proper artistic lighting. Such requirements include the correct selection of lighting according to the following parameters:

- Colour rendering: the right colour rendering of the light source can best convey the colour solution of the displayed paintings or other works of art;

- Illuminance: this indicator at high values can lead to a rapid discolouration of the exhibited items;

- The distance from the exhibition to the light source. Coming from a short distance, a constant and directional luminous flux is able to heat the illuminated surface, which, again, can lead to damaging the paints and canvas.

Considering the fact that the works of art acquire the value over time, which also destroys them, the installation of museum lighting of this kind requires the highest professionalism, as well as extensive expertise in the art and lighting engineering. Only in such a situation not only the requirements and standards would be complied with, but also the peculiarities of each piece of art presented at the exhibition would be taken into account. **In this situation, the skills of a lighting engineer and the modern equipment, after the exhibited items themselves, are the key to the success of art museums and exhibitions [1].**

2. MUSEUM EXHIBITION LIGHTING

In addition to artistic lighting, the museums often use exhibition lighting to highlight the certain areas of the premises.

Such lighting of museum exhibition halls shall comply with the following requirements:

- High-quality presentation of an item, so that visitors can fully view all its elements and details: colour, material, and texture;

- Taking into account the physiological features of the human visual analyser;

- The safety of exhibited items. Under light exposure, the paper becomes yellow, the organic elements disintegrate, and the chemical composition of the paints is subject to irreversible changes.

At the same time, in order not to overstrain human vision, the exhibition lighting should protect visitors from the blinding effects of luminaries for paintings, all kinds of glare. Besides, the design of lighting installations should be taken into account: skilfully conceal them, if it is a palace interior, and make them most lightweight and imperceptible in the exhibition space.

When selecting the light sources to illuminate paintings in a gallery or museum, it is necessary first of all to be guided by specific tasks. Incandescent, traditional, and halogen lamps have the advantage of a constant spectrum that provides a perfect colour rendering with the colour rendering index equal to 100. However, the legislation explicitly prohibits their purchase for cultural institutions fi-

¹ In respect to museum lighting, it is an integral of the illuminance over the time for a certain period of time

nanced from the state budget. It is worth noting that due to such requirements for museum lighting, the standard methods in this situation will not ensure the desired result, but rather accelerate the damage of exhibited items. Here, not only the standards of lighting level, as well as the state standards for lighting equipment, should be taken into account, but also many additional factors. For example, in the exhibition of paintings, when installing optimal lighting, it is important to consider the texture and colour of the walls, as well as the architectural aspects of the exhibition room and the arrangement of window openings. The ideal conditions for exhibiting a variety of works of art are the premises completely closed from the natural light [1].

3. THE STANDARDS SET FOR MUSEUM LIGHTING

All lighting systems installed in museums are aimed at the most effective presentation of the exhibited items, as well as at their preservation. All this is ensured by the lighting standards, prescribed in the special documentation, but they are set for incandescent lamps and cannot serve as a guide when using LEDs.

In this situation, unlike industrial, public, and residential premises, where the standards have minimum values, they are given to the maximum for museums. This means that these standards shall not be exceeded.

Moreover, each type of exhibited item has its lighting limits [1, 2]:

- Newsprint paper, fabrics, and watercolours have a maximum lighting level of 50 lx;
- Oil paintings have a level of 150 lx;
- Precious stones and metals have a level of 500 lx.

In addition, the requirements prescribe the minimization of infrared and ultraviolet radiation in the radiative flux. Ultraviolet radiation can have a direct negative impact through the destruction of molecular bonds, and infrared radiation can have the indirect one, provoking ageing of materials due to increased speed of chemical reactions at high temperature. In addition, the greatest danger is ultraviolet radiation.

National standards, recommendations, and requirements, as well as the state standards, were developed when the harmful impact of light on some works of art was not yet fully studied. Therefore, to-

day in the world there is a clear tendency to revise the standards for museum lighting.

According to one of the recommendations, the museum pieces should be given a “rest” after 2–3 years of continuous exhibiting. This allows to extend their storage life, and also to some extent mitigates the harmful impact of permanent lighting for several years.

Obviously, the greatest impact on the works of art is not so much by the lighting as by the amount of energy they absorb. Therefore, today it is proposed to set the exposure rate for each item.

For this reason, daylighting and artificial lighting systems of exhibition halls and museum depositories should be considered as the factors that, to one extent or another, standardize the exhibition cycle. As can be seen, in terms of organizing the museum lighting, there are quite a lot of nuances, standards, and requirements, which are obligatory to comply with if you want to preserve the exhibited works.

Today, it is recognized that the best conditions for showcasing the works of fine art are the rooms without daylighting. This is not only due to the fact that sunlight carries a certain proportion of ultraviolet radiation, which adversely affects the art paintings. The following things ensure the high-quality and full-fledged lighting of exhibited items: the absence of glare from windows on the works of art and the absence of additional outdoor lighting [1].

However, at the same time, historical buildings very often play the role of museums:

- Mansions;
- Palace buildings;
- Railway stations.

In a situation where there are still windows in the rooms, it is preferable to close them tightly or to curtain them off. In this case, the windows should be covered with special films capable of absorbing ultraviolet radiation. However, it is impossible and often not necessary to completely obscure the daylight. Its absence changes the architecture of buildings, prevents the perception of buildings as works of art. Therefore, a compromise between daylighting and artificial lighting should be found. The search for the compromise is the skill of a museum lighting engineer. Therefore, the following requirements are currently necessary for museum premises and depositories:

- Strict compliance with regulations, which are mostly based on previous research;

Table 1. Classification of Museum Exhibited Items by Light Resistance [2]

| Name of exhibited item and materials | Light resistance group | Colour group | Shape |
|--|------------------------|--------------|--------|
| Painting: | | | |
| Oil, tempera | II | 3, 4 | Flat |
| Watercolour, pastel | III | 3, 4 | Flat |
| Graphics: | | | |
| Black and white | III | 1 | Flat |
| Colour | III | 3, 4 | Flat |
| Iconography | III | 3, 4 | Flat |
| Manuscripts, books, newspapers | III | 1 | Flat |
| Photos | III | 1, 3 | Flat |
| Stamps | III | 4 | Flat |
| Jewels | I | 3 | Volume |
| Coins, medals, orders | I | 2 | Relief |
| Badges | I | 4 | Relief |
| Weapons | I | 2 | Volume |
| Clothing, fabrics, tapestry, lace, carpets, fur, leather | III | 2, 4 | Flat |
| Bone | II | 2 | Volume |
| Porcelain, ceramics, glass, enamel | I | 2, 3 | Volume |
| Utensils: | | | |
| Glass, metal | I | 4 | Volume |
| Wooden | II | 4 | Volume |
| Sculpture: | | | |
| Marble, gypsum, cast iron, | I | 1 | Volume |
| Bronze | I | 2 | Volume |
| Furniture: | | | |
| Wooden | II | 3 | Volume |
| With bronze parts | I | 2 | Volume |
| Minerals, rocks | I | 1, 2, 3 | Volume |
| Stuffed animal or bird | III | 4 | Volume |
| Technical Equipment | I | 1 | Volume |

– Setting the luminous flux with quality colour rendering;

– High adaptability of the premises to different levels of daylighting;

– Elimination of harmful effects from lighting devices;

– Convenience and appropriate arrangement of exhibitions.

Only guided by these requirements, it is possible to create optimal and high-quality museum lighting according to its technical characteristics.

The museum premises, as well as the exhibited items, shall be subject to strict requirements. These requirements should be developed. Guided by them, it will be possible to achieve optimal lighting for any item: artistic, biological, etc. These rules and

Table 2. Proposed Illuminance Levels for the Main Museum Premises and Exhibited Items [2]

| Lighted Item | Proposed average illuminance, lx | |
|---|--------------------------------------|-----------------------------------|
| | Horizontally at 0.8 m from the floor | At exhibition or working surfaces |
| A. Premises | | |
| General lighting of the exhibition rooms, in which all the main exhibited items are specially illuminated | 50 | |
| General lighting of rooms with large volume exhibition, as well as rooms where the central exhibition is furniture, finish, or decoration | 50–100 | |
| General lighting of historical and natural-historical museums | 50 | |
| General lighting of technical museums | 200 | |
| Lobbies, walkways, and stairs for visitors | 50 | |
| Reserve stocks (in aisles) | 50 | |
| B. Exhibited items standing separately, as well as arranged on walls, stands, tables, shelves, showcases | | |
| Exhibited items of Group I of light resistance, with very small details (for example, jewellery, coins, etc.) | | 300–500 |
| Exhibited items of Group I of light resistance (e.g. marble sculpture, porcelain, weapon samples, etc.) | | 200–500 |
| Exhibited items of Group II of light resistance (e.g. oil painting, wood, ivory, etc.) | | 75–150 |
| Exhibited items of Group III of light resistance (e.g. watercolour, tempera, pastel, fabrics, manuscripts, etc.) | | 30–50 |
| C. Museum staff workplaces | | |
| Work tables in reserve stocks | | 200 |
| Stands with exhibited items in reserve stocks | | 30 |

requirements shall be strictly complied with by all museums.

Since the presentation of a painting or sculpture requires a sufficiently high illuminance, while the preservation of the exhibited items is ensured at low levels, the museum lighting is always a compromise: the right solution here should be sought between the poles. Standard lighting techniques and the regulations in force specify only the right focus but do not provide ready-made answers. The situation is complicated by the fact that, in each case, many other factors have to be taken into account alongside the rules, for example, the colour and the texture of the walls, the architectural characteristics of the room, the arrangement of windows, and daily and meteorological changes in the lighting of the exhibition space. Moreover, the size of a work of art and its arrangement relative to the windows and other exhibited items should be al-

ways kept in mind, not to mention that it is impossible to adequately represent any work of art without deep insight into the author's conception. The ideal environment for each exhibited item inside the exhibition is always created by the efforts of a group of professionals, which includes lighting engineers, installation specialists, and art critics [3].

Today, due to the rapid progress in the production and introduction of light sources such as LEDs, the standards specified by the legislative and permissive documents developed for old light sources are outdated and cannot be the base for lighting project developers.

The current regulations in the Russian Federation have been developed for a long time and are mostly experimental because, at the time they were established, the impact of lighting on materials was not properly studied.

Today, a determined line is being set around the world to revise the generally accepted standards of exhibition lighting. The research initiated in Germany does not allow to agree with the staff of museums and art galleries who state that after three years of the exhibition it is necessary to give “rest”, as in this case they are preserved much better. The experts found out that not even the illuminance level, but the relevant irradiation, the value of which is measured in each case, has a great impact. However, there are many known examples when watercolour works are in standard conditions under open daylighting for more than a hundred years and do not lose their properties, disproving any rules. In fact, the optimal lighting for each exhibited item should include the setting of the optimal irradiation rate, which depends on the chemical composition of the exhibited item.

The museum pieces (paintings, graphics, sculptures, arts and crafts, works of ethnography, archaeology, etc.) are very diverse in size, texture, they may be flat or voluminous, colour or black and white, light-resistant or not, located on the floor, walls, in special stands, showcases, cabinets, vertically, horizontally or inclined.

The classification of exhibited items depending on their light resistance, colour characteristics, and shape is given in Table 1. According to light resistance, all exhibited items are divided into 3 groups: high (I), medium (II), and low light resistance (III). According to colour characteristics there are 4 groups: achromatic or grey (1), that is, having no apparent colour characteristics; monochrome (2), having more or less identical colour on the whole surface; multicolour tonal (3), in which the colour tone of the surface changes, but it is possible to distinguish the predominant one; multi-coloured mottled (4), for which all colour tones can be considered identical [2].

It should be borne in mind that among the types of minerals classified in a particular group of light resistance, there may be types with different light resistance. For example, precious gems are mostly of high light resistance, but some of them (aquamarine, amethyst, alexandrite, turquoise) are less resistant to light. Some types of paints, glasses, ceramics, etc. may also have lower light resistance.

Optimization of lighting systems for museum premises subject to the requirements of storage and exhibiting should be decided on the basis of the lighting standards given in Table 2 [2].

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