

## ARCHITECTURAL LIGHTING IN MUSEUMS

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### ABSTRACT

The role of light, mainly daylight, in the museum interiors is considered in three areas of its dominant usage: **light for architecture, light for an exhibited item, and light as an exhibited item.** This is predetermined by the architectural concept of the museum, due to the creative position of the architect, the author of the project creating a spatial composition of a museum building or complex with one or another daylighting system. Architectural form making is directly related to the nature of the exhibition lighting solution. Examples are given, mainly, from a varied foreign practice of modern museum construction on the projects of famous architects of the 20<sup>th</sup>-21<sup>th</sup> centuries in three classified areas.

**Keywords:** architecture, light, museum, exhibited item, visitor (viewer), architect

Museum and light are inseparable concepts, and this applies to any light in each museum. However, this connection is universal: in any room and open space, the activity of the seeing person is driven by the light. However, in the vast typology of world museums, this dynamically developing topic is particularly diverse and not known in all its scope even to a small circle of specialists. First, the museum typology in buildings, under the open sky, under the ground and under the water, large and small, mono- and polyfunctional, old and new is extremely branched, and this is probably the most complex in structure and content typology among public sites. It is reflected in the original architectural solutions of museums and museum com-

plexes. Secondly, in museums both simple and ingenious methods, systems, and techniques of day, artificial, and mixed (combined) lighting, general and accentuating, direct, diffused and reflected, white and chromatic, static and dynamic, with passive or programmable control and mode of operation, with elements of interactive lighting of a visitor in the exhibition labyrinths are widely used. In all cases, the purpose of creating and function-

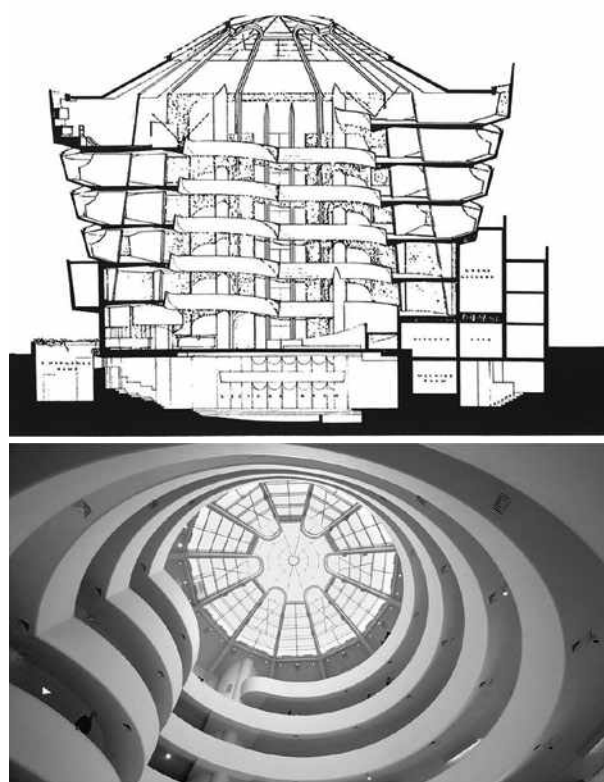


Fig. 1. Guggenheim Museum, New York (F.L. Wright, 1937). The sectional view of the building and the atrium interior in daylight

ing of the museum is to organize effective interaction of two components: the architectural and spatial environment with the items displayed in it and the visitors.

There are three evaluation categories of the interaction of light, mainly daylight, with architecture and exhibited item: **light for architecture, light for exhibited item, and light as exhibited item.** Moreover, daylighting in all cases acts and is considered as a powerful form-making and informative factor in architecture and as the principal means of creating emotionally imaginative expressiveness through examples of museum interiors. Of course, this classification is conditional, because the one group items to some extent have features of another, but gives grounds for formal analysis of exhibition light solutions.

The first group includes museums, where people, voluntarily or not, focus on architecture, the architectural space organization, plastic and colour decor, as the most remarkable thing in the interior or the interior ensemble. Architects, creators of such buildings, in most cases consciously give priority to architectural forms, rather than to the contents of the museum represented by the collection of exhibited items, permanent or temporary. For mobile exhibitions of different art genres, where universal exhibition halls and mobile, mostly artificial, lighting are needed, this priority is understandable, but the architect's desire to express himself is usually prevails: the previous tendency to design the museum buildings in the traditional academic style (for example, the Pushkin State Museum of Fine



Fig. 2. Museum of Art of the 21<sup>st</sup> century in Rome (Z. Hadid, 1999–2009). Interior with mixed lighting

Arts) was replaced in the middle of the 20<sup>th</sup> century by an increasingly active search for new spatial compositions and original figurative solutions. This was driven by the avalanche-like growth of various private collections occurred in the post-war period in Western countries. “New museums are living, developing, “open” systems, and they should be matched by architecture that has... structural flexibility and mobility” [1]. For the architect, it is obvious that “In any other sphere of design professional consciousness and values, ideology and creative experience are not manifested with such frankness as in museums” [1]. In our country, due to historical particularities, post-war museum construction was carried out mainly on memorial subjects, and many museums were established in existing buildings with their originally different function, so the daylighting systems in them are far from ideal for exhibitions.

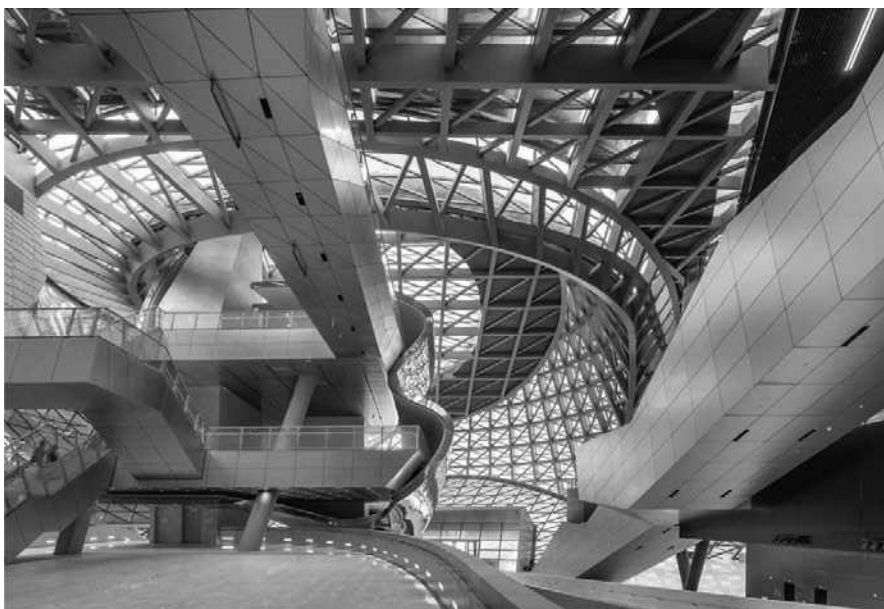


Fig. 3. The interior of the Museum of Modern Art in China (Coop Himmelblau Studio, 2016). Super-sophisticated structural shapes in the upper daylight

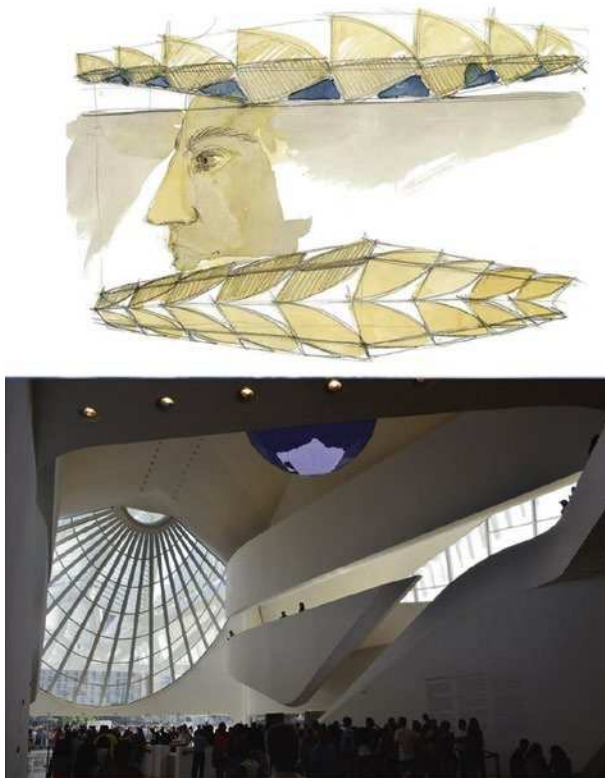


Fig. 4. Museum of the Future in Brazil (S. Calatrava, 2016). Searching for shape – building sketch and day interior

One of the pioneers of the new, completely original spatial planning of the building was F.L. Wright, the creator of “organic” architecture, built the New York Guggenheim Museum in 1937. The continuous spiral ramp adjacent to the outer wall of the building round in the plan rises seven levels around the central atrium with the upper daylighting. Spiral, not very convenient for visitors (feet get tired on an inclined surface), as if “wound” on the ephemeral air volume in the form of slightly narrowing to the top cylindrical daylight space, creating various and spectacular viewpoints at different levels. The exhibited items of changing exhibitions, suspended on the walls with negative inclination (paintings), as well as exhibited on the ramp (sculptures), attract the visitor’s secondary attention; the primary attention, especially on the first visit to the museum, is focused on the interior architecture (the exterior image of the building is not less impressive). This is one of the first, most refined and memorable images of the museum, where the trend, technique and style prevail. This is the **light for architecture** (Fig. 1).

In all kinds of variations, this style is reflected in the work of most practising foreign architects

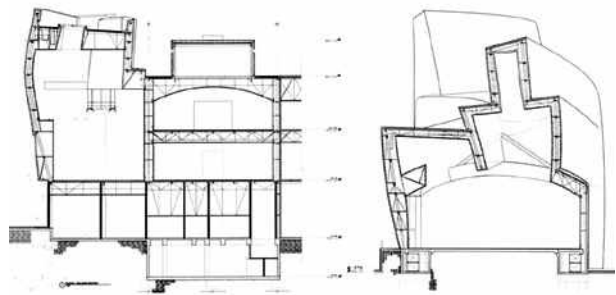


Fig. 5 Guggenheim Museum in Bilbao (F. Gehry, 1995). Appearance, sectional views and interior in natural light

of both world renown and less famous, who consider it a great luck to get the order to design a museum that can increase their popularity. In such museum interiors, the visitor, first of all, is amazed by the peculiarity, complexity, expressiveness of architectural forms and spaces, and the extravagance of daylighting techniques and then draws attention to the exhibited items, which are often not visible in the pictures (Fig. 2–4). At the same time, the extravagance of lighting is often forced: if the building is conceived by the author as a complex sculpture, in the external bizarre forms of which the shells with rooms are “crammed”, then their lighting techniques are forced to become sophisticated, which determines the individualized light-spatial and light-plastic effects in interiors (Fig. 5). The light manifestly “works” on architecture and is quite indifferent to the exhibition.



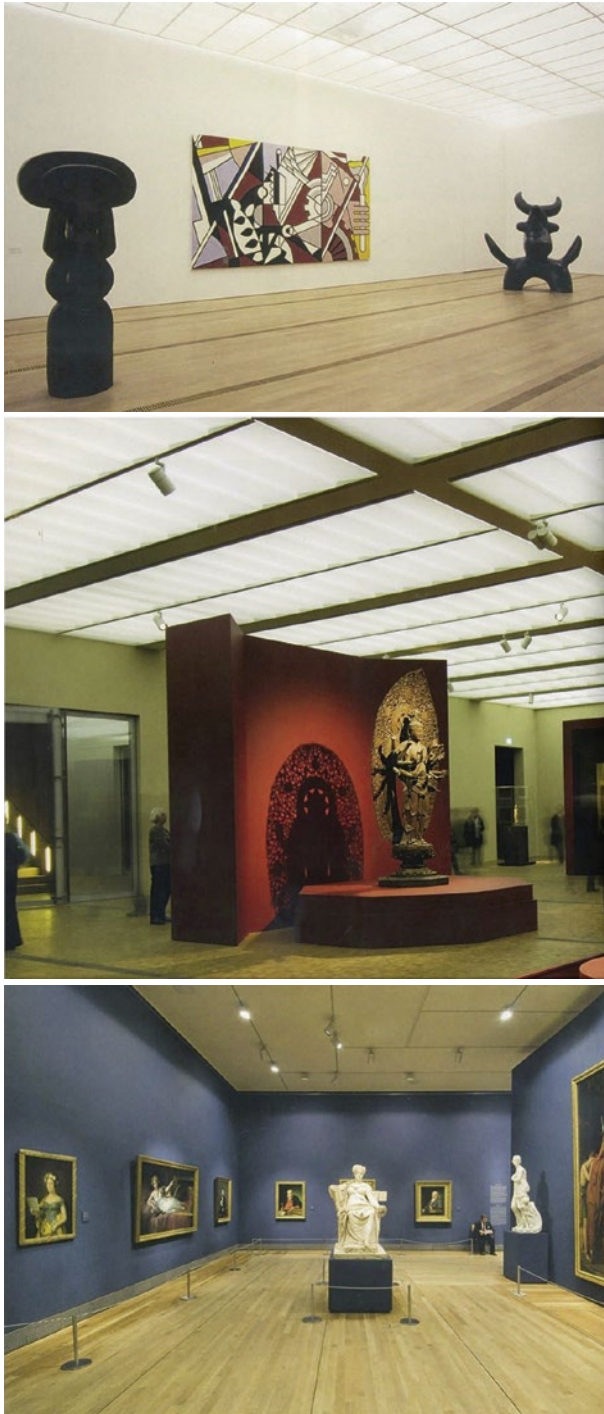


Fig. 6. “Filling” general lighting for flat, silhouette and voluminous exhibited items in halls with light and dark finish of walls and ceiling and different types of lighting installations

Formally, the core museum value is still the exhibited items. Therefore, the primary obligatory task of the designer and the museum specialist is to show them to the visitor in the best light, either literally or metaphorically. This is the second area of the “work” of museum lighting – **light for the exhibited item** – is usually realized by all



Fig. 7. Halls with different luminance adaptations due to combinations of different intensity and different types of artificial lighting systems and different finishing of interior surfaces

means of daylighting, artificial, and mixed lighting in different proportions. Man-made artificial lighting systems have much less impact on physical (not figurative!) form-making in the interior architecture, and in the presentation of the exhibited items are of mass, often crucial importance both in the evening and in the afternoon. There are three techniques of organizing the interaction of any light with the exhibited item:

- General, as a rule, abundant lighting of the exhibition space;
- “Targeted”, accent, individual lighting of the exhibited item;
- Combined lighting.

It should be kept in mind that at all techniques the artificial lighting can be selectively controlled over the entire range of characteristics: by specularity and contrast, which determine the shadow formation on the exhibited items, architectural forms, faces, and figures of visitors; width and intensity of light beams forming the light distribution in the interior space and a bright composition in the field of



Fig. 8. Accent artificial lighting of voluminous exhibited items in halls with different wall finishing

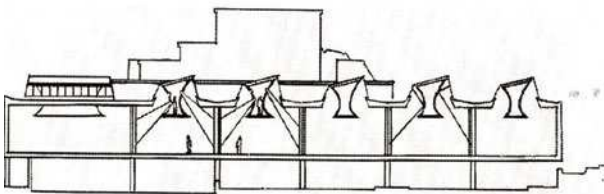


Fig. 10. Museum of Art in Alborg, Denmark (A. Aalto, 1958–1972). Transformation of direct sunlight into diffused light by means of lanterns of complex shape. Section and view of the day interior

view; radiation spectrum and lighting kinetics that affect the visitor’s emotions. General lighting – daylighting, artificial or mixed, completely “fill-



Fig. 9. National Gallery of Germany, Berlin (Mies van der Rohe, 1968). Exterior and interior of the daytime exhibition space with mixed lighting on the ground floor

ing” the interior with a certain intensity, focus from the top or top and side, and barely noticeable non-uniformity – is most universal and neutral in relation to the exhibited items, preferably flat or silhouette. In this case, the perception of the interior and the exhibited items largely depends on the finishing of the surfaces, especially the background walls (light or dark) and the ceiling, which determine the conditions of visual adaptation and contrast of exhibited item and background (Fig. 6–7).

These indicators are even more obvious with the local accent, usually artificial lighting: the dark environment enhances the luminance contrasts, which dramatizes the exhibition. Planar-exhibited items are less sensitive to accentuating light, the spot of which can cover them with a halo or, through modern optical devices, exactly coincide with their area. It is through this technique that the exhibited items are presented most effectively (Fig. 8).

In most of the exhibition rooms, the general (artificial and daylighting) plus accent (usually artificial) lighting, and at the same time, the ratio of general and local, reflected and direct, diffused and directional lighting with different scalar and vector values varies widely. In all cases, interior decoration, their colour scale is of importance (Fig. 8).

In the exhibition halls ensemble alternating according to a certain scenario of different lighting



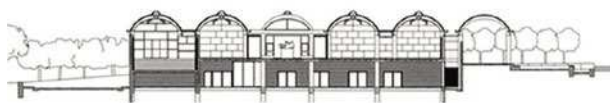


Fig. 11. Kimbell Museum in Fort Worth, Texas (L. Kahn, 1966–1972). Vaulted reflective roof and linear suspended light scattering device turn bright sunlight into a soft diffuse light in the exhibition halls. Section, day interior

techniques can in itself create a self-valuable lighting ensemble. This ability for daylighting is predicted by the architect in the project design, in accordance with his creative philosophy of attitude to light as a form-making factor, and the occasional “flaws” in lighting can be corrected by artificial light.

The trend of more respectful and attentive attitude to the exhibited item is demonstrated in the museums created by the leaders of the functionalism of the 20<sup>th</sup> century (Fig. 9–11), from which there was a style branch of minimalism in modern architecture, and the universals working in different styles (Fig. 12). Their architecture does not so much “hog the cover”, abandoning its own exclusivity and focusing the daylighting to the exhibition, thus

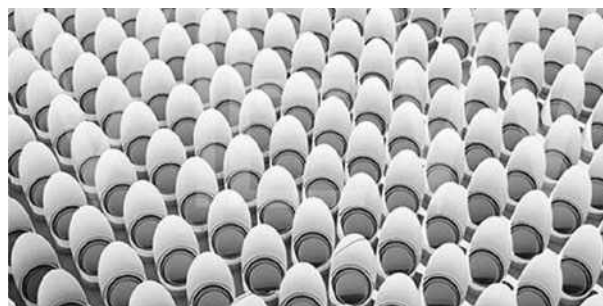


Fig. 12. Museum of Art in Atlanta. (R. Meier and R. Piano, 1980–1983). Section and view of the “carpeting” of the exhibition hall with clear-stories and day interior

creating optimal conditions for perception exhibited items. It, at the will of the author, as if sacrifices the own expressiveness, delegates part of the light expressive potential from architecture to exhibited items, builds the visitor’s attention in space, time, and hierarchical content of these items in the proper construction of the exhibition light composition.

The German National Gallery in West Berlin can be considered the flagship museum of this focus, with a powerful architectural image but extremely minimalist architecture in the interior, not distracting the visitor’s attention from the exhibited items, and a system of mixed (side daytime plus ceiling

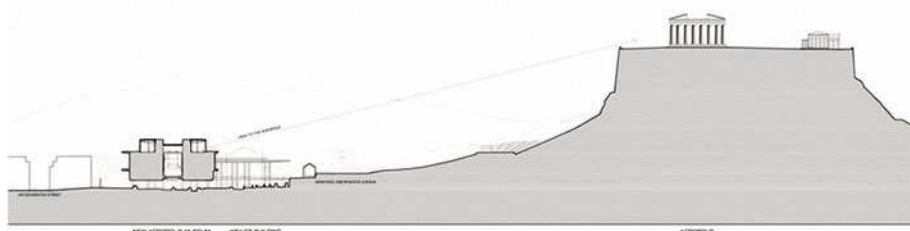


Fig. 13. Acropolis Museum in Athens. (B. Tschumi, 2009). Combined lighting of spacious exhibited items (natural side light and upper artificial light) with landscape and background views of the Acropolis and the Parthenon. Situation section and exhibition halls



Fig. 14. Holocaust Museum, Berlin (D. Libeskind, 1989–2001). General view and daylight interior lighting

artificial) lighting on the ground floor and artificial lighting in the underground floor (Fig. 9). L. Kahn, the adherer of sunlight, for the purposes of museum lighting created original vaulted reinforced concrete coverings with a clear-story in the vault crown, the direct light of which is transformed into a diffused, reflected by the vault and scattered by a linear sus-

pending light scattering device (Fig. 11). A. Aalto, a singer of soft northern light, invented quite complex volumetric plastic forms of covering halls to turn blindly rigid for museum premises sunlight into a safe dispersed one (Fig. 10). R. Meier and R. Piano “shattered” unsuitable for exhibition, bright sunlight in Atlanta with a complex and obviously expensive “carpet” system of numerous shaft clerestory above the exhibition hall. The parameters of clerestory with skewed lens shades were determined by the full-scale lighting modelling on the large layout of the hall in the conditions of real sunlight (Fig. 12). As a result, the exhibition hall in the daytime is abundantly filled with homogeneous, free, high-quality diffused light, available for any exhibited items at any point of the hall.

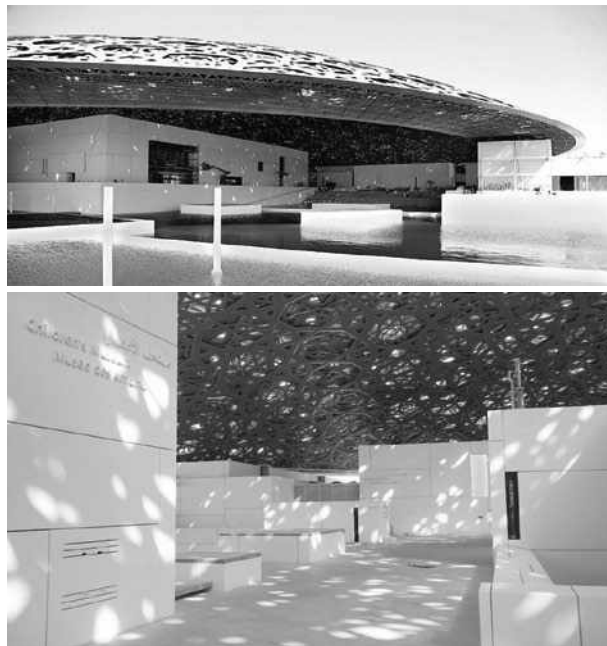


Fig. 15. Louvre Museum, Abu Dhabi (J. Nouvel, 2017). Multilayer mesh structure of dome roof in conditions of dominant sunlight provides infinitely diverse “Brownian” movement of numerous twinkles in different exhibition pavilions under it

The exhibited items often require a reasonable combination of daylighting with artificial light. In particular, these are the artefacts of archaeology and lost architecture, which were once perceived in the conditions of regional natural lighting. The number of such museums and the interest in them is growing all over the world. International contests for the project of the Acropolis Museum in Athens in 1976–1999 and a number of other architectural contests on similar topics offered a variety of approaches to the presentation of exhibited items: ground, semi- and underground. The realized Acropolis Museum demonstrates the exhibited items – preserved fragments of sculptures and architectural plastics on the facades and interiors of





Fig. 16. Modern Jewish Museum, San Francisco (D. Libeskind Studio, 1998–2008). Exterior evening appearance and daytime interior with continuous play of moving sunlight in space and bright spots on the sloping walls and floor



Fig. 17. Colourful artificial light in the installations of J. Turrell: Crater Roden Museum, Arizona

ancient pieces – in side daylighting through the facade stained glass windows and additional upper artificial lighting. At the same time, the contest program requirement and the obligatory element of this museum exhibition is the view of the Acropolis and the Parthenon from some exhibition halls (Fig. 13).

The most intriguing and unpredictable is the third area in the museum exhibitions: **the light as an exhibited item**. The light is always present in the process of presenting the exhibition and architecture to the audience. This is a fundamental, but rarely recorded by numerous analysts, a phenomenon that should be taken into account in any assessment, whether it be architecture or any other works of art, and in any lighting. In some museum interiors, this phenomenon consciously or intuitively becomes a reality, i.e. the exhibition subject (in all cases the light makes real the surrounding figural and spatial world).

The architectural and artistic role of daylighting in the internal space of buildings, including mu-

seums, is discussed in the rare in our science, successfully defended in 2018 thesis [2] with multiple fragmentary presentation and the author’s interpretation of the conceptual points of view of famous architects on this subject. It is clear that their opinions are purely individual and subjective, and there are few specific coincidences among different authors, except for the general obeisance to the role of light in creative philosophy and practice. These are not scientific theses, but rather, unsystematised professional reflections on always enough timeserving base of own, adapted to reality design methodology.

In the third type of museums, the central exhibited item is the light itself, its effects in the exhibition space in an explicit or veiled manner becomes the focus of the museum visitors. In some cases, a radical change in the structure of the light space due to the unusual focus and the “pulsating” amount of light from light openings irregular in the pattern and location in the rooms of different shapes and scales, alternating during the movement





Fig. 18. Colour as an exhibited item – the *Design Wing* Museum in Shanghai (2016) and the Museum of the 20<sup>th</sup> century in Florence (2014). Dominance of bright saturated colour over the material form of its “carrier”

of the viewer through the ensemble of museum interiors, depend on the emotional assessments of the viewer (Fig. 14). D. Libeskind said about his museum: “Light is something that penetrates through a sharp angle when you come to understand something about the past, which also speaks about the future. Suddenly you see the light in a completely different way and yourself too.” [3]

In other cases, a chaotic host of sunbeams and twinkles, slowly and fancily moving in space and sliding on complicated interior surfaces, is able to fascinate the viewer, provoke him to meditate if he is not in a hurry (Fig. 15–16). These effects can create an appropriate architecture in daylight, primarily sun light, especially if it uses special optical systems: coloured glass, which changes the spectral composition of daylight, glass prism decomposing the white light into a rainbow spectrum, hollow light guide translating “live” daylighting to the desired point of the interior, controlled mirrors, reflective screens and lenses, directing or focusing daylighting in the desired place, special masks creating a shadow pattern conceived and changing in sunlight, etc.

However, it should be recognized that the possibilities of global daylight managing in museums and elsewhere are not absolute, simple and require certain knowledge and talent. It is relatively easier to control man-made electric light. On its basis, new trends in architecture and art were born and gradually developed: light architecture, light design (*light art*), light shows, and light music. Cinema is a purely light art, and there are cinema museums. Implemented temporary and permanent lighting installations and performance, light shows and stage lighting, media and interactive lighting systems in interiors, city and plain air are also in some kind museumized. The artificial light as the central exhibited item in such cases is much more obvious than the daylight.

Although this article is mainly focused on daylighting in museums, I want to show the entirely expressive possibilities of light by the example of artificial lighting: already mentioned cinema in which only the light create a virtual visual world, which we believe as the present. J. Turrell, one of the most famous American lighting designers, creates by the colour illumination the three-dimensional installations stunning in the purity and beauty, temporary and permanent, as museum exhibited items. “In order to comprehend the splendour of “pure light”, he frees his works from the materiality of the subject world by emphasizing the materiality of light and giving it the form. Released from the burden of materiality, his works, based on projected light and fuzzy shadows of blurred images, are no more similar to painting or sculpture” [2]. In a number of installations, “closing the audience from the outside world, he leaves the only focus – a window into the sky, contemplating which they could “participate in divine events.” The endless movement of the ethereal colour sky from dawn to sunset, with its dramatic changes in saturation and shades from pale blue to cobalt, from dark ultramarine to deep purple and velvety black, encourages perception and allows to experience the feeling of being on the planet” [4] (Fig. 17).

Of course, in this case, when visiting such an exhibition, the visitor should have patience and time to feel, appreciate, or share these experiences.

Finally, the object of admiration can be the pure colour of items as a qualitative characteristic of any light from primary or secondary sources, when the shape of items, including coloured glass, is lapidary and in itself does not attract much atten-

tion (Fig. 18). This phenomenon of our visual perception (admiration of pure colour) is successfully used by textile production, architecture, and design (colour of environment elements), abstract painting.

## REFERENCES

1. Revyakin V.I. Muzei mira [World Museums] // Inform Express Publ., Moscow, 1993, 244 p.
2. Nasybullina R.A. Arhitekturno-hudozhestvennaia rol' estestvennogo sveta v formirovanii vnutrennego prostranstva zdaniy v sovremennoi' arhitekture [Architectural and artistic role of natural light in the formation of the internal space of buildings in modern architecture] // Thesis abstract of the Ph.D., Architecture, N. Novgorod, 2018.
3. Libeskind D//Newsweek, 2018 URL: (<http://enrope.newsweek.com/Daniel-libeskind-talks-about-his-childhood-bullies-nazi-germany-and-jewish-321345?rm=eu>. (reference date 25.05.2018)
4. Plummer H. The Architecture of Natural Light // London: Thames and Hudson Ltd., 2012, 256 p.



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