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Natural Light and Colour in Architecture: A Means of Space Composition in Art Buildings

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ABSTRACT

This paper highlights the importance of daylight and colours in art galleries and exhibition halls; how both can be fused to enhance the artwork on display with respect to the visual quality among the viewers. Lighting in art spaces if done correctly, makes colour and textures to come to life. Otherwise, it can undermine the impact of artworks on viewer's impressions. Apart from the quality, the relative position of the light source is also a crucial aspect for exhibiting art. Colour is an important part of art and life. It is a salient tool which can be utilized by artists to engage visitors/enthusiasts with the art. The approach of the interior designer empowers the art curator to tell stories, and to understand the key parameters of lighting art, the principles of daylight systems and colour mechanisms. While four different galleries were considered as case-studies, the galleries were analysed considering their lighting techniques, colours and materials adopted. Comparisons between the artificially and naturally lit areas were ascertained to get deeper understanding of the quality of light usage in art buildings. Findings from this study reveal that though light plays a crucial part in visual judgement by viewers, natural light appear to be more pleasurable than artificial light as it gives natural settings without ambiguity, which artificial light doesn't. Therefore, an interplay of both natural and artificial light usage in the interior spaces of art buildings remain optimal. The conclusions from this study aim to create a better understanding between art, daylighting and colour, and how it is important in this specific building type.

Keywords: daylight techniques, colour, user experience, interior architecture, artworks, art galleries

INTRODUCTION

The visual characteristics of a building that gives it a unique identity and differentiates it from others is the Architectural form. The Architectural form is the relationship between area and volume of the space and it plays a major role in the aesthetic pleasure of a building. This brings to bear the crux of the issue to be addressed in the topic light and colour in space compositions while addressing user aesthetic satisfaction; which is preliminarily judged by visual perceptions and varies according to subjective factors as existing in public buildings.

According to Jennath and Nidhish (2015), the following factors play a crucial role in an architectural form: building shape or form, texture and colour which are perceptible impressions and finishes linked to material usage, composition of architectural elements which may be regular or complex and light conditions in which the building is viewed. Ghavami (1997) opines that the role of light, which is the basis of creation and miracle of existence, is so significant. In the thoughts and minds of man, bright and sunny days are always accompanied with love and happiness and a kind of hopeful encouragement and excitement.

Light and Colour are fundamental to the quality of architecture, both have dramatic effects on the perception of the man-made architectural environment. So architecture must

consider the influence of light and colour from the very first phase of design (Zennaro, 2010). Heydari (2009) asserts that, light and lighting are the most important factors that cause people to have feelings of happiness by living in such spaces and places and taking the most pleasure from staying in such environment or, vice versa, they have gloomy, depressed and restless feelings by living in such spaces and places without adequate light. Madadpour (1998) claims that light affects the quality characteristics of elements, and their specifications depend on the quality of light. A space which is full of light and shade is rich with visual forces and is sensitive, physically and visually. Light affects the physical properties of space and also its body structure and creates the perception of space. The quality of light changes over time. In fact, the fourth dimension of light depends on the perception of space (Jolfayi, 2006).

As per Gestalt theory, human brain has a cognitive approach towards anything it sees. Considering, museums, colours, textures and light are important in making the interiors of a building interesting. All these key elements create amazing architecture and gives it the 'sense of place' (Joshi, 2014). Daylight characteristics cannot be substituted by artificial means, resulting from the human need for comfort (Boyce, 2003). The exhibition hall gathers quite a few purposes that may be enhanced by the use of daylighting. The right use of natural light in the spaces is a chief factor in terms of influencing the architectural space and visually elevating the displays, contributing to the interpretation of collections. It is also possible to create visual settings that are comfortable or calm, efficient and secure to the visitors, while simultaneously reducing – to a significant minimum, the light impairment of exhibits.

Most art buildings adopt and consume significant amounts of energy to maintain an internal environment to engage their visitors, protect and preserve their collections. Since the quality and content of these exhibition halls may be what controls visitors' behaviour, the previous experience(s) and interests, or even extensive social and environmental constraints that dictate the way visitors behave in a museum or gallery to well-defined and socially acceptable norms. The healthier the understanding of what controls these behaviours, the easier it will be to provide a pleasant experience for visitors in museums, and art buildings generally. Essentially, daylighting can be maximised and carefully used in exhibition halls to satisfy both intentions.

LITERATURE REVIEW

Perceptual Effects of Coloured Lighting on Space

Cao (2019) posits that colour has enormous emotive power in both architectural interiors and exteriors when designing with colour, it is important to give due considerations to lighting, materials and design as well. Odabaşioğlu (2009), postulates that people may have different impressions about the same space when they spend most of their lives in man-made environment and have an interaction with the spaces they live in. The two main factors that influence the perception of interior spaces are physical factors and psychological factors. The physical factors of an interior space that affects the perception of that space can be divided into two main part which are design and environment, the design part consists of form and composition, texture and material, size and proportion of the space. The environment part consists of heat, sound, colour and lighting in the space.

According to the Oxford English Dictionary (2002), composition is defined as the formation of a harmonious whole by combining various elements or parts. An additional factor that influences the perception of an interior space is the size and proportion of the elements of the space. The perception of height of a space can change according to the proportion of the wall and the windows in the space. Durak et al. (2007) stated that "in the design of an interior space many interrelated elements are considered such as form, structure, lighting, texture; colour and lighting should receive considerable attention among these elements". "Lighting,

can change the perception of a space in different ways. Colour properties of lamps, as a function of their spectral distribution, affect the perception of an interior space illuminated with that light (Fotios & Levermore, 1999). Colour used in a space can change the mood of its users. For example, a green room may be perceived to be open, tranquil and lacking cheerfulness whereas, a pink room may give a cheerful impression (Stahre, Harleman & Billger, 2004). A space can be perceived more or less appealing depending on the lighting conditions (Reisinger, Huedo & Vogels, 2008). It can be reinforced by non-uniform lighting and peripheral wall brightness (Kaufman, & Christensen, 1987). Veitch (2001) also states that a space appears fascinating or nice with nonuniform luminance distributions. The higher the luminance ratio at the eye height of a seated viewer, the more fascinating and nice the space appears. Additionally, Bornstein (1975) specified that pleasantness ratings vary with the wavelength of the light.

Additionally, Manav and Küçükdoğu (2006) state that according to the studies related to the illuminance level and space perception there is a significant difference between a 960 lux and 1500 lux in terms of the perception of the space. The illuminances over 1500 lux make the impression of a space unpleasant and cramped. However, Fleischer, Krueger and Schierz (2001) observed that higher illuminance levels make a room more pleasing. Light and colour in a space changes the aesthetic evaluation of a space. Veitch (2001) stated that aesthetic judgments are related to the interpretation and categorization of what people see, aesthetic judgments are also related to the appearance of space. Nakamura and Karasawa (1999) also stated that "there was the tendency that high illuminance was preferred in a space for public use and low illuminance was preferred in a space for private use. A calm and restful atmosphere was needed for privacy and a warm and intimate place could be obtained by using a lighting at low colour temperature and low illuminance". Lighting is one of the factors that are affecting the comfort in a space. Fleischer et al. (2001) state that according to the results of the study done with the workers of an office, warm light sources at low illuminance levels make people feel comfortable and when the illuminance level increases the pleasantness increases and the space is found comfortable. Among the scenarios created with 4000°K colour temperature, the scenario with 500 lux illuminance is preferred but the space can be uncomfortable (Manav & Küçükdoğu, 2006). A space was found to be more spacious under 5000°K colour temperature fluorescent lamps than it was under 2700°K colour temperature halogen lamps. This indicates that the change in colour temperature doesn't change the impression of a space. According to Callender (1983), in reference to the analysis of daylighting in religious spaces "It is necessary to have sufficient daylight on the altar and the choir for visual perception. The congregation in the nave need a special light effect for reading so that the angle of incidence should not disturb them."

Daylighting and Interiors of Spaces

Daylighting refers to the use of natural light either from direct sunlight or muted overcast light – which often makes colours more vivid and is more likely to reveal delicate details as well, muted light offers minimal contrast – to aid visual demand of space users. Natural light as primary source of illumination considers a space to be day lit in view of day lighting purists while others might consider simply a window with a view. Day lighting is said to have many aesthetic and health benefits. By researchers and designers reports, it is said to increase users' productivity and comfort also providing mental and visual stimulation which regulates the human circadian rhythms. However, Wymelenberg (2016), stated that daylight also can be too much of a good thing in that a building that has aggressive daylighting and poorly operated or used will cause more energy consumption and might put its occupants under excessive glare and thermal stress. On the other hand, Wymelenberg (2016) further stated that a few day light space users that consistently report, love working in the space and hope they never get a transfer elsewhere. Natural light being a dynamic and ephemeral tool for expressing the quality of space, no matter the use on a space, the intention of it architecturally should be directly found

in the evaluation of its quality. It is essential to understand how architecture is transformed by the dynamic and variable sources of light (Rockcastle, 2011).

Findings reveal that most people stay and spend more time indoors be it in the vehicle or buildings. Lack of exposure to natural lighting and fresh air results in a number of health issues. It has been discovered that the company of natural or daylight promotes health, wellbeing and productivity of human being. Natural light is an awesome, dynamic tool which transforms completely the effects on the perception (look and feel) of the building structure. A sensitive use of it creates a space or an environment that is warm and inviting otherwise it is a feeling of being blunt and cold. Other feelings are sense of intimacy, energizing and calming. Light generally defines the character of a space and individual perception. Different spaces demands different lighting solutions, the start point therefore is to begin with form and function, when and how the space is used followed by any other factor which includes but not limited to: space dimension, colour choices, furniture and materials, surface finishes and time of the day. All these influence or have effects on light reactions to spaces. Letting natural light in, energy expenses can be saved. Natural Light can be incorporated by the use of skylights, sun tunnels, clerestory window, glass door, and reducing bulky furniture and solid doors or openings with no door.

Light is a vital sign of life and wellness. Light rays passing through a hazy space arouse the divine feelings. Stained glass windows play an important role in reinforcing this ambiance. In mosques the dome resembles the Heavenly lighted sphere. After the Late Medieval Period the Gothic churches appeared and their interiors were quite dark. As a rule in Gothic cathedrals the maximum amount of light was where the maximum religious and intellectual content of the building was placed (Dora, 1985). This era is famous with the stained glass used in the windows of the churches. The colour used in the glass has contributed generating a stronger mystic ambiance with daylight. Renaissance architects, beginning with Brunelleschi, used light clearly to reveal their forms. The light source was never hidden. At St. Peter's, Michelangelo achieved lighting effects that were clearer and more direct. In the Baroque period, light was one of the elements of architecture that were manipulated for emotional effects (Dora, 1985).

Lighting in Art Spaces

When the lighting of an art space is done correctly, colours and textures come to life. Otherwise, this can damage art works. This happens by causing premature aging, and degradation of the artwork when light reacts with the pigmentation and material. Consequently, correct specification of light use can be very important. Light being electromagnetic radiation, also a form of energy, colours when combined in the colour spectrum, produces white light but outside this spectrum is ultraviolet and infrared radiation. Many light emit damaging wavelength, particularly the sun, hence the reason for choosing light correctly. Light guides and focuses attention; so lighting on artworks need to be brighter than the immediate surrounding area.

Art buildings have relatively low levels of illumination to limit the exposure of the artworks to light (lux-hours). Consequently, consideration should be given to lux-hours in art buildings. Lighting positioning is an important aspect for exhibiting art. Normally, in order to reduce glare, light source is kept at 30 degree angle from the piece of art.

RESEARCH METHODOLOGY

Design

The study employed case study approach to analyse the interiors of four art building facilities; these are: Nike Arts Gallery in Lekki, Lagos, Omenka Arts Gallery in Ikoyi, Lagos, Milwaukee Art Museum (MAM), Colorado and The Museum of Contemporary Art (MCA

Denver), Denver – which would serve as the basis or guide in terms of facilities to be made available in the course of the composition of art spaces via colour and light to be discussed.

In order to give the case studies a broader and richer perspective, eight professionals were interviewed on two broad areas of approaching light and colours in art buildings. Doing this extended the scope of the researcher, thereby setting the stage for a more robust analysis that covers the major aspects of the interaction of light and colours in art spaces. The four major professionals interviewed were Architects, interior designers, graphic designers and art curators. These four perspectives were classified further into two broad classes, which are:

The Structural/Functional Class: This includes the architect and the interior designer. This class basically views how the physical form of the spaces under consideration are affected by light and colours and how they affect practical functions and human behaviour within the space.

The Abstract/Transcendental class: This includes the graphic designer and art curator. These perspectives dwell mainly on light and colours as elements needed for visualizing and for art communication. These perspectives appeal to the emotional/psychological parts of our being as humans. They are primarily concerned with our mood, and are quite common in features such as poetry, religion, cultural entities and so on.

These professional paradigms shaped the way the interaction of light and colours were used in the case studies under consideration.

Case Studies

Case Study 1 – Museum of Contemporary Art (MCA), Denver

MCA Denver was founded in 1996 with the mission to celebrate the art of our time in the heart of Denver. The first exhibition for the newly formed museum took place at 1999 broad way. In October 2007, MCA Denver opened its new, 27,000-square foot, environmentally sustainable facility in downtown Denver designed by acclaimed architect Sir David Adjaye OBE of Adjaye Associates (UK). It was designed to minimize boundaries between the exterior spaces of the city and the interior galleries of the museum. The new museum space is housed within a translucent glass box, a design aesthetic that breathes a sense of openness into the space and provides the richness of soft natural light uncharacteristic of many museums. Perimeter circulation spaces lead to simple, elegantly proportioned areas for art display, and a powerful three-story atrium provides visual continuity and identity to the gallery volumes. The building houses five galleries, a space for lectures and presentations, a variety of support spaces, and a rooftop area for sculpture and events. The galleries provide space for multimedia art, works on paper, architecture and design, photography and new media. In addition, the new museum provides two educational spaces.

Case Study 2 – Milwaukee Art Museum (MAM), Colorado

In 2001, architect Santiago Calatrava designed the Quadracci Pavilion, which not only provided what was now the Milwaukee Art Museum with greater public gathering space, but also gave the city of Milwaukee a new, international icon. Milwaukee's first permanent art gallery was established in 1888. The project included a grand hall, new exhibition galleries, and an auditorium, as well as a store and a café, bringing the total size of the Museum to 341,000 square feet.

The museum's Quadracci Pavilion, its most dramatic feature is a set of "wings" – the Burke Brise Soleil (from the French for "sun breaker") – a moveable brise soleil, or sunscreen, with a 217-foot (66-metre) span that is raised and lowered throughout the day to provide shade to the interior of the museum and allows for daylighting, while creating a sort of kinetic urban sculpture. The brise soleil is made up of 72 steel fins, ranging in length from 26 to 105 feet, weighing 90 tons. It takes three and a half minutes for the wings to

open or close. The museum's holdings are displayed chronologically according to period: ancient, early European, 19th-century European, American to 1900, modern, and contemporary. The Milwaukee Art Museum, designed by Santiago Calatrava, is comprised of concrete, steel and glass evident in features like the steel of the movable sunscreen "wings" over a glass roof that soars 90 feet above a central hall.

Case Study 3 – Nike Arts Gallery, Lekki, Lagos

A five floor ultra-modern art gallery/centre, the centre was established in September 2009, solely by Chief (Mrs.) Oyenike Monica Okundaye aka "Nike", an artist. Also the Owner/Curator of the Nike Art Galleries at Osogbo, Ogidi-Ijumu and Abuja. The gallery is arguably the largest of its kind in West Africa. Accommodated in a five-storey tall building, it boasts of a collection of about 8,000 diverse artworks from various Nigerian artists. A magnificent five-storey building coated in spotless white, standing high and proud in its environs. Nike's Art Gallery tells its story from the outside of the building to its interior. The fence of the compound is adorned with rare marbles, while its walls are covered in different artistic inscriptions and drawings.

Case Study 4 – Omenka Arts Gallery, Ikoyi, Lagos

Omenka gallery is a Nigerian contemporary art gallery, which represents Nigerian and international artists at its exhibition space in Lagos. Omenka gallery was founded in Lagos in 2003 by Nigerian artist, curator and art administrator Oliver Enwonwu. Enwonwu's father, Ben Enwonwu (1917-1994). Since 2003, Omenka Gallery's programme of solo and group exhibitions has introduced new works by established and emerging Nigerian and international artists.

FINDINGS AND DISCUSSION

Findings

Light Composition

The first two buildings selected as case studies are the Museum of Contemporary Art, Denver (MCA) and the Milwaukee Art Museum (MAM).

Plate 1: The use of daylighting (skylight) in the interior of MAM, Colorado

Plate 2: The use of daylighting (Clerestory windows) in the interior of MCA, Denver

Their interior spaces were analysed for how they maximized the use of daylighting. This was done against the backdrop of artificial lighting, which had a varied effect on how these spaces and the artworks they contain were seen by patrons. What is quite striking in the case of natural lighting is how it gives a feel of seamless, flowing connection with the exterior. Within the spaces artworks were found more appealing, and the visual cues the lighting gave the artworks had an aura of originality. In addition to this, a better colour rendering with a fuller spectrum and an aesthetic blend with the exterior ('wild') environment gave the art pieces a very relatable ambience. The natural lighting, especially during 'high noon' also creates an atmosphere of elation and light-heartedness, which patrons in the gallery would find particularly pleasing. On a structural level, it is worthy of note that the backdrop/pre-eminence and interplay of natural or daylighting in these spaces was a major factor that would have determined the positioning and sizing of fenestrations relative to the interior spaces. However, it is with the insightful skills of an interior designer that the artworks (which are not to be under direct exposure to the rays of the sun) are arranged to maximize the incidence of ambient light without damage.

Moreover, significant amount of energy in the bid to maintain an internal environment to protect and preserve their collections, is consumed. This approach is not environmentally friendly, as it puts art galleries among buildings that do not qualify as energy efficient. Daylight being carbon free and cost free and can, if properly harnessed, play an important part in creating a low energy building, not to mention creating a situation where art is not viewed as a 'guilty pleasure' (in that it is viewed as a past time that is enjoyed in conflict with the global goals of conservation and energy savings). However, there are downsides to the uncontrolled use of daylight in museums and galleries. Sunlight has the potential to overheat a space or flood it with illumination that is too intense for the artworks. For this reason, creative daylighting strategies were employed in MCA and MAM to tackle the need for constant dependence on artificial lighting mechanisms as an augmentation for the deficit in the reach of daylight.

Albeit, an optimal compromise may be reached by the careful combination of both daylighting and artificial lighting on the artworks such that viewer experience is adequately catered for without an excessive and detrimental concentration on one approach at the expense of not leveraging on the other. This optimization in itself, the art (and science) of balancing natural and artificial light sources subject to cost and viewers' need(s) constraints is an area

that will require further research. However, given the scope of this study, these two – artificial and day lighting – can be combined (albeit in the right proportion) to achieve efficient lighting level in the spaces.

According to Alshaibani (2015), analysing factors such as; glare, space acclimation, reflection, solar rays must be handled effectively. The measure of sunlight reaching the ground fluctuates with the area, location, latitude, atmosphere, air quality and intensity of the sunlight. The sun's insolation measures up to 63MW with close to 134Kilolux; this is by the globally acceptable standard for the sun's luminous characteristics, typically called sunlight. Furthermore, we must also mention the atmospheric characteristics that affect the volume of illumination that reaches the earth's surface. Along this line, we refer to the International Commission on Illumination, which categorizes the sky (as affected by the atmosphere) into clear sky and overcast sky (Lim and Ahmad, 2013). As stated earlier, the amount of sunlight experienced in an area is dependent on its location which in turn affects the atmospheric characteristics and insolation intensity. It should be also stated that the time of the year, hence the season being experienced also plays a significant role in the availability of natural light. This fact is perhaps the greatest disadvantage to exclusively leveraging on natural light for the illumination of art spaces. With a constant stream of visitors, a non-constant source of illumination is not in any way desirable. This is however manageable when it comes to areas with a relatively even supply of sunlight such as tropical regions along the equator, and especially places with arid ecosystems. Temperate regions, given the right season can also have a generous supply of sunlight that will be quite useful for lighting purposes. Essentially, one may conclude that the adoption of natural light is time – and location – dependent.

Colour Composition

From the frames of the case studies adopted, one can see the use of colour in these art buildings were informed by the artwork type; whether painting, sculpture or metalwork as the case may be. Taking a closer look at MAM, it is seen in one of the exhibition rooms that different the colours were used on different walls (responsive or perception-enhancing wall pigmentation).

The colour blue was used on the wall, aided with the use of spotlight that concentrates on the metalworks, in order to highlight the metalworks on the wall which served as a canvas for it.

Plate 3: The use of varied colour in the exhibition interior of MAM, Colorado

The use of different colours in the spaces were purposely done to call viewers' attention to every piece of artwork in the space. Another technique adopted is seen in Nike Art Gallery, where the colour in the interior space is monochrome, white background through, but the

artwork by the reason of the cluster calls the attention of the viewer. This way, the visitors have a view of each and all artworks present on display.

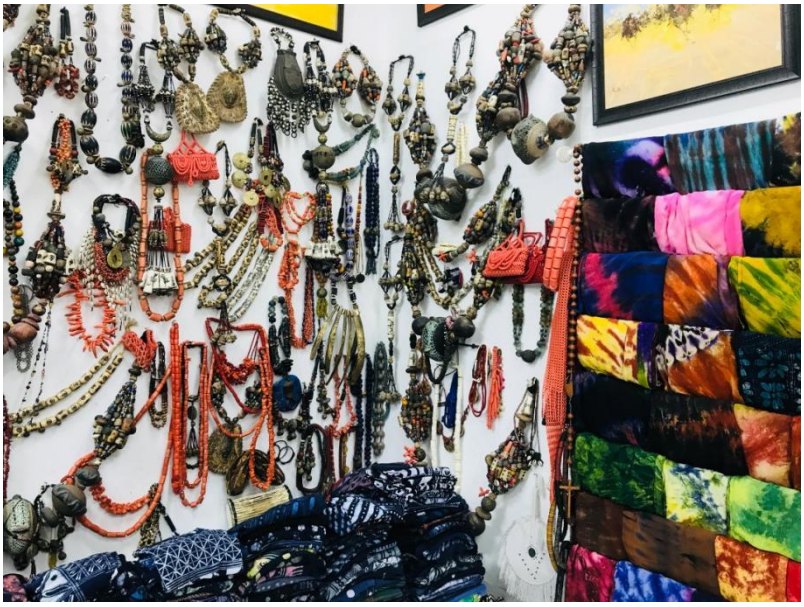

Plate 4: The cluster (collection) display of artworks in the exhibition interior in Nike Art Gallery, Lekki Lagos

Understanding the intention of the artist, what to be communicated and the kind of artwork will greatly inform the colour of such exhibition interior whether monochrome or polychrome. This way, interference between artworks and their canvases will be avoided.

Moreover, Omenka Art Gallery had a different approach. The composers applied both monochrome and polychrome in the interior without relying on the contrast afforded by a dark-themed interior. The use of white background and a colour which lies in between cream, beige and off white was adopted to vary the colour in different halls. This ranges from white and lemon-green in some halls to yellow, blue and lilac in others. The lighting type (spotlight) adopted complements the colour which still gives an appealing interior and minimal interference with the artworks.

Plate 5: The exhibition interior with the use of neutral colour in Omenka Art Gallery, Ikoyi Lagos

Plate 6: The exhibition interior with the use of white background in Omenka Art Gallery, Ikoyi Lagos

Plate 7: The exhibition interior with the use of two colour in Omenka Art Gallery, Ikoyi Lagos

Plate 8: The exhibition interior with the use of polychrome in Omenka Art Gallery, Ikoyi Lagos

Similarly, MCA incorporated the use of neutral colours and white in the interior, while the wall finish, with a fine-textured look makes the case for a smooth background for the artworks on display.

Plate 9: The exhibition interior with the use of neutral colour in MCA, Denver

Plate 10: The exhibition interior with the use of white background in MCA, Denver

Plate 11: The exhibition interior of MCA, Denver

The colour or finish used in these interiors were particularly significant in the outlook of the respective art spaces considered. This can be seen right from the ceiling, to the floor and the walls.

This created an overall effect of warmth and severity in dark-themed interiors, compared to the cheery, bright and light-heartedness of light-themed spaces. The case of MAM which has dark-themed interiors was achieved by the use of exotic material finish for both the floor

and the ceiling (vertical highlighting). This helped to create a distinct contrasting effect that highlights the sculptures and paintings against the whole dark interior.

Plate 12: The exhibition space with the use of white background and dark-themed interior in MAM, Denver

Plate 13: The exhibition space with the use of white background and dark-themed interior in MAM, Denver

Plate 14: The exhibition space with the use of white background and dark-themed interior in MAM, Denver

CONCLUSION

This study has shown that exhibitions that are associated with daylighting use and control techniques, as regards artworks and display, gives visual comfort without side-lining the economic and psychological benefits. Architecture is a form of art that communicates with people visually and emotionally, creating unique and inspiring environments. When it comes to art buildings, these designs should invite people to explore them. As described at the beginning, architecture becomes the container of art and daylight openings as the perforations of this container, which can create a dialogue between the interior and exterior contexts. Light being a distinctive feature in art buildings should be considered carefully for a better performing gallery. Art galleries and exhibition spaces are open when daylight is available, therefore, availability of daylight can result in to economic and psychological benefits.

Observations made from the case studies indicate that light plays an important part in the judgment that people make. The presence of daylight is needed to avoid the visual fatigue, which may result if illuminance is not fully satisfied. In addition to this, daylight does not only provide a better colour rendering, but also has better luminous quality that cannot be achieved by artificial light. Daylit areas of galleries, were found to be mostly crowded for most of the time, which shows an appreciation of natural light by the viewers as natural light is more pleasing and enjoyable.

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