VISUAL QUALITY ENHANCEMENT THROUGH LIGHTING IN THE DESIGN OF ART GALLERY IN LEKKI, LAGOS

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DECLARATION

I, SOLAJA ABIGAIL OLUWAKEMI, declare that this research project was carried out entirely by me under the supervision of DR. E.N. EKHAESE, of the Department of Architecture, Covenant University, Ota, Ogun State. This research project has not been presented, either wholly or partly, for any degree elsewhere before. All sources of scholarly information used in this research project were duly acknowledged.

Solaja, Abigail Oluwakemi .....

(14CA017516) Signature and Date

CERTIFICATION

We certify that this dissertation titled "**VISUAL QUALITY ENHANCEMENT THROUGH LIGHTING IN THE DESIGN OF ART GALLERY IN LEKKI, LAGOS**" is an original research work carried out by **SOLAJA ABIGAIL OLUWAKEMI (14CA017516)**, in the Department of Architecture, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Eghosa N. Ekhaese. We have examined and found this work acceptable as part of the requirements for the award of Master of Science in Architecture

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ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science (MSc) Degree in the Department of Architecture, College of Science and Technology, Covenant University.

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DEDICATION

This project is dedicated, first to God Almighty, for His grace, faithfulness and mercy. Secondly anyone who tackles the unknown and familiarizes it as I hope my thesis has done in its niche.

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ABSTRACT

The nature of art galleries is changing and evolving as time moves through and so does requirements and necessities on the lighting design and systems of the space which should respond to the new topologies of galleries. Lighting can no longer be seen simply as a tool for the illumination of art and making the gallery visible but it has become a vital part of the exhibition. The aim of this study was to assess lighting strategies used currently in art galleries (or related building types) as it pertains to art exhibition in Nigeria in order to identify areas for further improvement and implement the appropriate strategy in an art gallery design to be located in Lagos, Nigeria. The methodology employed in this research involves the positivist philosophy, with a mixed methods approach that involves the use of qualitative and quantitative data sources. From the surveys and case studies carried out, the study revealed no negative effects of employing daylighting in conjunction with artificial lighting in an exhibition space or other spaces within the art gallery, as long as the daylight was used in a controlled manner. The study discovered that, depending on the space within the Art gallery, both artificial and natural light can be employed, but the degree to which it is appreciated is determined on the space's function. Respondents favoured the use of daylight in general rooms; daylight was also viewed favorably in studio spaces; and in display spaces, despite a smaller percentage of affirmative replies, the architects and artists polled still favoured the use of daylight. The study identified some of the lighting techniques and strategies in use within the study area such as optimizing the internal reflective component of daylight, admitting diffuse white light and implemented the most appropriate as discovered in literature and during the course of study within the design of an art gallery in Lagos. The thesis will serve as a case study for integrating daylight and artificial light in a building typology and will contribute to the body of knowledge on lighting in this area.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Art galleries have been around for a long time, and they signify an institution or a place to showcase the ideas and inner thoughts of artists in any form and capacity through visual quality towards the art that is to be displayed (Wahab and Zuhardi, 2013). Another attempt to define it is to see it as an area or space where concepts are conveyed, objects are showcased, and the senses, most connected to visuals, are excited. (Rujibhong, 2012), stated that art exhibition centres are built to showcase art and artefacts to the general public. An Exhibition, as it relates to art galleries, is a collection of objects such as artworks to exhibit to the public (Steel, 2004). The exhibition of art is reliant on the nature of the artwork and the material and medium used. The overly inclusive layout of an exhibition is often regarded and to be viewed as a journey that shows the evolution of ideas and how they are portrayed. Exhibitions may also involve themes and display of the artwork in chronological order where the masterpiece can be viewed at the journey's completion.

Lighting is important for the gratification of art and spatial impression (Licht, Fördergemeinschaft Gutes, 2010). Lighting in art spaces originated in the 18th – 19th century. The Victoria and Albert Museum which was previously known as South Kensington Museum was the first ever to make use of artificial lighting system in an exhibition space (Andrikopoulos, 2016). Although the Sheepshanks Gallery which opened on the 22nd of June in 1857 and was designed by Captain Francis Fowke was the

first to appreciate and enjoy the benefits of artificial lighting as shown in figure 1. The lighting system was made up of 112 burners in the large exhibiting rooms and 84 burners in the smaller exhibiting rooms.

Figure 1.1: The Sheepshank Gallery
(Source: Google Images)

Captain Francis Fowke, the architect, gave specific attention and consideration to lighting. He adjusted and balanced the extents and sizes of the room so as to reduce the effects that daylight would have to create undesirable reflections, glare and utilized gas lamps mainly to let in daylight that is coming through the glazed rooftops and situating the gas pipe underneath the skylight so that the lighting effect is as like daylight as much as possible (Andrikopoulos, 2016). The Edinburgh Museum of Science and Art which was built in 1854 featured a gas lighting system in the exhibition space and so as the Oxford University Museum (1860), The Walker Art Gallery (1877), the Birmingham City Art

Gallery (1885) and the Grosvenor Gallery (1880) also because of the success of the utilization of gas lighting system in the South Kensington Museum in its exhibition spaces (Andrikopoulos, 2016). Short time after the success on the use of gas lighting system in exhibition spaces, electric lighting would be utilized for the lighting of galleries and museums. The South Kensington Museum was the first to install electric lamp in 1880, so did the Museum of Practical Geology (1881). The Ashmolean Museum introduced in 1895 electric lighting and the Leeds Art City Gallery which opened in 1888 was the first gallery to have been built with electric lighting specifically. By the 1900s, the start of the 18th century, Electricity had become the best method for illuminating interior spaces as it enhanced the integral aesthetic appeal of the exhibits on show even more than natural light according to a museum visitor at the time (Smith, 2013)

The origin of exhibition spaces in Nigeria was first developed as a museum to exhibit cultural art and resources (Oladumiye, Bolajoko, & Tolulope, Nigerian Museum and Art Preservation: A Repository of Cultural Heritage, 2016). Kenetth C. Murray, a British colonial art teacher established the first National Museum for conservation of Nigerian artifacts in Jos, 1943 which was followed in 1944 by the Esie Museum, and the Ife Museum in 1955 (Oladumiye, Bolajoko, & Tolulope, Nigerian Museum and Art Preservation: A Repository of Cultural Heritage, 2016). In 1957, the National Museum of Antiquities was established in Onikan, Lagos. These exhibition spaces in Nigeria were established in order to prevent the loss of the local artifacts which hold historical and archaeological value to foreigners (Ayansola, 2001). The importance and worth of art are respected, and encouraged in the developed world, where galleries, museums, theatres, and other art institutions, give loud testament to the need to improve and preserve the

legacy and culture of artistic future of the people (Oladumiye B. , 2003). Lighting systems have begun to evolve by including the users of exhibition spaces in art galleries, museums and visual art centers et cetera in recent years. Government policies are also emphasizing on the energy efficiency of lighting systems. There is a five-point scale indicator called the Ergonomic Lighting Indicator which can be used to assess the quality of light (Faranda, Guzzetti, & Leva, 2010). The indicator evaluates the quality of illumination based on brightness, appearance, comfort, originality and emotion.

1.2. STATEMENT OF THE PROBLEM

The display of art in galleries is in need of consideration of the human visual perception as opposed to the beauty and magnificence of the physical space. The unquestionable unease about the lighting system in art gallery exhibition spaces is not unfounded. So, I will highlight the different types of lighting design that are used in art exhibition spaces and implement the best into the final design.

The interaction between lighting and visual feeling significantly affects how humans perceive the world. Maintaining and sustaining visual quality in a space is important to helping perception. The maintenance of the visual quality in a space involves being aware and mindful of the type, colour and amount of light to be provided in a space (Lang, 2012). Lamentably, the quality of visual perception is often overlooked as against the overall aesthetics of the exhibition space.

This research aims to build a knowledge gap. There have been previous researches carried out on lighting systems and art galleries separately such as research work carried out by Edwin A. Umoh on Lighting systems and technologies in Nigeria, research work carried out by E. Bankole Oladumiye on Nigerian museum and Art preservation. This indicates

there is insufficient knowledge in both areas of art galleries and lighting in art galleries which is why this thesis is needed as it is intended to fill the knowledge gap.

1.3. RESEARCH QUESTIONS

As a result of the myriad of problem outline in the proposed study, there may be several questions raised in relations to the questions attempted to be answered by the researcher which include:

i. What are the socio-economic and demographic characteristics of users of the art gallery and exhibition centre in Lagos?
ii. What are the available lighting design and system application in art gallery and exhibition centre in Lagos?
iii. What are the visual quality characteristics in an art gallery and exhibition centre in Lagos?
iv. What are the factors required for enhancing human visual quality and visual comfort in an art gallery and exhibition centre in Lagos?
v. How can the final design be designed to focus on complying with efficient lighting systems and strategies?

1.4. AIM OF THE STUDY

The aim of this research is to develop a modern art gallery and exhibition center that incorporate an operational lighting design system to enhance the human visual quality.

1.5. OBJECTIVES OF THE STUDY

The objectives of the study include to:

i. Assess the socio-economic and demographic characteristics of users of the art gallery and exhibition center in Lagos.

ii. Identify the available lighting design system application in an art gallery and exhibition center in Lagos.

iii. Examine the human visual quality characteristics in an art gallery and exhibition centre in Lagos

iv. Analyze the factors for enhancing Human visual quality and visual comfort in an art gallery and exhibition center in Lagos.

v. Develop an art gallery and exhibition center be designed to focus on complying with efficient lighting systems and strategies.

1.6. JUSTIFICATION FOR THE STUDY

The display of artworks in art galleries and exhibition spaces needs to be addressed as there seems to be a lack of consideration of the viewer's visual perception as opposed to the aesthetics of the physical space. This research creates a point of exploration that should be used to learn about lighting design systems in art galleries and exhibition spaces. Identify the best to be used in order to effectively create a space for artists to exhibit their various artworks in whatever form and medium. There have been a handful of studies carried out on lighting design architecture in art spaces in Nigeria so this study will be an addition to the knowledge of the Nigerian Architecture. The existing gaps of literature on the achieving of visual quality in an art gallery and exhibition center will be attempted to be filled by this research.

In addition, this research allows policymakers and government officials to make appropriate recommendations for the use of standardized lighting systems and approaches in new and existing building developments in the quest for better art exhibitions across

the country. There will be identified gaps in the existing literature on the subject of lighting in art gallery design in Nigeria, and this research will attempt to fill those gaps.

1.7 SCOPE OF THE STUDY

The scope of the study is focused on exploring lighting designs in art gallery and exhibition centers in order to enhance visual quality of the users. In a bid to explore the existing lighting designs systems in an art gallery, case studies of multiple art centers, galleries and museums were carried out. On the conclusion of the various discoveries, a proposed art gallery and exhibition center is sited in Lagos. When researches on lighting systems are carried out, the researcher considers both the energy efficiency of the lighting system and its effectiveness. In this study, I will be mostly focused on implementing the best lighting design that can help improve the visual quality of the users using the factors analyzed for enhancing human visual quality and visual comfort.

1.8 LOCATION

Lagos is situated in the South West bank of Nigeria with a longitude and latitude of 6°35′N 3°45′E. Lagos has a tropical climate with a daily average high temperature of 27°C and an average annual rainfall of 1693 mm making it one of the coldest regions in Nigeria. High temperature and high humidity make the weather in Lagos pleasant most times but also partly humid and tropical hot. According to the last census conducted in Nigeria, the population in Lagos was estimated to be 140 million according to macrotrends.net. It is the largest urban area in the country with a legacy in culture and art. Lagos mirrors the elements of globalization and is rising in the ranks of the art society where is an ambitious, aspiring and growing group of artists and art collectors. There are art fairs, regular art auctions, international creativity festivals and celebrated culturally historic monuments. The location also presents with buildings that are used for art galleries and exhibition

spaces which makes this location an opportunity to situate an art gallery and exhibition center as Lagos is becoming a global art hub (Castellote & Okwuosa, 2020). The location was strategically chosen for this research and design purpose because of the socio-economic demographic of the people and the richness of culture and art in the space.

Map 1.1 Map of Nigeria in Lagos

Map 1.2 Map of Lagos

1.9. CLIENT/USERS

The client for this proposal is RADR Africa, a creative agency geared on promoting the arts and culture in Nigeria which was founded in 2016 by Ezinne Ogwumah. It's an art, culture and lifestyle company focused on curating and creating content around fashion, music, literary, photography, culture and lifestyles. RADR Africa believes in the expression of the beauty of arts and lifestyle.

CHAPTER TWO

LITERATURE REVIEW

2.0. OVERVIEW

This chapter aims to establish the study within the current fame of knowledge. In consonance with the laid-out objectives, it will introduce the different lighting designs in an art exhibition space as well as the main design requirements that must be attended to in the design on art galleries and exhibition centers. This chapter features a literature review on art galleries, visual quality factors of humans and the comparison of the different lighting design in an exhibition space.

2.1. INTRODUCTION

An art gallery is a space that is used for the presentation of art. It is a building or a hall or room that is used for the public exhibition of art. It is a private establishment which can be commercialized for the sales of artworks (Ansher, 2008) Light has been in existence from the beginning of time (Williams, 1999). It is something that everyone knows about and is familiar with. It originates from many sources, the main one being the sun which gives energy that is needed to sustain life. Before the 19th century, basically all light originated from a few types of luminous objects like the sun, stars and fire as they were the only objects that generated their own light. Throughout time we have learnt to harness and develop light and have discovered different ways to use it. Majority of the information we get from the environment is provided by our eyes as the eye is the most significant sense organ in the body of a human and without the existence of light it is impossible. Another definition according to Merriam-Webster is something that allows vision to be

possible. Light has consistently been considered as a physical factor and also a requirement to comfort in life of humans (Brandi, 2006).

2.2. HUMAN VISUAL QUALITY

The eyes and the brain work together to interpret and understand the visual environment (exhibition space) in the human visual system. By absorbing light, the optical components of the eye create an image of the environment on the retina. Light must pass through the eye without excessive absorption and dispersion in order to create an image of the target on the retina, and the image of the target must be focused on the retina (Rea, 2000). The human visual system can process information over a massive luminance but not at the same time. For the human visual system to deal with the large exposure of light from dark to light, it changes its sensitivity to light with a process called adaptation. If the human visual system can not completely adapt to the existing lighting in a space, its competences are limited (Cooper, 1995). Human visual quality can be reached through two conditions: Visual Performance and Visual Comfort.

Visual comfort is a subjective response to the quality and quantity of light in a space at any time. Visual comfort depends on human ability to control the levels of light around us. Both excessive or not enough light can cause visual discomfort. Changes in light levels can cause discomfort and fatigue as the human eye is constantly adapting to light levels depending on varying factors such as type of light, color, and age (Saint-Gobain, 2020). Visual comfort in an environment is influenced by the positioning of lighting fixtures, light distribution and the type of light reflective surface in the space. Visual comfort is improved and accomplished by providing the needed level of light that matches the task to be performed (Brien, 2016).

Visual performance depends mostly on the characteristic of lighting speed and precision and the visual system of the spectator (Sobhani & Far, 2018). There are concerns about the limits in visual performances and the visual systems capabilities and the quality of visual performance relies considerably on the characteristics of the lighting accuracy and speed and also the visual eye of the observer. According to the IESNA Lighting Handbook (2000), Visual performance are concerns with the limits and visible of the human eye's capabilities. Its performance is based majorly on the user's visual system – the eyes and the characteristic of the lighting accuracy and speed. There are variables for characters of visual performance. They include light distribution which is important on the effect of contrast, luminance and color contrast. The light distribution on and around a target can be measured and controlled by the characteristic of illuminance (i.e., the type of luminance casing), the light distribution techniques (such as direct light, indirect light and direct-indirect light), and light spectrum. Another variable is the Visual size and location of the target. For an object to the seen, it has to be larger than a minimum size. The applicable size of an object is an angular measure that hinge on the physical dimension of the exhibit itself, the distance from the spectator/visitor, the angle of inclination of the target from normal to the line of sight. The size is measured in the 2-dimension plane as a visual angle or as volume in 3-dimension plane as a solid, as shown below:

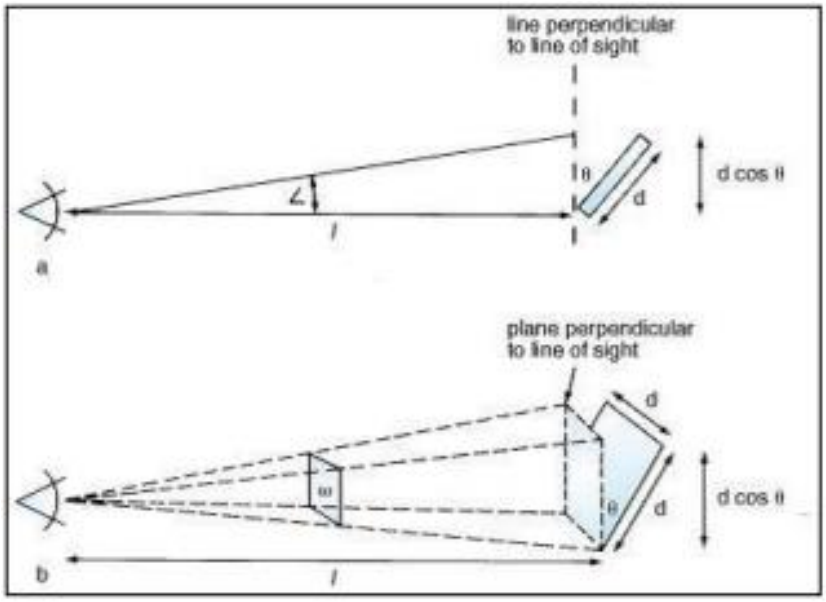


Figure 2.1 Distance and dimension of viewer determine the size of target
Source: The IESNA Lighting Handbook

Luminance and luminance contrast is also a variable for characters of visual performance. If there is a difference in the illuminance from the immediate background, the target will have a luminance contrast. The contrast in luminance may result to a target being darker than background or brighter than the target. When a background and its target are both diffuse reflectors like matte material, the luminance contrast is not affecting the change in illuminance, so the luminance contrast can be calculated from the reflectance. Color difference, being another variable can be found between the immediate background which is usually a wall or a partition and the colors of the object like the artwork. Cognitive factors such as perception and expectation influence and affect the measurement of detectability and ability to recognize the target. Visual comfort is important in visual quality as it can prevent symptoms and caused visual discomfort such as headaches; red, itchy, sore, watering eyes; and migraines. Not enough or insufficient light is one of the causes of discomfort which can cause problems such as – shadow, glare, veiling

reflections. The most commonly reported display problems are contrast and glare with the complaints coming from visitors from age 40 and above (Rutter, 1997).

In order to predict human visual quality based on lighting conditions, it is important to understand both the variables for optimum performances and the discomfort of the visual system of the observer. Visual discomfort can be caused by conditions that are not agreeable to the human eye. Conditions such as glare which is a discomfort that occurs in the presence of bright light created by direct or reflected light whether it is natural or artificial. It can cause difficulty in seeing. It can happen in two conditions: in the first situation, there is too much light and a large range of luminance in the environment. In the second situation, glare can occur on a reflective material and the angle of the light. Another condition is shadow, which occurs whenever light intercepts an opaque object. The impact and effect of the shadows can be overcome by either expanding the extent of inter-reflected light by utilizing high-reflectance surfaces or by providing local light in the shadowed area. If the exhibit is small in size and close to the area of interest, the shadow can be cast over an area considered meaningful which in that case can cause perpetual disarray and confusion especially if the shadow moves. Veiling Reflections**,** being another condition for discomfort is luminous reflections from semi-matte or specular surfaces that physically change the contrast of the visual task and thus changing the stimulus presented to the visual system. There are two factors that determine the nature and magnitude of the veiling reflection and they are the viewed speculative of the material and the shape and geometry between the target, the observer and any sources of high luminance.

2.3 ART GALLERY AND ART EXHIBITIONS

Art is a visual language with expressive and receptive segments in which thoughts and ideas are conveyed without making a speech. It is a form of language and a way of expression through which artists can become sensitive to their thoughts, ideas and feelings and communicate them to the public. (Silver, 2001). Art gallery is a place where the ideas and thoughts of artists are put on display for spectators. It is a place usually privately owned where art is displayed and its economical value of the art is appraised and put on sale (Moulin, 1997). Some art galleries are declared historical public institutions that are dedicated to exhibiting large collections. They may even function as institutions for preservation rather than for selling art (Debroux, 2017).

Art exhibitions have had a long, intricate history, developing and growing with the dynamical demands of the society and at the same time challenging those same demands. Art exhibitions are considered to be spark plug of art, craft and ideas to the general population as they signify a way of showing and appraising art that makes it significant, important and available to modern-day audiences. By nature, an art exhibition holds a mirror to society, therefore mirroring its interests and concerns while simultaneously testing and challenging its preconceptions and ideologies (Cline, 2012). The ultimate purpose of an exhibition is the communication of a message through the display of art in various forms in precise and clear visual language (Maina, 2015). Art exhibitions are deliberately and strategically locations at the nexus where different artists and their various forms of works and the public intersect (Marincola, 2006). There are different forms of art that can be exhibited in an art gallery: Photography, Digital Art, Sculpture, Drawings/Paintings, Video, AR/VR, Mixed Media, Graffiti, and Installation.

2.4. LIGHT, AND LIGHTING

Dating back to about 3000 centuries ago, man started to use fire as a source of light and warmth as the flames allow the people who live in caves habit there where sunlight do not enter. The brilliant carvings and drawings in Altamira cave going back tens of thousands of years could only have been done with artificial light. Light was not only used in indoor spaces. It was also used in the outdoors. About 260 B.C, the Pharos of Alexandria, a lighthouse was erected and proof suggests that in 378 A.D, there used light on the streets of the ancient city of Antioch. Functional and decorative light holders appear early in historical records but the liquid fueled lamps which was used for thousands of years experienced no significant development until the invention of the central burner by Aimee Argand in 1783. In that same year, Dutchman Jan Pieter Minckelaers developed a process that allowed for gas to be extracted from coal for the streetlamps. Just about immediately, experiments on developing electric arc lamps started which helped in the research of Werner Siemes as he succeeded in generating electricity in 1866. The real break in the use of electric light was in 1879 when Thomas Edison reinvented the incandescent lamp which was earlier invented by the German clock maker Johann Heinrich Goebel 25 years ago. In the recent decades, the development of lamps and luminaires has been especially dynamic as newer technologies, light and optical systems and materials are being developed (Hawary, 2011)

Lighting can be defined as the intentional utilization of light to attain applied, realistic and aesthetic effects in a space (Neddie, 2017). Light allows us to experience a space. With the use of light, it is possible to minimize or emphasize what spectators see (Lindh, 2012). As humans, we experience our surroundings and environment through our eyes as 80% of the sensory impressions we collect from our environment are visual. The eyes

would react most typically to the colors: red, blue and green. A color is perceived as bright when the hue, the light quality which is determined by its wavelength attracts attention by virtue of the brightness (Spacey, 2019). Warm colors such as red, yellow and orange are perceived as brighter colors and cooler colors such as blue on the other hand, are perceived as darker colors. Warm colors can be made darker by adding darker shades and tints and cooler colors can be made brighter by adding brighter tints (Rapid, 2017).

Throughout life, good lighting is a chief requirement for allowing us to clearly see and enjoy a sense of wellbeing and also work and decipher significant information and this can be achieved by good, professional lighting design. Hawary (2011) posit there are important key factors that have to be considered to achieve good lighting. They are illuminance, brightness distribution, glare, shadowing, light and color, direct and indirect light. Illuminance is known as a term that is used to describe the measurement of the amount of light that falls on and spreading over a surface. It correlates whit the way humans see or perceive the brightness of an object. The illuminance of a surface that is illuminated in the daylight is usually between 10000 lux and 100000 lux in an overcast sky and bright sunlight. For artificial lighting in an indoor space, 500-700 lux illuminance is considered to be enough. Brightness distribution describes the distribution of light around the room. In a room, the human eye constantly switches from near to far. When the difference between the brightness has been marked between the two zones, our eyes try to re-adapt to the surrounding, making the eyes get tired more quickly which diminishes the sense of wellbeing and visual performance. Glare is an upsetting side effects of lighting. Direct glare which is caused by a very clear contrast difference between very dark and very bright surfaces or due to bright lamps that are not shielded in

our line of vision which can put a strain on the human eyes and lead to tiredness and fatigue which leads to loss of concentration. Shadowing is a term that describes an object being enveloped in shadow or to cast a shadow over an object. A shadow is a dark area where an opaque object blocks the light from a light source. Shadow always exists where there is light and to guarantee that shadow does not obstruct our view, the light source should be placed in the right place. With light and color, the way color is perceived by the human eye under artificial light usually depends on the color rendering properties of the lamp from which the light is coming from. Lamps that have good color rendering properties produce and show natural colors while lamps that have poor rendering qualities lead to color distortion. Direct light is the type of light that comes from a light fixture that fall on a specific area or object. It is created from a light fixture that focuses the light in a certain angle. It makes a sharp contrast between light and shadow. A great example of direct light is downlights where the fixtures are turned downwards. Indirect light is used to illuminate a wider and extensive area. A source of light whose light illuminates different objects in a space with an even distribution of light is an indirect light source. It creates even harmonic light without the sharp contrast between light and shadow.

2.5. LIGHTING DESIGN CONSIDERATIONS

For effective lighting design, specific factors and considerations that affect purpose of lighting, the lighting in a space and objects in the space must be taken into consideration. Color temperature, color rendered, layered light, viewing angles, form and texture are all variables that factor into the effective lighting of the whole space. With an understanding and awareness of these factors, lighting elements can be combined with an architecturally designed space to create a functional and effective design for users to experience (Hunt, 2009). These factors include the Color Rendering Index (CRI). It describes the true hue

of light as it appears from a source. The CRI has been used to assess the impact of a light source on the color appearance of items for decades. Nickerson and Jerome first proposed the approach in 1965, but the Commission Internationale de l'Eclairage (CIE) standardized it in a technical paper in 1974. However, psychophysical tests have found that the CIE color rendering metric correlates poorly with the visual enjoyment of light from several so-called "white" Light-Emitting-Diodes in recent years (Smet, Ryckaert, Pointer, Deconinck, & Hanselaer, 2011). The scale of CRI ranges from 0 to 100 with natural light which has the best color rendering properties being 100. CRI is important depending on the purpose of the space. The human eye responds favorably to high CRI in retail, work places, museums and exhibition spaces which should have a CRI of 80-100. The displays and exhibits in inside museums and exhibition spaces should have a high CRI, whereas general lighting might have a lower CRI (Karlen & Benya, 2004). In the case that daylight is not accessible into the exhibition space, LED lighting is very close to replicating natural light as it mimics the properties of sunlight especially the light color temperature and color rendering index. Contrary to what is believed, Daylight is not yellow and with its color temperature ranging from 5200 – 6400 Kelvin, Sunlight is actually blue. Those values are the closest color temperature that artificial lighting comes to natural light and also the recommended color temperature range for lighting art. White light is measures to be at its purest at 6500 Kelvin. Many artists paint with light bulbs that are closer to 5000 Kelvin which is less cool or ‘blue’. The more color from a light source regardless of whether it is blueish or yellowish hue, the more the original colors of the art are distorted when it is being viewed. The aim of lighting an artwork is to get the light as close to pure white as possible.

Another component in lighting design is color temperature, which describes how light appears cool or warm. Warm light has a yellow to red color and has a temperature range of 2,500 to 3,500K. This color temperature is described as "warm and inviting." Warm color temperature lighting includes high-pressure sodium and incandescent lighting, as well as lighting that varies from 2,950 to 4,100K. Blue to white colors are seen in cool light. 3,600 to 8,000K is frequently associated with a chilly and sterile "feeling."

The form and texture of an object in a space is another component to consider in lighting design. Architects and interior designers develop structures and spaces that have a significant impact on the buildings as a whole that they design. The majority of users are affected by lighting either in a positive or negative way, but they are unable to articulate why they had a positive or negative experience. The correct angles of light must be used to highlight and emphasize architectural details in order to enhance the experience. floors, walls, ceilings and other features, in addition to materials and finishes, can become surprising elements for lighting in a space. When the lighting and architecture are incompatible, the viewer notices glare, the brightness or darkness of an exhibit, and how easy it is to see artifacts, which all contribute to a negative experience.

Lighting design achieves understanding of composition and visual aesthetics by layering light where each layer of light has a certain task and all the layers working together create a unified, interconnected design. Ambient, task, focal, and decorative lighting are all layers in exhibition lighting design that contribute to the overall aesthetic of a place. The overall lighting of a room is known as ambient layering. This form of lighting allows you to roam around in space and is significantly lower than the levels of task light. Task layer is the type of lighting that is used to perform tasks such as reading and writing. Pendants

and downlights are familiar forms of task lighting. The space feels more dramatic with a low ambient light level and a high task light level. High levels of ambient and task lighting encourage a more relaxed and pleasant mindset. Focal layers are typically used to draw attention to specific elements or displays. Focal lighting draws attention to an architecture feature, artworks, and objects. The goal of focal lighting is to focus attention on an object or feature rather than the light itself. A common sort of focal lighting is track lighting. Decorative layers serve as a decorative element in the area rather than a source of light. Decorative luminaires include chandeliers, sconces, lanterns, pendants, lamps, and surface lights. A full lighting system is created by combining layers with varied light intensities and to develop an effective lighting system in an exhibition space, all of these layers must be in place (Karlen & Benya, Lighting Design Basics, 2004). Lighting design can be complicated, but minimizing the number of different lamps and adopting multipurpose luminaries can help maintain an effective lighting design. Storage space and reordering costs must be considered while choosing luminaires. Also, the location of luminaires is vital for lamp replacement and re-aiming luminaires.

2.6 ART EXHIBITION

Exhibitions, according to (Wahab & Zuhardi, 2013), are collections of artifacts or artefacts, such as works of art, that are to be displayed to the public. Exhibitions can be intricate and extensive; they can showcase, and they can occasionally pique the interest of individuals who visit them. Museums, galleries, and visual art centers are common places to see or experience exhibitions. The primary purpose of art galleries is to display exhibits.

Exhibitions are how museums showcase their collections to a niche audience. The museum has a responsibility or involvement in molding the perception of the observer. Communication of meanings, as well as the display of permanent or temporary exhibitions, can be used to educate through art exhibitions. The purpose of art galleries is to communicate with the audience's sensibility (Agunbiade, 2018). For visitor apprehension, particularly at museums, four modes are described: contemplation, comprehension, discovery, and interaction. In contemplation, providing open-ended graphic remarks on the gallery walls to inspire thoughtful study and contemplation of works of art. In comprehension, it is aided by multi-layered graphics that combine words and images. Although the characteristics of each individual object or artwork may still require appreciation. The goal is for observer to uncover their significance by connecting one object to another, or by connecting each object to the larger theme or context. In discovery, the provision of full catalogue entries on the computer screen or laminated cards close to the hung artwork may aid in the discovery of the exhibit's meaning and in interaction, person-to-person interaction can be among the most effective experience that the museums can offer, especially if staff or volunteers are trained to elicit questions and involve visitors in their presentations (Ahmad, Abbas, Taib, and Masri, 2014).

According to Hooper-Greenhill (2013), color, graphics, pictures, catalogues, reference books, descriptive labels, and three-dimensional elements such as specimens, models, sculptures, busts, and other objects are among the elements used in art galleries for the public presentation of collections and artworks. Audio-visual tools are now included in contemporary settings to further enhance the exhibition's user experience. Cine films and movies, among other audio-visual techniques, are used.

2.7. LIGHTING IN AN ART EXHIBITION SPACE

The act of experiencing art is a complicated one. Engaging with art can entail a variety of processes, ranging from meaning-making to sentiments and assessments, personal associations, and body response, all of which can combine to create an aesthetic experience. Furthermore, new study has underlined the critical importance of context in influencing how people react to and perceive art. In any exhibition, lighting creates visual experiences (Pelowski, Graser, Specker, & Forster, 2019). Lighting affects the appearance of everything that can be seen, not just the things that can be seen. The quality of lighting is inextricably linked to the visual experience of art. Lighting for an exhibition show must strike a balance between the needs of the display and the preservation of the artwork and make the user's experience more enjoyable. Maintaining visual quality is critical for human perception, and lighting has a huge impact on how people perceive things. Maintaining visual quality entails paying attention to the type, color, and quantity of light available in a space or on an object. The three basic parameters of light, spectral power distribution (kind of light), associated color temperature (color of light), and illuminance (quantity of light), can be used to define these three factors (Bhattacharjee & Pal, 2018). Naturally, there are two types of light in an environment/surrounding – Natural (Daylighting) and Artificial. The role of light in an exhibition space is fundamental in playing the part of creating an atmosphere that is prime for spectating and viewing. There can be a difficulty in the balance of meeting the lighting needs of an artwork and creating interactive and intuitive experiences and encounters that accomplish the goal of an exhibition space which is a place to explore, inspire and discover. An experienced lighting designer is able to visualize how any lighting system would be perceived and how it would perform within a space and is also able to predict how a user will react to the lighting

system. This intuition is gained by years of experience and the understanding of the fundamental connection and relationship of light and space.

2.7.1 Daylighting

Daylighting is the controlled admission of direct sunlight or natural light into a building. By providing a direct link to the dynamic and constantly changing patterns of outdoor illumination, daylighting can assist in creating a visually stimulating and productive environment for users while maximizing visual comfort and lowering energy consumption (Aderonmu, Adesipo, Erebor, Adeniji, & Ediae, 2019). Daylight incorporation in an exhibition space creates a naturality because humans relate and identify with nature. Natural light can be utilized to create great, extraordinary effect to enliven and dramatize the design of any building/structure (De Chiara & Crosbie, 2007). The amount and levels of daylight available varies according to the time of day, weather, time of the year, pollution level and so on. Daylight in its maximum amount can be equated to 10,000-foot-long candles on a summer day that is sunny. However, on the basis on energy efficiency in buildings, only 5% of daylight should be allowed into a space. This is equated to 500-foot candles. More than 5% of daylight admittance into the building will generate too much heat for the comfort of the occupants. The amount of daylight that penetrates an exhibition hall must be given serious consideration, understanding how the use of natural light will impact the space. Therefore, the analyzation of these factors – reflection, glare, acclimation and delineation very closely. The proportion and scale of the space is an important factor to take in to consideration. The room depth and ceiling height directly connects to the measure and amount of daylight being absorbed and explore the reason for the light in a space (IESNA RP-30-96, 1996). Different room depths and heights can influence or affect the human perception of space. The measure of daylight

and the way the natural light is sifted into a space will create a few different, distinct effects in a space. For instance, in a room that is small, created with high ceilings and a punch of daylight, the room will be perceived or seen as being bigger than it is. In a room that is large, created with low ceilings and little amount of daylight in the space, the space will be perceived as smaller and can feel stale and confined. The amount of daylight and the placement of windows or glazing gives the design variety. The reflecting features and characteristics of the interior surfaces is another factor that should be taken into consideration according to IESNA standards. The materials to be used in the interior space should be selected to add to the overall aesthetics of the space. At the point when sunlight is allowed into a space, the finishes used in the interior of the space can create more surfaces that are reflective which can cause a negative effect. Finishes and materials that are too glossy or shiny or reflective create glare. The spectators or viewers may experience discomfort if there is too much reflective light or glare while they are interacting with the exhibition space which can greatly alter their experience.

Lighting design needs to envelop and encompass the elements and dynamics of daylight and utilize the light appropriately to help in creating a comfortable and interactive exhibition experience (Hunt, 2009). There are two types of daylight strategies which is lighting from side and lighting from the top. Lighting from the side and from the top are the main categories of the strategies. The system of day lighting will depend on the orientation and the layout and the building surroundings (Aminudin, 2015). Top lighting which is one of the common methods of introducing daylight into a space is through skylights and other means of top lighting. They behave the same way direct electric lighting does by radiating light downwards in to the space which is a principle commonly used for designing lighting

systems. Top lighting is unaffected relatively by the orientation of the site or building and the adjacent buildings. There are several standard prototypes for top lighting such as skylight; which is known as the horizontal glazing and permits the entrance of direct sky and solar radiation through a fenestrated opening or aperture. The Single Clerestory which produces direct and indirect lighting by the introduction of light through a vertical clerestory window. Some of the lighting coming through the vertical clerestory window may be reflected downwards from the ceiling into the space depending on the adjacent roof. Also, the site orientation or the orientation of the building of the site should be very well considered as a relative high percentage of direct light can cause glare and discomfort to the occupants of a space. The saw tooth single clerestory which produces direct and indirect light with a high percentage of the light bouncing off an adjacent slanted window in the space thereby increasing the amount of light coming downwards and minimize the amount of direct light entering the space and the Double Clerestory which is also known as the monitor. It permits the entrance of daylight in abundance into a space or building with proper choice of glazing especially in buildings where orientation or weather does not permit the saw tooth clerestory window or other unusual designs of apertures.

Another way of introducing daylight into a space is side lighting. Side Lighting makes use of vertical fenestration which are usually windows for the introduction of natural light into a space. Not like the top lighting, side lighting will in general introduce light that is excessively bright in relation to the room surfaces which sometimes causes glare. Be that as it may, the alluring view that the window provides makes glare a side effect that is acceptable. There are standard prototypes for side lighting such as overhanding soffits; which gives shading at a limited amount and are best used on the southern façade of a

building. Awnings and other types of extended shades give more protection. They are mostly used on the east and west sides of a building. Light shelves provide both indirect lighting and shading to a space. It increases the amount of depth of daylight penetration. It is best used on the south side of a building but can also be used on the east and west of the building.

The nature of art galleries and exhibition spaces are changing, evolving and advancing over time, so do the prerequisites and requirements needed for the lighting of these spaces. Unique architecture with shifting designs and sequences as well as the different types of exhibitions and curatorial ideas and concept make the lighting of the art galleries become an integral part that influences and impacts the overall experience of both the exhibition and the institution as there are various lighting approaches and techniques that reacts to the various requirements of exhibition shows and the design of the building.

The determination of the selection of the lighting typologies and sources to use have a strong solid correlation, in that the attributes and characteristics of the light sources that are utilized affects and influences the visual quality and the overall experience of the exhibition. The use of natural light in exhibition spaces has been the predominant light source until it has been barred and excluded from most of the show spaces due to the conservation prerequisites and requirements. As the way of life and culture is shifting towards having more accentuation and emphasis on the upmost ideal visual conditions for experiencing the art and the architectural setting of the spaces to support the satisfaction of the visitors, the use of daylighting in art galleries and exhibition spaces is reemerging the architecture, not just for the exhibits, but also to increase and expand the experience of the visitors. The introduction of daylighting in exhibition spaces can have various

purposes and serve various ambitions. Natural light can be used as the source of light i.e., the source of light where the exhibits/artworks are being displayed. The energetic properties of daylight are distinguishable and continually change the appearance and perception of both the displayed exhibit/artwork and the space. The experience of the exhibit is often uniquely different every time visiting an exhibition space under daylight. Daylight is often used as the source of light in sculpture galleries with less sensitive exhibits as evident in the Louisiana Museum of Modern art, Denmark or the Metropolitan Museum of Art, New York, USA. In spite of the fact that these spaces do not give consistent reliable or controlled qualities of lighting, the spatial quality and the experience of the visitors is one of a kind at every visit. The use of the connection with the outside world through the experience of daylight and a view to the outside world can increase the attention of the visitors, wellbeing and comfort in the space both physiologically and psychologically. Daylight has an exceptional color rendering quality. With the expectation of the naturalness of the appearance, the visual experience associated with daylight is often considered to be more comfortable and satisfactory than one under artificial light. Daylight makes the space and the exhibits appear the way they will appear in nature. Daylight can be used in anterooms, entry halls and spaces outside of the exhibition spaces to illuminate. The use of daylight into a space will certainly lead to a particular grade of light through the geometry of the room and it will also affect the appearance of the surfaces and materials in the building. The interior surfaces of a space and the objects within the space react to different colors of light and direction of light in the enhancing of architectural design and creating a space that is memorable. There is also the fact that the use of daylight is gaining importance in gallery architecture because of

the sustainability factor; the use of daylight can provide the opportunity to save energy as the use of electric lighting can possibly be reduced.

A challenge in the use of daylighting in art galleries and exhibition spaces is the management of the differing intensity if daylight as lighting conditions are affected by the geographical location of the building, the position of the sun and the cloud cover in the sky which shifts and varies throughout the time of day and year. Over the span of the day, daylight experiences spectral variations and moves from warm reddish light colors to blue tones. The other factors and variables that are to be taken into consideration are the orientation of the building, overshadowing through adjacent buildings and the impacts of reflective surfaces that can alter the lighting conditions inside of a space.

The strategy used in lighting control can be based on active or passive control principles. The goal of an active daylight control system is a steady, consistent narrow span of illuminance levels as performance target. So as to limit the vacillations and fluctuations in the intensity of daylight, the lighting levels need to be effectively modulated by means of automated blinds or louvres. These mechanisms are moderately intricate and complex systems that need to manage the scope of the angles of the sun and conditions of the sky conditions with higher control system management requirements and maintenance. There is a risk that could cause distraction and disturbance for the visitors which is the modulation in the lighting conditions in the space.

The passive daylight control system focuses and aims for the overall yearly exposure targets and takes into account reasonable variations in this range. As the system is static, it needs to provide the exclusion of daylight for all sky conditions and the transmission of diffused daylight and reflected sunlight only through fixed window/skylight design or

louvers. This system for most part has the advantage of reduced maintenance. Be that as it may, as a light level are increasingly variable within the limits set, the display of sensitive artwork with limited time of exposure should be painstakingly considered and the rotation and movement of artworks may be required.

The benefits of daylighting include sustainability, therapeutic aspects, reduced electrical loads and energy savings, lowered cooling loads in well-designed lighting systems, color benefits, and reduced stress and discomfort. Working with in daylight has been shown to lessen stress levels in a wide range of people (Ruck, 2000). Another advantage of lowering artificial lighting maintenance costs is the cost savings. The availability of daylight is a constant benefit, and it can be used to create energy via solar panels. However, Daylighting is not without several negatives, including glare from direct sunlight, as well as the possibility of heat buildup. Daylight, if properly handled, has the potential to raise energy expenses. The higher initial expenses of the more efficient designs may be dissuasive, and it was just discovered that daylight might have negative side effects like as skin cancer (Canada Academy, 2010). Due to the UV radiation that accompanies natural sunlight, artworks and literature might be exposed to damages. Perhaps the most significant disadvantage is that daylight does not exist indefinitely. At night, artificial lighting is required for illumination.

2.7.2 Artificial Lighting

There are several types of artificial lighting source that are used in interior spaces to provide light for seeing, adornment and accent. artificial lighting can be divided into thermal radiators such as the incandescent and halogen lamps, electrical/gas discharge lamps like the fluorescent, mercury discharge and metal halide lamps. The three primary

sources of artificial light can also be described to be incandescent, fluorescent and LED lights (Rajbahak, 2016). The interior artificial light that are typically used include LEDs, fibre optics, fluorescent, incandescent, HID and cold cathode. The use of artificial or electric lighting needs to be taken in to consideration in the integration into the daylighting system as the electric lighting system needs to be balanced and also blend in with the daylight in terms of or regarding light color, direction and intensity. Artificial lighting positions are related with the type of display. The display setting, amount of displays and the height of the ceiling. In normal practices, an art gallery exhibition installed with ceiling mounted light is either direct or indirect light. For exhibits with vertical display, the ceiling mounted light is installed at 30° angle with specific distance of the ceiling height- the human eye level + 577mm. This calculation creates for a minimum distant parameter for good visual experience of the viewer.

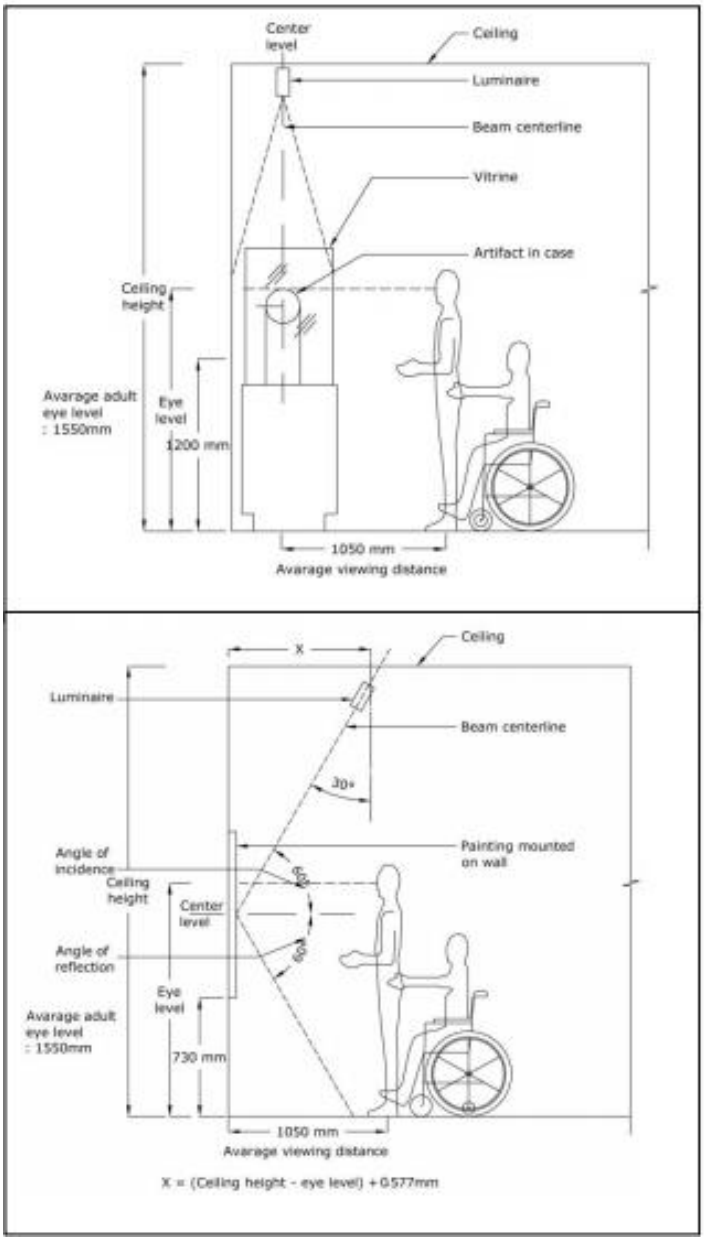


Diagram 2.1 Lighting guideline for vertical display; (b) Lighting guideline for freestanding display.
Source: The IESNA Lighting Handbook

There are various kinds of artificial light that can be used in the lighting design of an exhibition space. Ambient light is known as light that is as of now present in the environment before any extra light is added. It is also known as light that is equally

diffused through the environment. It can be generated by any light source. Ambient light is usually known as natural light either it is outdoors or indoors with light coming through the windows. It can also be considered to be the regular electric light that is found in a room. Arc light which can also be referred to as arc lamp is a lamp that can produce light by an electric arc. It is an exceedingly bright device in which the light is created by the electric arc that is between electrodes. The lights are somewhat blue in color when comparing it to the light of balanced daylight. Stray light in a lighting system, is light that was not planned or intended in the design. The light may originate from planned source but it falls away from an intended path of light. Floodlight is a wide beamed, high intensity artificial light which is regularly used to illuminate playing fields outdoor. It is a light fixture that is designed to use light to flood an area. Task Light is the type of lighting that is provided to increase light to better accomplish specific tasks or assignments in a room where there may be some existing ambient light already. Task lighting is particularly useful for seeing small objects or objects of lower contrast. Ultraviolet Light (UV Light) is a type of electromagnetic radiation that makes black light notice glow. Electromagnetic radiation originates from the sun and is transmitted in particles or waves at different frequencies and wavelength. Ultraviolet light falls in the scope on the electromagnetic spectrum between visible light and X-rays with frequencies of about 8 x 1014 to 3 x 1016 cycles/seconds or hertz (Hz), and wavelengths ranging from 380 nanometers to 10 nanometers.

Artificial light is contained within fixtures known as luminaries. Luminaires help diffuse light from a light source and preserve lights. Recessed cove, indirect pendant, direct and indirect pendants, recessed fluorescent, recessed can, wall wash, under cabinet lighting,

task light fixtures, and the wall scone are just a few of the several types of luminaires (Archtoolbox, 2021). In an art gallery, indirect pendant or wall wash fixtures are likely to be used substantially. The first serves to equally disperse a smoother, more balanced light throughout the room. Reflectors are used in wall wash fixtures to direct light to walls where art can be displayed.

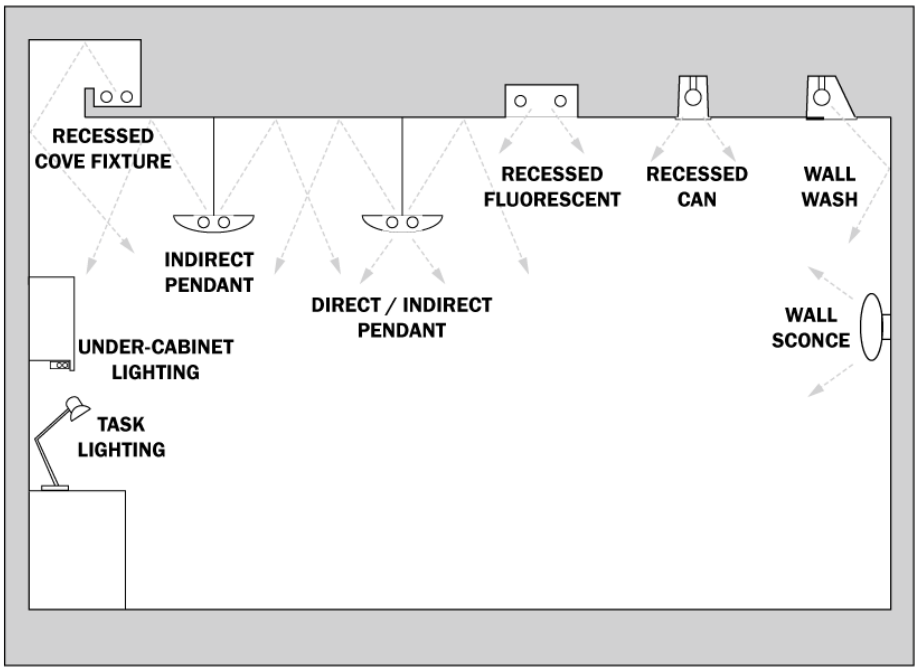


Figure 2.2: Showing types of luminaries
Source: Archtoolbox, 2021

An artificial light fixture consists of the bulbs that emit the light, luminaires and reflectors, as well as installation and maintenance methods. The circuitry and wiring (which includes ballasts) and emergency measures are the final components. Both artificial and natural illumination are affected by certain factors. The placement of lighting fixtures and fittings, the suitability of installation, lighting principles, and the knowledge that leads the execution of lighting are all factors to consider when it comes to artificial light. The

electrical make-up of the building, as well as the efficiency of the lighting material to be utilized, should be taken into account (Ropp, 2013).

Certain advantages can be predicted, according to Schenker (2019), when artificial light is implemented. Agriculture and safety are among the advantages. The first benefit is that artificial lighting extends working hours; it is always available during the day, and some artificial lights are even engineered to mimic daylight at night (Maintex International, 2018). Artificial light can be used to deliberately (and positively) change moods and emotions of users. The light can be adapted to meet a range of needs and occasions. Artificial lights with good standards transmit very little to no heat, while excessive daylight factors do, hence using artificial lights can help reduce cooling load in a building. Furthermore, artificial lighting can reduce glare, allow us more control over light color, and ultimately help target user satisfaction.

The downsides, on the other hand, are as follows: Ruck (2010) found a relationship between poor sleep habits, overall health problems, and artificial lighting. It can also be harmful to the environment due to the required energy consumption or the materials used to produce the fixtures. Even the most environmentally friendly systems can have substantial initial installation costs, and the requirement for highly experienced labor to install the fixtures adds to the electrical demand.

2.8 INNOVATIVE APPROACHES

2.8.1 Case Study: Turner Contemporary Art Gallery

Building Information: Turner Contemporary is an art gallery located in Margate, Kent, England that is envisioned as a contemporary art space and it is also known as a facilitator for the regeneration and renewal of the town. The building was

designed by David Chipperfield, who designed the building for 3 floors, making it 20 meters high. The gallery has been condemned for being "bleak, brutal and alien". Construction on the building started in 2008, and was completed April 2011, making it able to open that same month, costing 17.5 million Euros.

Location: Margate, Kent, England

Year of Construction: 2008 - 2011

Architect/Designer: David Chipperfield

Project Cost: 17.5 million Euros

Table 2.1 Turner Contemporary Art Gallery Observation

Major Facilities	In addition to the main exhibition spaces, the building comprises of Foyle rooms, Learning Studios, administration and a host of other facilities
Use of artificial light and/or daylight	The building design incorporates both artificial lighting fixtures (primarily LED strip and spotlights) as well as natural light filtered in through the side and top apertures
Lighting elements present	Primary use of curtain walls and use of tinted glass on apertures and openings being recessed within the walls. The design features multiple top lighting apertures of various sizes.
Light Apertures present (size, shape and location)	Rectangular side apertures in several placements as well as in strips. The skylights featured are of rectangular shapes using shading devices to control amount of light let in.

Architectural features and characteristics	The interior of the building features exposed concrete walls painted white, vinyl floor finish. The exterior facade features exposed concrete that embraces the surroundings and creates a public square complementing the urban area.

Spaces

a. **Foyle Rooms**: These are dedicated, flexible space that can be multi-purpose. It is located on the ground floor of the gallery with floor to ceiling windows that give remarkable view to the sea. The space is designed with white walls that creates elegance and inspiration.

   They can be used for business meetings, lunches, weddings or parties. It can be sub-divided into 3 separate, equally sized and soundproof rooms for smaller events or meetings. They also have windows that have electronically controlled shades and blinds.

Figure 2.3.1: Interior view of the Foyle Rooms

b. **Clore Learning Studio**: The studio is located on the first floor of the gallery. It is also adjacent to the main exhibition spaces. The studio is a bright, spacious room with tall windows that offers a remarkable view of the sea and across the Harbour

Arm. It is used for educational purposes and can be used for private and corporate events.

Figure 2.3.2: Interior View of Clore Learning Studio

c. **Sunley Gallery**: This gallery is a wide, stylish space that is located on the ground floor of the gallery which is adjacent to the main reception. It has tall windows that overlooks the sea. The space can also be used for different events outside of normal gallery hours.

Figure 2.3.4 Interior view of Sunley Gallery

In the Turner Contemporary Art Gallery, Arup provided the artificial light and electric lighting design for the Turner Contemporary Art Gallery, located on Margate's seafront. The light that gets into the galleries is free from direct sun, but differs significantly as there are changes in the maritime atmosphere. The influence of the artificial light modelling can be seen in the form, plan and overall arrangement of the gallery spaces, and careful arranging of skylights and windows allows the galleries to be lit with diffused sunlight and indirect artificial light without the need for intricate control systems.

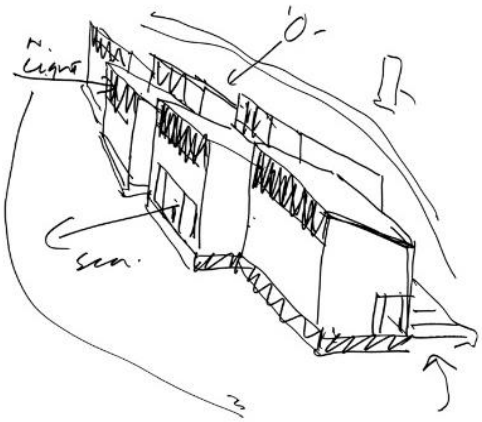


Figure 2.3.5 Concept Sketch Turner Contemporary Art Gallery

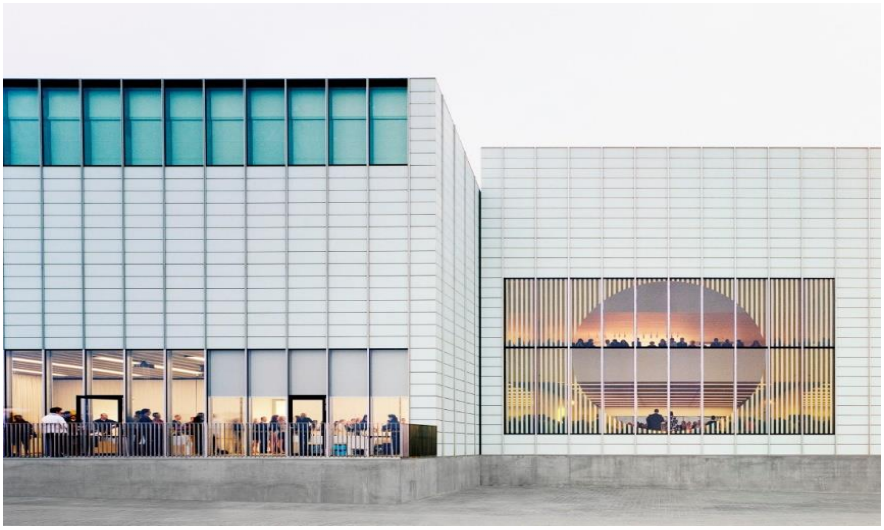


Figure 2.3.6 Exterior View Turner Contemporary Art Gallery

Figure 2.3.7 Interior View Turner Contemporary Art Gallery

Figure 2.3.8 Interior View Turner Contemporary Art Gallery

Figure 2.3.9 Interior view Turner Contemporary Art Gallery

Figure 2.3.10 Site Plan Turner Contemporary Art Gallery

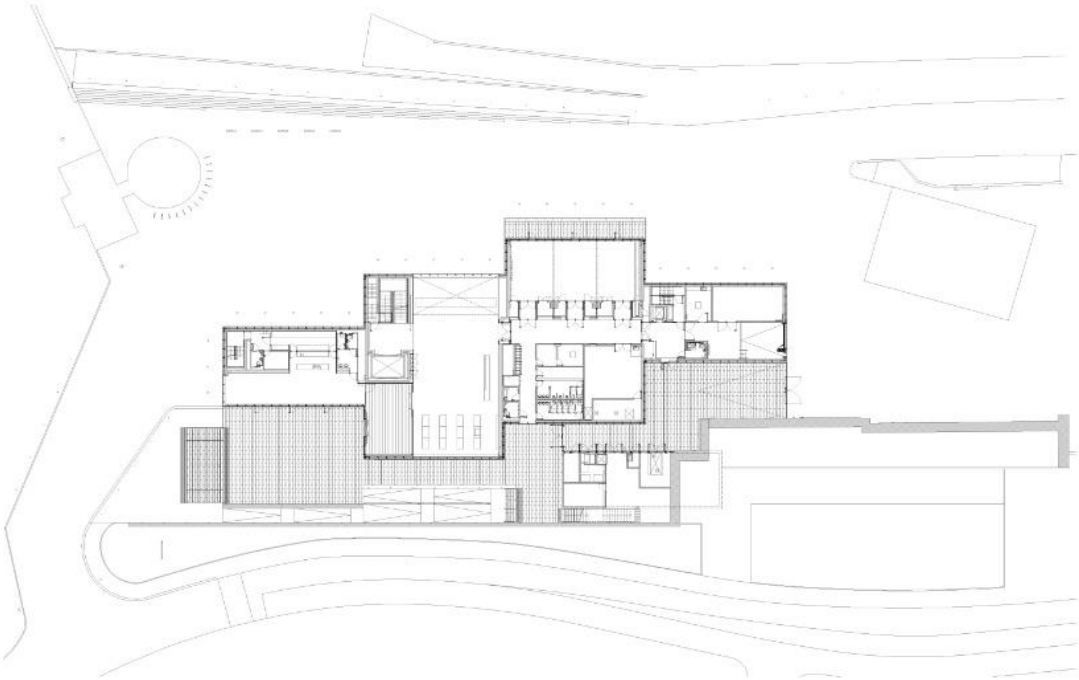


Figure 2.3.11 Ground Floor Plan Turner Contemporary Art Gallery

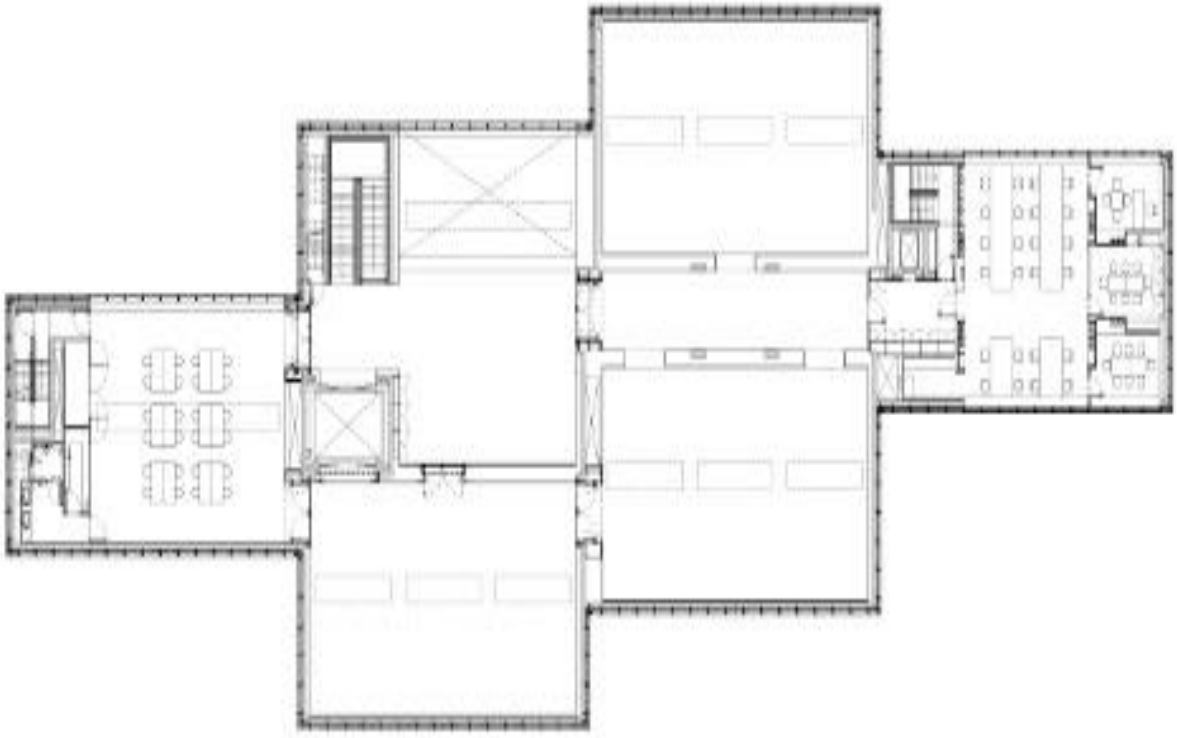


Figure 2.3.12 First Floor Plan Turner Contemporary Art Gallery

2.8.2 Case Study 5: The Hepworth Gallery, Wakefield, UK

Building Information: The Hepworth Gallery is located in Wakefield, West Yorkshire, England. The gallery is located on the south side of a water body named River Calder. It was named after an artist and a sculptor, Barbara Hepworth who is a native of the city and was also educated there. The building was designed by David Chipperfield, a British Architect and was built by Laing O'Rourke. The building costs 35 million euros.

Location: Wakefield, UK

Year of Construction: 2011

Architect/Designer: David Chipperfield

Project Cost: 35 million Euros

Table 2.2 The Hepworth Gallery Observation

Major Facilities	In addition to the main exhibition spaces, the building comprises of learning studios, an auditorium, an archive, and a café and shop and gardens
Use of artificial light and/or daylight	The building design incorporates both artificial lighting fixtures as well as natural light filtered in through the side and top apertures
Lighting elements present	Primary use of curtain walls and use of tinted glass on apertures and openings. The design features multiple top lighting apertures of various sizes mostly found on corridors and transition spaces
Light Apertures present (size, shape and location)	Rectangular side apertures in several placements as well as in strips. The skylights featured are of rectangular shapes using shading devices to control amount of light let in.

Architectural features and characteristics	The gallery is accessed via a new pedestrian bridge across the River Calder, next to which the building is situated. The interior of the building features concrete walls painted white, vinyl floor finish. The exterior facade features exposed concrete that embraces the surroundings and creates a public square complementing the urban area.

The gallery is a structure that is made up of 10 trapezoidal blocks. The galleries on the upper-level of the structure are lit with artificial light from the large windows in the pitched roofs. The windows have the views of the river, the skyline of the city and historic waterfront. The façade of the building is cladded with self-compacting pigmented concrete which was made on site, making it the first of its kind in the UK. The building includes spaces such as an auditorium, garden, learning studios, shop and café.

The building needs artificial light and artificial lighting system. The galleries in the building are day-lit, using combination of windows and skylights which are arranged in an asymmetrical way to create a gentle yet confident, definite variation of the levels of artificial light. This allows for variety of art that were created using different media to be displayed in a room.

Figure 2.4.1 Exterior view of The Hepworth Gallery

Figure 2.4.2 Exterior view of The Hepworth Gallery

Figure 2.4.3 Exterior view of The Hepworth Gallery

Figure 2.4.4 Exterior view of The Hepworth Gallery

Figure 2.4.5 Interior view of The Hepworth Gallery

Figure 2.4.6 Interior view of The Hepworth Gallery

Figure 2.4.7 Site Plan of the Hepworth Gallery

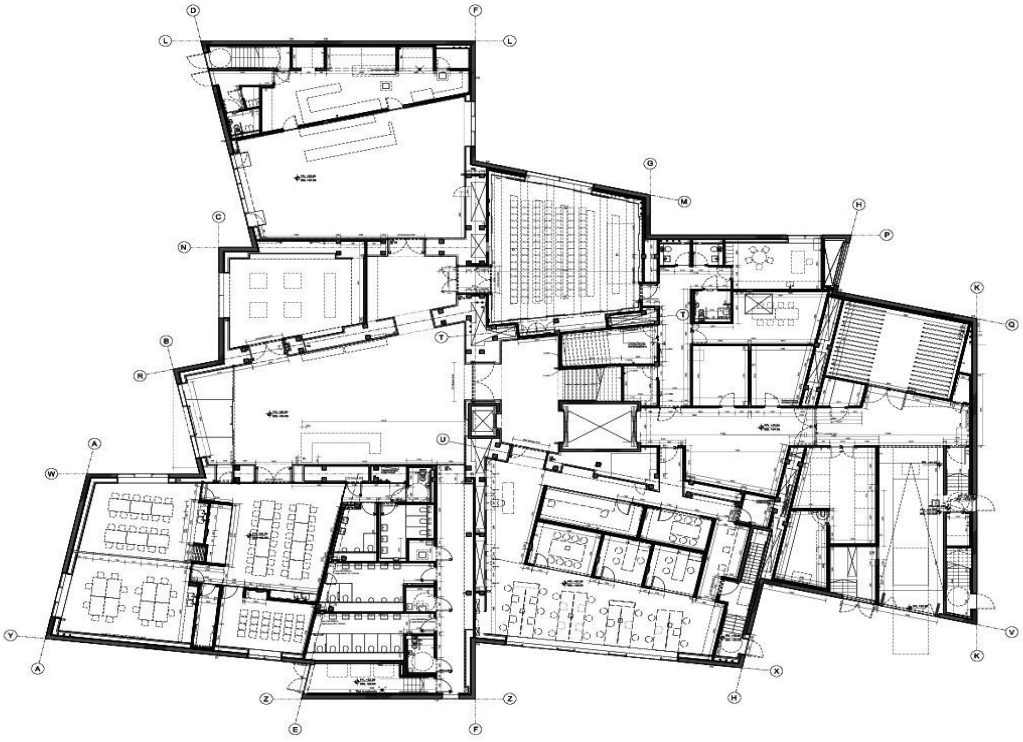


Figure 2.4.8 Ground Floor Plan of The Hepworth Gallery

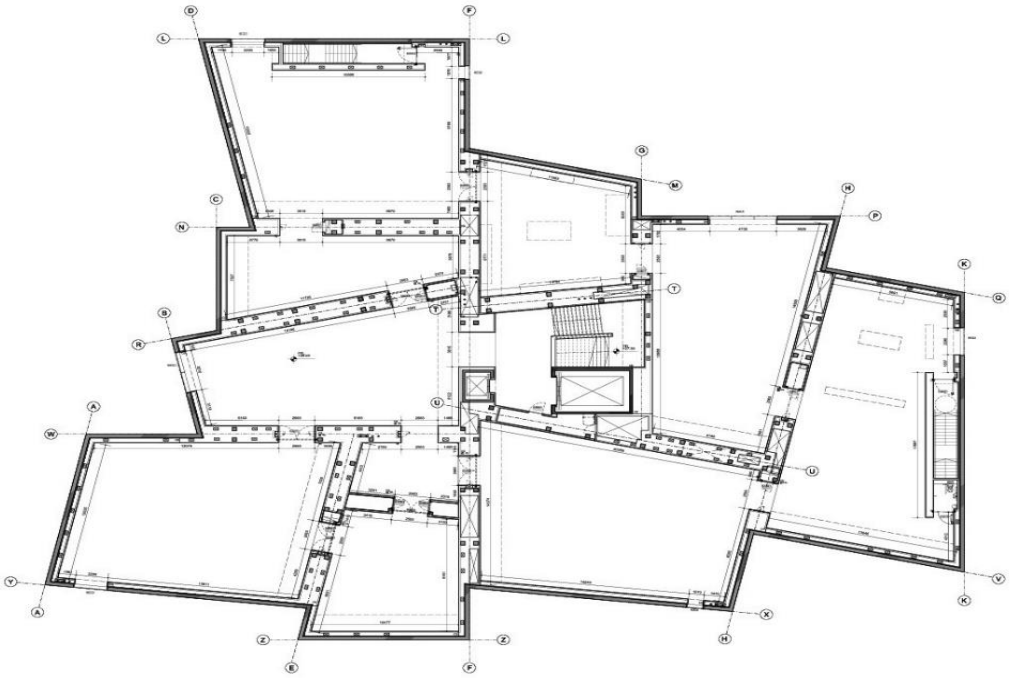


Figure 2.4.9 First Floor plan of The Hepworth Gallery

2.9 CONCLUSION

Light being distinctive feature in art galleries 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 economical and psychological benefits. Specialists working in art galleries currently argue that artificial lighting is preferable in practice. Two perspectives on the subject may be found in the literature: one arguing for the use of artificial lights exclusively, and the other pushing for a balance of artificial and natural illumination. Daylighting design is referred to as the considerations that affect daylight performance in buildings and environments. It includes factors such as orientation or arrangement, massing, aperture placements and sizes, glazing and shading systems, volume and geometry, and the reflectivity and character of interior surfaces (as well as exterior in some respects). According to Kahu (2012), The following

are fundamental criteria in the design of lighting for art galleries and exhibition spaces: Firstly, keep display or exhibition locations out of direct sunlight. Second, ultraviolet exposure should be limited by the use of UV filters. UV filters are either incorporated into the glazing or in specific instances. Finally, contemplate about how you can make the best use of the following components: sidelights, top lights, shading systems, and sensors.

Due to Nigeria's unpredictable power supply, daylighting was required at the proposed visual arts center in Jos. For some purposes, natural light is also preferable. Colors of artworks can be presented in white light during the day, which lessens the effects of color discrimination. Due to the more naturally dispersed nature of the light, daylight has been demonstrated to boost user productivity (a concept that goes hand in hand with enhancing good experiences). Daylight also provides relaxing situations. However, in exhibition rooms, daylight must be managed to prevent artworks from being damaged by Ultraviolet radiation. When it comes to the utilization of daylight, the following suggestions should be taken into consideration: the use of laminated glass in building apertures, light wells, clerestory windows/openings, reflective blinds, roof monitors, various angles of reflective surfaces (interior and exterior), light shelves, tubular skylights or light tubes for lighting exhibition spaces, especially transparent insulation, and also top lighting fixtures such as atriums and roof lights (Philips, 2004). After planning to maximize daylight, Karlen, Spangler, and Benya (2017) created and used artificial lights to ensure lighting beyond daylight hours and to give further effect in selected locations. It makes use of both mechanical and electrical ways to produce light. Artificial lighting in art galleries is often classified as task lighting, accent lighting, mood lighting, or modulated lighting. Task lighting is light that is used for primary vision in both general and specific settings. These

lights are utilized in studios and restaurants, among other places. Accent lights help to draw attention to a particular area and will be common in exhibition rooms. While mood lighting is used to generate distinct atmospheres, modulated lighting is used to define and express form, shape, and visual scale; it can also be found in exhibition spaces (Nikolic, 2017).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Chapter Overview

This chapter features and justifies the methods that are used in getting the data for research and achieving the objectives of the research. It addresses on the strategies that are adopted to give answers to the research questions drawn from the research problem. This chapter will also discuss the research philosophy adopted by the study, provides information on the research design being adopted, introduce the research instruments developed, and discusses the study population, sample size and sampling technique used in obtaining primary and secondary data and their method of analysis. The chapter will also outline the methods adopted for each objective of the study.

3.2. Research Philosophy

A research philosophy is a conviction around the way that the facts and information gathered in a research study should be analyzed and used. The research philosophy that is to be adopted for this research work would support the choices and decisions that are made as regards the methodological approach to research such as the research strategy to be adopted, data collection techniques to be used and the data analysis procedures. It enables the design of a clear and articulate research project. There are various types of research philosophies which are impacted by practical implications and reflect important assumptions that serve as a base for research strategy. They can be characterized into five which are; Positivism, Critical realism, Interpretivism, Postmodernism and Pragmatism. This research takes on the Positivism approach. It sticks to the view that through observation using the senses can factual knowledge be gained. Therefore, I am using

structured questionnaires to gather quantitative data due to the need to observe data from identified variables.

3.3. Research Approach

Research approach is the process or way that the research study is tackled. It is the ways or methods that the results for the research are gathered. The research approach that is utilized in this study is the mixed method approach, this will include quantitative research that will be carried out through instruments (survey) and qualitative research that will be carried out through observation (case studies) to assess various ways to enhance visual quality through lighting designs used in art galleries and exhibition.

3.4. Research Design And Strategy

The research design that is utilized in this research is a mixed design method that would be used for the collection of data for this research. The mixed design method is a mix of both quantitative and qualitative design methods, to couple the strength of the two methods and reduce their weaknesses. The quantitative data has numerical values associated with it that can or will be used for mathematical calculations and can be analyzed. This will be used to obtain data from users of art galleries and exhibition spaces using survey questionnaire. The qualitative data on the other hand is data that can be observed and recorded. It does not hinge on statistical analysis or summary but on the researcher's perception and observation. For this research, art galleries and exhibition spaces will be studied to obtain data. The research time is expected to be within a year with information acquired from primary source as well as secondary sources.

3.4.2. What am I Studying?

What I am studying is lighting in art galleries and exhibition centers. Particularly, the study will be centered around the specific lighting systems in place to ensure optimum visual quality for users – both artists and spectators.

3.4.3. What will I observe?

My observation will be centered around the systems in place for lighting and how it can further be improved upon to enhance visual quality.

3.4.4. When will I make my observation?

My observation will be made within a year.

3.4.5. How will I collect data?

Data gathered for the research is a mix of both desk and field research. Field research will be collected though observations of multiple case studies of art galleries and exhibition centres.

3.4.6. Why is the study critical?

This study will help define better lighting design systems in art galleries and exhibition centres. It will also help produce guidelines for improved lighting systems in art galleries and exhibition centres in Nigeria.

3.4.7. What is the sample population (n)?

There are twenty-one art galleries in Nigeria, a small population for formula sampling. As such using criteria from the research questions that specifies between 4-30 objects of inquiry; I have selected 3 of those galleries to serve as case studies.

3.4.8. What techniques will I adopt?

Using past studies surrounding lighting in art spaces, I made a checklist of measures that should be in place within the case studies and assess how the lighting systems can be improved upon.

3.4.9. Research strategy

The Positivist strategy is used for the research. A natural approach to observation is employed to study art galleries with the use of case studies. Case studies help in the documentation of observations by the researcher of singular establishments and helps the observer describe the already existing conditions. Case studies however are limited by the constraint of being a single establishment so there is need to look at an adequate sample population so that findings derived from the research can be more easily generalized. The case study research approach being adventurous in nature allows for the observation of the phenomena in its natural setting with the researcher asking the 'how' and 'why' in order to understand the nature and complexity of the occurring phenomena.

3.5 SOURCE OF DATA

3.5.1 Primary data

The primary data collection that was used for this research is, a combination of research tools– case studies and questionnaires.

3.5.1.1. Case studies

An in-depth research will be carried out on existing art galleries and exhibition center buildings to observe lighting designs adapted within the building. Art galleries and exhibition centers will be studied.

3.5.1.2. Questionnaires

Questionnaires were distributed to building users (audience, artists and workers) of art galleries and exhibition center buildings to know how and if the existing lighting design in the spaces enhances the visual quality of the users and what methods to improve or enhance it. Questionnaires is chosen for this research because they are a reliable and quick method to collect information from multiple respondents in an efficient and timely manner. A general disadvantage of the questionnaires however is their fixed and strict

format, which eliminates the possibility for more in-depth or abstract observation which is why interviews were also be carried out.

3.5.1.3. Scheduled Observation

Scheduled Observation will be carried out by the researcher with the visit to selected art galleries and exhibition centers for physical observation.

3.5.1.4. Interview

An interview comprises of a structured, semi-structured or unstructured dialogue between the researcher and participants for evaluation of the particular areas of research concern.

3.5.2 Secondary data

The secondary data collection carried out for this research was done to review existing literature that served as a basis for this research on things relevant to this research. This was drawn from books, journals, conference proceedings, seminar papers, magazines and internet sources that are properly verified and referenced accordingly.

3.6. OPERATIONALIZATION OF VARIABLES

Operationalization of variables can be defined as a process in which the variables that are to be used in a research or study are properly defined and clear so they can be articulated in quantitative and qualitative terms and the values can be analyzed statistically.

Table 3.1 Table showing Operationalization of Variables

No.	Variables	Measurement	Data Classification
A	**BIO-DATA OF RESPONDENTS**		
a.	Gender	Male or Female	Nominal
b.	Age	Below 20/ 21 -30 years/ 31 -40 years/ 41 – 50 years/ 51and above	Ordinal
c.	Highest Level of Education	Primary Education / Secondary Education / Tertiary Education / Postgraduate Education (Masters, Ph.D.)	Ordinal

d.	Category	Art Spectator/Artist/Curator/Gallery Worker/Art Student/Architecture student/ Art Enthusiast/ Others	Ordinal
e.	Employment Status	Student/Employed/Self-employed or Freelancer/Unemployed/Other	Ordinal
f.	Monthly Earning	Below ₦20,000/ ₦20,000 - ₦60,000/ ₦61,000 - ₦100,000 / ₦101,000 - ₦140,000/Above ₦150,000	Ordinal
g.	Place of Residence	Lagos (Mainland)/ Lagos (Island)/ Abuja/ Port Harcourt /Others	Ordinal
h.	Have you ever been to an art gallery	Yes/ No	Nominal
i.	Which of these art media are you familiar with in an art gallery	Photography/ Digital Art/ Sculpture /Drawings or Paintings /Video /AR or VR/ Mixed Media/ Others	
B	**LIGHTING DESIGN IN AN ART GALLERY AND EXHIBITION CENTRE**		
1.	Which of this color(s) is/are suitable for the walls of an art exhibition space?	White/ Blue/ Yellow/ Others	Ordinal
2.	Which of this color(s) is/are suitable for lighting an art exhibition space?	Natural Light/White/ Blue/ Yellow/ Others	Ordinal
3.	Which of these lighting approaches are you familiar with in an art gallery	Daylight/ Top Lighting / Side or Directional Lighting / Light Shelves/ Others	Ordinal
4.	The use of daylight in art galleries and exhibition centers	Absolutely inappropriate / Inappropriate/ Neutral / Appropriate/ Absolutely appropriate	Ordinal
5.	The use of artificial light in art galleries and exhibition centers	Ditto	Ordinal

6.	The use of both daylight and artificial light (more daylight, less artificial) in art galleries and exhibition center	Ditto	Ordinal
7	The use of both daylight and artificial light (less daylight, more artificial) in art galleries and exhibition center	Ditto	Ordinal
8	The adequacy of the amount/intensity of light available in the entire art exhibition space	Absolutely Inadequate / Inadequate / Neutral / Adequate /Absolutely Adequate	Ordinal
9	The adequacy of the amount/intensity of light available for an artwork	Ditto	Ordinal
10	The adequacy of the size of light available for an artwork	Ditto	Ordinal
C	**Measure of Visual Performance Characters in an Exhibition Space**		
11.	How much contrast do you experience when viewing an artwork in an exhibition room?	Very Little / Little /Not Sure /None / Much / Very Much	Ordinal
12.	Which one of these Light Distribution techniques are you familiar with for lighting an artwork	Direct Light / Indirect Light / Direct-Indirect Light /Others	Ordinal
13.	How close are you allowed to get to an artwork/exhibit?	Very Near / Near / Neither Near or Far / Far / Very Far	Ordinal
14.	Do you notice if the background on the wall is lighter or darker than the artwork?	Yes / No / Not Sure	Ordinal
15.	Have you ever experienced any of these discomforts due to the lighting of an artwork?	None / Headache/Migraine / Itchy/Watering eyes / Glare / Shadow /Others	Ordinal

16.	How often do you experience glare when looking at an artwork	Often / Rarely / Never	Ordinal
17.	How often do you see shadow when looking at an artwork	Often / Rarely / Never	Ordinal

3.7. TREATMENT BY OBJECTIVE

Objective 1: To assess the socio-economic and demographic characteristics of users of the art gallery and exhibition centre in the study area

i. Data requirement: This data is quantitative in nature.

ii. Data sources: the data to achieve this objective will be gotten from, the administration of survey questionnaire forms to users of art galleries and exhibition spaces.

iii. Data analysis and presentation: The data will be analyzed though content analysis and descriptive statistics and will be presented in a descriptive manner aided with the use of tables, figures, charts wherever necessary.

Objective 2: To identify the spatial requirements and use of spaces in an art gallery.

i. Data requirement: The data required is qualitative

ii. Data sources: the data to achieve this objective will be gotten from case studies carried out by the researcher on existing art galleries and exhibition centers. Data can also be gathered from relevant literature on art galleries.

iii. Data analysis and presentation: the data gotten will be presented in a narrative form with the aid of pictures and plates where necessary.

Objective 3: To identify the existing lighting design and the best lighting design system application in art spaces.

i. Data requirement: This data is quantitative in nature

ii. Data sources: The data will be gotten from a review of existing relevant literature on existing lighting designs in art spaces.

iii. Data analysis and presentation: The data will be presented in a descriptive manner aided with the use of tables, figures, pictures wherever necessary.

Objective 4: To identify the factors of achieving visual quality and visual performance characters in an exhibition space.

i. Data requirement: This data is quantitative in nature

ii. Data sources: The data will be gotten from a review of existing relevant literature.

iii. Data analysis and presentation: The data will be analyzed using the relative importance index. Data can be presented using tables.

Objective 5: To develop a modern art gallery and exhibition center be designed to focus on complying with efficient lighting systems and strategies

The aim of this objective is to bring together all forms of data, findings, observation, results and conclusion derived from this study, to guide in the design of an art gallery and exhibition center.

3.8 CASE STUDY SELECTION CRITERIA

The criteria for selecting the case studies were:

i. The presence of daylighting as well as artificial lighting architectural elements in the building.
ii. Scope of facilities provided;
iii. Architectural identity and a subjectively appealing design aesthetic.
iv. A display of various ranges of art

3.9 OBSERVATION GUIDE

Section A: Building Information

1. Name of Building:
2. Location:
3. Year of Construction:

Section B: Observations

1. Major Spaces and facilities
2. Interior Building materials
3. Lighting elements present
4. Use of Daylight and/artificial light within space
5. The positioning of artworks on display
6. Lighting elements present (Light shelves, reflective panels, shading devices etc.)
7. Nature of Light Apertures (Size, shape and location)
8. Building's Architectural features and characteristics

3.10 VALIDITY OF RESEARCH

Research can only be accurate if the research instruments employed are valid. To ensure the validity of this study, instruments of data collection will be employed to test the study population so as to remove researcher's bias.

3.11 ETHICAL CONSIDERATIONS

Ethical considerations manage and deals with the verification and authentication of the data collected so as to prevent fabrication and falsification of data, limit the margins of mistakes and advance knowledge and truth. This research would involve the interaction with humans so it is essential to build and establish trust with the willing participants of the study. In this way, the willing participants of the research would be required to give

full consent. To comply with the ethical considerations recognized by the school, this research will ensure the anonymity of respondents, while treating the information provided with absolute confidentiality used solely for the purpose of this research. The respondents will be made aware of the aims and objectives of this research, with the awareness of their rights to accept or decline questionnaires and interview questions and participated voluntarily.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSIONS

4.1 Overview

This chapter shows all of the results gotten from the various methods of data collection instrument. The results were analyzed alongside the objectives listed in the previous chapter. Each of the analyzed results draw inferences and conclusions that would inform the design of a modern art gallery and exhibition center.

4.2 Data Presentation and Discussions

4.2.1 Physical Characteristics of Art Galleries in the Study Area

There were case studies carried out by the researcher on two existing art galleries in Lagos, Nigeria and at the same time, three case studies outside the country on art galleries were also carried out, all while using an observation guide. The case studies allowed for the observation of physical characteristics of the art galleries, as well as the various lighting techniques in place, as well as the program of spaces and their functional relationships in design, as specified in the objectives. Following Objective 5, the case studies are presented with tables and illustrations. The typical physical qualities discovered in case studies were as follows: white painted walls in building designs with primarily exhibition rooms which are widespread. The galleries were multi-story buildings, and the exhibition areas accounted for 8/10 of the total space requirements. The rooms are predominantly lighted by artificial light, and the art shows and exhibitions are limited to the interior areas in all but one case study (the Nike art gallery). All of the apertures seen can be classified as side lighting, and the majority of them were concealed or augmented with shade mechanisms and devices. The floor layouts are kept open to

allow for flexibility and to maximize space, and the materials used for floor finish were typically brightly colored.

Table 4.1 Observation of Physical Characteristics of Case Studies

S/N	Gallery Observed	Location of apertures for admitting Light	Nature of shading device used	Geometry of the space	Headroom of the spaces	Materials used in the spaces
1	**Nike Art Gallery**	Rectangular openings were located on the sides of the building	The use of customized metal frames in form of motifs to filter light	The spaces are rectangular with wide expanses of wall spaces	The headroom of the spaces is averagely about 3.5m high	Ceilings are white painted screeded slabs; White ceramic tiles and White painted walls
2	**Hourglass Art Gallery**	One single rectangular window present on the ground floor	The single window has no shading device	The spaces are rectangular with wide expanses of wall spaces	The headroom of the spaces is averagely about 3.0m high	The ceilings were finished with white Plaster of Paris. The walls are painted in white on both the ground and first floor The floor on the ground floor was finished with brown colored vitrified tiles and wood textured vinyl tiles

3	**Nimbus Art Gallery**	Clearstory windows in exhibition spaces, rectangular opening		The spaces are rectangular with wide expanses of wall spaces	The headroom of the spaces is averagely about 3.6m high	The walls are masonry units, reinforced concrete columns, glass, stones, steel, bamboo and artistic wall. The floor is made up of glazed ceramic tiles on a concrete mix. The ceiling is finished with timber panels.

4.2.2 Lighting Strategies adopted in the Selected Art Galleries

Based on the case studies, both of the art galleries centers visited depended primarily on artificial lighting. Side apertures were used in stairwells and less-visited exhibition spaces to let natural light in Nike Art Gallery. In the Nike art gallery, all of these windows were embellished with shading devices using the shading device to either filter or exclude natural light from entering the exhibition spaces. The artificial lighting used at both Nike Art Gallery and Hour Glass Art Gallery were white. Aside from direct lighting sources, the lighting techniques observed included the use of mirrors as reflective panels in the Nike Art Gallery.

Table 4.2 Lighting Strategies in Case Studies Visited

S/N	Gallery Observed	Treatment of Natural Light	Location of Apertures	Position of Light Fixtures	Color of Artificial Light	Nature of Artificial Light (Direct/Indirect)	Lighting Strategies identified
1	**Nike Art Gallery**	Daylight is filtered through custom metalwork	Apertures are located on the sides of the building envelope	Artificial lights are placed on the ceilings	White	Light is indirect and diffused	White walls, Bright coloured finishes, shading devices and reflective mirror panels diffuse the lights
2	**Hourglass Art Gallery**	Apart from the one window on the ground floor, no daylight is allowed into the gallery	The aperture is located on the side of the building	Artificial lights are placed on the ceilings	Warm, White Lights	Some of the light presents are set directly on the artworks and others are indirect and diffuse around the exhibition space	White walls, Bright colored finishes
3	**Nimbus Art Gallery**	Daylight is filtered through rectangular openings and clerestory windows.	Apertures are located on the sides of the building envelope	Artificial lights are placed on the ceilings	White	The light is indirect and diffused; while some of the light presents are set directly on the artworks	White walls, Diffusion of lights

4.2.3 Spatial Requirements and their functions in an Art Gallery

The information needed to achieve this objective was gathered through the literature review, case studies, and interviews with people who were well-versed in the subject matter. The most common response from interviews (mostly from individuals who considered themselves unqualified to address questions about design) was that the availability of exhibition halls was critical. The main entry lobbies, performance rooms, arts and crafts display areas, as well as studio or creative spaces; and omitting the designer's additions, workshops and learning spaces; are the common places one can anticipate to find in art galleries, as established in chapter two.

Following the transcription of two interviews with two artists with architectural backgrounds, the following spaces were identified as being essential to the design:

i. Public exhibition spaces
ii. Exclusive exhibition room
iii. Transition spaces (to be used in cases of the non-typical exhibition)
iv. Storage space
v. Workshop, open to the public
vi. Meeting rooms
vii. Learning spaces as well as those designated for interaction
viii. Lobby spaces that allow for large numbers of people

The spaces listed above are necessary. Any further spatial definition is as advised by the architect, designated designer, or the request of the client. The specific descriptions of these spaces are provided in chapter five.

4.3 Survey Analysis

To satisfy this objective, the data was retrieved from 105 questionnaires that were distributed to Architects, Artists, artists and art students as well as other general users of art galleries in Lagos, state Nigeria using purposive sampling. The survey carried out was done to measure the methods and ways to enhance the visual comfort and visual quality of the visitors using an ideal lighting design system in the design of the art gallery and exhibition center. The information to be retrieved included the forms of art to be displayed within the art galleries; the opinions of the informed and uninformed (as it regards lighting in art galleries) on the appropriateness and importance of different lighting systems and strategies. The questionnaires were administered using Google forms, online surveys and were then analysed in IBM SPSS statistics software. The information acquired is presented in pie charts, tables, line charts as well as bar charts.

Objective 1: Assessment of the socio-economical and demographic characteristics of the users of the art gallery

This objective is to create a profile of respondents according to their socio-economic status and the demographics. The table below shows the socio-economic and demographic profile of all the respondents which will aid in the understanding of the relationship of the respondents with art galleries.

Table 4.3: Table showing overall demographic and socio-economic charachteristics of respondents

S/N	Socio-Economical Background		Frequency	Percent
1	Gender	Male	63	58.3%
		Female	42	41.7%
2	Age	Below 20	2	3.7%
		21-30	91	84.3%
		31-40	12	13%
		41-50	-	-
		51 and above	-	-
3	Highest Level of Education	Primary Education	1	0.9%
		Secondary Education	3	2.8%
		Tertiary Education	65	62%
		Postgraduate Education	36	34.3%
4	Category	Art Spectator	13	12%
		Artist	13	12%
		Curator	2	1.8%
		Gallery Worker	1	0.9%
		Art Student	4	3.7%
		Architecture Student	47	43.5%
		Art Enthusiast	17	15.7%
		Others	8	10.4%
5	Employment Status	Student	39	36.1%
		Employed	41	38%
		Self Employed/Freelancer	24	22.2%
		Unemployed	4	3.7%
		Others	-	-
6.	Monthly Earnings	Below N20,000	12	11.1%
		N20,000 – N60,000	48	44.4%
		N61,000 – N100,000	12	13.9%
		N101,000 – 149,000	13	13%
		Above N150,000	19	17.6%
7	Residency	Lagos (Mainland)	60	55.6%
		Lagos (Island)	16	14.8%
		Abuja	13	12%
		Port Harcourt	5	4.6%
		Others	11	10.4%
8	Ever been to an art exhibition	Yes	90	85.7%
		No	15	14.3%
9	Familiar art media in galleries visited	Photography	92	85.2%
		Digital Art	59	54.6%
		Sculpture	62	57.4%
		Drawings/Paintings	87	80.6%
		Video	28	25.9%
		AR/VR	19	17.6%
		Mixed Media	20	18.5%
		Others	-	-

Source: Author's Fieldwork (2021)

a. **Respondents Profile**: The profile of respondents describes their genders and age, their level of education, their careers as well as the level of information on matters about lighting in art galleries. It also highlights the earnings and residency of the respondents.

i. **Gender of respondents**

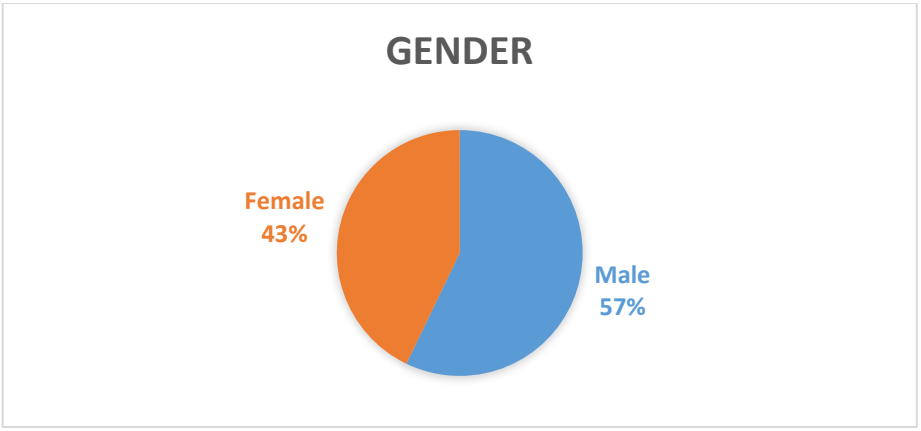


Chart 4.1: Chart showing gender of respondents
Source: Author's Fieldwork

As indicated in chart 4.1. above, 57% of the respondents were male, and the other 43%, female

Age of respondents

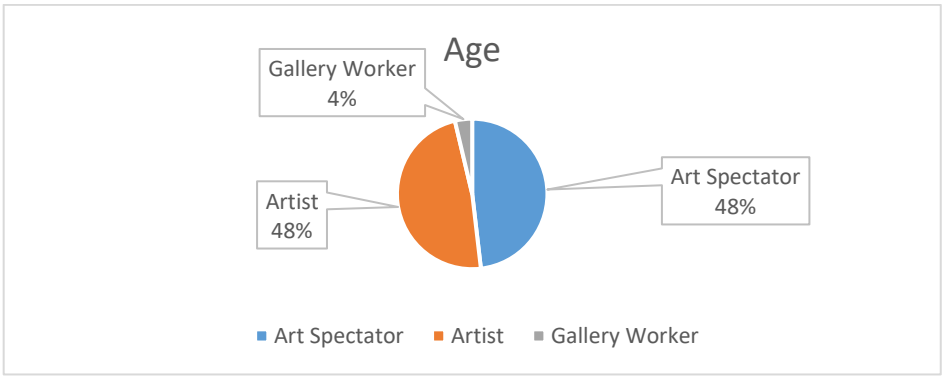


Chart 4.2: Chart showing Age of respondents
Source: Author's Fieldwork

The majority of respondents (%) are of the age 21-30 and they constitute 84% of the responses. 12% of the respondents are 31-40 and 4% of the respondents are below 20 years of age

ii. Highest level of Education of respondents

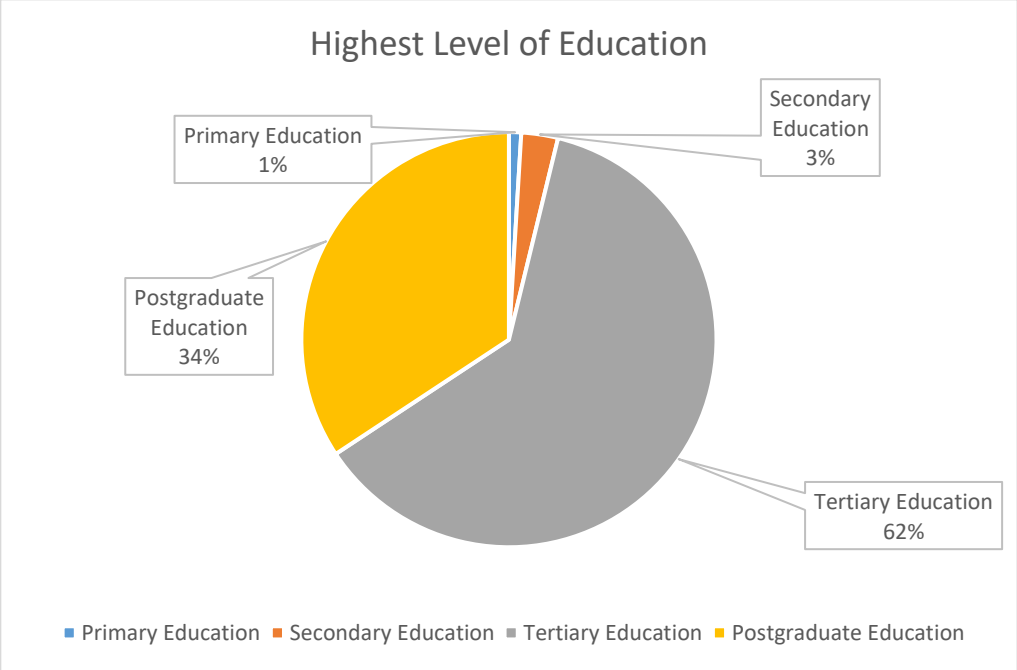


Chart 4.3: Chart showing Highest level of education of respondents

Source: Author's Fieldwork

The majority of respondents (%) possess a B.Sc. degree, or/and M.Sc. degree holders. Respondents of B.Sc. holders constitute 62% of the responses. Respondents of M.Sc. holders constitute 34% of the responses. The other respondents had secondary school education with 3% of the respondents and 1% of the respondents has a primary school education. The survey was mainly distributed among respondents with tertiary certifications and majorly in fields deemed to be relevant to the subject matter.

iii. Professional Category of respondents

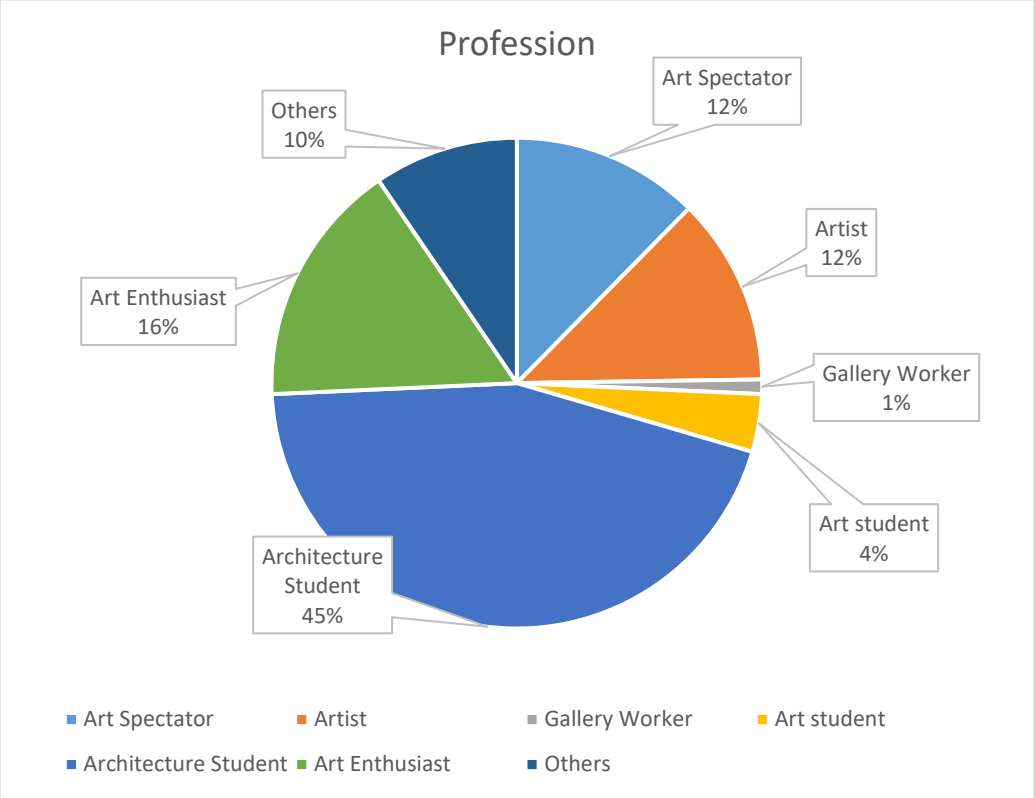


Chart 4.4: Chart showing Profession of respondents

Source: Author's Fieldwork

In chart 4.4 it can be observed that nearly half (45% approximately) of all respondents at the time of distribution happened to be architecture students with artists, art enthusiasts, art students, art spectators, gallery owners and others forming the remainder of respondents with 12%, 16%, 4%, 12%, 1% and 10% respectively.

iv. Employment Status of respondents

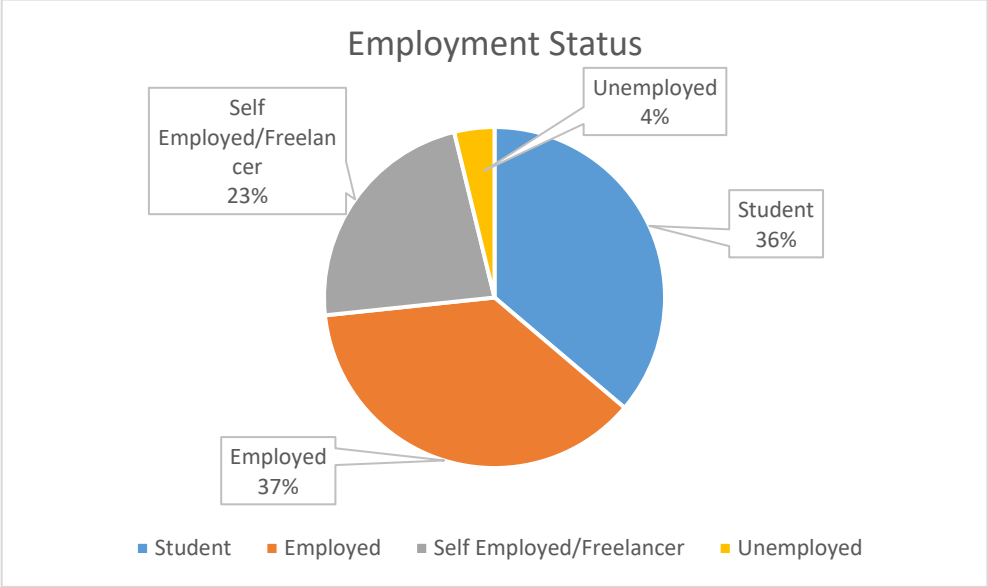


Chart 4.5: Chart showing Profession of respondents

Source: Author's Fieldwork

In chart 4.5, The majority of the respondents are either Employed or Students with 37% and 36% respectively. 23% of the respondents are self-employed or freelancers while the remaining 4% are unemployed.

v. Monthly Earnings of respondents

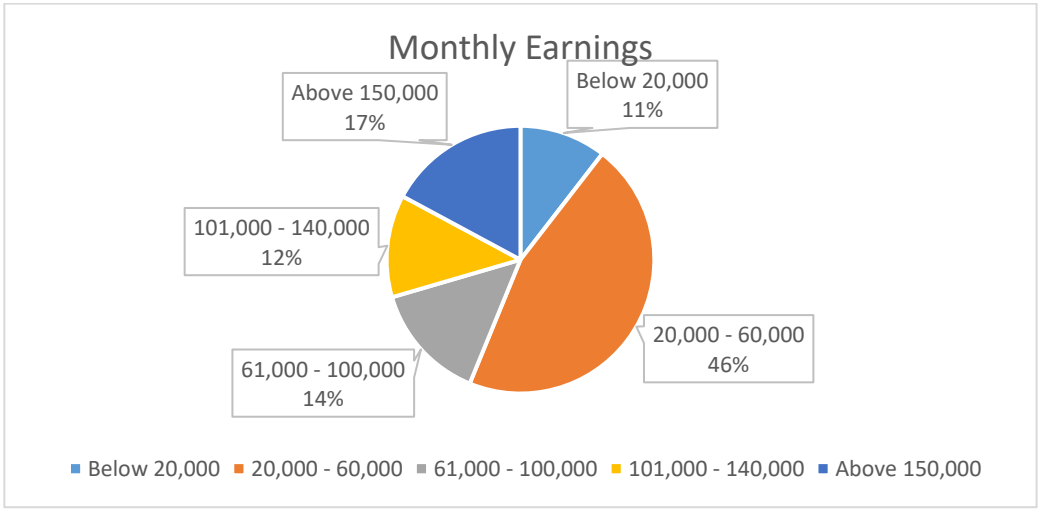


Chart 4.6: Chart showing Monthly Earnings of respondents

Source: Author's Fieldwork

In chart 4.6, it can be observed that 11% of the respondents earn below N20,000; 46% of the respondents earn N20,000 – N60,000; 14%of the respondents earn N61,000 – N100,000; 12%of the respondents earn N101,000 – N140,000 and 17% earn above N150,0000.

vi. Residence of Respondents

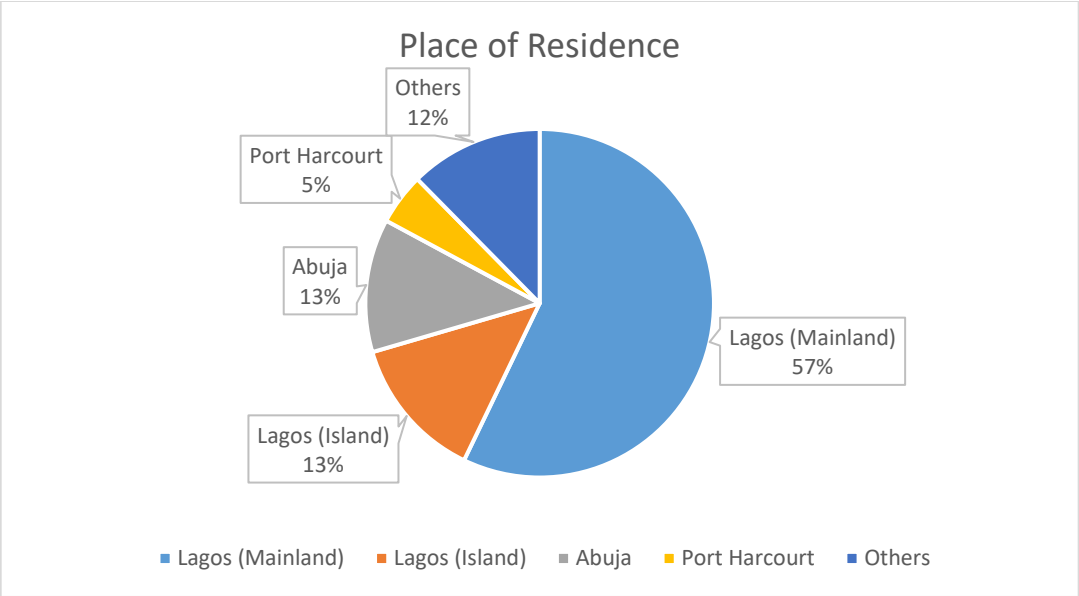


Chart 4.7: Chart showing Places of Residence of respondents

Source: Author's Fieldwork

In chart 4.7, The majority of the respondents, 57% reside on Lagos (Mainland), 13% of the respondents reside on Lagos (Island), 13% of the respondents reside in Abuja, 5% of the respondents reside in Port-Harcourt and 12% reside in other places such as Ogun state, Oyo state and Ibadan.

vii. Respondents visiting an art gallery

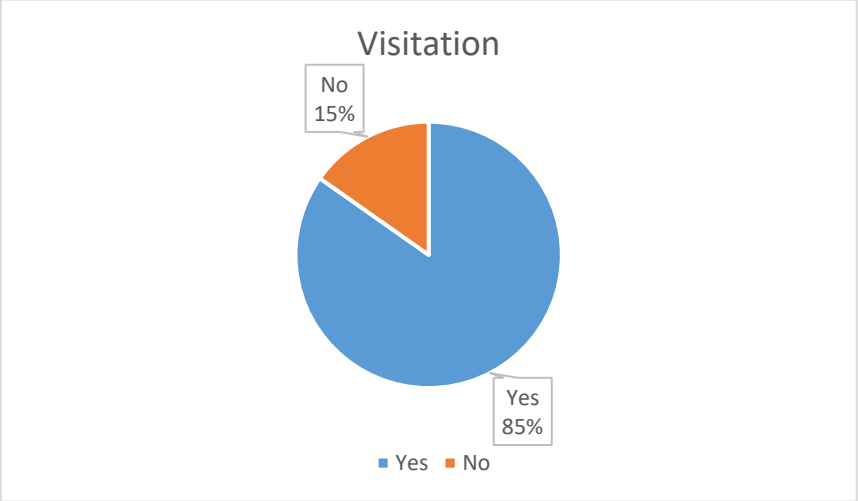


Chart 4.8: Chart showing Places of Residence of respondents
Source: Author's Fieldwork

In chart 4.8, 85.7%, the majority of the respondents, have visited an exhibition while the remaining 14.5% have not.

Objective 2: Identification of the available lighting system applications in an art gallery

This objective was satisfied with interviews conducted by the researcher with workers of the gallery and also artists on exhibition within the art gallery and also certain questions in the questionnaires structured for the respondents. The table below documents the interview transcription of two gallery workers, while the other two are artists (with backgrounds in architecture). The interview questions are structured to satisfy the objective of identifying the lighting systems available in art galleries.

Table 4.4: Table showing interview transcription of two gallery owners and two artists with background in architecture

Interview Question	Interviewee			
	Mrs. Nike (Gallery Owner)	**Anonymous (Gallery Manager)**	**Fadesere Dimeji (Artist/Architect)**	**Otulana Laughter (Artist/Architect)**
What sort of lighting strategies are in place in the art gallery?	On all floors, the only purposeful decision was to use fluorescent lighting. The initial design purpose called for the use of a skylight, however due to budget concerns, the proposal was shelved.	'I am not really qualified to answer questions about what light and type to use. It is usually up to the architect that designed the space and that is what we use. Sometimes also, the artist that is exhibiting might have some opinions or ideas on the type of light they want to use"	"I believe that natural light is essential. But, more crucially, lighting that allows each piece to stand on its own and catch the eye of the viewer." Each space's lighting is different. Depending on the space, there should be a variety of natural, mild, harsh, and no light at all.	"Light is important in galleries. Natural and artificial lighting can both be used." In some situations, there may be a requirement for no light at all. In the exhibition spaces, a skylight with "translucent dampers" that diffuse the light is recommended. Natural light isn't required everywhere, but it would be fine in most cases. This is especially true in the longer passageways. Lighting for the studio must be planned and installed where necessary.
Do you think there are different lighting for interior and exterior?	Yes, I believe there are	they think this question is considered technical and for the architects to recommend	I believe that exterior and interior lighting should be different.	I think so

What is the impact of various lighting systems on one's sensory experiences?	There have been no unpleasant experiences with visitors to the art gallery. The lights are mostly aimed at the artwork. The lights allow you to appreciate the artwork's brilliance. The light aids in the presentation of beauty. They enable people to see beauty.	There was no specific response.	Visitors experience anxiety and uneasiness as a result of the harsh bright lighting. Soft lighting creates a more intimate atmosphere. Different hues and shades of light, regardless of intensity, provoke different emotional responses. Some are cheerful, while others are somber, and some, like the bluer lights, are more sensual.	Different lighting systems create varying effects. Natural lighting may provide a sense of openness. Incandescent lights have a tendency to make people tired.

Source: Author's Fieldwork (2021)

b. Level of adequateness of the Lighting systems and strategies in place for Art Galleries by respondents

The next set of questions posed collected information on the form/media of art exhibited in art gallery, the degree of adequacy of specific lighting strategies and familiarity with different lighting techniques. The questions were posed to get a grounded opinion and so reflect some values of local designers, artists and art centre users alike.

i. Art media most familiar with

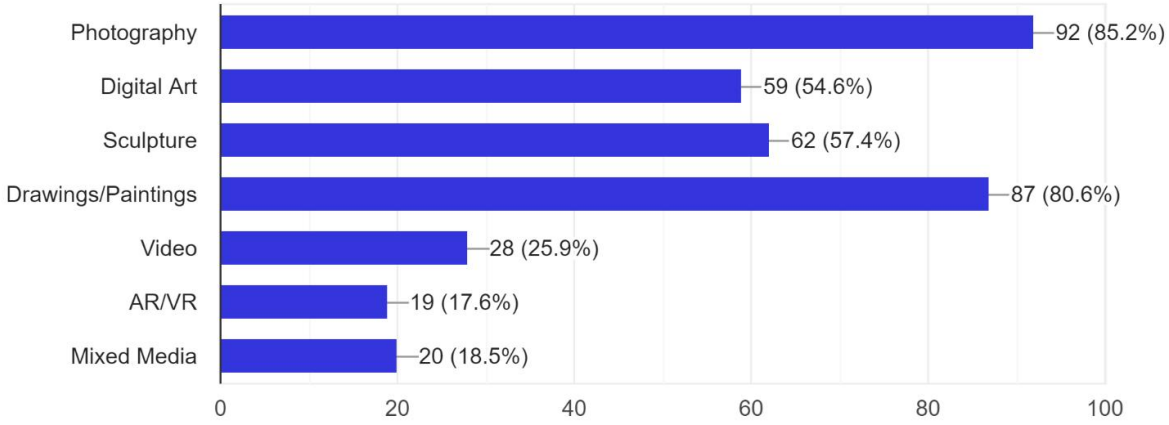


Chart 4.9: Bar Chart showing Art media most familiar with among respondents
Source: Author's Fieldwork

Amongst the recorded responses, Photography, sculptures, drawings and paintings were ticked as appropriate with 85.2%, 57.4% and 80.6% respectively. Digital art, which is the next highest, scored at least 54.6% in terms of selection while video art was deemed appropriate by 25.9% of respondents. The lowest approved were AR/VR and Mixed Media with 17.6% and 18.5% respectively. The inference from the data is that the art forms that counted at above 90% are more accepted locally as to be displayed in art centres. In other words, these are what the respondents would expect to see on display if they visited an art gallery. The lower scores for AR/VR and Mixed Media indicate they are perhaps not very commonly on display in art centres within the study area. Video and digital art are however sufficiently identified with. The above-average count indicates some level of awareness of the art forms even if they are not the most popular or most expected.

ii. Colour most suited for the walls of an exhibition space

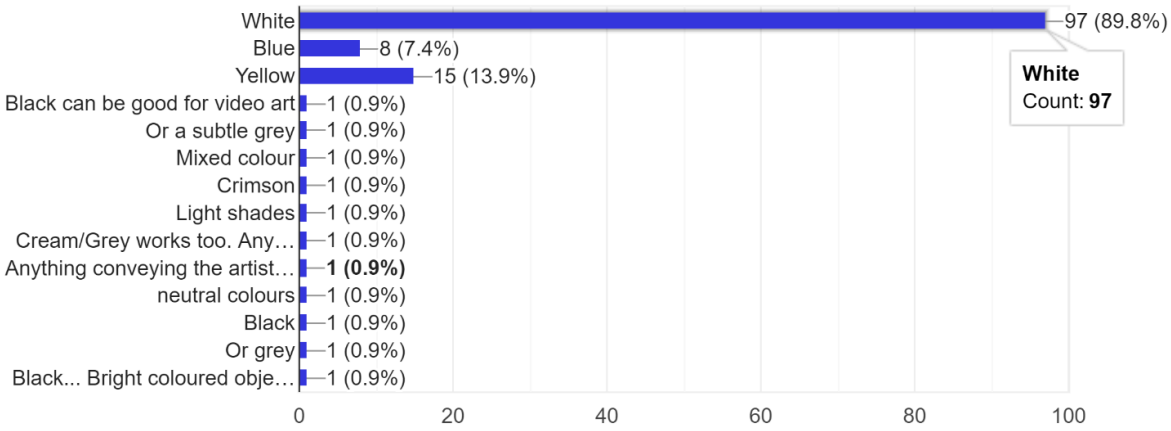


Chart 4.10: Bar Chart showing color most suited for wall color among respondents

Source: Author's Fieldwork

According to the bar chart above, White was selected by respondents the most by an apparent margin with 89.8% of the responses. Yellow was another selected choice with only 13.9% and blue with 7.4%. Other responses were open to suggestion as some respondents suggested black, grey, cream or other neutral colors. The highest selection, White ties in with the information provided from the interview with an informed artist who asserted that the white walls are the best colours to use on walls as they provide contrast between the background and the artwork giving it the entire focus.

iii. Colour of light most suitable for lighting an exhibition space

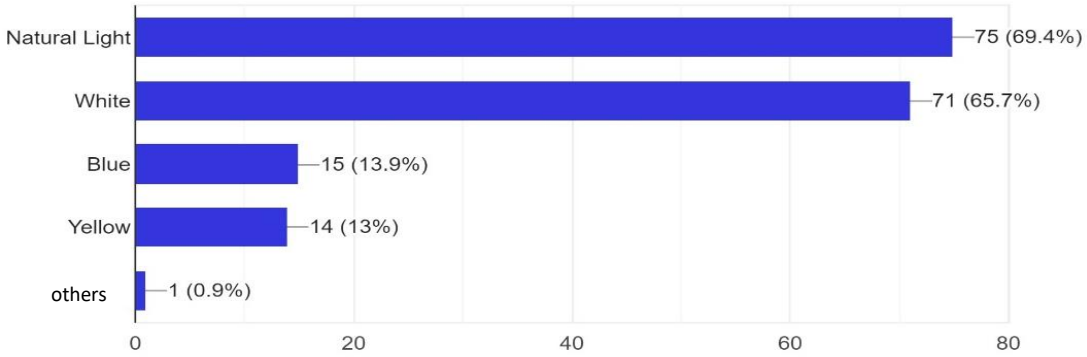


Chart 4.11: Bar Chart showing color of light most suitable among respondents

Source: Author's Fieldwork

The respondents were asked to select the colours of light they deemed most suitable for an art gallery. The different lights and the frequencies of selection by respondents are presented in the chart above. By an apparent margin, natural light and white light were selected by most respondents to be appropriate for the lighting in an art gallery. The second colour most selected is was blue light and closely following is a yellow light. The highest-scoring pair tie in with the information provided from the interview with one informed artist who asserted that the white LED lamps as well natural lights go more readily with more colours and are more agreeable to the eyes of spectators. The interviewee also stated that yellow incandescent lights are easier on the eyes than artificial blue lights. The inference from the results of this particular survey in tandem with the interviews show that white and yellow lights are deemed more optimal as lighting colours for an art gallery.

v. Appropriateness of the use of Daylight vs Artificial light in exhibition spaces

To ascertain the appropriateness and importance of daylight and artificial light in the significant spatial divisions in an art gallery (general/public space, art studio, or exhibition space); the questions were posed in the surveys using Likert scales ranging from absolutely inappropriate to absolutely appropriate or Not at all important to extremely important. The data is presented in charts below comparing where necessary, the appropriateness vs the perceived importance. The importance charts determine how essential a feature is (in situations of marginal or unclear relevance). In contrast, the appropriateness gives the impression that it belongs or fits into the specified lieu. The data on importance is collected to add a layer of context to some of the measures described.

a. Adequacy of the use of daylight in art galleries and exhibition centres

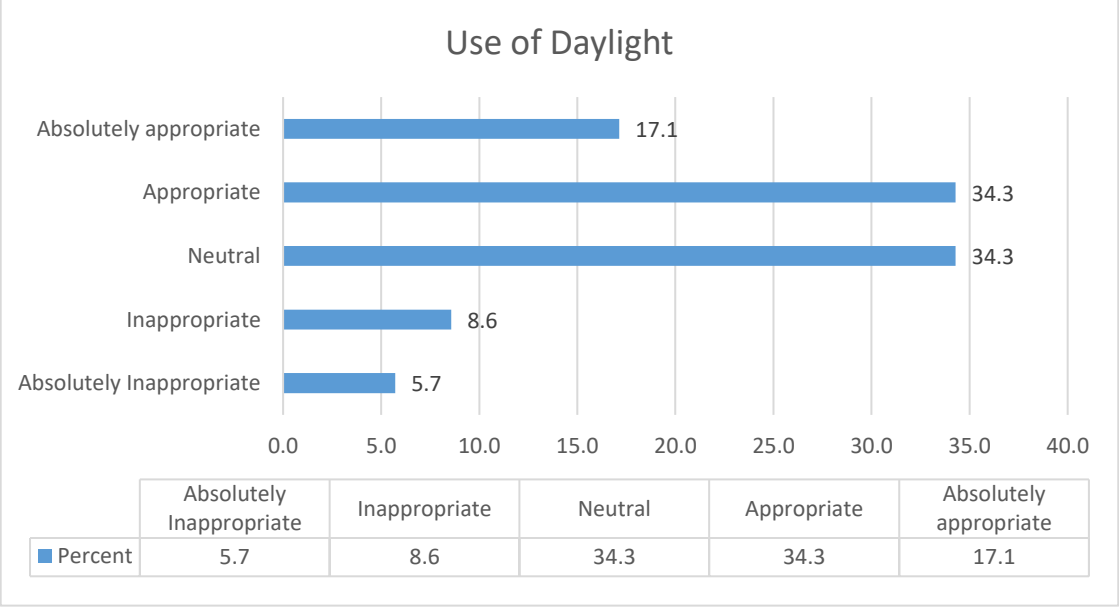


Chart 4.12: Bar Chart showing adequacy according to the respondents of daylight use in art gallery

Source: Author's Fieldwork

Amongst the recorded responses, 5.7% think it is absolutely inappropriate to use daylight in art galleries; 8.6% consider it inappropriate; 34.3% of the respondents think neutral of the idea and the same percentage think of it as appropriate; 17.1% percent think the idea absolutely appropriate.

b. Adequacy of the use of artificial light in art galleries and exhibition centres

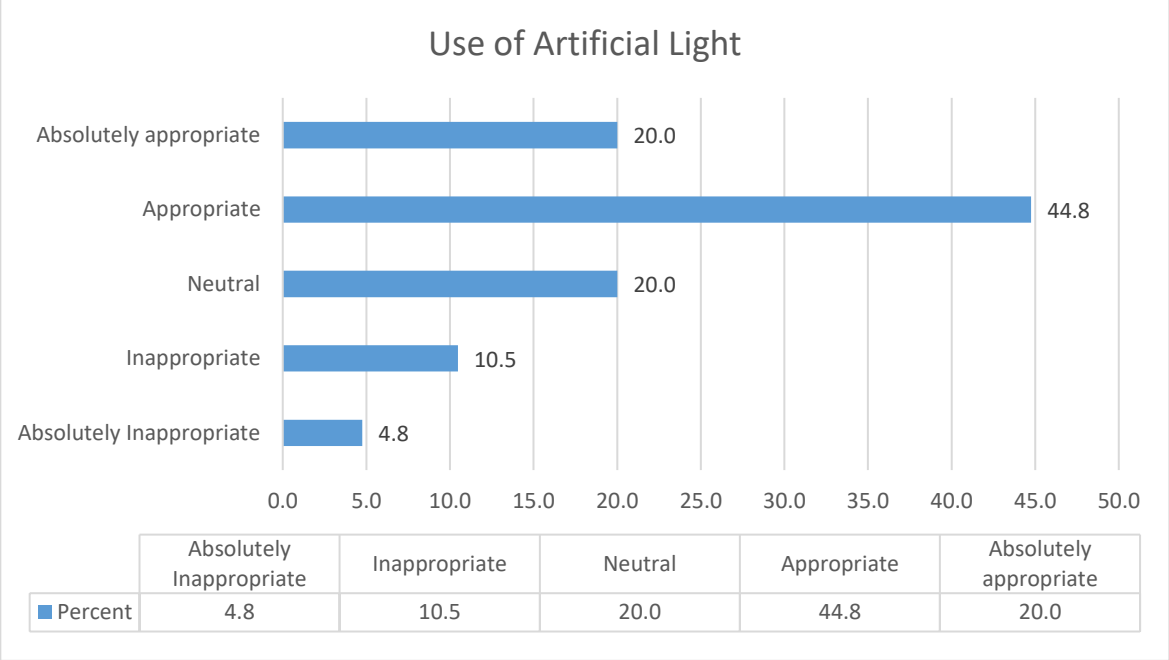
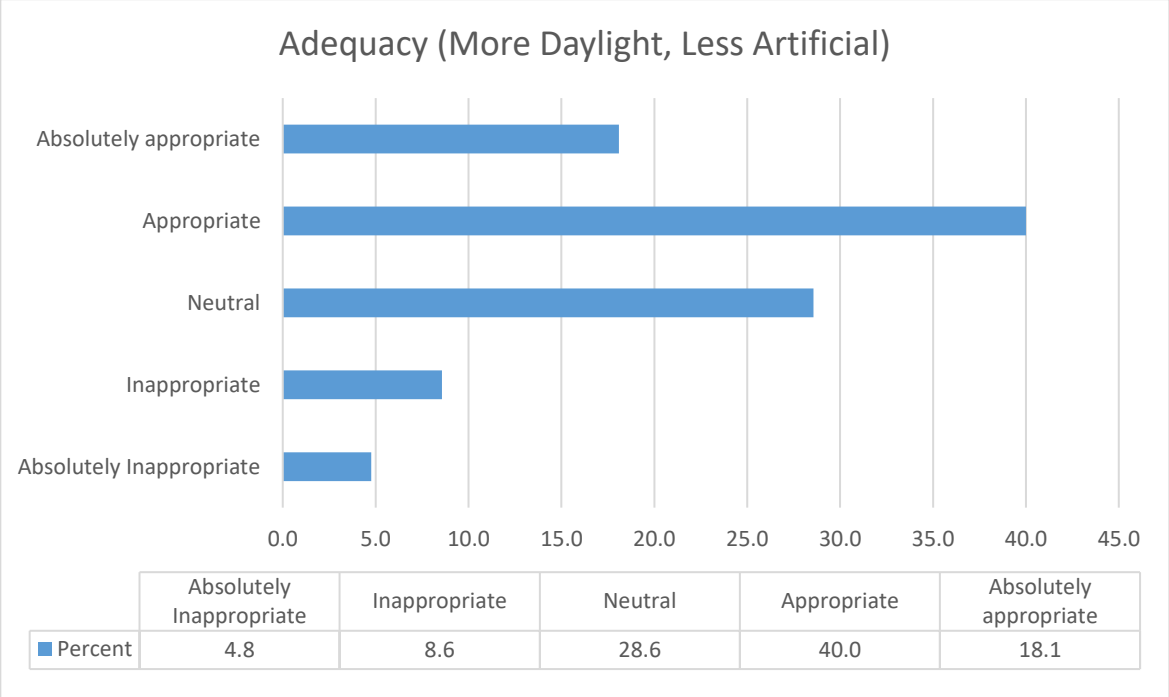


Chart 4.13: Bar Chart showing adequacy according to the respondents of Artificial Light use in art gallery

Source: Author's Fieldwork

Amongst the recorded responses, 4.8% think it is absolutely inappropriate to use artificial lighting in art galleries; 10.5% consider it inappropriate; 20% of the respondents think neutral of the idea; 44.8% think the idea appropriate; and 20% think it absolutely appropriate.

c. Adequacy of the use of both daylight and artificial light in art galleries and exhibition centres (more daylight, less artificial)



	Absolutely Inappropriate	Inappropriate	Neutral	Appropriate	Absolutely appropriate
Percent	4.8	8.6	28.6	40.0	18.1

Chart 4.14: Bar Chart showing adequacy according to the respondents of use of both daylight and Artificial Light in art gallery (more daylight)

Source: Author's Fieldwork

Amongst the recorded responses, 4.8% think it is absolutely inappropriate of use of both artificial and daylight with more use of daylight; 8.6% think it inappropriate; 28.6% are neutral on the idea; 40% think it appropriate and 18.1% think it absolutely appropriate.

d. Adequacy of the use of both daylight and artificial light in art galleries and exhibition centres (less daylight, more artificial)

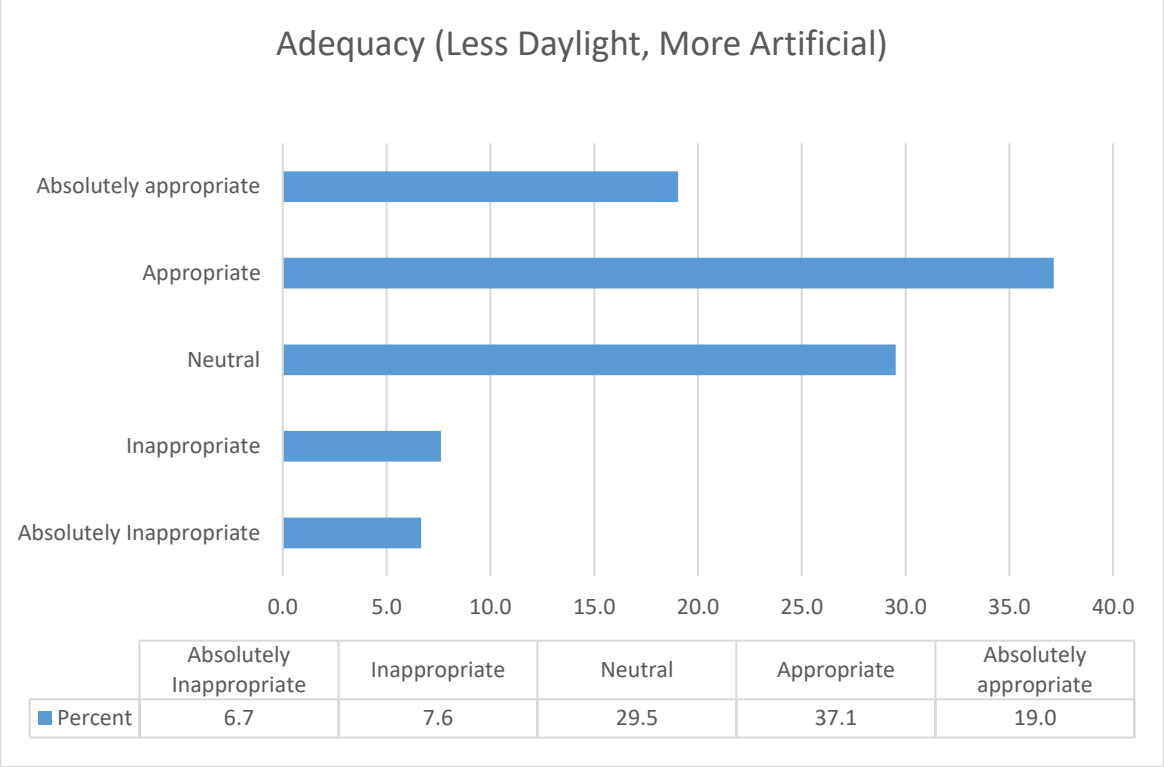


Chart 4.15: Bar Chart showing adequacy according to the respondents of use of both daylight and Artificial Light in art gallery (less daylight)

Source: Author's Fieldwork

Amongst the recorded responses, 6.7% think it is absolutely inappropriate of use of both artificial and daylight with more use of daylight; 7.6% think it inappropriate; 29.5% are neutral on the idea; 37.1% think it appropriate and 19% think it absolutely appropriate.

Objective 3: Human visual quality characteristics on an art gallery

Based on the literature review reserch conducted on Human visual quality, it can be measured by visual performance and visual comfort. Visual comfort is a subjective reaction to the quality and quantity of light in a given place at any given time. The capacity to alter the levels of light around us is essential for visual comfort. Visual discomfort can be caused by both too much and too little light. While ot may not be noticable the level of visual comfort that one experiences, several visual discomfort characteristics can be felt. Below is a table showing the mean analysis of the visual discomfort by respondents

Table 4.5: Table showing mean and standard deviation of visual discomfort based on respondents

	N	Mean	Std. Deviation
None	105	1.44	.499
Headache/Migraine	105	1.90	.308
Itchy/Watering Eyes	105	1.90	.308
Glare	105	1.71	.454
Shadow	105	1.85	.361

Source: Author's Fieldwork (2021)

Based on the table above, Headache/Migraine and Itchy/Watering eyes are the highest visual discomfort felt by respondents with mean of 1.90 with a minimum of 1 and maximum of 2. The next hightst visual discomfort experienced is excessive shadow with a mean of 1.85. Glare comes in next with a mean of 1.71 which is usually caused by excessive light introduced in the space. A mean of 1.44 was measuref for respondents who felt no visual discomfort while in an exhibition.

Based on these results, conclusion can be drawn that most people feel one or multiple visual discomfort while in an art exhibition rather than none at all.

Levels of visual discomfort in relation to the ages of the respondents

Based on Rutter, 1997, One of the reasons of discomfort is a lack of or insufficient light, which can result in issues such as shadow, glare, and veiling reflections. Contrast and glare are the most generally reported display issues, with complaints coming from visitors aged 40 and above. Age can be placed as a factor that affects the visual discomfort experienced by respondents.

i. *Table 4.6: Table showing cross tabulation betweeen age of respondents and visual discomfort experienced (none);*

		Visual discomforts due to the lighting of an artwork? (None)		Total
		Yes (F)	No (F)	
Age	Below 20	0	4	4
	21 - 30	48	40	88
	31 - 40	9	4	13
Total		59	46	105

Source: Author's Fieldwork (2021)

Based on the table above with 105 respondents, 59 of the respondents experience none of the visual discomforts and 46 of the respondents have experience one or more of the visual discomfort. For respondents below the ages of 20, none have experienced none while the 4 have experienced one or multiple visual discomforts. For respondents within the age of 21 - 30, 48 have experienced none while the 40 have experienced one or multiple visual discomforts. For respondents within the age of 31 - 40, 9 have experienced none while the 4 have experienced one or multiple visual discomforts.

ii. *Table 4.7: Table showing cross tabulation between age of respondents and visual discomfort experienced (Headache/Migraine)*

		Visual discomforts due to the lighting of an artwork? (Headache/Migraine)		Total
		Yes (F)	No (F)	
Age	Below 20	2	2	4
	21 - 30	9	79	88
	31 - 40	0	13	13
Total		11	94	105

Source: Author's Fieldwork (2021)

Based on the table above with 105 respondents, 11 of the respondents experience Headache/Migraine and 94 of the respondents have not experienced it. For respondents below the ages of 20, 2 have experienced headache/migraine while the 2 have not experienced the discomfort. For respondents within the age of 21 - 30, 9 have experienced headache/migraine while 79 have not experienced the discomfort. For respondents within the age of 31 – 40, 13 have not experienced the discomfort.

iii. *Table 4.8: Table showing cross tabulation between age of respondents and visual discomfort experienced (Itchy/Watering Eyes);*

		Visual discomforts due to the lighting of an artwork? (Itchy/Watering Eyes)		Total
		Yes	No	
Age	Below 20	0	4	4
	21 - 30	10	78	88
	31 - 40	1	12	13
Total		11	94	105

Source: Author's Fieldwork (2021)

Based on the table above with 105 respondents, 11 of the respondents experience Headache/Migraine and 94 of the respondents have not experienced it. For respondents below the ages of 20, none have experienced itchy/watering eyes while the 4 have not

experienced the discomfort. For respondents within the age of 21 - 30, 10 have experienced itchy/watering eyes while 78 have not experienced the discomfort. For respondents within the age of 31 – 40, 1 has experienced itchy/waterung eyes while 12 have not experienced the discomfort.

iv. Table 4.9: Table showing cross tabulation betweeen age of respondents and visual discomfort experienced (Glare)

		Visual discomforts due to the lighting of an artwork? (Glare)		Total
		Yes	No	
Age	Below 20	0	4	4
	21 - 30	26	62	88
	31 - 40	4	9	13
Total		30	75	105

Source: Author's Fieldwork (2021)

Based on the table above with 105 respondents, 30 of the respondents experience glare and 75 of the respondents have not experienced it. For respondents below the ages of 20, none have experienced itchy/watering eyes while the 4 have not experienced the discomfort. For respondents within the age of 21 - 30, 26 have experienced glare while 62 have not experienced the discomfort. For respondents within the age of 31 – 40, 4 have experienced glare while 9 have not experienced the discomfort.

Table 4.10: Table showing cross tabulation betweeen age of respondents and visual discomfort experienced (Shadow)

		Visual discomforts due to the lighting of an artwork? (Shadow)		Total
		Yes	No	
Age	Below 20	0	4	4
	21 - 30	16	72	88
	31 - 40	0	13	13
Total		16	89	105

Source: Author's Fieldwork (2021)

Based on the table above with 105 respondents, 16 of the respondents experience shadow and 89 of the respondents have not experienced it. For respondents below the ages of 20, none have not experienced the discomfort. For respondents within the age of 21 - 30, 16 have experienced shadow while 72 have not experienced the discomfort. For respondents within the age of 31 – 40, 13 have not experienced the discomfort.

Objective 4: Factors for enhancing Human visual quality and visual comfort based on lighting

Based on the literature review, the different lighting approaches and lighting distribution techniques used in an exhibition space; same as the color of the wall in contrast with the artwork, proximity/nearness to viewing the artwork. It can affect the visual comfort and visual quality experienced by the respondents.

Table 4.11: Table showing satisfaction of respondents with various lighting approaches

	Daylight		Top Lighting		Side/Directional		Light Shelves		Others	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	61	58.1	69	65.7	41	39.0	39	37.1	2	1.9
No	44	41.9	36	34.3	64	61.0	66	62.9	103	98.1
Total	105	100.0	105	100.0	105	100.0	105	100.0	105	100.0

Source: Author's Fieldwork (2021)

Amongst the recorded responses, 61 out of 105 (58.1%) of the respondents are satisfied with daylight as a lighting approach while 44 out of 105 (41.9%) of the respondents are not satisfied with it. 69 out of 105 (65.7%) of the respondents are satisfied with top lighting as a lighting approach while 36 out of 105 (34.3%) of the respondents are not satisfied with it. 41 out of 105 (39%) of the respondents are satisfied with side/directonal lighting as a lighting approach while 64 out of 105 (61%) of the respondents are not satisfied with it. 39 out of 105 (37.1%) of the respondents are satisfied with light shelves as a lighting approach while 66 out of 105 (62.9%) of the respondents are not satisfied with it. 2 out of 105 identified other lighting approaches such as 3-pointer light. Based on this analysis, a greater percentage (58.1%) are satisfied with the use of daylight as a lighting approach in an art gallery. This analysis would be used in the final design of the art gallery.

Table 4.12: Table showing satisfaction of respondents with various lighting distribution techniques

	Direct Light		Indirect Light		Direct/Indirect Light	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	60	57.1	40	38.1	43	41.0
No	45	42.9	65	61.9	62	59.0
Total	105	100.0	105	100.0	105	100.0

Source: Author's Fieldwork (2021)

Amongst the recorded responses, 60 out of 105 (57.1%) of the respondents are satisfied with direct light as a lighting distribution technique while 45 out of 105 (42.9%) of the respondents are not satisfied with it. 40 out of 105 (38.1%) of the respondents are satisfied with indirect light as a lighting distribution technique while 65 out of 105 (61.9%) of the respondents are not satisfied with it. 43 out of 105 (41%) of the respondents are satisfied

with direct/indirect light as a lighting distribution technique while 62 out of 105 (59%) of the respondents are not satisfied with it.

i. Contrast while viewing artworks

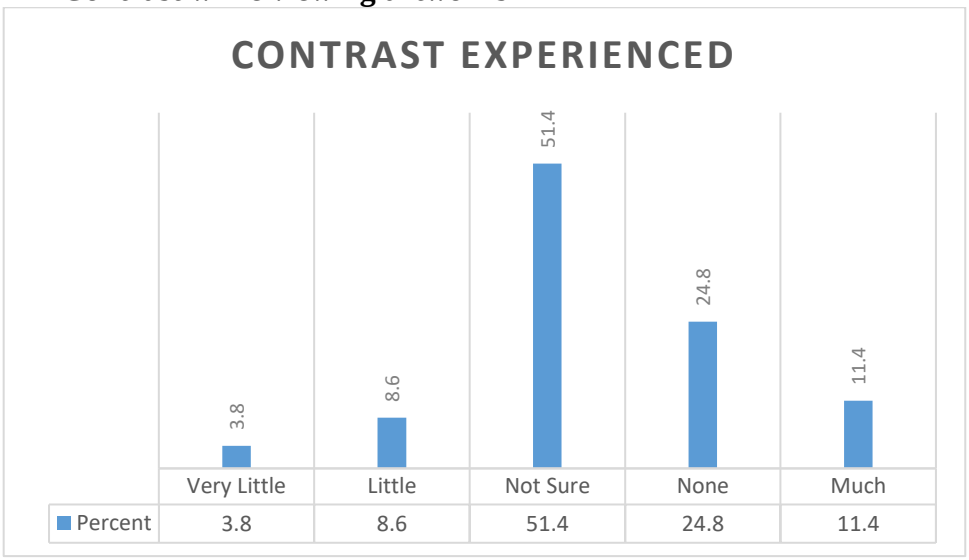


Chart 4.16: Bar Chart showing level of contrast experienced based on respondents
Source: Author's Fieldwork

The chart presented above shows the responses of the level of contrast experienced while viewing art. The majority of responses were not sure if they do; with the option featuring as a ticked option in 51.4% of all questionnaires. The option 'none' was the next most favoured among the respondents with 24.8%.). 11.4% of the respondents said much while 8.6% and 3.8% said little and very little respectively.

ii. Closeness to viewing an artwork

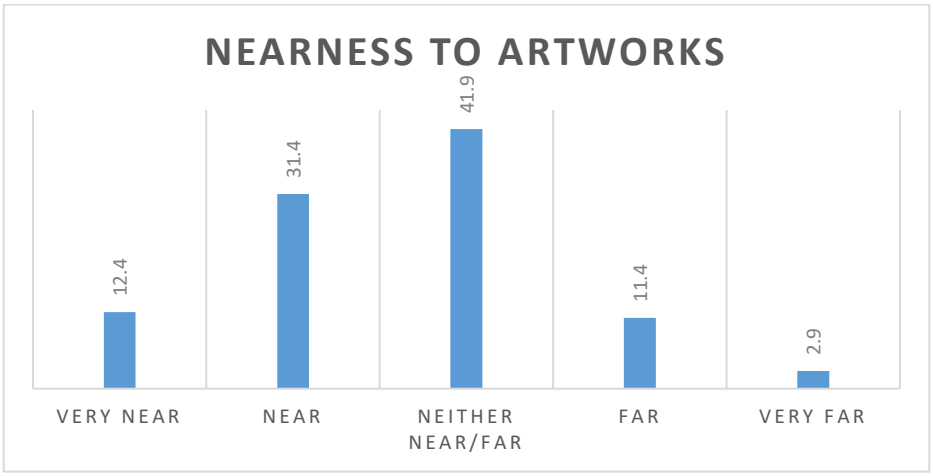


Chart 4.17: Bar Chart showing level of closeness to artworks based on respondents
Source: Author's Fieldwork

From chart 4.18 above, 41.9% of respondents are neither near or far to see an artwork. 31.4% have to get near and 12.4% have to get very near. 11.4% and 2.9% are alright with standing far and very far from the artwork respectively to see.

iii. Lightness of the wall background in relation to artwork being exhibited

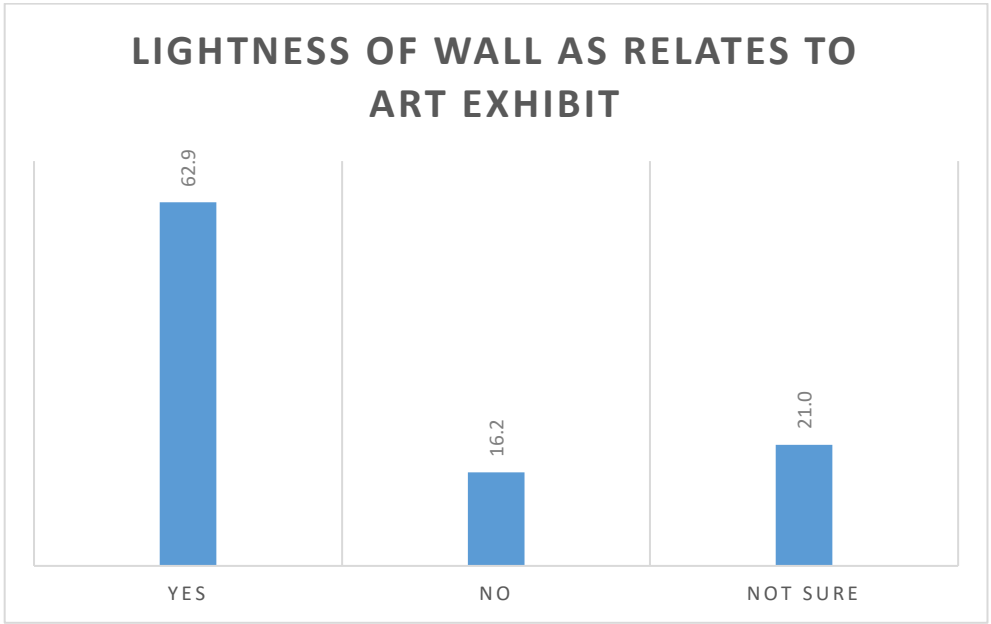


Chart 4.18: Bar Chart showing lightness of the wall background as it relates to art exhibits based on respondents
Source: Author's Fieldwork

Amongst the recorded responses to measure if respondents notice the lightness of the background wall, 62.9% responded yes, 16.2% responded with a no and 21% are not sure they notice.

Areas of Further Research

In the course survey, certain data points were marked as inconclusive. More research on the level of knowledge of architects, artists, and students in these fields on lighting in general, and lighting in art galleries in particular, is needed, in my opinion. A more extensive study of the many lighting techniques that can and should be used in art galleries is also recommended—perhaps aimed at even more knowledgeable people in the research field. Finally, a more comprehensive investigation is needed to determine the lighting quality in art galleries in the study area.

4.4 Case Studies

4.4.1 Case Study 1: Nike Art Gallery, Lagos

Name of Building: Nike Art Centre

Location: Ikate, Lekki, Lagos

Year of Construction: 2008

Table 4.4.1 Case study of Nike Art Gallery

Major Facilities	The art centre is comprised mainly of the main art halls and the dedicated art store building adjacent to the main building
Use of artificial light and/or daylight	The building's interior relies mainly on artificial lights (fluorescent lights). The natural light fixtures are used for staircases as well as the less-visited parts of the gallery
Lighting elements present	The side apertures were decorated, with metalwork motifs that act as filters for the lights. The exhibition spaces also feature mirrors that serve to reflect the lights more evenly across space.

Light Apertures present (size, shape and location)	Except for a few spaces, the windows present are small, slender rectangles (600 by 2100mm). They are located at the staircases and the boundary rooms used for more private exhibitions.
Architectural features and characteristics	The floor is finished with ceramic floor tiles, and the sand crete walls are painted in white all through. The design features four floors all of a typical square floor plan. Through the centre is a void covered on top with a roof finished on its interior with wood. It also features artistic ornamentation on its white exterior walls

Map 4.1 Site plan of Nike Art Gallery, Lekki, Lagos
Source: Google Earth (2021)

Plate 4.1 Entrance to Nike art gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

Plate 4.2 Adjourning building of Nike art gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

4.4.1.1 Overview

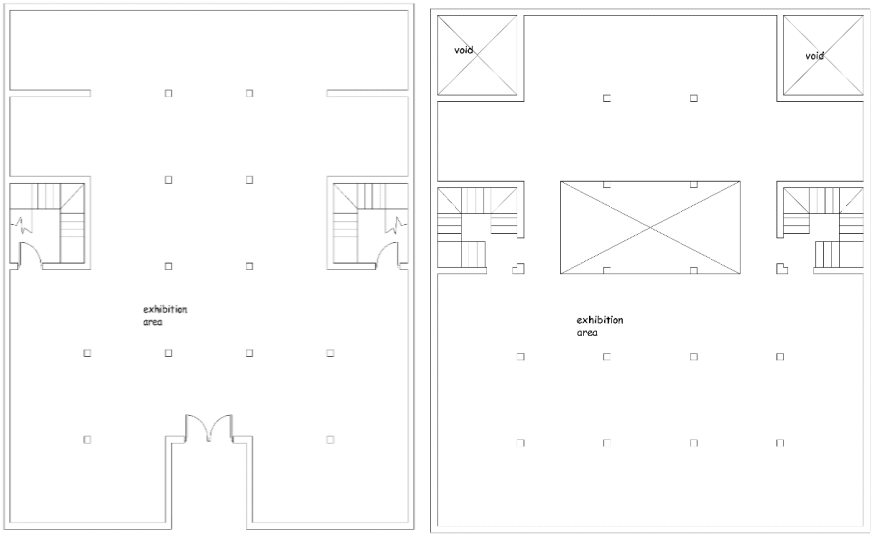
The gallery exhibits a typical post-modern architectural character. The building is a five-storey building with pent floor and external sanitary facilities. The symmetrical building is enclosed, painted white and has a walkway around the building. All floors are majorly exhibition spaces. On entering the site of the existing development, to the right sits an art and craft shop and a sit out. various sculptural supports were used along the entrance and the aisles; a feature found in traditional places and entrance porches.

Plate 4.3 Approach view of Nike art gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

4.4.1.2 Spatial Analysis

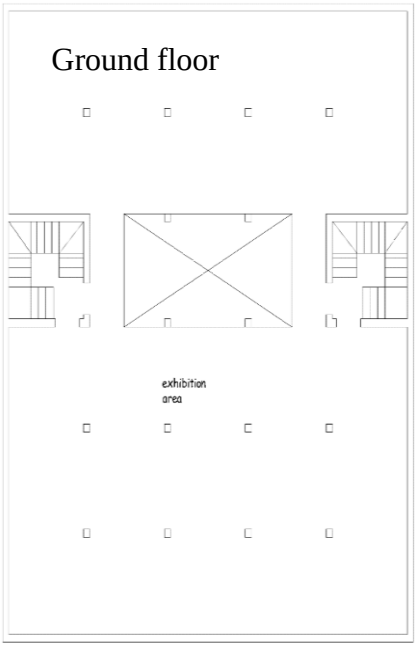
The main building has its entrance directly opposite the site entrance welcoming the visitors with small sculptures and arts as well as natural landscape. The building entry has

a headroom of 4.5m and other floors have head room of 3.6m. all floor are used for exhibition of art works and sculptures. There are two stairways lying in opposite directions to one another. All floor except the fifth floor is enclosed without windows. The building houses various spaces like; bookshelves, stores, and offices. The main building occupies about 579 sqm of the site with an atrium at the centre of the building.



Ground floor

First floor



Typical second to fifth floor

Plate 4.4 Floor plans of Nike art gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

4.4.1.3 Building Components: Walls, Roof, Ceilings and Floors

The gallery's walling system is made of concrete masonry units, reinforced concrete columns, glass, stones, steel and awning windows. The supporting building is made of concrete masonry units and glass. The exterior wall finishes consist of white wall paint. The interior wall finishes consist of white wall paint, full wall glass, shattered glass and ceramic tiles. The building has a red corrugated roof covering with timber fascia boards covering, while the roof eaves soffits are finished with white coated parapet. The ceiling of the gallery is finished with timber panels. The external flooring system is made of herringbone interlocking stone. The internal floor finishing system is mainly glazed ceramic tiles. However, the flooring system on the fifth floor is majorly laminated timber panels.

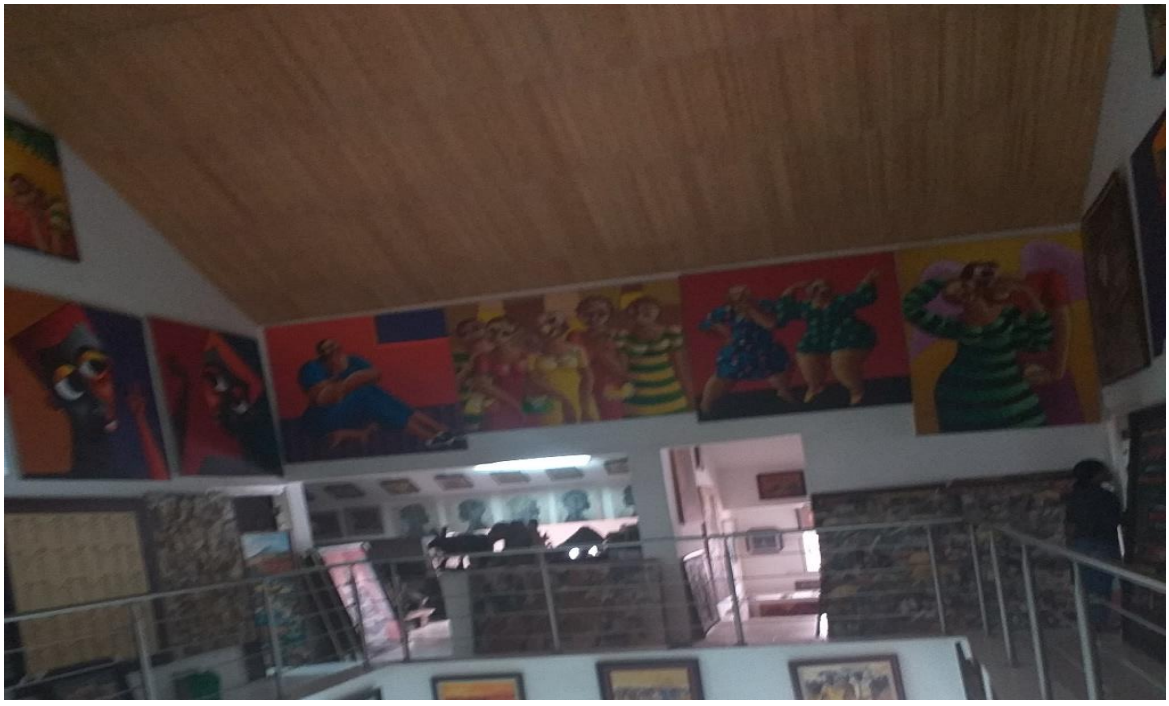


Plate 4.5 Ceiling view of Nike Art Gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

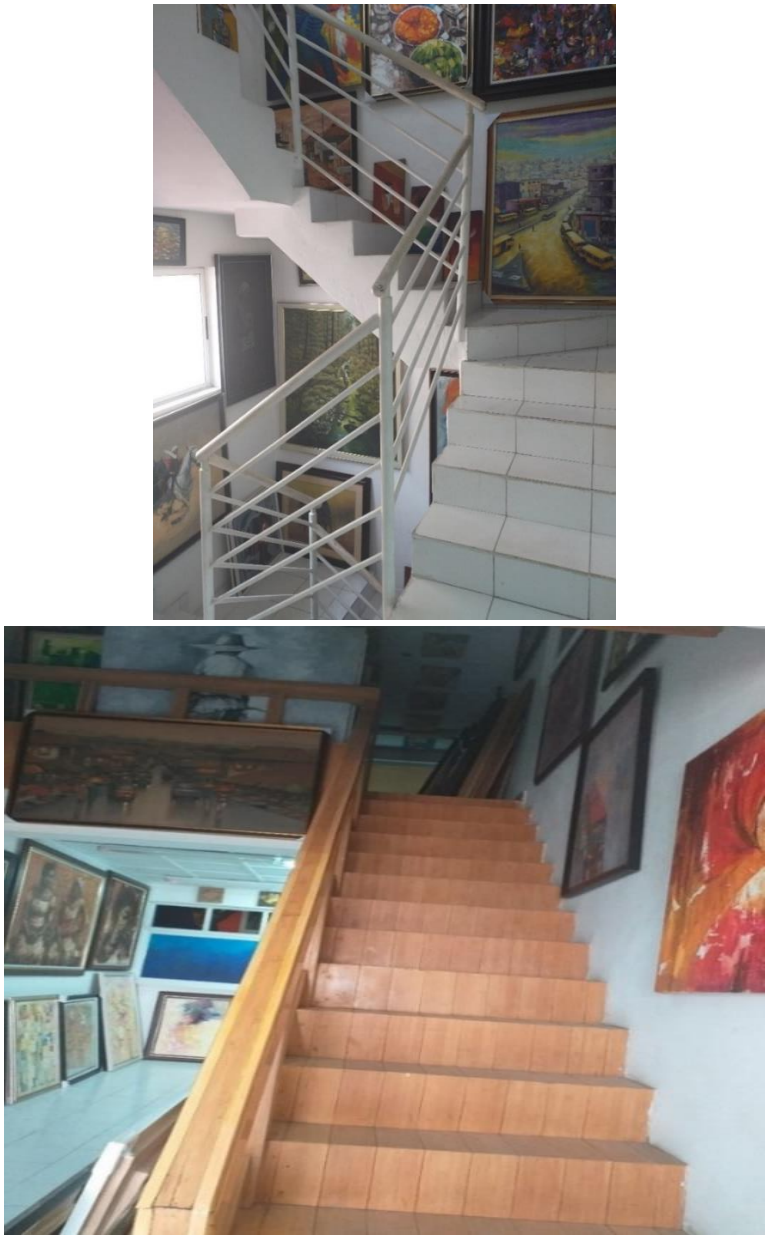


Plate 4.7 Floor finishes used in Nike Art Gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

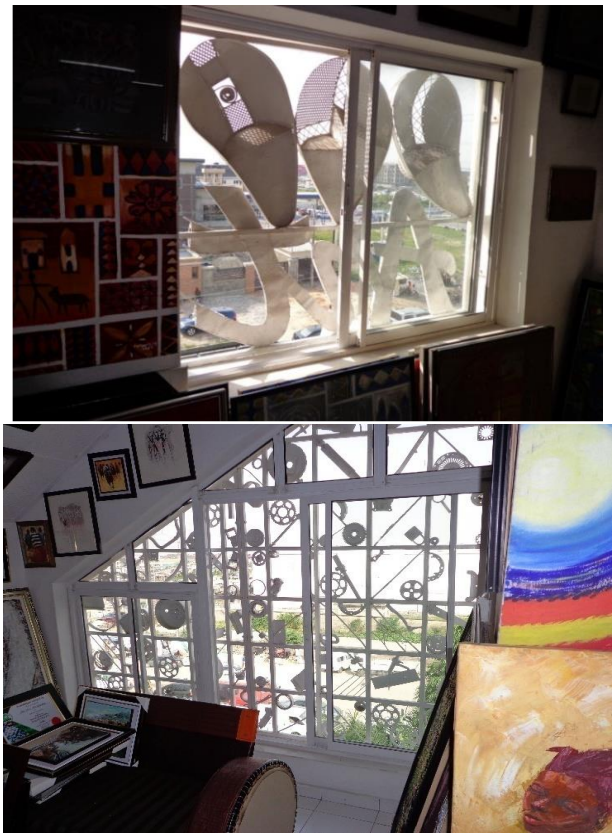


Plate 4.8 Custom window frames used in Nike Art Gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

4.4.1.4 Building Services

Wall mounted air conditioning units are strategically placed on each floor due to lack of openings into the spaces. The stores are ventilated both naturally and artificially. The gallery makes use of electric power supply by the National grid and also has an alternative power supply generator located at rear of the site. Water is supply through the use of borehole water system stored in tanks positioned at behind the toilet.

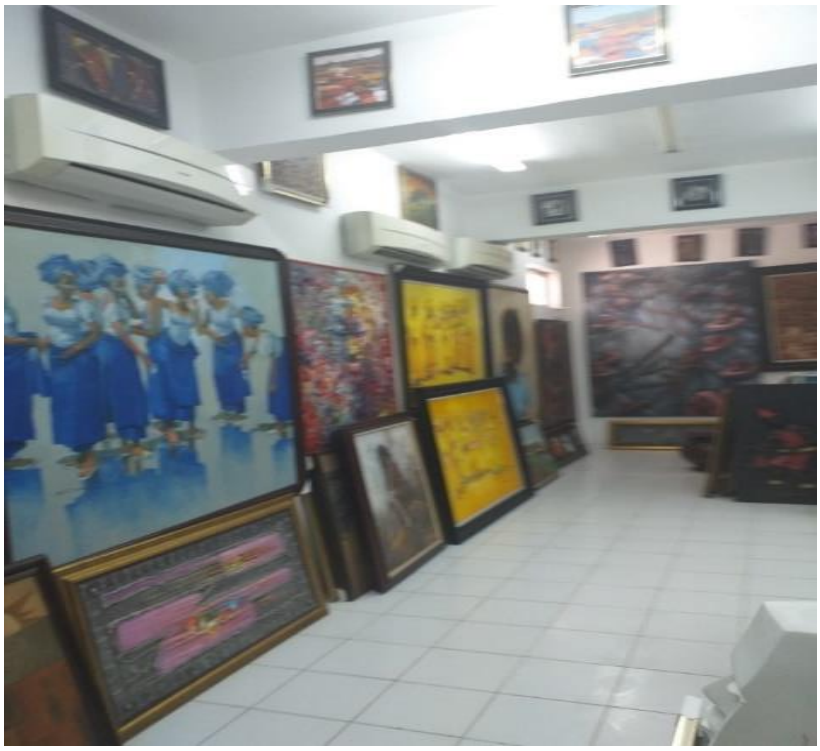


Plate 4.9 Air conditioning units used in Nike art gallery, Lekki, Lagos
Source: Author's fieldwork (2021)

4.1.1.5 Structural System

The building has a structural system of reinforced concrete columns and beams. A timber frame structure supports the roof while the loadbearing wall are used for the building.

Plate 4. 10 Columns and Beams used in Nike Art Gallery, Lekki, Lagos
Source: Author's Fieldwork (2021)

4.4.2 Case Study 2: Hourglass Art Gallery

Name of Building: Hourglass Art Gallery

Location: Victoria Island, Lagos

Year of Construction:

Table 4.4.2 Case study of Hour Glass Art Gallery

Major Facilities	The gallery features three main exhibition rooms. One large one on the ground floor and two smaller ones on the upper level. The staff also have a kitchenette space adjacent to one of the art storages rooms
Use of artificial light and/or daylight	But for one window on the ground floor, the building relies solely on artificial light for the entire gallery.
Lighting elements present	There are no light shelves, reflective panels or shading devices to note. The windows are completely covered. Admittance of light into the building is only via the artificial fixtures
Light Apertures present (size, shape and location)	The single window present is a 1.2 x1.2m sized window.
Architectural features and characteristics	The walls are painted in white. The floors are finished on the ground floor with brown-grey vitrified tiles and with vinyl tiles on the first floor. The building was converted into an art gallery from residential design. It features an expansive open plan on the ground floor and segmented exhibition rooms on the upper level.

Map 4.2 Site Plan of Hourglass Art Gallery, Lagos
Source: Google Earth (2021)

Plate 4.11 Approach view of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

4.4.2.1 Overview

Hourglass gallery is notable as a place to go and appreciate various works of art from artists around the African continent. Located in the serene environs of Victoria Island, the Hourglass gallery seeks to promote and develop visual art and artists by promoting them and their work. It is owned by Dozie Igweze. Housed in a two-storey building. The gallery shares its facilities with others in its building.

Plate 4.12 Approach view of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

Plate 4.13 Approach view of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

4.4.2.2 Spatial Analysis

The main building houses other facilities as the art gallery is located at the rear side of the building with a slim brick finish on the entrance external wall. The gallery is housed on two levels. The ground floor consists of the main exhibition space, shaped like the letter 'L' alongside the gift shop, the staff lounge, toilet and storage room. A staircase is located on the left side of the giftshop leading to the first floor. The first floor has two small exhibition rooms on the either side of the building with storage rooms serving them both. Administrative offices are also located on this floor.

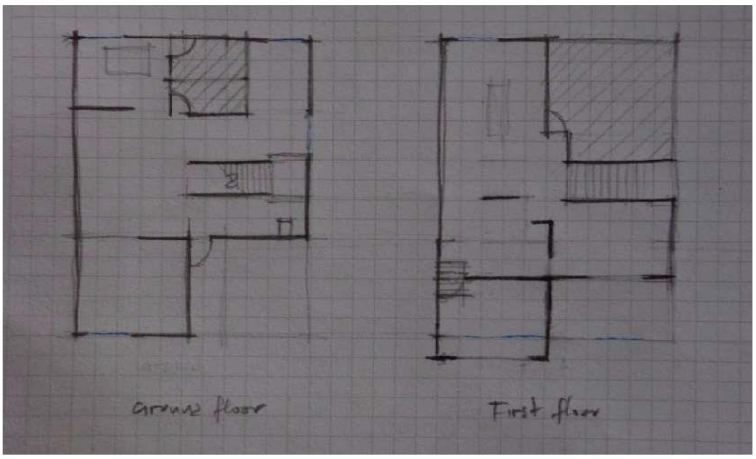


Plate 4.14 Floor plans of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

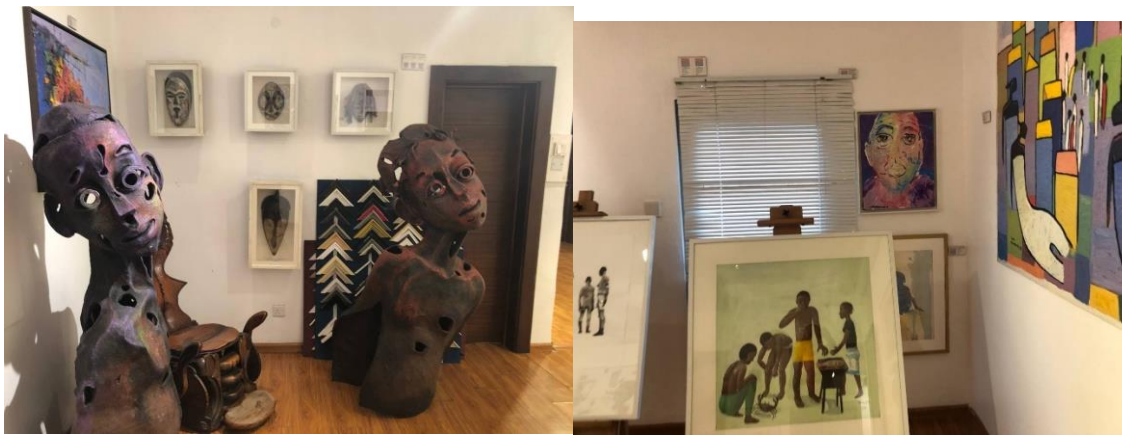


Plate 4.15 Exhibition halls of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

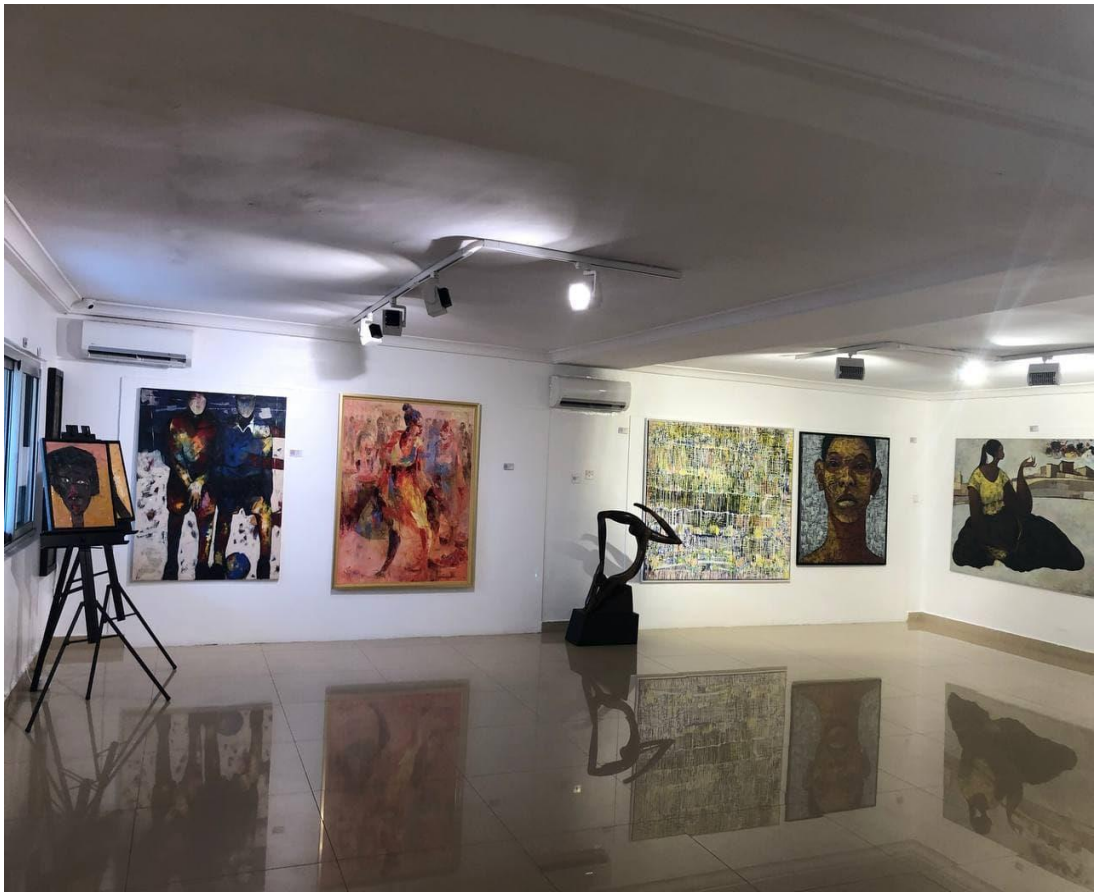


Plate 4.16 Main Exhibition Hall of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

4.4.2.3 Building Components: Walls, Roof, Ceiling, Floor

The gallery's walling system is made of concrete masonry units and reinforced concrete. The interior wall finishes consist of white wall paint. The building has a corrugated roof covering with timber fascia boards covering, while the roof eaves soffits are finished with white coated parapet. The ceiling of the gallery is finished with Plaster of Paris. The external flooring system is made of paved concrete tiles. The internal floor finishing system is brown-grey vitrified tiles on the ground floor and with vinyl tiles on the first floor.

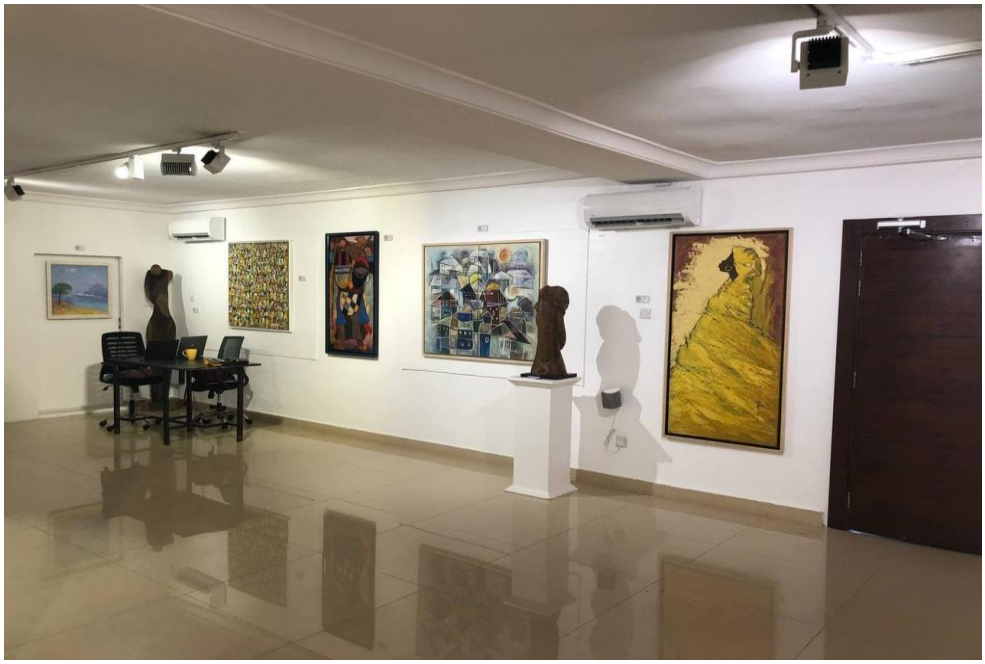


Plate 4.17 Walls, Roof, Ceiling and Floor of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

4.4.2.4 Building Services

Wall mounted air conditioning units are strategically placed on each floor due to lack of openings into the spaces. The gallery makes use of electric power supply by the National grid and also has an alternative power supply generator located at rear of the site. Water is supply through the use of borehole water system stored in tanks positioned at behind the toilet.

Plate 4.18 Conditioning Unit of Hourglass Art gallery, Lagos
Source: Author's fieldwork (2021)

4.4.2.5 Structural System

The building has a structural system of reinforced concrete columns and beams. A timber frame structure supports the roof while the loadbearing wall are used for the building.

4.4.3 Case Study 3: Nimbus Art Gallery

Name of Building: Nimbus Art Gallery

Location: Ikoyi, Lagos

Year of Construction: 1970

Table 4.4.3 Case study of Nimbus Art Gallery

Major Facilities	The gallery is a two-storey building initially for residential use. It features a library, bar, performance space for a live band, event spaces, storage, shops, art and crafts shop and offices.
Use of artificial light and/or daylight	Clerestory windows in the exhibition; entrance door is made of glass so it allows ambient lighting into the reception.
Lighting elements present	There are no light shelves, reflective panels or shading devices to note.The windows are completely covered. Admittance of light into thebuilding is only via the artificial fixtures
Light Apertures present (size, shape and location)	clerestory windows in the exhibition hall but they are not effective. The entrance door is made of glass so it allows ambient lighting into the reception.

Architectural features and characteristics	The walls system is made of concrete masonry units, reinforced concrete columns, glass, stones, steel, bamboo and waste materials in artistic expressions. The floors externally are finished a concrete mix and shattered ceramic tiles. The internal floor finishing system is mainly shattered glazed ceramic tiles on a concrete mix

Map 4.3 Site view of Nimbus gallery, Ikoyi, Lagos
Source: Google Earth (2021)

4.4.3.1 Overview

Nimbus gallery was built in 1970. It is notable as a place to go and appreciate various works of art. Located in the serene environs of Ikoyi, the Nimbus gallery seeks to promote and develop visual art and artists by promoting them and their work. It was later developed by Tola Akerele. Housed in a two-storey building. The building was initially a residential building but has now been converted to the gallery and one would never

guess it was once a residential building because it looks like it was purpose built. The Bogobiri empire is a traditional building. The building is a two-storey building with external features like a hotel name Bogobiri house, and shops for artefacts and books. On entering the site of the existing development, to the right sits an art and craft shop and a gate house with an exterior shattered glass finish.

Plate 4.19 Approach view of Nimbus gallery, Ikoyi, Lagos
Source: Author's fieldwork (2021)

4.4.3.2 Spatial Analysis

The main building has its entrance directly opposite the site entrance welcoming the visitors with shattered glass finishes on external wall. The gallery is housed on two levels. The building entry has a headroom of 3.6m and has a library for traditional books. the building consists of exhibition hall which is on the first floor, the bar and a space for live band and jazz which is on the ground floor. There are also two sit outs used for specials

exhibitions and event which are in front and behind the exhibition spaces respectively. The building also houses various spaces like stores and offices.

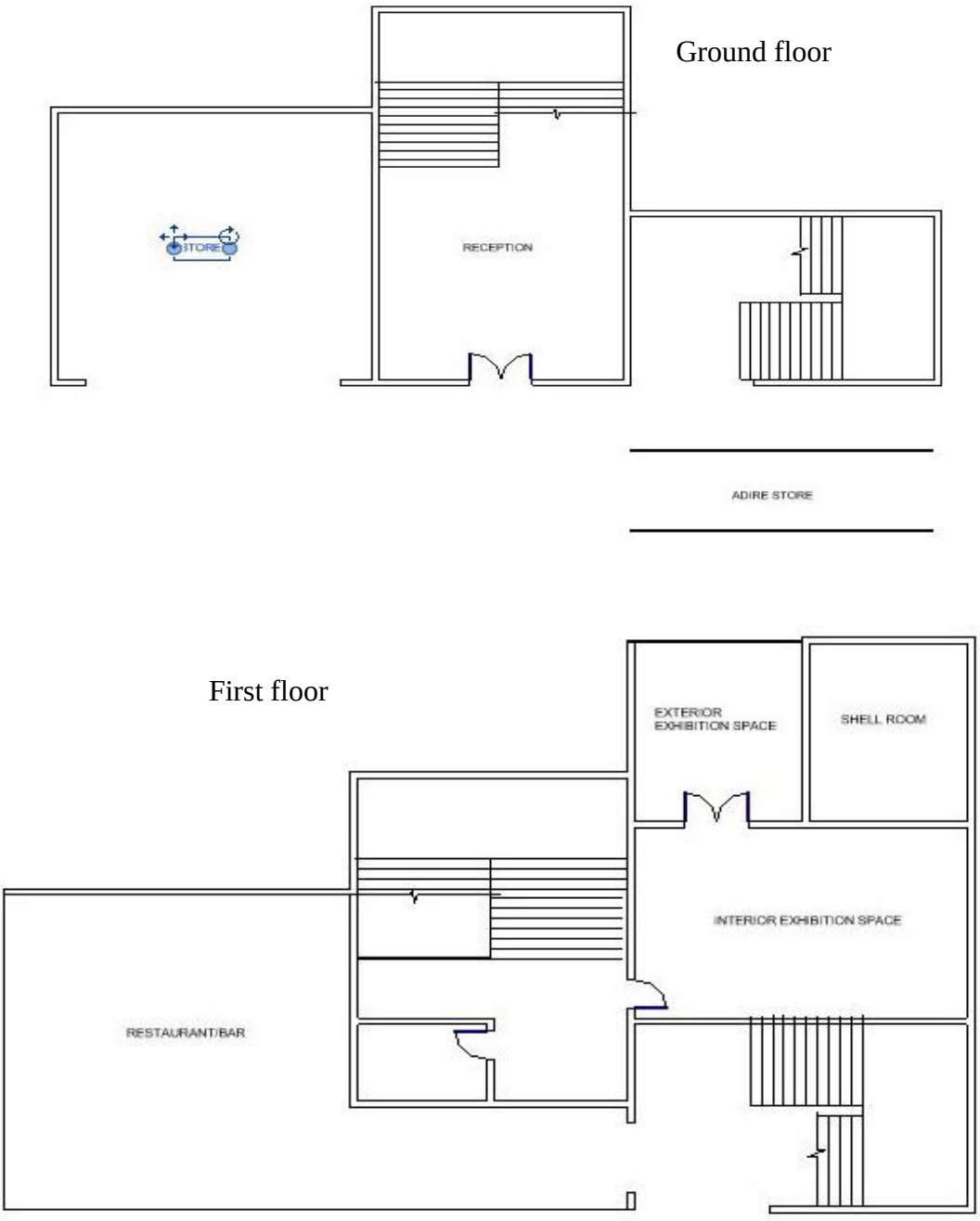


Plate 4.20 1Floor plans of Nimbus gallery, Ikoyi, Lagos
Source: Author's fieldwork (2021)

4.4.3.3 Building Component: Wall, Roof, Ceiling, Floor

The gallery's walling system is made of concrete masonry units, reinforced concrete columns, glass, stones, steel, bamboo and waste materials in artistic expressions. The supporting building is made of concrete masonry units, bamboo, stone and glass. The exterior wall finishes consist of stick-on pebbles, and shattered glass. The interior wall finishes consist of white wall paint, full wall glass and shattered glass. The finishes also have artistic and rustic ornaments.

Plate 4.21 Interior views showing the walling system of Nimbus gallery, Ikoyi, Lagos
Source: Author's fieldwork (2021)

The building has a brown asbestos roof covering, while the roof eaves soffits are finished with an asbestos boards and timber battens. The ceiling of the gallery is finished with timber panels. The external flooring system is made of a concrete mix and shattered ceramic tiles. The internal floor finishing system is mainly shattered glazed ceramic tiles on a concrete mix.

Plate 4.22 Flooring finishes used in Nimbus gallery, Ikoyi, Lagos
Source: Author's fieldwork (2021)

4.4.3.4 Building Services

Wall mounted air conditioning units are strategically placed on each floor due to lack of openings into the spaces. The stores are ventilated both naturally and artificially. The gallery makes use of electric power supply by the National grid and also has an alternative power supply generator located at rear of the site. Water is supply through the use of borehole water system stored in tanks positioned at behind the toilet.

Plate 4. 23 Air conditioning units used in Nimbus gallery, Ikoyi, Lagos
Source: Author's fieldwork (2021)

4.4.3.5 Structural System

The building has a structural system of reinforced concrete columns and beams. A timber frame structure supports the roof while the loadbearing wall are used for the building.

4.5. Interviews

Interviews were carried out at the locations of the case studies on the staff that work at the art galleries. As the interview was semi-structured, the respondents were allowed to deviate from the specified guide on occasion. The respondents found some questions to be uninteresting, however, several areas of the survey were discussed in depth by respondents. The interview was designed to provide insight on the more technical aspects of the day-to-day running, lighting, and developing an art gallery. In order to establish themes for the phenomenological study, a minimum of 4 people were interviewed. Two of the interviewees were gallery workers, while the other two were artists (with backgrounds in architecture). Both in-person and phone interviews were conducted. A

digital recorder was employed, unless the respondent specifically requested not to be recorded.

4.5.1 Further Notes on the Interviews

During the interviews, both of the gallery staff claimed fairly categorically that they were less qualified to respond to questions about lighting. One such respondent stated that all lighting selections were left to the architect in charge of the design. "Whatever the architect gives us, the gallery and the artists adapt." In the semi-structured interviews, specific questions were brushed off. Nonetheless, the respondents provided insight into concerns other than illumination, such as the day-to-day running of an art gallery. Two of the interviews were carried remotely by phone calls and using voice notes sent online via messaging platforms, which means some of the indicators and cues that one would notice in a one-on-one interview scenario were missed by the researcher.

4.6. Site Analysis Results

Towards the objective of proposing the art gallery design, a project site was located in Lekki, Lagos. This section of the chapter presents the analyses of particular features of the site. The analysis shows data on the location of the site, the climatic data, topography, accessibility, vegetation, as well as the intended actions to integrate or counterbalance these features. The Ultraviolet index and visibility averages are also presented for the chosen location.

4.6.1. Site Location

The proposed site for the intended art gallery design is located in Lekki, Lagos. It is bordered in the west by Freedom Way and to the south by the Lekki-Epe Express Way

Map 4.4 Site location in Lekki, Lagos
Source: Google Maps (2021)

4.6.2. Site Selection Criteria

There are two significant approaches to increase the number of prospective visitors when selecting potential sites for art galleries: additional attractions and the positioning and spatial layout of the art gallery. The siting in the city centre is ideal, especially if there is a concentration of mixed-use developments nearby. A location that is convenient for visitors while also encouraging them to return is first-rate and ideal (Lord & Lord, 2002). The suitability of the selected location for the proposed art gallery design is premised on the following criteria:

A. Conformity with Development Plan of The State Government

The selected site can be easily accessed through the truck-B road connecting the Lekki toll gate and Epe. The site location is providing proximity to the reserved government area and places of attraction for tourists such as Elegushi beach, Lekki Conservation Center, and several others. This will encourage a more significant number of visitors from all around the State to access the site easily and, likewise, travellers.

B. Nearness to existing infrastructure

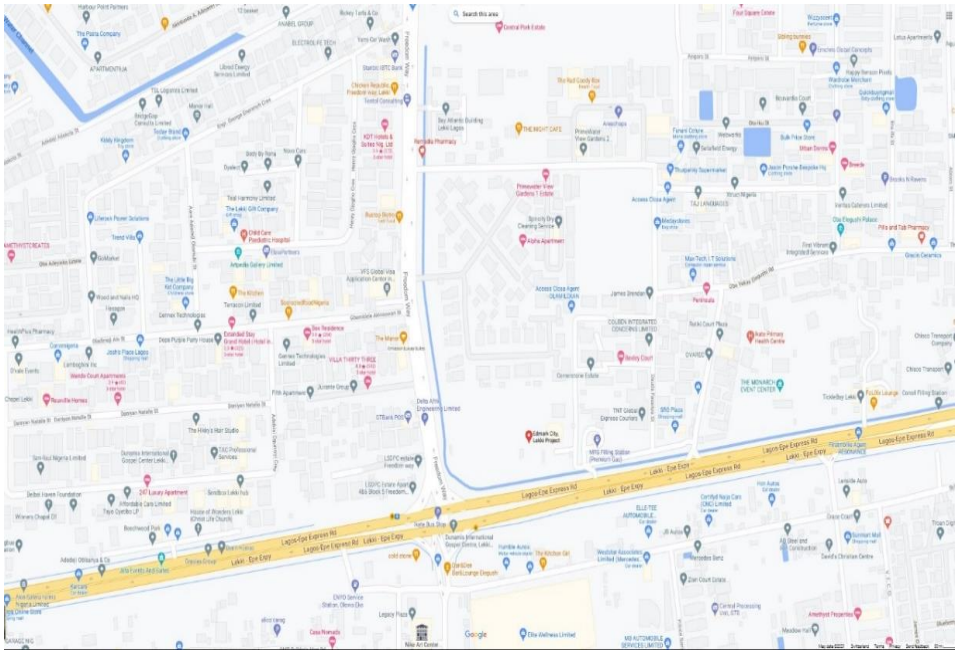
The site is located near existing infrastructure facilities such as roads, power lines, and water supply. The proposed development will further contribute to the expansion of urban development around the vicinity of the site.

C. Land Availability and Visibility of the selected site

For the project, it is estimated that a sizable piece of land was required for the building design. The property was selected because it covers up to 17,000 square metres of land space which is estimated at around 1.7 hectares to be adequate. The selected site will make the art gallery easily accessible by persons moving along the road where the site is located.

D. Proximity to places of attraction

The selected site has a good proximity factor to well-known places of interest, such as the Freedom Park, Lagos, Festac town, The Nike Art Gallery, Tafawa Balewa Square, and the Cathedral Church of Christ, Lagos.



Map 4.5 Map showing the Proximity of Places of Attraction
Source: Google Maps (2021)

4.6.3. Climatic Data

For an insight into the climate data in the Lagos Lekki region, all data were obtained from WorldWeatherOnline.com the data looks at the averages of the various aspects over a year within the context of the site.

A. Rainfall Data

Lekki has a seasonal rainy season. The total amount of rain, measured in millimetres and averaged over a year, reaches a high of 490mm in July. Rainfall drops to roughly 360mm during the August break and then surges back up to 480mm by the end of September. Rainfall gradually decreases from then on, corresponding with the "Harmattan" or dry season, until it reaches a low of 0mm on average at the end of the year. The dry season lasts until the beginning of May, when occasional rainfall of roughly 170mm occurs (World Weather Online, 2021).

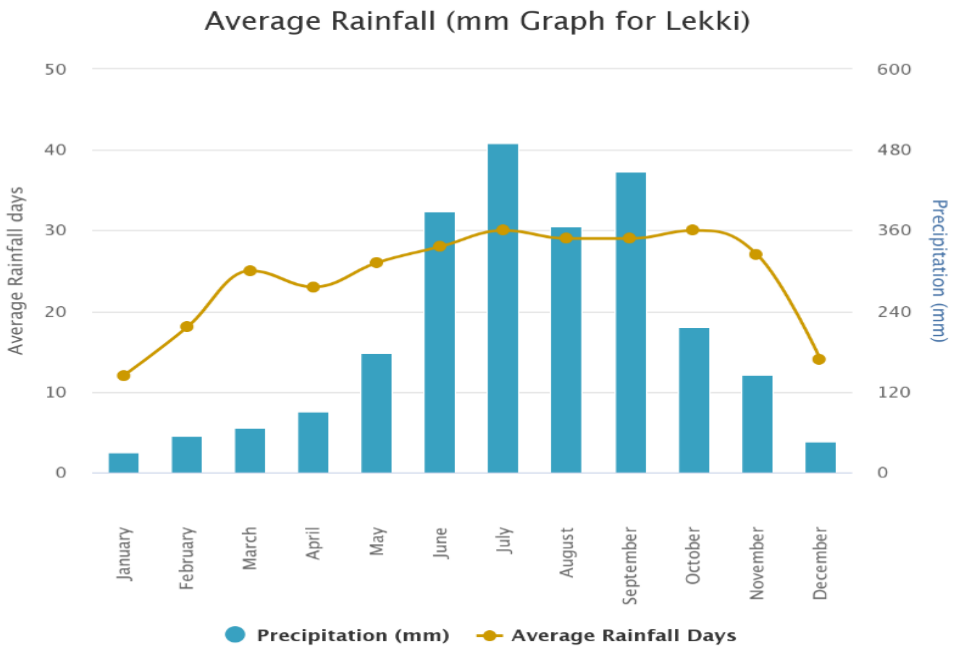


Chart 4.6.1 Average rainfall in Lekki, Lagos, Nigeria
Source: World Weather Online (2021)

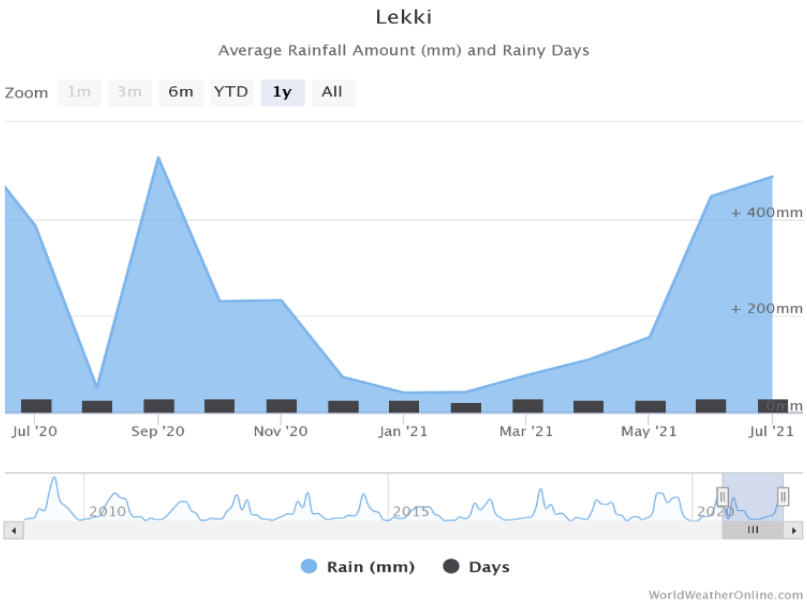


Chart 4.6.2 Average rainfall Amount in Lekki, Lagos, Nigeria
Source: World Weather Online (2021)

B. Wind Data

Wind speeds and gusts in Lekki are at their maximum for the entire year right before September. Wind speeds gradually increase from +13.7kmph in January to +15.5kmph at the peak, then gradually decrease to just below +12.5kmph at June. The wind vane for Lagos in chart 4.6.4 illustrates that the wind is primarily from the south west coast, where the Atlantic Ocean meets Lagos.

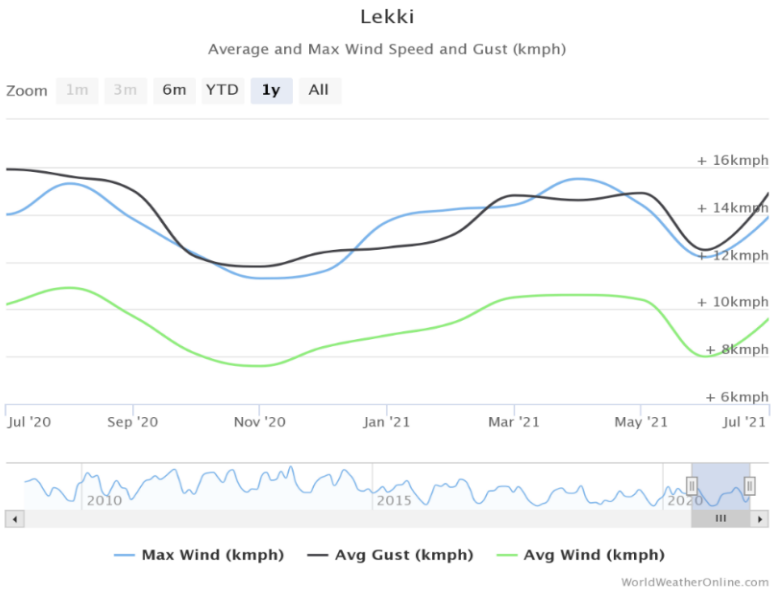


Chart 4.6.3 Line chart showing average wind speed in Lekki
Source: World Weather Online, (2021)

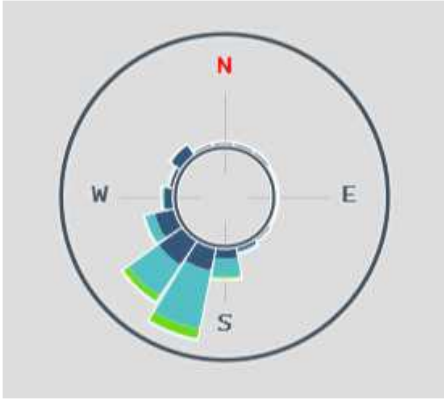


Chart 4.6.4 Wind Rose for Lekki
Source: World Weather Online (2021)

C. Temperature

For a year in Lekki, the average temperature is high or very high. The maritime mass influences the area during the rainy season, and the average maximum temperature ranges from 28 to 35 degrees Celsius. The daily average temperature is roughly 25 -28 degrees Celsius. The Harmattan period, or dry season, is dominated by north-east trade

winds. Temperatures drop at night, but daytime averages of up to degrees Celsius are maintained.

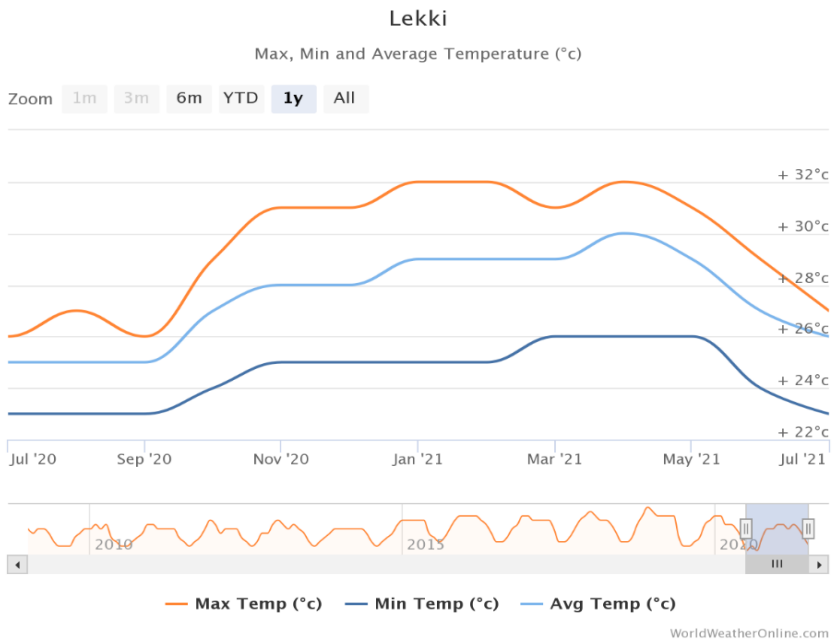


Chart 4.6.5 Line chart showing maximum, minimum and average temperature in Lekki
Source: World Weather Online (2021)

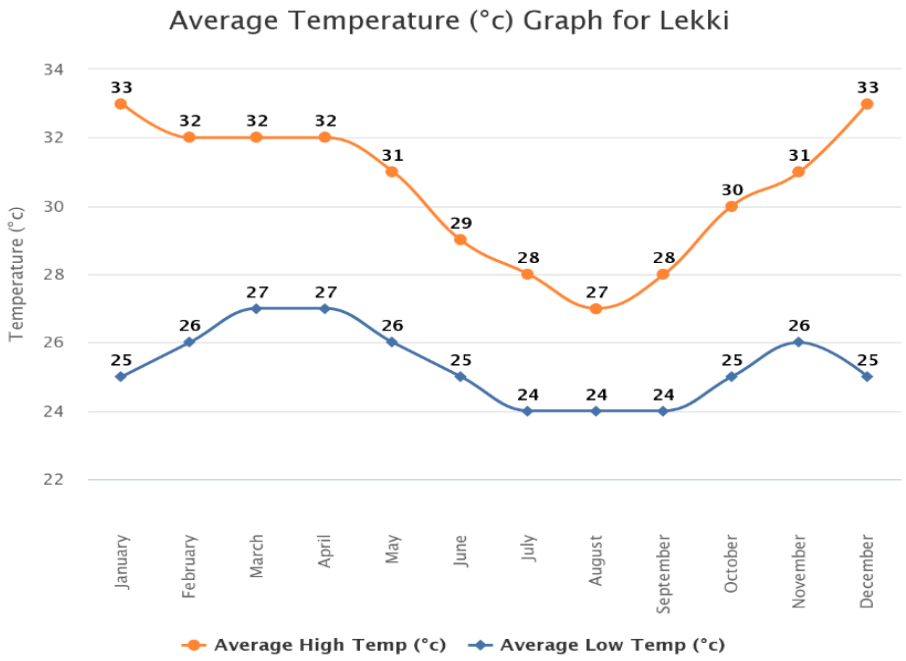


Chart 4.6.6 Line chart showing temperature in Lekki
Source: World Weather Online (2021)

D. U.V Index

According to the World Health Organisation, the Ultraviolet index measures how likely a person is sunburnt in a given region, and it is measured on a scale ranging from 1-11. In Lagos, the Ultraviolet index maintains a high level all through the year with the minimum in the months May through September and December is around six and the maximum of 8 in March, April and November and December. The ultraviolet index is also relevant to the preservation of art. Such high levels of UV radiation indicate the need for more precaution administering daylight in spaces.

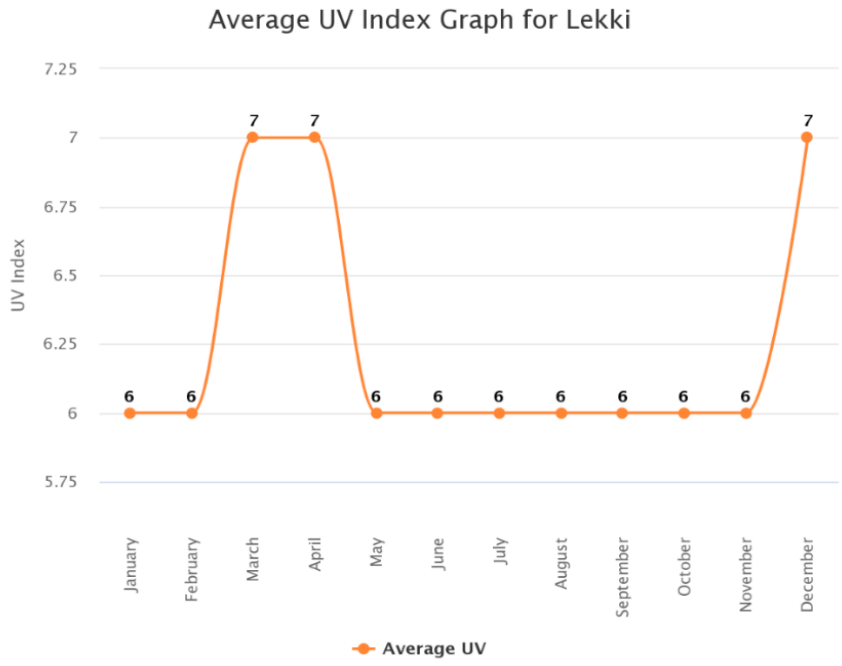


Chart 4.6.7 Line chart showing Average UV Index Graph in Lekki
Source: World Weather Online (2021)

Chart 4.6.8 Bar chart showing average UV index in Lagos
Source: World Weather Online (2021)

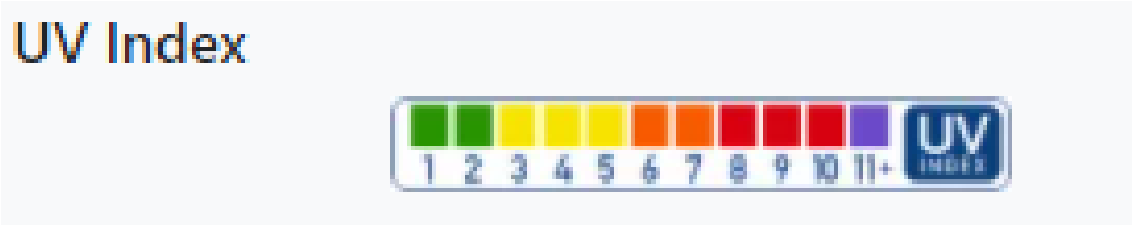


Figure 4.1 U. V index scale
Source: World Weather Online (2021)

4.6.4. Impact of Climatic Features of The Site on The Proposed Art Gallery Design

The site location is characterized by high precipitation rate, a wide temperature range temperature and large amounts of sunshine with high relative humidity. This has a significant influence on the design of the building and the site. The high precipitation rate and the natural slopes on-site infer that the site must be adequately drained to avoid flooding and the formation of water pools. The roof must able to effectively provide adequate runoff due to the high rate of precipitation in the region. The roof must be well-

drained to prevent the excess accumulation of water which become additional live loads on the structural frame of the building and could become a potential hazard. The high amount of rainfall in Lekki, Lagos is caused by the high relative humidity in the atmosphere, this should inform the kind of exterior materials to be specified and the type of finishes to be determined to prevent decay and rust. Due to the high amount of sunshine and high temperature of the site, the design must respond using passive design strategies to improve the thermal comfort of the potential users of the building. A well-oriented building form that is adequately insulated should be adopted while incorporating shading devices to meet the requirements induced by the site. The interior spaces should also be well ventilated to promote thermal comfort within the building and negate damage to the preserved exhibits. The prevalent winds are from the south-western and southern direction, and the design should be appropriately oriented to harness the natural breeze from the Atlantic for natural ventilation. The structural design should also cater to the high wind speeds between 12Km/hr and 28km/hr, considering the lateral wind loads on the building. The adoption of the sunlight within spaces must incorporate materials that filter out excess UV radiation and cater to preservative requirements of the artwork on display. The employment of extensive overhangs may serve as a countermeasure to the high levels of radiation and also allow for the admittance of diffuse light into the building envelope.

4.6.5. Site Characteristics

4.6.5.1. Site Analysis

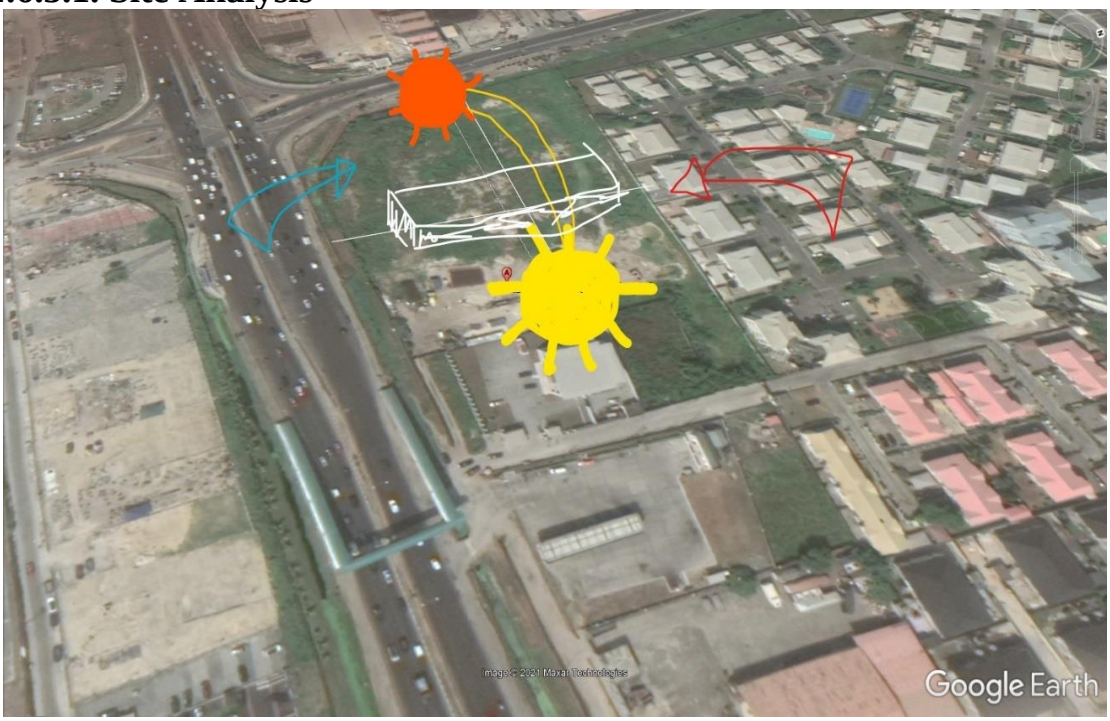


Figure 4.3 Sketch of initial site analyses
Source: Google Maps (2021)

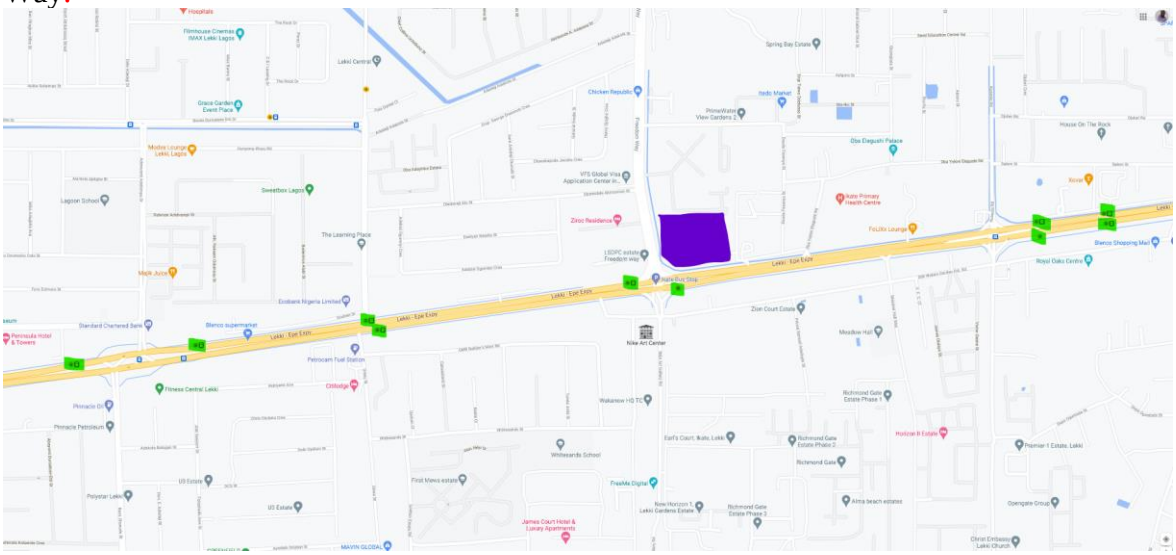
A. Geographical Location

The site is located at longitude 6.433735, Latitude 3.482806 in Lekki, Lagos, Nigeria

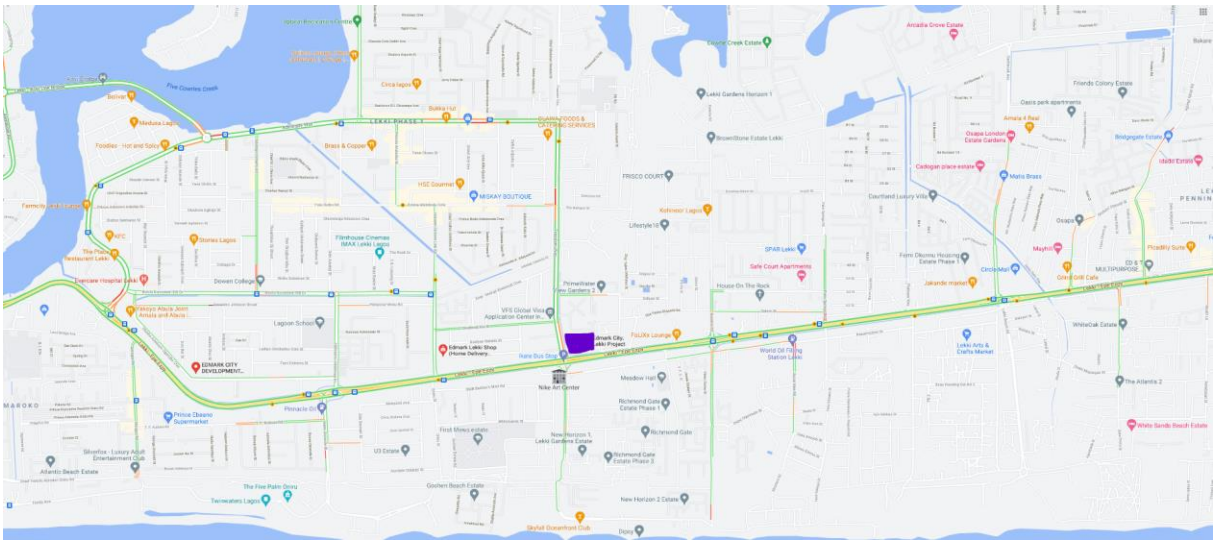
Map 4.6 Site Location;
Source: Google Maps (2021)

B. Accessibility

The site is located along the Lekki-Epe Express Way and can be assessed though Freedom Way.



Map 4.7 Map showing nearby Bus stops (Highlighted green)
Source: Google Maps (2021)



Map 4.8 Map Showing major access routes to site
Source: Google Maps (2021)

C. Sunrise and Sunset

The sun rises at about 6:00am and sets at about 6:30pm on the site. A building envelops that will minimize the negative impact of solar radiation will be conceptualized. To

counterbalance the high temperatures and UV index, large overhangs and other shading devices will be employed.

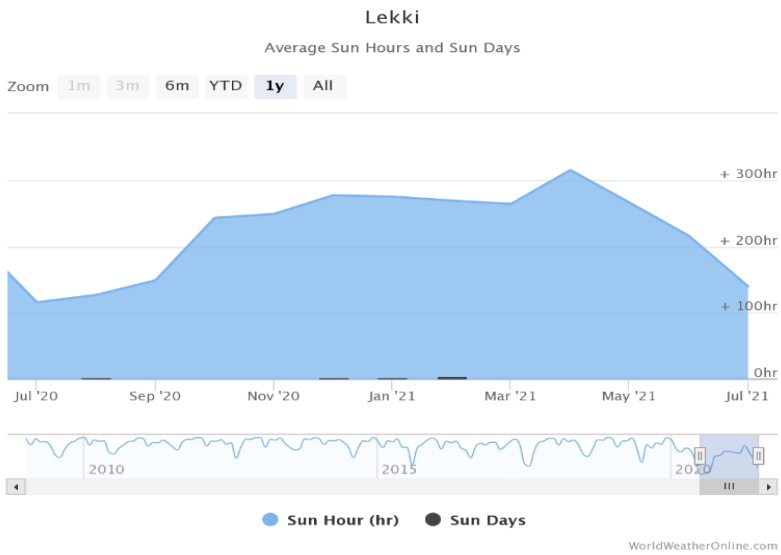


Chart 4.6.1 Area chart showing average Sun hours and days in Lekki
World Weather Online (2021)

D. Vegetation

Shrubs, grasses and deciduous trees densely vegetate the site. An expanse of greenery will be designed to modify the microclimate within the proposed art gallery and to make the environment more aesthetically pleasing

Plate 4.24 Longitudinal topographical profile of site
Source: Google Earth (2021)

E. Topography

As illustrated in the elevation profiles below, the site is relatively flat. It gently slopes from the south to meet a slope from the North forming a shallow trough with the lowest point 0.75 metres deep measured against the highest point in the northern site boundary. From the east, the site gently slopes towards the West.

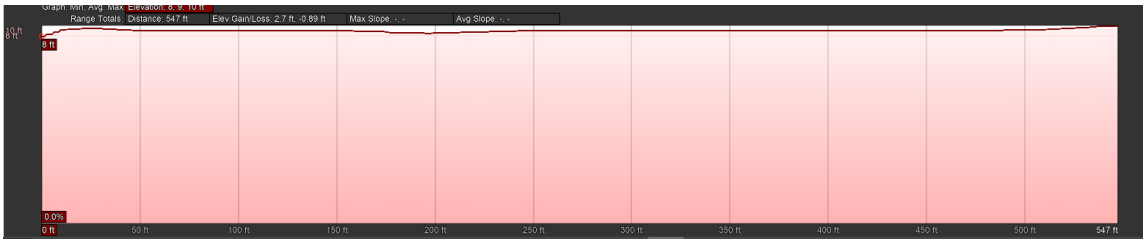


Figure 4.5 Longitudinal topographical profile of site
Source: Google Earth (2021)

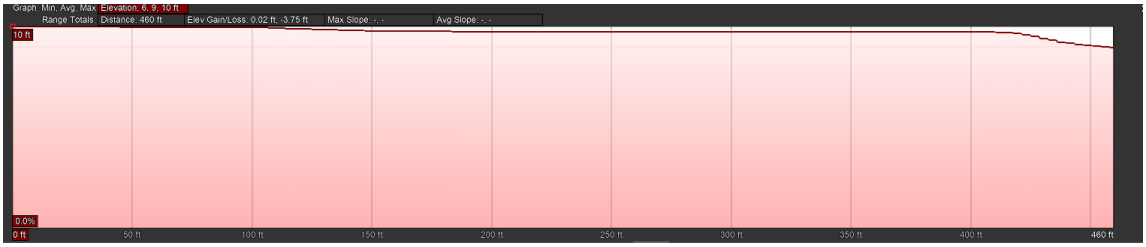


Figure 4.6 Latitudinal topographical profile of site
Source: Google Earth (2021)

F. Adjoining developments

To the west of the site is Freedom Way Road, while to the east lies Wema Bank., an institutional development. In the south, lies the Lekki-Epe Express way providing the first access point to the site and to the North are residential developments.

Plate 4.25 Adjoining development around the site (Wema Bank)
Source: Author's Fieldwork (2021)

Plate 4.26 Adjoining development around the site (Wema Bank)
Source: Author's Fieldwork (2021)

Plate 4.27 Adjoining development around the site (Residential Buildings)
Source: Author's Fieldwork (2021)

4.5. CHAPTER SUMMARY

The discourse in this fourth chapter has given a detailed account of the data collected, results derived from the survey and case studies carried out per the objectives of the research as stated in the first chapter. It has also described the results obtained from the analysis of the proposed site for the design of the art gallery. All this was carried out to proffer sufficient knowledge of the components, features and spatial requirements of an art gallery all in a bid to aid the design stage.

CHAPTER FIVE

DESIGN CRITERIA AND APPROACH

5.1 OVERVIEW

This chapter focuses on the research work's fifth objective, which was defined in the first chapter: "Develop an art gallery and exhibition center be designed to focus on complying with efficient lighting systems and strategies." The topics of this chapter explore design criteria and approaches. The design process is determined by preliminary factors and design considerations, which are presented and addressed. They include the functional and space requirements, functional links between these spaces, legal and planning regulations, and the overall development process of the proposed art gallery.

5.1 PROJECT AIM

The project is aimed at proposing an art gallery and exhibition center to be designed to focus on complying with efficient lighting system and strategies for Radr Online, situated in Lekki, Lagos State, that will help to increase and enhance the visual quality and visual comfort of the visitors. This is to be achieved by infusing lighting systems and strategies to create a building envelope with a malleable interior that effectively accommodates the needs of the art galleries at minimal cost to the stakeholders. The project will focus on having spaces that can be adapted to fit any exhibition ranging from the traditional arts to digital arts

5.2 DESIGN OBJECTIVES

i. Analyse site properties and characteristics of adjoining properties

ii. Identify the spatial requirements and spatial functions in an art gallery

iii. Implement appropriate lighting systems and strategies as identified in studies in the design of an art gallery.

5.3 FUNCTIONAL AND SPACE CRITERIA

The functional and space criteria are the spaces considered for this art gallery and exhibition space to be fully functional and efficient. For the purpose of this project, the spaces have been grouped into three units which are:

a. Exhibition Unit

b. Ancillary Unit

c. Commercial Unit

d. Support Unit

5.3.1 Exhibition Unit

This unit accommodates all the spaces for exhibitions as well as the support facilities servicing them. The exhibition spaces can be designed to be adaptable, which allows the space to be a large exhibition, as well as having the capacity to be separated into three smaller exhibition halls.

Table 5.1 Spatial analysis of Exhibition Unit

SPACE	SPACE DESCRIPTION	SPACE FURNITURE
Exhibition space	This accommodates all the spaces for exhibitions as well as the support facilities servicing them. The exhibition spaces can be designed to be adaptable, which allows the space to be a large exhibition, as well as having the capacity to be separated into three smaller exhibition halls	Custom
Control room	This is the room where the audio and visual quality of performances are being monitored	Shelves Chairs Tables

5.3.2 Ancillary unit

The ancillary unit in the building serve as a support facility to the art gallery by housing the administrative and operation arm of the gallery. The spaces in this unit are offices, store room, guard room, lounges, and studio.

*Table **5.2** Spatial analysis of Ancillary Unit*

SPACE	SPACE DESCRIPTION	SPACE FURNITURE
Offices	This space is used for commercial and administrative activities.	Chairs Tables Shelves
Storage	This space is used to store temporary artworks that have or will be put up for display in the gallery.	Chair Table Shelves
Lounges	This space is used to accommodate the visitors for relaxation and recreational purposes	Custom chairs, tables
Workshop Studios	It is used for educational purposes and can be used for private and corporate events.	chairs, tables Platform
Artist Studios	It is used for private purposes for artist to work in	chairs, tables

5.3.3 Commercial Unit

Though the building is designed to be an art gallery and exhibition center, there needs to be an avenue for the owners to make money irrespective of whether its art season or not, hence the addition of commercial spaces. These commercial spaces are money-making ventures of the facility to keep the place running, the spaces in this unit include: a store, restaurant, lounge.

Table 5.3 Spatial analysis of Commercial Unit

SPACE	SPACE DESCRIPTION	SPACE FURNITURE
Store	This space is used for sales of souvenirs and gift items.	Chairs Shelves
Restaurant	This space is used to cater to the welfare of the audience before and after performances with the provision of food and drinks, it can also be used as an event space	Chairs Tables
Lounge	This is the room where dignitaries and executives can relax before a show	Chairs Tables

5.3.4 Support Unit

The support or service spaces are designed to help with the daily running of the art gallery.

The unit includes the control room, server room, mechanical room, CCTV room et cetera.

Table 5.4 Spatial analysis of Support Unit

SPACE	SPACE DESCRIPTION	SPACE FURNITURE
Server room	This space is used for housing servers	Server Shelves
Mechanical room	This space is used to control the auxiliary support unit of the building	Chairs Tables
CCTV	This is the room where security is monitored	Chairs Tables

5.4 Functional Requirements

5.4.1 Parking Facilities

The parking space provided in the art gallery design should be sufficient for both visitors and staff. Consideration should be given to providing services for buses that may be conveying groups and tours, delivery trucks as well as other vehicles for support

facilities in the art centre. It will also be necessary to provide accessible parking for the staff and visitors that are differently-abled.

5.4.2 Conveniences

All through the design scheme, it is necessary to provide toilet facilities for male and female users and staff. Staff toilets are, for the most part, to be separate from those of the visitors. Baby changing facilities and cleaner's stores will form a part of the conveniences, and it is necessary to provide accessible toileting facilities for the differently-abled.

5.4.3 Outdoor Circulation

The site will be planned in a manner allowing smooth movement of visitors and staff around from the points of ingress, car parks and, out to the points of egress. The flow of the site design should favour pedestrian movement while being accommodating of vehicular traffic. Site circulation routes must take into cognisance the differently-abled.

5.4.4. Indoor Horizontal and Vertical Circulation

The design of circulation within the building envelope encompasses the vertical and horizontal movements by users as well as staff across the different levels. The circulation will be designed to optimise not just exhibitions but the day-to-day running of the art gallery in other departments. Corridors, staircases, elevators, ramps etc. are to be as accessible as possible to facilitate seamless translation of users and staff

5.4.5. Other Functional Requirements

5.4.5.1. Lighting

Based on data gathered, the design will incorporate the use of both daylighting and artificial lighting. Dividing the spaces into exhibition, art creation and general spaces; the different locations will favour artificial light or daylight as deemed appropriate. To summarise, the art exhibition spaces will incorporate both but favour artificial light, and the general and art creation spaces such as the workshops will favour daylight even with

the incorporation of artificial light as well. With all the aforementioned benefits of using daylight, it will be implemented in the following ways according to the guidelines identified in the course of the literature review.

a. Use of laminated glass for all fenestration on the building complex
b. Use of clerestory windows
c. Reflective blinds
d. f. Application of reflective surfaces within rooms to diffuse light
e. g. Use of Light shelves which allows for controlled reflected light into the spaces
f. Transparent insulation on building envelope
g. j. External reflectors
h. k. Use of top lighting with adequate filters

5.4.5.2. Artificial Lighting

Artificial lighting is human made and allows more control and variety within the building. The different versions of artificial light to be used will include:

1. Task lighting: Task lighting will be used in specific locations for particular functions or tasks. They will be found in spaces like the studios.

2. Accent lighting: Accent lights will be used to draw focus and lay emphasis. It will be mainly applied within exhibition spaces. Floodlights, spotlights etc. are examples of accent lights. They may be used to highlight edges, faces and boundaries within selected spaces.

3. Mood lighting: Mood lights are used for the more general spaces, and will create particular moods or atmospheres. They are primarily decorative and can help create awareness or prepare the minds of visitors for specific spaces.

5.4.5.3. Ventilation

The art gallery should be adequately ventilated to facilitate adequate thermal comfort, which would improve staff and visitor comfort level while creating a conducive environment. Conditioned air should be provided in the exhibition galleries and conservation unit because exhibits are prone to damage and contamination by particles and dust in unfiltered air.

5.4.5.4. Noise Control

The level of noise within the art galleries and exhibition spaces shall be reduced to a bearable minimum where possible. Active and passive means of sound/noise control will be applied, such as the use of absorbent or reflective materials and adequate zoning, respectively.

5.4.5.5. Controlling UV Radiation

To allow the safe use of daylight within spaces, particularly the exhibition spaces, laminated glass will be used. Laminated glass is comprised of multiple layers of glass with one or more layers of transparent or tinted glass, specially treated plastic Polyvinyl Butyral (PVB) and sandwiched between the glass layers. The glass panes (layers) may be made of regular glass or tempered glass for added strength. Laminated glass has the following properties; Apart from combating noise by the extra insulation layer, heat is also controlled by the use of laminated glass. Ultraviolet light is the leading cause of deterioration and fading of furnishings, pictures, and fabrics. In Lagos, the site location of the UV index is well above average throughout the year. Laminated glass screens out 99% of the sun's UV radiation, protecting displays or exhibits from fading. The laminated glass retains colour and strength for the life of the building and is as easily cleaned as any conventional glass.

5.4.4.6. Display Techniques.

To maintain the attention of the guests and ensure effective communication by the various media, the display techniques employed deserve careful consideration within all exhibition spaces. Display techniques employed shall include:

i. Walls: In the exhibition halls, the walls form the display surface for a majority of the exhibits. They are primarily utilised for the flat works such as murals, paintings, drawings, etc. Walls give flexibility when it comes to colours and texture of display surfaces as they are more easily altered. Walls may be fixed or adjustable and as such, can help with a variety of arrangements that keeps the exhibition fascinating. Walls also differ in shape and geometry; each with a differing effect. For example, curved walls will instil a more transitional feel and will be used in those transitional spaces.

ii. Panels: Panels are in truth highly similar to walls. They are, however, far more flexible. With panels, one can more easily alter the spaces, and some panels may even be suspended within different spaces. Panels also come in different shapes and sizes, and for the optimal arrangements and designs, other experts on exhibition will be needed from time to time. Panels in the plan are to be used in tandem with walls as complimenting elements to further aid flexibility in the exhibition rooms. Typically, a panel will be installed with independent lighting above, within or around it.

iii. Cases: Cases are specified usually for 3D exhibits but may be used for 2D works as well. They serve to protect works from theft or damage.

iv. Outdoor exhibits: Outdoor exhibitions are to be geared towards more durable artworks such as metal, concrete, marble etc. sculptures. They will take place typically for short periods in the exterior spaces provided and only a few of the exhibits

5.4.4.7. Safety Precautions

Passive and active measures should be taken to avoid and control the incidence of fire; to safeguard lives and property. The speedy exit of people in the case of a fire should be carefully considered using multiple exit points as well as a well-located muster point. Provision should be made for appropriate fire prevention systems while still acknowledging the unique needs of an art gallery. For security, alarms, use of guards and closed-circuit monitoring should be provided around the art gallery site and within the museum building. It is also paramount to specify materials with the requisite fire ratings and so on. Sensitive areas should be zoned such that they are under surveillance and kept more private to deter theft.

5.5. LEGAL AND PLANNING REGULATIONS

Per the Physical Planning Department of Lagos State and the National Building Code, the set guidelines for any physical development in Lagos and Nigeria, respectively include building lines and setbacks, safety requirements, height restrictions and other requirements as stipulated. These guidelines are also specific to project types and location In Lagos State the regulations in place, for commercial developments the minimum include the setback from the front of the site; 9m, 6m form and the side and end of the site boundary. Aluko (2011), states that the maximum coverage for commercial land use, i.e., the amount of built-up area on a site, should not exceed 70%. The National building code classifies art galleries, museums and art centres as Group a building. They are termed as “assembly”. The classification describes requirements for the provision of parking facilities and conveniences. The minimum required number of plumbing fixtures for group A-3 (Assembly) which includes museums, galleries, lecture halls, auditoriums without permanent seating and libraries is shown below in table 5.5

Table 5.5 Plumbing fixture requirements

Plumbing Fixture	Male	Female
Water Closet	1 per 125	1 per 65
Lavatories	1 per 200	1 per 200
Drinking Fountain	1 per 500	1 per 500
Urinals	Maximum substitution of 50% of the required water closet	
Other	One service sink	One service sink

Source: International Plumbing Code, (2000)

The required minimum standard for parking facilities for cars, cycles and accessible stalls for use in group A-3 (Assembly) which includes museums, galleries, lecture halls, auditoriums without permanent seating and libraries is shown below

Table 5.6 Parking requirements

Parking Spaces for operational use	Car Park for attendees	Cycle Park for staff	Cycle Park for short term stay	Accessible parking for up to 200 bays	Accessible parking for more than 200 bays
1	1/45 SQM	1/10 employees	1/30 SQM of public floor space	Three bays or 6% of total capacity whichever is greater	Four bays plus 4% of the total capacity

Source: Cardiff Council (2010)

5.6. BEHAVIOURAL AND AESTHETIC CRITERIA

The Design typology has no strict guideline for appearance in Lagos. It must however serve functions of exhibition and art creation with the implemented programme. The use of materials and design for light must aid this primary function. The intention is to model

an eye-catching design that attracts a reasonable audience and reminds one of sculptural art pieces itself.

CHAPTER SIX

DESIGN PHILOSOPHY, CONCEPTUALISATION AND PROPOSAL

Design impacts the world covertly or overtly in passive or active ways. Great design is beyond impressive aesthetics. It also includes how well the spaces are planned and laid out to how well the structure stands and seamlessly blends into the immediate environment amongst other structures in the built environment and, finally, its impact on the environment. It is only then that designers and users experience the bustle impact of a design. Below are the guiding philosophy, concepts, and justifications that served as an inspiration to guide the final conception of the proposed development; Art gallery.

6.1 Design Philosophy

The research influenced the design philosophy carried out to enhance human visual quality within an exhibition space in an art gallery using both daylighting and artificial lighting. The design considered both lighting strategies in the art gallery. This also helps to create grander proper integration of both strategies. Hence the project was focused more on the functionality of each space concerning lighting of such spaces.

6.2 DESIGN CONCEPT JUSTIFICATION

The concept of this design came as a result of identifying the various functional units present in the design with the aim of adequately lighting them with the use of either daylight or artificial light or both. The building uses a parametric façade with the use of curves to accentuate the aesthetics. The façade would be used to introduce various approaches of daylight integration such as skylight, top lighting, clerestory lighting.

6.3 DESIGN DEVELOPMENT PROCESS

The design process was thus; first information on suitable lighting techniques was pooled from the survey and other data collection instruments. From the case studies and literature review, yet more design criteria were highlighted. The bubble diagrams and functional spaces followed before the site was zoned and analysed for its unique features. Upon the analysis of the site, the bubble diagrams were revisited, and circulation patterns were drawn up. At this stage, armed with spatial requirement, the next step was to start on the conceptualisation of the form, The form was to satisfy specific aesthetic benchmarks, and by default, functional ones were revisited until it also served to be practical in different regards, but particularly in terms of the lighting scheme

6.4 SITE ZONING

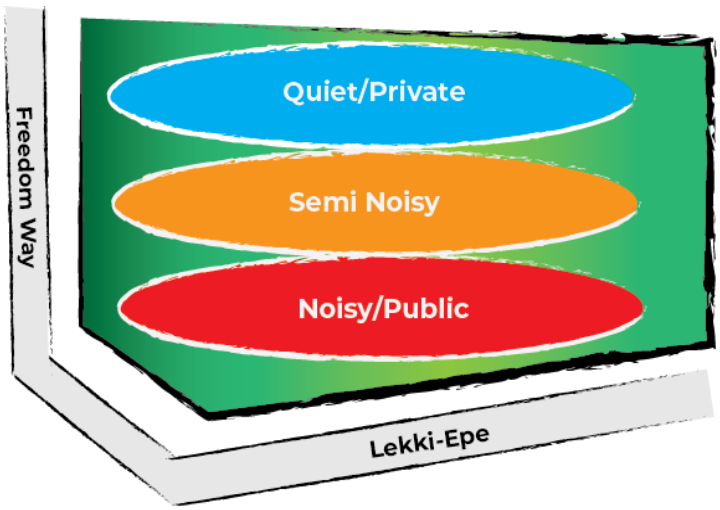


Figure 6.1 Preliminary site zoning based on Noise and Privacy

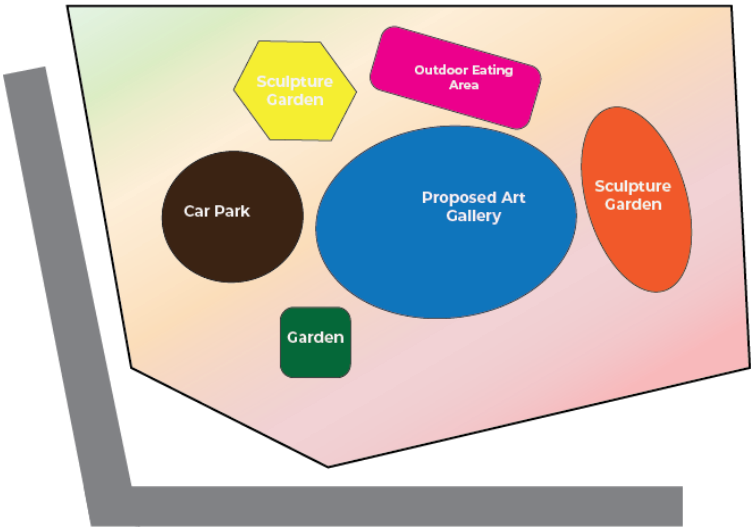


Figure 6.2 Preliminary site zoning sketch

6.5. BUBBLE DIAGRAMS

Figure 6.3 Overview Bubble Diagram sketch

Figure 6.3 Ground Floor Bubble Diagram sketch

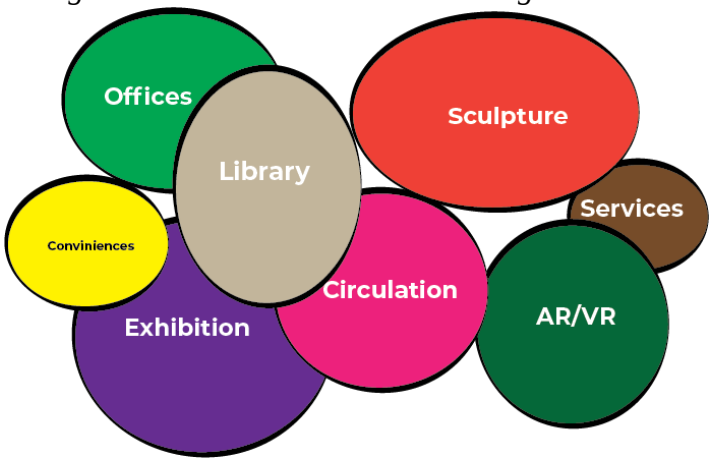


Figure 6.4 First Floor Bubble Diagram sketch

6.6. FLOW CHARTS

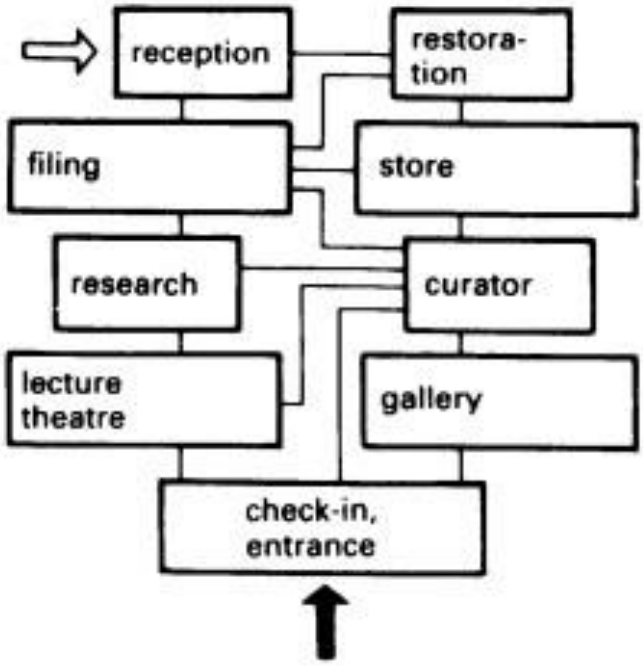


Figure 6.5 Typical Interior circulation pattern

6.7. WORKING DESIGN CONCEPT

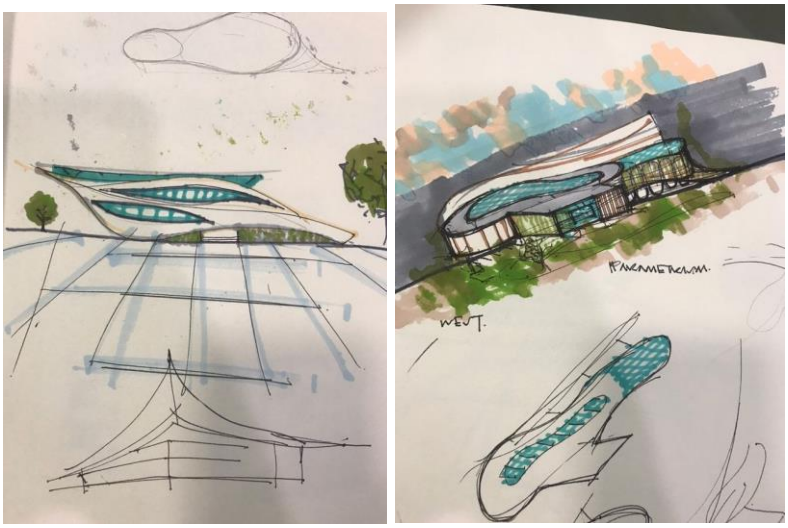


Figure 6.6 Working design sketch concept with use of parametric design

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COVENANT UNIVERSITY SCHOOL OF POSTGRADUATE STUDIES

APPENDIX I

QUESTIONNAIRE

ENHANCING VISUAL QUALITY THROUGH LIGHTING DESIGN IN AN ART GALLERY AND EXHIBITION CENTRE, LAGOS, NIGERIA

Dear respondent,

I am a MSc. Student of the Department of Architecture in Covenant University, currently carrying out research on the "**Enhancement of Visual Quality in an Art Gallery and Exhibition Centre through Lighting Design in Lagos, Nigeria"**. I would like to seek your co-operation in answering the questions below as honestly as possible. I can assure you no part of the information provided would be used for anything other than its intended purpose

SECTION A: BIO-DATA OF RESPONDENTS

Please tick [√] as adequate.

a. **Gender**: Male [ ] Female [ ]

b. **Age**: Below 20 [ ] 21-30[ ] 31-40[ ] 41-50[ ] 51 and above [ ]

c. **Highest level of education**: Primary Education [ ] Secondary Education [ ] Tertiary Education [ ] Postgraduate Education (Masters, Ph.D.) [ ]

d. **Category**: Art Spectator [ ] Artist [ ] Curator [ ] Gallery Worker [ ] Art Student [ ] Architecture Student [ ] Art Enthusiast [ ] Others [ ] Please Specify …….

e. **Employment status**: Student [ ] Employed [ ] Self Employed/Freelancer [ ] Unemployed [ ] Others [ ] Please Specify …….

f. **How much do you earn monthly**: Below ₦20,000 [ ] ₦20,000 - ₦60,000 [ ] ₦61,000 - ₦100,000 [ ] ₦101,000 - ₦149,000 [ ] Above ₦150,000

g. **Where do you reside**: Lagos (Mainland) [ ] Lagos (Island) [ ] Abuja [ ] Port Harcourt [ ]
Others [ ] Please Specify ……

h. **Have you ever been to an art exhibition**: Yes [ ] No [ ]

i. **Which of these art media are you familiar with in an art gallery**? Photography [ ] Digital Art [ ] Sculpture [ ] Drawings/Paintings [ ] Video [ ] AR/VR [ ] Mixed Media [ ] Others [ ] Please Specify ……

SECTION B: Lighting design in an Art Gallery and Exhibition Centre

1. Which of this color(s) is/are suitable for the walls of an art exhibition space? White [ ]
Blue [ ] Yellow [ ] Others [ ] Please Specify ……

2. Which of this color(s) is/are suitable for lighting an art exhibition space? Natural Light [ ] White [ ] Blue [ ] Yellow [ ] Others [ ] Please Specify ……

3. Which of these lighting approaches are you satisfied with in an art gallery? Daylight [ ]
Top Lighting [ ] Side/Directional Lighting [ ] Light Shelves [ ] Others [ ] Please Specify ……

To what degree is the adequateness of the following using the following parameters: **Absolutely inadequate (AI) (1)**; **Inadequate (I) (2)**; **Neutral (N) (3)**; **Adequate (A) (4)**; and **absolutely adequate (AA) (5)**

To what degree are these Indices adequate in the exhibitions you have visited using the following parameters: **Absolutely Inadequate (AI) (1); Inadequate (I) (2); Neutral (N) (3); Adequate (A) (4); and Absolutely Adequate (AA) (5)**

		(1) AI	(2) I	(3) N	(4) A	(5) AA
4	The use of daylight in art galleries and exhibition centers					
5	The use of artificial light in art galleries and exhibition centers					
6	The use of both daylight and artificial light (more daylight, less artificial) in art galleries and exhibition center					
7	The use of both daylight and artificial light (less daylight, more artificial) in art galleries and exhibition center					

		(1) AI	(2) I	(3) N	(4) A	(5) AA
8	The adequacy of the amount/intensity of light available in the entire art exhibition space					
9	The adequacy of the amount/intensity of light available for an artwork					
10	The adequacy of the size of light available for an artwork					

SECTION C: Measure of Visual Performance Characters in an Exhibition Space

11. How much contrast do you experience when viewing an artwork in an exhibition room?
Very Little [ ] Little [ ] Not Sure [ ] None [ ] Much [ ] Very Much [ ]

12. Which one of these Light Distribution techniques are you satisfied with for lighting an artwork? Direct Light [ ] Indirect Light [ ] Direct-Indirect Light [ ]
Others [ ] Please Specify ……

13. How close are you allowed to get to an artwork/exhibit?

Very Near [ ] Near [ ] Neither Near/Far [ ] Far [ ] Very Far [ ]

14. Do you notice if the background on the wall is lighter or darker than the artwork
Yes [ ] No [ ] Not Sure [ ]

15. Have you ever experienced any of these discomforts due to the lighting of an artwork?
None [ ] Headache/Migraine [ ] Itchy/Watering eyes [ ] Glare [ ] Shadow [ ]
Others [ ] Please Specify ……

16. How often do you experience glare when looking at an artwork?
Often [ ] Rarely [ ] Never [ ]

17. How often do you see shadow when looking at an artwork?
Often [ ] Rarely [ ] Never [ ]
If you would like the result of this study, please leave your email address below
……

APPENDIX II

Interview Guide

1) What is the nature of the day-to-day running of the art gallery?

2) What spaces are needed in the art gallery and exhibition center and what do they function as?

3) What sort of lighting design and strategies are currently in place in your art gallery?

4) What is the impact of various lighting systems have on one's sensory experiences?

5) Do you think there are different lighting for interior and exterior?

6) What keeps people coming back to the art gallery?

APPENDIX III

OBSERVATION GUIDE

Section A: Building Information

1. Name of Building:

2. Location:

3. Year of Construction:

Section B: Observations

1. Major Spaces and facilities
2. Interior Building materials
3. Use of Daylight and/artificial light within space
4. The positioning of artworks on display
5. Lighting elements present (Light shelves, reflective panels, shading devices etc.)
6. Nature of Light Apertures (Size, shape and location)
7. Building's Architectural features and characteristics

CONCEPTUALIZATION

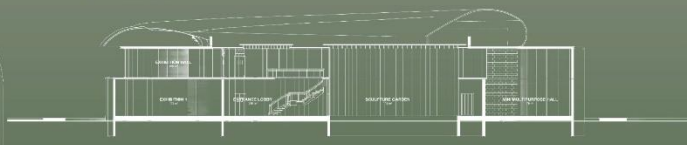
PRESENTATION DRAWING

The CONCEPT adopted in this proposal to achieve proper daylighting and artificial lighting are TOPLIGHTING, SIDELIGHTING, LIGHT DUCTS, REFLECTIVE PANELS, WHITE REFLECTIVE and EMISSIVE, TEXTURES. Adjustable Brice soleils panels were introduced to help adjust and regulate the natural light within the spaces and transparent materials (One way glazing) were implored within to help transmit enough sunlight within.

Ground Floor Plan

Section 1

Section 2



First Floor Plan

ADJUSTABLE BRICE SOLEILS PANELS to regulate sunlight in the interior spaces

HIGH DENSITY PTFE MEMBRANE used as facade to reduce sun intensity, transmit light and serve as aesthetics

Transparent Dampalon Roofing

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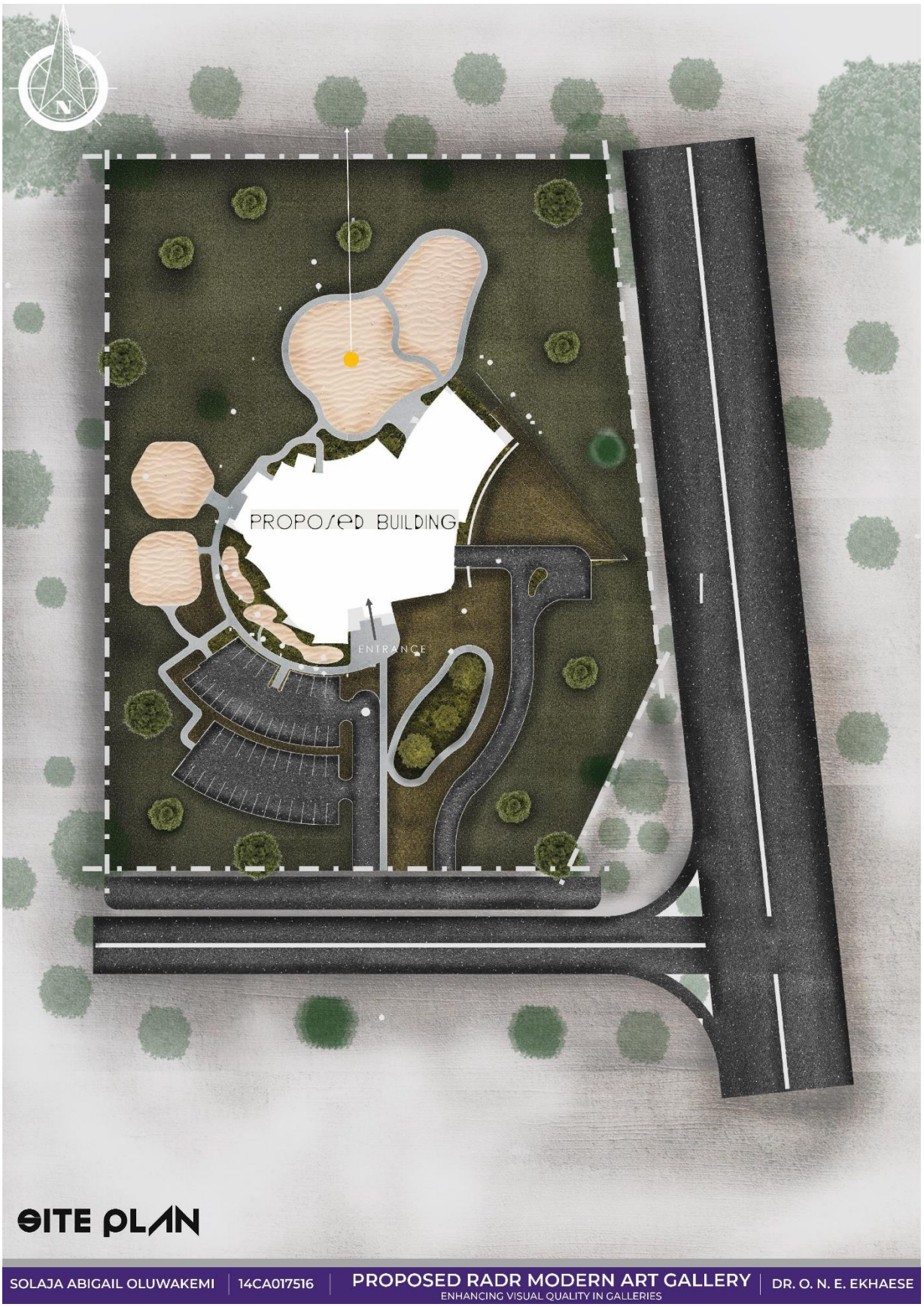
ENHANCING VISUAL QUALITY IN GALLERIES


PROPOSED BUILDING
ENTRANCE
SITE PLAN
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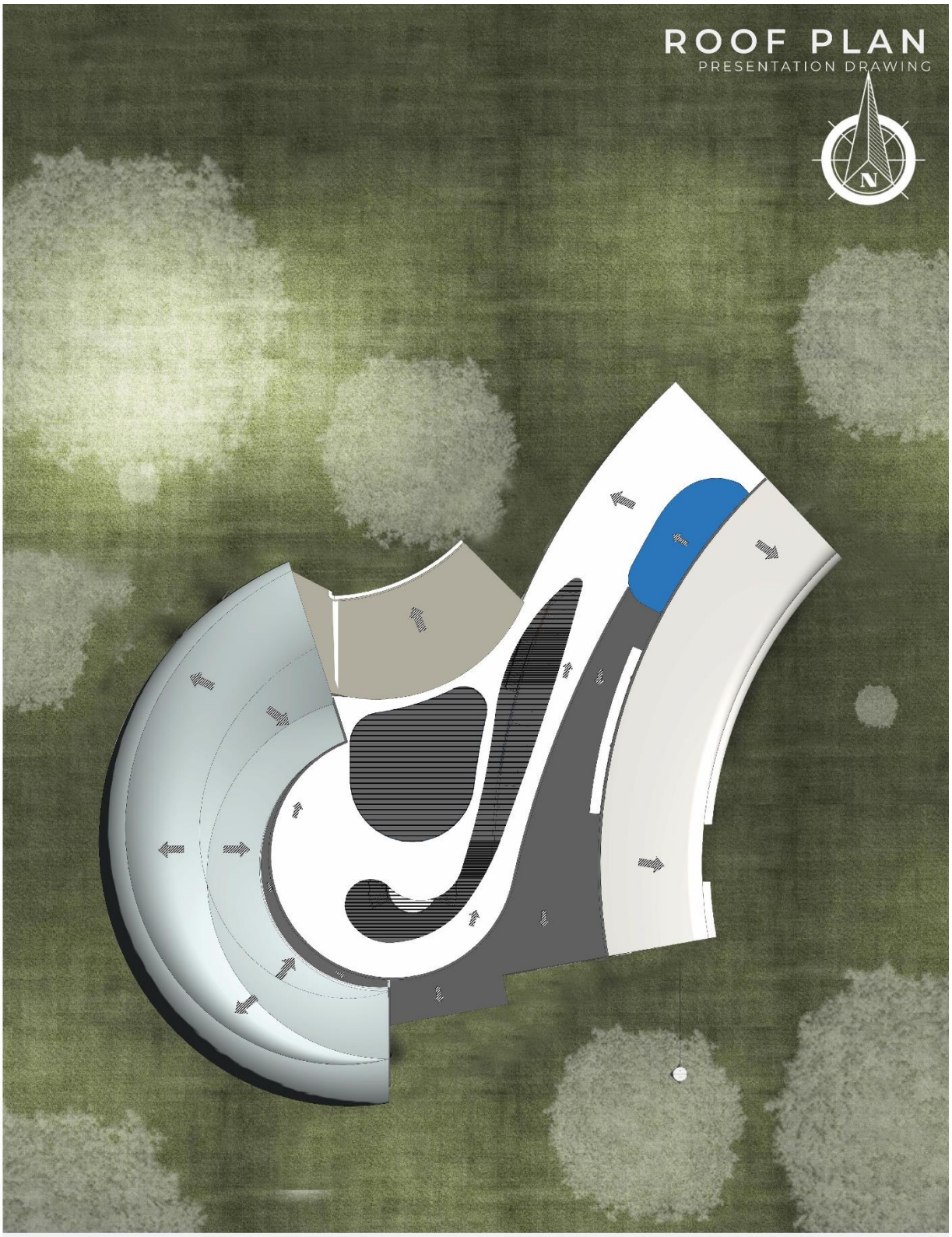

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ELEVATIONS

PRESENTATION DRAWING

REAR VIEW ELEVATION

LEFT SIDE ELEVATION

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ELEVATIONS

PRESENTATION DRAWING

RIGHT SIDE ELEVATION

APPROACH ELEVATION

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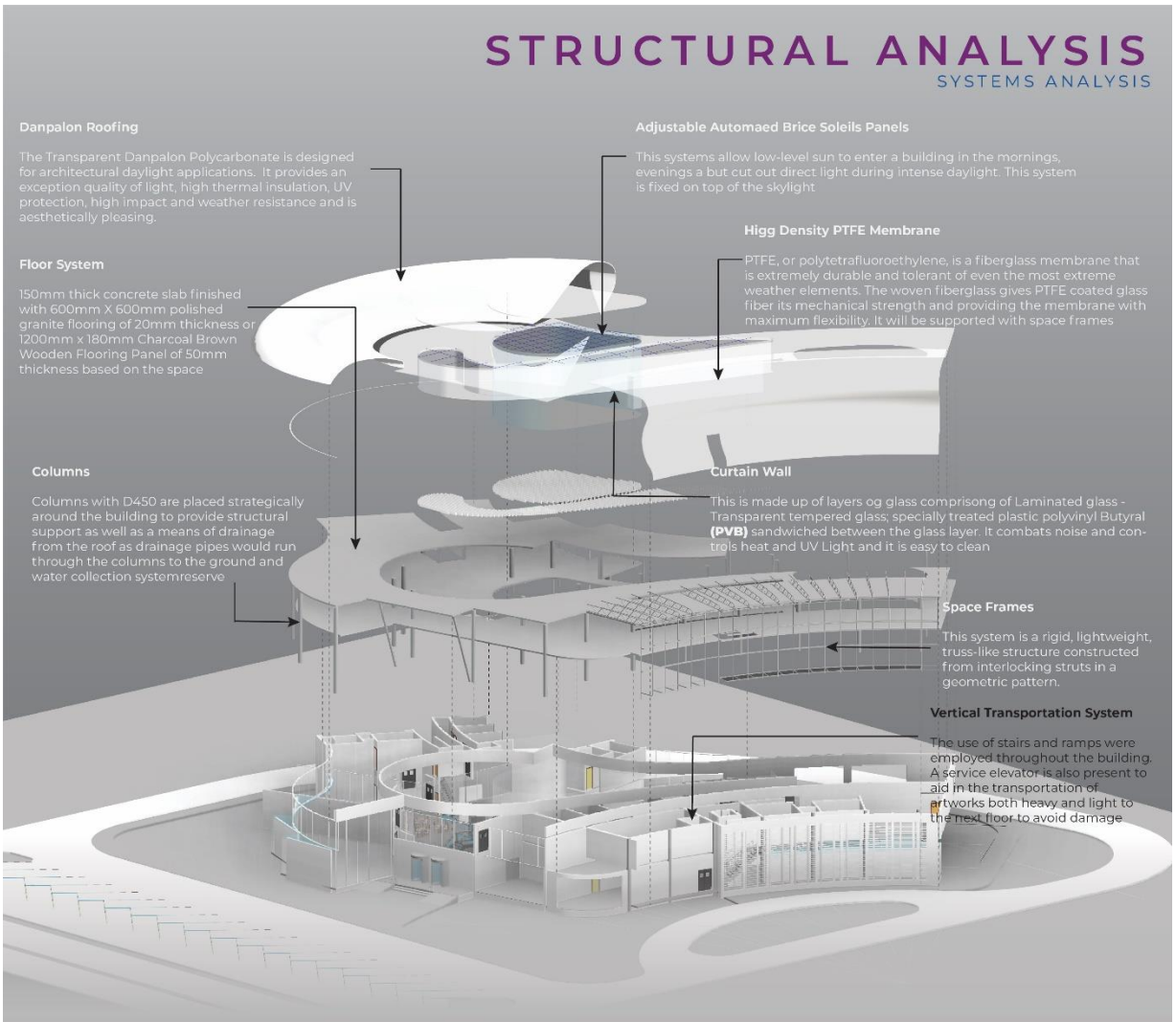
ENHANCING VISUAL QUALITY IN GALLERIES

STRUCTURAL ANALYSIS

SYSTEMS ANALYSIS



Thermal Performance System

A high performance façade combined with an efficient system of cooling will ensure that the design parameters are achieved and that comfort is maintained with efficient use of energy

Waste Management System

Waste mnagement systems are provided for collectiong re-stroom waste A rain water collection system is also created from the roof to the ground where the water collection is located through the columns that are in the building

Noise control and Management

Materials such as the Laminateg glass for the curtain wall around the building helps to combat noise as well as the Danpalon material and the high density PTFE

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