

Optimizing Passive Daylighting in Cultural Centers: A Design for Igbo Cultural Center, Ugwuomu

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ABSTRACT

Passive daylighting is a process that makes use of systems engineered to allow more light into the building, thus partially reducing the need for mechanical systems. It also allows for investigating miscellaneous architectural elements and design techniques-starting from strategic window placement to the use of atria, and courtyards. It avails site analyses and advanced simulation tools to establish the best solution for a particular set of climatic conditions and cultural center requirements. This research project aims to investigate various design strategies that are visited, cultural center can employ in order to effectively apply principles of passive daylighting for enhanced indoor lighting quality and comfort through minimization of overheating due to increased energy efficiency

The main benefits of passive daylighting systems highlighted by the findings of this research include improved indoor lighting, reduced energy use, and compliance with current sustainable building practices. Finally, it puts in the limelight an early integration of passive design principles into projects, the application of sustainable materials, and periodic maintenance services for ensuring that their performance is long-lasting. Next, some of the probable areas of further research in the field in the future can involve new materials and innovative technologies which might extend passive daylighting systems.

ACKNOWLEDGEMENT

Acknowledgment of this work is firstly to the all-knowing God, who has provided wisdom and guidance throughout this research journey. Secondly, I dedicate this research with gratitude to Godfrey Okoye University, my academic haven, for providing a suitable setting for scholarly endeavors and learning. Your information and insights are genuinely appreciated and recognized for forming the foundation of this study.

DEDICATION

This work is dedicated with love and gratitude to my beloved family and friends for their constant support, encouragement, and understanding during this research project. To my father, Mr. Arinze Onaga, for his continuous support throughout the years. To my mother, Mrs Martina Arinze-onaga, for her constant words of encouragement and help. I dedicate this research to you in all.

CERTIFICATION

I certify that this project has been prepared under my supervision in the department of
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Date.....

APPROVAL

ARC. This research titled Passive Lighting in Cultural Centers: A Design for Igbo Cultural Center, Ugwuomu undertaken buy Arinze-Onaga Oluebubechukwu with the registration number U22/ARC/184 has been assessed and approved by the committees of department of Architecture and Faculty of Natural Sciences and Environmental Studies, Godfrey Okoye University Enugu Nigeria

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CHAPTER ONE

Introduction

1.1 Background of the study

Passive lighting refers to the use of natural light (mainly sunlight) to illuminate a space, without relying on electrical lighting systems. Natural lighting in buildings is useful for reducing the use of artificial lighting, so it is expected to save electricity consumption to energy consumption (Brilianty Wijaya, Nurul Jamala, Baharuddin Hamzah (2024)). Natural lighting serves both qualitative and quantitative purposes. Qualitatively that is minimizing errors, minimizing hidden reflections, and avoiding excessive brilliance ratios. Quantitatively it is to collect light for visual performance and minimize artificial lighting according to the needs of a particular activity (Brilianty Wijaya, Nurul Jamala, Baharuddin Hamzah (2024)). In the context of centers, passive lighting refers to the deliberate architectural manipulation of form, orientation, material, and aperture to introduce and distribute natural light into the building particularly in foyers, circulation areas, rehearsal rooms, and, where acoustically and functionally appropriate, within the performance volume itself. Centers or theaters rely heavily on artificial lighting because these spaces are designed for controlled visual experiences like performances, speeches, or presentations.

cultural centers are public venues designed for the presentation, and preservation of cultural expressions, including music, theatre, dance, and film. These spaces are carefully designed with specialized architectural, acoustic, and technical feature to enhance audience experience and performance quality. Venues are not only functional but also symbolic spaces that reflect cultural identity and artistic expression. In summary, cultural centers are multi-functional cultural hubs that combine architectural design, acoustic engineering, and social purpose to support artistic performance, cultural preservation, and community interaction.

Igbo cultural centers, these centers are mainly centered around the passing down of igbo culture through theater arts the auditorium will also display common igbo folk tales (*Akụkọ Ifo*) to appeal to a much younger audience a few examples of some folk tales are; Tortoise, The Birds, and The Feast in The Sky, The Vulture and the Sky, and Why the Lizard Nods. The centers will also exhibits that will display some traditional artifacts such as Bronze Roped Pot, Shell and Leopard Vessel, and Igbo Masks and many more, all for the education and enlightenment of the people of the eastern region especially the youth who are the future for tomorrow.

1.2 Statement of problem

Despite the availability of daylight throughout most of the year in tropical climates, many cultural centers are designed with limited consideration for daylight integration. The enclosed nature of exhibition, driven by acoustic and visual performance requirements, often results in poorly lit ancillary spaces such as foyers, lobbies, and circulation areas. These spaces frequently depend on artificial lighting even during daytime, leading to unnecessary energy use.

1.3 Aim and objectives of the study

Aim

The aim is to access passive lighting strategies in cultural centers with a view to reforming the design of a cultural center at uguwomu.

Objectives

- a) To identify and analyze existing passive lighting patterns or strategies applicable in centers design
- b) To assess the energy performance implications of passive lighting integration in cultural centers
- c) To develop design recommendations or guidelines for the integration of passive lighting

1.4 Research questions

The questions that will be asked for this study are as follows:

- a) What are the passive lighting strategies and patterns are currently employed in centers
- b) How does the integration of passive lighting affect the overall thermal and cooling load of an centers?
- c) How can passive lighting strategies be adapted to suit tropical or hot-humid climatic conditions while maintaining optimal indoor environmental quality in centers spaces?

1.5 Significance of study

This study is valuable because it is related to the increasing requirement for sustainable and energy efficient In the field of building design, especially in large public areas like centers. By looking at the role of lighting. The research also offers insights on how natural light can be effectively used to provide passive lighting. To minimize reliance on artificial lighting, and thus on energy use and operation, costs.

The results from this research will be useful to architects, designers and engineers since it provides some creative ideas for using the passive light in the design of centers without negatively impacting upon the goals and outcomes for the project.

Visual comfort and functional needs. It also identifies ways of managing glare, Optimizing lighting distribution, and the user experience in such environments. Finally, the study's contribution towards environmental sustainability is through the promotion of design approaches that minimize carbon footprint and promote green building practices, consistent with the worldwide efforts for the same. Energy conservation and climate responsive architecture.

1.6 Scope of limitations

1.6.1 Scope

This study focuses on the integration of passive lighting strategies in cultural center design, with particular emphasis on performance halls, lecture theatres, and multi-purpose assembly spaces, exhibition spaces.

1.6.2 Delimitations

The research I undertook in daylight in cultural center design involves setting boundaries to focus the scope of study and make it manageable. Here are some key factors:

1. Geographical Factor: Focus on cultural centers in a particular region or climate zone to account for local daylight patterns and environmental conditions.
2. Size and capacity: To ensure consistency in the analysis, concentrate on libraries of a specific size or user capacity
3. User groups: Concentrate on the impact of daylight of primary user groups such as students, researches, or general public patrons, rather than all potential users. Delimit the study to either public areas of the cultural center or staff areas to maintain focus.

4. Technological Aspects: Use of specific tools for daylight simulation, while avoiding comparisons across multiple tools and limiting the study to using certain advanced glazing materials or smart lighting controls rather than a broad range of technologies.
5. Research Methods: Choose either quantitative methods (e.g light measurements, user surveys) or qualitative methods (e.g interviews, Observational studies) to maintain clarity in the research approach.

These delimitations make the study more focused, manageable, and relevant, allowing for a thorough and meaningful daylight analysis in library design.

1.7 Organization of the study

This study is organized into five distinct chapters, each addressing specific aspects of passive lighting in centers design.

Chapter One: Introduction

This chapter presents the background of the study, highlighting the importance of lighting in cultural centers and the growing need for sustainable design strategies such as passive lighting. It

also outlines the statement of the problem, aim and objectives of the study, research questions, scope, and significance of the study.

Chapter Two: Literature Review

This chapter reviews relevant scholarly works and existing theories related to passive lighting and centers design. It examines concepts such as daylighting strategies, visual comfort, glare control, and energy efficiency. The chapter also explores previous studies and case examples to establish a theoretical foundation for the research.

Chapter Three: Study area

This chapter describes the methods used to carry out the study. It includes the research design, data collection techniques (such as case studies, observations, or simulations), sampling methods, and tools for data analysis. It explains how information on passive lighting in centers is gathered and evaluated.

Chapter Four: Research methods and data analysis

This chapter presents the collected data in an organized manner and analyzes the findings. It evaluates how passive lighting is applied in selected centers, identifies challenges, and assesses its impact on visual comfort, functionality, and energy performance.

Chapter Five: Design Synthesis and Development

This chapter summarizes the key findings of the study, draws conclusions based on the analysis, and provides recommendations for improving the use of passive lighting in centers design. It may also suggest areas for further research.

CHAPTER 2

Literature review and case studies

Daylighting use is the intentional use of daylight to light building interiors; it stands as One of the aspects of architectural design most studied. It is important not only in aesthetic aspects, The three domains of psychological, physiological and environmental. The illumination during the day has become a fundamental need. A passive strategy in line with worldwide efforts to minimize the carbon emissions of buildings. This is a novel idea of a passive way of lighting (distinct from active or mechanically mediated illumination). Construction strategies that use the geometry of form, orientation of surfaces to create a systems approach. the proportions of a building and the color, texture and reflectivity or transparency of surfaces to control daylight without Electrical or mechanical assistance. Whisky's passive lighting is based on the following principles: Concerned with bioclimatic architecture, mainly describing the architecture that responds to climate, not against it: against it. This separation takes on special significance when

talking about theatre and the centers for the performing arts. It is therefore necessary to consider the integration of natural light carefully, while balancing it with the controlled importance. lighting requirements needed during performances. There is a plethora of lighting strategies that can be used in building designs below are three strategies that can be incorporated in theater designs.

2.1 Side lighting

The daylighting of vertical openings like windows, clerestories or glazed openings. Passive daylighting is most frequently used in general building design, and the most common option is called walls. For This is a basic problem that performing arts centers have to cope with, namely the gradient of light. may be in opposition to requirement for controlled and even illumination in the centers. However, even if it does come through side lighting, either through deep reveals or light shelves or translucent glazing, light can Glare can be effectively diffused, reducing glare in the area of daylit spaces. Positioned above the main area of use, Clerestory windows are a sophisticated way of using side light. Lighting specially designed for centers. By providing bright skylights at high level, it is possible to avoid direct sunlight entering into sight lines, but at

the same time allow a high proportion of light penetration in the form of diffuse. skylight.



Picture side lighting

2.2 Top lighting

The brightest part of the sky dome is directly accessible through top lighting in the form of roof lights, lanterns and skylights. Top lighting can provide good uniform levels of illuminance over a large plan area and therefore is an effective method for centers designs where achieving a good spatial coverage is a key concern. But unwanted top-lighting means that there are issues of glare and unwanted solar heat gain, which will require diffusing glaze or dynamic shading systems. These controls can be included and top lighting can provide a quality of illumination. Today, a tradition of top lighting of performance spaces is also evident in the use of roof lanterns in

historic theatre structures like the Teatro alla Scala in Milan and the Royal Opera House, London. They also show how top lighting in auditoria can be technically realized and how they can create exceptional auditoria space quality. Today's understanding of this tradition, with the support of parametric design tools and modern high-performance glazing systems, takes these possibilities to the next level.

picture of top lighting

2.3 Light Redirection and Distribution Systems

Mitigation strategies for redirection of light in the form of light shelves, prismatic glazing and fiber-optic daylighting. However, passive lighting strategies are a newer type of system, which are systems that switch off the light when it is not needed. These systems capture daylighting at the building façade and diffusing it to the inner part of the building, blocking the. The drawbacks

of the standard side or top lighting with respect to range and uniformity of penetration. In performing arts centers can have controlled admissions with light redirect systems. dividers daylight into the various spaces/clusters of spaces within the building including areas like foyers, circulation cores and backstage. Otherwise, they would not be available for natural light.

- 4.1 Consider the design of a “light shelf” for the south side of an office building located at a site with latitude 30° . The idea is that the light shelf should help keep direct sunlight from entering the office. It also bounces light up onto the ceiling to distribute natural daylight more uniformly into the office.

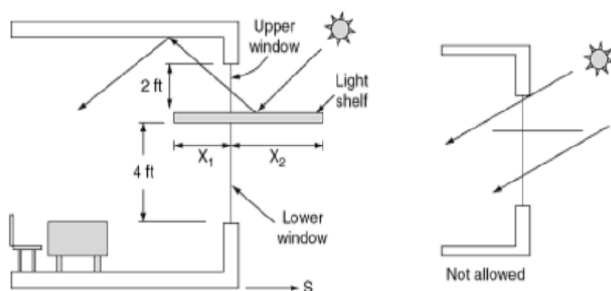


FIGURE P4.1

As shown, the window directly above the light shelf is 2-ft high and the window directly below is 4 ft. What should the dimensions X_1 and X_2 be to be sure that no direct sunlight ever enters the space at solar noon?

Picture of an application of light shelves

2.4 Building Orientation

The direction the building faces directly the rate in which light enters the building. There are four cardinal point namely North, South, East and West the sun rises from the East and sets in the West. According to research the best placement for building to receive maximum light is facing towards North-South to reduce glare into the building.

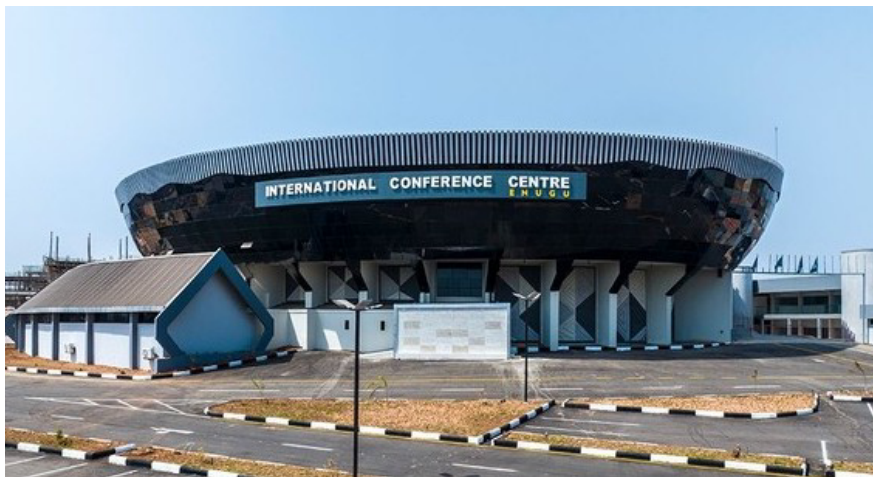
Case Studies

Case Study 1

International Conference Center, Enugu

The conference center is located in Independence layout, Okpara square, Enugu the center is an Auditorium used to host Exhibitions, Seminars and all other forms of showcases.

The conference center was initially abandoned in 2007 during the tenure of the former governor of Enugu state Dr. Chimaroke Nnamani but the project was later picked up by the current governor Gov. Peter Ndubuisi Mbah. The auditorium is designed to host members of u to 3,000. The center also host a reception where other services can be found as well as a shopping mall as well as a smaller dome of a smaller capacity of 500 persons and also on the same site another event center with a capacity of 1,500 persons



Main Conference Center with capacity of 3,000 persons

Merits

1. The auditorium is well designed to suit its capacity with efficient spacing and seating capacity
2. Circulation: There is easy access into and out of the building allowing guests enter and exit the building without overcrowding
3. Accesses: Easy access to conveniences
4. Building Aesthetics: The external of the building is aesthetically pleasing
5. Acoustics: the sound system is well planned for which allows the sound travel to all parts of the auditorium

Demerits

1. Poor Lighting: The building has little passive lighting being sent into the auditorium while the lobby surrounding the auditorium is well light that is without artificial light being sent into the auditorium it remains poorly light
2. Poor Ventilation: The auditorium is poorly ventilated with little external windows found and no ventilation system

2.2.1 Case Study 2

Enugu National Museum

The museum was established in 1972 as one of four Unity Museums proposed by the federal government to integrate the various sections of the country after the Civil War of 1967–1970. It is described as the only museum in the country dedicated to the 'No Victor, No Vanquished' slogan of 1970, designed to heal the wounds of the Civil War. The three galleries; the Unity Gallery, the Igbo World View Gallery, and the Coal City Gallery, each serve a distinct narrative role, from pan-Nigerian cultural objects to a display depicting precolonial Igbo architecture, giving insight into the Igbo house and the things found within it.



Enugu national museum of unity entrance

Merits

1. The museum is symbolic and civic in nature and has Urban fabric of Enugu. It is situated in the GRA, close to colonial era administrative buildings, The structures, consolidate the

city's civic identity and its ties to the history of its governance. and national significance. Located here was a federal museum, whose location was decided due to its importance. Deliberate in terms of architecture and politics, the location of the building emphasizes this. intent.

2. Functional Layout and Visitor Flow: The gallery is organised in a sequential layout which facilitates a clear flow and readable experience by visitors. The progression from national (Unity Gallery) to regional Between Igbo World View and the local (Coal City) scales are effective curatorial stories. produces a progressive and contextual narrative about Nigeria's cultural past. The spatial The organization is user-friendly and doesn't need to have a vast wayfinding facility
3. Transportation Adequacy: The access of the road from the museum to the GRA (The main arterial road) is adequate. Makes the City of Enugu relatively accessible to its urban population. It is within walking distance. The open compound provides a permeable public interface, and the key civic institutions are of importance. has helped to create a wider institutional social life, especially in the evenings.

Demerits

1. Deterioration and Poor Maintenance: Visitor accounts and published reviews consistently Describe in detail how the building was in disrepair or 'rundown' or 'dusty,' and in need of 'paint & renovation' While maintenance is in part a funding issue for institutions. For this building, the design seems to be somewhat vulnerable to the tropical weather. The lack of

strong, easy-to-use material specifications like fair-faced. Has increased the long-term maintenance of the concrete, laterite or other local material used.

2. Limited Accessibility for Persons with Disabilities: Ramp access, tactile pathways, Toilet facilities that are accessible, and audio-visual interpretive systems for visitors with sensory impairments. The existing building is not a typical building with disabilities. This restricts the museum's reaches and challenges its national mandate, which is inclusive.
3. Expansion of its Visitor Amenities and Space: The museum does not have any separate areas to house visitor's contemporary museum use like temporary exhibition rooms, an auditorium or a theater. A lecture theatre or conservation laboratories, a gift shop, or a dedicated café. These are now They are deemed to be integral elements of the contemporary museum typology and their lack reduces the capacity of the institution to provide education programming, generate revenue and attract a young audience.

Case Study 3

The museum was created in line with the "Tomorrow is Here" agenda of Governor Peter Mbah, in an initiative to rebrand Enugu as a technology-integrated state around the year 2024. It is located in the Government House complex (the Lion Building) and according to the Visit Enugu

platform "is a pioneering and interactive display room of curated exhibits of pre-colonial civilizations, coal mining history and notable personalities. It also has a re-created Igbo parlor based on *Things Fall Apart* by Chinua Achebe. The Enugu State Digital Museum was created as part of the Governor Peter Mbah's 'Tomorrow is Here' development agenda that kicked off after he was inaugurated in May 2023. The government created a lofty socio-economic development plan that aims to grow Enugu state's Gross Domestic Product (GDP) by seven times from about \$4.4 billion to \$30 billion by 2031. A key element of this was the shift to positioning Enugu as a technology-enabled state, which included smart infrastructure, digital governance, and culturally oriented institutions. The museum has been designed under this cultural-digital vision – not just for the preservation and communication of Enugu's rich history and the pre-colonial Igbo civilization, but also its coal mining heritage and the lives of its notable personalities – but through the medium of technology. In November 2024, a video tour was released confirming the museum was up and running by then, putting the opening date as one of the first 18 months of the Mbah administration.



Enugu Government House complex (the Lion Building)

Merits

1. The immersive and engaging visitor experience: The museum's experiential quality is its main architectural beauty. The museum can convey historical information in a way that is more immediate and dramatic than traditional methods of display, thanks to the use of digital artefacts, interactive displays, and immersive spaces that bring to life the cultural memory and literary heritage. This type of museum design is inherently more accessible and engaging to younger visitors and school groups than the glass case display of objects. The museum's online version also allows the museum's content to be updated, extended and refreshed, without the limitations of physical artefact collections.

2. **Low Physical Footprint and High Cultural Impact:** The museum will be a retrofit of existing governmental space rather than a new-built, which means that the impact is great despite the physical size being modest. This is an architectural merit when the public budget is very limited: the museum is providing a high impact cultural environment with investment of interior design rather than capital construction. This approach is efficient and replicable as models of adaptive reuse of underutilised governmental space to create a public cultural institution in other states.

3. **The Enugu State Digital Museum** is one of the earliest purpose-built Digital Museums in South-East Nigeria and one of the few digital museums on the African Continent. The institution itself is a great typological departure from the traditional display-cabinet approach to cultural architecture in Nigeria, to the participatory, immersive idea of the institution. The Digital Museum is a provocative alternative to the National Museum of Unity which has been facing difficulties in terms of deteriorating state of the collection and low patronage in Enugu.

Demerits

1. **Accessibility Barriers:** The Government House complex itself has a large accessibility barrier as the museum is located within it. The Government House precincts in Nigeria are generally highly secure and have limited access, gate checks and institutional procedures which may be unfamiliar and intimidating to regular visitors to the precinct, especially children, elderly visitors or rural visitors visiting the city. This flies in the face

of the basic idea behind museum design: that a public cultural institution should be freely and easily accessible to all members of the community it serves. If a museum is not physically and/or psychologically accessible, it cannot meet its educational or social mission. The Digital Museum's civic precincts setting is not open to approach as is the case with the National Museum, and therefore has less democratic outreach.

2. **Reliance on Mechanical Systems and Power Infrastructure:** Digital museums rely on continuous electrical power, by definition. Reliable and continuous power is needed for every aspect of the visitor experience from screens to interactive kiosks, projectors to ambient lighting, climate control systems and much more. This is an important vulnerability in the operating and design aspects of public institutions in Nigeria, where the power supply is often erratic, and diesel generators are the source of electricity supply. Ideally, a solar-powered, battery storage, and resilient power infrastructure should be integrated into the purpose-designed digital museum design. The current retrofit configuration, in a Government House facility, could be aided by the State's own generator systems, but is not sustainable in the longterm and is operationally expensive.
3. **Digital Museum installations are technologically perishable:** screens degrade, software becomes obsolete, interactive systems require constant maintenance and upgrade. A physical exhibit, if properly conserved, can last for centuries, but a digital exhibit must be constantly funded to keep it up-to-date and operational. If this plan is not integrated into the institutional model, the museum will become outmoded and/or dysfunctional or even abandoned within 10 years. This is a common problem in digital museums around the

world and especially a problem in Nigeria, where public institutions have traditionally been reluctant to secure regular funding for maintenance. The architectural brief for a purpose-designed digital museum should embrace this and anticipate it by designing for upgradability, in terms of modular systems, accessible wiring and flexible spatial configurations.

Chapter 3

The Study Area

3.1 Geographical Location and setting of Enugu

Enugu is the capital city of Enugu state, located at the south eastern region of Nigeria. It lies approximately between latitude 6°31'23.64"N and longitude 7°28'06.24"E according to the 2006 census, the city had a population of 722,664 but it is believed to have grown to 3.3 million as of 2014. The name Enugu is derived from the Igbo words **Énú Ùgwú** which translates to “hilltop”. Reflecting the city’s hilly geography. The city was named after Enugwu Ngwo, an area where coal was discovered.

Enugu, the capital of Enugu state in southeastern Nigeria, has a rich history. Its name is derived from the Igbo words the name Enugu is derived from the Igbo words **Énú Ùgwú** which translates to “hilltop”. Reflecting the city’s hilly geography. The city became the capital of the eastern region after Nigeria gained independence in 1960 and later became the capital of the short-lived Republic of Biafra in 1967 Enugu is also Known for being in a area where coal was discovered.

The first Settlement in the Enugu area was the small Nike village of Ogui, which had been established since the era of the Atlantic slave Trade. The Nike people, whose name means “with strength or power” in the Igbo language, expanded their territory through slave raiding, using enslaved individuals as part of their defense strategy and establishing slave camps at the borders of their lands. They were in an alliance with the Aro people, who formed the Aro Confederacy, an Igbo organization that controlled slave trading in Enugu area from 1690 to 1901. The Aro

people conducted trade from Arochukwu in the South, while the Hausa traded from the north, providing horses to the Nike for Igbo rituals. Both the Aro and Hausa were considered as foreigners to the area. Migrating to and from what is now the city of Enugu

Picture map of Enugu

The study's location is taken at Ugwuomu Nike in Nigeria Enugu state. Ugwuomu Nike is a community known for its rich history and cultural heritage.

The Ugwuomu community is known for its cultural festivals, traditional ceremonies and ceremonies and vibrant cultural practices highlighting Igbo heritage.

Agriculture, trade, and crafts are significant to the local economy of Ugwuomu Nike, with many residents engaged in farming and small-scale businesses.

Over the years, Ugwuomu Nike has seen infrastructure and community services development, contributing to its growth as a residential area

Like many Igbo communities, Ugwuomu Nike has traditional leadership structures and commercial decision-making processes that help govern and preserve its cultural identity

Ugwuomu Nike is located in Enugu East Local Government Area (LGA) of Enugu State, Nigeria. This LGA encompasses several communities, Including Ugwuomu Nike, Enugu east LGA is Known for its mix of urban and rural settlements and plays a significant role in the administration and development of the region

Picture map of Enugu east

Source GIS Department of The Enugu state ministry of Lands (2017)

3.2 Site Selection Criteria

The research Focuses on Godfrey Okoye University's planned permanent site in Ugwuomu, Nike, Enugu State, Nigeria. The researcher, who is involved in the university's development, intends to design a master plan for this location.



Godfrey Okoye University's main campus' masterplan

Source: Godfrey Okoye University, Academics

3.3 BRIEF HISTORY OF THE STUDY AREA

Godfrey Okoye University (GO University) was established in 2009 by the Very Reverend Father Professor Dr. Christian Anieke for the Catholic Diocese of Enugu. The university,

which received its operational license from the National Universities Commission (NUC) on 3 November 2009, is owned by the Catholic Diocese of Enugu and is the first university owned by a Catholic Diocese in Africa. GOU began with 215 students in 2009 and grew to admit 1,200 students by the end of 2012. The university's maiden convocation took place from 1st to 7th December 2013, during which 100 students were awarded bachelor's degrees. GOU is also a member of the Committee of Vice-Chancellors of Nigerian Universities (CVC)

Below is the list of faculties and courses offered:

- Faculty of Management and Social Sciences - Accounting, Banking and Finance, Business Administration with Management/ Marketing/ Public Administration, Economics, International Relations, Management, Marketing, Political Science, Mass Communication, Psychology, Public Administration, Sociology.
- Faculty of Natural and Applied Sciences: Applied Biology, Biotechnology, Microbiology, Computer Science, Mathematics, Biochemistry, Chemistry, Physics, Architecture, Industrial Chemistry, Physics with Electronics/ Industrial Physics/ Geophysics, Renewal Energy/ Physics with Electronics
- Faculty of Education: Primary Education, Biology Education, Chemistry Education, Computer Science Education, English/Literary Studies Education, History, International Studies and Diplomacy Education, Mathematics Education, Physics Education, Political

Science and Government Education, Economics Education, Social Studies Education,
Business Education, Education Management

- Faculty of Arts: English and Literature Studies, History, International Studies and Diplomacy, Music, Philosophy, Religious Studies
- Faculty of Medicine: Medicine & Surgery
- Faculty of Law: Law

3.4 PHYSIOGRAPHY, CLIMATE AND VEGETATION

3.4.1 Physiography

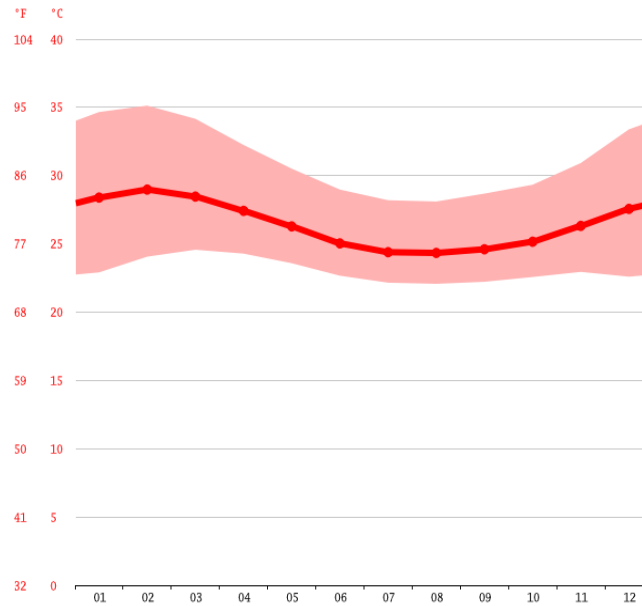
Ugwuomu Nike is a prominent hill located in Enugu State, Nigeria. Physiographically, it is characterized by its elevation and the surrounding terrain. The hill offers a panoramic view of the area and is notable for its natural features, vegetation, and possibly historical or cultural significance to the local community.

3.4.2 Climate

The climate of Ugwuomu Nike, located in Enugu State, Nigeria, is typically tropical savanna

1. Temperature: Generally warm throughout the year, with average temperatures ranging from 25°C to 30°C. It can get hotter during the dry season
2. Rainfall: Ugwuomu Nike experiences a bimodal pattern of rainfall. The primary rainy season usually occurs from April to October, with a peak in rainfall around July and August. There is also a shorter rainy season from November to March.
3. Dry Season: The dry season lasts from November to March. During this period, temperatures can be higher, and humidity levels may be lower.
4. Humidity: The region can be quite humid, especially during and immediately after the rainy season
5. Vegetation: The hill and its surroundings support tropical vegetation typical of savanna climates, characterized by grasslands, scattered trees, and shrubs.

Overall, Ugwuomu Nike's climate is influenced by its location in the tropical savanna belt of West Africa, with distinct wet and dry seasons shaping its environmental conditions.



Temperature graph of Enugu

Source: <https://en.climate-data.org/africa/nigeria/enugu/enugu-542/>

3.5 POPULATION, CULTURE AND ECONOMIC DEVELOPMENT

Nike is significant in terms of land mass. Her land covers a large area in the local government area of Enugu East. Nike has been endowed with quite a reasonable population compared to other neighboring towns, with Ugwuomu Nike being one of the twenty-four villages in Nike for example, she had a population of 22,214 in the 1963 census. She has projected a population of 35,670 in 1985 and 39,372 in 1990.

3.5.1 Culture

Enugu hosts significant Igbo traditional festivals, including the Mmanwu and New Yam festivals. The Mmanwu festival features various masquerades and is supported by the Enugu Council of Arts and Culture, while the New Yam festival, known as 'iwa ji', celebrates the harvesting and feasting of the new yam, a staple crop and cultural symbol for the Igbo people. The Enugu Festival of Arts, established in 1986, showcases African culture and traditions and has modernized the Mmanwu festival by relocating it from traditional village surroundings to the urban setting of Enugu. Notably, Princess Diana of Wales was a spectator of Enugu's cultural shows during her visit in 1990.

Enugu's tourism industry, overseen by the Enugu State Tourism Board (ESTB), features a range of historic and recreational sites. Visitors can enjoy panoramic views from the Udi Hills, explore public parks like the Polo Amusement Park and Murtala Muhammed Park, and tour the city's former coal mines. Onyeama and Okpara. Additionally, attractions include The Institute of Management and Technology (IMT) Sculptural Garden and Art Gallery, the Eastern Region Parliamentary Building, the Old Government Lodge, the Enugu Golf Course, and the Enugu Zoo with its botanical garden and zoological section. The National Museum, although located nearby,

receives few visitors and is managed by the National Commission for Museums and Monuments (NCMM). Other cultural attractions include galleries like the Bona Gallery.

3.5.2 Population

Population

The Enugu metropolitan area's population was officially recorded as 722,664 in the 2006 Nigerian census, but unofficial estimates suggest a much higher figure of around 3.3 million as of 2014. Population estimates of Nigerian cities, including Enugu, have been subject to dispute, with allegations of population inflation and deflation, particularly favoring the northern part of the country. Enugu's population is predominantly Christian, like the rest of southeastern Nigeria, and the majority of the people speak Nigerian English alongside the dominant Igbo language, reflecting the region's ethnic diversity and economic development.

Enugu, known as the Coal City, thrived on coal mining in the Udi plateau, driving its early 20th-century economy. The Nigerian Coal Corporation, established in 1950, centralized coal mining activities in Enugu. The city was linked to Port Harcourt in the south and Kaduna in the north through the Eastern Line, facilitating transportation. However, the Nigerian Civil War led to significant devastation, causing a decline in coal production. By 2005, coal mining ceased to be the city's primary source of income, and the mines remained inactive. Enugu also boasts mining activities for other minerals such as iron ore, limestone, fine clay, marble, and silica sand

3.5.3 Economic development

Enugu's economy heavily relies on open markets and street vendors, with a significant presence of child hawkers. The city has three main urban markets: Ogbete Market, akunanaw Market, and New Market, each serving different trading needs. Ogbete Market acts merchants from surrounding areas and features both food and non-food goods.

additionally, Enugu hosts industries such as brewing, soft-drink bottling, assembly planted the production of machinery, pottery. tiles, steel, cement, asbestos, petroleum, and pharmaceuticals. Furthermore, Sosoliso Airlines operated from the Akanu Ibiam International Airport in Enugu for a period.

The former Eastern Region, known for its significant production of palm kernels and other cash crops. experienced a decline in agricultural output following the Nigerian Civil War and the subsequent oil boom years. This decline was primarily due to damage to plantations and processing equipment during the war. As a result, Enugu State, along with the rest of Nigeria, once a net exporter of agricultural produce, now faces the need to import food, exacerbated by the diversity of dialects in the Igbo language.

CHAPTER FOUR

RESEARCH METHODOLOGY

This chapter presents the research design adopted for the study of passive daylighting strategies in cultural centers, with specific application to the proposed Igbo Cultural Center at Ugwuomu Nike, Enugu. Given that the study seeks not only to understand existing passive daylighting practice but also to generate design guidelines for a real building proposal, a mixed-methods, case-study-based design research approach was adopted. This approach combines qualitative case study analysis with quantitative daylighting simulation, structured across three phases: an exploratory phase, an analytical phase, and a design synthesis phase, each corresponding directly to one of the study's three research objectives.

4.1 Research Design

The study adopts a mixed-methods, case-study-based design research approach. This design was selected because passive daylighting research for an active design proposal cannot rely on literature review alone, nor can it depend solely on instrumented field measurement, since the study's case study buildings are existing public facilities that are not readily available for long-term sensor installation or controlled experimentation. Instead, the design combines documented case evidence with computational simulation to produce results that are both grounded in built precedent and quantitatively verifiable.

The research design is organized into three interconnected phases:

1. Phase One – Exploratory Phase (Qualitative): A comparative analysis of existing cultural center case studies in Enugu, evaluated specifically for their daylighting performance in auditorium and exhibition spaces, addressing Objective (a) of the study.
2. Phase Two – Analytical Phase (Quantitative/Simulation): Daylighting simulation of a base-case model derived from the case study geometry, followed by simulation of proposed passive strategies against established performance metrics, addressing Objective (b) of the study.
3. Phase Three – Design Synthesis Phase: Translation of simulation findings and case study lessons into design guidelines and the design proposal itself, addressing Objective (c) of the study.

4.2 Data Needs and Sources

The data required for this study fall into four categories: climatic data, site data, case study data, and simulation data.

1. Climatic data: Temperature, rainfall, humidity, and sun-path data for Enugu, sourced from meteorological records and climate data platforms (e.g., climate-data.org), used to establish the environmental design parameters for simulation.
2. Site data: Topographic, orientation, and contextual data for the Ugwuomu Nike site, obtained through site survey and existing masterplan documentation from Godfrey Okoye University.

3. Case study data: Photographic documentation, spatial layouts, and observational notes on daylighting conditions at the International Conference Center Enugu, the Enugu National Museum of Unity, and the Enugu State Digital Museum, obtained through site visits, since formal architectural drawings for these facilities are not publicly available.
4. Simulation data: Outputs generated using Radiance and Honeybee, including illuminance levels, spatial Daylight Autonomy (sDA), Annual Sunlight Exposure (ASE), and Useful Daylight Illuminance (UDI) values for both base-case and proposed design conditions.

4.3 Population and Sampling Procedure

The population relevant to this study comprises existing cultural centers within Enugu that share climatic and typological conditions with the proposed Igbo Cultural Center. A purposive, non-random sampling procedure was adopted, in which three case studies were deliberately selected: the International Conference Center Enugu, the Enugu National Museum of Unity, and the Enugu State Digital Museum. These cases were selected because they are located within the same climatic zone as the study area, ensuring consistency in environmental conditions, while collectively representing a spectrum of cultural building typologies, ranging from large-capacity performance venues to traditional and digital museum formats. This purposive approach ensures that findings are directly transferable to the design of the proposed cultural center, rather than attempting to generalize across a broader, less relevant population of cultural buildings worldwide.

4.4 Methods and Instruments for Data Collection

Data collection for this study relies on the following methods and instruments:

1. Site observation and photographic documentation of daylighting conditions, apertures, and orientation at each case study location.
2. Review of architectural literature, published case commentary, and available site plans or masterplans.
3. Climatic data extraction from meteorological and climate data sources.
4. Computational daylighting simulation using Radiance and Honeybee to model and test base-case and proposed daylighting strategies under Enugu's climatic conditions.

Sensor-based field measurement, occupant questionnaires, and stakeholder interviews, while considered, were excluded from the primary data collection methods, as the case study buildings are not accessible for long-term instrumentation or formal survey administration within the scope of an undergraduate research project. This delimitation is stated explicitly to keep the research design realistic and achievable.

4.5 Methods of Data Analysis

Data generated from the study will be analyzed through two complementary methods, corresponding to the qualitative and quantitative components of the research design.

1. Comparative case study analysis: Findings from the three case studies will be organized and interpreted using the study's Environment–Space–Experience framework, allowing daylighting performance to be assessed consistently across environmental conditions, spatial configuration, and occupant experience.

2. Simulation-based comparative analysis: Base-case daylighting performance will be compared against simulated outcomes for each proposed passive strategy (side lighting, top lighting, and light redirection systems), using sDA, ASE, and UDI as the primary performance indicators. This comparison will identify which strategies, or combinations of strategies, best balance daylight admission with glare and solar heat gain control for the auditorium and ancillary spaces of the proposed cultural center.

Together, these two analytical methods provide both a qualitative grounding in built precedent and a quantitative, performance-based justification for the daylighting strategies adopted in the design proposal presented in Chapter Five.

Chapter 5

Design Synthesis and Development

What it means by passive daylighting in cultural centers is to design the building in such a way that architectural design helps in the passage and flow of daylight inside the building. Aim: do not use mechanical systems and improve indoor environment quality for the occupants.

Among the key principles of the passive daylighting design are the strategic placement of windows, and atria to facilitate the movement of light into the building. This then would warrant the use of passive daylighting techniques in any design for a cultural center, which allows human health and enjoyment within the premises and, therefore, is sustainable in a relation very much needed for today and towards a greener future of cultural institutions.

5.1 The Design Brief

Design a sustainable and efficient passive daylighting system for cultural centers, aiming to improve the indoor environmental quality while reducing energy use. Meet the aesthetic requirements for cultural space and address different occupancy patterns. Taking into account the

local climatic conditions, cultural relevance of the space, identity aspects, and, above all, user comfort. Therefore, a stride to make sure that an opening is availed for strategies such as the use of side lighting, top lighting, among others, would ensure a harmonious indoor environment, apt for creativity and wellness. At the end of it, the design seeks to balance the preservation of culture, being environmentally responsible, and ensuring the satisfaction of the occupant.

Passive daylighting systems must be applied to cultural centers in order to get indoor lighting quality as well as energy efficiency, while still providing visitors with true comfort.

5.2 Design Requirements for Activities/Planning Data (Standards and Anthropometrics)

Design specification for activities/planning data includes standards like access, safety and usability. Anthropometric data need to be considered with respect to the users for user comfort and ergonomics. This needs to conform to both industry regulations as well as space and experience principles and limitations. Clear communication channels, easy navigation. And flexible enough to accommodate differentiated user needs at the same time need to be prioritized. Make work flows optimized for efficiency and make cognitive load cheaper. Furthermore, incorporation of mechanisms that provide feedback for improvement is needed. Balancing these criteria shall result in a user-centered design that is geared toward the enhancement of productivity and satisfaction in the long run.

Various standards and guidelines linked to accessibility, safety, and usability issues need to be kept in mind while designing activities or planning data. Anthropometric data makes a design comfortable and ergonomic for users. Industry regulations regarding space limitations should be followed, and best practices of user experiences should be incorporated. Important areas of consideration include clear communication, ease of navigation, and flexibility to cater for different needs of users. The user-centered design, making the workflow efficient, reducing cognitive load, and ensuring feedback-process for continuous refinement-are the building blocks that result in greater productivity and user satisfaction.

5.2 Schedule of Accommodation

1. PROJECT INITIATION PHASE:

- a. Scope and objectives of the project
- b. Preliminary Research regarding Passive daylighting systems
- c. Identification of key stakeholders and the project team
- d. Preliminary Budget and Timeline

2. CONCEPT DEVELOPMENT PHASE:

- a. Requirements and Preferences Gathering
- b. Passive daylighting Design Concepts Brainstorming
- c. Select appropriate passive daylighting strategies
- d. Develop preliminary design sketches and design concepts

3. DESIGN DEVELOPMENT PHASE:

- a. develops Design concepts development proposed for Comment
- b. Preliminary Passive daylighting Diagrams and schematics
- c. Prepare list of materials and technologies that will be used in the component manufacture and the implementation of the major components
- d. Conduct simulations and energy modelling to measure the performance

4. DOCUMENTATION PHASE:

- a. Prepare detailed Passive daylighting Design Specifications
- b. Develop construction drawings and Technical Specifications
- c. Prepare Bills of Quantities and Cost estimates
- d. Identify Approvals and Permits Required for construction

5. IMPLEMENTATION STAGE

- a. Invite bids and award suppliers and contractors for Passive daylighting systems parts
- b. Implement construction and installation of passive daylighting systems
- c. Monitor quality assurance and inspect
- d. Correction of problem or deviations that occurred from construction

6. TESTING AND COMMISSIONING STAGE

- a. Test operational performance of passive daylighting systems in mode

- b. Adjust set number as to systems for essential operation
- c. Final test and commissioning of systems
- d. Train system to be handed to a system owner

7. TURN-OVER AND HAND-OVER PHASE:

- a. Handover the project to the client
- b. Evaluation certain case of passive daylighting systems performance
- c. Resolving operational problems or inadequacy
- d. Document lessons learned and best practice for future project

5.3 Special consideration

1. Preservation Historical and Cultural: The building's architectural heritage and cultural value is acknowledged and respected. Any alteration in concern to passive ventilation should not cause damage in the historical safe or aesthetic value.
2. Mixed-Use Spaces: Many cultural centers combine quiet exhibitions with highly active events.
3. Noise Control: Ensure that the passive daylighting solutions do not introduce unwanted noise. Cultural centers have avenues like theatres or auditoriums in which sound quality is very important.

4. Integration of Natural Lighting and Natural Ventilation: Integrate windows, louvers, and other openings that can be designed uniquely to allow much natural light and airflow. Integrate atriums and courtyards at appropriate locations within the spaces for day lighting or while encouraging cross ventilation.

5. Seasonal Variations and Climate: Ventilation design of buildings should be suited for a particular climate of the region, and seasonal variations in airflow or temperature should be carefully considered. Modification of indoor conditions should be achieved with the help of thermal mass, shading devices, and ventilation chimneys throughout the year.

6. Energy Efficiency: Reduce the dependability on mechanical lighting and air conditioning through energy efficiency. Apply passive solar design concepts to help reduce both heating and cooling loads.

8. Comfort and Safety: Make sure the daylight design provides visitor comfort with providing good illumination.

9. Compliance and Standards: Building codes and standards of a local nature concerning fire safety and occupant health will be adhered to.

10. Landscaping Integration: Landscaping may contribute to improve the microclimatic nature of a building and also its contribution to natural lighting

11. Maintenance and Durability: Design solutions that are hardy and easy to maintain, especially since cultural centers may have a tight budget for maintenance.

5.4 Site Inventory and Analysis

A cultural center site can be analyzed for good passive lighting by evaluating the, surrounding structures for shade and block wind, sun exposure, and Orientation of the building, the natural ventilation opportunities, thermal mass locations, and use of sustainable materials needs to be accounted. The topography of the site and the site-specific climatic data may help to enhance the use of passive lighting strategies. Various natural lighting enhancement concepts include atriums, and operable windows. The effective passive lighting of cultural centers seeks a proper balance between aesthetic and functional design. Mechanical devices for shading, thermal insulation, and provision of pathways for natural light should increase comfort while reducing energy consumption.

Site inventory is analyzed to implement passive daylighting in cultural centers concerning studies of: prevailing wind direction, local climatic conditions, and orientation of building for good lighting. Operatives should consider the potential of natural lighting at windows, skylights, and building layout. The possible utilization of thermal mass, vegetation, and shading devices should be taken into consideration as well in the regulation of indoor temperature. Passive lighting strategies that incorporate top lighting and light redirection can be integrated within the building envelope, by which the comfort levels increase and the dependence upon mechanical systems decreases. Detailed research facilitates the design process that develops a sustainable and energy-efficient cultural place, focusing on strategies of natural daylighting.

5.5 Analysis and Presentation of Data

Designing passive lighting strategies for the designated cultural place in Ugwuomu Nike in Enugu requires elaborating the thoughts of different parameters that require ventilation and how the same shall be achieved in practice to please the visitors inside comfortable with the exposure of light within the building.

1. Orientation and Layout of the Building:

- a. Orientation of the building to allow the maximum amount of light to enter into the building.
- b. window placement by positioning openings to ensure optimum lighting is achieved

2. Atrium or Central Courtyard Design:

- a. Atrium or central courtyard designed to act as the source for natural lighting
- b. Exploit the lighting by bringing in light from the outside.

3. Natural Daylighting

- a. Design operable windows with vents at appropriate locations to allow more light into the building.
- b. Use clerestory windows to provide an outlet for hot air and an inlet for cooler air.

4. Roof Design

The roof shall be designed to allow for natural ventilation and daylighting. This is done by providing cupolas, skylights, or roof monitors.

5. Choice of Materials:

a. High thermal mass materials for better temperature control since they absorb heat and release it at a slow pace.

b. Bright and reflective surfaces for the building exteriors that will reflect most heat and consequently reduce heat gain at the building. This will further reduce the use of mechanical cooling at the building.

6. SHADING AND LANDSCAPING:

a. Use shading elements like awnings, louvers, or vegetation to protect the building from direct sunlight and reduce heat gain.

b. Plant trees and develop green areas around the building to enhance air quality, provide shading, and increase the overall comfort of the space.

c. Provide automated controls for window opening, the operation of vents, and shading devices to satisfy the criteria of environmental parameters that would ensure effective air circulation for comfort.

8. CROSS-VENTILATION PATHWAYS:

a. Define the path clearly so that the movement of air in and out of the building is facilitated with openings opposite walls or on different sides for cross-ventilation.

b. There would be no obstruction inside due to interior partitioning or an arrangement of furniture that may impede natural ventilation.

9. THERMAL COMFORT DESIGN:

- a. Natural materials self-regulate the temperature and humidity indoors to offer comfort conditions to the visiting public.
- b. These will incorporate elements of thermal mass, such as stone or concrete flooring, which absorbs heat during the day and releases it at night when it gets cooler, thus maintaining comfortable indoor temperatures.

10. NIGHT FLUSHING:

- a. Exploit the cooler temperatures that occur outside at night by getting rid of heat trapped indoors; this can be implemented by the design of openings that can be left open during the night where areas of the building intend to take advantage of natural ventilation.
- b. Incorporate remotely controlled automated operable windows or vents to facilitate night flushing to reset the building temperature before the start of the next day operation.

5.6 DESIGN CONCEPT AND DESIGN PROPOSAL

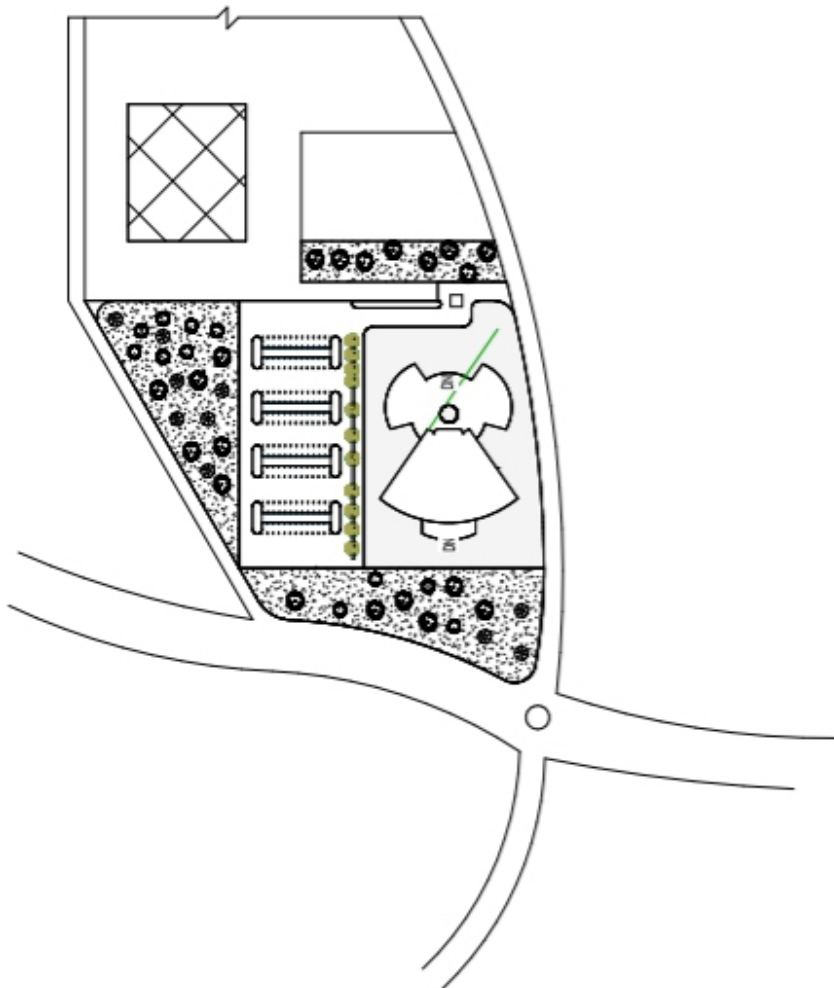
Design concept

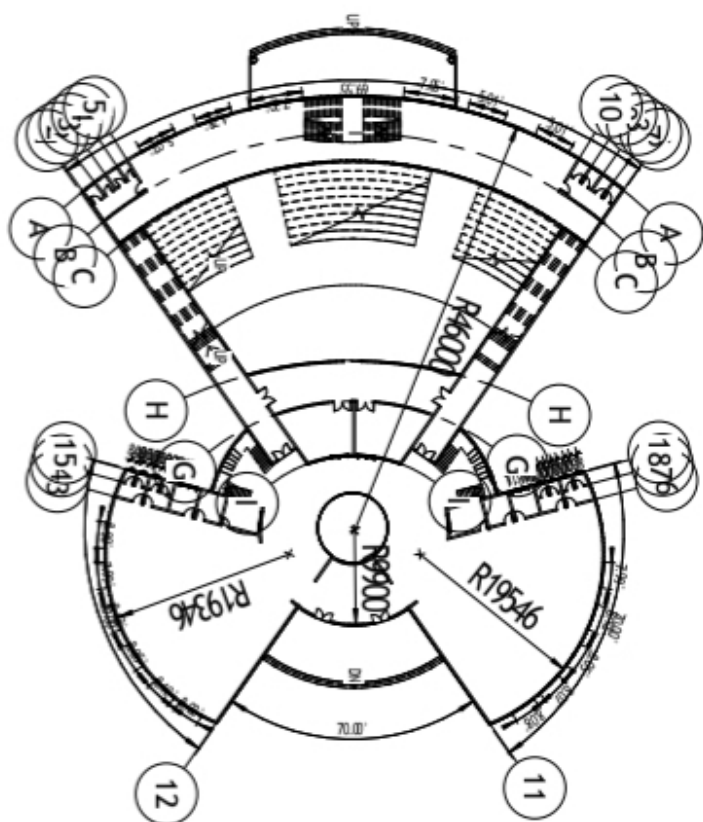
Treat daylight as a curated exhibit in itself controlled, filtered, and choreographed rather than simply admitted. The building's envelope acts as a series of light-modulating layers, each tuned to a different function within the cultural center (galleries, auditorium, lobby, archives)

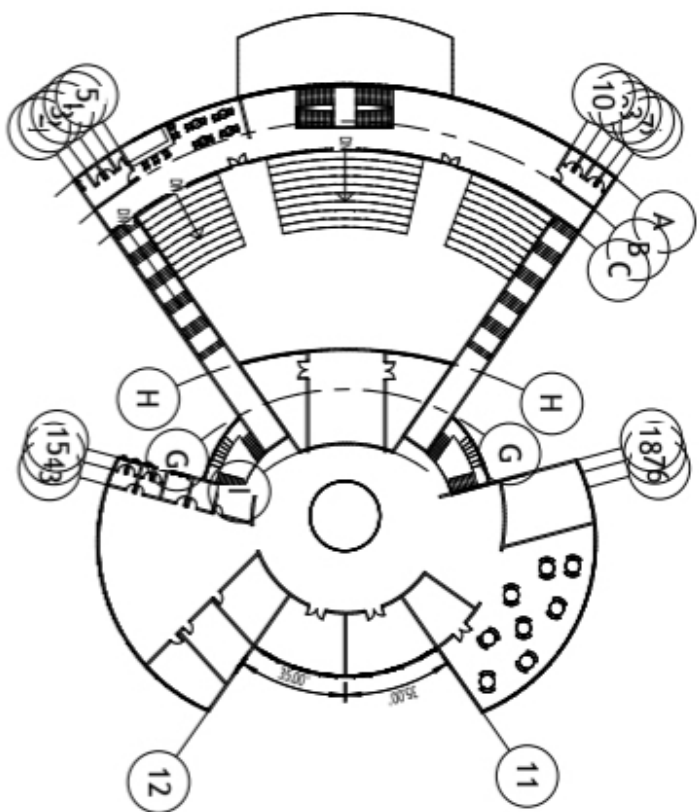
Design Proposal

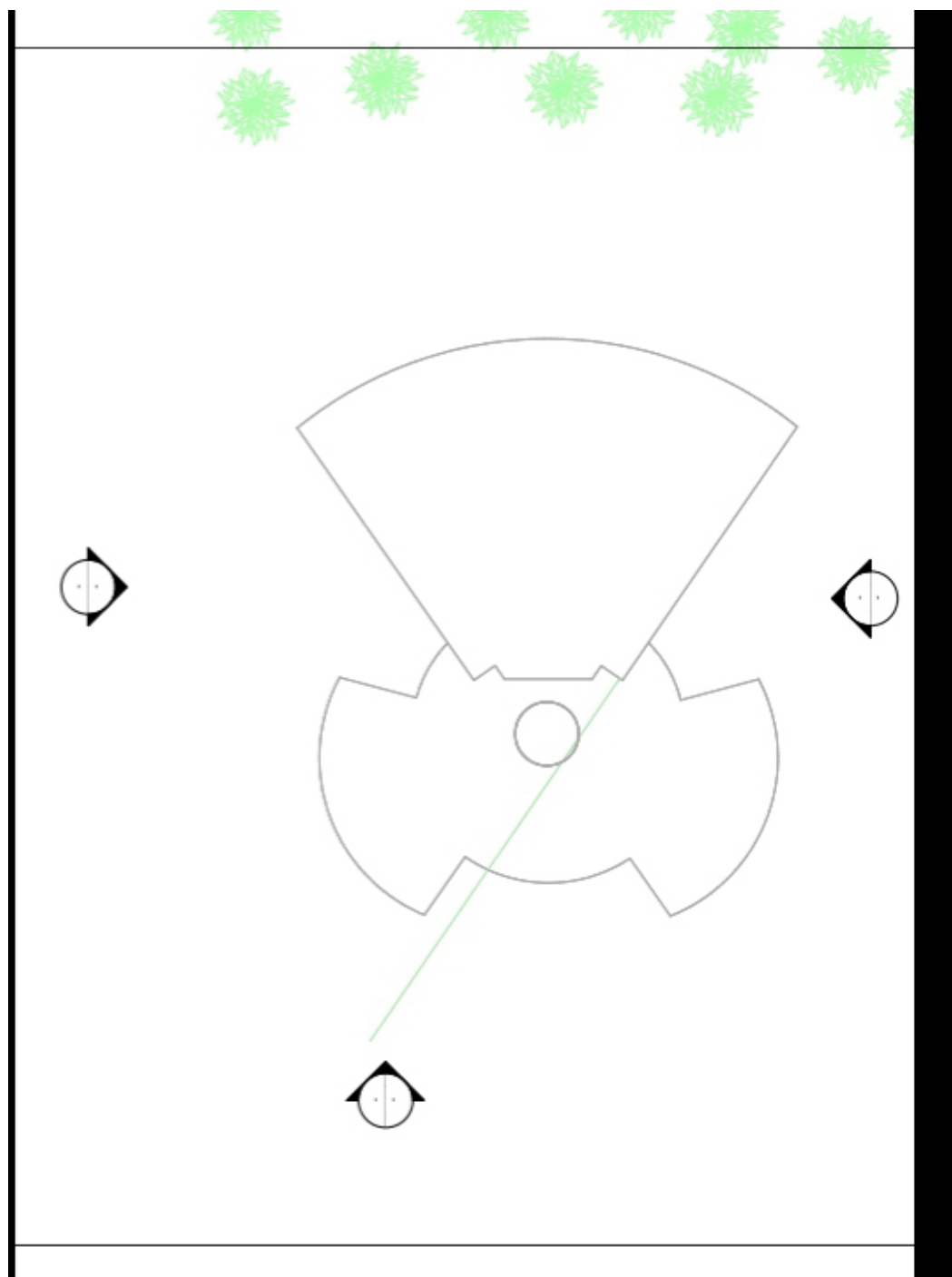
Title: Passive Daylighting Design Proposal for Cultural Centers at Ugwuomu Nike in Enugu

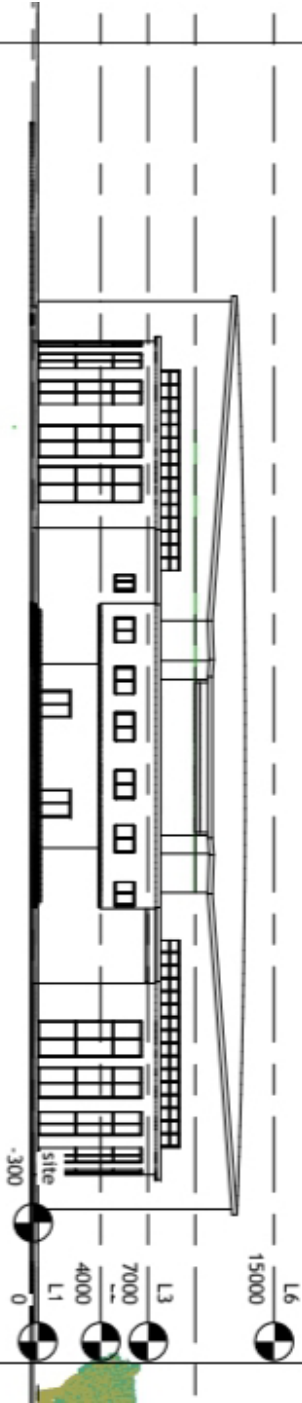
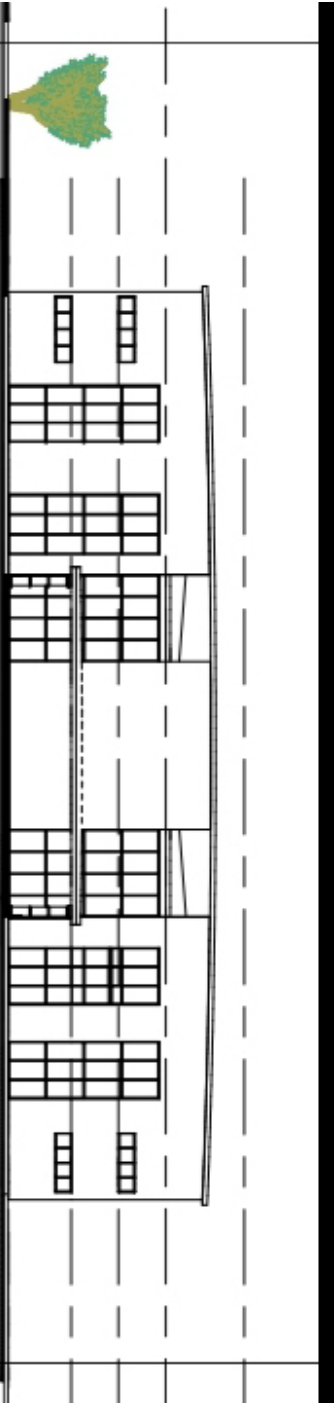
Summary of Proposal: The passive daylighting design to be proposed shall aim at creating maximum natural lighting, minimizing mechanical systems, and incorporating sustainable solutions that deal with local climatic conditions and architectural context at Okpara Square. Functionality and aesthetics will be maximally adapted to ensure seamless marriage with the existing centers.



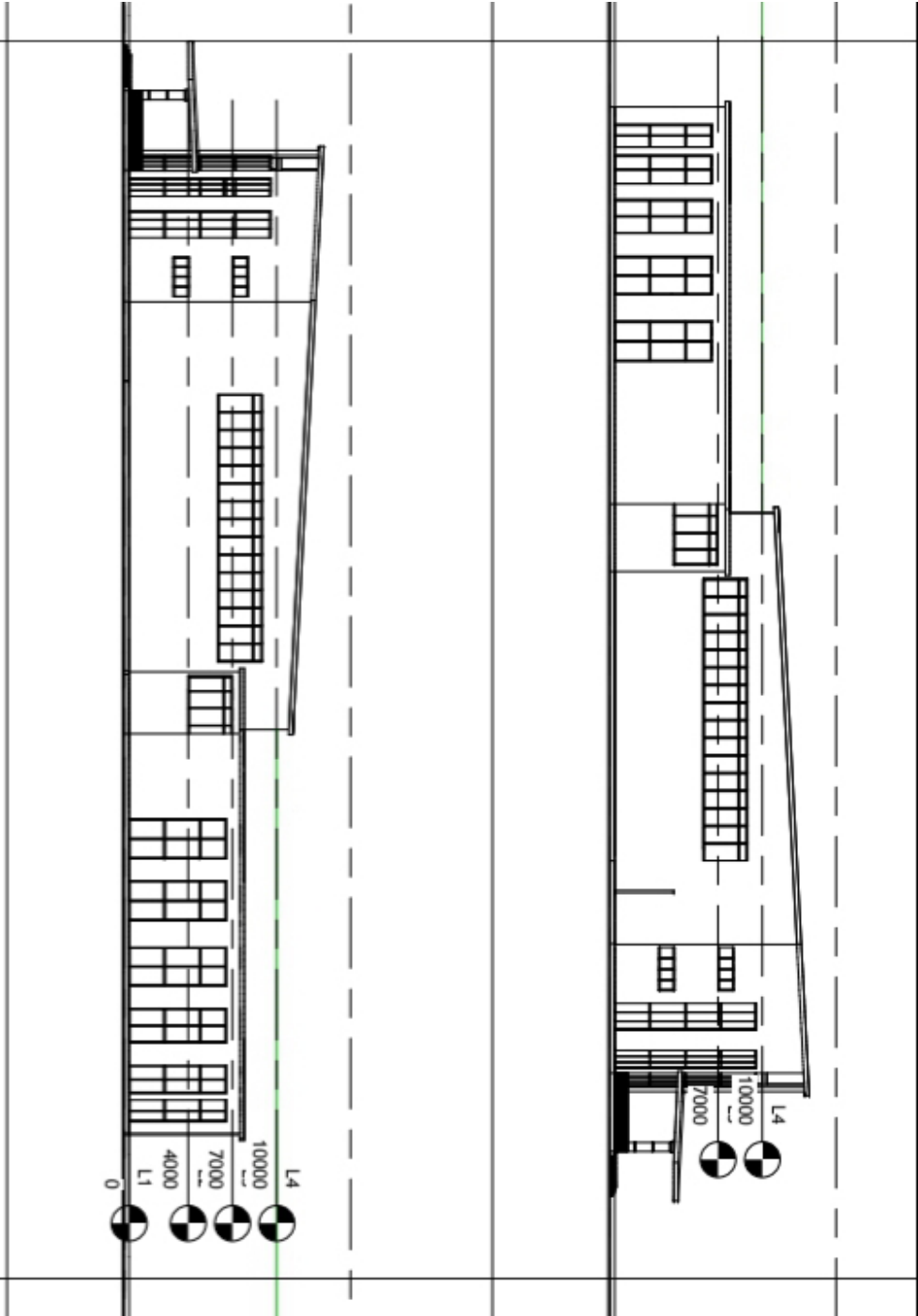


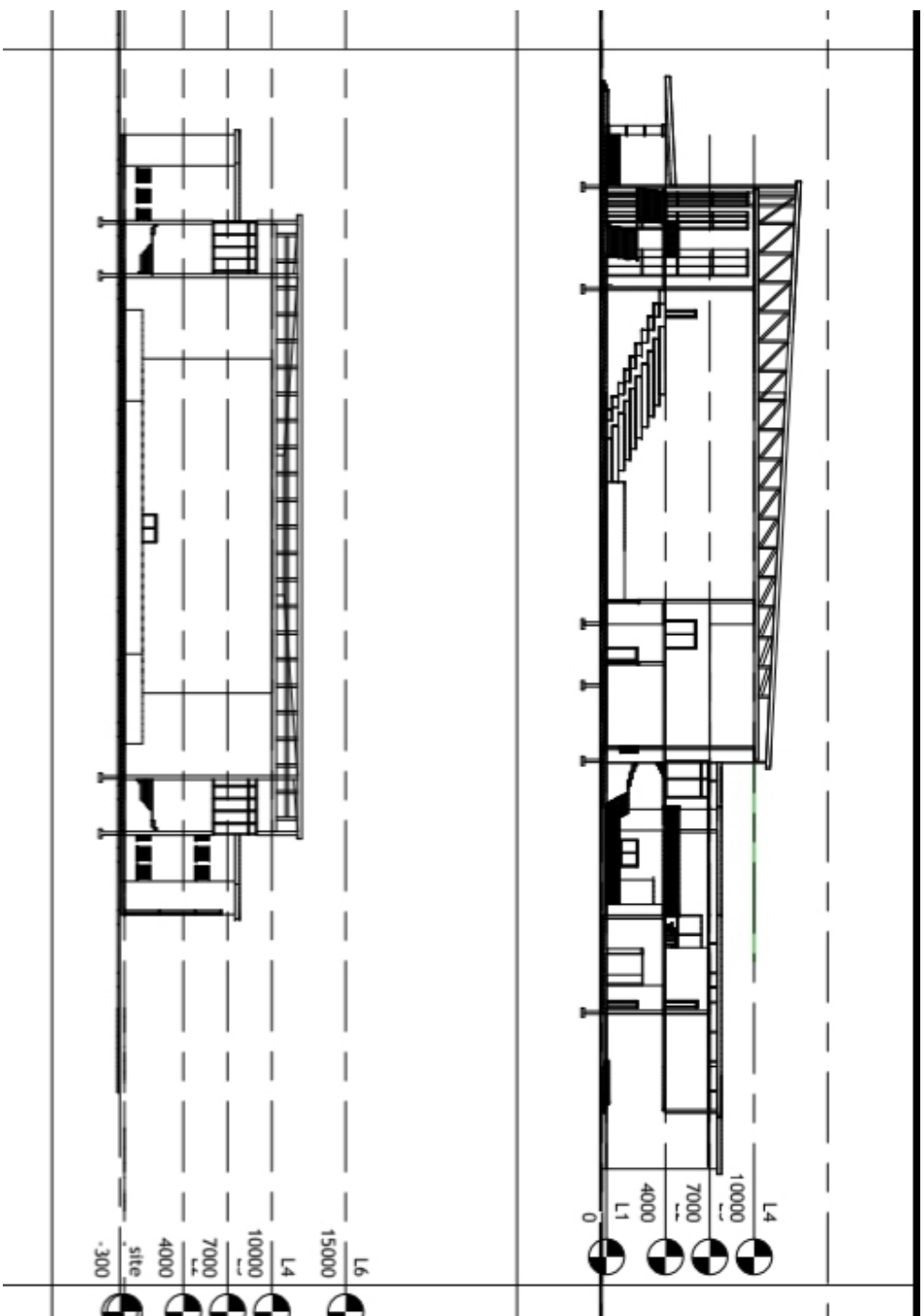






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CHAPTER SIX

Summary, Conclusion and Recommendations

6.1 Summary of Findings

The aim of this study was to investigate passive daylighting techniques for cultural centers in a tropical environment with the proposed Igbo Cultural Center, which is to be built in Ugwuomu Nike, Enugu, as the focal point. The research sought three aims: 1) to identify and analyse the passive lighting patterns found in the existing literature that could inform cultural centre design; 2) to evaluate the energy performance implications of cultural centres incorporating passive lighting; and 3) create design recommendations for the incorporation of passive lighting. The major issues and findings identified in the literature review, in the case studies and on the site are highlighted below.

- The literature reviewed shows that passive lighting methods such as side lighting, top lighting and light redirection and distribution systems have their advantages and disadvantages for auditoriums and performance halls. Side lighting via clerestories provides diffused, glare-controlled lighting for areas where line-of-site matters, whereas top lighting provides strong uniform illumination across large floor plates but requires choice of diffusing glazing (or shading) to control solar heat gain and glare. Systems that redirect light (light shelves, prismatic glazing) allow daylighting to penetrate deeper, into such areas as foyers and circulation cores.
- Daylighting performance was found to be strongly linked with building orientation and that building orientation with a long-axis in the north-south direction is the best option for

reducing unwanted glare and solar heat gain and for maximising usable daylight in the Nigerian tropical climate.

- In the case study, the International Conference Center, Enugu, it was found that circulation, acoustics and external aesthetics were satisfactory but the auditorium received little to no passive daylighting and there was also a poor relationship between the design of ancillary public spaces (well-lit lobbies) and the performance volume, which still relies heavily on artificial lighting even during the day.
- The climates of the sites and Ugwuomu Nike has been analyzed and established as a tropical savanna climate characterized by the availability of large amount of daylight hours throughout the year, bimodal rainfall and high humidity which requires careful control of glare and solar heat gain as well as the durability of the materials to deal with the climatic condition.
- As part of design synthesis, using building orientation, clerestory apertures and roof openings, atria, shading and materials, was determined to be a strategy that should not be incidental, but rather a planned means of reconciling the performance lighting demands of the auditorium with the daylighting requirements of foyer and circulation spaces and ancillary areas within the proposed cultural center.

6.2 Conclusion

The results of this study have demonstrated that passive daylighting is still underutilized in the design of buildings. The Nigerian context [with its year-round supply of natural light] notwithstanding, there are cultural centers that are excellent. offered by the tropical climate. In all the reviewed case studies, a pattern emerged in that.

Auditoria and enclosed performance volumes that have limited or no provision for audience members to communicate with each other. They are completely exposed to artificial light, and daylight is allowed in, frequently, unintentionally, to the periphery, to lobby spaces, foyers. This disconnect represents A lost chance for energy savings and a repudiation of the long architectural tradition. A lost opportunity for energy savings and a repudiation of the long architectural tradition. the tradition found in prior instances like the Teatro alla Scala and Royal Opera House for use of Lit up the spaces of performance venues to make them more interesting and experience-rich in the light of day.

The study also indicates that passive daylighting can be effectively incorporated into the cultural context. center design is not just about introducing apertures; it's about carefully controlling light. reaction to the acoustic, visual and programmatic requirements, respect for quantity, direction and glare. Specially designed for auditoria, galleries, and exhibitions. Strategies such as clerestory side lighting, the addition of the right kind of north lighting, filtered top lighting and light redirection systems are also necessary to achieve this. south building orientation, offer a viable means of achieving this balance in the hot-humid climate of Enugu.

The study also finds that passive design strategies are more effective at providing a more economical solution. sustainable and resilient alternative to the strong reliance on mechanical and electrical systems that is seen in similar cultural facilities, especially public power supply that is not reliable in the case of the country. Nigerian context. In conclusion, the proposed Igbo Cultural Center at Ugwuomu Nike offers a chance for the community to learn more about their culture and heritage. prove that passive daylighting, if used as an intentional design approach, rather than as a consequence of a poorly designed facade, can prove to be a successful design strategy. afterthought, can improve visual comfort, reduce energy consumption and help to

strengthen the cultural heritage. And symbolic identity of the building, while responding to the drawbacks found in the current facilities. The local cultural institutions in the area.

6.3 Recommendations

Based on the results and conclusions of this research, the following recommendations are suggested for the design and future development of the passive daylighting in cultural centers:

- The orientation of buildings should be considered as early in the design process as possible; the long axis of the auditorium and main exhibition volumes need to be oriented north–south to minimize direct solar penetration and glare with an optimum amount of diffuse daylight.
- The main light sources should be clerestory windows in the auditorium as well as in other spaces, allowing high-level diffuse daylight to enter, but not overhang or into the sightlines of audience or performance areas, and sawtooth or monitor roof light structures should be considered for improving light penetration into the exhibition and lobby spaces.
- Light redirection devices, like light shelves, translucent or prismatic glazing, should be included at building envelopes to increase daylight into deeper interior areas like backstage support areas, circulation cores and foyers which would otherwise depend on artificial light.
- Considering the region's high humidity and the strong heat gain in the daytime, special attention should be given to the integration of glare and solar heat gain control measures with the daylighting apertures to ensure the visual comfort of the occupants and to avoid excessive solar gain and consequently, thermal loading.

- Discussed was the need to have accessibility provisions in the design process to make the cultural center inclusive to persons with disability, as existing cultural institutions in Enugu are lacking of this.
- Daylighting simulation software (e.g. Radiance, Honeybee, and DIALux) should be used at the development phase of the design to assess and verify proposed daylighting strategies using established performance parameters (e.g. spatial Daylight Autonomy and Annual Sunlight Exposure) before construction begins, to ensure that the design intent translates into measurable performance.
- The design of new cultural facilities in the region should be based on the results of post-occupancy evaluation after the cultural centre has been put into operation, which should verify the comfort of the users and the efficiency of daylighting in use, and which should also provide feedback to the design of future cultural facilities.
- There is need for further research to establish long-term energy and cost-saving potential of passive daylighting in Nigerian cultural centers, and to determine the glare level and visual comfort requirements that are more suitable to igbo cultural performances to create a more robust evidence-based basis for future design guidelines.

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