Proposed Faculty Building of Basic Medical Science(s) for Lead city University, Ibadan, Oyo state

(Application of Natural Lighting in Faculty Building Design)

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Being an MSc Thesis Submitted to the Department of Architecture, Faculty of Environmental Design and Management, Lead City University, Ibadan, Oyo State, Nigeria

In Partial Fulfilment of the Requirements for the Award of Master Degree (MSc) in Architecture

2024

Certification

This is to certify that Folajimi Ayodele OLAYIWOLA with matriculation number LCU/PG/005058 carried out this research work titled "Application of Natural Lighting in Faculty Building Design" in the Department of Architecture, Faculty of Environmental Design and Management, Lead City University, Ibadan, Oyo state, for the award of Master Degree (MSc) in Architecture and that this has not been previously submitted.

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Dedication

This research is specially dedicated to Almighty God, the author and finisher of our faith, in whom all things are possible. The giver of life and the lifter of men for His grace and mercies upon my life, especially during the process of conducting this research. I also dedicate this work to all who contributed and supported me in making this project a success. May God reward you bountifully. I appreciate and celebrate each one of you.

Acknowledgement

I am grateful to Lead city university management for giving me the opportunity to carry out this research and providing an enabling environment to learn.

I also wish to recognize the incredible support from my academic community. My sincere appreciation to Arc. Olaniyan Martins, my dedicated supervisor, for his guidance during the challenging phases of this work. I also appreciate Dr. (Arc.) Adedire Funmilayo and Dr. (Arc.) Obaleye Oludare for their invaluable support. Special thanks to Arc. Aseyan Babajide, Dr. Ayanleke Oluwatosin, Arc. Fasheun-Motesho YMO, Arc. Adeola Ademola, and all lecturers for their immense support and selfless effort in ensuring the success of this research.

I return all glory and praises to Almighty God for guiding my path from cradle to this present moment. I affirm: YOU ARE ABLE.

My sincere gratitude goes to my wife, Olajumoke Olayiwola (Ifemi), and our children, Adedotun, Emmanuel, and Joy Olayiwola for the endurance, support and encouragement for a successful post graduate programme. I LOVE YOU GUYS. Profound thanks to my fathers in the Lord, Pastor Joseph Olajimi and Prophet Samuel Otokuefor for their invaluable support, both physical and spiritual. And to my father Mr. Fawibe Olusegun Olayiwola, and my mother-in-law, Mrs. Adeoya M. Olaiya, for absolute parental and moral support. May God grant you long life in good health to enjoy the fruits of your labour.

In addition to my family, I appreciate the efforts of my research assistant, as well as the colleagues who in no little measure provided guidance and advice. Finally, to inspirational and unequivocal senior colleagues and friends, including Arc. Morenikeji Semiu and Segun Ojeleye for their love and support during this post graduate programme. GOD BLESS YOU ALL.

Abstract

This thesis explored the effective application of natural lighting in the design of faculty buildings to enhance energy efficiency, sustainability, and occupant well-being. By reviewing existing literature and extensively analyzing case studies, the research identified key strategies for optimizing natural light, such as building orientation, window placement, and the use of reflective materials in academic settings. The findings indicated that strategic architectural design could significantly reduce reliance on artificial lighting, lower energy consumption, and improve indoor environmental quality. The study provided practical guidelines for architects, while sturdily emphasizing on the use of daylighting systems, such as skylights, light shelves, and adaptive technologies that respond to changing daylight conditions. This research contributed best actionable insights for designing healthier, more conducive educational buildings. Ultimately, it underscored the critical roles of natural lighting in shaping effective and inspiring educational spaces, advocating for a holistic approach to building design that harmonizes environmental, economic, and social dimensions.

Word count: 152 words.

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Chapter One

Introduction

1.1 Background to the Study

The integration of natural lighting in architectural design has become a paramount consideration in the quest for sustainable and energy-efficient buildings, aiming to enhance both the functional and aesthetic qualities of educational environments.

Natural lighting, often referred to as daylighting, is the practice of using natural light from the sun to illuminate building interiors. This approach, which dates back to ancient architecture, has seen renewed interest in contemporary building design due to its numerous benefits. Not only does it reduce the dependency on artificial lighting, but it also provides significant health, environmental, and economic advantages (Chung & Burnett, 2021). The integration of natural lighting in architectural design has been a focal point in sustainable building practices and energy-efficient design, particularly in educational settings where the well-being and performance of students and staff are of utmost importance.

As higher education institutions expand and evolve, the design of faculty buildings plays a crucial role in creating conducive learning environments. The application of natural lighting in these structures is particularly pertinent, given the long hours students and faculty spend in these spaces. Daylighting can enhance the aesthetic appeal of buildings, creating visually stimulating and pleasant environments. In educational settings, the presence of natural light has been linked to improved academic performance, enhanced concentration, and reduced absenteeism (Heschong Mahone Group, 1999; Li, Tsang, & Cheung, 2020). Studies indicate that students exposed to natural light in their learning environments tend to perform better on tests and exhibit higher levels of engagement and attentiveness (Boyce et al., 2019).

Furthermore, research has shown that natural lighting can significantly impact the well-being and productivity of building occupants. According to a study by Edwards and Torcellini (2002), natural light enhances mood, increases alertness, and can improve academic performance. Moreover, integrating natural lighting reduces energy consumption, leading to lower operational costs and a smaller carbon footprint, which is essential for large, heavily utilized faculty buildings (Dubois & Blomsterberg, 2011). The design of faculty buildings, particularly those dedicated to specialized disciplines such as Basic Medical Sciences, presents unique challenges and opportunities. These buildings must meet diverse requirements, including lecture halls, laboratories, offices, and communal spaces, each with specific lighting needs. Effective natural lighting strategies can significantly enhance the functionality and aesthetics of these spaces, fostering a conducive learning and working environment (Karolides, 2023).

Given the specific needs of medical science facilities, such as precise visibility for laboratory work and comfort for long hours of study and research, a well-thought-out natural lighting design can make a substantial difference in the building's overall performance and user satisfaction (Knoop et al., 2020).

1.2 Problem Statement

Despite the well-documented advantages of natural lighting, its implementation in educational buildings, particularly in developing countries like Nigeria, remains suboptimal (Abdul-Azeez & Taiwo, 2022). This reliance on artificial lighting not only contributes to higher energy costs but also negatively impacts the health and productivity of students and staff. Studies have shown that artificial lighting, especially when used excessively, can lead to issues such as eye strain, headaches, and reduced alertness, all of which are detrimental to the learning environment (Ekpenyong & Usman, 2020).

Moreover, the architectural design of some faculty buildings does not optimally utilize available natural light, leading to dark, uninviting spaces that hinder the educational experience (Udoakah & Essien, 2021). Addressing these challenges requires a critical re-evaluation of architectural practices and a commitment to implementing more sustainable, energy-efficient design solutions that prioritize the use of natural light in faculty buildings (Onifade et al., 2023).

In the context of Lead City University, there is a noticeable lack of effective natural lighting integration in the design of faculty buildings. This deficiency manifests in several ways, including increased energy bills, diminished student performance, and overall dissatisfaction with the learning environment. For a specialized facility like the Faculty Building of Basic Medical Science, inadequate lighting can severely hamper educational and research activities, which require specific lighting conditions for tasks such as detailed observations and precise experimental procedures (Thum & Gustafsson, 2019).

This core problem highlights the need for a comprehensive approach that not only meets the specific lighting requirements of such a facility but also leverages the benefits of natural lighting. This thesis investigates the principles and benefits of integrating natural light into the architectural design of educational institutions, focusing on faculty buildings.

1.3 Aim and Objectives of the Study

The aim of this study is to explore the application of natural lighting in the design of faculty buildings and to assess its impact on energy efficiency and occupant health. The specific objectives are:

2. To identify best practices and innovative strategies for integrating natural lighting in in faculty building designs.
3. To propose comprehensive design guidelines for integrating natural lighting in faculty buildings.

1.4 Research Questions

The study seeks to answer the following research questions:

1. How is natural lighting utilized in existing faculty buildings?
2. What are the best practices for the integration of natural lighting in the design of faculty buildings?
3. How can natural lighting be effectively optimized in the design of faculty buildings to meet its specific needs?

1.5 Significance of the Study

This study is significant for several reasons. First, it contributes to the body of knowledge on sustainable building practices, particularly in the context of educational facilities. Second, it provides architects and designers with practical insights and guidelines for incorporating natural lighting into faculty buildings. Third, by highlighting the benefits of natural lighting, the study underscores the potential for improved energy efficiency and occupant well-being. Finally, the findings of this research can inform policy decisions related to building codes and standards, promoting more sustainable construction practices in the educational sector (Reinhart & LoVerso, 2010).

1.6 Scope of the Study

The scope of this study is limited to faculty buildings within higher education institutions. It will focus on the architectural design aspects related to natural lighting, including window placement, building orientation, and the use of daylighting technologies. The study will consider both new construction and retrofitting of existing buildings. Geographically, the research will concentrate on faculty buildings in temperate climates, where the availability and intensity of natural light vary seasonally.

1.7 Limitation of the Study

This study has several limitations. First, the focus on temperate climates means that the findings may not be fully applicable to faculty buildings in tropical or polar regions. Second, the study relies on case studies and existing literature, which may not capture all the nuances of individual buildings and their specific contexts.

1.8 Operational Definitions of Terms

Natural Lighting (Daylighting): Practice of using sunlight to illuminate interior spaces in faculty buildings, controlled by sensors to optimize lighting throughout the day, improving visual comfort and reducing energy consumption.

Faculty Buildings: Structures within higher education institutions consisting of classrooms, offices, laboratories, and other academic facilities designed with natural lighting strategies.

Energy Efficiency: Reduction of energy required to power lighting systems in faculty buildings, achieved by strategic use of daylight to replace artificial sources.

Occupant Health and Well-being: Physical and psychological state of individuals using a faculty building, directly influenced by natural lighting's ability to improve concentration, mood, and overall productivity.

Daylighting Technologies: Systems like skylights, light shelves, and reflective surfaces to enhance availability of natural light in indoor spaces.

Conducive Learning Environments: Academic spaces optimized for teaching and learning, with proper natural lighting that supports focus, comfort, and productivity.

Carbon Footprint: Total reduction in greenhouse gas emissions as a result of minimizing artificial lighting in faculty buildings.

Functionality of Spaces: Degree to which academic spaces are usable and efficient, enhanced by the proper application of daylighting systems for multiple purposes.

Aesthetic Appeal of Buildings: Visual and sensory attractiveness of faculty buildings due to natural lighting, which enhances occupants' satisfaction.

Operational Costs: Ongoing financial savings associated with the day-to-day functioning of a faculty building through the application of natural lighting.

User Satisfaction: Overall contentment of building occupants, evaluated based on their experience with natural lighting systems enhancing comfort and productivity.

Chapter Two

Literature Review

2.1 Conceptual Review

2.1.1 Natural Lighting

Natural lighting, or daylighting, is increasingly recognized as a critical component in the design of educational buildings, including faculty buildings. The benefits of natural lighting extend beyond energy efficiency, influencing psychological well-being, productivity, and overall satisfaction of occupants (Klepeis et al., 2022).

Natural lighting, also known as daylighting, is the deliberate use of natural light to illuminate the interior spaces of buildings. It encompasses the strategic placement of windows, skylights, light shelves, and reflective surfaces to maximize the ingress and distribution of daylight. The primary objective of natural lighting is to reduce reliance on artificial lighting, thus conserving energy, enhancing visual comfort, and improving the well-being of occupants (Paule & Romera, 2019).

Daylighting strategies involve the comprehensive analysis of solar angles, building orientation, and the integration of architectural elements that facilitate the penetration and diffusion of natural light. By harnessing the dynamic and varied qualities of daylight, architects and designers can create spaces that are not only energy-efficient but also aesthetically pleasing and psychologically beneficial (Odeleye & Okoro, 2021).

2.1.1.1 Evolution of Natural Lighting in Architecture

Natural lighting has been a cornerstone of architectural design and human activity throughout history. Early civilizations, including the Egyptians and Greeks, meticulously planned their structures to maximize daylight use. Egyptian temples and Greek houses often featured courtyards and clerestory windows that facilitated the entry of daylight into interior spaces (Plummer, 2012). This delves into the chronological development of natural lighting, highlighting significant milestones and innovations across different eras.

i. Ancient Civilizations and Natural Lighting

a) Egyptian Architecture

In ancient Egypt, the interplay of sunlight and architecture was pivotal. Egyptian builders designed their monuments to harness the power of the sun, not only for practical purposes but also for religious and symbolic reasons. The orientation of the Great Pyramid of Giza is a testament to this, with its sides aligned to the cardinal points and the internal chambers positioned to capture the sun's rays during specific times of the year. This alignment was intended to symbolize the pharaoh's eternal union with the sun god Ra, reflecting the civilization's deep connection with celestial bodies (Wright & Jago, 2021).

b) Greek and Roman Innovations

The Greeks and Romans further advanced the use of natural lighting. Greek temples featured open colonnades that allowed light to filter through, enhancing the spiritual ambiance. The Parthenon, for example, used its strategic orientation and open structure to maximize natural light (Mark, 1996).

The Romans, known for their engineering prowess, introduced innovations like the oculus and large windows. The development of the hypocaust system, which combined underfloor heating with large windows, exemplified the Roman innovation in integrating light and climate control. The Pantheon's oculus, a central opening at the dome's apex, allows natural light to flood the interior, creating a dynamic interplay of light and shadow that changes with the time of day and seasons. This not only illuminated the space but also had symbolic significance, connecting the earthly realm with the heavens (Paule & Romera, 2019).

ii. Medieval and Renaissance Developments

a) Gothic Architecture

During the medieval period, Gothic architecture revolutionized the use of natural light. Gothic cathedrals, such as Notre-Dame de Paris, were designed to elevate the soul towards the divine. Stained glass windows became a hallmark of Gothic cathedrals, serving both aesthetic and didactic purposes. These windows depicted biblical scenes and saints, transforming natural light into a tapestry of color and narrative, symbolizing divine illumination (Gonzalez, 2022). The manipulation of light in Gothic architecture symbolized divine presence and spiritual transcendence (Greenhalgh, 2020).

b) Renaissance Architecture

The Renaissance marked a return to classical principles, with an emphasis on proportion, symmetry, and the harmonious use of natural light. Architects like Filippo Brunelleschi and Leon Battista Alberti sought to create spaces that were both functional and aesthetically pleasing. Brunelleschi's design for the Florence Cathedral dome incorporated large windows at the base, allowing natural light to penetrate and illuminate the vast interior space, enhancing its grandeur (Kruft, 1994).

Leon Battista Alberti's treatises on architecture further emphasized the importance of light. He advocated for buildings that maximized natural illumination through strategically placed windows and open courtyards. This period also saw the development of linear perspective in art and architecture, which relied on a scientific understanding of light and vision (Anderson, 2020).

iii. The Industrial Revolution and Artificial Lighting

The Industrial Revolution brought a paradigm shift, with the widespread adoption of artificial lighting. The advent of gas lighting and later electric lighting revolutionized how spaces were illuminated, reducing reliance on natural light. However, the period also saw the construction of factories and large public buildings with vast windows and skylights, designed to maximize daylight during working hours (Schivelbusch, 1988; Wright & Jago, 2021).

iv. Modernist Movement

The early 20th century saw a resurgence of interest in natural lighting, driven by the emergence of the Modernist movement, which emphasized simplicity, functionality, and the integration of natural light. Architects like Le Corbusier and Frank Lloyd Wright were at the forefront of this movement advocating for open plans, extensive glazing, and the seamless integration of indoor and outdoor spaces.

Le Corbusier's designs, including the Villa Savoye, featured horizontal windows that provided consistent natural light and views of the surrounding landscape. He famously stated, "Light is the key to architecture," underscoring his belief in the fundamental role of natural light in creating harmonious spaces (Le Corbusier, 1986; Cohen, 2020).

Frank Lloyd Wright's architectural philosophy also prioritized natural light. His iconic Fallingwater house, with its extensive use of glass and open floor plan, exemplifies his approach to blending indoor and outdoor spaces. Wright's designs often featured large windows, clerestories, and skylights to ensure that natural light permeated the interior spaces, creating a sense of openness and connection with nature (Pallasmaa, 2020; Friedman, 2019).

v. Contemporary Sustainable Practices

In the 21st century, the focus has shifted towards sustainability and energy efficiency, leading to innovative approaches in utilizing natural light. The advent of green building practices and technologies has transformed how natural light is harnessed in modern architecture. Contemporary designs incorporate advanced materials and technologies, such as light diffusing panels, dynamic facades, and smart glass, to optimize daylight use while minimizing energy consumption (Loonen et al., 2021). These innovations reflect a growing commitment to creating buildings that are not only environmentally responsible but also conducive to the well-being of their occupants. In educational settings, the integration of natural lighting has been linked to improved student performance, reduced absenteeism, and enhanced overall satisfaction (Odeleye & Okoro, 2021). This ongoing evolution in natural lighting strategies underscores the importance of aligning architectural design with sustainability goals, particularly in the context of faculty buildings where the quality of the environment directly impacts educational outcomes (Vazquez et al., 2023).

2.1.1.2 Theoretical and Fundamental Principles Guiding Natural Lighting

The theoretical underpinnings of natural lighting are rooted in both the science of light and architectural design principles.

i. **Key scientific principles include:**

   a) **Reflection:** Light reflects off surfaces at an angle equal to its incidence. Reflective surfaces within a building can help distribute daylight more evenly (Ghaffarianhoseini et al., 2019).

   b) **Refraction:** Light bends as it passes through different media (e.g., glass). Understanding refraction is crucial for designing glazing systems that optimize light entry while minimizing glare and heat gain (Mandic et al., 2021).

c) **Absorption:** Surfaces absorb a portion of the light that strikes them. Materials and colors used in interior finishes can influence the amount of light absorbed or reflected, thereby affecting the overall daylighting performance (Almusaed & Almssad, 2020).

ii. Architectural Design Principles

In architectural theory, concepts such as light direction, light distribution, and light control are fundamental. The orientation of a building plays a critical role in determining how sunlight enters and moves through spaces. North-facing windows typically provide consistent, diffuse light, while south-facing windows receive direct sunlight, which can be intense and require shading devices to control glare and heat (Tregenza & Wilson, 2011).

The daylight factor (DF) is a key metric in daylighting design, defined as the ratio of indoor illuminance at a specific point to the outdoor illuminance under overcast sky conditions. A higher daylight factor indicates better natural light availability inside the building. Effective daylighting design aims for a balanced distribution of light, avoiding both underlit and overly bright areas to ensure visual comfort.

Several fundamental principles guide the effective application of natural lighting in architectural design:

a) **Daylight Autonomy**

Daylight autonomy refers to the extent to which natural light alone can satisfy the lighting requirements of a space without the need for artificial lighting. This principle aims to maximize the use of daylight, reducing energy consumption and enhancing occupants' comfort and well-being. Daylight autonomy is a key metric in assessing the effectiveness of natural lighting in buildings (Santos et al., 2020).

b) **Orientation and Sun Path**

Understanding the sun's path and the orientation of a building is crucial for optimizing natural light. By aligning buildings and windows to take advantage of the sun's movement, architects can ensure that spaces receive appropriate amounts of light throughout the day and across different seasons. Szokolay (2014) highlights the importance of solar geometry in designing buildings that maximize daylighting potential.

c) **Window-to-Wall Ratio (WWR)**

The window-to-wall ratio is a critical factor in determining the amount of natural light entering a space. Larger windows typically allow more light but can also lead to issues like glare and heat gain. The WWR must be carefully balanced to provide sufficient light while mitigating potential drawbacks such as increased energy use for cooling (Jakubiec & Reinhart, 2019).

d) **Light Distribution and Diffusion**

Natural light should be distributed evenly throughout a space to avoid excessive contrast and glare. This can be achieved through the use of light shelves, diffusers, and other architectural elements. A research study by Li and Tsang (2008) discusses various design strategies for achieving uniform light distribution, emphasizing the role of interior architectural features.

e) **Reflectance and Interior Finishes**

The materials and colors used inside a building significantly impact how light is reflected and perceived. Lighter colors and reflective surfaces can help amplify natural light. High-reflectance surfaces enhance the effectiveness of natural lighting by bouncing light deeper into the space (Ghaffarianhoseini et al., 2019).

f) Glare Control

While natural light is beneficial, excessive brightness can cause discomfort and reduce productivity. Glare control strategies, such as shading devices, louvers, and blinds, help manage the intensity and direction of sunlight. A study by Jakubiec and Reinhart (2019) investigates the effectiveness of various glare control measures in office environments.

g) Thermal Comfort

Natural lighting must be balanced with considerations for thermal comfort. Windows and other openings that allow light can also let in heat. Heschong (2002) discusses the dual impact of daylight on visual and thermal comfort, advocating for integrated design approaches that address both aspects.

h) Building Envelope Design

The design of the building envelope, including walls, roofs, and fenestrations, plays a significant role in controlling natural light. Features like clerestory windows, atriums, and skylights can enhance daylight penetration into deeper areas of a building. Building envelope design is crucial for achieving optimal daylight performance (Almusaed & Almssad, 2020).

i) Integration with Artificial Lighting

Effective natural lighting design often involves integrating natural and artificial lighting systems. Smart lighting controls and sensors can adjust artificial lighting based on the availability of natural light. This integration can significantly improve energy efficiency and lighting quality (Santos et al., 2020).

j) Human Factors and Well-being

Natural light has a profound impact on human health and well-being. Exposure to natural light can improve mood, productivity, and overall health. Boyce (2014) provides an extensive review of the psychological and physiological benefits of natural lighting in indoor environments.

k) Sustainability and Energy Efficiency

Maximizing natural light contributes to sustainable design by reducing the need for artificial lighting and decreasing energy consumption. Sustainable architecture often incorporates natural lighting strategies to achieve energy efficiency and reduce the building's environmental footprint. According to Edwards and Torcellini (2002), daylighting is a fundamental component of green building practices.

l) Balancing Quantity and Quality

Achieving the right balance between the quantity and quality of natural light is crucial. Overly bright areas can cause discomfort and glare, while insufficient light can lead to underlit spaces. Designers must consider factors such as light intensity, distribution, and color rendering to create visually comfortable environments (Ghaffarianhoseini et al., 2019).

2.1.1.3 Strategies for Integrating Natural Lighting

i. Daylighting Strategies

Daylighting strategies have become central to sustainable building design. These strategies aim to maximize the use of natural light while minimizing energy consumption and enhancing occupant well-being (Dubois & Blomsterberg, 2019).

ii. Architectural Features

Incorporating architectural features such as atriums, courtyards, and open-plan layouts can enhance the effectiveness of natural lighting. These elements create opportunities for daylight to penetrate deeper into the building, providing even and consistent illumination. According to

Andrade and Kuczynski (2021), these features significantly contribute to the overall daylighting efficiency in sustainable building designs.

iii. Tubular Daylighting Devices

Tubular daylighting devices (TDDs), also known as light tubes or solar tubes, capture sunlight through a rooftop dome and channel it down a reflective tube into interior spaces. TDDs are particularly effective in bringing natural light into areas of a building that are far from exterior walls (Hassan et al., 2022).

iv. Reflective Surfaces

Utilizing surfaces and materials that enhance light reflection, can enhance the distribution of natural light within a space. The use of reflective surfaces and materials increase the effectiveness of natural light, reducing the need for artificial lighting and creating a brighter, more pleasant environment. Light-coloured walls, ceilings, and floors, as well as the use of light shelves and reflective finishes, can help maximize the penetration and diffusion of natural light (Arabi & Dabiri, 2020).

v. Daylight Harvesting

Advances in building materials and technologies have further enhanced the ability to control and utilize natural light. This technique involves using sensors and controls to adjust artificial lighting based on the availability of natural light. When daylight levels are sufficient, artificial lights are dimmed or turned off, leading to significant energy savings. Daylight harvesting systems can be integrated with building management systems for automated control and optimization.

Low-emissivity (low-E) glass, for example, reduces heat gain while allowing visible light to pass through, improving energy efficiency (Chen & Zhang, 2021). Automated shading systems, such as motorized blinds and dynamic facades, adjust according to the position of the sun, optimizing natural light while minimizing glare and heat gain. Smart glass technologies, which change transparency in response to light levels, offer additional control and flexibility (Sartori et al., 2023).

vi. **Building Certifications and Standards**

Green building certifications, such as LEED (Leadership in Energy and Environmental Design), emphasize the importance of natural light in sustainable design. LEED standards encourage the incorporation of daylighting strategies to reduce energy consumption and improve indoor environmental quality (Pacheco-Torgal, 2020).

2.1.1.4 Importance of Natural Lighting

The importance of natural lighting extends across various domains, impacting energy efficiency, occupant health, and environmental sustainability. Key benefits include:

i. **Energy Efficiency**

Natural lighting reduces the need for artificial lighting, which accounts for a significant portion of a building's energy consumption. By harnessing daylight, buildings can achieve substantial energy savings and lower operational costs (Zhao et al., 2020).

ii. **Visual Comfort**

Well-designed daylighting can create visually comfortable environments by providing balanced light levels and reducing glare. Natural light also enhances the color rendering of interior spaces, making them more aesthetically pleasing and functional. As noted by Jelicic et al. (2022), effective daylighting design contributes to creating visually comfortable environments that support well-being and productivity.

iii. Environmental Impact

Utilizing natural light reduces the carbon footprint of buildings by lowering energy consumption and associated greenhouse gas emissions. This contributes to the broader goals of environmental sustainability and climate change mitigation (Guerreiro et al., 2021).

iv. Aesthetic and Psychological Benefits

Natural light enhances the aesthetic quality of spaces, creating more inviting and dynamic environments. It also fosters a connection to the outdoors, which can improve the psychological well-being of occupants. According to Fisher et al. (2021), exposure to natural light positively affects mood and creates a more engaging and pleasant environment.

v. Health and Well-being

Exposure to natural light has been shown to improve mood, reduce stress, and enhance cognitive performance. Natural light supports circadian rhythms, which regulate sleep-wake cycles and overall physiological health. In educational settings, students in naturally lit classrooms tend to perform better academically and exhibit fewer behavioural issues (Clements & Siskind, 2023).

2.1.2 Natural Lighting in Educational Buildings

Educational buildings are designed to facilitate learning, teaching, and research activities. These structures vary widely in terms of size, function, and architectural style, reflecting the diverse needs of educational institutions. They are critical spaces where the physical environment significantly impacts learning, productivity, and well-being of students and faculty members alike. The design and implementation of natural lighting within these structures play a pivotal role in creating conducive learning environments.

Key types of educational buildings include:

i. **Primary and Secondary Schools**

Primary and secondary schools form the foundational stages of formal education. These buildings are designed to cater for younger learners, providing classrooms, laboratories, libraries, recreational facilities, administrative offices, play areas and multipurpose halls. The design of these spaces focuses on creating safe, stimulating environments that support various learning activities (MacDonald & Avery, 2020).

ii. **Specialized Training Facilities**

Structures designed to provide vocational training, technical education, and professional development, often including workshops and simulation environments. These buildings are equipped with specific tools, machinery, and environments to simulate real-world work settings. This category includes institutions like technical colleges, trade schools, and apprenticeship centers (Adams et al., 2022).

iii. **Colleges and Universities**

Higher education institutions encompass colleges and universities that offer undergraduate, graduate, and postgraduate education. Complex campuses comprising diverse building types serving various functions that support the academic and extracurricular activities of students and faculty (Wang & Li, 2021).

2.1.2.1 Categories of Higher Education Institution Buildings

Higher education campuses include numerous specialized buildings:

i. **Administrative Buildings**

Administrative buildings house the offices for managing the institution's operations, including admissions, finance, human resources, and academic administration. These buildings are critical for the smooth functioning of the institution (Nair & Zimring, 2020).

ii. **Library Buildings**

Library buildings provide access to physical and digital resources for academic research and study. They often include reading rooms, computer labs, and spaces for group study, playing a central role in supporting the academic endeavours of students and faculty (Bland & Tschera, 2022).

iii. **Student Services Buildings**

These buildings support student needs outside of academics, offering services such as counseling, health services, career centers, and financial aid offices. They are essential for student welfare and holistic development (Kuk, 2022).

iv. **Recreational and Sports Facilities**

Recreational and sports facilities provide spaces for physical activity, sports, and recreational programs. These may include gyms, swimming pools, sports fields, and fitness centers, promoting physical health and wellness among students (Gibson & Manolessou, 2021).

v. **Residential Buildings**

Residential buildings offer housing accommodations for students and sometimes faculty. These buildings include dormitories, apartments, and residential halls, providing a living environment that supports academic and social life (Harrison & Schaefer, 2021).

vi. **Health and Medical Facilities**

Health and medical facilities include clinics, hospitals, or medical schools associated with the institution. They offer healthcare services to students and staff and serve as training grounds for medical students (Stokols, 2020).

vii. **Research Centers and Laboratories**

Research centers and laboratories are dedicated to scientific research and experimentation across various disciplines. These facilities are equipped with advanced technology and equipment to support innovative research (Becker et al., 2022).

viii. **Cultural and Performing Arts Centers**

Cultural and performing arts centers house spaces for cultural events, performing arts, galleries, or museums. These buildings support the cultural and artistic expressions of the academic community (Hoffman, 2021).

ix. **Support Services Buildings**

Support services buildings provide maintenance, IT support, sustainability initiatives, and other logistical support. They ensure the efficient operation of the institution's infrastructure (Schmidt & Bach, 2022).

x. **Academic Buildings**

Academic buildings encompass all structures directly supporting academic activities, including faculty buildings. They are the core structures within higher education institutions, designed to support teaching, learning, and research activities. These buildings vary significantly in their design and functionality, tailored to meet the diverse needs of various academic disciplines and pedagogical approaches (Zimring et al., 2021). The primary types of academic buildings include lecture halls, laboratories, classrooms, and workshops.

a) **Lecture Halls**

Lecture halls are large rooms equipped to facilitate lectures, presentations, and discussions for sizable audiences. These spaces often include tiered seating to ensure clear sightlines for all attendees and advanced audio-visual equipment to enhance the delivery of content. The design of lecture halls emphasizes acoustics, visibility, and technology integration to create an optimal learning environment. Studies have shown that well-designed lecture halls can significantly impact student engagement and comprehension (Bridges & Gibson, 2023).

b) Laboratories

Laboratories are specialized facilities equipped for scientific research and practical learning. These spaces are essential for disciplines such as chemistry, biology, physics, and engineering, where hands-on experimentation and research are integral to the curriculum. Laboratories are designed with safety in mind, incorporating features such as fume hoods, emergency showers, and secure storage for hazardous materials. The layout and equipment in laboratories are continuously updated to keep pace with advancements in technology and scientific methodologies (Vijayakumar et al., 2022).

c) Classrooms

Classrooms are fundamental components of academic buildings, providing spaces for teaching smaller groups of students. These rooms are designed to be flexible and adaptable, supporting various instructional methods, including lectures, group work, and interactive learning. Modern classrooms often feature moveable furniture, interactive whiteboards, and connectivity for digital devices, allowing for a dynamic and collaborative learning environment (Roksa & Arum, 2021).

d) Workshops

Workshops are specialized areas designed for hands-on training or artistic production, often found in technical, vocational, and arts education programs. These spaces are equipped with tools, machinery, and materials necessary for practical training in field. The design of workshops emphasizes safety, accessibility, and functionality, ensuring that students can engage in practical tasks effectively and safely (Harrington & McKinney, 2022).

Academic buildings play a crucial role in shaping the educational experiences of students and faculty. Well-designed academic buildings can enhance learning outcomes, foster collaboration, and support innovative teaching practices. The quality of the physical learning environment has been linked to improved student performance, satisfaction, and retention rates. Moreover, academic buildings that incorporate sustainable design principles contribute to the institution's overall sustainability goals and create healthier learning spaces (Miller & Dammann, 2023).

2.1.3 Faculty Buildings

Faculty buildings often referred to as a faculty office building or academic building are integral components of higher education institutions designed specifically for faculty members. designed to support the work of academic staff and foster collaboration between faculty and students. These buildings include faculty offices, conference rooms, and other amenities that support the academic and administrative roles of faculty.

i. Faculty Offices

Faculty offices are private or shared spaces where faculty members conduct their work, including research, teaching preparation, administrative duties, and student consultations. These offices are essential for providing a conducive environment for intellectual work and privacy for sensitive discussions. The design of faculty offices often includes ergonomic furniture, adequate storage, and access to technological resources, ensuring that faculty have the necessary tools and comfort to perform their duties effectively (Hancock et al., 2020).

ii. Conference Rooms and Meeting Spaces

Faculty buildings also include conference rooms and meeting spaces where faculty can collaborate, hold meetings, and conduct seminars or workshops. These rooms are equipped with technology to facilitate presentations, video conferencing, and collaborative work. The availability of such spaces supports interdisciplinary collaboration and fosters a sense of community among faculty members (Gao et al., 2019).

iii. **Additional Amenities**

Many faculty buildings offer additional amenities such as lounges, and wellness rooms to enhance the work-life balance of faculty members. These spaces provide opportunities for informal interactions, relaxation, and self-care, contributing to the overall well-being and job satisfaction of faculty (Tucker, 2021).

iv. **Classrooms and Lecture Halls:** Spaces for teaching and learning, equipped with modern technological tools to enhance the educational experience (Booth & Pritchard, 2022).

v. **Research Laboratories:** Specialized facilities for scientific and technical research, often requiring precise lighting and environmental controls (Barrett et al., 2019).

vi. **Support Facilities:** Ancillary spaces such as libraries, IT centers, and administrative offices that support the overall functioning of the academic environment (Miller, 2020).

Faculty buildings play a critical role in supporting the professional activities and well-being of faculty members. The quality and functionality of these spaces can significantly impact faculty productivity, job satisfaction, and the overall academic environment. Well-designed faculty buildings facilitate effective teaching and research, promote collaboration, and help attract and retain high-quality faculty. By providing spaces that meet the diverse needs of faculty, institutions can foster a supportive and thriving academic community.

2.2 Design Considerations

Designing faculty buildings with effective natural lighting requires an all-inclusive approach, integrating architectural design, environmental analysis, and building performance criteria. Key design considerations include:

i. **Site Orientation and Climate Analysis:** The first step in designing for natural lighting is analyzing the site's orientation and climate. The position of the building relative to the sun's path, prevailing winds, and local weather patterns influences the amount and quality of daylight that can be harnessed. For example, in temperate climates, south-facing orientations maximize sunlight exposure, while in hot climates, minimizing direct sunlight can reduce cooling loads (Fabbri & Lee, 2021).

ii. **Window Design and Placement:** The size, shape, and placement of windows are critical to optimizing natural light. Large, strategically placed windows can enhance light penetration, but they must be carefully designed to avoid issues such as glare and excessive heat gain. High-performance glazing, such as low-E glass, can help control light transmission and improve thermal performance (Baker & Marchant, 2022).

iii. **Skylights and Atriums:** Incorporating skylights and atriums can significantly improve daylighting in deep-plan areas that traditional windows cannot reach. These features introduce light from above, providing even and diffuse illumination throughout the space. Skylights with diffusing elements or automated shading can help control light levels and prevent glare (Gonçalves et al., 2020).

iv. **Interior Layout and Space Planning:** The interior layout of the building should facilitate the flow of natural light. Open-plan designs, minimal interior partitions, and the use of light-transmitting materials can enhance light distribution. Positioning key functional areas, such as classrooms and offices, near windows can maximize their access to natural light (Gibson & Williams, 2023).

v. **Shading and Glare Control:** Effective daylighting requires controlling glare and heat gain. External shading devices, such as overhangs, louvers, and pergolas, can block direct sunlight while allowing diffuse light to enter. Internal shading devices, such as blinds and curtains, provide additional control and flexibility for occupants (Keller et al., 2021).

vi. **Energy Efficiency and Sustainability:** Integrating natural lighting with energy-efficient systems and sustainable design practices is essential for reducing the building's environmental impact. This includes using daylight sensors and controls to adjust artificial lighting based on available daylight, incorporating energy-efficient HVAC systems, and selecting sustainable building materials (Sullivan et al., 2022).

2.3 Empirical Review

2.3.1 Impact of Natural Lighting

The impact of natural lighting on building occupants has been extensively studied, revealing numerous benefits across various settings. Workers in naturally lit environments report fewer instances of eyestrain, headaches, and fatigue. The presence of natural light also positively influences mood and motivation, contributing to a more pleasant and effective work environment (Elzeyadi, 2020).

In educational environments, natural lighting has been shown to significantly enhance academic performance, reduce stress, and improve overall well-being. In office settings, natural light has been linked to increased productivity, job satisfaction, and overall health. Research indicates that students in naturally lit classrooms perform better on tests, have higher attendance rates, and exhibit fewer behavioral problems compared to those in artificially lit environments (Mills et al., 2023).

I. Academic Performance

Extensive research demonstrates the positive impact of natural lighting on academic performance. Key studies include:

a) **Heschong Mahone Group (1999):** This seminal study found a strong correlation between daylighting and improved student performance. Students in classrooms with the most daylight progressed faster in reading and math compared to those in classrooms with the least daylight.

b) **Nicklas and Bailey (1996):** This study analyzed the performance of students in daylit schools and found that students in naturally lit environments performed better academically and had higher attendance rates than those in artificially lit environments.

c) **Woolner et al. (2007):** Research conducted in the UK highlighted the importance of natural light for student well-being and academic success. The study found that well-lit classrooms improved student concentration and reduced absenteeism.

II. Health and Well-being Benefits

The health and well-being benefits of natural lighting are well-documented. Key findings include:

a) **Circadian Rhythms:** Exposure to natural light helps regulate circadian rhythms, which are crucial for maintaining healthy sleep-wake cycles. Properly aligned circadian rhythms contribute to overall health, reducing the risk of sleep disorders and associated health problems (Chellappa et al., 2022).

b) **Mental Health:** Natural light exposure has been linked to reduced symptoms of depression and anxiety. It is particularly effective in mitigating Seasonal Affective Disorder (SAD), a type of depression that occurs during the darker months of the year (Hansen et al., 2021).

c) **Visual Comfort and Eye Health:** Natural light provides a balanced spectrum of light, reducing eyestrain and discomfort compared to artificial lighting. This is particularly important in educational settings where prolonged visual tasks are common (Jin et al., 2023).

2.3.2 Benefits of Natural Lighting

Studies on the outcomes of natural lighting integration in educational buildings highlight several positive results as benefits, including:

I. **Enhanced Learning Environments:** Studies have consistently shown that students in classrooms with ample natural light achieve better academic results as it improves academic performance and student engagement. Natural light enhances concentration, comprehension, and information retention, contributing to a more effective learning experience (Klepeis et al., 2023).

II. **Health and Well-being:** Exposure to natural light is crucial for maintaining circadian rhythms, which regulate sleep-wake cycles and overall physiological health. Natural light has been linked to reduced incidence of depression, anxiety, and Seasonal Affective Disorder (SAD). In educational settings, students and faculty members benefit from improved mood, reduced stress levels, and enhanced overall well-being (Chellappa et al., 2022).

III. **Energy Savings:** By reducing the need for artificial lighting, natural lighting significantly lowers energy consumption and operational costs. Buildings with effective daylighting strategies can achieve substantial energy savings, contributing to environmental sustainability and financial efficiency (Gou et al., 2022).

IV. **Aesthetic and Architectural Value:** Natural lighting enhances the aesthetic quality of interior spaces, creating more inviting and dynamic environments. The interplay of light and shadow adds visual interest and depth, making spaces more appealing and inspiring (Kim & Kim, 2023).

V. **Enhanced Indoor Environmental Quality:** Natural light improves indoor environmental quality by providing a connection to the outdoors, enhancing ventilation, and reducing the build-up of pollutants from artificial lighting sources. This leads to healthier and more comfortable indoor environments (Liu et al., 2023).

VI. **Sustainable Development:** The use of natural lighting supports broader sustainability goals by reducing the building's carbon footprint and reliance on non-renewable energy sources. This contributes to the overall environmental performance and sustainability of educational institutions (Pacheco et al., 2022).

2.3.3 Techniques and Methods for Effective Daylighting

To implement effective daylighting, a range of techniques and methods are utilized:

i. **Building Orientation and Site Planning:** By orienting the building to optimize solar exposure and using site features like vegetation and topography, designers can enhance daylight availability and control (Baker & Steemers, 2023).

ii. **Windows and Glazing:** High-performance glazing materials, such as low-emissivity (low-E) glass, allow for the transmission of visible light while reducing heat gain. The size, shape, and placement of windows are designed to maximize light entry and distribution (Huang et al., 2022).

iii. **Skylights and Roof Monitors:** These features introduce daylight from above, providing even illumination to large, open spaces. Modern skylights often incorporate diffusing elements to spread light uniformly (Liu et al., 2023).

iv. **Light Shelves and Reflectors:** These horizontal surfaces placed above windows reflect daylight deeper into the interior, improving light distribution and reducing the need for artificial lighting (Foster et al., 2023).

v. **Daylight Harvesting:** This technique involves the use of sensors and controls to adjust artificial lighting based on the amount of available daylight. When natural light levels are sufficient, artificial lighting is dimmed or turned off, leading to significant energy savings (Gou et al., 2023).

vi. **Shading Devices and Control Systems:** Automated shading systems, such as blinds and louvers, adjust according to the position of the sun, optimizing daylight while minimizing glare and heat gain. Dynamic facades and smart glass technologies also play a role in managing light levels (Andersen et al., 2022).

2.3.4 Challenges Encountered in Implementing Natural Lighting Strategies

Implementing natural lighting strategies in faculty buildings presents several challenges:

i. **Glare and Heat Gain:** Balancing sufficient daylight while minimizing discomfort from glare and excessive heat is a primary challenge. Glare can cause visual discomfort and reduce the usability of spaces, while excessive heat gain can increase cooling loads and reduce thermal comfort (Wang et al., 2023).

ii. **Architectural Constraints:** Adapting existing structures to accommodate new daylighting strategies can be complex and costly. Retrofitting older buildings with modern daylighting technologies often requires significant structural modifications and careful planning (Kats et al., 2022).

iii. **Cost Implications:** The initial investment costs for advanced glazing, daylighting systems, and shading devices can be high. While these investments typically result in long-term energy savings, the upfront costs may be a barrier for some institutions (Eley et al., 2023).

iv. **Maintenance and Durability:** Ensuring the longevity and performance of daylighting components is essential for maintaining their effectiveness. Regular maintenance of glazing, shading devices, and control systems is necessary to prevent degradation and ensure optimal performance over time (Harris et al., 2023).

Chapter Three

Research Methodology

3.1 Research Design

Research methodology refers to the systematic approach and techniques used to collect, analyze, and interpret data to answer specific research questions or hypotheses. It encompasses overall research design, data collection methods, data analysis techniques, and procedures that guide the research process. A well-defined research methodology ensures that the study is conducted in a structured and rigorous manner, leading to valid and reliable results (Creswell, 2014).

This chapter details the research methodology employed to examine the application of natural lighting in the design of faculty buildings. Specifically, it focused on case studies of existing educational buildings that have successfully integrated natural lighting strategies.

The research design is centered on a qualitative case study approach. This method allowed for an in-depth exploration of how natural lighting is utilized in faculty buildings, providing a comprehensive understanding of design principles, challenges, and outcomes.

3.2 Case Study Selection

Case studies were selected based on their relevance to the research objectives. Specifically, the selected buildings are recognized for their innovative use of natural lighting within educational settings. By focusing on buildings that have successfully integrated natural lighting, the research aimed to identify effective design strategies, materials, and technologies that enhance both the aesthetic and functional qualities of educational spaces.

3.3 Data Collection Methods

Data was collected using a combination of methods to ensure a robust analysis:

i. **Site Visits:** Where possible, visits to the selected buildings to observe the implementation of natural lighting strategies, taking note of spatial arrangements, materials used, and overall effectiveness.

ii. **Architectural Plans Review:** Examination of design documents and architectural plans to understand the conceptualization and technical details of natural lighting integration.

iii. **Online Research:** Utilizing online resources such as academic journals, architectural websites, and digital archives to gather detailed information about the case studies. This includes virtual tours, published articles, and expert reviews.

3.4 Data Analysis

The analysis of case studies focused on evaluating the application of natural lighting within the selected buildings with the following key criteria's serving as the framework:

i. **Identification of Natural Lighting Strategies**: Reviewing architectural plans, published articles, and online resources to identify the specific strategies employed, such as the use of skylights, clerestory windows, light shelves, and reflective surfaces.

ii. **Assessment of Spatial Layout:** Analyzing how the spatial organization of the building supports the penetration and distribution of natural light. This includes examining the orientation of spaces, the placement of windows, and the use of open versus enclosed areas.

iii. **Evaluation of Material Use:** Investigating the materials used in the building's construction that enhance natural lighting, such as translucent materials, reflective surfaces, and light-coloured finishes.

3.5 Case Studies Analysis

3.5.1 Case Study One – Erasmus Brussels University, Faculty of Applied Sciences and Arts (Faculty Building).

3.5.1.1 Locational Information

Located in Anderlecht, Brussels, Belgium, this architectural project was completed in 2020. Designed by B-architecten, the structure spans an area of 9,000 square meters.

Fig 3.1: Exterior View of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

3.5.1.2 Building description

I. The building is strategically located near Dansaertstraat, in a lively and trendy district of Brussels.

II. A prominent structure featuring a modern and transparent design with a heavy-set finishing touch.

III. The building features contemporary architecture with an emphasis on sustainability and energy efficiency.

IV. The building's ground floor features an open, sunken, and covered recreation ground, connecting seamlessly to the square outside through a full glass façade.

V. It accommodates more than 1,000 students and includes two auditoriums, 40 classrooms, a library, a cafeteria, and various meeting areas.

VI. The building utilizes energy-efficient glass, light-colored interior finishes, and sustainable building materials to enhance natural lighting and reduce energy consumption.

Fig 3.2: Cafeteria of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

3.5.1.3 Spatial Accommodation

The building includes variety of spaces designed for different purposes, such as auditoriums lecture halls, laboratories, seminar rooms, administrative offices, cafeteria, library, student common areas and study landscape.

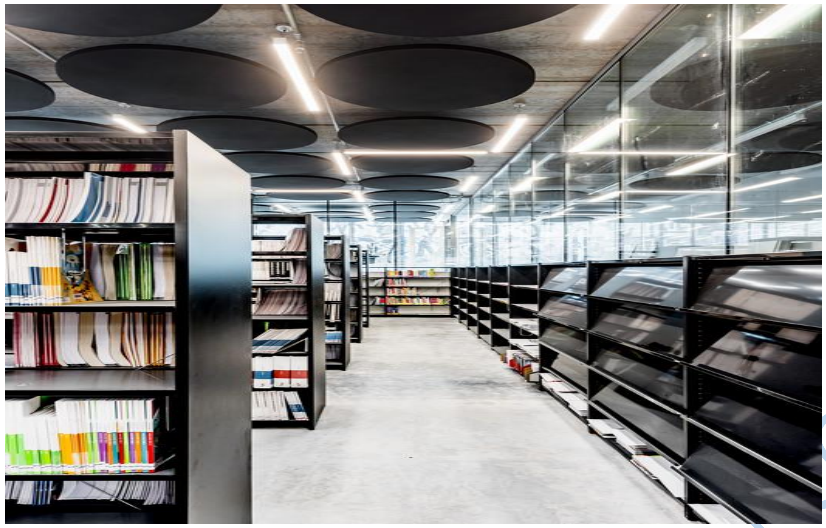

Fig 3.3: Library of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

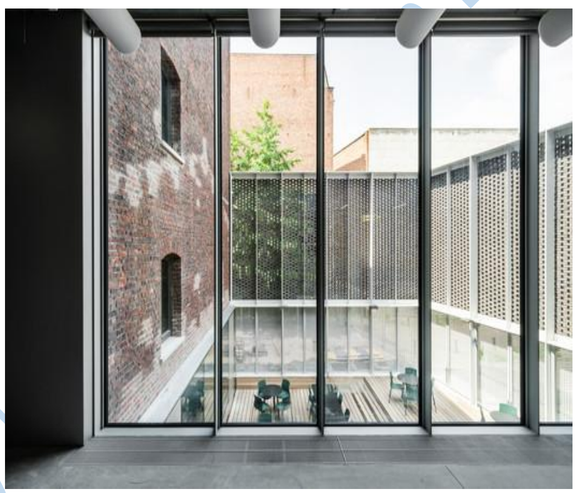

Fig 3.4: Courtyard View of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

3.5.1.4 Framework Analysis

The Erasmus Brussels University of Applied Sciences and Arts extensively used natural lighting in its design. The building features large glass facades that allow ample daylight to penetrate the interiors, significantly reducing the need for artificial lighting during the day.

Fig 3.5: Lobby of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

3.5.1.5 Appraisals

Some of the design highlights of the Erasmus Brussels University Faculty that can be adopted in similar projects include the following:

i. The design emphasized open spaces and flexibility to accommodate different teaching and learning styles.
ii. The building's design reduced reliance on artificial lighting, leading to significant energy savings.
iii. The modern design and ample natural light contributed to an aesthetically pleasing environment.
iv. The design strategically positioned its spaces to maximize light distribution throughout the building.
v. The open layout and transparent design foster interaction, inclusivity and accessibility.

vi. The use of glass facades allows natural light to flood the interiors, creating a pleasant and productive environment.

vii. The connectivity between the indoor and outdoor spaces creates a seamless experience for students and staff.

A number of shortcomings were identified from the analysis of the Erasmus Brussels University Faculty's design. These shortcomings include:

i. Large windows can sometimes result in excessive glare, requiring the use of shading devices.

ii. The heavy reliance on glass might pose challenges in terms of energy efficiency and climate control, especially during extreme weather conditions .

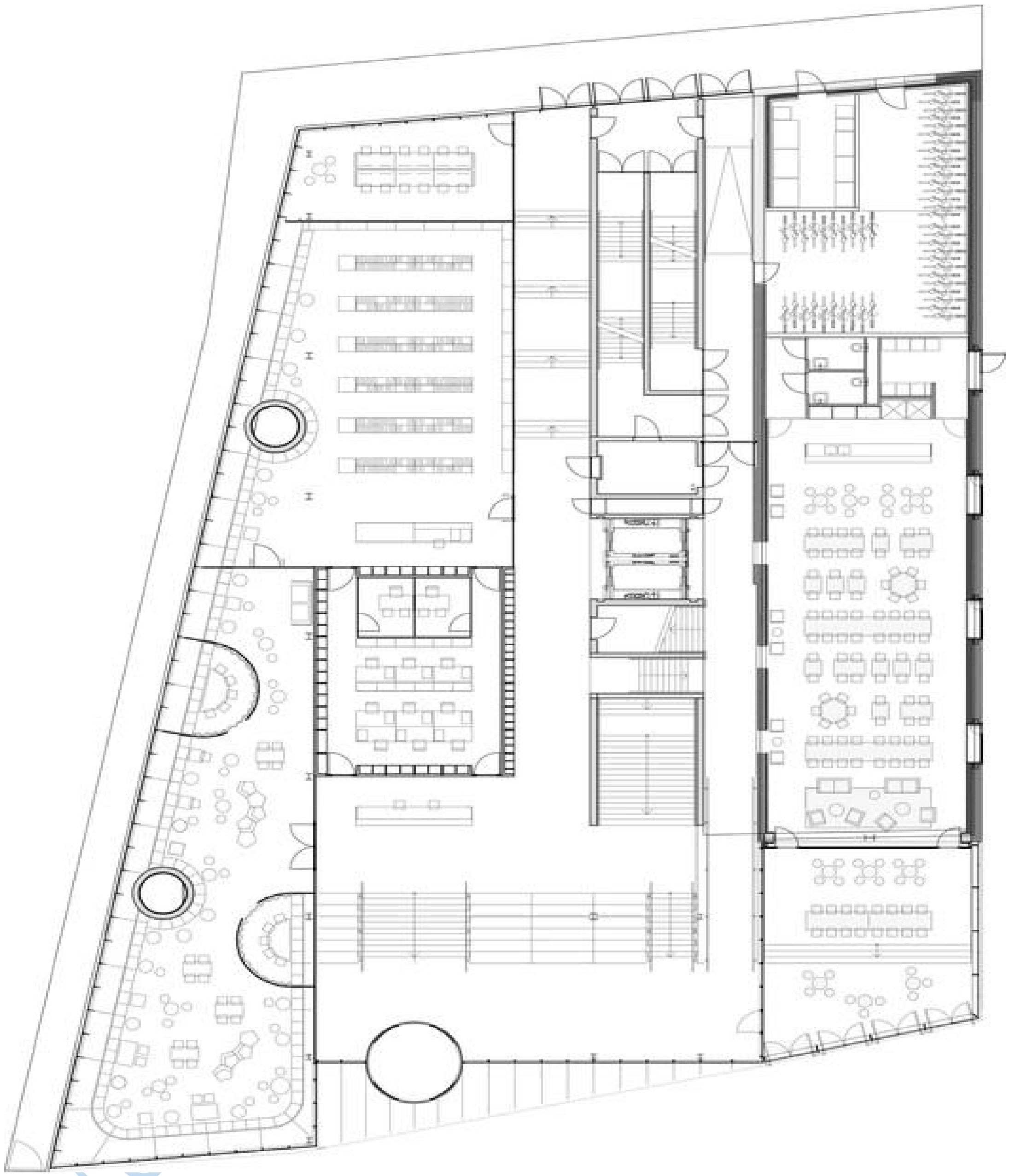

Fig 3.6: Ground Floor of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

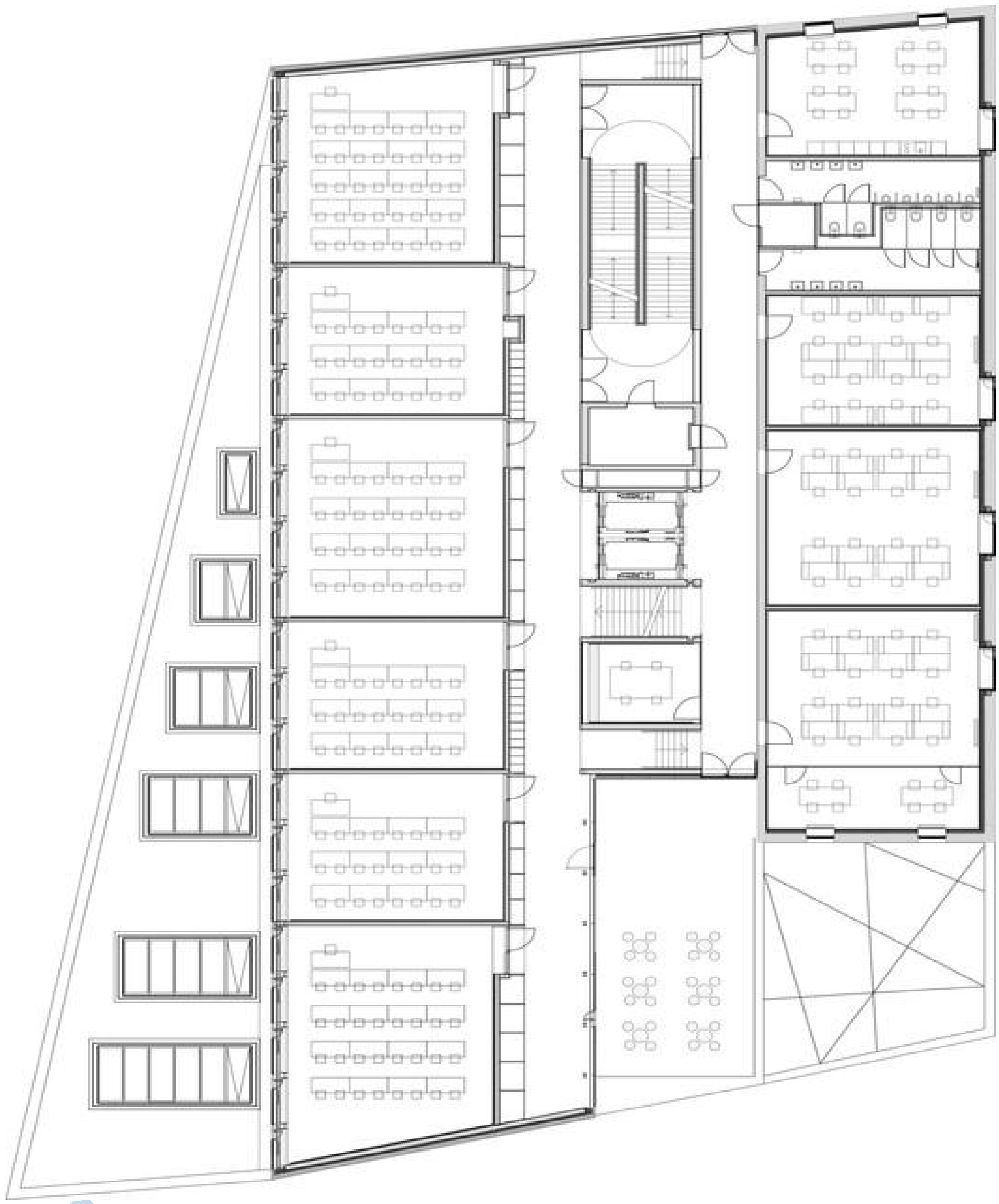

Fig 3.7: First Floor of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

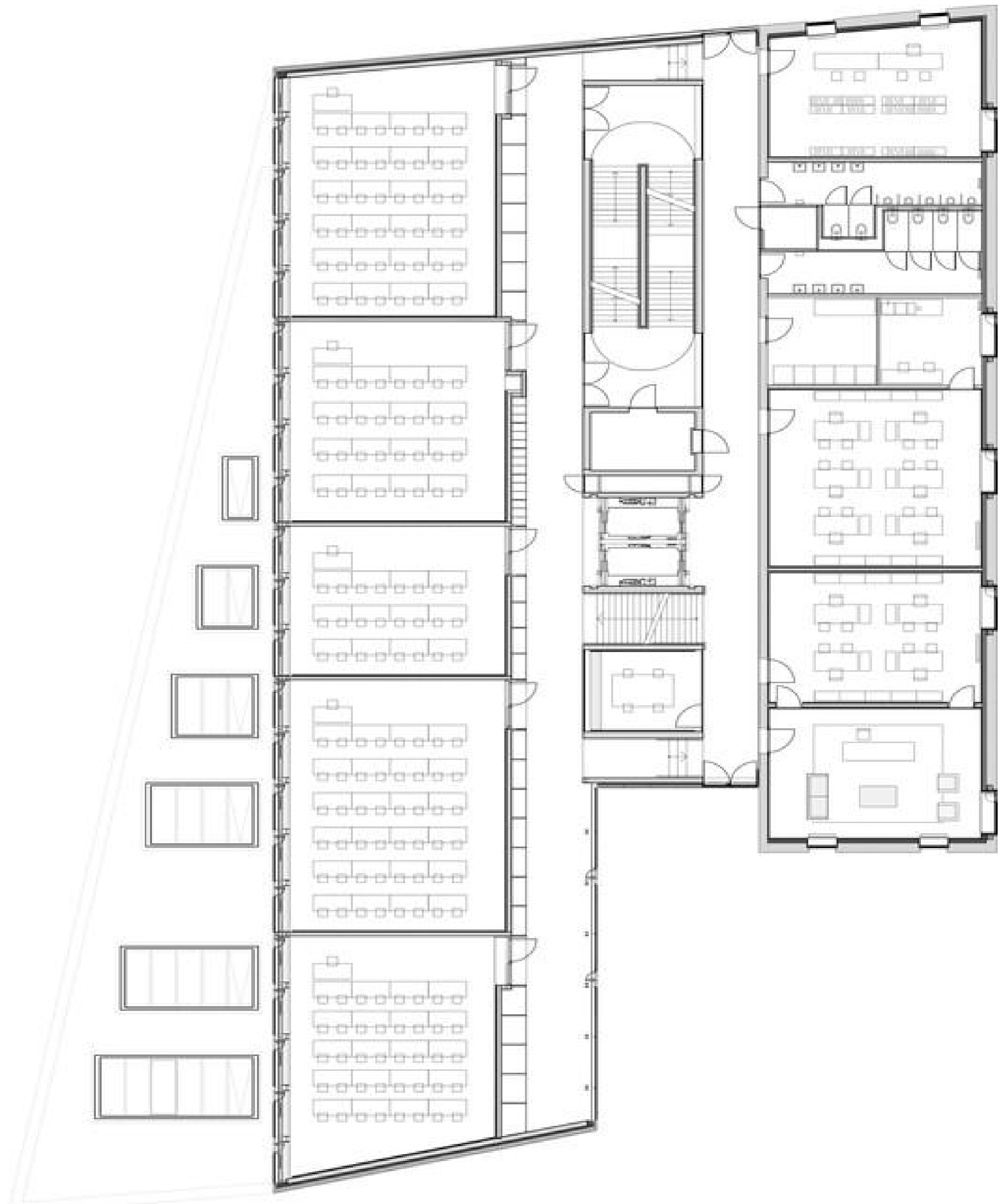

Fig 3.8: Second Floor of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

Fig 3.9: Third Floor of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

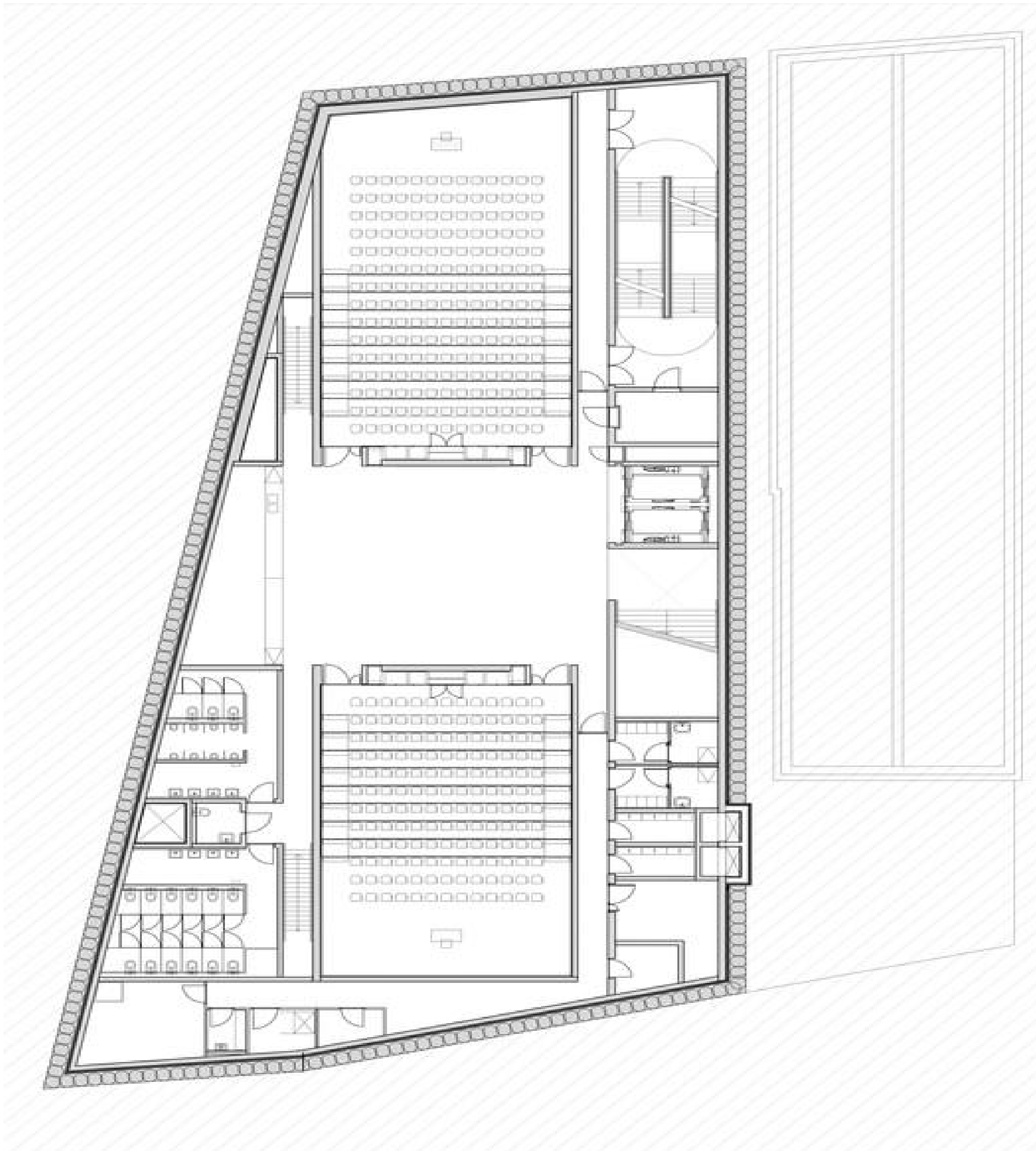

Fig 3.10: Fourth Floor of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

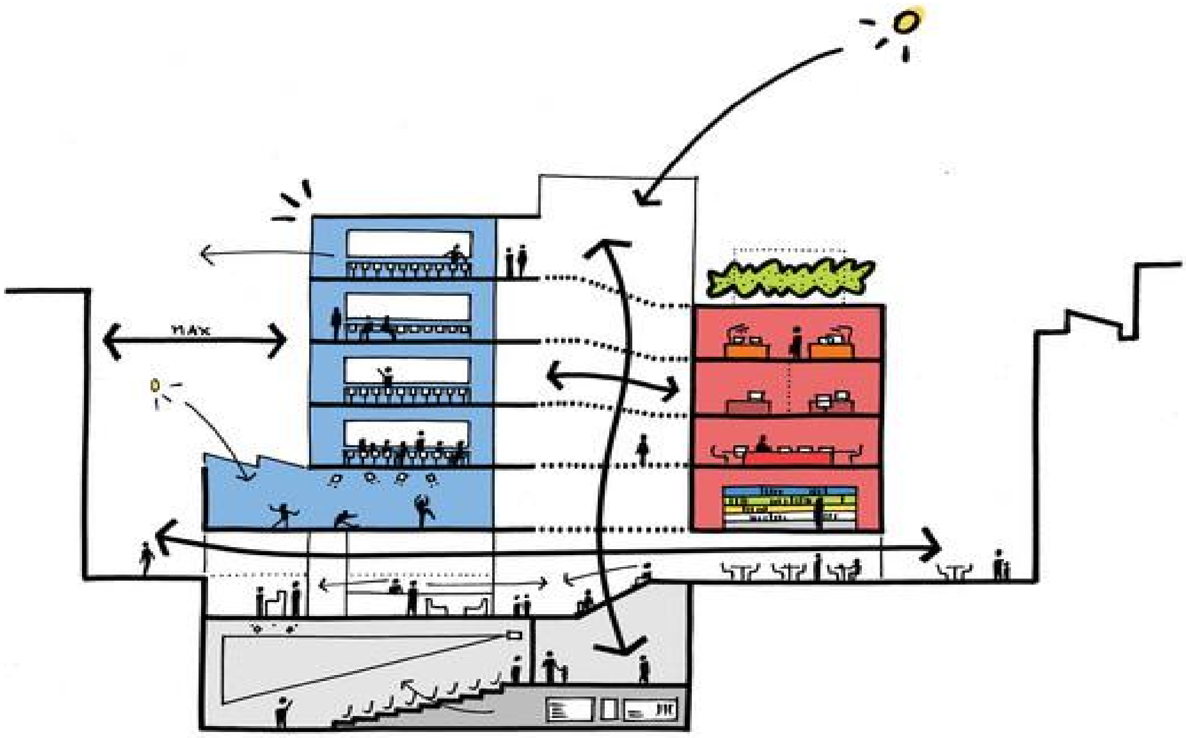

Fig 3.11: Section View of Erasmus Brussels University Faculty

Source: (https://www.archdaily.com/960024/erasmus-university-college-b-architecten)

3.5.2 Case Study Two – College of Health Sciences (COHES), Bowen University (Faculty Building).

3.5.2.1 Locational Information

Located in Iwo, Osun State, Nigeria, this project was completed in 2002.

Plate 3.1: Approach View of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

3.5.2.2 Building description

I. The college is situated within Bowen University's main campus in Iwo, Osun State, Nigeria.

II. The building is characterized by its functional design and emphasis on creating a conducive learning environment.

III. Dedicated to providing top-notch education in various health-related fields.

IV. The College of Health Sciences comprises multiple departments, including Anatomy, Physiology, Medicine, Surgery, Nursing Science, Physiotherapy, Public Health, Medical Laboratory Science, and Nutrition and Dietetics.

V. The layout promotes interaction and collaboration among students and faculty.

Plate 3.2: Laboratory View of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

3.5.2.3 Spatial Accommodation

The facility includes lecture halls, laboratories, faculty offices, a library, and student lounges.

3.5.2.4 Framework Analysis

The design of the College of Health Sciences at Bowen University integrated natural lighting through the use of large windows and courtyards strategically placed. These features ensured that classrooms, laboratories, and common areas receive sufficient daylight, reducing reliance on artificial lighting and creating a healthier indoor environment for students and staff .

Plate 3.3: Lecture Hall of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

Plate 3.4: Laboratory Interior of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

Plate 3.5: Laboratory Interior of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

Plate 3.6: Courtyard of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

3.5.2.5 Appraisals

Some of the design highlights of the College of Health Sciences (COHES) that can be adopted in similar projects include the following:

i. The building's design incorporated courtyards and light wells that facilitate natural ventilation and lighting, improving indoor air quality and reducing energy costs.
ii. Clearly defined zones for different functions (teaching, research, administration) improving efficiency.
iii. Built with locally sourced, durable materials to withstand the regional climate.
iv. Thoughtful landscaping provided outdoor learning spaces and enhanced the building's aesthetic.

A number of shortcomings were identified from the analysis of the College of Health Sciences (COHES) design. These shortcomings include:

i. Managing heat gain in a tropical climate can be challenging, necessitating the use of shading devices and ventilation strategies.
ii. The reliance on natural ventilation can be challenging during extreme weather conditions, necessitating supplemental mechanical systems.

Plate 3.7: Laboratory View of College of Health Sciences (COHES), Bowen University

Source: Field work (2024)

3.5.3 Case Study Three - College of Medical Sciences, Yobe State University (Faculty Building).

3.5.3.1 Locational Information

Located in Damaturu, Yobe State, Nigeria, this project was completed in 2012.

Plate 3.8: Exterior View of College of Medical Sciences, Yobe State University

Source: Field work (2024)

Plate 3.9: Faculty Entrance of College of Medical Sciences, Yobe State University

Source: Field work (2024)

3.5.3.2 Building description

I. Designed to cater to the medical education needs of the region, it combines functionality with a simple aesthetic.

II. The building is designed to support rigorous academic and clinical training.

III. The building uses materials that enhance natural light while maintaining thermal comfort.

IV. The construction primarily uses concrete and local materials, ensuring sustainability and ease of maintenance.

Plate 3.10: Lecture Hall of College of Medical Sciences, Yobe State University

Source: Field work (2024)

Plate 3.11: Lecture Hall of College of Medical Sciences, Yobe State University

Source: Field work (2024)

3.5.3.3 Spatial Accommodation

The college includes lecture theaters, laboratories, clinical training rooms, administrative offices, and student study areas.

3.5.3.4 Framework Analysis

The college employed a combination of clerestory windows, atriums, and light wells to bring natural light into interior spaces. Solar shading devices are used to control glare and heat gain.

Plate 3.12: Side View of College of Medical Sciences, Yobe State University

Source: Field work (2024)

3.5.3.5 Appraisals

Some of the design highlights of the College of Medical Sciences that can be adopted in similar projects include the following:

i. The design optimized layout prioritizes functionality and accessibility.
ii. Natural lighting contributed to a sustainable design by lowering the demand for artificial lighting.
iii. Spaces designed for community health initiatives and practical training.
iv. Materials and design were chosen to withstand local environmental conditions and provide long-term durability.

A shortcoming was identified from the analysis of the College of Medical Sciences design. This shortcoming includes:

i. Balancing natural light with thermal comfort in an arid climate can be difficult, requiring careful design and material choices.

3.5.4 Case Study Four - Faculty of Engineering, University of Lagos (Faculty Building).

3.5.4.1 Locational Information

Located in Lagos, Nigeria, this project was completed in 1970.

Plate 3.13: Entrance of Faculty of Engineering, University of Lagos

Source: Field work (2024)

3.5.4.2 Building description

I. One of Nigeria's leading engineering schools, known for its rigorous academic programs and contributions to engineering research and development.

II. It reflects the architectural style of the era, focusing on functionality and durability.

III. These facilities are designed to cater to various engineering disciplines such as, Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering, Chemical Engineering, and Systems Engineering.

IV. The construction of the Faculty of Engineering buildings employs a mix of traditional and modern materials, including concrete, bricks, glass, and metal.

Plate 3.14: Back View of Faculty of Engineering, University of Lagos

Source: Field work (2024)

Plate 3.15: Courtyard Linking Departments at Faculty of Engineering, University of Lagos

Source: Field work (2024)

3.5.4.3 Spatial Accommodation

The facility includes lecture halls, laboratories, workshops, faculty offices, and collaborative spaces for students. The design emphasizes functionality and flexibility.

Plate 3.16: Courtyard of Faculty of Engineering, University of Lagos

Source: Field work (2024)

Plate 3.17: Lecture Hall Side view of Faculty of Engineering, University of Lagos

Source: Field work (2024)

3.5.4.4 Framework Analysis

The Faculty of Engineering at the University of Lagos incorporated natural lighting primarily through large windows and open courtyards. These design elements allow daylight to penetrate deep into the building, illuminating lecture halls, laboratories, and offices without extensive use of artificial lighting.

3.5.4.5 Appraisals

Some of the design highlights of the Faculty of Engineering that can be adopted in similar projects include the following:

i. The building featured wide corridors and large windows, which enhance natural lighting and ventilation, creating a more comfortable environment.

ii. The designs focused on durability and longevity, ensuring that the facilities remain functional for extended periods.

iii. The building's design enhanced energy efficiency by reducing the reliance on artificial lighting.

A shortcoming was identified from the analysis of the Faculty of Engineering design. This shortcoming includes:

i. Over time, the building has faced maintenance challenges, particularly with regard to ensuring consistent thermal comfort and addressing wear and tear.

3.5.5 Case Study Five - Faculty of Arts, University of Ibadan (Faculty Building).

3.5.5.1 Locational Information

Located in Ibadan, Oyo State, Nigeria, this project was completed in 1950. It was designed by architects Maxwell Fry and Jane Drew.

Plate 3.18: Exterior View of Faculty of Arts, University of Ibadan

Source: Field work (2024)

3.5.5.2 Building description

I. One of the oldest faculties at the University of Ibadan, established when the university itself was founded.

II. The initial design was overseen by British colonial architects as part of the broader university planning.

III. The Faculty of Arts occupies a central position on the expansive university campus.

IV. The original buildings were constructed using colonial-era materials, such as brick and mortar, while more recent additions have incorporated modern materials like reinforced concrete and glass.

V. The architectural style reflects a blend of traditional and contemporary elements, aiming to preserve the historical significance of the faculty while accommodating modern needs.

VI. The faculty comprises various departments, including English, History, Philosophy, Religious Studies, and Languages and Linguistics.

Plate 3.19: Side View of Faculty of Arts, University of Ibadan

Source: Field work (2024)

Plate 3.20: Bird-Eye View of Faculty of Arts, University of Ibadan

Source: Field work (2024)

3.5.5.3 Spatial Accommodation

The facility includes lecture theaters, seminar rooms, faculty offices, a library, and student common areas. The layout promotes interaction and collaboration.

Plate 3.21: Side View of Faculty of Arts, University of Ibadan

Source: Field work (2024)

3.5.5.4 Framework Analysis

The Faculty of Arts employed natural lighting through large windows and open corridors. These features ensure that lecture halls, seminar rooms, and offices are well-lit during the day, enhancing the academic environment.

Plate 3.22: Courtyard/Seat-Out of Faculty of Arts, University of Ibadan

Source: Field work (2024)

Plate 3.23: Courtyard of Faculty of Arts, University of Ibadan

Source: Field work (2024)

3.5.5.5 Appraisals

Some of the design highlights of the Faculty of Arts that can be adopted in similar projects include the following:

i. The building's historical significance and architectural beauty enhanced campus identity and cultural value.

ii. The integration of natural light and well-designed spaces positively impacts student well-being and academic performance.

iii. Natural lighting complemented the historic architecture, preserving its aesthetic value while enhancing functionality.

iv. The design reduced the need for artificial lighting, supporting the university's sustainability goals.

A number of shortcomings were identified from the analysis of the Faculty of Arts design. These shortcomings include:

i. Some parts of the building faced issues related to maintenance and modernization, impacting their functionality and comfort.

ii. The building might benefit from modernization and upgrades to meet current educational standards and technological advancements.

3.5.6 Case Study Six - Faculty of Basic Medical Science, University of Ibadan (Faculty Building).

3.5.6.1 Locational Information

Plate 3.24: Faculty Lecture Hall Entrance of Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

The Faculty of Basic Medical Sciences is located within the University of Ibadan's main campus, adjacent to the College of Medicine and the University College Hospital (UCH). This positioning fosters close integration between theoretical studies and clinical practice. The faculty benefits from the region's abundant natural light, making it ideal for implementing natural lighting strategies. this project was completed in 1950. It was designed by architects Maxwell Fry and Jane Drew.

Plate 3.25: Lecture Hall Approach of Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

3.5.6.2 Building description

I. The building features a modern design with elements of tropical architecture. It includes clean lines, large windows, and louvered panels to balance aesthetics and functionality. The building is divided into three wings for different departments, connected by central atriums with skylights. The slightly off-axis orientation maximizes natural light while minimizing direct sunlight during peak hours.

II. The design incorporates passive cooling through cross-ventilation, light shelves for deeper light penetration, and minimal reliance on artificial lighting during the day.

III. Designed to accommodate around 1,500 students and 150 faculty members, with flexible spaces that can be adapted for various needs.

IV. Spaces are allocated to maximize comfort and functionality, with special attention to natural lighting and adaptability.

Plate 3.26: Faculty Research Center of Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

3.5.6.3 Spatial Accommodation

The faculty includes lecture theatres, laboratories, offices, and common areas. Laboratories are on the north side for consistent light, while lecture theatres use clerestory windows. Offices benefit from large windows with views of the surrounding greenery.

Plate 3.27: Seat-Out at Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

3.5.6.4 Framework Analysis

The Faculty of Basic Medical Sciences at the University of Ibadan effectively uses natural lighting through large windows, and light shelves, enhancing visibility and reducing reliance on artificial light.

Plate 3.28: Lecture Hall Interior of Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

Plate 3.29: Seminar Room/Laboratory of Faculty of Basic Medical Science, University of Ibadan

Source: Field work (2024)

3.5.6.5 Appraisals

Some of the design highlights of the Faculty of Basic Medical Science that can be adopted in similar projects include the following:

i. **Energy Efficiency:** Reduced reliance on artificial lighting and air conditioning.
ii. **Enhanced Learning Environment:** Improved visibility and a pleasant atmosphere.
iii. **Aesthetic Appeal:** The dynamic interplay of light and shadow enhances the building's visual appeal.

A number of shortcomings were identified from the analysis of the Faculty of Basic Medical Science. These shortcomings include:

i. **Glare Issues:** Glare in certain areas during specific times of the day.
ii. **Inconsistent Lighting:** Uneven light distribution in some spaces.
iii. **Thermal Comfort Issues:** Potential overheating in areas with extensive glass.
iv. **Maintenance:** High maintenance requirements for large windows.

3.5.7 Case Studies Adoptions

Based on the appraisals from the analysed case studies, the integrated design approach for the new faculty building will focus on:

1. **Sustainable Design:** Using energy-efficient materials and integrating natural lighting to reduce energy consumption and enhance the indoor environment.
2. **Functional Zoning:** Clearly defining zones for different functions such as teaching, research, and administration to improve operational efficiency.
3. **Climate Control:** Implementing strategies to manage glare and heat gain, ensuring thermal comfort in various weather conditions.

4. **Durability and Maintenance:** Choosing durable materials and establishing a maintenance plan to ensure long-term functionality.
5. **Historical Preservation:** Balancing modernization with the preservation of historical and cultural significance where applicable.

By incorporating these strategies and addressing the limitations highlighted in the case studies, the new faculty building will offer a conducive, sustainable, and efficient learning environment for students and staff.

3.6 Conclusion

In conclusion, the analysis of the six case studies—Erasmus Brussels University, Faculty of Applied Sciences and Arts; College of Health Sciences, Bowen University; College of Medical Sciences, Yobe State University; Faculty of Engineering, University of Lagos; Faculty of Arts, University of Ibadan; and Faculty of Basic Medical Science, University of Ibadan provides valuable insights into the effective design of faculty buildings. Each case study highlights the importance of integrating natural lighting, ensuring sustainable practices, creating functional and flexible spaces, and maintaining historical and cultural significance.

These insights will be instrumental in informing the design of the new faculty building, ensuring it is not only aesthetically pleasing and functional but also sustainable, durable, and culturally significant.

Chapter Four

Site Analysis and Design Synthesis

4.1 The Study Area

Oyo State, located in southwestern Nigeria, is renowned for its rich cultural heritage and historical significance. Established in 1976, the state has its capital in Ibadan, one of Africa's largest cities. The state boasts a diverse population, a vibrant economy, and significant contributions to Nigeria's educational and political landscape. Its climate, a blend of savannah and forest vegetation, supports a robust agricultural sector, which drives the state's economy alongside trade and manufacturing. A well-developed road network enhances transportation and connectivity, making Oyo State a hub for economic activities and investments.

Ibadan, the capital of Oyo State, is historically significant and situated approximately 120 kilometers northeast of Lagos. The city lies on the fringe of the rainforest and savanna regions, experiencing a tropical climate with distinct wet and dry seasons. Established in the 1820s, Ibadan quickly became an important military and commercial center. During the British colonial period, it served as the capital of the Western Region and has since retained its status as a prominent cultural and educational hub. Its architecture reflects a blend of traditional Yoruba designs and colonial influences. With a population exceeding 3 million, Ibadan is one of Nigeria's largest cities and a melting pot of various ethnic groups, predominantly the Yoruba.

Ibadan is renowned for its educational institutions, making it a significant educational hub in Nigeria. The city is home to The University of Ibadan, established in 1948, holds the distinction of being Nigeria's oldest university and the first to be founded in the country. Over the years, it has set a high standard for higher education and research in Nigeria, becoming a beacon of academic excellence.

Another prominent institution in the city is The Polytechnic, Ibadan, which is well-known for offering a diverse range of technical and vocational programs. This institution plays a vital role in equipping students with practical skills and knowledge needed in various industries. In addition to these public institutions, Ibadan is home to several private universities and colleges. These private institutions further enrich the city's educational landscape, providing students with a variety of options for pursuing higher education and professional training.

Ibadan's historical significance, diverse population, and strong emphasis on education make it stand out as a prominent educational and cultural beacon. The city's rich academic history, coupled with its vibrant cultural heritage and strategic location, continues to attract students and scholars, reinforcing its status as a cornerstone of education in Nigeria.

4.1.1 Site Location

The site of the Proposed Faculty Building of Basic Medical Science is located at Lead city University, Ibadan, Oyo state.

Fig 4.1: Site Location of Proposed Development

Source: Field work (2024)

4.1.2 Site Selection Criteria

When selecting a site, the focus should be on several key criteria to ensure the site provides a conducive learning environment, and integrates well with the existing campus and community. To ensure an effective site selection, the following were considered:

i. **Proximity to Campus**

Prioritizing selecting a site within or very close to the main campus. This proximity ensures that students and faculty can easily access the new building without significant travel. It promotes a sense of community and facilitates collaboration with other departments. Being close to the campus core means that students can move between classes, laboratories, and libraries efficiently, maximizing their learning experience.

ii. **Accessibility**

Ensuring that the site is accessible by major roads and public transport is crucial. A location that is well-served by existing transportation networks to facilitate the daily commute for students, faculty, and staff. Good accessibility also means that visiting lecturers, external examiners, and guest speakers can reach the site easily, enhancing the academic environment. Additionally, ease of access is important for emergency services to ensure safety and quick response times.

iii. **Infrastructure and Utilities**

The site should have access to essential utilities like water, electricity, and internet. Reliable infrastructure is non-negotiable for a medical sciences faculty, where laboratories, classrooms, and offices require uninterrupted power and high-speed internet for research and learning activities. Also, the feasibility and cost of extending existing utilities to the site if necessary. This includes ensuring there are adequate sewer and waste management systems to handle the faculty's needs.

iv. **Space for Development**

The site should have sufficient space not only for the initial construction but also for potential future expansion. A location with enough room to build lecture halls, laboratories, offices, and recreational areas for students. Additionally, ample space for parking is important, considering the number of students and staff who may drive to the campus. Planning for future growth is essential, as the faculty may need to expand its facilities to accommodate more students or new programs.

v. **Environmental Considerations**

Choosing a site that allows for sustainable building practices. This includes ensuring the location can take advantage of natural lighting and ventilation, reducing the building's energy consumption. Choosing a site that minimizes harm to the local ecosystem and incorporates green spaces can create a healthier and more pleasant environment for everyone. Sustainable practices not only benefit the environment but also reduce operational costs in the long term.

vi. **Soil and Topography**

Thorough soil testing and assessing the topography of the site to ensure it is stable and suitable for construction. The land should not require extensive modification, which can be costly and time-consuming. A stable and well-drained site is essential to avoid structural issues in the future. Understanding the geological characteristics of the site helps in planning the foundation and construction processes more effectively.

vii. **Safety and Security**

Safety and security are paramount. Choosing a site in a secure area to ensure the safety of students, faculty, and staff. Additionally, the site should be designed with security features such as adequate lighting, controlled access points, and surveillance systems. A safe environment is essential for creating a conducive learning atmosphere and for protecting the university's assets and resources.

4.1.3 Site Analysis

Selecting the right site is pivotal in a design proposal, as it profoundly impacts both the project's development and its final outcome. Environmental and geographical characteristics, such as micro-climate, topography, temperature, humidity, and vegetation, play a critical role in determining the site's suitability. Key elements like water bodies, access routes, trees, the local climate, and utility lines influence the building layout. Additionally, proximity to existing features affects the design's form, aesthetics, and cost-efficiency. Conducting a comprehensive site analysis ensures that the design objectives are met, facilitating the harmonious integration of the site and structure while reflecting the surrounding environment.

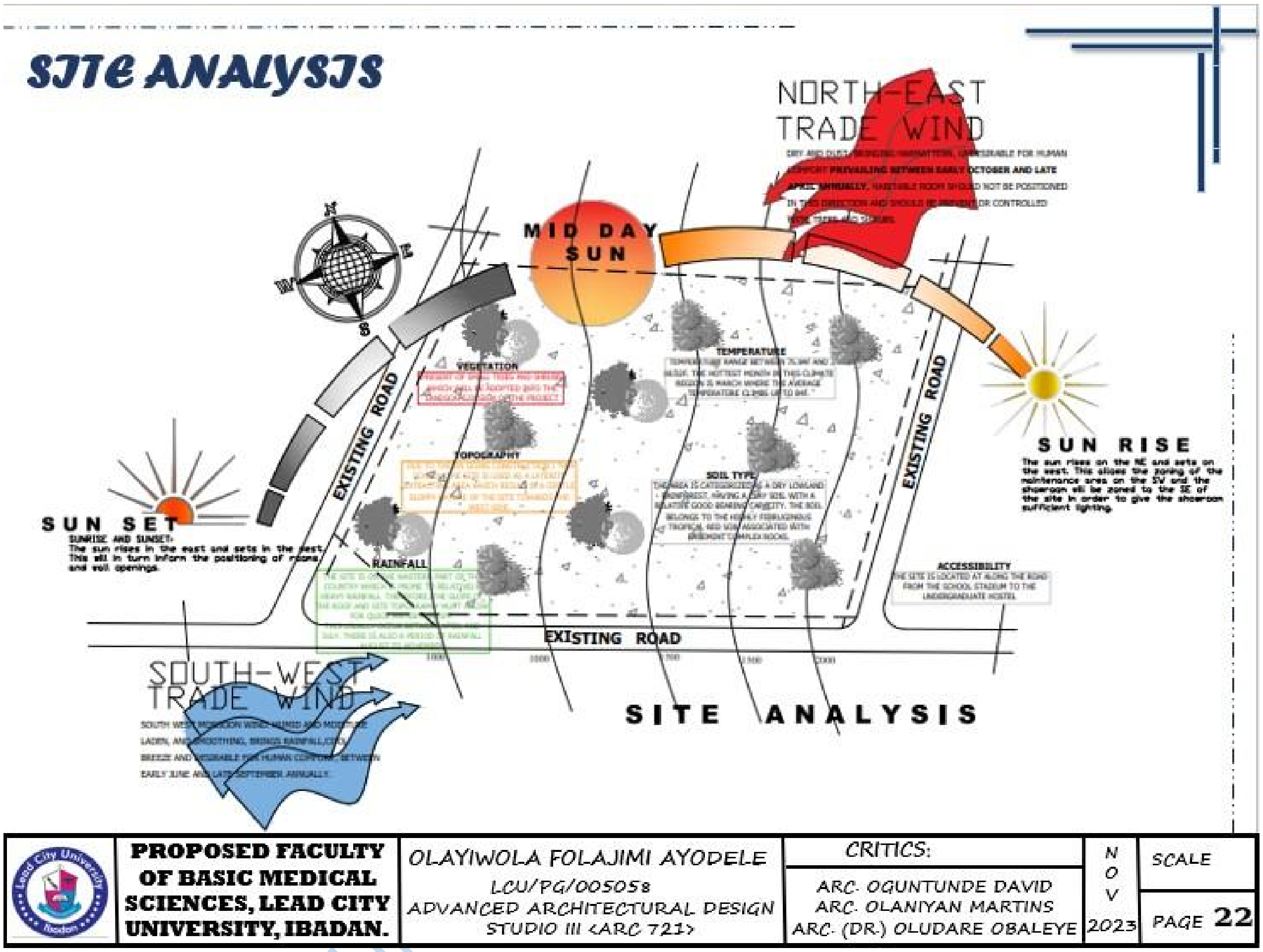

Fig 4.2: Site Analysis

Source: Field work (2024)

i. **Site Accessibility**

The proposed site offers easy and convenient access for both vehicular and pedestrian traffic. The site is accessible from the major roads surrounding the university, ensuring smooth transit for students, faculty, and visitors.

ii. **Proximity to Public Utilities**

The site boasts excellent access to essential infrastructure, including well-maintained roads, reliable electricity, potable water, advanced telecommunications, and robust security systems. This ensures that the new faculty building will have all necessary services to operate efficiently.

iii. **Drainage and Topography**

The site features a gentle, evenly distributed slope, which is advantageous for construction. It is essential to design the site to direct rainwater flow towards designated collection areas, ensuring efficient drainage and water management. Proper drainage will prevent waterlogging and maintain the integrity of the building's foundation.

iv. **Vegetation**

The site is currently covered with dense vegetation, including tall grasses, shrubs, and large trees. These will need to be cleared to prepare the area for construction. However, careful planning will ensure that valuable trees and green spaces are preserved or replaced to maintain an environmentally friendly campus.

v. **Soil Condition**

The site features a solid laterite soil foundation, ideal for construction and landscaping. Its suitability ensures stable foundations for the project. This type of soil is particularly advantageous due to its natural durability and stability, providing a strong foundation for structures and facilitating effective landscaping efforts. Overall, the soil condition of the selected site plays a pivotal role in shaping the feasibility, durability, and sustainability of the proposed construction project.

vi. **Wind Direction**

The site is influenced by both the north-east trade wind and the south-west trade wind. The north-east wind brings cool, dusty conditions, while the south-west wind offers cold humidity, providing natural comfort. Proper ventilation is crucial, so the building's long sides should be positioned to maximize airflow and natural cooling, enhancing indoor air quality and thermal comfort.

vii. Sunlight and Temperature

Managing solar gain and temperature is vital for the proposed faculty building. The building's orientation should minimize excess heating while strategically placing solar panels to maximize the capture of solar radiation throughout the day. This approach will harness solar energy to power the building, reducing energy costs and promoting sustainability.

4.2 Project Analysis and Design Synthesis

4.2.1 Brief Analysis

The proposed Faculty of Basic Medical Sciences at Lead City University represents a significant expansion of the university's academic offerings and research capabilities in healthcare. Establishing such a faculty can attract top-tier faculty and students interested in medical sciences, thereby elevating the university's profile in the field of healthcare education. It also aligns with the growing demand for skilled healthcare professionals in Nigeria and globally, contributing to workforce development in critical healthcare areas.

Additionally, the construction and development of the faculty represents a strategic initiative to meet the growing demand for healthcare professionals while enhancing the university's reputation and impact in the field of medical education and research.

4.2.2 Brief Development

Several spaces were identified as common across all five case studies examined in this study. These spaces underwent critical analysis to determine their required standards, capacity, and specific functions within a Faculty of Basic Medical Science building. These spaces include:

i. Classrooms
ii. Laboratories
iii. Offices
iv. Lecture Halls
v. Library
vi. Study Areas

4.2.3 Design Considerations

Design considerations for the proposed faculty building encompasses both functional requirements and aesthetic elements that support and enhance its operational efficiency. Here are key design considerations:

i. **Functional Layout:** Design spaces that facilitate effective teaching, research, and learning experiences. This includes classrooms, laboratories, simulation rooms, and study areas that are flexible, accessible, and equipped with advanced technology.

ii. **Health and Safety:** Prioritize health and safety considerations with features like well-ventilated spaces, adequate lighting, ergonomic furniture, and emergency response systems to ensure a secure and comfortable environment for students, faculty, and staff.

iii. **Accessibility:** Ensure accessibility for all individuals with disabilities, including barrier-free entrances, ramps, elevators, and accessible restrooms, to promote inclusivity and compliance with accessibility standards.

iv. **Natural Lighting:** Incorporate ample natural lighting through strategically placed windows and skylights to enhance indoor environments, reduce energy consumption, and improve occupant well-being and productivity. Utilize daylighting strategies that minimize glare and optimize natural light distribution throughout the building.

v. **Ventilation:** Implement effective ventilation systems to maintain indoor air quality, control temperature, and reduce the spread of airborne contaminants. Incorporate mechanical ventilation with energy-recovery systems to enhance energy efficiency while providing adequate fresh air circulation throughout the building.

vi. **Sustainable Design**: Integrate sustainable design principles such as energy-efficient systems, natural lighting, green building materials, and water conservation measures to minimize environmental impact and operational costs.

vii. **Technological Integration:** Plan for robust IT infrastructure, including high-speed internet, digital learning tools, and telemedicine capabilities to support modern educational practices and research advancements in healthcare.

viii. **Collaborative Spaces:** Create collaborative spaces such as meeting rooms, lounges, and interdisciplinary hubs that foster teamwork, innovation, and knowledge exchange among students, faculty, and healthcare professionals.

ix. **Aesthetic Appeal:** Design a visually appealing campus that reflects the institution's identity and promotes a conducive learning environment. Consider landscaping, outdoor seating areas, and artwork that inspire creativity and well-being.

x. **Flexibility for Future Growth:** Plan for future expansion and adaptability with modular designs and flexible spaces that can accommodate evolving educational needs and advancements in medical sciences.

4.2.4 Conceptual Development

The core concept driving the design of the Faculty of Basic Medical Sciences building is **"Daylighting"**. An intentional strategy to harness natural light as a primary light source within the indoor environment. This approach not only prioritizes sustainability by reducing energy consumption but also enhances occupant well-being and performance.

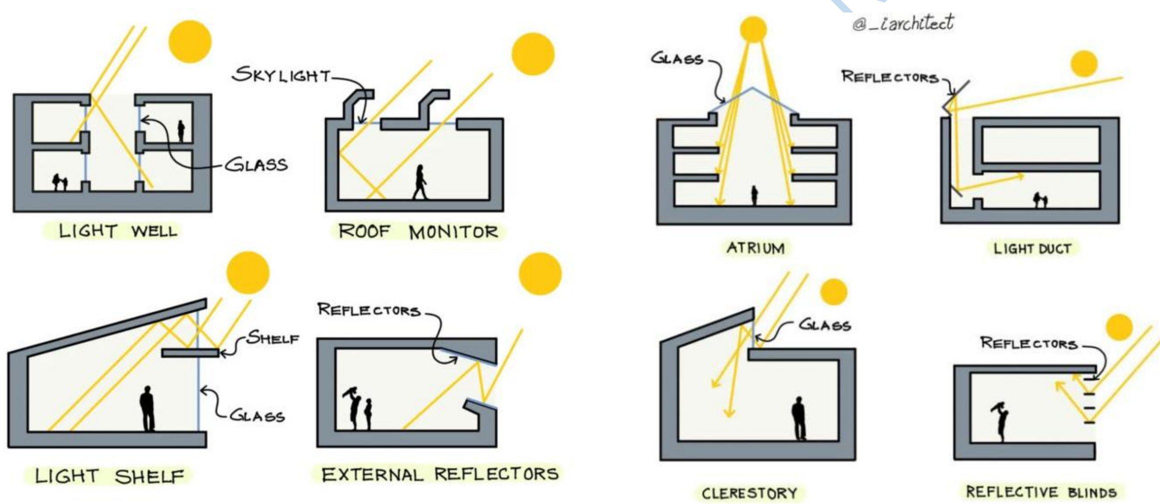

Fig 4.3: Daylighting Concept

Source: (https://www.arch2o.com/natural-lighting-in-architecture/)

By strategically integrating ample glazing, skylights, and light shelves, the aim is to optimize natural light penetration deep into the building's interior spaces. This design strategy promotes visual comfort, minimizes reliance on artificial lighting during daylight hours, and fosters a connection to the natural environment.

Incorporating advanced daylighting controls and shading systems will further enhance energy efficiency by dynamically adjusting lighting levels based on available natural light. This ensures that lighting conditions are always optimal for learning, research, and collaboration within the faculty.

4.2.5 Functional Relationship

The functional relationship chart portrays a comprehensive depiction of how spaces interconnect within the facility. This visual mapping enables designers to swiftly discern which areas are interconnected and which are distinct. Such clarity facilitates strategic positioning of related spaces in close proximity and isolation of unrelated ones. Moreover, the chart aids in zoning decisions, promoting a design that optimizes functionality through logical and efficient space organization.

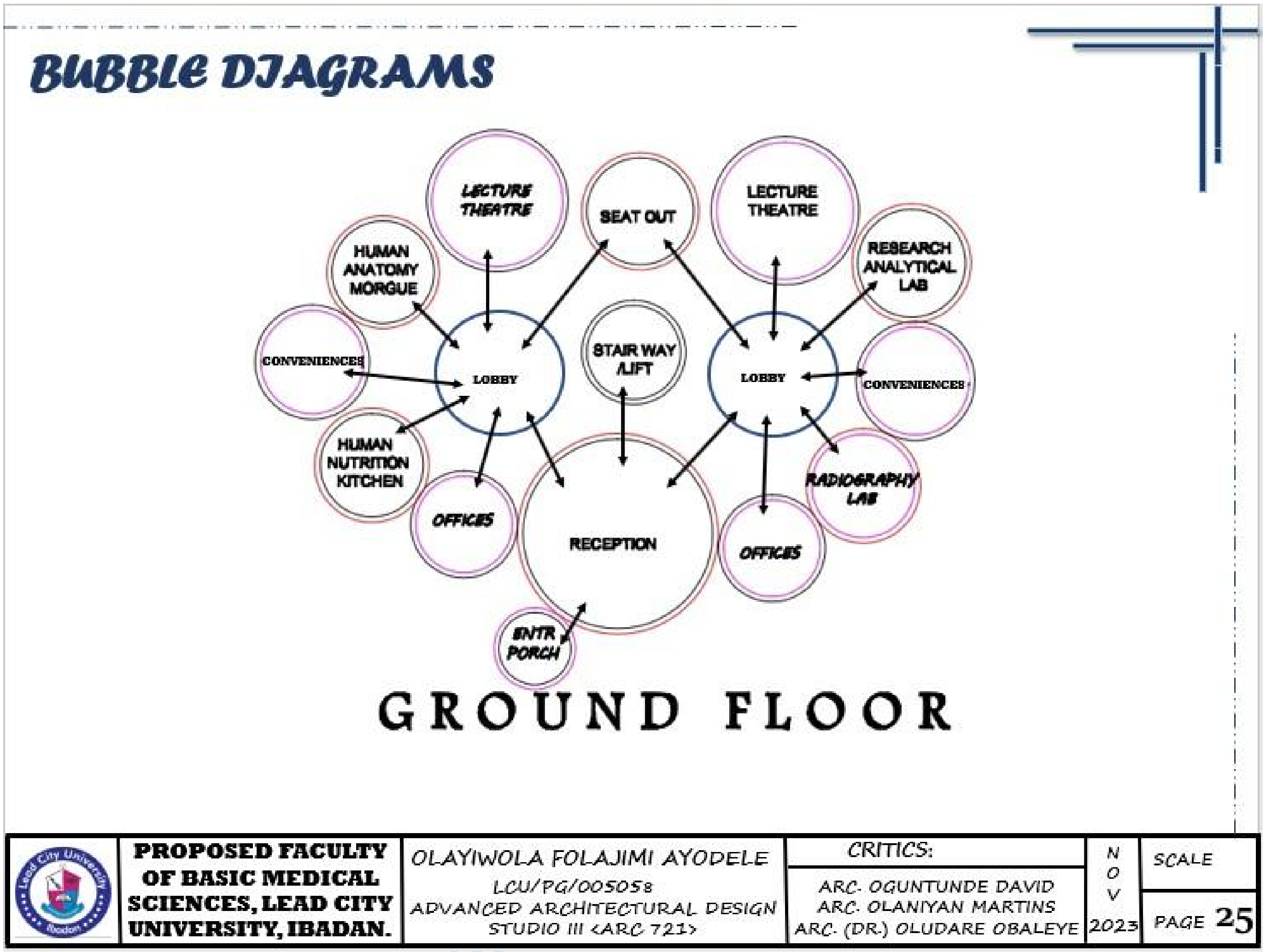

Fig 4.4: Ground floor Bubble Diagram

Source: Field work (2024)

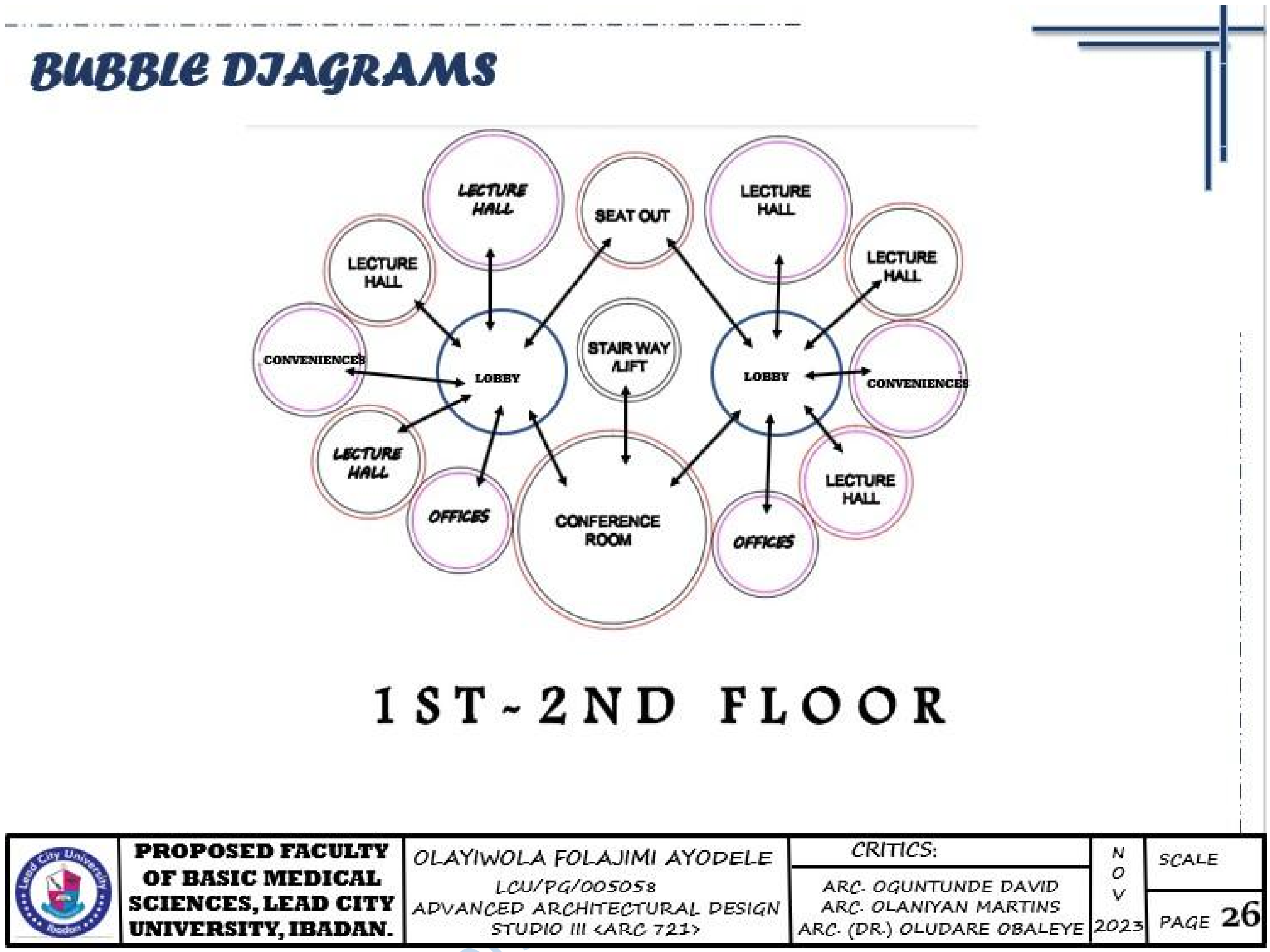

Fig 4.5: First & Second Floor Bubble Diagram

Source: Field work (2024)

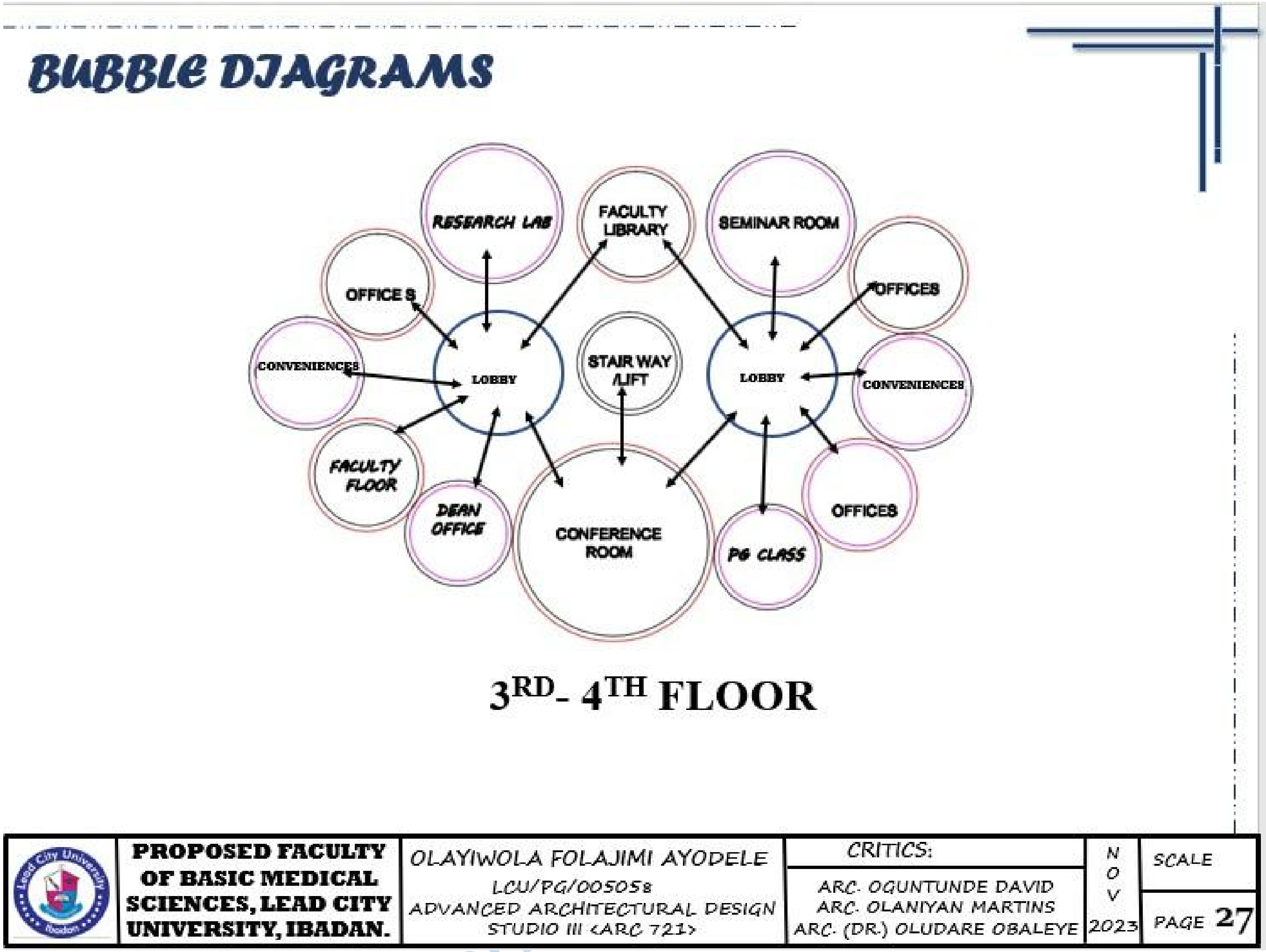

Fig 4.6: Fourth floor Bubble Diagram

Source: Field work (2024)

4.2.6 Space Allocation / Schedule of Accommodation

Table 4.1: Schedule of Accommodation

Source: Field work (2024)

SPATIAL ANALYSIS

SPACES	NO OF UNITS	DIMENSIONS	TOTAL AREA
LECTURE HALL	36	8.9m X 13.1m	116m²
ENTRANCE TERRACE	1	2.4m X 5.7m	13m²
RECEPTION	1	9.1m X 5.7m	52m²
GENERAL OFFICE	1	3.1m X 3m	9m²
HEAD OF DEPT. OFFICE	6	3.7m X 3m	46m²
LECTURER OFFICE	30	3.9m X 3m	111m²
PROFESSOR OFFICE	18	2.4m X 3m	7m²
SENIOR PRINCIPAL OFFICE	10	4.2m X 5.7m	24m²
FACULTY LIBRARY	1	4.2m X 3.9m	16m²
ICT ROOM	1	4.2m X 3.7m	13m²
CONVENIENCES	8	1.2m X 1.8m	2m²
STAIR HALL	1	3.1m X 4.7m	102m²
SECRETARY	20	2.7m X 5.7m	64m²
DEAN OFFICE	1	9.3m X 5.7m	49m²
MEETING ROOM	2	9.1m X 5.7m	105m²
SECRETARY	1	3.7m X 4.2m	15m²
SEAT OUT	1	2.4m X 5.7m	13m²
COURT YARD	1	5.7m X 5.7m	33m²
RESEARCH LABORATORY	5	1.2m X 1.8m	69m²

PROPOSED FACULTY OF BASIC MEDICAL SCIENCES, LEAD CITY UNIVERSITY, IBADAN.	OLAYIWOLA FOLAJIMI AYODELE LCU/PG/005058 ADVANCED ARCHITECTURAL DESIGN STUDIO III <ARC 721>	CRITICS: ARC. OGUNTUNDE DAVID ARC. OLANIYAN MARTINS ARC. (DR.) OLUDARE OBALEYE	NOV 2023	SCALE	PAGE 23

4.2.7 Construction Methods and Materials

4.2.7.1 Methods

i. **Concrete Construction**

a) **Cast-in-Place Concrete:** Used for foundations, columns, and structural walls to provide strength and stability.

b) **Precast Concrete:** Prefabricated concrete elements for efficiency and quality control in construction.

ii. Steel Frame Construction

Structural steel frames for large spans and flexibility in building layout, allowing for future modifications.

iii. Masonry Construction

a) **Brick Masonry:** Used for exterior facades to provide thermal insulation and aesthetic appeal.

b) **Block Masonry:** Used for non-load-bearing walls and partitions within the building.

iv. Wood Frame Construction

Timber framing for low-rise sections or interior partitions, providing flexibility and sustainability benefits.

v. Composite Construction

Combines different materials like concrete and steel to optimize structural performance and construction efficiency.

4.2.7.2 Materials

i. Exterior Finishes

a) **Brick:** Traditional and durable option for facades, offering thermal insulation and aesthetic versatility.

b) **Metal Panels:** Lightweight and durable, used for modern architectural finishes and rain screen systems.

c) **Glass:** Energy-efficient glazing systems for windows and curtain walls, enhancing daylighting and building aesthetics.

ii. Roofing Materials

a) **Roof Membranes:** Waterproof and durable membranes for flat and low-slope roofs, ensuring long-term protection.

b) **Metal Roofing:** Durable and energy-efficient option for sloped roofs, offering aesthetic flexibility.

iii. **Interior Finishes**

a) **Drywall:** Common for interior partitions and ceilings, providing fire resistance and acoustic insulation.

b) **Flooring:** Options include vinyl, carpet tiles, and ceramic tiles for durability and ease of maintenance in high-traffic areas.

c) **Ceiling Systems:** Suspended acoustical ceilings for sound absorption and integration of lighting and HVAC systems.

iv. **Structural Insulation**

a) **Spray Foam Insulation:** Provides superior thermal resistance and air barrier performance in walls and roofs.

b) **Fiberglass Insulation:** Traditional option for thermal and sound insulation, used in cavity walls and roof spaces.

4.2.8 Building Services

4.2.8.1 Mechanical Services- Heating, Ventilation, and Air Conditioning (HVAC):

i. **HVAC Systems:** Centralized systems designed to provide thermal comfort and indoor air quality control throughout the building.

ii. **Air Handling Units (AHUs):** Units that circulate and filter air, providing fresh air intake and temperature control.

iii. **Chilled Water Systems:** Cooling systems using chilled water circulation for air conditioning.

iv. **Boiler Systems:** Provide hot water or steam for heating and domestic use.

4.2.8.2 Electrical Services

i. **Power Distribution:** Distribution of electrical power from the main supply to outlets and equipment throughout the building.

ii. **Lighting Systems:** Interior and exterior lighting solutions designed for energy efficiency and occupant comfort.

iii. **Emergency Power Systems:** Backup generators or uninterruptible power supply (UPS) systems to ensure critical operations during power outages.

iv. **Lightning Protection Systems:** Safeguards against lightning strikes to protect the building and its occupants.

4.2.8.3 Plumbing and Sanitary Services

i. **Water Supply Systems:** Supply of potable water for drinking, sanitation, and firefighting purposes.

ii. **Sanitary Systems:** Drainage and disposal of wastewater and sewage from sinks, toilets, and other plumbing fixtures.

iii. **Fire Protection Systems:** Fire detection and suppression systems, including sprinklers, fire alarms, and smoke detectors to ensure safety.

4.2.8.4 Communications and Security Systems

i. **Telecommunication Systems:** Network infrastructure for data, voice communication, and internet access throughout the building.

ii. **Security Systems:** Surveillance cameras, access control systems, and intrusion detection systems to protect building occupants and assets.

4.2.8.5 Vertical Transportation

i. **Elevators and Lifts:** Vertical transportation systems to facilitate movement between floors, ensuring accessibility for all occupants.

ii. **Stairs:** Staircases providing alternative means of vertical circulation, promoting physical activity and emergency evacuation routes.

4.2.8.6 Environmental and Sustainable Systems

i. **Daylighting and Natural Ventilation:** Incorporation of design strategies to maximize natural light and ventilation, reducing energy consumption.

ii. **Energy Management Systems:** Monitoring and control systems to optimize energy usage and enhance building efficiency.

Chapter Five

Conclusion and Recommendation

5.1 Project Appraisal

The exploration of natural lighting in faculty building design represents a critical inquiry into sustainable architectural practices aimed at enhancing occupant well-being, energy efficiency, and environmental stewardship. Through meticulous research and analysis, this thesis has illuminated the potential benefits and challenges associated with the integration of natural light into educational environments.

Key findings have underscored the positive impact of natural lighting on student performance, productivity, and overall satisfaction. Additionally, the empirical investigation has identified various design strategies and technologies that optimize daylighting, such as building orientation, window placement, shading devices, and light redirecting systems. However, challenges such as glare control, thermal comfort, and design flexibility must be addressed to fully realize the benefits of natural lighting in faculty building design.

5.2 Conclusion

In conclusion, the application of natural lighting in faculty building design represents a holistic approach to architectural innovation that prioritizes human-centric design principles and environmental responsibility. Through strategic architectural interventions, such as proper building orientation, optimized window placement, the use of reflective materials and the use of daylighting systems, architects can optimize daylighting while minimizing reliance on artificial lighting while improving visual comfort and well-being.

The findings indicate that harnessing the inherent qualities of natural lighting systems can significantly reduce energy consumption, enhance indoor environmental quality, and improve user satisfaction. Moreover, the research highlights the value of daylighting as a fundamental design consideration in educational facilities and the importance of considering daylighting strategies from the early stages of design, emphasizing an all-inclusive approach that balances environmental, economic, and social dimensions.

5.3 Recommendations

Based on the findings of this research, the following recommendations are proposed for architects, designers, and educational institutions involved in faculty building projects:

I. **Prioritize Daylighting Design:** Place greater emphasis on daylighting design considerations from the conceptualization phase to maximize the benefits of natural lighting.

II. **Utilize Daylighting Simulation Tools:** Incorporate daylighting simulation tools and software to evaluate and optimize daylighting strategies during the design process.

III. **Promote Interdisciplinary Collaboration:** Encourage collaboration between architects, engineers, and other stakeholders to ensure holistic design solutions that address both technical and aesthetic aspects of natural lighting.

IV. **Invest in Occupant Education:** Educate building occupants about the benefits of natural lighting and encourage behaviours that support daylighting, such as adjusting window treatments and minimizing obstructions to daylight penetration.

V. **Monitor and Evaluate Performance:** Implement post-occupancy evaluations to assess the actual performance of daylighting strategies and identify areas for improvement to ensure long-term effectiveness in future projects.

VI. **Stay Updated on Best Practices:** Stay abreast of latest research, technologies, and best practices in daylighting design to continually improve the effectiveness and efficiency of natural lighting solutions.

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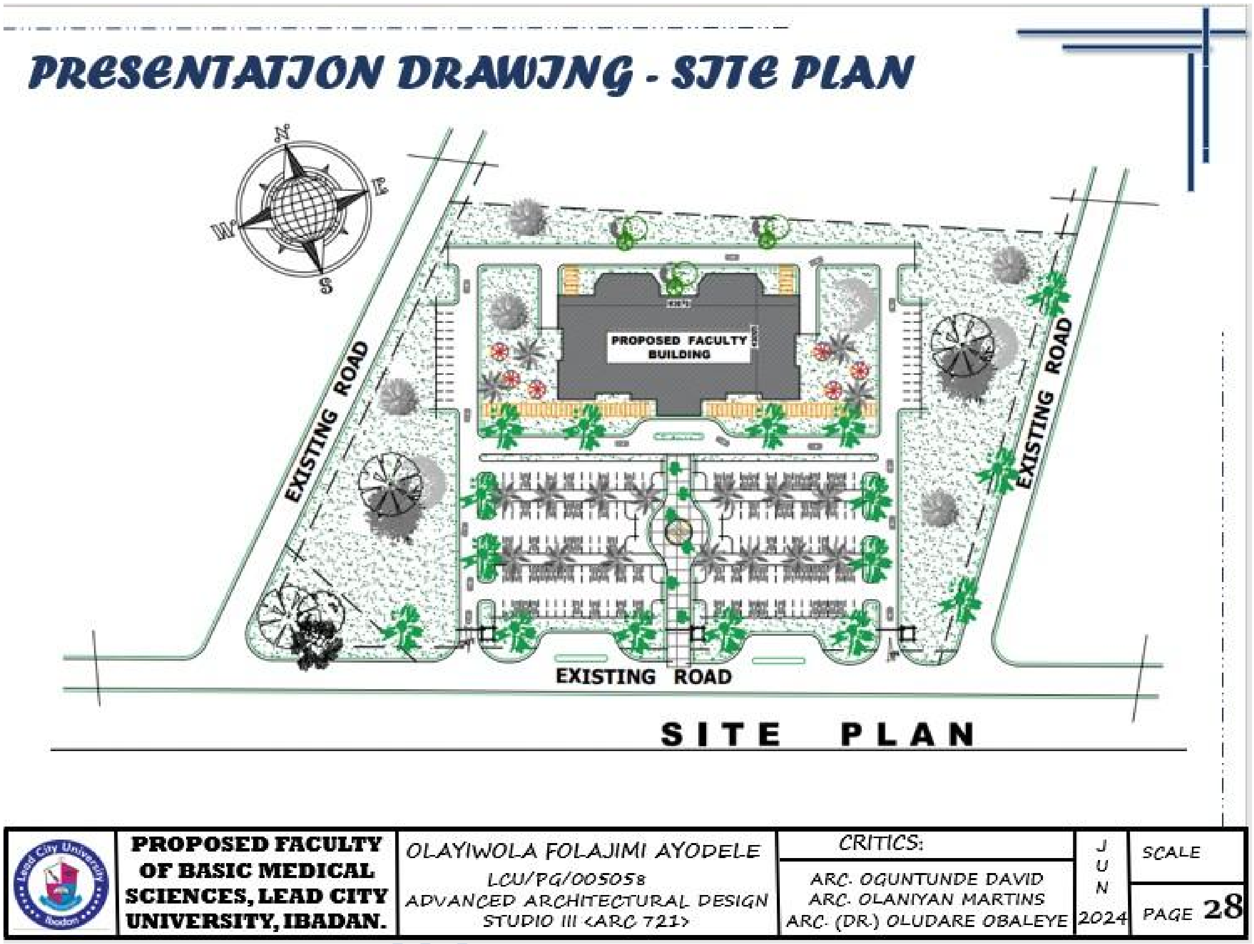
Appendices

Appendix 1 – Presentation Drawings



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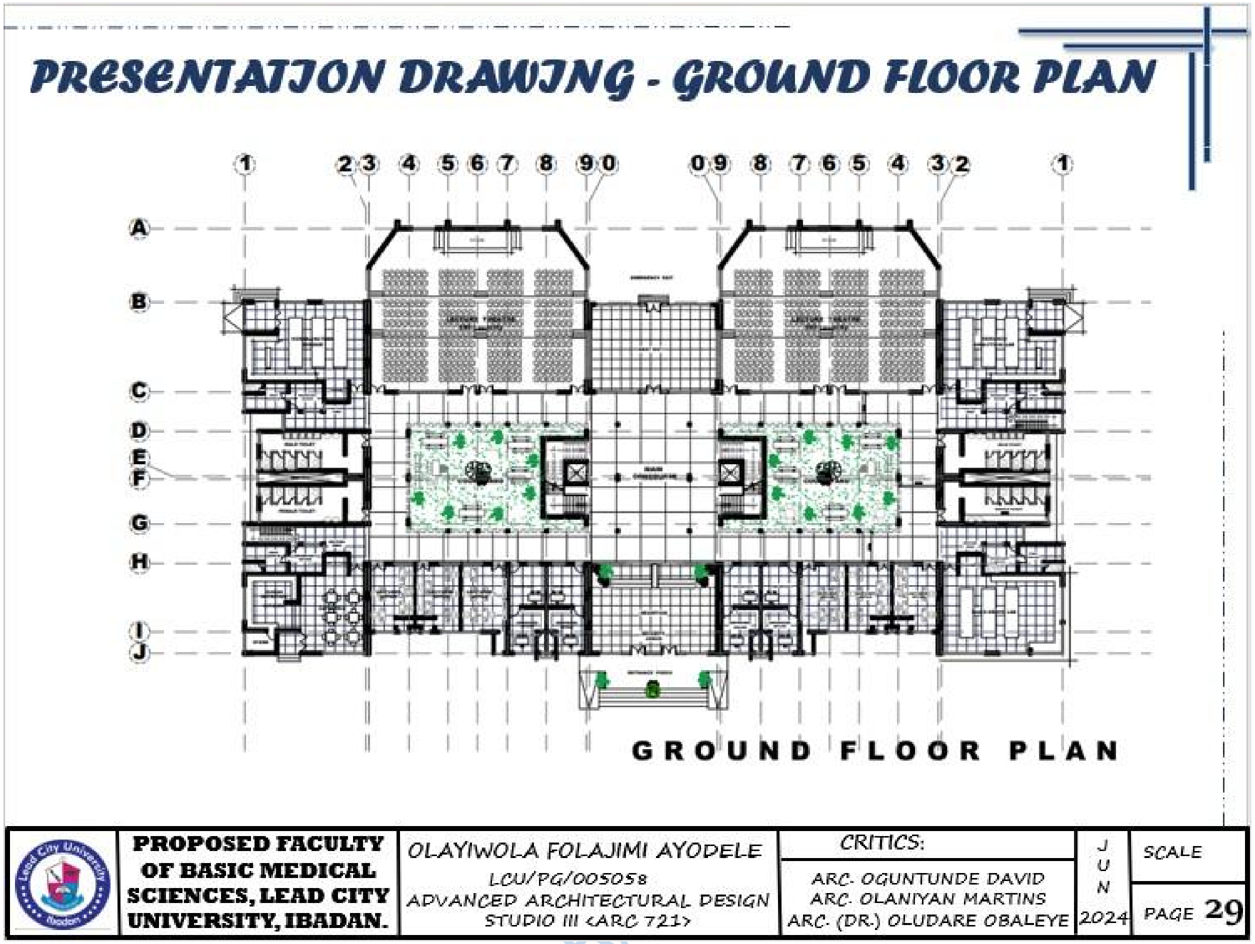
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PROPOSED FACULTY OF BASIC MEDICAL SCIENCES, LEAD CITY UNIVERSITY, IBADAN.
OLAYIWOLA FOLAJIMI AYODELE
LCU/PG/005058
ADVANCED ARCHITECTURAL DESIGN STUDIO III <ARC 721>
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ARC. OLANIYAN MARTINS
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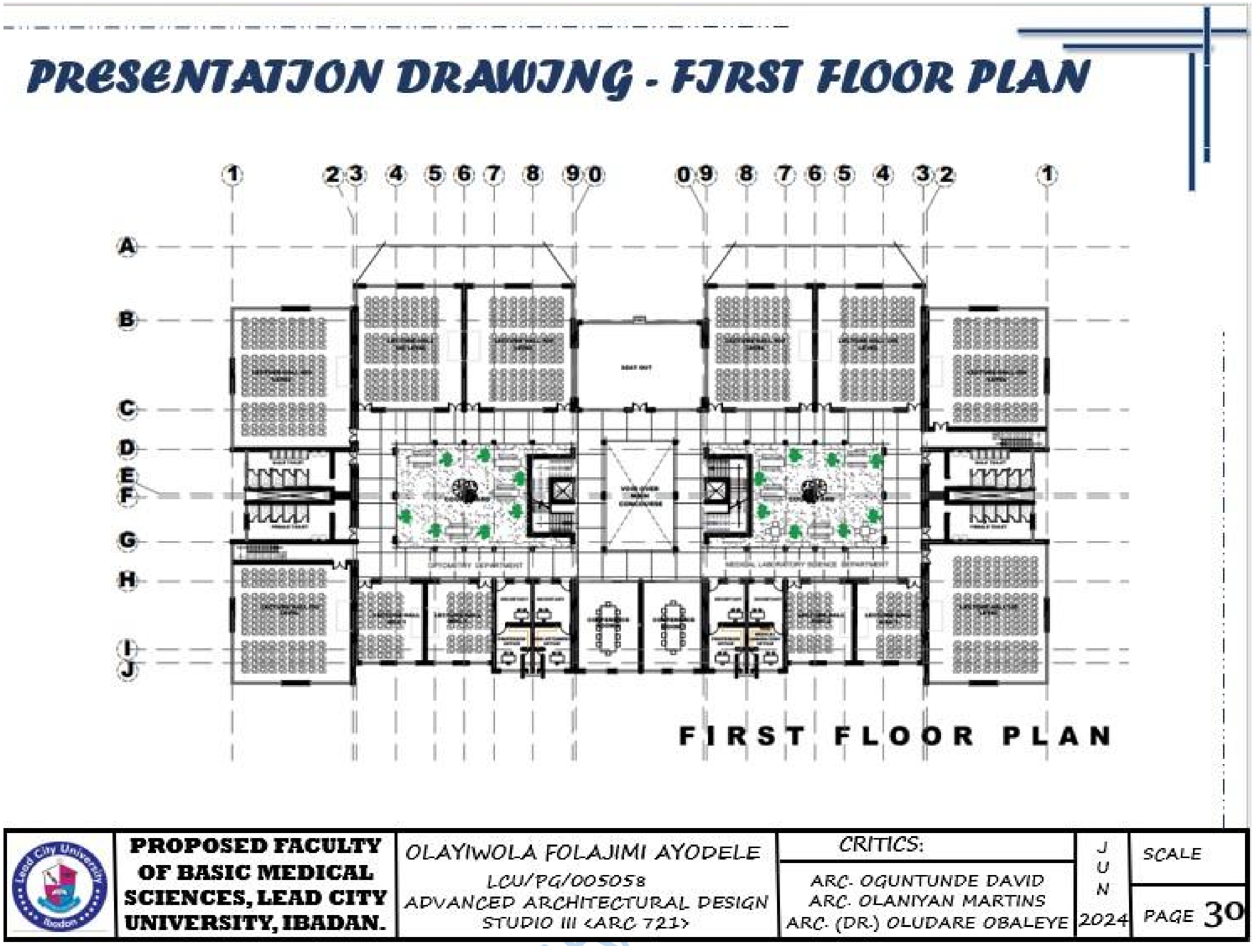
Appendix 2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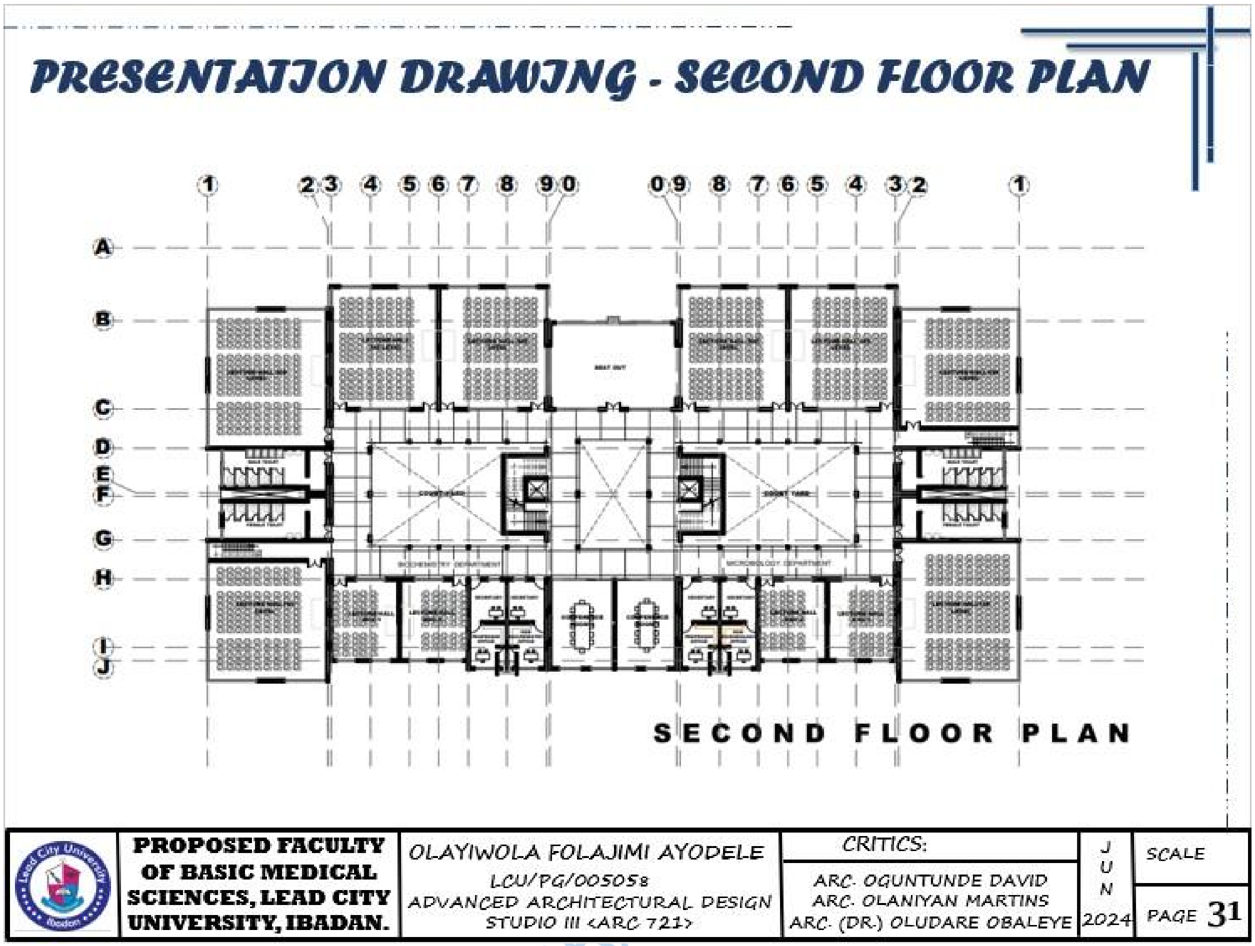
Appendix 3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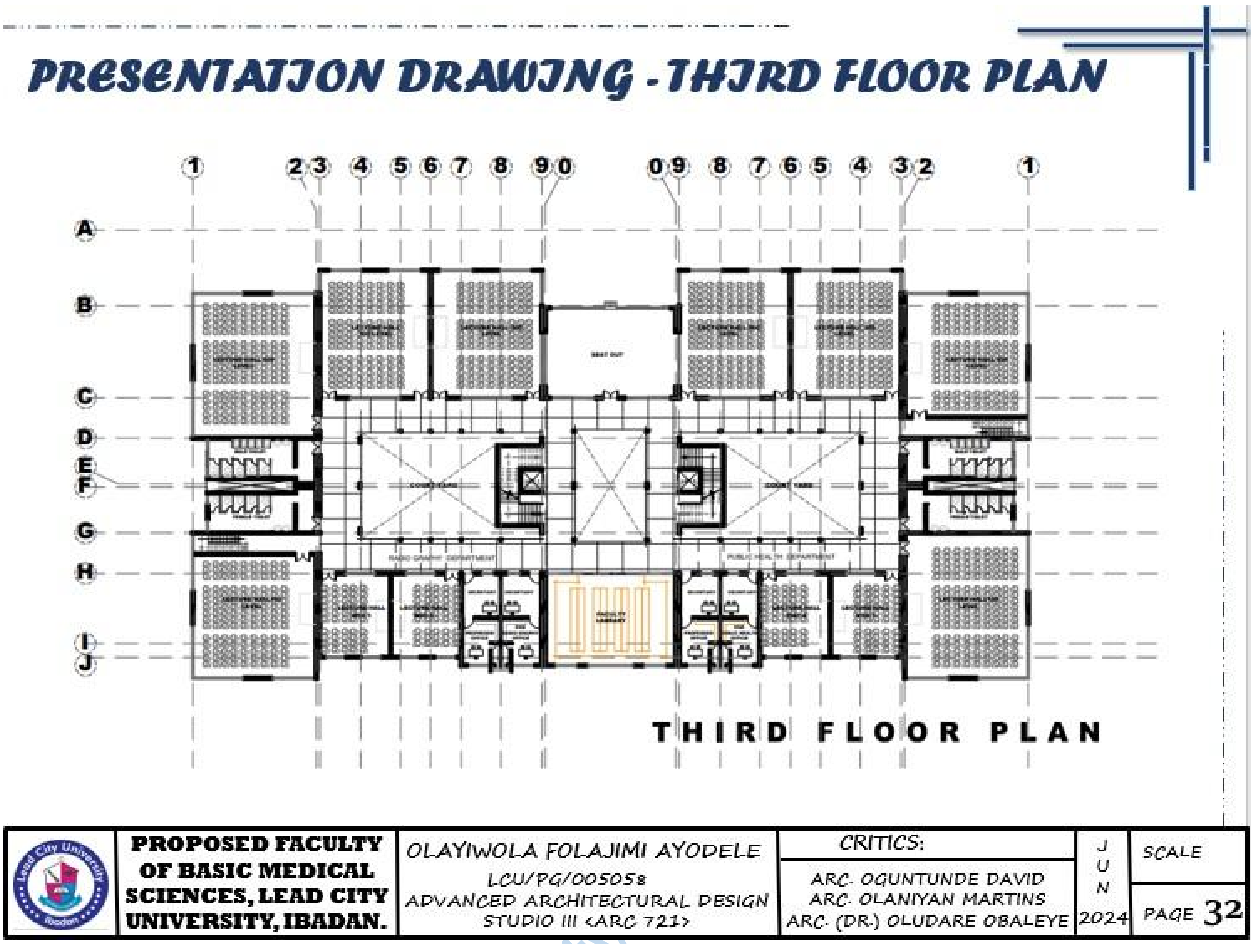
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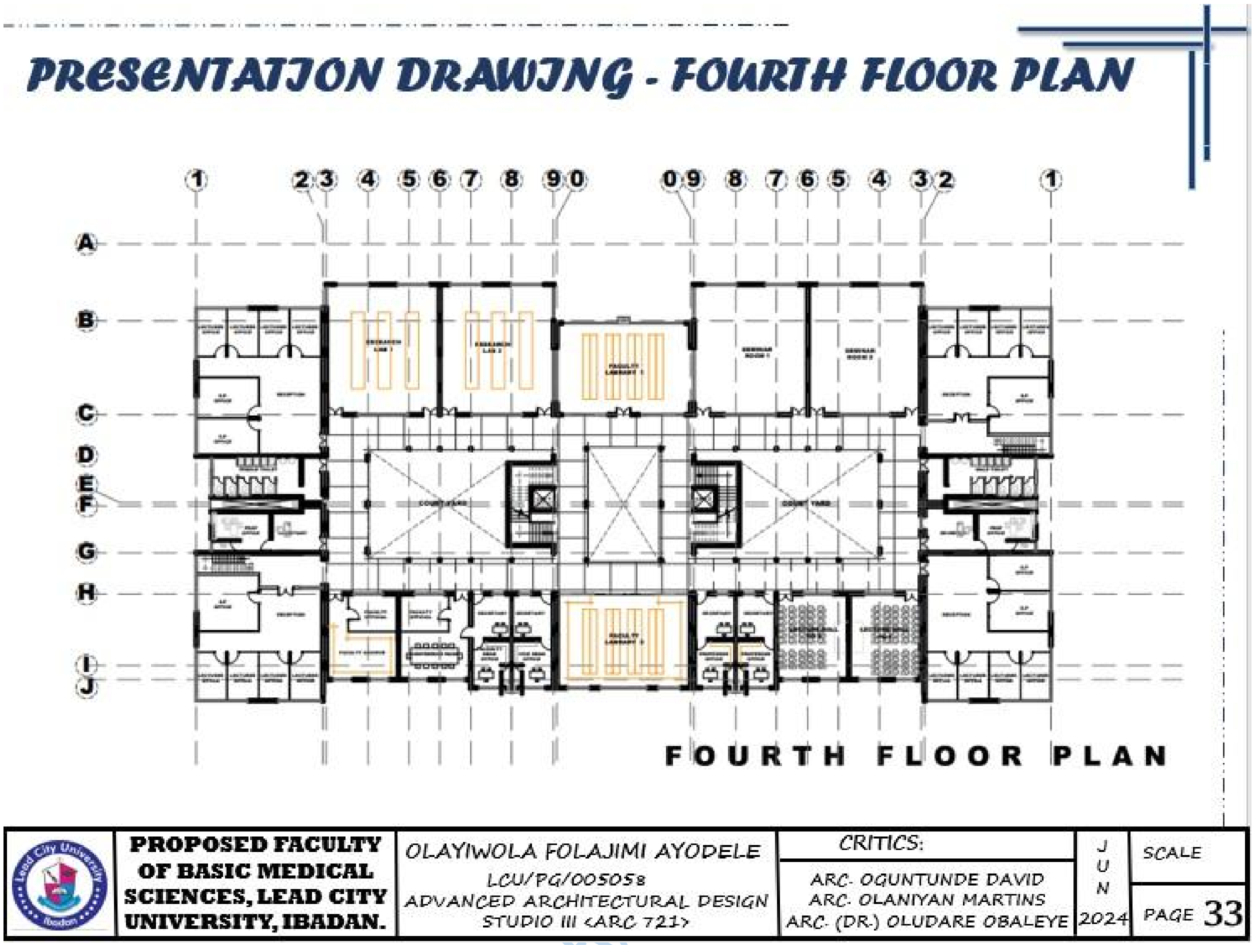
Appendix 5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Appendix 6

3D VISUALIZATION

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Appendix 7

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Appendix 8

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Appendix 10


3D VISUALIZATION
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Appendix 11

Bio-data

A. Personal Data

1. Full Name:	OLAYIWOLA Folajimi Ayodele
2. Address:	12 Lemo Layout, Ogunseitan Street, Agbaje, Orita Challenge, Ibadan, Oyo State, Nigeria.
3. Email Adress:	fawibefolajimi@gmail.com
4. Phone Number:	08028462968 / 09037972822
5. Date of Birth:	05/05/1980
6. Place of Birth:	Ibadan
7. Nationality:	Nigerian
8. Marital Status:	

9. Name and Address of Next of Kin: Olayiwola Jumoke Ayobami. 12 Lemo Layout, Ogunseitan, Agbaje, Orita Challenge, Ibadan, Oyo State, Nigeria

B. Educational Background

1. Educational Institutions Attended with Dates and Qualification:

Qualifications	Institution	Date
MSc Architecture	Lead City University, Ibadan, Oyo State.	2022 - Date (Ongoing)
BSc. Architecture	Lead City University, Ibadan, Oyo State.	2020 - 2022

HND Architecture	The Polytechnic, Ibadan, Oyo State	2015 – 2017
OND Architecture	Federal Polytechnic Ede, Osun State.	2001 – 2003
Secondary School	Government College, Apata Ganga, Ibadan.	1992 - 1998
Nursery and Primary School	Comfort Nursery and Primary School, Agodi gate, Ibadan	1986 - 1992

C. Awards and Fellowships:

1. Departmental Ambassador 2003 (National Association of Architecture Students NAAS Federal Polytechnic Ede Chapter)

2. Award of Excellent Service (Pro – Chancellors Community Service Certificate. Leadcity University)

D. Work Experience: With Dates

1. 2010 – 2015; Boldform Consult Ltd (Architectural and Construction Firm) 1st Basement floor, Olusegun House, 34 Oyo Road, Sango, Ibadan, Oyo State.

2. 2015 Till Date; LightGlory Assure Design Consult (Architectural and Construction Firm) Ileri Oluwa Shopping Complex Suite U4, Olororo Bus Stop, Orita Challenge, Ibadan, Oyo State.

E. Publications –

…………………………………… ……………………………………

Signature Date

The University Compliance Certification

This is to certify that the Thesis by Folajimi Ayodele OLAYIWOLA, with the matriculation number LG/PG/005058 in the Department of Architecture, Faculty of Environmental Design and Management Lead City University, Ibadan, is in full compliance with the University format and style of Thesis.

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