Proposed High-Rise Office Building

(Roles of Sustainable Architecture in Minimizing the Environmental Impacts of Building)

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Certification

This is to certify that **Abdulazeem Adedolapo AKANMU** with matriculation number **LG/PG/005100** carried out this research work titled "**Roles of Sustainable Architecture in Minimizing the Environmental Impacts of Building**" in the Department of Architecture, Faculty of Environmental Design and Management, Lead City University, Ibadan, for the award of Master Degree (M.Sc.) in Architecture and this has not been previously submitted.

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Dedication

This research is dedicated foremost to ALLAH (S.W) for His grace and mercy upon my life especially during the process of carrying out the research. I also dedicate this to all people that contributed and supported me to make the research a successful one. I appreciate you all.

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Even though the above-mentioned institutions and persons have assisted in the process of this research work, I alone stand responsible for the errors, if any, found in the work.

Abstract

Sustainable architecture has important roles to play in reducing the impact of buildings on the environment, due to the fact that performance of building has great influence on life quality, comfort, security, health. However, the number of resources consumed in the construction, use and operation of buildings, as well as the harm done to the built environment through the emission, pollution and waste of its components, gives greater concern and contributing largely to environmental degradation and climate change. To counteract this, it is essential to incorporate sustainable design elements into our buildings. This research investigates the role of sustainable architecture in achieving environmentally friendly office buildings, it addresses the challenge of minimizing the environmental impact of office building. The project draws upon a comprehensive study of office building across various regions and leverages a thorough review of relevant sustainable architecture literatures. The proposed office building integrates key sustainable architectural design elements like landscaping, energy efficiency, water conservation, and renewable energy. The study emphasizes the importance of prioritizing and addressing the need to minimize the environmental impact of the building throughout its life cycle, from pre-design to post-construction. By doing so, we can contribute to a more sustainable future, conserve resources, and improve public health.

Keyword: *Energy efficiency, Environmental impact, Landscaping, Office buildings, Renewable energy, Sustainable architecture, Sustainable design elements, Water conservation.*

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Table of Contents

List of Figures

List of Plates

List of Tables

Chapter One

Introduction

1.1 Background to the Study

Sustainable architecture, also known as green architecture, seeks to minimize the negative environmental impact of buildings with efficiency and moderation in the use of materials, energy, development space, and ecosystems (Buchanan, 2017; Kibert, 2016). This architectural approach uses a conscious strategy to integrate energy and ecological conservation in the design of the built environment (Edwards, 2018). Sustainable architecture encompasses the theory, science, and style of buildings designed and built following environmentally friendly principles, aiming to reduce the harmful effects of construction on the natural environment (Guy & Farmer, 2001). Sustainable Architecture in this context is described as an efficient use of resources to meet the current and future needs while minimizing adverse impacts of buildings on the natural environment (Ragheba, 2015). Green architecture aims to reduce resource consumption during the construction, operation, and maintenance of buildings, while also limiting environmental damage caused by emissions, pollution, and waste (Ragheba, 2015).

According to Raynsford (1999), industries vary in their environmental impact, but the built environment is recognized as the largest source of greenhouse gas emissions, responsible for up to 50% of global carbon dioxide output. Moreover, the environmental effects embedded in a building throughout its entire life cycle can be comparable in scale to those produced during its operational phase (Citherlet, 2001). Numerous studies have demonstrated a connection between building conditions and public health. As noted by the California Integrated Waste Management Board (2000), the construction industry accounts for 40% of the materials used in the global economy and is responsible for 40–50% of greenhouse gas emissions and pollutants that contribute to acid rain. Sartori and Hestes (2007), Ramesh and Prakash (2010), and Yung et al. (2013) have identified that the operational phase of buildings, particularly the energy required for their

operation, has the most significant environmental impact. The categories of impact analyzed in Life Cycle Assessment studies on building environmental effects vary depending on the study's objectives, data availability, and the relevance of specific impacts. "In the literature on Life Cycle Assessments (LCAs) applied to entire buildings, the most frequently examined impacts include global warming, acidification, eutrophication, and ozone depletion, which are consistently present in most studies (Khasreen et al., 2009). Among the various environmental impacts of buildings, global warming currently receives the most attention, requiring action from governments, industries, and the public. Growing concerns about environmental conditions, both locally and globally, highlight the need for change. Global warming, driven by the overuse of waste sinks, is primarily caused by the release of greenhouse gases, which are by-products of fossil fuel combustion (Bernardi et al., 2017).

Sustainable architecture plays a crucial role in mitigating the environmental impact of buildings, not only because of its contribution to the national economy but also due to the significant influence building performance has on quality of life, comfort, safety, and health. Sustainable design focuses on reducing negative effects on both human health and the environment. Architects and designers committed to sustainability aim to protect natural resources air, water, and land by selecting eco-friendly materials and adopting responsible construction practices. This involves key considerations in four areas: site development, material usage, energy efficiency, and indoor air quality (Roy, 2008). Achieving sustainable, eco-friendly architecture has become a fundamental goal in all human activities aimed at improving life. As a result, the shift towards more sustainable practices is regarded as a primary objective in contemporary architecture (Mahdavinejad et al., 2014).

The buildings we inhabit for living, working, and recreation shield us from the elements, but they also influence our health and the environment in many ways. As the environmental consequences of buildings become more evident, sustainable architecture has gained prominence. It involves

adopting healthier, more resource-efficient approaches to construction, renovation, operation, maintenance, and demolition (Roy, 2008).

1.2 Statements of the Research Problems

The construction and operation of buildings significantly contribute to global energy consumption and greenhouse gas emissions through the pollution and waste produced by their components, raising concerns and greatly contributing to environmental degradation and climate change. While the extent of environmentally harmful activities varies across industries, it is widely acknowledged that the built environment is the largest source of greenhouse gas emissions, accounting for up to 50% of global carbon dioxide emissions (Raynsford, 1999). Although sustainable architecture has emerged as a potential solution to address these issues, there remains a gap in understanding the specific roles and effectiveness of sustainable architectural practices in reducing the environmental impact of buildings throughout their lifecycle.

Research such as Adiba (2022) emphasize the urgency of minimizing construction's ecological footprint, gaps persist in understanding integration challenges and opportunities, as also highlighted by Harald et al. (2021) and Amita et al. (2021).In addition, research indicates that commercial buildings, particularly office buildings, account for a significant portion of the energy used by buildings in numerous nations, including the United States, Hong Kong, the United Kingdom, and China (Mu'azu, 2012). Moreover, studies from Moňoková and Vilčeková (2020) and Xu and Tan (2018) suggest a need to explore integrative relationships between sustainable environmental architecture and design elements.

This research aims to address this gap by investigating the various roles that sustainable architecture plays in reducing the environmental impacts of buildings. Specifically, this study will examine:

1. The effectiveness of different sustainable design strategies in reducing energy consumption, water usage, and waste generation in buildings.

2. The impact of sustainable materials and construction techniques on the overall environmental performance of buildings.
3. The long-term environmental benefits of sustainable architecture compared to conventional building practices.

By exploring these aspects, this research seeks to provide valuable insights for architects, other professionals, and policymakers in developing more effective sustainable building strategies. The findings of this study will contribute largely to the growing body of knowledge on sustainable architecture and inform future practices aimed at creating more environmentally responsible built environments.

1.3 Aim

This paper aims to study the roles of sustainable architecture in minimizing the environmental impacts of buildings.

Objectives

The objectives of this paper will focus on the following:

1. To identify the role of sustainable architecture in minimizing the environmental impact of building.
2. To identify the strategies used in minimizing the environmental impact of building.
3. To incorporate the findings in this research into my project design.

1.4 Research Question

1. What is the roles of sustainable architecture in minimizing the environmental impact of buildings?
2. What strategies are employed to reduce the environmental impact of buildings?
3. How can the findings from this research be incorporated into project design?

1.5 Significant of the Study

This study will help to achieve one of the objectives of the sustainable architecture in promoting sustainability in buildings. It will provide specialist knowledge and become a useful reference to architects, other professionals and researchers in the adoption of sustainable architectural design elements in the design of sustainable public buildings. This will also encompass the following:

i. The need to identify and document the existing situation;
ii. The need to provide intervention models to ameliorate the existing situation; and
iii. The need to provide frameworks that enhance sustainability in buildings.

This will aid policy makers in incorporating sustainable architectural design elements decisions with reference to sustainability in the design of public building and not only office building.

1.6 Scope of the Study

Sustainable architecture in itself is vast in scope which has necessitated this study being limited to the aspect concerning the roles of sustainable architecture and strategies in achieving it. Inclusive is the effects these have on the built environment. This research shall focus on roles of sustainable architecture in minimizing environmental impacts of building and sustainable architectural design elements that will aid in the design of an office building that will promote sustainability in the tropical climate.

1.7 Operational Definition of Terms:

Sustainable architecture: Sustainable architecture refers to the design, construction, operation, and eventual demolition of buildings with a focus on minimizing their environmental impact throughout their life cycle. It prioritizes the use of renewable resources, energy efficiency, and the creation of healthy indoor environments.

Sustainability: Sustainability is a comprehensive concept that refers to the capacity to fulfill present needs without hindering future generations' ability to satisfy their own needs. It encompasses environmental, social, and economic factors. In this context, we concentrate on the

environmental dimension of sustainability, which is intrinsically connected to sustainable architecture.

Environmental impact: The environmental impact of a building refers to the negative effects it has on the environment throughout its life cycle. This can include: Energy consumption, Material use, Waste generation, Water usage.

Chapter Two

Literature Review

2.1 Conceptual Review

This chapter highlights the meaning and origin of the term sustainable Architecture, an intense review of literature that elaborate the concept of sustainable architecture design elements related to environmental impact of building. This chapter examines previous studies by many other researchers in this area of study and analyses some of the existing body of literature to find out how the studies were conducted conceptually and theoretically.

2.1.1 Historical Development of Sustainable Architecture

The term “sustainability” derives from the Latin word sustinere, which combines *sub* (meaning "from below") and tenere (meaning "to hold up"). This etymology conveys the concept of something that supports, maintains, or endures (Mahdiraji et al., 2018). The seeds of sustainable architecture were sown long before the formalization of the term. Ancient civilizations, from the Greeks to the Chinese, employed bioclimatic design principles, strategically positioning buildings and utilizing natural materials to optimize thermal comfort and resource efficiency (Harindra Syam et al., 2023). Vernacular architecture, the traditional building practices of different cultures, also played a significant role. These practices, often informed by local climate and available resources, embodied a form of natural sustainability. The 21st century has seen continued advancements in sustainable architecture. Technological innovations like high-performance building materials, renewable energy integration, and smart building technologies have opened new possibilities for reducing a building's environmental footprint (Harindra Syam et al., 2023).

The increasing significance of Life Cycle Assessment (LCA) in sustainable architecture cannot be overstated. LCA is a method that evaluates the environmental impact of a building over its entire

lifecycle, from material extraction to demolition. This comprehensive approach enables architects to make informed choices regarding material selection, construction techniques, and building operations to reduce the overall environmental footprint (Sharma et al., 2022). Sustainable architecture is no longer just about reducing environmental impact; it's also about designing buildings that can withstand extreme weather events and other climate-related challenges (Hwang & Augenbroe, 2022). Sustainable architecture has come a long way, evolving from its early roots in bioclimatic design and vernacular practices to a sophisticated field driven by innovation and environmental awareness. Recent advancements in materials, technologies, and design methodologies offer exciting possibilities for creating a more sustainable built environment. Also (Harindra Syam et al., 2023) emphasize, the future of sustainable architecture lies in continuous exploration, integration of new technologies, and a holistic approach that considers the entire life cycle of a building.

Figure 1. The concept of Sustainability

(Harindra Syam et al., 2023)

2.1.2 Sustainable architecture design elements

Sustainable architecture design elements are those that consider the environmental impact of a building throughout its lifecycle, from construction to operation. They strive to minimize the building's footprint while creating a healthy and comfortable living space. Here are some key elements of sustainable architecture:

- **Site Selection and Development:** Choosing a site that minimizes disruption to the natural environment and leverages existing features is crucial. This can involve reusing previously developed sites, designing buildings to fit the contours of the land, and preserving natural habitats (Martins et al., 2023).
- **Energy Efficiency:** Sustainable buildings are engineered to minimize energy consumption for heating, cooling, and lighting. This goal can be accomplished through various features, including passive solar design, high-performance insulation, energy-efficient appliances, and LED lighting (Arasteh et al., 2021).
- **Water Conservation:** Water-saving plumbing fixtures, rainwater harvesting systems, and grey water reuse systems can all help to reduce a building's water consumption (Akan et al., 2022).
- **Material Selection:** Sustainable buildings use materials that are durable, non-toxic, and have a low environmental impact. This can include recycled materials, locally sourced materials, and rapidly renewable materials like timber, bamboo, bricks (Lenzen & Steen, 2024).
- **Renewable Energy:** Solar panels, wind turbines, and geothermal systems can all be used to generate renewable energy for a building. This can help to reduce the building's reliance on fossil fuels (Hwang & Augenbroe, 2022).
- **Indoor Environmental Quality:** Sustainable buildings aim to create a healthy and comfortable indoor environment for their occupants. This can be accomplished through various features, such as natural ventilation, ample natural light, and the use of low-VOC materials (Al Horr et al., 2021).

- **Waste Reduction:** Sustainable buildings are designed to minimize waste during construction and operation. This can involve using prefabricated components, recycling construction waste, and composting organic waste.

By incorporating these elements into their designs, architects can create buildings that are not only beautiful and functional but also environmentally responsible (Ghiat et al., 2023).

2.1.3 Sustainable architecture roles

Sustainable architecture is essential in reducing the environmental impact of buildings throughout their entire lifecycle, encompassing design, construction, operation, and eventual demolition by:

2.1.3.1 Reducing Embodied Energy and Material Use:

Resource-Efficient Design: Sustainable architects prioritize efficient building design, minimizing the overall size and material usage. This translates to less embodied energy in materials and reduced environmental impact from resource extraction and processing (Lenzen & Steen, 2024).

Recycled and Sustainable Materials: Sustainable architecture emphasizes using recycled content materials, reducing the demand for virgin resources and the associated environmental damage. Additionally, specifying rapidly renewable materials like bamboo or utilizing locally sourced materials can further minimize embodied energy (Lenzen & Steen, 2024).

2.1.3.2 Minimizing Construction Waste:

Prefabrication and Modular Construction: Sustainable practices often involve prefabricating building components off-site, which minimizes on-site waste generation. Additionally, modular construction allows for easier disassembly and reuse of materials at the end of a building's life cycle (Ghiat et al., 2023).

Waste Reduction Strategies: Careful planning, material selection, and implementing waste reduction strategies during construction can significantly reduce the amount of debris ending up in landfills. This can involve practices like material reuse on-site and proper recycling of leftover materials (Ghiat et al., 2023).

2.1.3.3 Enhancing Operational Energy Efficiency:

Passive Design Strategies: Sustainable architecture prioritizes passive design principles that leverage natural elements for heating, cooling, and lighting. This can involve strategies like building orientation, proper window placement, and utilizing natural ventilation to minimize reliance on mechanical systems and reduce energy consumption (Hwang & Augenbroe, 2022).

Energy-Efficient Technologies: The use of energy-efficient building envelopes featuring high insulation values, along with energy-saving appliances and LED lighting, further diminishes a building's operational energy consumption and reduces greenhouse gas emissions. Furthermore, incorporating renewable energy sources, such as solar panels or wind turbines, can significantly lessen reliance on fossil fuels (Arasteh et al., 2021).

2.1.3.4 Promoting Water Conservation:

Low-Flow Fixtures and Water-Saving Technologies: Sustainable buildings utilize low-flow plumbing fixtures, rainwater harvesting systems, and greywater reuse systems. These approaches can greatly decrease a building's dependence on municipal water supplies and alleviate pressure on freshwater resources (Arasteh et al., 2021).

Landscaping with Native Plants: Sustainable landscaping practices involve using native and drought-tolerant plants, minimizing the need for excessive irrigation and promoting water conservation (Arasteh et al., 2021).

2.1.3.5 Improving Indoor Environmental Quality (IEQ):

Natural Ventilation and Day-lighting: Sustainable design prioritizes natural ventilation and day-lighting strategies, reducing the need for artificial lighting and ventilation systems and creating a healthier and more comfortable indoor environment (Al Horr et al., 2021).

Low-VOC Materials: Utilizing building materials with low or no volatile organic compounds (VOCs) emissions minimizes off-gasing of harmful chemicals, improving indoor air quality and occupant health (Al Horr et al., 2021).

By implementing all the strategies mentioned above, sustainable architecture minimizes the environmental impact of buildings across their lifespan. Sustainable buildings have lower carbon footprints, conserve resources, and contribute to a healthier environment for both occupants and the environments.

2.1.4 Environmental Impact of Buildings

Humans undeniably require shelter for their well-being. The construction, utilization, and disposal of buildings for housing have a substantial effect on the consumption of natural resources and the generation of waste. The construction sector is the biggest consumer of resources and raw materials due to this demand. Industrialization led to a significant increase in resource consumption and carbon emissions. Non-renewable fossil fuels like coal and oil were the primary resources used during this time. Since the industrial revolution, resource consumption has steadily increased, driven by the growth of factories, rising living standards, and environmental damage (Qarout, 2017).

In addition, the building industry's greenhouse gas emissions linked to global climate change have been steadily rising. The International Energy Agency recently reported a 45% increase in building-related emissions since 1990 (IEA, 2017). These facts highlight the importance of managing the environmental impacts of buildings, particularly greenhouse gas emissions, in order to achieve a sustainable economy and mitigate global warming (Foster, 2020).

Buildings have a significant impact on the environment throughout their entire life cycle, from construction to demolition. The following are the breakdown of the key areas of environmental concern:

2.1.4.1 Embodied Energy and Material Production

Manufacturing building materials like concrete, steel, and glass requires a lot of energy, leading to greenhouse gas emissions and resource depletion. A study in the journal Energy and Buildings found that the energy used to make building materials can be a big part of the total energy a building uses throughout its life. (Dodoo, A et'al. 2017).

2.1.4.2 Construction Waste

Construction activities generate a large amount of waste, including wood, concrete, and metal scraps. This waste often ends up in landfills, taking up space and potentially leaching harmful chemicals. The Environmental Protection Agency (EPA) says that about 60% of the trash in landfills in the United States comes from the construction and demolition of buildings. (EPA, 2023).

2.1.4.3 Operational Energy Use

Buildings consume a substantial amount of energy for heating, cooling, lighting, and appliances and this energy consumption contributes to greenhouse gas emissions and air pollution. The International Energy Agency says that buildings use about 40% of the world's energy and are responsible for 36% of the carbon dioxide emissions caused by using energy. (WGBC, 2017).

2.1.4.4 Water Use

Buildings use water for a variety of purposes, including toilets, showers, and landscaping. Excessive water use can strain water resources and lead to depletion of aquifers. A report by the World Green Building Council highlights that buildings are responsible for approximately 20% of global freshwater consumption. (WGBC, 2017).

2.1.4.5 Indoor Environmental Quality

Poor indoor air quality in buildings can lead to a variety of health problems for occupants, including respiratory issues and allergies. The EPA identifies indoor air quality as one of the top five environmental health risks. (EPA, 2023).

2.1.5 Concept of Office Building Design

An office space is defined as a facility suited for the performance of managerial and administrative duties, as well as those of accounting, marketing, information processing, consulting, human resource management, banking, insurance, teaching, and healthcare. An office building is a structure designed and constructed specifically to house office spaces. These spaces are used by businesses and organizations for various administrative, managerial, and professional activities (Cyril M. Harris, 2023).

2.1.5.1 Types and Classifications of Office Buildings:

Office buildings can be categorized in several ways, depending on factors like size, function, and location. Some of these includes:

Types of office buildings by size:

- **Low-rise office buildings (typically 2-4 stories):** Often found in suburban areas or integrated into mixed-use developments. They cater to businesses seeking a more affordable and accessible workspace, and may house a single tenant or multiple smaller businesses (Cyril M. Harris, 2023).
- **Mid-rise office buildings (5-12 stories):** Offering a balance between size and accessibility, these buildings are popular choices for businesses in urban or suburban settings. They can

accommodate a mix of office layouts, including open-plan environments, private offices, and collaborative spaces (Cyril M. Harris, 2023).

- **High-rise office buildings (exceeding 12 stories):** Prominent in urban centers, these buildings offer expansive views and concentrated office space for large corporations, financial institutions, and other businesses requiring a high-profile presence (Cyril M. Harris, 2023).

Classifications of office building by function:

- **Single-tenant office buildings:** Designed for a single occupant, offering a high degree of customization and control over the layout, security features, and amenities. These buildings often cater to large companies or government agencies (Cyril M. Harris, 2023).
- **Multi-tenant office buildings:** House multiple businesses with dedicated office spaces on different floors or sections. Typically managed by a building owner or property management company, they offer businesses of various sizes a cost-effective and flexible option (Cyril M. Harris, 2023).
- **Co-working spaces:** Provide shared workspaces for individuals, startups, or freelancers. Offering flexible leases, collaborative environments, and networking opportunities, co-working spaces are becoming increasingly popular (Cyril M. Harris, 2023).

2.2 Design Considerations for Office Buildings

The design of an office building significantly impacts employee well-being, productivity, and overall company culture. Today's work environments demand flexibility, functionality, and a focus on human-centered design. This necessitates a comprehensive approach that considers various factors beyond just aesthetics.

2.2.1 User-Centered Design:

When developing the building's layout, all of the tenant’s requirements must be considered. Modern office design has shifted from a one-size-fits-all approach to a user-centered idea (UCD)

that prioritizes employee well-being and fosters a positive work experience (Hussein et al., 2019). This people-centric approach starts with understanding employee needs through surveys, focus groups, and activity-based workplace (ABW) analyses (Preiser & Nasar, 2018). When planning a building, it's important to consider factors like the size of the organization, how it might grow in the future, how often it will need space, how people will gather, what technology is needed, how sound is handled, how much weight the floors can hold, how much storage is needed, what special utilities are needed, and how the building should look. You also need to think about logistics, such as loading, storage, utilities, moving things around, health, transportation, and budget. (Bakri et al., 2020).

2.2.1.1 Benefits of User-Centered Design

UCD offers numerous benefits. When employees feel their needs are considered in the design, they experience greater satisfaction and a sense of ownership over their workspace, leading to increased productivity and potentially lower absenteeism rates (Bakri et al., 2020). Additionally, UCD can promote innovation by fostering collaboration through thoughtfully designed break areas and informal interaction spaces (Park et al., 2023).

2.2.2 Functionality and Efficiency:

Functionality and efficiency are also crucial design considerations. Space planning should optimize workflow and minimize wasted space, offering a mix of open areas for collaboration, private areas for focused work, and dedicated zones for specific activities (Vischer, 2006). Accessibility for people with disabilities is also essential, adhering to current building codes (International Code Council, 2021).

2.2.3 Promoting Employee Well-being and Flexibility:

Employee well-being directly impacts productivity and company performance. Natural light exposure improves mood, alertness, and overall well-being, so prioritizing large windows and

skylights is key (Veitch & Galasiu, 2020). Investing in ergonomic furniture (adjustable chairs, desks, and monitor placements) reduces musculoskeletal disorders and promotes good posture (Hedge et al., 2018). Maintaining good air quality and comfortable temperatures through air filtration systems and temperature control mechanisms further enhances employee well-being, also raised flooring enables easy access to cabling and power distribution, as well as improved air distribution, capabilities to accommodate individual occupant comfort, should be considered (Azevedo et al., 2018). Finally, noise control through sound-absorbing materials and strategically placed meeting rooms minimizes distractions and facilitates efficient communication (Topçuoğlu & Yılmaz, 2022).

2.2.4 Sustainable Practices:

Sustainability practices are no longer an afterthought but a core design consideration. Utilizing energy-efficient lighting and appliances, water-saving fixtures, and recycled materials during construction benefits the environment and the company's bottom line (Singh et al., 2021). Implementing smart building technologies further optimizes energy consumption for heating, ventilation, and air conditioning (HVAC) systems (Arasteh et al., 2023).

2.2.5 IT infrastructure and technology integration

Successful office design also includes robust IT infrastructure for data needs and technology integration, aesthetics that reflect the company's brand identity, and flexibility to accommodate future growth and evolving needs.

2.3 Empherical Review

2.3.1 Sustainable Architecture in a Built Environment

Sustainable architecture focuses on minimizing the negative impact of buildings on the environment by using resources efficiently and responsibly. It aims to conserve energy and protect

the natural world through thoughtful design (Harindra Syam et al., 2023). To achieve aesthetic appeal in sustainable architecture, it is important to consider how space is perceived visually, how people experience space, and how the design connects with the natural environment (Masridin & Ismail, 2022).

2.3.2 How Architecture Can Contribute to Environmental Sustainability

Since the Industrial Revolution, human actions have fundamentally altered the relationship between ourselves and the natural world. Climate change, caused by the buildup of heat-trapping gases and the subsequent shifts in weather patterns, has become one of humanity's most pressing challenges, buildings are significant contributors to this problem due to their energy consumption and resulting CO2 emissions (Emekci, 2021). To address these threats and achieve sustainable development, a new approach to building design and construction is essential. This approach must consider the limitations of our environment and the needs of contemporary society (Emekci, 2021). It requires the integration of environmental responsibility, climate awareness, and sustainable methods for production and energy use (Harindra Syam et al., 2023). In essence, new building designs must find a way to balance environmental concerns with the needs of modern life.

2.3.3 Sustainable Design and Architecture

Sustainable architecture is a growing field that focuses on designing buildings that minimize negative environmental impact while maximizing human comfort and efficiency (Kumar & Singh, 2024). The goal is to create structures that are in harmony with their surroundings and use resources responsibly. This includes efficient planning, flexible design, waste reduction, and cost-effectiveness (Zhang & Liu, 2023). Sustainable buildings should also protect and enhance natural values (Lee & Chen, 2022). Sustainability in architecture goes beyond physical considerations. It involves preserving the Earth and its resources for future generations. Sustainable architecture combines technological advancements with human needs to create healthy and environmentally

friendly living spaces. In 1994, the International Council of Building (CIB) defined sustainable architecture as the creation of artificial environments that are ecologically sound and resource-efficient (Wang & Li, 2021).

A sustainable building is one that has minimal negative impact on both the built and natural environments. It considers the building itself, its surroundings, and the broader regional and global context. In essence, sustainable architecture is a design approach that responds to local conditions and seeks to create desirable living environments while minimizing ecological damage. It is flexible, adaptable, and resilient to change, and it often incorporates unique local characteristics (Kim & Park, 2020).

2.3.4 Environmental Impacts on Building

Buildings are more than just places to live and work, they are significant contributors to environmental concerns. Understanding their impact is crucial for developing sustainable solutions. The impact of buildings on the environment isn't just about their daily use. The International Energy Agency (IEA) recently reported that buildings account for about 30% of the world's energy consumption, leading to a significant increase in greenhouse gas emissions (IEA, 2023). However the impact starts even before people move into a building. Dixit et al., (2021), emphasizes the importance of embodied carbon, the environmental burden associated with material extraction, transportation, and construction. The choice of building materials significantly influences a building's overall environmental footprint.

Construction activities themselves also have a significant environmental impact. Building and construction sector accounts for approximately 37% of global waste generation (WGBC, 2020). Minimizing waste production and promoting recycling are key strategies for mitigating this impact.

The well-being of the people who occupy buildings is also a crucial environmental consideration. Li et al., (2023), highlights the connection between indoor environmental quality (IEQ) and human

health. Sustainable design principles that prioritize natural ventilation, day lighting, and healthy materials can significantly improve indoor air quality and occupant well-being.

Conclusively, recent literature underlines the multifaceted nature of the environmental impact of buildings. Sustainable architecture offers a path forward, with a focus on energy efficiency, low-carbon materials, water conservation, waste reduction, and occupant health. By adopting these principles and constantly innovating, the building industry can play a vital role in creating a more sustainable future.

Chapter Three

Methodology (Case Study)

3.1 Research Design

This section involves the method adopted to assess the approaches used to source information and the study of the proposed building type base on the literature reviewed.

The study encompasses the exploration of sustainable architectural design element for sustainability in the office building.

The goal of this study is to explore sustainable architectural design element for sustainability in office building. The explorative method is selected for the study because it is proper when the focusing study is to examine the peculiarity of a region. In this study, it becomes clear that it is qualitative in nature; this is due to the difficulty of the subject and the difficulty by which perception is quantified. Thus, it is important to understand what makes an office building a sustainable building before trying to quantify it and its underlying factors.

3.2 Case Study method

A case is a chronologically and geographically isolated event (Johansson, 2003). Veal (2006) notes that a case study may refer to both a research method and an analytical unit since it involves the assessment of unique occurrences (cases) of the investigated topic. Understanding a complicated instance via in-depth description and examination of the instance in connection to its surroundings is the purpose of case studies (the United States General Accounting Office, 1990). This research will apply an empirical method to gather data on a small number of instances that meet some of the

topic's distinguishing qualities. The basis for these conclusions is a mixed qualitative case study analysis and a thorough examination of relevant published and grey literature. In this case study, we analyse social interaction based on its qualities.

3.2.1 Case Studies Selection Criteria

According to Schon (1991), architectural processes depend on a knowledge repertoire of circumstances from direct experience or established precedents. Veal (2006) discovered that picking examples for a case study was comparable to sampling in quantitative research; in both situations, the cases were selected on purpose. In light of these studies, Oluigbo (2010) suggested that identifying instances necessitates possessing certain essential qualities that pertain to the issue under consideration.

I carefully selected the case studies that would serve as the foundation of my thesis.

- As a building with adequate analysis in scope of facilities required to make it operate as an office building.
- As a facility that has employed the concept of sustainable strategies.

3.3 Data Collection

Case studies for theoretical study in Architecture may need the use of common data collecting techniques (Oluigbo, 2010). These techniques include, among others, observation and participant observation, visual survey and checklist, interviews, questionnaire, models and simulation, and scientific measuring devices. For the purpose of this research, visual survey interview, questionnaire and checklists analysis based on the assessment of the level of successful place for social interaction on the selected case studies were adopted.

3.3.1 Instrument of Data Collection

Case study methodology will include the use of many data collection sources to adequately capture the complexity of instances (Yin, 2003; Veal, 2006; Johansson, 2003). Depending on the nature of the investigation at hand, the Visual Survey used here may be depicted in several ways. Photographs of important case studies to evaluate sustainable office building strategies and the extent to which they were really applied. Some case study components were also outlined. Using these illustrations, we can determine how different case studies use space. The variables of design element considered in architecture in connection to kinds of public buildings will also be mentioned in field form. In addition, the existence and kinds of supplementary amenities in the inspected region will be noted.

3.3.2 Procedure for Data Collection

In order to gather this information, we examined office buildings in our backyard and throughout the globe, taking notes on the visual features of the structures and sketching their floor plans. The analysis of the data acquired via visual survey and observation is based on descriptive narratives of what was seen and reported utilising data collecting methods. This description covered primarily three aspects;

a) Site planning and landscaping
b) Building envelope and material types
c) Building form and shapes

3.4 Operationalization of Variables

From the review of literature highlighting methodological approaches to case study researches on office complex and energy efficiencies, it is apparent that irrespective of organizing framework, methodological and philosophical differences the strategies for designing an energy efficiency building generally comprises:

- Building Envelope
- Building Shape/Form
- Site Planning/Landscape
- Sustainable Materials
- Spatial Concept

In line with the strategies for designing sustainable buildings the following variables will be adopted.

a) Site planning and landscaping
b) Building envelope and material types
c) Building Orientation and Form

3.5 Case Study Analysis

3.5.1 Heritage Place, Lagos.

Heritage Place is a world-class development situated in the heart of Lagos's business and retail centre, close to the city's most recognisable attractions. With its cutting-edge design and construction, this eco-friendly building is one of the most innovative buildings in Nigeria.

Heritage Place will eventually be one of Lagos' most conspicuous and readily accessible

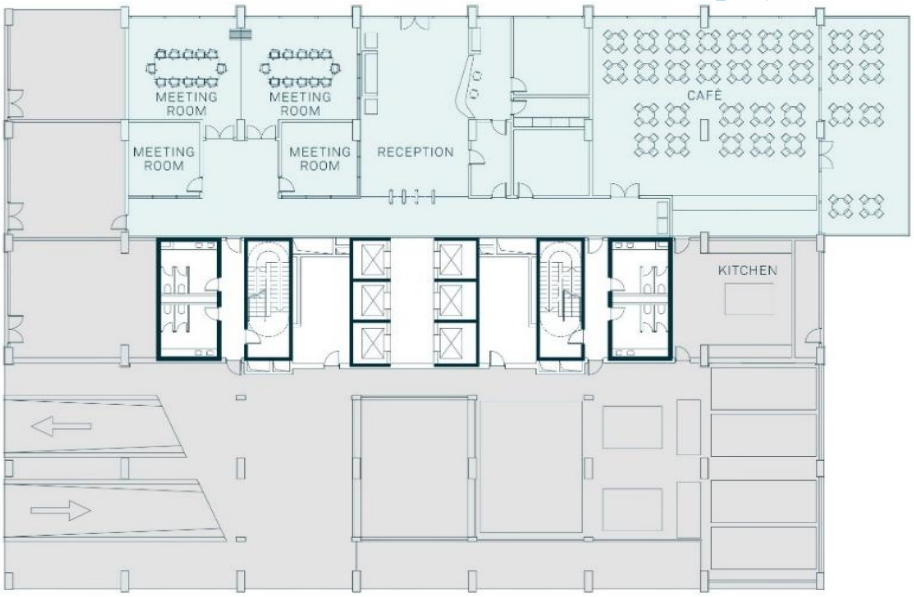
monuments. It is located in the centre of Lagos, near the junction of Laggard Avenue and Kingsway Road.

Plate 3.1: Exterior View of the office Building

Source: (Archdaily, 2020)

3.5.1.1 Site Planning and Landscaping

The building's 1,450 parking spaces and 14,500 square feet of business space make it quite a spectacle. Green features include a 30–40% reduction in energy use, a double-volume welcome, suspended ceilings, elevated floors, a café and coffee shop, a plaza, and customisable floor plate sizes ranging from 450–2,000 square meters. Built to globally recognised Grade 'A' standards, the



broad floor layouts are extremely adaptable to the demands of modern tenants. A new standard for Nigerian architecture on account of its distinctive design, prestigious location, and industry-leading specs. Heritage Place aspires to become synonymous with innovative, eco-friendly business.

Figure 3.1: typical car park

Source: (Archdaily, 2020)

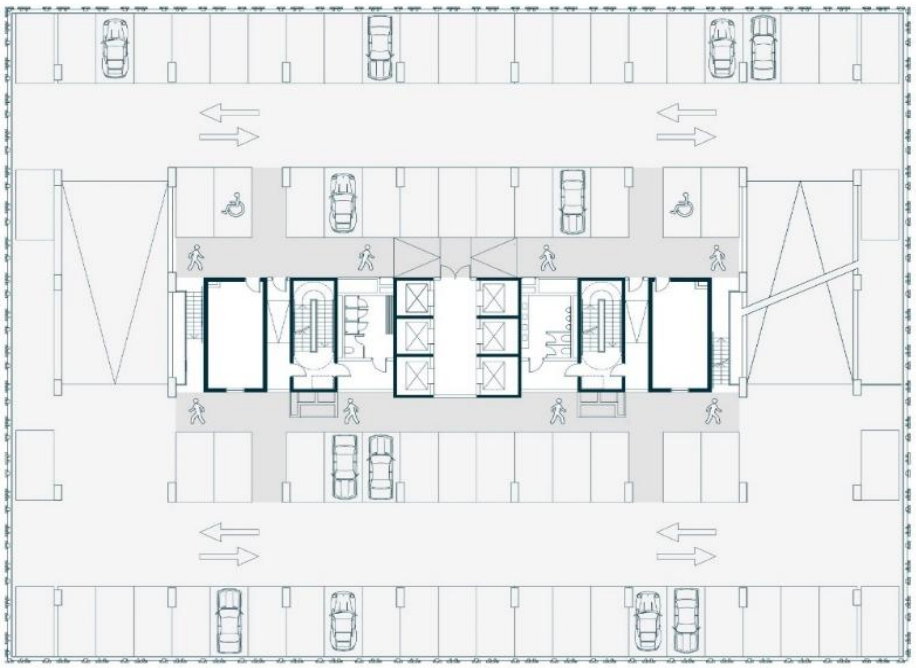


Figure 3.2: Ground floor plan

Source: (Archdaily, 2020)

SPACE PLANS
Typical upper
Total headcount: 247
Offices: 187
Meeting rooms: 60

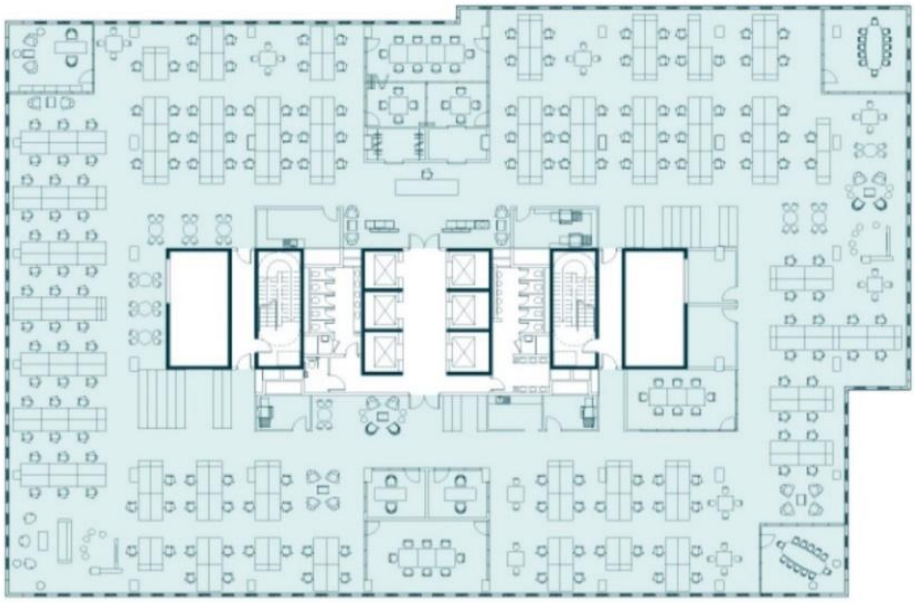


Figure 3.3: Upper floor plan

Source: (Archdaily, 2020)

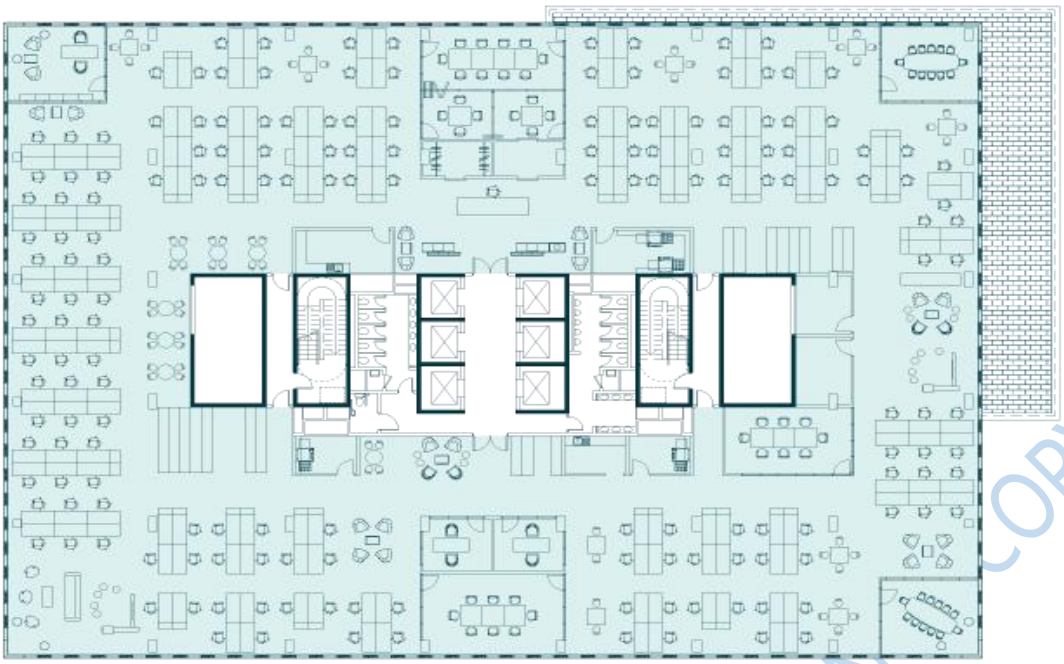


Figure 3.4: Upper floor plan with terrace
Source: (Archdaily, 2020)

3.5.1.2 Building Envelope and Material Types

Heritage Place is the first commercial building in Lagos to be designed and built to LEED standards, and it uses cutting-edge environmental technology to meet and exceed current and future environmental requirements. The external thermal envelope and high-efficiency windows help keep the building cooler in the summer.

Plate 3.2: Exterior view of heritage building
Source: (Archdaily, 2020)

3.5.1.3 Building Orientation and Form

The structure's location and form allow sufficient fresh air and light to penetrate while keeping the inside reasonably cool and shady from the sun. This building prioritizes water and energy efficiency, as well as occupant comfort. Rainwater and condensation are collected and reused for watering gardens and flushing toilets, significantly reducing reliance on fresh water. The design also focuses on occupant well-being. High-efficiency lighting and ample natural light, along with good ventilation, create a comfortable and healthy work environment. Finally, the building incorporates a storm-water management system to handle heavy rainfall and reduce the burden on the city's sewage system.

Figure 3.5: Sectional perspective
Source: (Archdaily, 2020)

Table 2: Checklist Assessment Criteria for Sustainable Architectural design elements.

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope
		Use of external Insulation					●	
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally light with large glazed panel
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of open able Windows			●			The use of open able casement windows,
4	Site and external spaces	Use of interwoven Landscape		●				Not enough landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			
		Use of plants		●				
8	Existing energy source	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting.
		Use of natural gas			●			

Source (Researcher's Field Work)

3.5.2 Nestoil tower, Lagos Tower

The Nestoil Tower is a one-of-a-kind mixed-use development strategically located at the intersection of two major business districts (Akin Adesola Street and Saka Tinubu Street) in Victoria Island Lagos, with a panoramic view of the Eko Atlantic City and the Atlantic Ocean. The development is targeted at dynamic businesses, multi-national industries, financial institutions that require top brand positioning and desire to be at the very heart of their target market. Sitting on a land size of 3900 square metres on 15 floors, the Nestoil Tower is an iconic structure with 10,000 square metres leasable commercial spaces and 23 residential apartments to provide a flexible accommodation to occupiers.

Plate 3.3: bird eye view of Nestoil tower

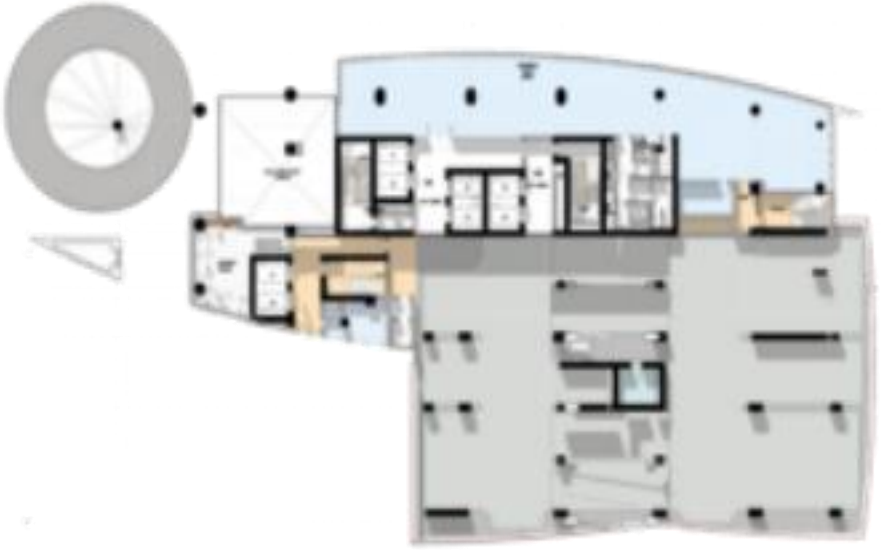
Source: (Hudders Field Property Agency, 2019*)*

3.5.2.1 Site Planning and Landscaping

Gross floor space of the 15-story, mixed-use skyscraper is 32,300 square metres, which includes a generator cage, gatehouse, and technical basement. There include apartments, offices, a café, and a conference room. In addition, a helipad and 230 parking spaces are provided inside the building's multilevel parking garage.

Plate 3.4: bird eye view of Nestoil tower

Source: (Hudders Field Property Agency, 2019)



Ground Floor

- Business Suite of 276 m2
- Restrooms with disabled facilities
- Kitchenette
- Plug And Play Internet Facility
- Parking floor, 24 cars on split levels
- Security Office

Figure 3.6: Ground floor plan of Nestoil tower

Source: (Hudders Field Property Agency, 2019)

1st- 2nd Office Floor

- Business Suite of 213 m2
- Restrooms with disabled facilities
- Kitchenette
- Plug And Play Internet Facility
- Parking floor, 24 cars on split levels
- Central canteen area

Figure 3.7: First- Second floor plan of Nestoil tower

Source: (Hudders Field Property Agency, 2019)

3rd –9th Office Floor

- Open office floor of 541 m2
- Restrooms with disabled facilities
- Kitchenette
- Plug And Play Internet Facility
- Parking floor, 24 cars/floor on split levels

Figure 3.8: Third- ninth floor plan of Nestoil tower

Source: (Hudders Field Property Agency, 2019)

10th Floor

- Flexible office spaces from 15 – 72 m2
- Restrooms with disabled facilities
- Kitchenette
- Plug And Play Internet Facility
- Fully equipped gym

Figure 3.9: Third- ninth floor plan of Nestoil tower

Source: (Hudders Field Property Agency, 2019)

3.5.2.2 Building Orientation and Form

The main architectural idea revolves on the building's sweeping curving front, which is highlighted by horizontal tubular characteristics. The cutting-edge contemporary composition of the structure is completed with a surround of solid white metal panels along the curving curtain walls.

Plate 3.5: Interior view of office space in Nestoil tower

Source: (Hudders Field Property Agency, 2019)

Plate 3.6: Nestoil tower entrance

Source: (Hudders Field Property Agency, 2019)

Plate 3.7: Nestoil tower night rear view

Source: (Hudders Field Property Agency, 2019)

Table 3: Checklist Assessment Criteria for Sustainable Architectural design element

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	The exterior were most covered with double curtain wall.
		Use of external insulation				●		
		Use of smooth surface finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	Interior spaces were light through double curtain wall.
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of open-able windows			●			The use of open-able projected windows
4	Site and external spaces	Use of interwoven landscape			●			Few soft landscaping.
		Use of impervious surfaces			●			
5	Building form	Large building surface area					●	gentle curved surfaces of high performance glazing with horizontal tubular
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Win dow shading	Use of horizontal and vertical shading devices			●			
		Use of interior blinds			●			
		Use of recessed walls			●			
		Use of overhangs			●			
		Use of plants		●				
8	Existing energy source	Use of PV cells			●			
		Use of natural gas			●			

Source (Researcher's Field Work)

3.5.3 Hudson Commons, New-York.

The original Hudson Commons structure, originally built in 1962, Hudson Commons began its life as a warehouse. In 1983, it underwent its first transformation into an office building. Further renovations occurred in 1997, but the most significant change came with the redevelopment/overbuild project completed between 2018 to2019. An additional seventeen storeys were added on top of the black masonry-clad tower, resulting in 700,000 square feet of new office space for the neighbourhood. This repositioned LEED Platinum office skyscraper at the entrance

to the Hudson Yards submarket retains the character of the site and surrounding neighbourhood.

Plate 3.8: Hudson Commons Area view

Source: (Hudson Commons Property specs, 2024)

3.5.3.1 Site Planning and Landscaping

This building has around 350 parking spaces and 14 stories of office space. This building is a paragon of sustainability, with features such as a double-volume lobby, suspended ceilings, raised floors, a café and coffee shop, plaza, and customizable floor plate sizes ranging from 450 to 2,000 square metres. The vast floor layouts, designed to globally recognised Grade 'A' standards, provide

great space, efficiency, and flexibility to contemporary tenants. Its distinctive design, superb location, and cutting-edge facilities set a new standard for the built environment in Nigeria.

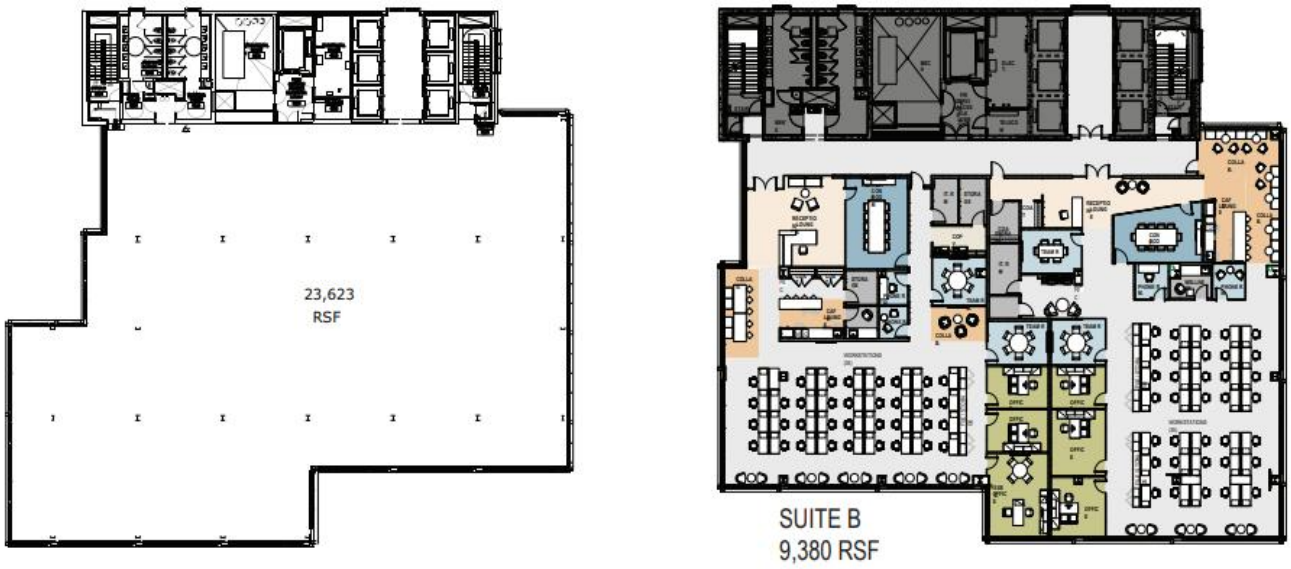


Figure 3.10: 12th – 15th floor plan of Hudson Commons building

Source: (Hudson Commons Property specs, 2024)

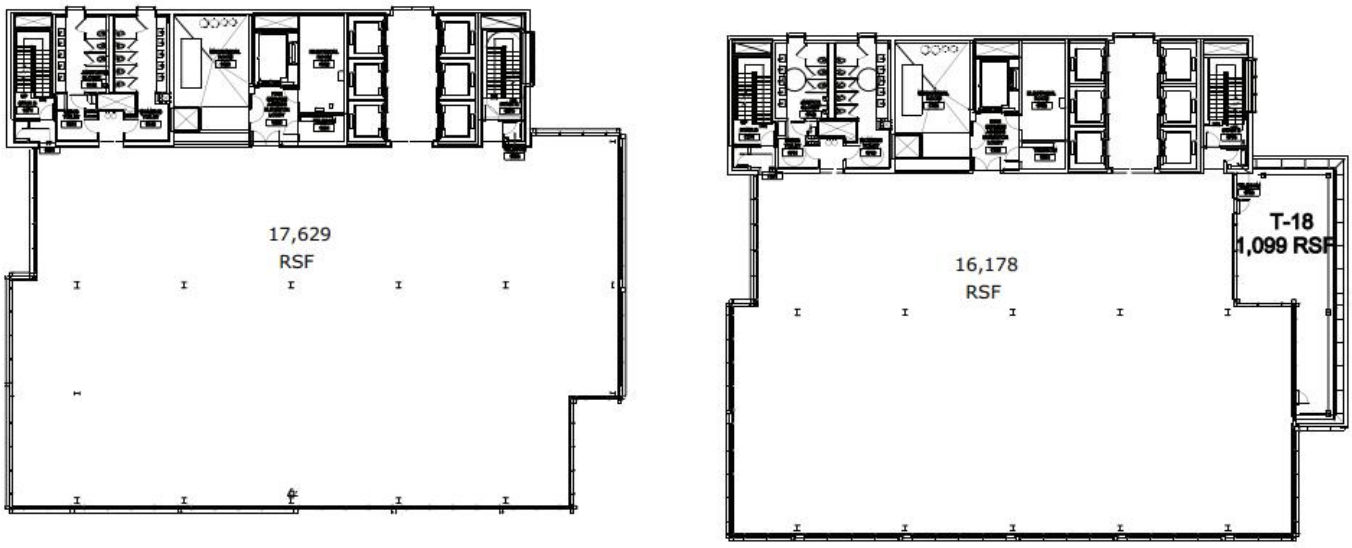


Figure 3.11: 17th – 18th floor plan of Hudson Commons building

Source: (Hudson Commons Property specs, 2024)

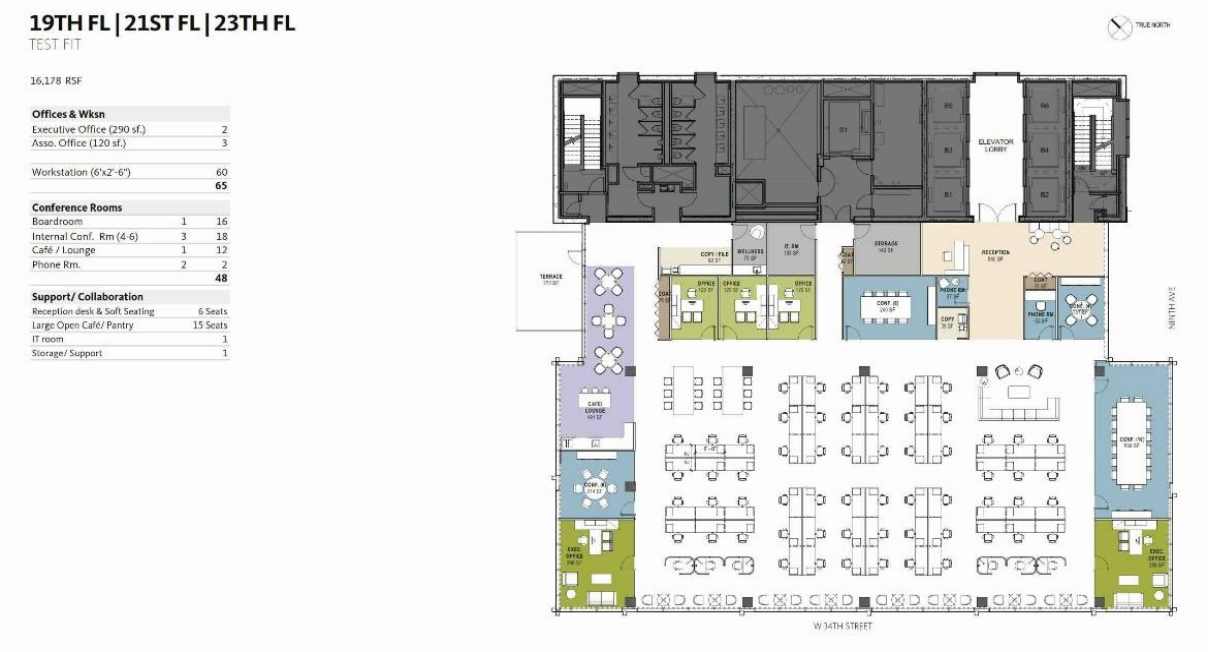


Figure 3.12: 19th – 23th floor plan of Hudson Commons building

Source: (Hudson Commons Property specs, 2024)

3.5.3.2 Building Envelope and Material Types

Hudson commons' exterior has undergone a significant upgrade to prioritize energy efficiency and meet the stringent standards of leed certification and NYC building codes. This focus on sustainability is evident in the building envelope, a critical barrier between the interior and exterior environment. Double-paned windows and a modern curtain wall system work together to create a high-performance thermal barrier, reducing unwanted heat transfer and improving overall building energy efficiency. Furthermore, special attention was paid to the podium level, by enlarging the windows and lowering the sill height, they were able to maximize the amount of natural light penetrating the space. This not only improves the occupant experience by creating a brighter and more welcoming environment but also reduces reliance on artificial lighting, contributing to the building's overall sustainability goals. Importantly, the enlarged windows utilize energy-efficient glazing, ensuring thermal comfort for occupants while maintaining the desired level of

transparency. This combination of design elements showcases hudson commons' commitment to

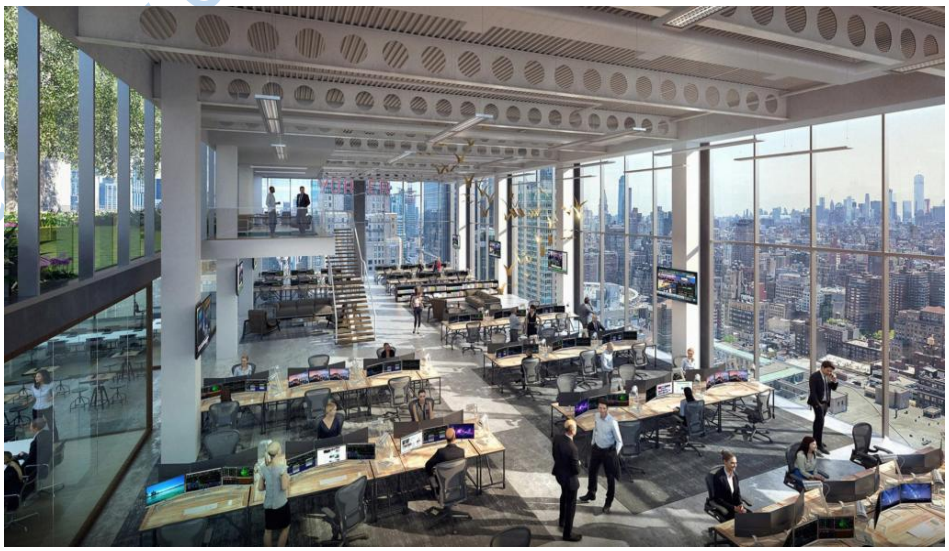
both energy efficiency and occupant well-being.

Plate 3.9: Street views of Hudson Commons building

Source: (Hudson Commons Property specs, 2024)

3.5.3.3 Building Orientation and Form

The way the building is positioned and shaped has a large surface area that allows in a lot of natural light and air, while keeping it cool. This means the building needs less energy for cooling,



heating, and air conditioning.

Plate 3.10: Interior of office space in Hudson Commons building

Source: (Hudson Commons Property specs, 2024)

Table 3: Checklist Assessment Criteria for Sustainable Architectural design element

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	
		Use of external Insulation				●		
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	Interior spaces were light through windows, however this appears inadequate due to use of small windows for large spaces.
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of open-able Windows			●			The use of open-able casement windows, but inadequate ventilation
4	Site and external spaces	Use of interwoven Landscape			●			No soft landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Proper building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		No wall/ sun shading, no tall trees, no plants only overhangs at some areas of the building. Venetian blinds were used on windows. This exposes it to direct solar radiation
		Use of interior blinds				●		
		Use of recessed walls				●		
		Use of overhangs				●		
		Use of plants				●		
8	Existing energy source	Use of PV cells		●				
		Use of natural gas			●			

Source (Researcher's Field Work)

3.5.4 Mesiniaga Tower, Malaysia

Mesiniaga Tower, designed by architect Ken Yeang, stands as a landmark of bioclimatic design in high-rise buildings. The company belongs to Mesiniaga Berhad, located near Subang Parade and Empire Subang. This cutting-edge structure was built between 1990 and 1992. After completion, architect Ken Yeang's extensive investigation of bio-climatic design principles was honoured with the Aga Khan Award for Architecture in 1995. The building is approximately 12,346 square metres of floor space and extension potential span 15 stories.

Plate 3.11: Exterior of Mesiniaga Tower

Source: (David Douglass & Archdaily, 2024)

3.5.4.1 Site Planning and Landscaping

Mesiniaga Tower embraces bioclimatic design principles, seamlessly integrating with its surroundings. The tower rises from a landscaped berm, a green buffer that visually connects the

building to the street level and potentially offers a cooler microclimate around the base. This landscaped base might even contribute to storm water management through rainwater absorption.

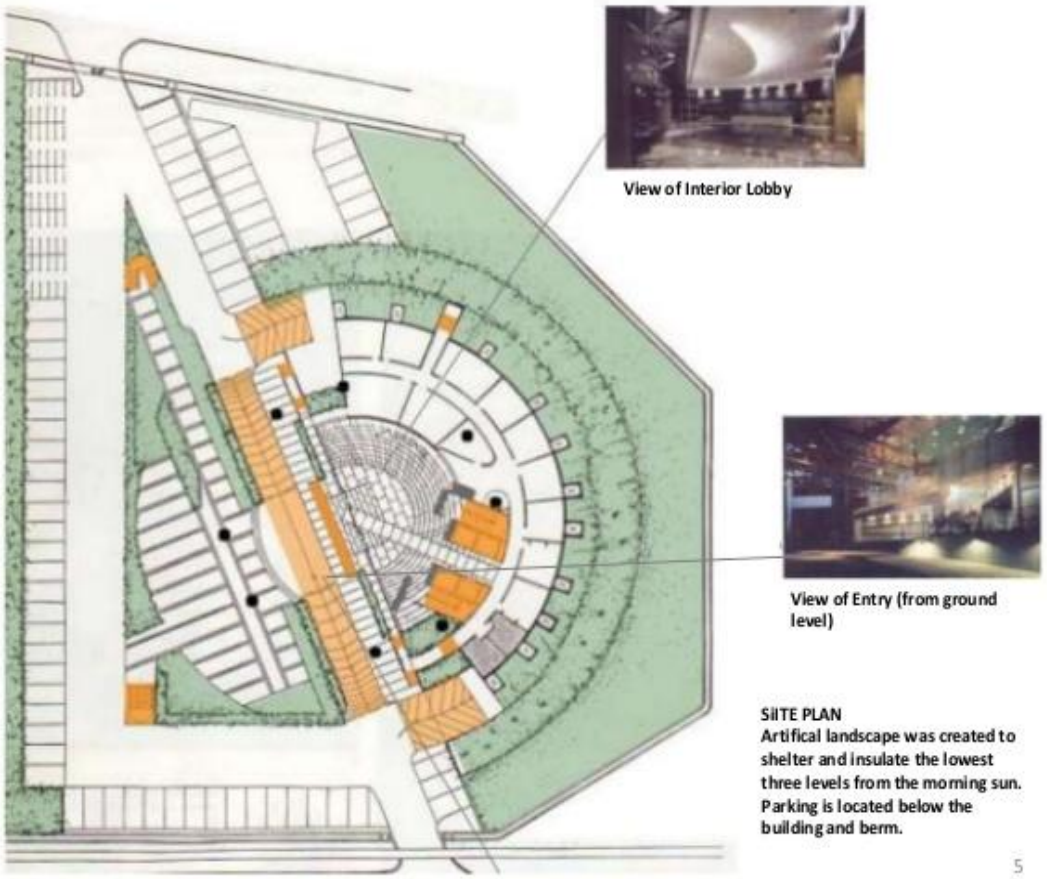


Figure 3.13: Site plan of Mesiniaga Tower

Source: (David Douglass & Archdaily, 2024)

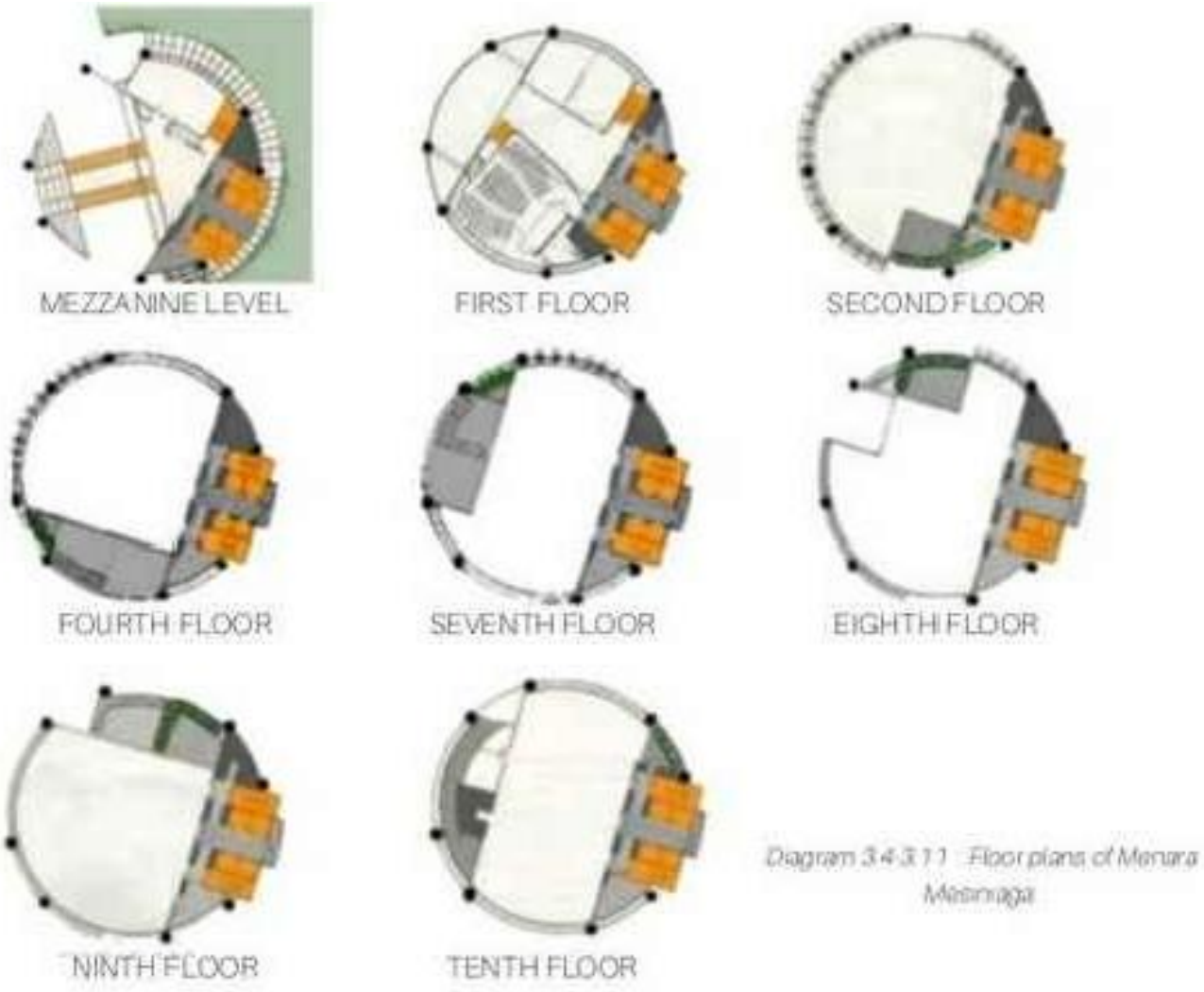


Figure 3.14: Floor plans of Mesiniaga Tower

Source: (David Douglass & Archdaily, 2024)

3.5.4.2 Building Envelope and Material Types

The building's "skin" is where the true innovation lies. Landscaped sky courts, like spiraling green ribbons, weave their way up the cylindrical facade. These aren't merely decorative; they function as natural ventilation channels, drawing cool air into the building and promoting air circulation. This innovative design strategy has the potential to significantly reduce reliance on mechanical ventilation systems. The building envelope likely utilizes light-colored glass to reflect sunlight and minimize heat gain. Strategically placed aluminum louvers or fins on the facade, particularly on the east and west sides, could provide additional shade throughout the day, further reducing solar heat absorption. This thoughtful combination of a landscaped berm, skycourt ventilation, and a light-reflective envelope with potential shading elements showcases Mesiniaga Tower's commitment to bioclimatic design, creating a sustainable and occupant-friendly environment within the urban landscape.

Plate 3.12: Elevations of Mesiniaga Tower

Source: (David Douglass & Archdaily, 2024)

3.5.4.3 Building Orientation and Form

The orientation and shape of the structure allow for plenty of natural light and ventilation while limiting the building's exposure to the sun, cutting down on the amount of energy needed to maintain comfortable inside temperatures and air quality. The use of aluminium louvres on the building's exterior reduces the amount of heat the building absorbs from the sun. The equatorial solar route is represented by the louvres' placement: narrow strip louvres screen the north and south facades, which get the least direct sunlight, while large bands of metal practically cover the full window on the west. A crown of tubular steel is planned for the top of the tower to hold solar panels in the future to help meet the building's increasing electrical demands. The rooftop pool and entertainment area are both kept cool and protected by this crown.

Plate 3.13: views of open terrace and landscaping element of Mesiniaga Tower

Source: (David Douglass & Archdaily, 2024)

Table 4: Checklist Assessment Criteria for Sustainable Architectural design element

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	
		Use of external Insulation				●		
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	Interior spaces were light through windows, however this appears inadequate due to use of small windows for large spaces.
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of open-able Windows			●			The use of open-able casement windows, but inadequate ventilation
4	Site and external spaces	Use of interwoven Landscape			●			Soft landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices					●	No wall shading, no tall trees, no plants only overhangs at some areas of the building. Venetian blinds were used on windows. This exposes it to direct solar radiation
		Use of interior blinds					●	
		Use of recessed walls					●	
		Use of overhangs					●	
		Use of plants					●	
8	Existing energy source	Use of PV cells			●			
		Use of natural gas				●		

Source (Researcher's Field Work)

3.5.5 Kingsway Tower, Ikoyi, Lagos state

Kingsway Tower is a prominent mixed-use building located in Ikoyi, Lagos, Nigeria. Designed by South African architects SAOTA, this 15-story tower is situated on a major thoroughfare, Alfred Rewane Road, which connects the city to the north and south. The building features a basement, two levels of retail space, a parking area, and 12 office floors. Kingsway Tower not only introduces innovative architectural concepts to Lagos, a rapidly growing city and economic hub, but it also sets a new standard for quality and execution. This reflects the increasing global importance of the Nigerian market.

Plate 3.14: Street views of Kingsway Tower

Source*: (*kingsway tower / saota & Archdaily, 2020)

3.5.5.1 Site Planning and Landscaping

The building is located in Ikoyi, a high-end residential area. The area has recently been rezoned to allow for offices and hotels, leading to a surge in construction projects. The building has 12 floors

of corporate offices with panoramic views of Lagos. The office spaces cover a total area of 14,827 square meters. Two floors are occupied by high-end retail stores. The basement parking can accommodate 343 vehicles. The building's modern design, prime location, and advanced features set a new standard for buildings in Nigeria. The office spaces are spacious, efficient, and flexible, meeting the needs of today's businesses.

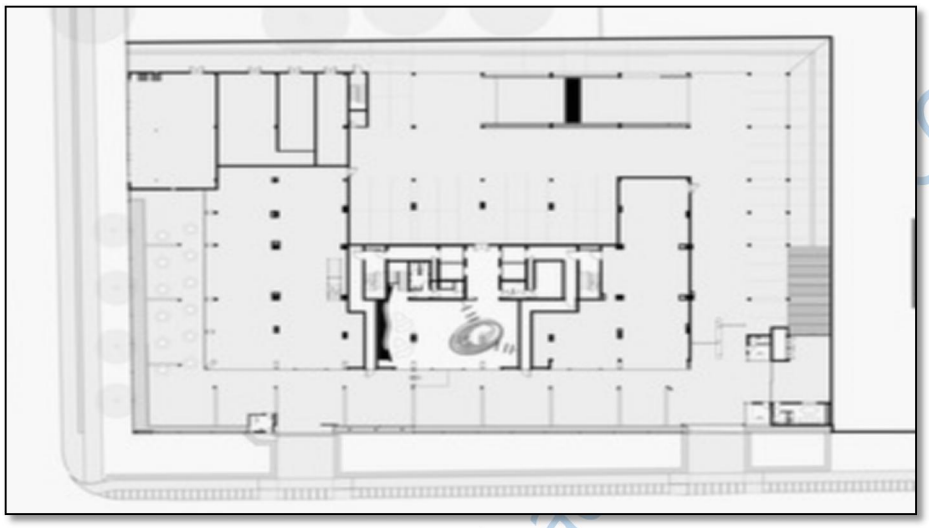


Figure 3.15: Ground floor plan of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

Figure 3.16: First floor plan of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

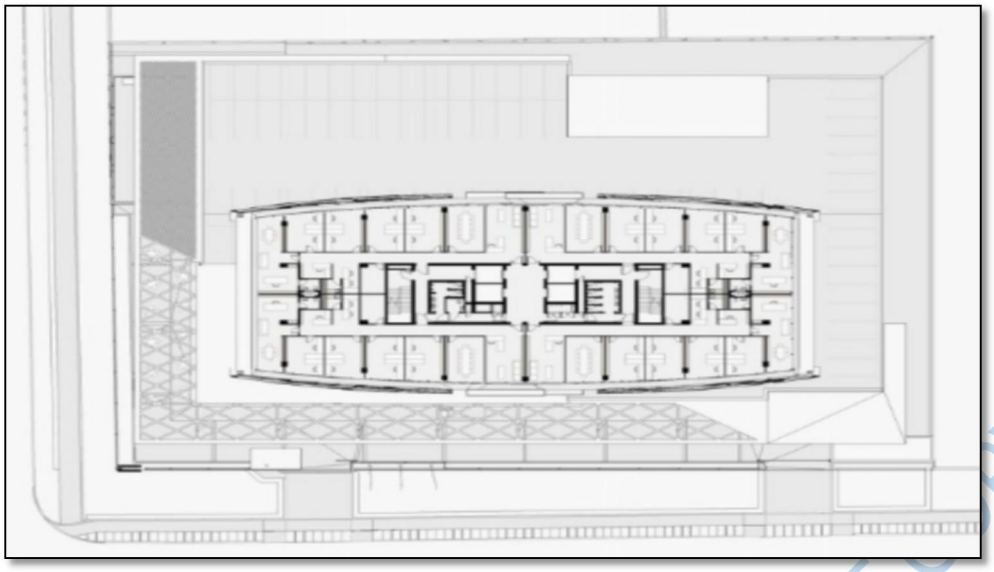


Figure 3.17: Seventh floor plan of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

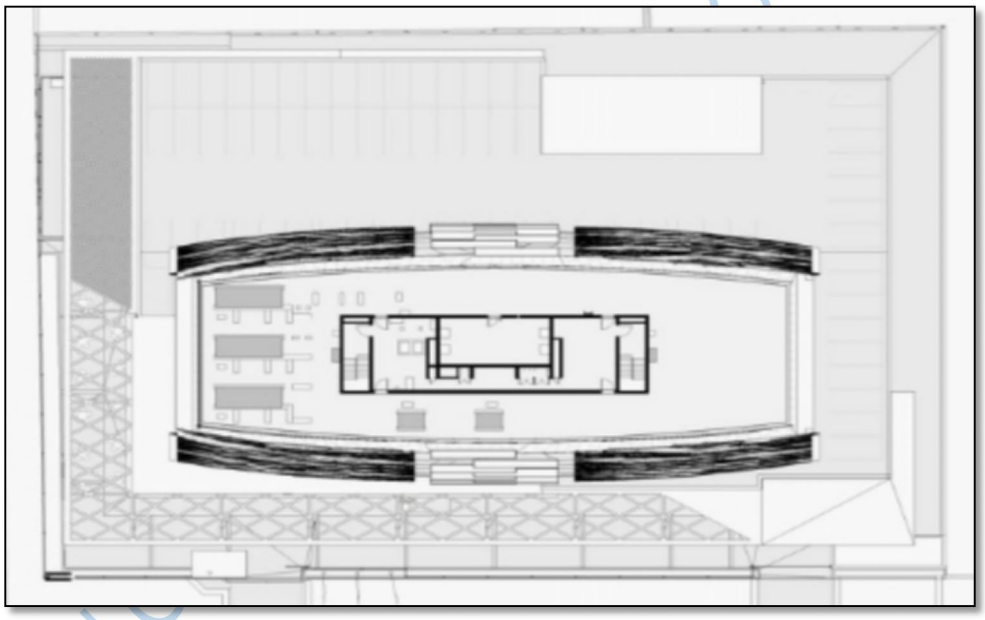


Figure 3.18: Roof plan of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

3.5.5.1 Building Envelope and Material Types

The building's exterior is covered with perforated aluminum screens, which are located at the edge of the building's structure. These screens help to reduce the amount of sunlight that enters the building, improving its energy efficiency. They also allow for easy cleaning and maintenance.

Inside, the lobby features a diagonal grid pattern that matches the shape of the entrance canopy. The architect designed the building with curved glass walls and fixed sunscreens on the outside. The windows are double-glazed to reduce heat loss, and the high ceiling helps to keep the building cool. The use of natural wood panels and Italian flooring adds to the building's elegant style, making it one of Nigeria's most impressive structures.

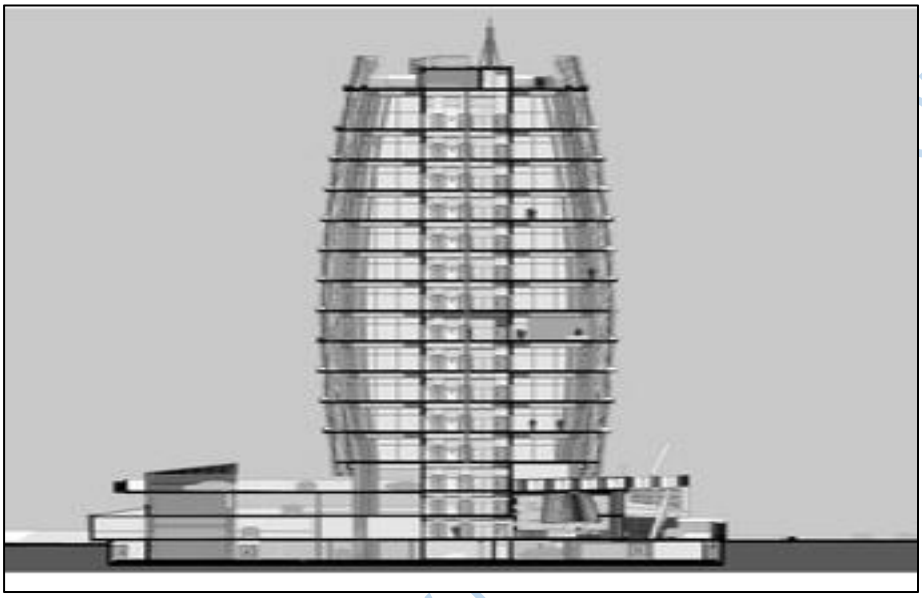


Figure 3.19: Section B-B of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

Figure 3.20: Section A-A of Kingsway Tower

Source: (kingsway tower / saota & Archdaily, 2020)

3.5.5.3 Building Orientation and Form

The building is not only functional but also visually stunning. The architect took Nigeria's tropical climate into account by designing the building to face north-south, preventing direct sunlight from entering at any time of day. The design also includes vertical plants and shading screens to keep the building cool. The impressive entrance features a curved podium slab that extends over the sidewalk, creating a shaded and inviting lobby that is particularly appealing on hot days.

Figure 3.21: Approach view of Kingsway Tower

Source: (*kingsway tower / saota* & Archdaily, 2020)

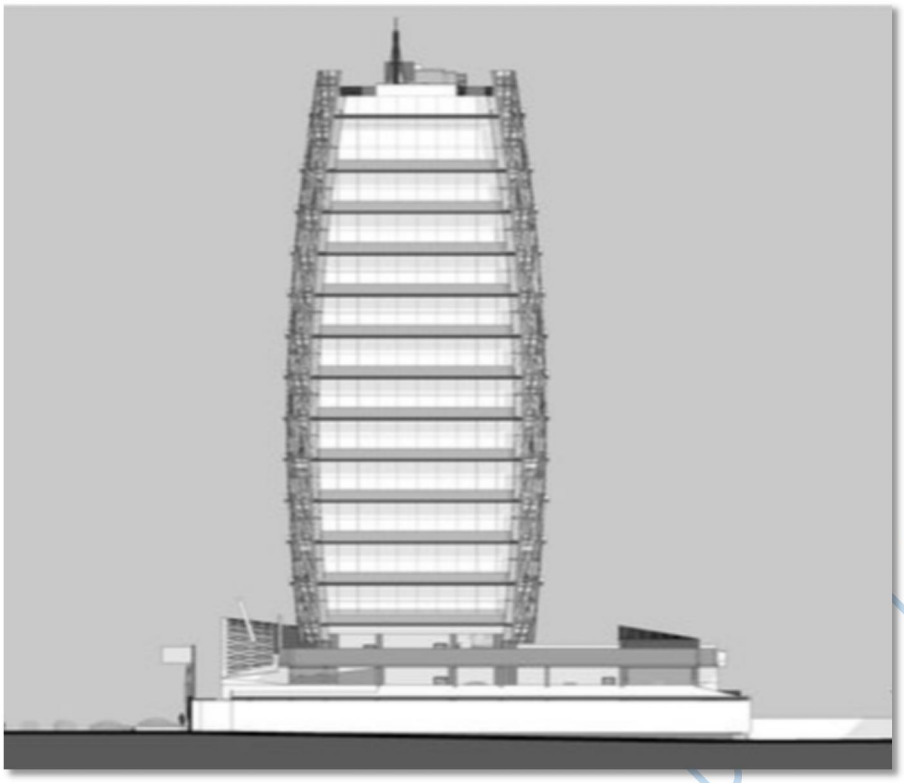


Figure 3.22: Right -side view of Kingsway Tower

Source: (*kingsway tower / saota* & Archdaily, 2020)

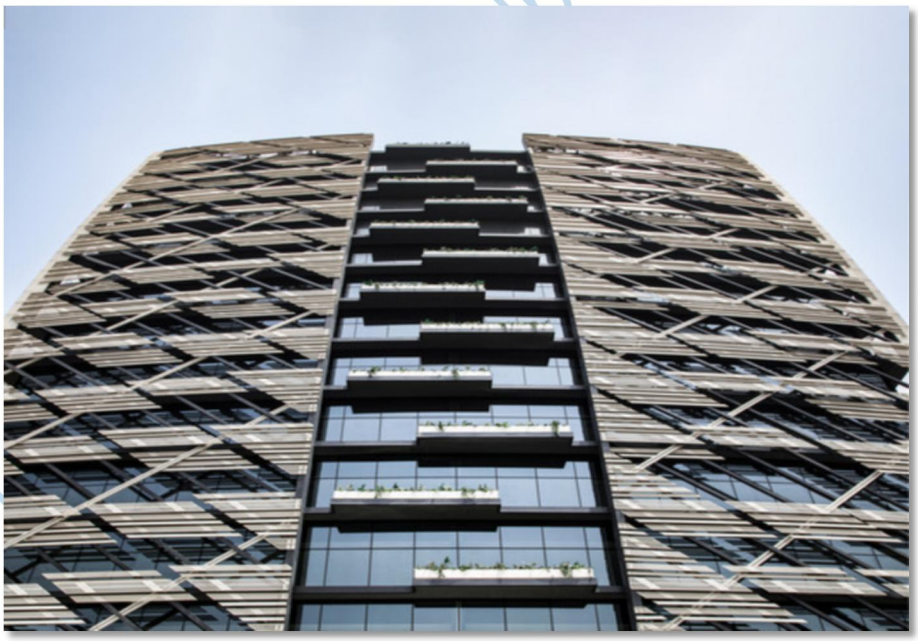


Plate 3.15: Folded, perforated aluminum wall shading of Kingsway Tower

Source: (*kingsway tower / saota* & Archdaily, 2020).

Table 5: Checklist Assessment Criteria for Sustainable Architectural design element

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	
		Use of external Insulation				●		
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	Interior spaces well lightened through windows.
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of open-able Windows				●		The use of openable casement windows, but inadequate ventilation
4	Site and external spaces	Use of interwoven Landscape		●				Inadequate Soft landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices					●	No tall trees, plants only on overhangs and at some areas of the building. Folded, perforated aluminum wall screens shading, were used on curtain walls.
		Use of interior blinds					●	
		Use of recessed walls	●					
		Use of overhangs					●	
		Use of plants			●			
8	Existing energy source	Use of PV cells		●				
		Use of natural gas				●		

Source (Researcher's Field Work)

Chapter Four

Site Analysis and Design Synthesis

4.1. Study Area

This section discusses the preliminary design proposal and the design decisions taken to arrive at the proposed high-rise office building design. The solution for the proposed design is based on the space requirements, case studies, site location characteristics and the roles of sustainable architecture in minimizing environmental impact of building to ensure user wellness and sustainability.

4.1.1. Site Location

The site is located in Glover Street, ikoyi, Lagos States. The site is very close to Niger Towers.

Figure 4.1 showing Google earth view of proposed site location.
Source: Google Earth.

Figure 4.2 showing Google earth view of proposed site.
Source: Google Earth

4.1.2 Site Selection Criteria

Site selection for this project is very important, has it greatly affects the functional use of the facility, for the effective site selection, certain criteria were considered in selecting the site;

I. Land use: In Lagos State there is strict compliance with the land use as been designed in the city‘s master plan.

II. Accessibility: The land should be accessible easily by most intended user of the facility through vehicle, pedestrian.

III. Services: The site should have some existing services like water reticulation, and electricity.

IV. Proximity to residential Area.

V. Topography: The topography of the site is expected to have a relatively gentle slope so as to enhance the outdoor activities and to reduce cost of constructing the outdoor pitches.

VI. Expansion Possibilities: The site should be easy to accommodate more outdoor activities as need of the user increases.

4.1.3 Site Analysis

The site has some physical characteristics that needed to be documented for the purpose of proper and effective design and to be able to maximize the full potentials of the site.

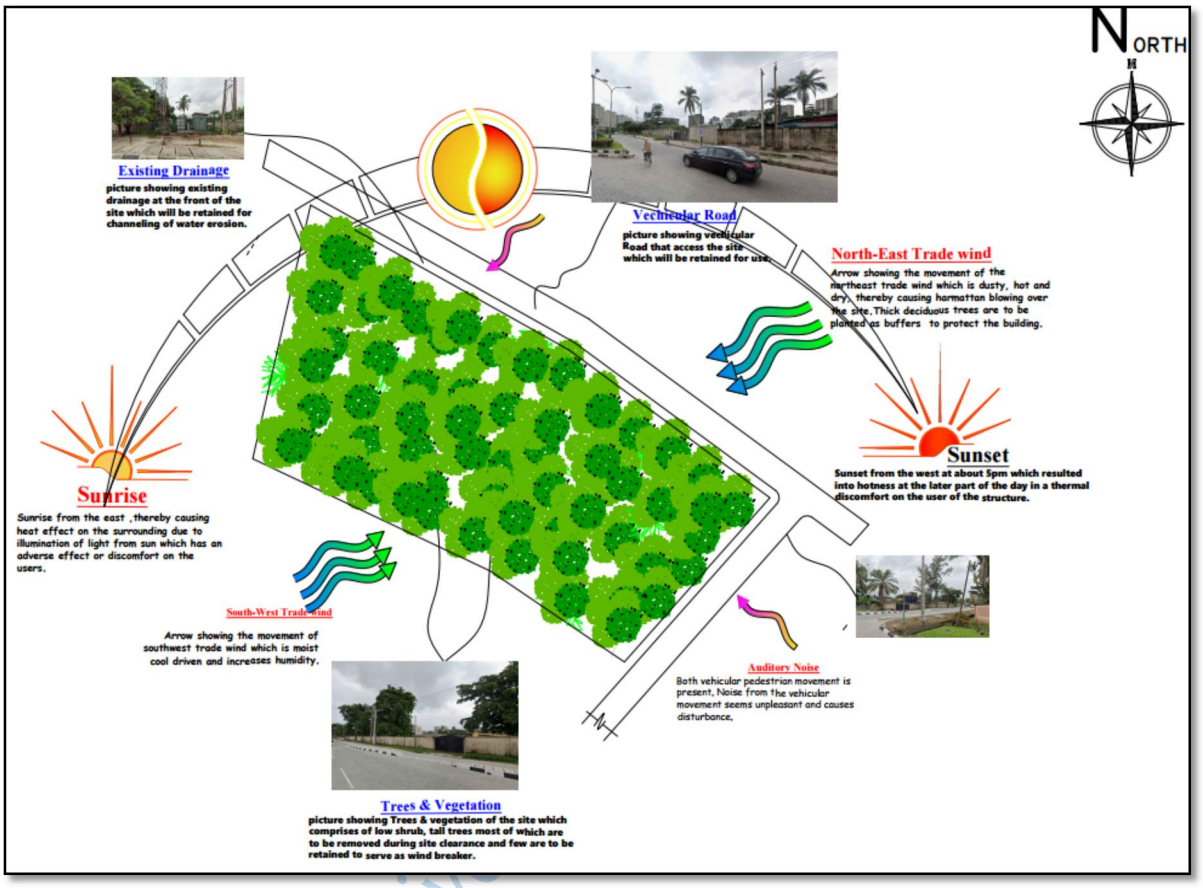


Figure 4.3 showing site analysis of the proposed site.

Source: Author's fieldwork.

Site Accessibility

The site has easy and convenient access for both vehicular Water Way and pedestrian. The site is accessable from the major road that runs through Lagos streets and major roads.

Nearness to Public Utilities

There are basic infrastructures in place e.g., Good Roads, Electricity, Water, Telecommunications, Security etc.

Drainage and Topography

The site has a gentle slope spread evenly throughout. Drainages are also in place for water collection and disposal.

Vegetation

Lagos is located within the tropics, hence it enjoys two distinct season which are the cold and dry seasons. This enables a wide range of vegetation ranging from thick undergrowth, short grasses to evergreen trees in the site's immediate vicinity. Soil is sandy, and it is low bearing capacity.

Soil Condition

It has a Loose Sandy soil with good sub-surface condition for construction and landscaping. It gives satisfactory geological and soil condition with no rock crops.

Wind Direction

The north-east trade wind brings cold, dust, harmattan and these cause discomfort. The south west trade wind brings cold humidity which gives comforting effect to the people. Proper ventilation is considered as part of the building effective arrangement. The building's elevations are positioned such that they receive the maximum amount of air.

4.2 Project Analysis and Design Synthesis

4.2.1 Brief Analysis

There is High demand for office spaces in Lagos State due to the high population and Administrative. Also there is high need for sustainable open office spaces that could reduce cost of running an office. Azwat innovation Ltd an estate developer and agro-allied company is proposing to build a lettable office complex to meet peoples demand. The facility is to be built and each office spaces are for sale for interested companies.

4.2.2. Brief Development

Some spaces were found to be common to all the five case studies examined in this study. These spaces were studied critically to determine the standard required, the number of units per people, their capacity and exact function they perform in an Office design. These spaces are;

- Indoor parking
- Outdoor parking
- Convenience
- Reception
- Waiting Area
- Mechanical Room
- Electrical Room
- Circulation Area
- Restaurant and bar
- Offices
- Outdoor Sitting Area
- Service circulation
- Security post
- Maintenance, electrical and IT department

4.2.3. Design Consideration

4.2.3.1 Site planning and landscaping

The site planning was carefully planned to accommodate the outdoor activities in relation to the indoor facilities for easier use of both facilities simultaneously, vehicular movement and pedestrian movement were clearly separated . Longer Side of the building was positioned to Face

North -South Direction to minimize solar gain into the Building. Enough greens are also introduced to cool and also provide fresh air For the Office building.

4.2.3.2 Spatial Organization

Most of the spaces were allocated based on standards for the offices and the anthropometry of the human being in relation to the activity within the spaces.

4.2.3.3 Sustainable Design Strategies

Sustainable Design strategies are used in the design of the office complex to a large extent.

4.2.3.3.1 Passive Design Elements

The office building will utilize photovoltaic cells to harness sunlight and generate alternative and renewable energy. Solar panels will also be integrated directly into the building's design and construction, serving as both an energy-generating system and a structural element.

4.2.3.3.2 Rainwater / storm water collections and recycling

Rainwater, storm water collection and recycling systems will be incorporated to ensure sustainable water management and resource conservation and avoid flooding.

4.2.3.3.3 Green spaces and walls

Green spaces/ areas will be provided for ecological benefits such as carbon sequestration, storm water management, and biodiversity conservation.

4.2.3.3.4 Sun shading element

Sun shading elements will be provided to control the amount of sunlight that enters the building which improve comfort and better lighting quality.

4.2.3.4 Landscape

The site's natural features will incorporate both soft and hard landscaping to provide a serene and enjoyable atmosphere for the building occupants. The layout has been carefully designed to allow easy access to both indoor and outdoor amenities for simultaneous use.

4.2.3.5 Circulation

The office building will give room for the relation of spaces, hence, corridors, passage way and road are recommended as important part of the whole design structure. More so, horizontal and vertical movement of people is considered as integral part of the design therefore stairs and lifts will be provided in linking floors.

4.2.3.6 Scalability and Flexibility

Flexible floor plans and modular spatial designs which can help with scalability allowing for future expansion and modifications to accommodate changing needs.

4.2.3.7 Accessibility

The building will be easily accessible by all users, this means the entrance to the site will be well defined for ingress and egress from the building.

4.2.3.8 Security and Safety

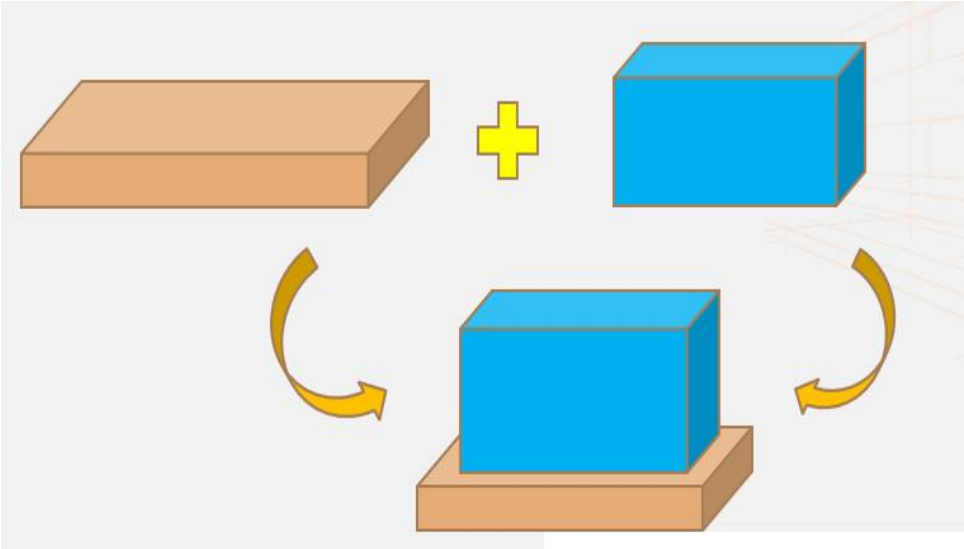
With the influx of vehicular traffic (Ingress and Egress). The site will accommodate high level of parking space and as such, gate item guards and external monitoring will cater for security of vehicle and the likes.

4.2.3.9 Lightning and Ventilation

Artificial and natural lighting within the building will be considered, emphasis will be laid on the use of short corridors and lobby, which will however help to check dark and blank spaces within the building.

4.2.4 Conceptual Development

The concept in architecture refers to the fundamental guiding principle that shapes the design of a structure. It involves combining various elements into a coherent whole. In the case of this office building, the aim was to bring people closer to nature by using natural materials and incorporating natural forms into both the interior and exterior of the building. The concept is to derive a functional passive building that is smart, efficient and sustainable. This will be addressed by adopting a form evolving from horizontal and vertical "Rectangular shape"



4.2.5 Space Allocation / Schedule of Accommodation

Space name	Space size	Space size (area)
Offices spaces		
Reception		
Indoor car parks		
Restaurant and bar		
Circulation area		
Outdoor sitting area		
Game arcade		

conveniences		

4.2.6 Construction Methods and materials

The method of construction to be adopted is the frame framing system for the civil work, most other component should be fabricated on site and placed in the right position. The steel work will be prefabricated and placed in position, while the aluminum works will be done by tower aluminum Nigeria and brought to site completed with proper specification. Due to the nature of the site soil, pile Foundation with deep pile columns will be used to support the building. All wiring and piping should be by conduit and the water supply pipes should be ppr pipes with less joints and thus reducing leakages.

The external work will be properly completed, with trees planted and well-guarded for it to nurture, walk ways will be put in place with concrete paving stone.

The material for construction will be predominantly concrete, steel, timber and glass will be used in some areas.

Reinforced Concrete

Concrete, especially when reinforced with steel, is incredibly strong, making it an ideal material for structural elements. Its flexibility also makes it well-suited for curved or slanted walls.

Steel

Steel is a very strong and flexible material that can withstand a lot of stress without breaking. It's also durable if it's protected from rust. Because steel is so strong, you can use smaller pieces, which means the foundation doesn't need to be as big or heavy.

4.2.7 Building Services

4.2.7.1 Water supply

There will be provision for ground water tank and overhead water tank for the purpose of storage. Duct are located close to the wet areas of the building. The ducts are wide enough to be accessible from the back for easy maintenance.

4.2.7.2 Power supply

Power shall be tapped from the Power Holding Company of Nigeria (PHCN)'s national grid. However, the design shall also cater for its own power needs. There is provision for building integrated photovoltaic panel for alternative power source. Transformer will also be installed on the site because of the amount of power needed by the facility.

4.2.7.3 Refuse disposal

The building has a chute for refuse disposal from each floor, this is an enclosed place were the refuse will be thrown from each floor and collected on the ground floor to avoid littering of all the space. From here it's going to be taking to site waste disposal prior to when the disposal agency will come for the final disposal

4.2.7.4 Waste water and sewage disposal

Waste water from water closets shall be drain through the central sewer line to the sewage treatment plant for treatment and subsequently disposed environmental board.

4.2.7.5 Firefighting system

Fire hydrants for easy water collection by fire fighters, fire extinguisher should be strategically located on the corridors, smoke detectors water sprinklers should be provided in each space and corridors,

Chapter Five

Conclusion

5.1 Project Appraisal

The research work is built on the subject of sustainable architecture in office Building, the problem definition being that sustainable architectural design elements can offer a better methodology towards achieving a sustainable building. The argument draws its background to the study of Office Complex within and outside Nigeria. This research investigates the roles and application of sustainable architectural design elements in achieving environmentally responsible office buildings. Certain key Strategies such as Site planning and landscaping, Building envelope and material types, Building Orientation, Form and ventilation among others were highlighted and discussed in the research. It tackles the challenge of minimizing the environmental impact of office spaces through a comprehensive study of office complexes across various regions. A thorough review of relevant literature on sustainable architecture establishes a strong foundation for integrating these design elements. The research employs a multifaceted approach, including: analyzing case studies to understand the practical implementation of sustainable strategies in real-

world settings; conducting user surveys with occupants and maintenance staff to gather valuable insights on user needs and building performance; and utilizing findings from the literature review, surveys, and five case studies to inform the design and planning concepts for a proposed sustainable office building.

5.2 Conclusion

This research project demonstrates the effectiveness of sustainable architectural design elements in achieving environmentally responsible office buildings. Sustainable architecture presents a compelling solution for mitigating the environmental impact of the built environment by integrating key sustainable strategies like landscaping, energy efficiency, water conservation, and renewable energy. By prioritizing and addressing the pressing need to minimize the environmental impact of the built environment throughout a building's life cycle, we can contribute and create a more sustainable future and can conserve resources, improve public health.

5.3 Recommendation

From the Study conducted, the major findings suggests that with a comprehensive sustainable design practice and implementation by the architects and subsequent problem solving approach from the drawing board will provide a better recourse to address the issue of sustainability and how these problems can be avoided in the future. Therefore the following recommendations should be applied;

i. The Architects and designers should be enlightened on the importance and complexity of Buildings and sensitivity to sustainability at large.
ii. Adequate landscaping, energy efficiency, water conservation, and renewable energy should be employed to enhance sustainability.
iii. The Architects and other Building professionals should be mandated to apply sustainable design practice and strategies during design and Construction.

References

Adiba, X., (2022). The importance of environmental sustainability in construction. *doi: 10.1016/b978-0-323-85698-0.00014-9*

Akan, A. E., Oti, S. H., & Onundi, B. Y. (2022). A Review of Sustainable Urban Drainage Systems (SUDS) for Mitigating Climate Change Impacts. Journal of Sustainable Water Management, 18(2), 145-163.

Al Horr, Y., Arif, M., Katafygiotou, M., & Mazuir, H. (2021). The Impact of Green Building Design on Indoor Environmental Quality (IEQ) and Occupant Wellbeing: A Review. Sustainable Cities and Societies, 70, 102881.

Amita, Rajkumar, Tiwari, H., & Salunkhe, H. H. (2021). Investigating integration of sustainability ideas in design of construction projects. *International Journal of Advance Research and Innovative Ideas in Education.*

Arasteh, D., Mahdavinejad, M., & Pour Rahimian, H. (2023). A review on the application of artificial intelligence for improving building energy efficiency. *Sustainable Energy Technologies and Assessments*, 57, 102422.

Arasteh, D., Rezazadeh Amin, N., & Zolghadr, A. (2021). A Review on the Application of Artificial Intelligence for Improving Building Energy Efficiency. Intelligent Buildings International, 13(4), 321-341.

Azevedo, I. M., Neto, A. L., & Oliveira, J. A. (2018). *Indoor environmental quality and human performance: A review*. International Journal of Environmental Research and Public Health, 15(10), 2294. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5707925/

Bakri, A. M., Ibrahim, N. M., & Mat, N. S. (2020). The impacts of user-centered office design on employee satisfaction and work performance. *Journal of Facilities Management*, 18(4), 382-399.

Commercial Property Classifications & Types of Office Spaces (https://www.ioptimizerealty.com/services/office-space) (2022).

Cyril M. H (2023). Dictionary of Architecture and Construction (3rd Edition). [Book]

Dabija, A.M. (2019). Sustainability in Architectural Design: Smart Systems and Traditional Materials. *doi: 10.1088/1757-899X/603/3/032081*

Dixit, M. K., Fernández-Solís, M., Lele, S., & Prakash, A. (2021). Embodied carbon in the construction industry: A review of LCA studies. *Resources, Conservation & Recycling*, 171, 105594.

Dodoo, A., Gustavsson, T., & Skaar, C. (2017). The environmental impact of conventional and modern methods of building construction – A comparative LCA study. *Energy and Buildings*, 140, 326-345. https://www.sciencedirect.com/science/article/pii/B9780128117491000079

Environmental Protection Agency (EPA). (2023, November 22). Construction and Demolition Debris. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials.

Environmental Protection Agency (EPA). (2023, April 13). Indoor Air Quality (IAQ). https://www.epa.gov/air-quality

International Energy Agency (IEA). (2022). Global Status Report for Buildings and Construction. https://www.iea.org/data-and-statistics/charts/global-co2-emissions-from-buildings-including-embodied-emissions-from-new-construction-2022

Emekci, S. (2021). The Role of Sustainable Architecture in an Era of Environmental Challenges. January, 252–268. https://doi.org/10.4018/978-1-7998-8331-9.ch013

Foster, G. (2020). Circular economy strategies for adaptive reuse of cultural heritage buildings to reduce environmental impacts. Resources, Conservation and Recycling, 152(October 2019), 104507. https://doi.org/10.1016/j.resconrec.2019.104507

Ghiat, O., Al-Jabi, N., Antoni, M., & Fazah, S. (2023). Circular Economy in Construction: A Literature Review. Journal of Cleaner Production, 390, 115930.

Harald, N., Røstvik, N., & et al. (2021). Sustainable Architecture—What's Next?. doi: 10.3390/ENCYCLOPEDIA1010025

Harindra Syam, F., Wisdianti, D., & Sajar, S. (2023). Study of Sustainable Architecture Concepts. International Journal of Research and Review, 10(4), 419–424. https://doi.org/10.52403/ijrr.20230450

Hedge, A., Gunnarsson, L.S., & Lindqvist, U.G. (2018). The relationship between office design and employee health and well-being: A literature review. *Work*, 28(1), 119-138. https://doi.org/10.1080/09613218.2019.1710098

Hussein, H. A., Ibrahim, A. H., & Ali, H. I. (2019). User-centered office design for the improvement of employee performance in Malaysia. *International Journal of Technology and Management*, 14(3), 547-562.

Hwang, B., & Augenbroe, G. (2022). Sustainable building for climate change adaptation: A critical review. *Building and Environment*, 228, 109542.

Ilvitskaya, S. V., Lobkov, V. A., & Lobkova, T. V. (2019). Natural materials in sustainable architecture building system. doi: 10.1088/1757-899X/687/5/055030.

International Code Council. (2021). *International building code* (IBC). International Code Council.

International Energy Agency (IEA). (2023). *Global Status Report for Buildings 2023*.

Kim, I., & Park, J. (2020). Sustainable Architecture: A Case Study Analysis. Journal of Architectural Engineering, 26(4), 04020003.

"Kingsway Tower / SAOTA" 26 Sep 2020. ArchDaily. Accessed *10 Nov 2022*. <https://www.archdaily.com/948253/kingsway-tower-saota> ISSN 0719-8884

Kumar, A., & Singh, B. (2024). Sustainable Architecture: A Review of Recent Trends and Developments. Building Research & Information, 52(1), 1-20.

Lenzen, M., & Steen, B. (2024). A Critical Review of Life Cycle Assessment (LCA) of Building Materials. Journal of Industrial Ecology, 18(3), 772-789. doi: 10.1111/jiec.13402

Lee, E., & Chen, F. (2022). The Role of Sustainable Architecture in Achieving Sustainable Development Goals. Sustainable Cities and Society, 75, 103567.

Li, B., Yan, J., Guo, Z., & Deng, S. (2023). A review of occupant-centric indoor environmental quality (IEQ) and thermal comfort in buildings. *Building and Environment*, 232, 109614.

Mahdiraji, H. A., Arzaghi, S., Stauskis, G., & Zavadskas, E. K. (2018). A hybrid fuzzy BWM-COPRAS method for analyzing key factors of sustainable architecture. Sustainability (Switzerland), 10(5), 1–26. https://doi.org/10.3390/su10051626

Martins, I. S., da Silva, P. P., Leal, J. P., & Rocha, F. (2023). Brownfield Redevelopment and Sustainable Urban Regeneration: A Review of Drivers, Challenges, and Practices. Land Use Policy, 122, 106322.

Martek, I.; Hosseini, M.R.; Shrestha, A.; Zavadskas, E.K.; Seaton, S. The Sustainability Narrative in Contemporary Architecture: Falling Short of Building a Sustainable Future. Sustainability 2018, 10, 981.

Masridin, M. H., & Ismail, A. S. (2022). CRITICAL REGIONALISM APPROACH FOR DJAMI MOSQUE DESIGN TOWARDS THE AESTHETICS OF SUSTAINABILITY. Journal of Islamic Architecture, 7(2), 220–232. https://doi.org/10.18860/jia.v7i2.17135.

Moňoková, A., & Vilčeková, S. (2020). Sustainable Construction - Environmental Impacts Assessment of Architectural Elements and Building Services. International Journal of Engineering Research in Africa, doi: 10.4028/WWW.SCIENTIFIC.NET/JERA.47.77

Park, J. H., Kim, J. Y., & Jeon, S. Y. (2023). The impact of activity-based working (ABW) on knowledge sharing and innovation: A multilevel mediation model. *Sustainability*, 15(4), 1422.

Preiser, W. F. E., & Nasar, J. L. (2018). Assessing building performance: History, theory, and methods. John Wiley & Sons.

Qarout, L. (2017). Reducing the Environmental Impacts of Building Materials: Embodied Energy Analysis of a High-Performance Building. *PhD Thesis*, *May*.

Sharma, A., Huisingh, D., Widén, J., & Malmqvist, T. (2022). Life cycle assessment for buildings: A review of impact categories, methods and future directions. *Sustainable Cities and Societies*, 78, 103742.

Singh, V., Maurya, A. K., & Rawat, S. (2021). A review on adoption of green building practices for sustainable development of buildings. *Materials Today: Proceedings*, 47, 1002-1009.

Topçuoğlu, B., & Yılmaz, H. (2022). The effects of noise pollution on human health and sustainable solutions. *Environmental Pollution*, 309, 119922.

Wang, G., & Li, H. (2021). Assessing the Sustainability Performance of Green Buildings: A Review. Energy and Buildings, 238, 111287.

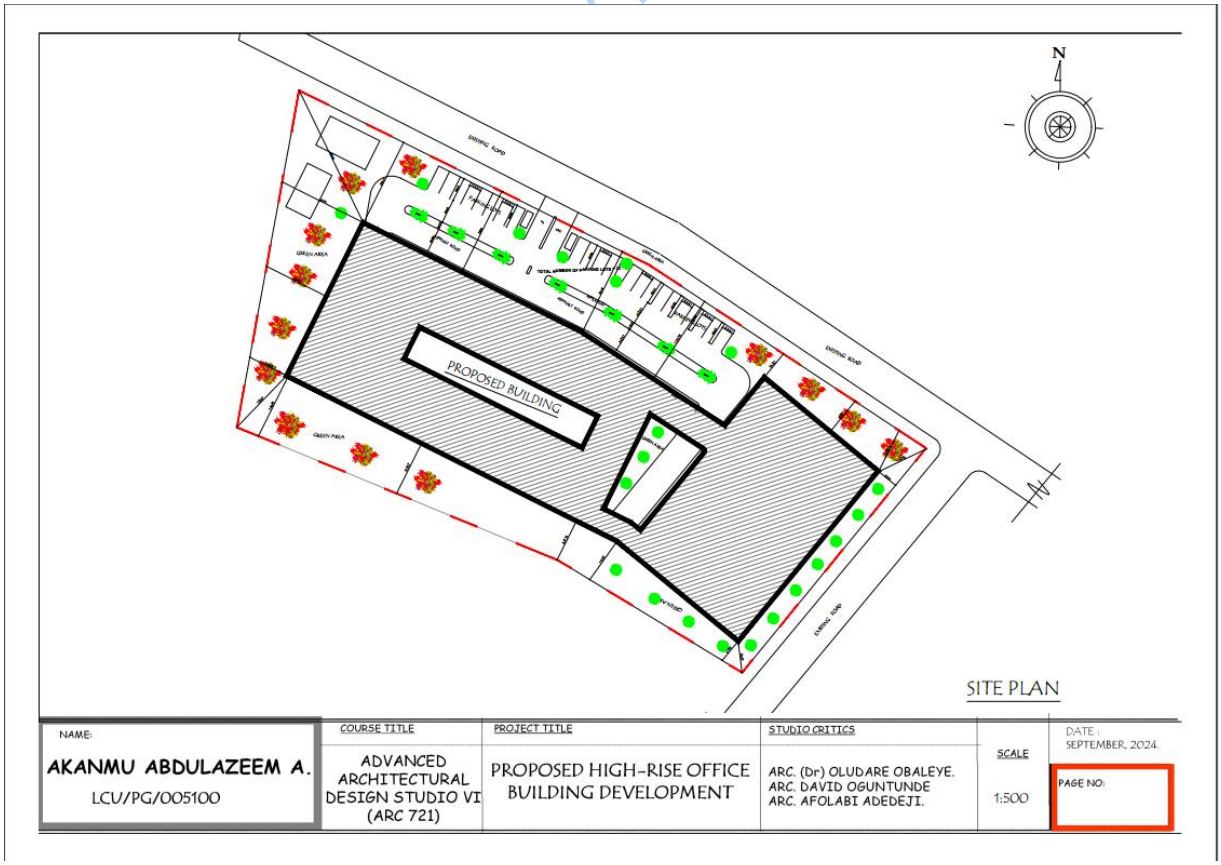
World Green Building Council. (2017). Bringing embodied carbon upfront: A global guide for responsible building.

Xu, T., & Tan, S. (2018). A Design of Sustainable System towards Green Architecture. International journal of engineering and technology, doi: 10.7763/IJET.2017.V9.1000.

Zabihi, H., Habib, F., & Mirsaeedie, L. (2012). Sustainability in Building and Construction : Revising Definitions and Concepts. *International Journal of Emerging Sciences*, *2*(December), 570–578. http://ijes.info/2/4/42542406.pdf.

Zhang, C., & Liu, D. (2023). Sustainable Architecture: A Comprehensive Review. Journal of Cleaner Production, 387, 125872.

Appendix I and II: PRESENTATION AND WORKING DRAWING



SITE LAYOUT

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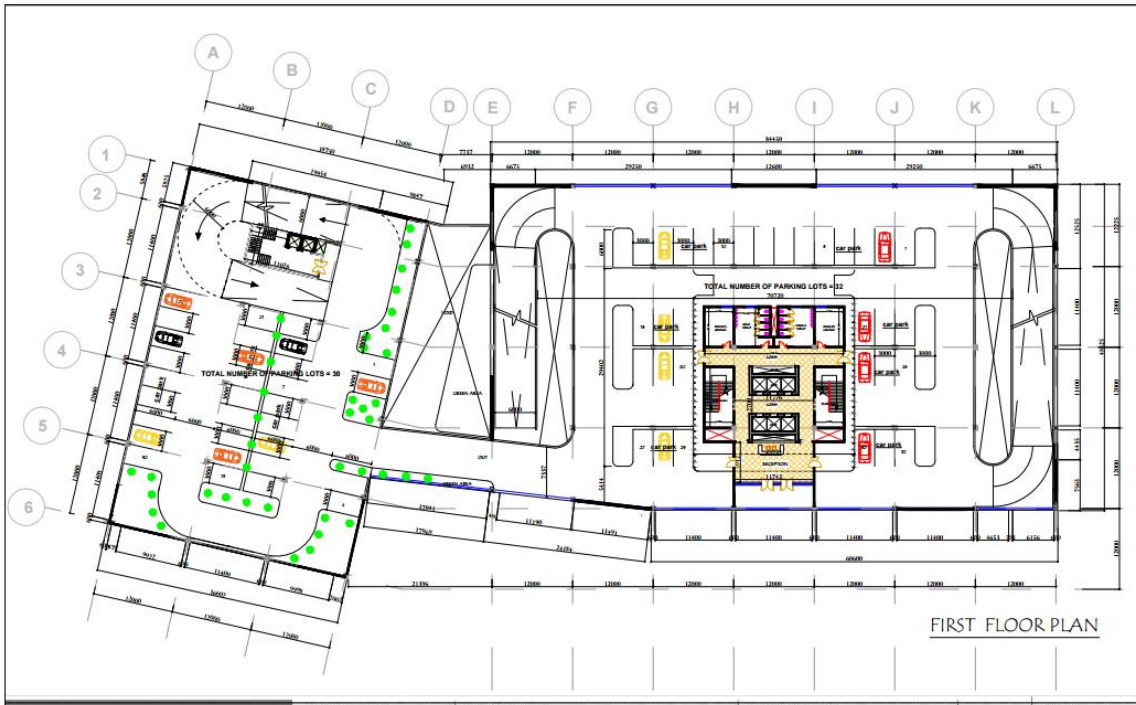
AKANMU ABDULAZEEM A. LCU/PG/005100	ADVANCED ARCHITECTURAL DESIGN STUDIO VI (ARC 721)	PROPOSED HIGH-RISE OFFICE BUILDING DEVELOPMENT	ARC. (Dr) OLUDARE OBALEYE. ARC. DAVID OGUNTUNDE ARC. AFOLABI ADEDEJI.	1:500	SEPTEMBER, 2024. PAGE NO:



FIRST FLOOR PLAN

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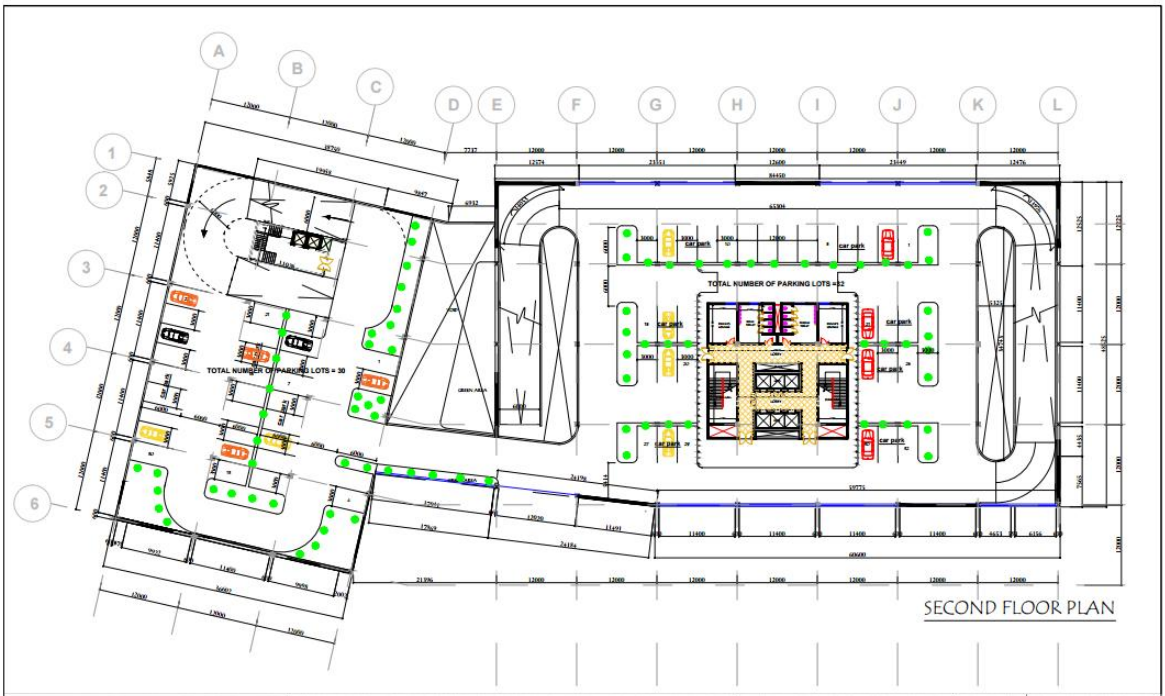

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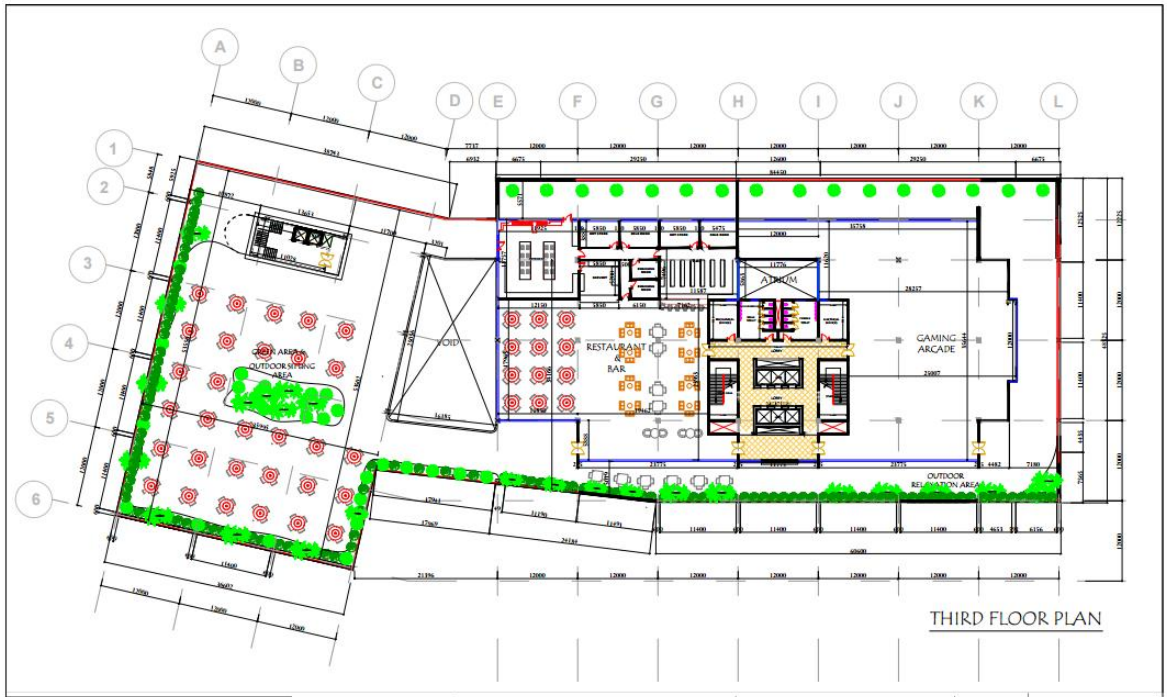

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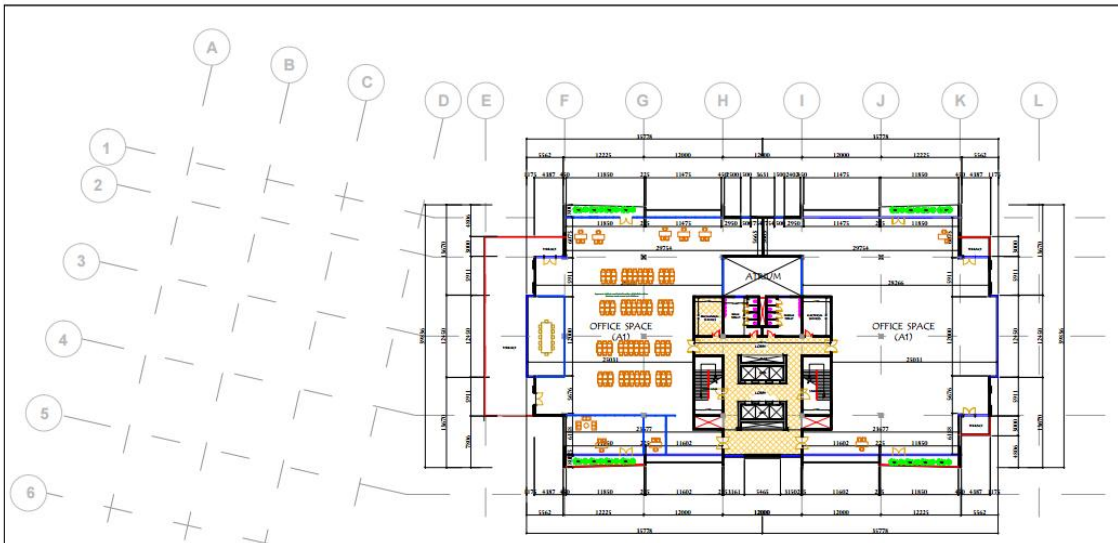

FOURTH FLOOR PLAN

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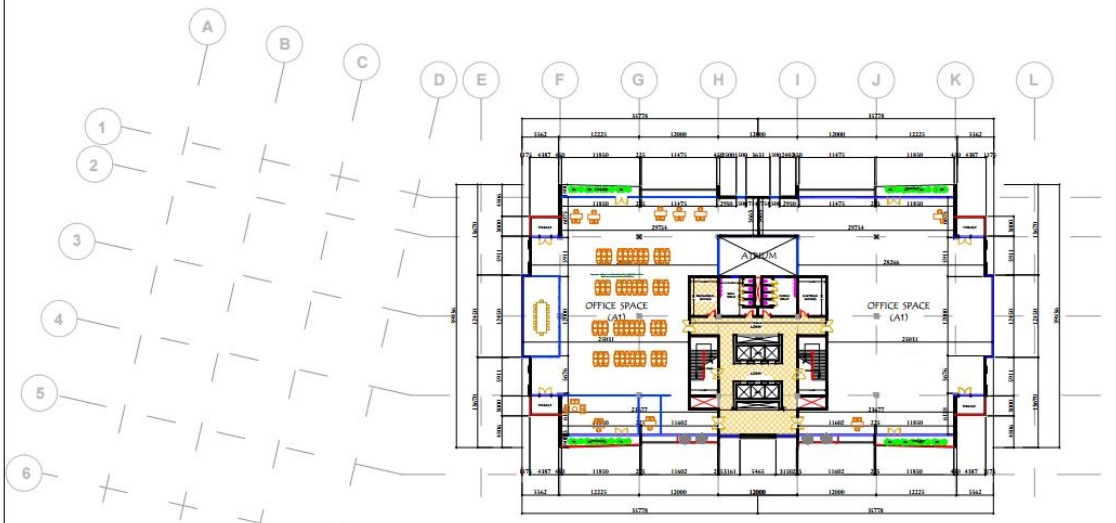
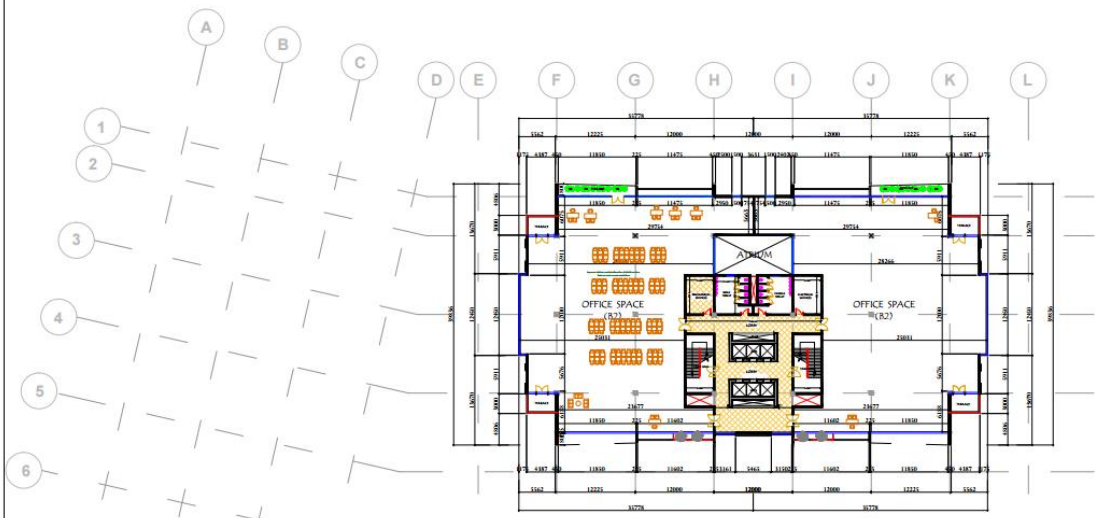


TYPICAL FIFTH - NINETH, FOURTEENTH - SEVENTEENTH FLOOR PLAN

NAME:	COURSE TITLE	PROJECT TITLE	STUDIO CRITICS	SCALE	DATE :
AKANMU ABDULAZEEM A. LCU/PG/005100	ADVANCED ARCHITECTURAL DESIGN STUDIO VI (ARC 721)	PROPOSED HIGH-RISE OFFICE BUILDING DEVELOPMENT	ARC. (Dr) OLUDARE OBALEYE. ARC. DAVID OGUNTUNDE ARC. AFOLABI ADEDEJI.	1:300	SEPTEMBER, 2024. PAGE NO:



TYPICAL TENTH & FIFTEENTH FLOOR PLAN

NAME:	COURSE TITLE	PROJECT TITLE	STUDIO CRITICS	SCALE	DATE :
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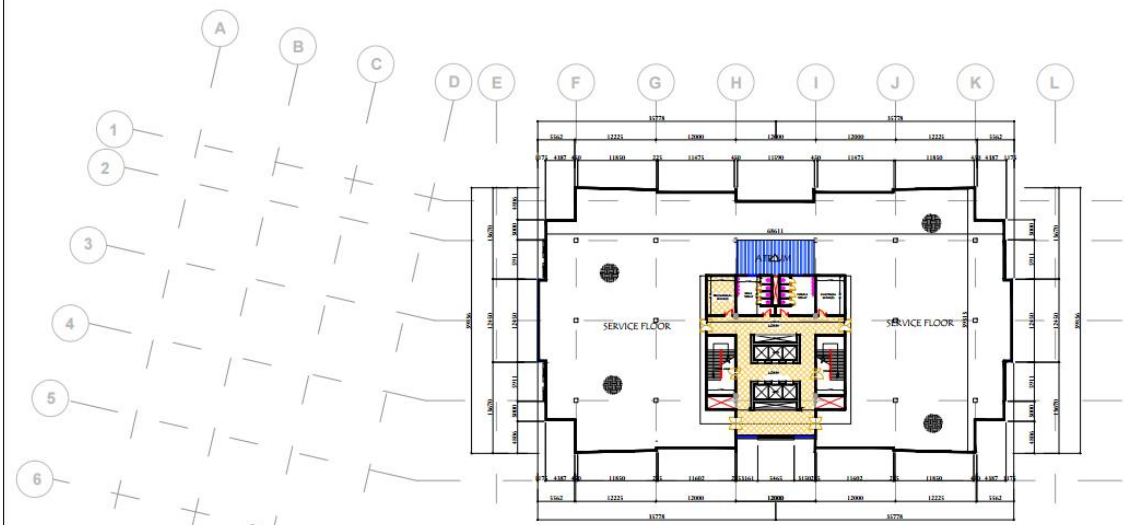

SERVICE FLOOR PLAN

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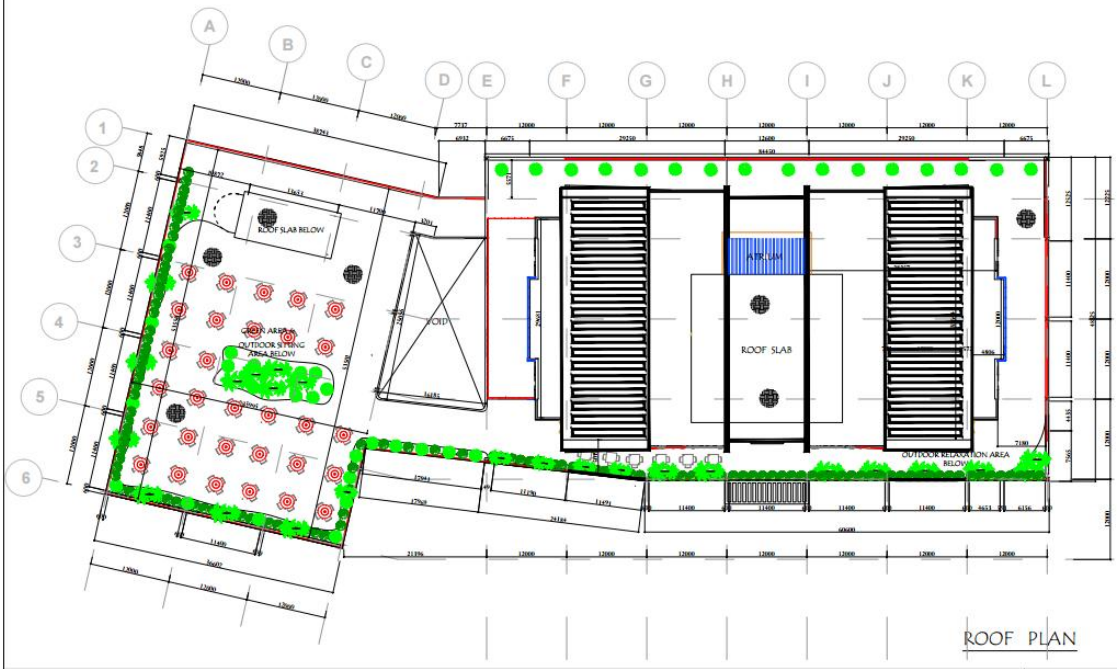

ROOF PLAN

NAME:	COURSE TITLE	PROJECT TITLE	STUDIO CRITICS	SCALE	DATE :
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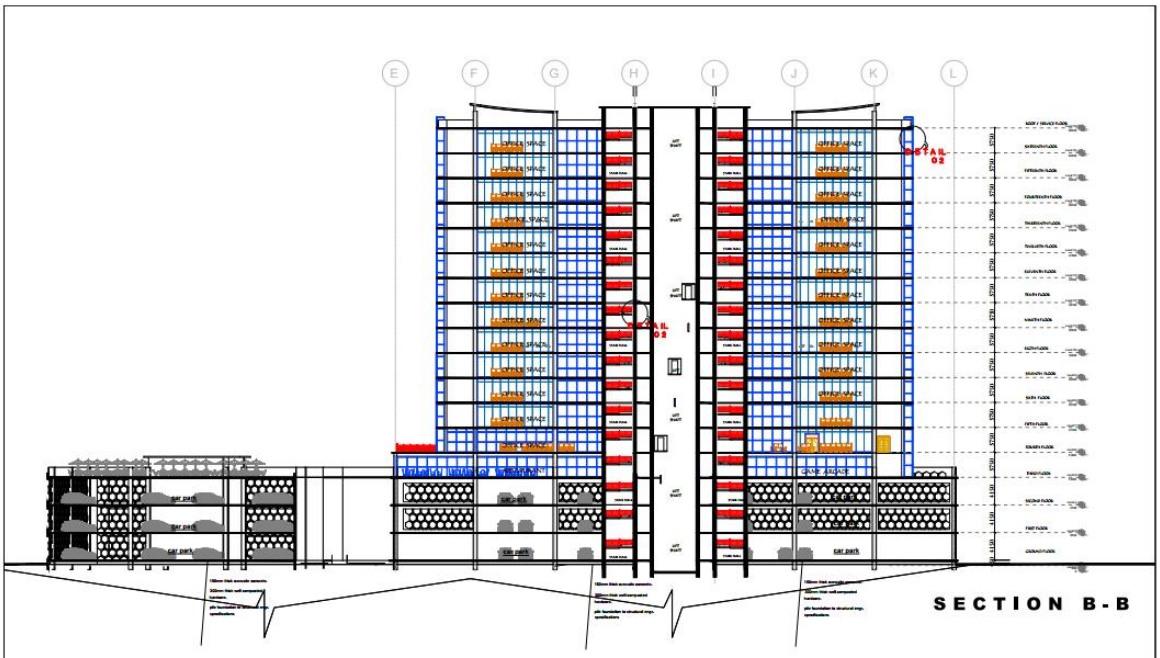
SECTION A-A

NAME:	COURSE TITLE	PROJECT TITLE	STUDIO CRITICS	SCALE	DATE :
AKANMU ABDULAZEEM A. LCU/PG/005100	ADVANCED ARCHITECTURAL DESIGN STUDIO VI (ARC 721)	PROPOSED HIGH-RISE OFFICE BUILDING DEVELOPMENT	ARC. (Dr) OLUDARE OBALEYE. ARC. DAVID OGUNTUNDE ARC. AFOLABI ADEDEJI.	1:300	SEPTEMBER, 2024. PAGE NO:



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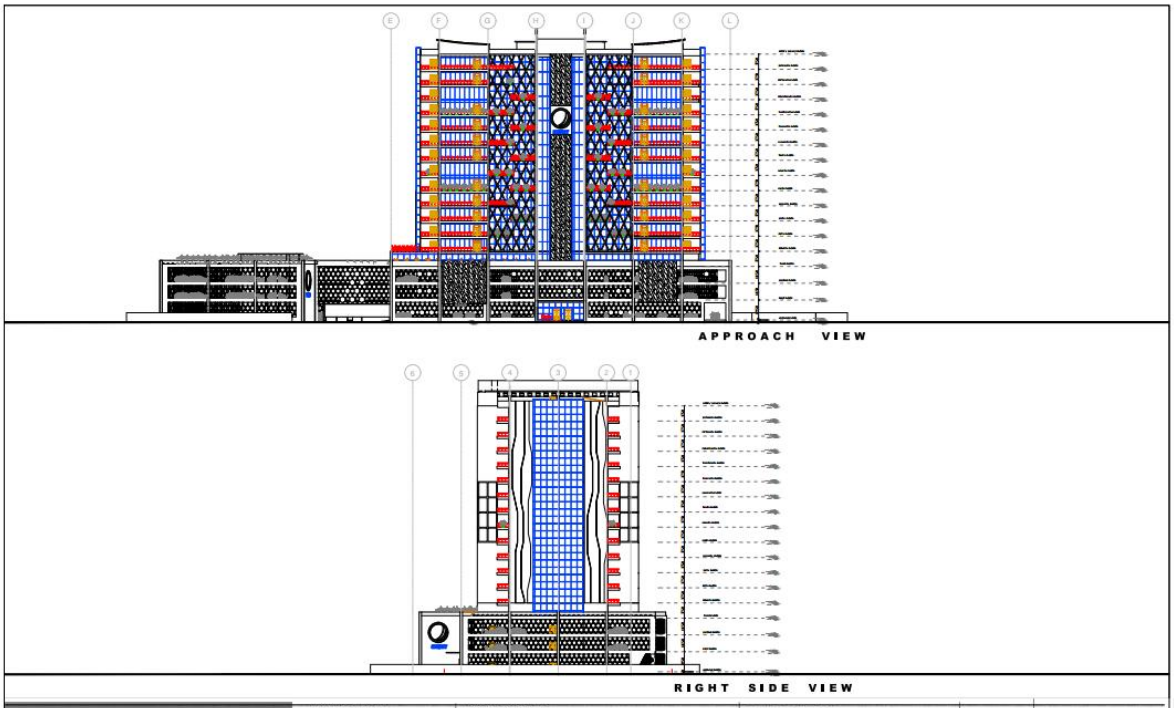

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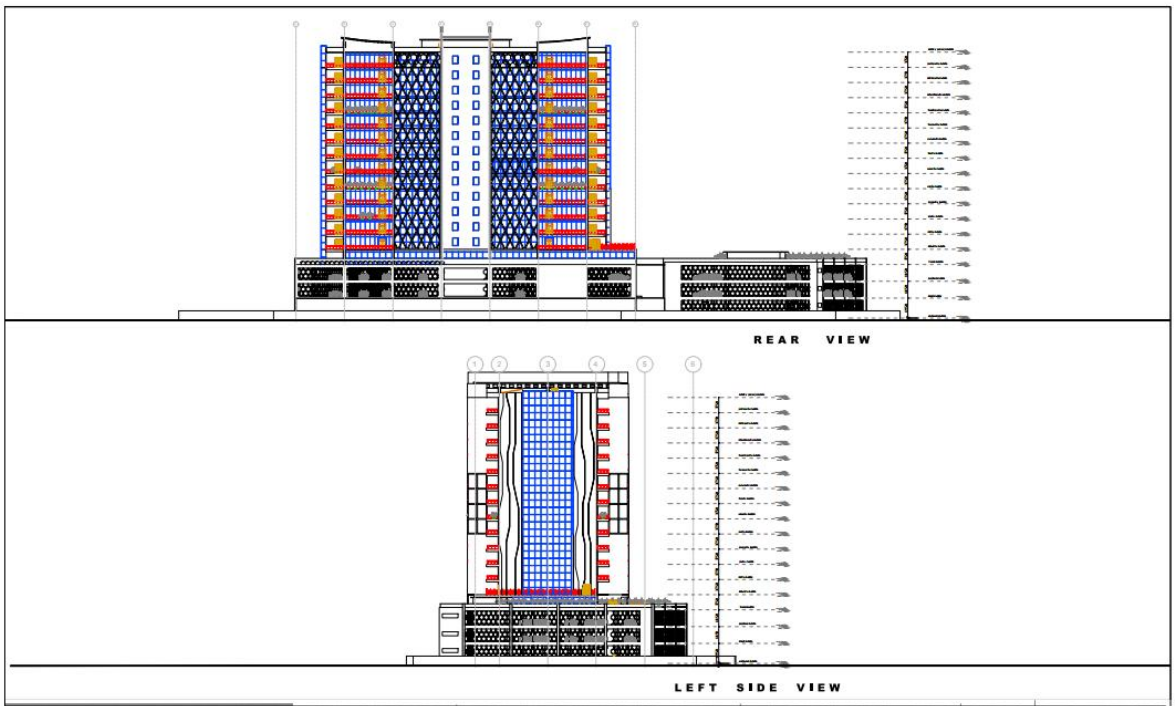

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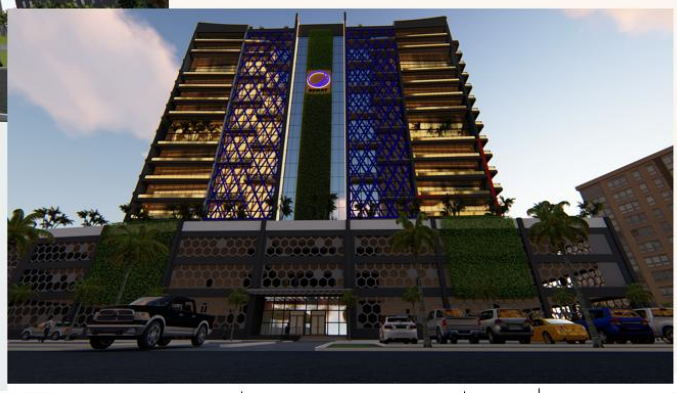

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Bio-data

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4. Next of Kin	
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B. Education background with date

i. Institutions attended with dates

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The polytechnic, Ibadan, Oyo State. 2012-2020

Al-Hayyu Model College Akingbade, Old-ife road, Ibadan, Oyo State. 2009-2012

Ibadan Grammar School, Molete, Ibadan, Oyo State. 2007-2009

Ansar-ud-deen Nursery and Primary School, Liberty road, Ibadan, Oyo State. 1997-2007

ii. Qualifications with dates

M.Sc. Architecture (LCU): 2024

B.Sc Architecture (LCU): 2022

Higher National Diploma in Quantity Surveying: 2020

Higher National Diploma in Architectural Technology: 2018

National Diploma in Quantity Surveying: 2016

National Diploma in Architectural Technology: 2014

WASSCE: 2012

C. Working experience with date

Avalon and Partners Ltd.: 2018-2020

Azwat Innovation Ltd.: 2014 - 2018

Desired Choice Step Ltd. : 2013-2014

Freelance Architecture and graphics Designer. 2014- till date

D. Professional affiliation

Graduate member, Nigerian Institute of Architects, Oyo State Chapter.

Probationer Member Nigerian Institute of Quantity Surveyors, Oyo State Chapter.

Member, Young Quantity Surveyors Forum (YQSF)

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Signature Date

The University Compliance Certification

This is to certify that this thesis by Abdulazeem Adedolapo AKANMU with matriculation number LCU/PG/005100 in the Department of Architecture, Faculty of Environmental Design and Management, Lead City University, Ibadan, is in full compliance with the University's format and style of Thesis.

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