Proposed Telecommunications Head Office Building for MTN Ng, Falomo, Lagos, Nigeria. (Design Strategies to achieve Environmental Sustainability in Telecommunication Facilities)

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Certification

This is to certify that Victor Adedeji ADEYEMO, with matriculation number LG/PG/002793 carried out this research work titled 'Design Strategies to achieve Environmental Sustainability in Telecommunication Facilities' 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 to God Almighty.

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Abstract

The increasing demand for sustainable development presents a challenge for the global telecommunications industry, including Nigeria, to reduce its carbon footprint without compromising functionality and efficiency. Thus, this study aims to explore and assess design strategies to achieve environmental sustainability in telecommunications buildings within Nigeria. Employing a case study approach, six cases were examined, consisting of two international and one local telecommunication office buildings, along with three other office buildings each representing a key aspect of the design development. These case studies were evaluated based on design strategies identified from empirical studies in the literature review, including sustainable site design, water conservation and quality, energy and environment, and conservation of materials and resources. The findings revealed varying degrees of implementation of these strategies in the selected case studies. Drawing insights from the case study analysis, the research proposes an environmentally sustainable head office building for MTNng in Falomo, Lagos. By incorporating the sustainable design strategies learned from the case studies, the proposed design aims to mitigate the environmental impact. Ultimately, the study's findings and recommendations offer a roadmap for architects, engineers, and stakeholders involved in designing and constructing telecommunications buildings in Nigeria. Implementing these guidelines can effectively reduce the industry's carbon footprint, conserve energy resources, and actively contribute to the overarching goal of sustainable development. Ultimately, the research endeavour seeks to foster an environmentally conscious and responsible telecommunications sector in Nigeria.

Keywords: Telecommunications, Sustainability, Environmental Sustainability, Green House Gas Emissions.

Word Count: 231

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Chapter One

Introduction

1.1 Background to the Study

Industrialization on a global scale has spurred the necessity for efficient and rapid communication methods among people in various environments (Maiti et al., 2022). Modern communication networks, extensive and advanced, are now playing pivotal roles in transforming economies and creating economic opportunities (Tschang & Almirall, 2021). Consequently, the demand for communication services has led to a rapid rise in telecommunication companies. However, the sustainability of these telecommunication facilities is facing serious challenges due to the effects of global warming, climate change, limited energy availability, and escalating energy costs (Molla, 2009).

The term "Telecommunication facilities," as defined by (Manzuma et al., 2020), typically encompasses sub-functions such as data centres, switches, customer service centres, call centres, and administrative buildings. Additionally, (Gungor et al., 2013) has further elaborated on telecommunication facilities, describing them as comprising the physical infrastructure, equipment, and technologies utilized to enable long-distance communication and information exchange. These facilities necessitate a substantial and uninterrupted power supply for optimal functioning. Given the unreliable power supply situation in Nigeria, which has been a major obstacle to economic and industrial development (Jimah et al., 2019), most telecommunication companies rely directly or indirectly on non-renewable energy sources like coal, fossil fuels, and natural gas.

As the demand for telecommunications continues to grow and becomes increasingly imperative in society, the industry's high energy consumption directly impacts the environment in which it operates. The telecommunication sector is estimated to contribute approximately 4% to global electricity

consumption (X. Zhou et al., 2019). Apart from the social and economic implications, the most concerning aspect is its contribution to greenhouse gas (GHG) emissions, primarily due to its extensive energy use (Tătaru et al., 2020).

The importance of energy efficiency is beyond dispute as we strive for a more competitive, secure, and sustainable energy system (Radonjič & Tompa, 2018). Energy efficiency encompasses various environmental pollution management issues, particularly those related to climate change, and extends beyond merely emphasizing reduced energy usage to include GHG reduction. Global warming, recognized as one of the most significant risks to the world's environment and economic growth (Oluwaseyi, 2018), calls for all economic sectors to contribute to reducing their impacts. In response, major industrialized countries have already taken actions and made commitments to limit GHG emissions.

Today, due to the reality of high energy consumption, there is a growing concern about its impact on the environment. The ongoing focus on global warming and environmental sustainability has driven the imperative for the industry to seek ways to reduce emissions into the environment. From an architectural perspective, achieving this can be accomplished through the implementation of design strategies that reduce energy consumption and, in some cases, recycle emissions for environmental benefits. Such efforts aim to achieve environmental sustainability. Therefore, this study aims to identify effective design strategies that can promote environmental sustainability in telecommunication facilities.

1.2 Statement of the Problem

The immense use of telecommunications has exploded in all areas of business activities offering great benefits and convenience and irreversibly transforming businesses and societies in the global world. The importance of telecommunications over the years has been enormous in the society and can’t be

eradicated, however at the same time it has contributed tremendously towards environmental problems such as GHG emissions leading to global warming and climate change (Okedere & Oyelami, 2021). Operational control of telecommunication facilities is problematic without burning fossil fuels and dependency on generators. All these factors contribute towards environment problems.

Globally, the total electrical energy consumption by data center, switches, servers, and computers continues to rise and directly contribute to increases in GHG emissions (Baccour et al., 2019) (Uddin et al., 2011) as most of the electricity is generated by burning coal, oil, or gas. As a matter of fact, certain telecommunication facilities are rated or ranked based on the sources and energy service consistency of energy supply.

Despite the stark reality of high energy consumption, there is a growing concern about its impact on the environment. And the current focus on global warming and environmental sustainability has made it imperative, that the industry seeks ways to reduce the emissions into the environment. Architects typically respond to this situation by the use of both active and passive design strategies to reduce energy consumption and in some cases recycle the emissions into what can benefit the environment so as to achieve environmental sustainability.

1.3 Aim and Objectives of the Study

The aim of this study is to design a telecommunication head office facility for MTN Telecom Nigeria that adopts design strategies and considerations for environmental sustainability.

While the specific objectives are to;

1. Assess the current environmental impact of telecommunication facilities
2. Identify the design strategies that can improve environmental sustainability in telecommunication facilities

3. Integrate these design strategies that can be used to achieve environmental sustainability

1.4 Research Questions

1. What is the current environmental impact of telecommunication facilities?
2. What are the design strategies that can improve environmental sustainability in telecommunication facilities?
3. How do we integrate these design strategies to achieve environmental sustainability?

1.5 Significance of the Study

In today's world, telecommunications play a vital role in connecting people and places, exemplifying the concept of a "global village." Despite its significant developmental contribution, telecommunications also add to the growing concern of GHG emissions due to their reliance on non-renewable energy sources. This issue is particularly pressing in developing countries, given the erratic power supply (Jimah et al., 2019). Therefore, this research aims to explore specific design strategies and considerations that can promote environmental sustainability in telecommunication facilities within Nigeria.

Architects and designers will find this study beneficial as it offers design considerations applicable during the design process to achieve environmental sustainability in telecommunication facilities. The research seeks to strike a balance between energy consumption levels and the emission of GHGs into the environment.

Ultimately, this study will prove valuable to anyone seeking knowledge about environmental sustainability and design strategies for telecommunication facilities in Nigeria.

1.6 Scope of the Study

This study is an inquiry into how environmental sustainability can be achieved in telecommunications facilities by means of architectural design strategies.

Environmental sustainability and coping architectural design strategies are broad topics, upon which a lot of studies have been previously been carried out.

However, the scope of the study is limited to environmental sustainability that can be achieved by reduction of emissions into the natural environment

1.7 Limitation of the Study

Obtaining pictures and information related to telecommunications head office buildings proved to be challenging due to their sensitive nature. Additionally, accessing online information necessitated data subscriptions, incurring significant costs while conducting this research.

1.8 Operational Definitions of Terms

1. **Environmental Sustainability:** Environmental sustainability refers to the concept of meeting the needs of the present without compromising the ability of future generations to meet their own needs. In the context of this study, it specifically relates to implementing design strategies in telecommunication facilities that minimize negative environmental impacts, promote resource efficiency, and support long-term ecological balance.
2. **Design Strategies:** Design strategies in this study pertain to specific approaches, techniques, or methodologies employed during the design phase of telecommunication facilities to achieve environmental sustainability objectives.

3. **Telecommunication Facilities:** Telecommunication facilities encompass physical structures, buildings, or infrastructures utilized by telecommunication companies to house equipment, technology, and communication systems necessary for telecommunication operations
4. **Renewable Energy:** Renewable energy refers to energy derived from naturally replenishing sources, such as solar, wind, hydroelectric, geothermal, or biomass, which can be used to generate electricity or provide heating and cooling. In this study, renewable energy is considered as a design strategy to achieve environmental sustainability by reducing reliance on non-renewable fossil fuel-based energy sources.
5. **Waste Reduction:** Waste reduction encompasses practices and strategies aimed at minimizing the generation of waste materials within telecommunication facilities. It involves measures such as recycling, reuse, and responsible waste management to reduce the overall environmental impact associated with waste production and disposal.
6. **Water Conservation:** Water conservation refers to the responsible and efficient use of water resources within telecommunication facilities. Design strategies focused on water conservation may include the use of water-efficient fixtures, rainwater harvesting systems, water recycling and reuse methods, and minimizing water wastage to promote sustainable water management practices.
7. **Sustainable Materials:** Sustainable materials are those that have a reduced negative impact on the environment throughout their life cycle. These materials are responsibly sourced, manufactured using environmentally friendly processes, have minimal carbon footprint, and can be recycled or disposed of in an eco-friendly manner. In this study, the use of sustainable materials in the design of telecommunication facilities is explored as a strategy for environmental sustainability.

Chapter Two

Literature Review

2.1 Conceptual Review

2.1.1 Sustainability

The notion of sustainability has been a central topic in academic discourse, continuously evolving and adjusting over time. The need to address these concerns led to a rise in environmental consciousness during the 1970s, highlighted by the United Nations Conference, which stressed the significance of implementing measures to tackle environmental challenges (Correia, 2019). This conference played a pivotal role in introducing the term "sustainability." However, it was not until 1987 that a clear definition of sustainability was presented by the World Commission on Environment and Development. They defined it as a model of economic development that allows for meeting the current generation's needs while safeguarding the ability of future generations to fulfil their own needs (R. Zhou & Lee, 2022). This definition brought sustainability to the forefront and established a fundamental understanding of its principles.

In a more explicit context, sustainability can be defined as the ability to fulfil our current needs while safeguarding the capacity of future generations to meet their own needs across natural, social, and economic dimensions (Loviscek, 2021). It is crucial to recognize that sustainability extends beyond environmentalism and encompasses considerations for social justice and economic advancement.

Sustainability has garnered significant attention in recent years due to concerns about the environmental impact of human activities and the imperative for long-term conservation of resources. While sustainability has been defined in various ways, its fundamental essence lies in meeting the requirements of the present generation while ensuring that future generations can do the same (Kuhlman & Farrington, 2010). Also, ssustainability was also defined by (Ahady et al., 2019) as a way of living and working in which meet and integrate existing environmental, economic and social needs without compromising the well-being of future generations. The concept of the connection between the environment, the economy, and social fairness is also mentioned in the paper as a way to demonstrate responsibility for leaving a better legacy for our children and their children (Mensah, 2019b). Reduced use of nonrenewable resources, reduced waste, and the creation of healthy, productive environments are the main goals of sustainability.

Furthermore, the term sustainability also refers to a strategy for promoting, implementing, or advocating sustainable development (Damico et al., 2022). Sustainable development has emerged as an alternative means to addressing environmental damages caused to the environment by the over-exploitation of resources, environmental degradation, climate change, and population increase (R. Zhou & Lee, 2022). According to (Damico et al., 2022) by 2050, world population growth will increase by 26%, to a total of 9.7 billion people. This growth will affect the quality of life of future generations. Thus, the need arises for a development that meets the needs of the present without compromising the ability of future generations to meet their own needs which can be applied as a concept in almost all disciplines.

Notably, the early works on sustainability laid the foundation for understanding the intricate relationship between human activities and the natural world (Mensah, 2019b). Concepts such as ecological conservation and the preservation of biodiversity became focal points within this realm. As

sustainability gained traction, its scope expanded to encompass social and economic dimensions (Zhou et al., 2020). People started recognizing the interconnectedness of environmental sustainability, social justice, and economic development. The concept of the triple bottom line emerged in 1994 (Bauling, 2017), emphasizing the need to balance ecological integrity, social equity, and economic prosperity.

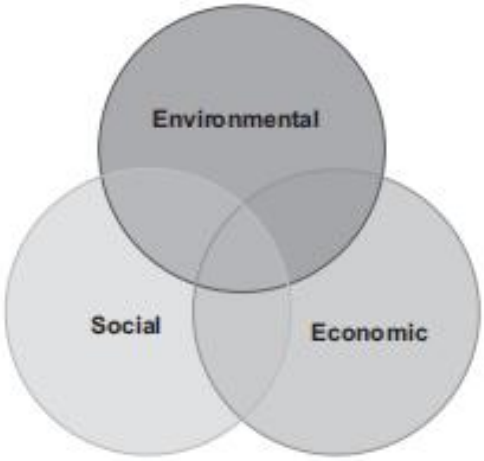


Figure 2.1 : The Nested Sphere Model
Source- (Correia, 2019).

2.1.1.1 Environmental Sustainability

Environmental sustainability entails the responsible and balanced management of our natural resources, ecosystems, and the overall environment. It recognizes the intricate interconnectedness between human activities and the health of our planet (Mensah, 2019b). Environmental sustainability is a critical aspect of sustainability, as it refers to the ability to protect and conserve the natural environment (Seddon et al., 2021), including its ecosystems, species, and natural resources, to ensure their long-term viability. Also, environmental sustainability can be referred to as the practice of using and managing resources in a way that preserves the natural environment for present and future generations (Mensah, 2019b). It involves making choices and implementing strategies that minimize negative impacts on ecosystems,

reduce resource consumption, and promote long-term ecological balance. It encompasses practices that aim to minimize negative environmental impacts, promote conservation, and foster long-term ecological balance (Nikolaou et al., 2021).

Also, environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems (Olalekan et al., 2019) to support health and wellbeing, now and in the future. Because so many decisions that impact the environment are not felt immediately, a key element of environmental sustainability is its forward-looking nature.

One of the key principles of environmental sustainability is the concept of the "three pillars" or "triple bottom line" approach (Muñoz-Pascual et al., 2019). This approach considers the environmental, social, and economic aspects of sustainability. It acknowledges that environmental protection cannot be achieved without considering the social and economic implications of our actions. Therefore, sustainable practices should not only benefit the environment but also contribute to social well-being and economic prosperity. At its core, environmental sustainability embodies the delicate balance between human activities and the preservation of the natural world (Mensah, 2019a).

Environmental sustainability focuses on various aspects and strategies (Murshed, 2020). These may include but not limited to;

1. Conservation and Preservation

Conservation and preservation are two essential foundations of environmental sustainability (Viccaro & Caniani, 2019) , working together to safeguard and maintain our natural resources and promote a harmonious coexistence between humans and the environment (Henrique et al., 2019). Conservation and preservation efforts ensure the sustainable use and management of resources, preventing overexploitation and degradation (Ferreira et al., 2022).

2. Renewable Energy

Promoting the use of renewable energy sources, such as solar, wind, and hydroelectric power, reduces reliance on fossil fuels and minimizes GHG emissions (Qazi et al., 2019). According to , (Mondejar et al., 2021) transitioning to a clean energy economy is a crucial step towards achieving environmental sustainability. Renewable energy plays a pivotal role in achieving environmental sustainability (Ike et al., 2020) by offering a clean, abundant, and sustainable alternative to traditional fossil fuel-based energy sources. It encompasses a wide range of energy technologies that harness naturally replenishing resources, such as sunlight, wind, water, and geothermal heat, to generate power. The adoption and widespread use of renewable energy have numerous environmental benefits and contribute to mitigating climate change, reducing pollution, and promoting a more sustainable and resilient energy system (Eitan, 2021).

3. Waste Reduction and Recycling

According to (Saldaña-Durán & Messina-Fernández, 2021) waste reduction and recycling are essential pillars of environmental sustainability, aiming to minimize the generation of waste and maximize the reuse and recycling of materials (Olughu, 2021). These practices contribute to the conservation of natural resources, the reduction of pollution, and the mitigation of the environmental impacts associated with waste disposal.

One of the significant benefits of waste reduction and recycling is the conservation of natural resources (Olalekan et al., 2019). By recycling materials, we can conserve raw materials such as timber, minerals, and fossil fuels that are used in the building construction process. This helps to preserve natural habitats, reduce deforestation and habitat destruction, and mitigate the depletion of non-renewable resources (Magazzino et al., 2020). Furthermore, recycling also reduces the energy and water

consumption associated with extracting, processing, and manufacturing new materials, leading to a more sustainable use of resources (Neumann et al., 2022).

2.1.1.2 Economic Sustainability

Economic sustainability can be understood as a production system that meets current consumption levels without jeopardizing future needs (Mensah, 2019a) , According to , (Rupprecht et al., 2020), economic sustainability entails the capacity of an economy to uphold and enhance its overall well-being over time, while guaranteeing equitable and efficient fulfilment of the present and future generations' requirements. Economic sustainability can be viewed as the ability of an economic system to sustain a desired level of economic output (Dogan & Inglesi-Lotz, 2020) and ensure a satisfactory standard of living for its populace, while emphasizing resource efficiency, minimizing waste (Fatimah et al., 2020), and avoiding adverse effects on the environment and social well-being.

Economic sustainability focuses on maintaining long-term economic growth and development (Giddings et al., 2002) while considering the impact on the environment and society. It aims to ensure that construction activities are conducted in a way that meets present needs without compromising the ability of future generations to meet their own needs, hence the 6 Rs of economic sustainability (Murray et al., 2017) which are a set of principles or strategies that can designers in achieving economic sustainability during the construction processes. The "6 Rs" is a concept that is associated with sustainable waste management practices. These Rs stand for Reduce, Reuse, Recycle, Rethink, Refuse, and Repair. Social sustainability.

2.1.1.3 Social Sustainability

According to (Mckenzie, 2004), social sustainability refers to the long-term well-being and flourishing of individuals, communities, and societies. It recognizes the interconnectedness between social systems, environmental systems, and economic systems, and seeks to ensure that social considerations are integrated into sustainable development practices. Social sustainability focuses on addressing social issues, promoting social equity, and safeguarding the rights and well-being of all members of society (Eizenberg & Jabareen, 2017).

According to the findings of (Eizenberg & Jabareen, 2017), social sustainability research often draws its foundations from the influential 1987 Brundtland Report, titled "Our Common Future." The report provides a definition of sustainable development that highlights the interconnectedness of human well-being, environmental objectives, and economic progress. It emphasizes the importance of meeting the current needs of society while ensuring that future generations can meet their own needs without facing resource depletion or environmental degradation.

2.1.2 Building Impacts on Environmental Sustainability

According to a study conducted by (Akadiri et al., 2012), the construction industry plays a crucial role in any economy but has a significant negative impact on the environment. Compared to other industries, the construction sector is rapidly expanding worldwide, leading to increased energy consumption and reliance on finite fossil fuel resources. This trend has raised concerns regarding potential supply difficulties and the depletion of energy resources.

Buildings, in particular, have been identified as major contributors to environmental issues (Röck et al., 2020) such as ozone layer depletion, carbon dioxide emissions, global warming, and climate change. The production of building materials consumes a considerable amount of energy, and energy is also consumed during the construction phase. Once a building is completed, further energy is required for heating, lighting, power, and ventilation.

(Amaral et al., 2020) also argued that aside from energy consumption, the construction industry is also a significant source of environmental pollution. It accounts for a substantial consumption of raw materials (Umar et al., 2021), with an annual usage of 3 billion tons or approximately 40% of global consumption, thereby generating a substantial amount of waste.

It is evident that the building industry has altered the environment in numerous ways in the previous years (Newman et al., 2021) , through the process of its construction activities and the operational life of the buildings globally. The building industry has several impacts on the sustainability of the environment, some of which are as follows:

- **Resource Depletion:** The construction of buildings requires the extraction and depletion of natural resources such as timber, minerals, and aggregates (Adjei et al., 2018). This can lead to habitat destruction, deforestation, and loss of biodiversity.
- **Energy Consumption:** The building industry is a significant consumer of energy, both during the construction phase and throughout the lifespan of buildings. The energy used in building operations, heating, cooling, lighting, and electrical appliances contributes to GHG emissions and climate change.
- **Carbon Emissions:** Building operations, including energy consumption and the use of fossil fuels, contribute to carbon dioxide and other GHG emissions. These emissions contribute to global warming and climate change (Terrenoire et al., 2019).
- **Waste Generation:** The construction and demolition of buildings generate large amounts of waste, including construction debris, packaging materials, and discarded building components. Improper waste management practices can lead to landfill pollution and resource wastage.
- **Water Usage:** According to (Mannan & Al-Ghamdi, 2020) the building industry consumes significant amounts of water during construction, operation, and landscaping activities. High

water demand can strain local water resources, leading to water scarcity and ecological imbalances.

- **Pollution and Air Quality:** Construction activities and building operations can release pollutants into the air, contributing to poor air quality. These pollutants include dust, emissions from construction machinery, and volatile organic compounds (VOCs) from building materials.
- **Urban Heat Island Effect**: Dense urban areas with a high concentration of buildings can experience the urban heat island effect, where the built environment absorbs and retains heat, leading to higher temperatures compared to surrounding rural areas. This effect can exacerbate energy consumption and heat-related health issues.
- **Environmental Degradation:** Building development can result in the destruction of natural habitats, wetlands, and ecosystems. This loss of natural areas can disrupt wildlife habitats, reduce biodiversity, and impact ecological balance.
- **Indoor Environmental Quality:** Buildings can have a direct impact on the health and well-being of occupants. Poor indoor environmental quality, including inadequate ventilation, mold growth, and exposure to harmful chemicals, can lead to health problems and reduced quality of life.

However, the building industry also presents opportunities for promoting sustainability. Designing and constructing energy-efficient, green buildings with renewable energy systems, efficient water management, and sustainable materials can contribute to environmental preservation.

Several efforts have been made to mitigate the negative impacts of the building industry on the environment, some of which are sustainable practices, green building certifications, energy-efficient design, waste management, and responsible material sourcing. Additionally, government regulations

and policies can play a crucial role in promoting sustainable building practices and incentivizing environmentally friendly choices within the industry.

2.1.3 Green and Sustainable Architecture

Green architecture, alternatively referred to as green design, is an architectural method that places emphasis on reducing adverse effects on human health and the environment. It serves as a solution to address the negative impact of buildings on the environment, as pointed out by (Ragheb et al., 2016). Architects and designers who embrace the "green" ideology work towards safeguarding the air, water, and soil by choosing eco-friendly building materials and adopting sustainable construction techniques. This holistic concept of environmentally conscious architecture has gained widespread recognition.

Green architecture typically exhibits several key characteristics, which may include:

- Efficient ventilation systems for heating and cooling purposes.
- Energy-efficient lighting fixtures and appliances.
- Water-saving plumbing fixtures to reduce water consumption.
- Thoughtfully designed landscapes to maximize passive solar energy utilization.
- Minimal disruption to the natural habitat.
- Incorporation of alternative power sources such as solar or wind energy.
- Use of non-synthetic and non-toxic materials.
- Utilization of locally sourced woods and stone.
- Responsible harvesting of wood resources.
- Adaptive reuse of existing buildings.
- Integration of recycled architectural salvage.
- Efficient utilization of space.

While not all green buildings possess all of these features, the ultimate aim of green architecture is to achieve full sustainability (Javed et al., 2020). This approach is also referred to by various other terms, including sustainable development, eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture, and natural architecture, as stated by the US Green Building Council (Baum, 2006).

2.1.4 Green Building Rating Systems

These are the tools that has been developed to ensure the practices of sustainable architecture. Green Building Rating Systems (GBRSs) are tools designed to evaluate a building's performance or anticipated performance. These tools enable a comprehensive assessment, facilitating comparisons with other buildings., Green Building Rating Systems (GBRSs) have also been described by (M.S. Pradnya V. Kulkarni & Dr. L.S.Pammar, 2019) as voluntary and market-driven standards implemented by third-party organizations. These systems evaluate the sustainability level of buildings through a comprehensive assessment based on multiple criteria. They encourage the adoption of environmentally, socially, and economically sustainable practices in the design, construction, and operation of buildings or neighbourhoods. GBRSs can be considered as established tools dedicated to evaluating a building's performance according to a predefined set of criteria, typically encompassing aspects such as site, water, materials, energy, indoor environmental quality, and other attributes related to sustainable design.

The impacts of buildings on our life, business, and natural environment have fuelled a global trend in the building industry to “go green”. This has helped escalate various green building rating systems (GBRSs) around the world (Lu et al., 2019). Growing attention to global environmental and societal challenges requires the construction sector to be more sustainable, because of its major impact on these challenges. Beyond regulations and policy enforcements, a voluntary effort is required of all the

stakeholders to design, construct, run and manage buildings assuming a holistic approach to sustainability so therefore sustainability assessment has been recognized as a crucial mean to this end, and Green Building Rating Systems (GBRSs) have emerged as a valuable tool to assess and guide the whole construction process to be greener (Marchi et al., 2021). There are several types of GBRSs that has been done and is in use different countries, however, t(Sartori et al., 2021). the most popular ones are, LEED and BREEAM.

The LEED (Leadership in Energy and Environmental Design) Building Rating Systems, developed by the U.S. Green Building Council (USGBC)(Chi et al., 2020), assess and certify the sustainability and environmental performance of buildings worldwide. The rating systems consist of several categories that cover different aspects of building design, construction, operation, and maintenance(Pham et al., 2020). The main categories within the LEED Building rating systems(Cordero et al., 2019) are: location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation, regional priority, and integrative process, also, BREEAM (Building Research Establishment Environmental Assessment Method) is a widely recognized and widely used environmental assessment and certification system for buildings. It evaluates the sustainability and environmental performance of buildings based on various categories. The main categories within the BREEAM Building Rating Systems are; health and wellbeing., energy, transport, water, materials, waste, land use and ecology, pollution, and innovation.

2.1.5 Telecommunication Facilities

Telecommunication facilities encompass the physical infrastructure, equipment, and technologies utilized to enable communication and the exchange of information over long distances (Gungor et al., 2013) These facilities consist of various components such as network infrastructure, transmission systems, devices, satellites, data centres, and associated hardware and software.

The significance of telecommunication facilities lies in their capacity to connect individuals, organizations, and societies, facilitating the smooth flow of information and enabling diverse forms of communication, as mentioned by (Castells, 2008).

These facilities offer a multitude of benefits to individuals, businesses, and societies (Roztocki et al., 2019). Some of these benefits include:

i. **Connectivity:** Telecommunication facilities enable individuals in different locations to establish connections, irrespective of distance. They facilitate real-time communication through voice calls, video conferencing, messaging, and data transfer, promoting collaboration, remote work, and global communication.

ii. **Global Communication:** Telecommunication facilities have transformed the world into a closely connected global community. They facilitate international voice calls, internet connectivity, email communication, and instant messaging, fostering cultural exchange, economic growth, and collaboration on a global scale.

iii. **Economic Growth and Development:** Telecommunication facilities are instrumental in driving economic growth by enabling efficient communication and information exchange among businesses, customers, and governments. They support e-commerce, online banking, digital transactions, supply chain management, and remote market access, resulting in increased productivity, enhanced business efficiency, and economic development.

iv. **Information Access:** Telecommunication facilities provide individuals with access to an extensive range of information and knowledge available on the internet. Through internet connectivity, people can access educational resources, research materials, news, and entertainment from anywhere in the world. This access to information promotes learning, empowers individuals, and contributes to personal and professional growth.

v. **Emergency Communication:** Telecommunication facilities are crucial during emergencies and disasters as they enable the timely dissemination of critical information, emergency alerts, and coordination of response efforts. They support emergency services, public safety communications, and provide a means for affected communities to seek help and connect with their loved ones during challenging circumstances.

vi. **Bridging the Digital Divide**: Telecommunication facilities play a significant role in reducing the digital divide, particularly in underserved areas. By providing internet connectivity and access to telecommunication services, these facilities promote equal opportunities for education, healthcare, job opportunities, and social inclusion, bridging the gap between developed and developing regions.

vii. **Innovation and Technological Advancement**: Telecommunication facilities drive innovation and technological advancements across various fields. They support research and development in wireless communication, network protocols, data transmission, and security. These advancements result in the introduction of new services, improved performance, and enhanced user experiences.

2.1.5.1 Data Centre

Data centres are a critical element of telecommunication facilities (Wang et al., 2019), serving as the core foundation of contemporary telecommunication infrastructure. They play a crucial role in storing, processing, and distributing data, which is essential for seamless communication within modern telecommunications networks. Data centres serve as fundamental components of IT business organizations, offering functionalities such as centralized data storage, data backup and recovery, data networking, and data distribution. Contemporary data centres consist of a vast number of servers that handle processing tasks for various internet-based enterprises, financial and commercial applications, networking and storage applications, as well as high-tech and academic applications (Uddin & Rahman, 2012).

According to (Hoefler et al., 2022), data centres are specialized facilities that house servers, storage systems, and networking equipment. They store and process large amounts of data, providing the infrastructure for cloud computing, web hosting, and other online services. Data centres ensure data availability and enable efficient communication and access to digital resources. Also, data centres play a crucial role as the central infrastructure supporting our increasingly digital world (Masanet et al., 2020). The author also stated that the demand for their services has been steadily increasing, driven by emerging technologies such as artificial intelligence, smart energy systems, distributed manufacturing, and autonomous vehicles. These data-intensive technologies are expected to further amplify the demand for data centres in the future.

However, it is important to note that data centres are energy-intensive operations, estimated to consume approximately 1% of the world's electricity (Avgerinou et al., 2017) and emits up to 2% of the global CO2 emissions. However, according to (Koronen et al., 2020) the rapid growth of data centres has raised concerns about their environmental impact. To address these concerns, data centre operators and technology companies have been actively pursuing measures to improve their environmental sustainability.

Some key strategies and initiatives employed by data centres to minimize their ecological footprint and promote environmental sustainability (Murugesan, 2008);

i. **Energy Efficiency:** Data centres are known for their high energy consumption. To mitigate this, data centre operators are adopting various energy-efficient practices and technologies, including:

- Equipment consolidation
- Advanced cooling systems
- Power management
- Renewable energy

ii. **Waste Management:** Data centres generate substantial amounts of waste, including electronic waste and packaging materials. To minimize their environmental impact, data centres are focusing on waste management strategies, such as:

- Recycling programs
- Packaging optimization.
- Asset lifecycle management

iii. **Water Conservation:** Water is another critical resource used in data centres for cooling and other operational processes. To conserve water and promote sustainable water management, data centres are adopting measures like:

- Water-efficient cooling systems
- Water recycling and reuse
- Rainwater harvesting

iv. **Green Building Design:** Data centres are increasingly adopting green building practices to reduce their environmental impact during construction and operation. Key considerations include:

- Energy-efficient infrastructure
- LEED certification
- Natural cooling and ventilation
- Sustainable site selection

2.1.6 Spatial Requirements for Telecommunication Facilities

The spatial requirements for a telecommunication head office building can vary based on several factors, including the size of the organization, the scope of operations, and specific functional requirements. Here are some general considerations and spatial requirements to keep in mind:

Administrative Areas;

- **Administrative Offices:** Space should be allocated for administrative functions, such as human resources, finance, legal, and management offices.
- **IT Support:** A dedicated area for IT support staff, including help desk services, troubleshooting, and equipment maintenance, may be required.
- **Workstations:** Adequate space should be allocated for employees' workstations, considering factors such as desk space, seating arrangements, and any specific equipment or technology requirements.
- **Meeting Rooms:** Various sizes of meeting rooms or conference rooms should be provided to accommodate different types of meetings, such as team meetings, client meetings, and board meetings.
- **Executive Offices:** Separate offices may be required for executives, managers, and department heads, depending on the organizational structure.
- **Collaboration Areas:** Spaces for collaboration, brainstorming, and informal discussions, such as open-plan areas, breakout rooms, or lounge spaces, should be included to foster teamwork and innovation.
- **Support Areas:** These may include reception areas, waiting areas, mailrooms, copy/print centres, and storage spaces for office supplies and equipment.

Data Centre;

- **Floor space:** If the head office building includes a data centre, a dedicated area should be allocated for server racks, networking equipment, and storage systems. The size of the data centre will depend on the organization's IT infrastructure requirements.

- **Cooling and power infrastructure:** Sufficient space should be provided for cooling systems, power distribution units, backup power generators, and other supporting infrastructure to maintain proper operating conditions for the data centre.

Support Facilities;

- **Cafeteria and breakrooms:** A designated area for dining, refreshments, and relaxation should be included to cater to the needs of employees.
- **Training and conference facilities**: Depending on the organization's requirements, dedicated spaces for training sessions, workshops, and large-scale presentations may be necessary.
- **Wellness facilities**: Some organizations may consider incorporating wellness facilities, such as fitness centres or meditation rooms, to promote employee well-being.
- **Parking and accessibility:** Adequate parking spaces and accessibility provisions should be considered to accommodate employees, visitors, and any necessary infrastructure for vehicles or deliveries.

2.2 Design Considerations

When creating the design for a telecommunication head office building, it is crucial to consider several important factors to achieve a design that is both efficient and effective. Here are some significant design considerations to keep in mind;

2.2.1 BIPV (building integrated photovoltaics) Solar Panels

BIPV solar panels which are innovative and sustainable solution that combines the functionality of traditional building materials with the ability to generate clean and renewable electricity will be adopted. These solar panels are integrated directly into the building's design and construction, serving as both an energy-generating system and a structural element.

The Integration of BIPV Solar Panels offers several advantages:

- **Architectural Integration:** BIPV solar panels are designed to blend seamlessly with the building's aesthetics, offering flexibility in terms of shape, colour, and transparency.

Figure 2.2 : Architectural Integration of Bipv Solar Panels
Source- (Google search)

- **Cost Savings:** While the initial installation cost of BIPV solar panels may be higher compared to traditional building materials, they offer long-term cost savings through reduced energy bills and potential revenue generation from excess electricity production that can be fed back into the grid.

Figure 2.3 : BIPV Solar Panels
Source- (Google search)

- **Renewable Energy Generation**: BIPV solar panels harness sunlight and convert it into electricity, providing a sustainable and clean source of energy for the building. This reduces dependence on fossil fuels and helps mitigate climate change.
- **Energy Efficiency:** BIPV solar panels not only generate electricity but also provide additional benefits such as insulation and shading, contributing to improved energy efficiency within the building. They can help reduce heating and cooling loads, resulting in lower energy consumption and enhanced indoor comfort.

Figure 2.4 : Energy Efficient BIPV Solar Panels
Source- (Google search)

2.2.2 Scalability and Flexibility

Telecommunication companies often experience rapid growth and evolving technology requirements. Design the building with scalability in mind, allowing for future expansion and modifications to accommodate changing needs. Flexible floor plans, modular spaces, and adaptable infrastructure can facilitate easy reconfiguration and upgrades.

2.2.3 Connectivity and Network Infrastructure

As a telecommunication company, robust connectivity is crucial. Design the building to support high-speed, reliable internet connectivity and network infrastructure. Adequate space for telecommunication rooms, server rooms, cable pathways, and equipment storage should be allocated, considering redundancy and fault tolerance.

2.2.4 Security

Telecommunication head office buildings house critical infrastructure and sensitive data. Implement stringent security measures, including access control systems, video surveillance, intrusion detection, and physical barriers to protect against unauthorized access, data breaches, and equipment theft.

2.2.5 Energy Efficiency

Energy consumption is a significant concern in telecommunication facilities. Incorporate energy-efficient design principles, such as optimized HVAC systems, insulation, lighting controls, and renewable energy sources. Implement green building practices to reduce environmental impact and operational costs.

2.2.6 Collaboration and Communication Spaces

Promote collaboration and effective communication among employees by including dedicated spaces for meetings, brainstorming sessions, and informal interactions. Design open-plan areas, breakout rooms, conference rooms, and technology-enabled collaboration spaces to facilitate teamwork and innovation.

2.2.7 Work Environment and Employee Well-being

Create a comfortable and healthy work environment to enhance productivity and employee satisfaction. Consider factors such as natural lighting, ergonomic workstations, proper acoustics, indoor air quality, and amenities like breakout areas, recreational spaces, and wellness facilities.

2.2.8 Accessibility

Ensure that the building design complies with accessibility regulations and provides equal access for individuals with disabilities. Incorporate accessible entrances, ramps, elevators, and facilities to accommodate diverse needs.

2.2.9 Sustainability

Incorporate sustainable design principles to minimize the building's environmental footprint. Use energy-efficient materials, implement water conservation measures, optimize waste management systems, and prioritize the use of renewable resources. Consider obtaining green building certifications such as LEED (Leadership in Energy and Environmental Design).

2.2.10 Aesthetics and Branding:

Reflect the company's brand identity through the building's design. Consider architectural elements, signage, and interior design that align with the company's visual identity, values, and culture.

2.2.11 Compliance and Regulations

Ensure that the building design adheres to local building codes, zoning regulations, and industry standards specific to telecommunication facilities. Engage with relevant authorities and consultants to navigate compliance requirements effectively.

2.2.12 Disaster Resilience

Telecommunication head office buildings should be designed to withstand natural disasters and potential disruptions. Incorporate resilient design features, such as backup power systems, redundant infrastructure, and disaster recovery plans, to ensure uninterrupted operations during emergencies.

2.2.13 Indoor Environmental Quality

Green building design prioritizes the comfort and well-being of occupants by ensuring excellent indoor environmental quality. This includes providing adequate ventilation, using non-toxic and low-emission materials, controlling indoor pollutants, and optimizing natural daylight and views to enhance occupant satisfaction and productivity.

2.3 Empirical Review

2.3.1 Design Strategies for Achieving Environmental Sustainability

To achieve sustainable development, it is essential that the design, specification, supervision, and management of buildings and the construction process prioritize the efficient utilization of resources and ecological processes (Sang & Yao, 2019). Design strategies play a critical role in attaining environmental sustainability by incorporating ecological factors into the planning, development, and execution of diverse products, systems, and constructed environments (Bibri et al., 2020).

These strategies centre around minimizing resource usage, decreasing waste generation, and advocating for sustainable practices throughout the entire lifecycle of a design. The four essential components of green building design that must be embraced to achieve environmental sustainability, as stated (Mohammed, 2016) , are as follows:

1. Sustainable Site Design;
2. Water Conservation and Quality;

3. Energy and Environment; and

4. Conservation of Materials and Resources.

2.3.1.1 Sustainable Site Design

Sustainable site design, also known as sustainable site planning or sustainable landscaping, involves the thoughtful design and development of outdoor spaces to minimize negative environmental impacts and promote long-term ecological health (Akadiri et al., 2012). This approach integrates environmentally friendly principles into the planning, construction, and management of various sites, ranging from residential gardens to commercial developments and public parks.

The primary objective of sustainable site design is to reduce resource consumption, preserve natural habitats, and enhance the overall quality of the environment. Key considerations include water conservation, energy efficiency, biodiversity, storm-water management, and the use of recycled or locally sourced materials. By incorporating these sustainable design principles, site designers aim to create spaces that are both functional and environmentally responsible.

Several key principles and strategies are commonly employed in sustainable site design:

a) **Site Analysis:** Thoroughly analysing the site's natural features, climate, and surroundings informs design decisions and minimizes negative impacts.

b) **Biodiversity and Habitat Protection:** Preserving existing natural features, incorporating native plants to support local wildlife, and creating habitats that promote biodiversity.

c) **Storm-water Management:** Implementing techniques like permeable paving, green roofs, and rain gardens to manage storm-water runoff, reducing water pollution and mitigating flooding.

d) **Material Selection:** Choosing environmentally friendly materials, such as recycled or locally sourced materials, to minimize environmental impact during production, use, and disposal.

In essence, sustainable site design recognizes the interconnectedness between the built environment and the natural world, striving to create harmonious spaces that protect and enhance the ecological systems they are a part of, as stated by (Reed & Woodworth, 2021). By considering these principles and implementing sustainable practices, site designers can contribute to the overall sustainability and resilience of our communities. A comprehensive site assessment offers numerous benefits, identifying fragile or ecologically important areas that require protection and guiding the strategic placement of residential areas to minimize disruption to the land and ecosystems.

2.3.1.2 Water Conservation and Quality

According to (Akadiri et al., 2012), water conservation technologies and strategies are often overlooked when designing a whole-building approach. However, there is increasing attention to planning for various water uses within structures due to the growing awareness of the water-saving benefits achieved through water-efficient measures, as highlighted by (Omer & Noguchi, 2019). Several strategies can be employed throughout a building's life cycle to reduce water consumption, including:

a) Incorporating water-efficient plumbing fixtures like ultra-low flow toilets, urinals, and waterless urinals, low-flow and sensor-activated sinks, low-flow shower-heads, and water-efficient dishwashers and washing machines to minimize wastewater generation.
b) Collecting rainwater and using grey water storage for irrigation purposes, significantly reducing the need for treated water. This collected water can be recycled within the building to irrigate ornamental plants or flush toilets.

2.3.1.3 Energy and Environment

Energy and the environment play crucial roles in the design of sustainable buildings (Stanaszek-Tomal, 2020). Sustainable building practices focus on reducing the adverse effects of buildings on the environment while maximizing energy efficiency and sustainability (Franco et al., 2021) Incorporating energy and environmental considerations into building design is a robust approach to achieve environmental sustainability. Here is a summary of how sustainable building design integrates energy and environmental elements:

a) **Energy Efficiency:** Green building design gives priority to energy efficiency, aiming to minimize energy consumption (Haruna et al., 2021). This involves using energy-efficient building materials like insulation and windows, as well as incorporating efficient HVAC systems. Energy-efficient lighting, appliances, and controls are also integrated to reduce energy usage and lower GHG emissions.

b) **Renewable Energy:** green building design promotes the utilization of renewable energy sources to power buildings. This includes the installation of solar panels, wind turbines, or geothermal systems to generate clean and sustainable energy on-site. By embracing renewable energy, dependence on fossil fuels is reduced, leading to a decrease in carbon emissions.

c) **Passive Design Strategies:** Passive design strategies are employed to optimize energy efficiency without relying heavily on mechanical systems. Green buildings utilize techniques such as passive solar design, natural ventilation, daylighting, and shading to maximize natural energy sources and reduce the need for artificial lighting, heating, and cooling.

2.3.1.4 Conservation Of Materials and Resources.

The conservation of materials and resources is a core principle in sustainable practices (Muscat et al., 2021), involving the responsible handling and effective use of materials, energy, and natural resources to minimize waste, safeguard ecosystems, and decrease environmental consequences. The subsequent components are essential considerations regarding the conservation of materials and resources:

a) **Reduce, Reuse, Recycle:** Conservation efforts are guided by the "3 R's" principle, which promotes waste reduction, material and product reuse, and material recycling to extend their lifespan. This approach minimizes resource extraction and waste disposal, conserving valuable resources.

b) **Material Efficiency:** Design strategies focusing on material efficiency aim to minimize the use of raw materials and optimize resource utilization. This includes incorporating lightweight materials, modular designs, and innovative construction techniques that reduce material waste during manufacturing, construction, and operation.

c) **Sustainable Material Selection:** The selection of sustainable and environmentally friendly materials is critical for resource conservation. This involves choosing materials with low embodied energy, considering their life cycle impacts, and prioritizing renewable, recyclable, or locally sourced materials. Sustainable material choices promote resource conservation and minimize environmental harm.

d) **Sustainable Waste Management**: Proper waste management practices, including waste segregation, recycling, and composting, play a vital role in conserving materials and resources. Recycling and reusing materials decrease the need for raw material extraction, while composting organic waste contributes to the creation of nutrient-rich soil amendments.

Chapter Three

Research Methodology

3.1 Research Design

This section focuses on the method used to assess information sources and study the proposed building type based on literature review.

3.2 Case Studies Selection Criteria

A total of five case studies were carried out, each symbolizing and identifying instances possessing certain intrinsic qualities that pertain to the proposed design, including;

- The first case study is **Maroc Telecom, located in Rabat, Morocco**, it serves as an international example of a purpose-built telecommunications headquarters that incorporates sustainable and environmentally-friendly architectural practices. Evaluating this type of building is crucial as it provides essential guidance during the design process.
- The second case study, the **Telecom Office Building in Portugal**, another international example. This building represents a retrofitted telecommunications headquarters, which is a common approach for telecom companies due to their continuous growth. Despite being a converted structure, it incorporates elements of sustainability.

- The third case study is the **MTN PLACE Office complex in Falomo Lagos Nigeria,** representing a local example of a retrofitted telecommunications headquarters. As with the previous case, the retrofitting is due to the growth of telecom companies. Despite the conversion, the building prioritizes sustainability and integrates green architectural practices.
- The fourth case study, **Heritage Place, Lagos Nigeria,** which is an office building that would serve as the foundation of a building with adequate analysis in scope of facilities required to make it operate as an office building and as a facility that has employed the concept of energy efficiency strategies.
- The fifth case study, **Sterling Bank, Lagos Nigeria**, is a project study of where BIPV solar panels has been integrated which has drastically cut down the energy cost and has reduced the environmental footprint of the building as a whole.
- The sixth case study, **GTbank Data Centre, Lagos Nigeria**, is a project study on a data center design which gives an insight about the technicality of this type of design.

3.3 Case Study Analysis Framework

The framework employed in this study, derived from existing literature on design strategies, focuses on assessing the environmental sustainability of buildings. This framework will be used to evaluate case study 1-4 based on the following key components:

- **Sustainable Site Design:** This aspect of the framework examines how well the building integrates with its surroundings, considering factors such as site selection, land use, and ecological preservation. It assesses the extent to which the case studies incorporate sustainable site planning and design principles, such as minimizing environmental impact, preserving biodiversity, and promoting efficient land use.

- **Water Conservation and Quality:** This component evaluates the case studies' water management practices, including the efficient use of water resources, implementation of water-saving technologies, and strategies for maintaining water quality. It considers measures such as rainwater harvesting, water-efficient fixtures, wastewater treatment, and stormwater management to ensure responsible water consumption and protection of water resources.
- **Energy and Environment:** This dimension focus on the energy efficiency and environmental performance of the buildings. It assesses factors such as energy consumption, renewable energy integration, indoor environmental quality, and reduction of greenhouse gas emissions. The framework evaluates how effectively the case studies incorporate energy-efficient systems, utilize renewable energy sources, enhance occupant comfort, and minimize their environmental footprint.
- **Conservation of Materials and Resources:** This element examines the case studies' approach to sustainable materials selection, waste reduction, recycling, and resource conservation. It assesses strategies such as using recycled or locally sourced materials, implementing efficient construction techniques, and adopting practices that minimize waste generation and promote the circular economy.

By employing this comprehensive framework, the study will systematically evaluate each case study's environmental sustainability across these four key dimensions. The outcomes will provide valuable insights into the effectiveness of the design strategies implemented in the case studies, facilitating knowledge and insights into the proposed design.

3.4 Case study 1 - Maroc Telecom, RABAT, MOROCCO

3.4.1 Description of the Building

The Maroc Telecom tower is a 135-meter-high office building in Rabat, Morocco, designed by French architects, Jean-Paul Viguier and Associates.

The project consists of;

- Main building (Glass Tower) - an 87m high skyscraper with 20 floors, and
- an auditorium building with 4 underground parking levels (approx. 410 cars).

The 20-storey tower offers over 27000 sqm of premium office space in a striking angular form that adds character to the skyline of the Moroccan city.

Figure 3.1 : Exterior view of Maroc Telcom Building showing the office and auditorium
Source- (Takuji S)

Figure 3.2 : Exterior view of Maroc Telcom auditorium with 4 underground parking levels
Source- (Takuji S)

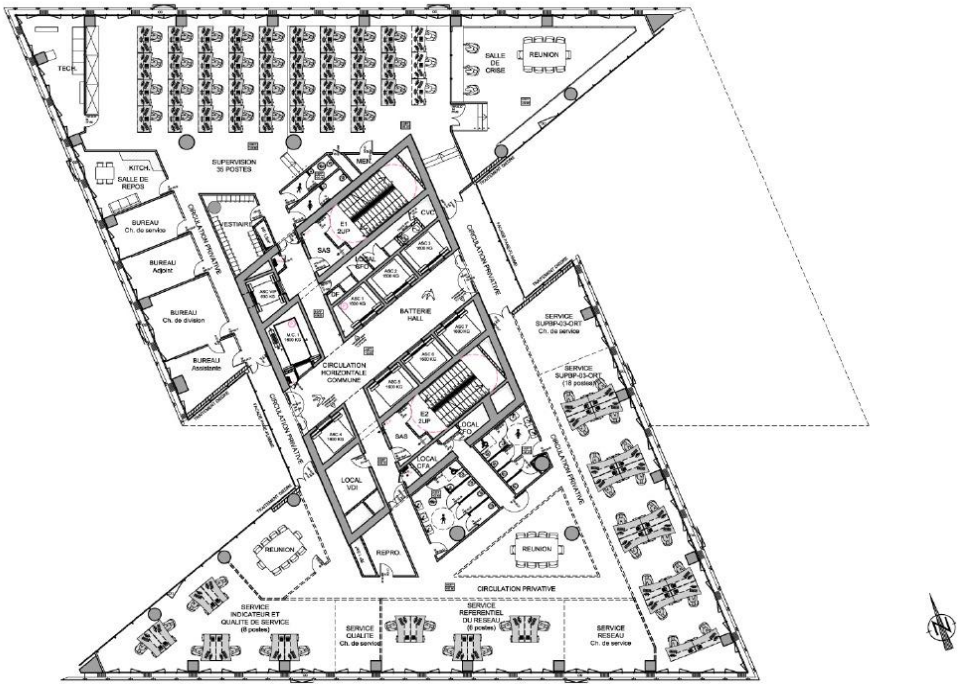


Figure 3.3 : Floor plan layout of Maroc Telcom office building
Source- (Takuji S)

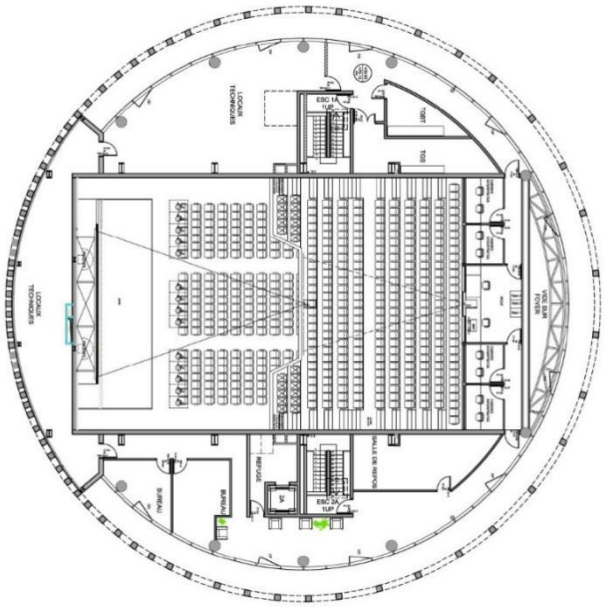


Figure 3.4 : Floor plan layout of Maroc Telcom Office Building
Source- (Takuji S)

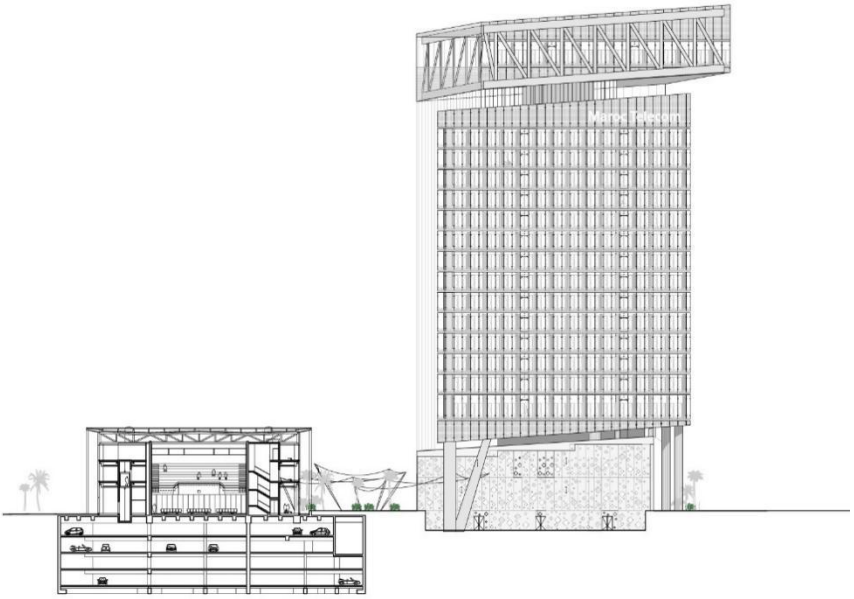


Figure 3.5 : Sectional view cutting the main building and the auditorium of Maroc Telecom
Source- (Takuji S)

3.4.2 Framework Analysis

3.4.2.1 Sustainable Site Design

a) **Site Selection:** The choice of the site for Maroc Telecom involved careful consideration of environmental factors. Sustainable site planning taken into account the site's accessibility, proximity to public transportation, and existing infrastructure to minimize the need for new construction and reduce transportation-related emissions.

b) **Land Use Optimization:** Sustainable site planning aims to optimize land use efficiency. This involved designing the site to maximize the building's footprint while minimizing disturbance to natural features. The layout of the telecommunications headquarters has been strategically planned to minimize the impact on the surrounding environment and make efficient use of available space.

c) **Stormwater Management:** Techniques such as permeable pavement, rain gardens, or retention ponds have been incorporated to capture and treat rainwater on-site, reducing the strain on local drainage systems and minimizing water pollution.

d) **Ecosystem Preservation** - Efforts may have been made to protect and integrate natural features, such as trees, green spaces, or wetlands, into the design of the headquarters.

e) **Outdoor Environment:** Consideration of the outdoor environment is crucial in sustainable site planning. The design of Maroc Telecom has incorporated outdoor spaces that promote occupant well-being, such as gardens, courtyards, or outdoor seating areas. These spaces provide access to nature, enhance the quality of the outdoor environment, and promote a healthier and more enjoyable workplace for employees.

Figure 3.6 : 3d view of the Maroc Telcom Building
Source- (Takuji S)

3.4.2.2 Water Conservation and Quality

a) **Water-Efficient Fixtures:** Maroc Telecom have incorporated water-efficient fixtures throughout the building, such as low-flow toilets, faucets, and showers. These fixtures are designed to minimize water consumption without compromising functionality, helping to conserve water resources.

b) **Wastewater Treatment:** Sustainable practices have included the treatment of wastewater generated within the building. Wastewater treatment systems, such as greywater recycling or on-site wastewater treatment plants.

c) **Stormwater Management:** To mitigate stormwater runoff and protect water quality, Maroc Telecom have employed stormwater management strategies. These could include the use of permeable surfaces, such as pervious pavement or green roofs, to allow water to infiltrate the ground instead of running off into storm drains.

3.4.2.3 Energy and Environment

a) **Energy Efficiency Measures:** The telecommunications headquarters have implemented various energy efficiency measures to reduce overall energy consumption. This includes the use of energy-efficient lighting systems, such as LED lighting, occupancy sensors, and daylight harvesting techniques to optimize natural lighting and minimize reliance on artificial lighting.

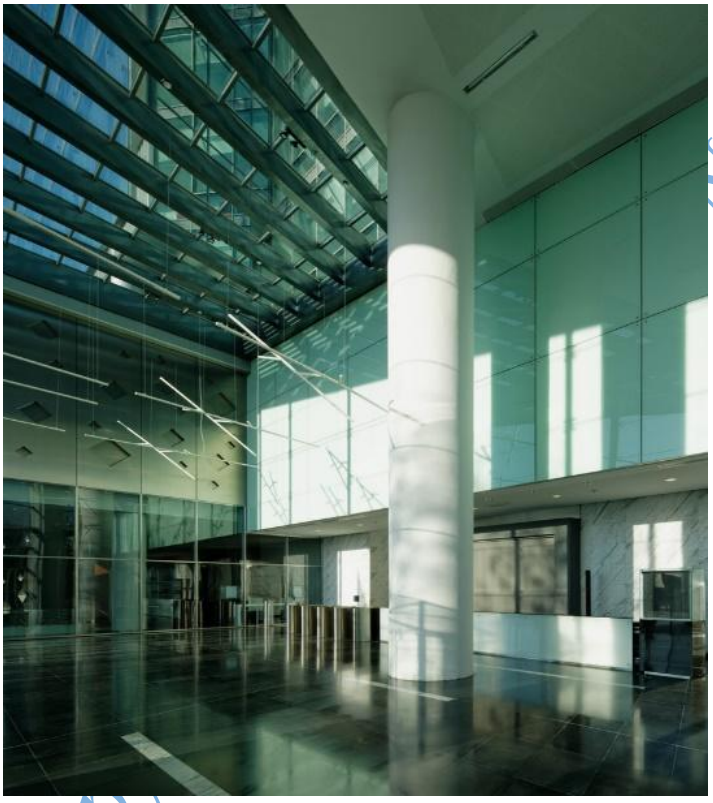


Figure 3.7 : Interior view of Maroc Telcom Building office building
Source- (Takuji S)

Figure 3.8 : Exterior view of the Maroc Telcom Building office at night showing LEED lighting systems
Source- (Takuji S)

b) **Renewable Energy Integration:** Maroc Telecom have incorporated renewable energy sources to meet a portion of its energy needs. By utilizing clean, renewable energy, the headquarters have reduced its reliance on fossil fuel-based energy and contributed to a lower carbon footprint.

c) **Indoor Environmental Quality:** The design and operation of Maroc Telecom have prioritized indoor environmental quality to create a healthy and comfortable working environment for occupants. Strategies could include proper ventilation systems, control of indoor air quality, and the use of low-emission building materials to minimize the presence of harmful pollutants.

Figure 3.9 : Interior view of the Maroc Telcom Building office
Source- (Takuji S)

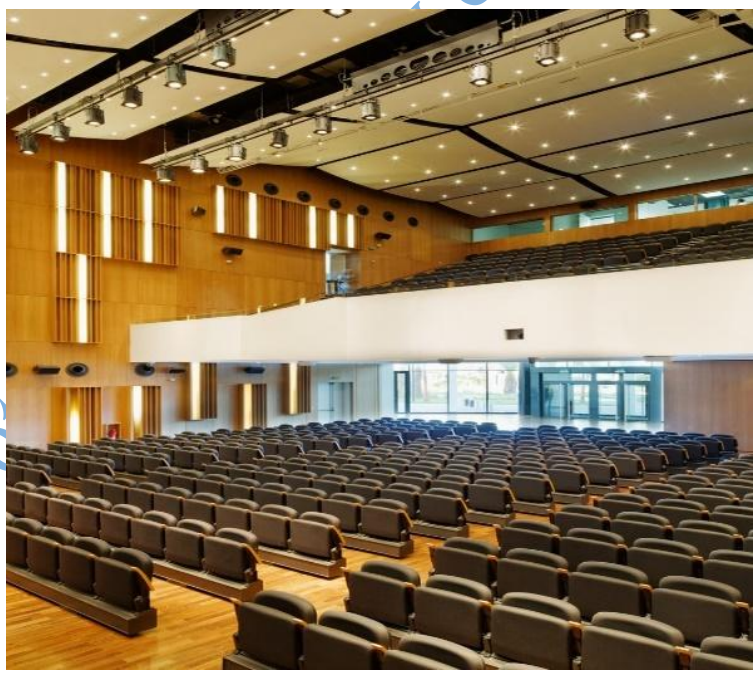


Figure 3.10 : Interior view of the Maroc Telcom auditorium
Source- (Takuji S)

3.4.2.4 Conservation of Materials and Resources

a) **Sustainable Materials Selection:** The construction and design of Maroc Telecom have prioritized the use of sustainable and environmentally friendly materials.

b) **Waste Reduction and Recycling:** Waste reduction strategies have been employed to minimize construction and operational waste.

c) **Efficient Construction Techniques:** Sustainable construction techniques have been utilized to optimize resource use during the building's construction phase. Efficient construction techniques help reduce the overall environmental impact associated with the construction process.

3.4.3 Building Appraisal

a) **Reduction of Energy Consumption** - The methods of reducing energy consumption indicate a thoughtful approach to energy efficiency. The use of movement detectors in the meeting rooms allows for the air conditioning to be limited or adjusted based on occupancy. This ensures that energy is not wasted on cooling or heating empty rooms, contributing to overall energy savings. Additionally, the rotating metallic blinds on the building's glass facade can be adjusted to control the amount of sunlight entering the building. By managing natural light, the need for artificial lighting can be reduced, further decreasing energy usage.

b) **Optimal Water Management, Thermal and Acoustic Comfort, and Safety** - The design of the building has achieved optimal water management, ensuring efficient usage and conservation of water resources. This includes the installation of water-saving fixtures, such as low-flow toilets and faucets, as well as systems for rainwater harvesting or greywater recycling.

c) **Use of Sustainable Energy** - The building utilizes renewable energy sources. This includes the installation of solar panels or wind turbines to generate electricity, thereby reducing reliance on

fossil fuels and decreasing the carbon footprint of the building. Sustainable energy sources contribute to a cleaner and more sustainable environment.

d) **Proper Zoning and Well Laid Out Circulation** - Proper zoning refers to the effective division of space within the building for different purposes or functions. This allows for efficient utilization of the available area and optimized use of resources. Zoning can involve separating areas for specific activities, such as workspaces, meeting rooms, common areas, or utility rooms.

3.5 Case Study 2 - Telecom Office Building, Portugal

3.5.1 Description of the Building

The building was remodeled from an office designed building to a telecommunication headquarters. The building dates back to the 70's, being the architectural character clearly associated with that decade. Despite being originally built for the same office functions and purpose, the adopted inner organization became gradually obsolete, facing the technical, functional and safety requirements demanded by the per formative needs of a contemporary office's building.

Project Information

- **Architects:** Oficina Ideias Em Linha: Oficina Ideias Em Linha - José Laranjeira
- **Area :** 10000 m²
- **Year :** 2010
- **Photographs :** Francisco Nogueira
- **Location :** Portugal

Figure 3.11 : Exterior view of Telecom Office Building, Portugal
Source- (Francisco Nogueira)

3.5.2 Framework Analysis

3.5.2.1 Energy And Environment

a) **Energy Efficiency Measures:** The telecommunications headquarters have implemented various energy efficiency measures to reduce overall energy consumption. This includes the use of energy-efficient lighting systems, such as LED lighting, occupancy sensors, also, introduction of passive security system, as well as thermal and acoustic insulation, enhanced the building's functional performance and increase its comfort standards.

b) **Indoor Environmental Quality:** The retrofitting process of Telecom Office Building have prioritized indoor environmental quality to create a healthy and comfortable working environment for occupants. This upgrade allowed the inner areas to benefit from natural lighting and ventilation, and the thermal comfort needed by office activities, which the building will now house in optimal per formative conditions.

Figure 3.12 : Interior view of Telecom Office Building, Portugal
Source- (Francisco Nogueira)

3.5.2.2 Conservation of Materials and Resources

a) **Sustainable Materials Selection:** The retrofitting process of Telecom Office Building, have prioritized the reintegration of sustainable and environmentally friendly materials.

b) **Waste Reduction and Recycling:** Waste reduction strategies have been employed to minimize construction and operational waste.

c) **Efficient Construction Techniques:** The original façade system was replaced and reinforced by shading panels fixed over a technical corridor levelled with each floor concrete slab, along the southern - and most exposed - facade.

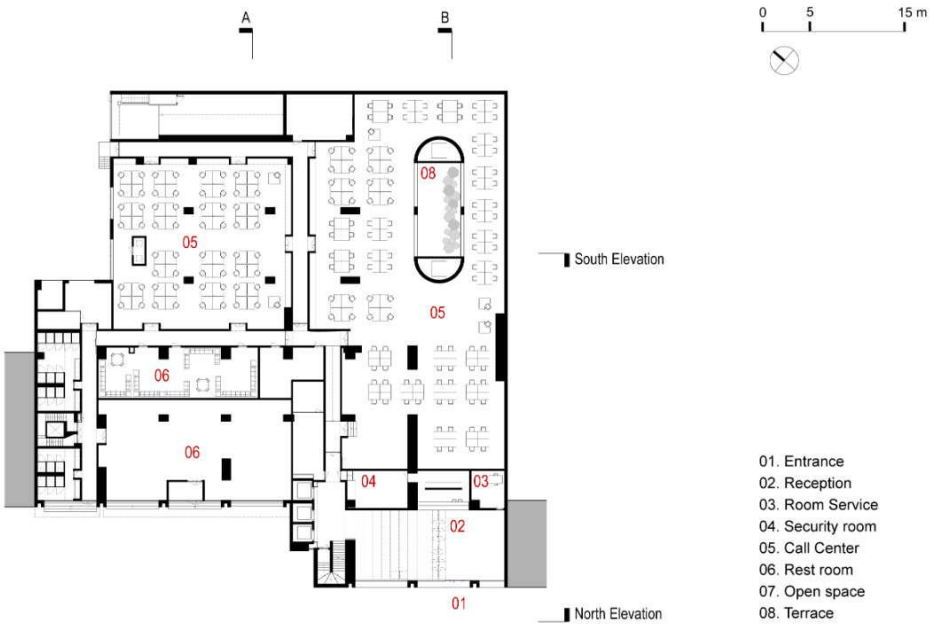


Figure 3.13 : Ground floor plan view of Telecom Office Building, Portugal
Source- (Francisco Nogueira)

Figure 3.14 : First Floor Plan and Typical Floor Plans of Telecom Office Building, Portugal
Source- (Francisco Nogueira)

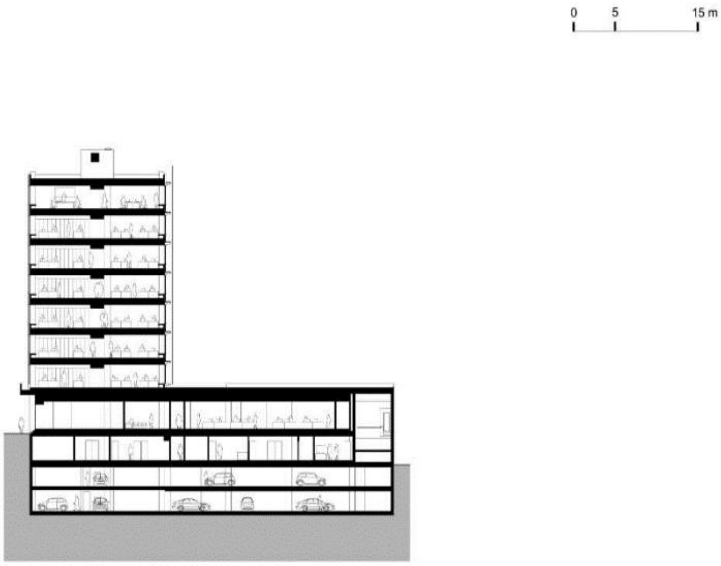


Figure 3.15 : Sectional View Showing Underground Parking of Telecom Office Building, Portugal

Source- (Francisco Nogueira)

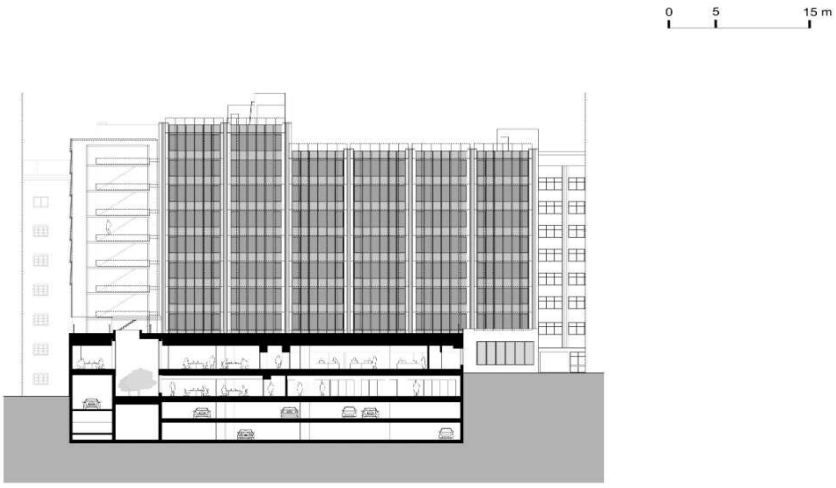


Figure 3.16 : Sectional View of Telecom Office Building, Portugal Showing Underground Parking

Source- (Francisco Nogueira)

3.5.3 Building Appraisal

a) **Reduction of Energy Consumption:** Despite being a remodeled building, efforts have been made to reduce energy consumption. This indicates that energy-efficient measures have been implemented during the renovation process. These measures include; the installation of energy-efficient appliances, and LED lighting, improved insulation, and better control systems for heating, ventilation, and air conditioning (HVAC) systems. By reducing energy consumption, the building becomes more environmentally friendly and can potentially save on operational costs.

b) **Natural Lighting and Ventilation:** The remodeling has allowed the inner areas of the building to benefit from natural lighting and ventilation. This means that design changes have been made to maximize the use of natural light sources, such as; windows, and skylights, or light tubes. Additionally, the building has been designed or modified to facilitate proper airflow and ventilation, which can contribute to a healthier and more comfortable indoor environment for office activities.

c) **Thermal Comfort and Functional Performance:** The upgraded building now provides the thermal comfort required for office activities. Furthermore, measures have been taken to enhance the safety and security of the building without relying heavily on active security measures like alarms or surveillance systems. Additionally, thermal and acoustic insulation has been incorporated, reducing heat transfer and noise transmission, respectively. These improvements enhance the building's functional performance and increase comfort standards for its occupants.

d) **Well-Laid-Out Circulation:** This implies that the layout and design of the building have been carefully considered to ensure smooth and efficient circulation. Well-planned circulation pathways can contribute to better traffic flow within the building, minimizing congestion and improving accessibility. This can be achieved through thoughtful placement of corridors, staircases, elevators, and other circulation elements.

e) **Consideration for the Environment:** The remodeling process has incorporated environmentally friendly practices. This includes; the use of sustainable materials, implementation of energy-efficient technologies, water-saving fixtures, and waste management systems. By considering the environment, the building demonstrates a commitment to reducing its ecological footprint and promoting sustainability.

3.6 Case Study 3 - MTN PLAZA Office Complex, Falomo Lagos

3.6.1 Description of the Building

Project Information

- Original: Unknown
- Interior Retrofit: Consultants Collaborative Partnership (CCP)
- External: Adeniyi Coker Consultants Limited (ACCL)
- Multi-Storey Car-Park, Energy Centre, Jetty: ACCL

MTN Nigeria Telecommunications Ltd. (MTNN) head office functions are situated within the MTN Plaza Office complex which are strategically located at Falomo, Ikoyi, Lagos. The complex spans facilities located on both sides of Falomo Bridge and also includes jetty facilities. The complex comprises of a retrofitted main office building, purpose built multi-storey car park and energy and services building. Additional parking is also accommodated under Falomo Bridge.

Figure 3.17 : Existing Retrofitted MTN PLAZA Office
Source- (Adeniyi Coker Consultants Limited (ACCL))

Main Office Building Description

11 Floors (11,000m^2 approx.) accommodating;

- Service Centre,
- Mini Auditorium, and
- Administrative Offices.

The building was originally built in the early seventies and as a purpose-built office facility.

The building was retrofitted by MTNN to accommodate its head office functions.

Multi-Storey Car Park

7-Storeys (31,000m^2) accommodating;

- Event Centre, and

- Administrative Offices.
- Multi-storey car park consisting of
    - 600 regular (buses and cars) and
    - 42 disabled parking spaces.

Energy Centre

Energy/services Building accommodating;

- Generators,
- Main Load Voltage Room,
- Water and Sewage Treatment Plants.

3.6.2 Framework Analysis

3.6.2.1 Energy And Environment

a) Use of Variable Refrigerant Flow (VRF) air condition / cooling Systems.

b) Use of LED Lighting.

c) Use of special thermal windows glazing system on façade.

d) Insulated and ventilated Wall cladding system.

e) Use of motion detector sensors for lighting and access systems.

3.6.2.2 Water Conservation and Quality

a) Use of grey water to flush toilets.

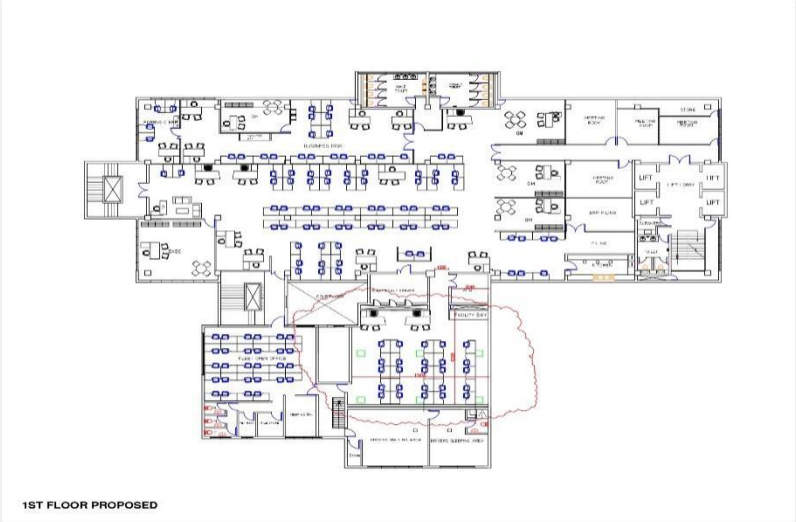


Figure 3.18 : MTN PLAZA Office 1st Floor Plan
Source- (Researcher's Field Work)

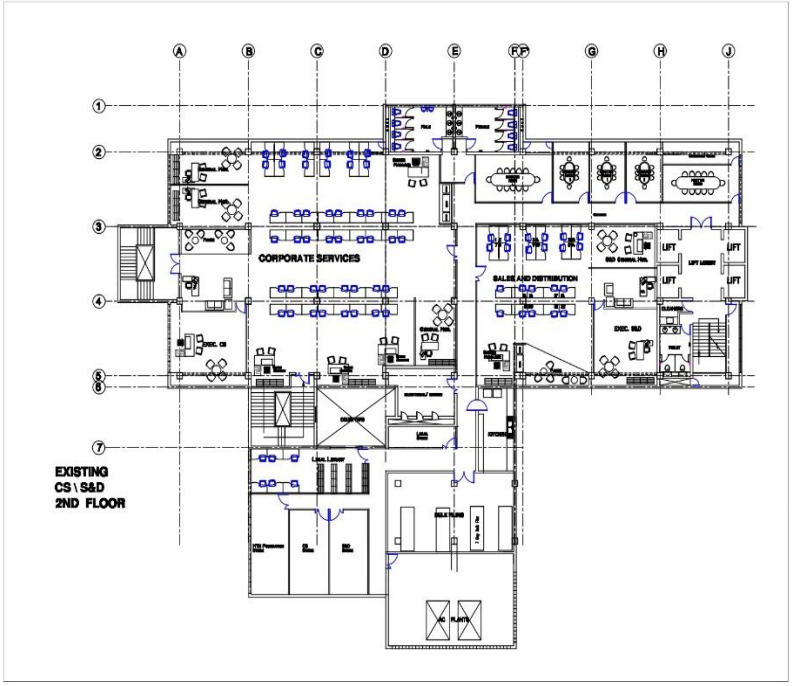


Figure 3.19 : MTN PLAZA Office 2nd Floor Plan
Source- (Researcher's Field Work)

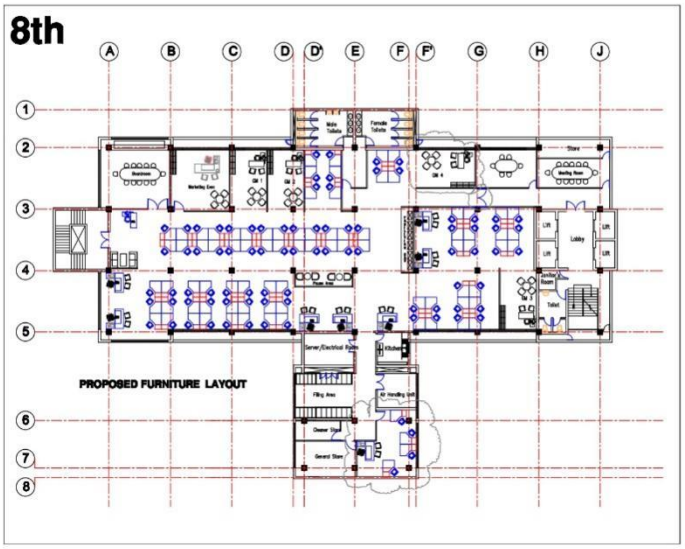


Figure 3.20 : MTN PLAZA Office 8th Floor Plan
Source- (Researchers' Field Work)

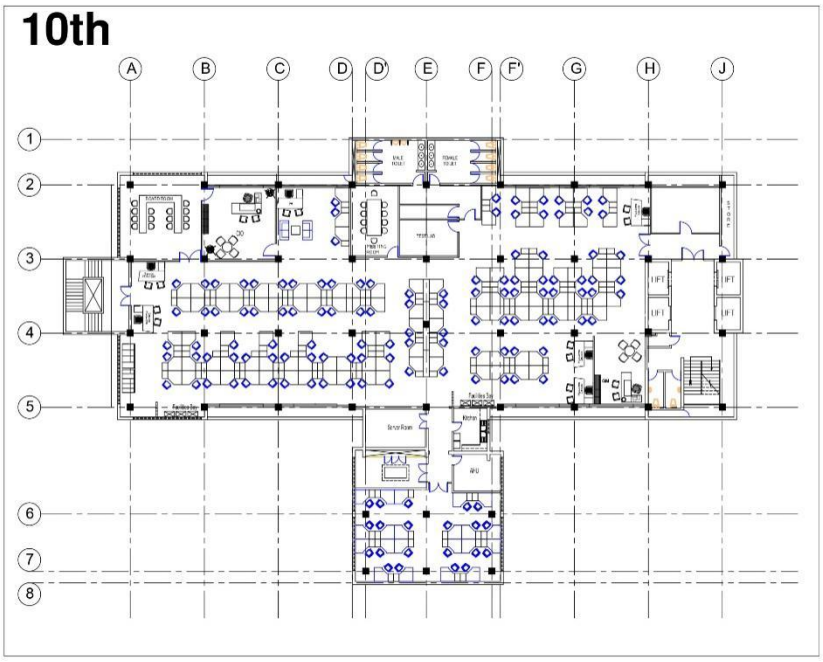


Figure 3.21 : MTN PLAZA Office 10th Floor Plan
Source- (Researcher's Field Work)

3.6.3 Building Appraisal

3.7 Case Study 4 - Heritage Place, Lagos.

3.7.1 Description of the Building

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

Figure 3.22 : Exterior View of Heritage Place
Source- (Google search)

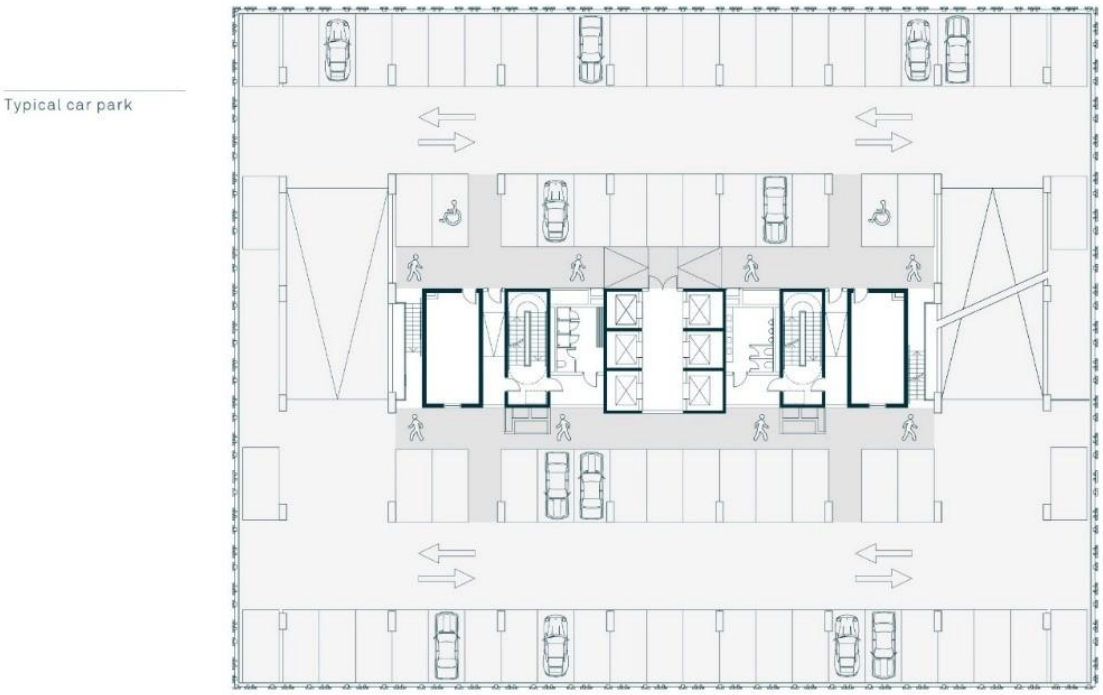


Figure 3.23 : Multilevel Parking Heritage Place
Source- (Google search)

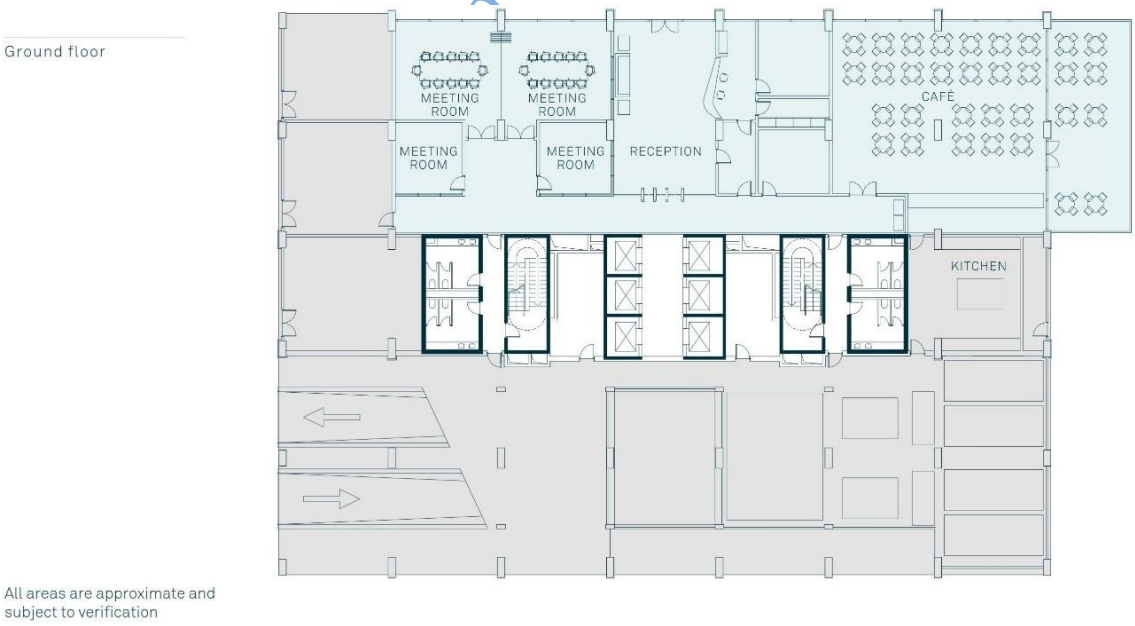


Figure 3.24 : Ground Floor Plan Heritage Place
Source- (Google search)

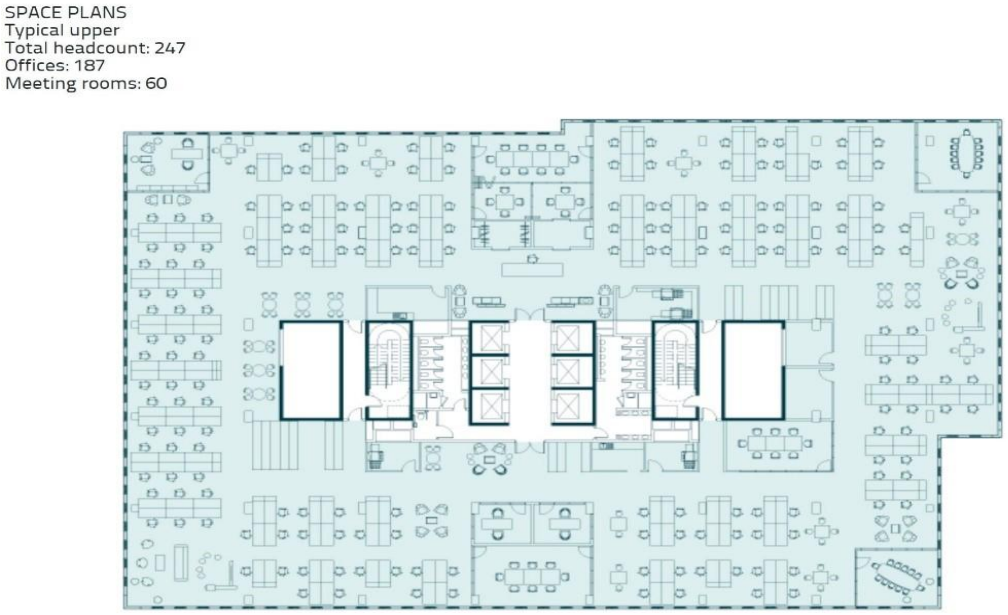


Figure 3.25 : Typical Floor Plans Heritage Place
Source- (Google search)

3.7.2 Framework Analysis

3.7.2.1 Water Conservation and Quality

a) Rainwater is collected and reused in the watering of the gardens, condensate is recovered from the building's cooling units, and precise control systems are installed in the bathroom facilities to minimise water waste.

b) Utilizing rainwater collection and condensate recovery from cooling systems to reduce potable water consumption.

c) Utilization of collected water for toilet flushing and irrigation.

d) Storm water attenuation to handle a storm that occurs once every twenty years.

3.7.2.2 Energy and Environment

a) Automatic presence detectors and high-efficiency lights decrease and replenish energy on demand.

b) High-efficiency lighting and automatic presence detection.

c) Ventilation rates, material quality, and outside views enhance the thermal and visual comfort of the occupants and the quality of the interior air.

d) Heat recovery by use of the centralised ventilation system (cooling).

e) Hand-wash basins and urinals with motion sensors contribute to a reduction in potable water usage.

3.8 Case Study 5 - Photovoltaic Façade - Sterling Bank, Lagos.

3.8.1 Description of the Building

Project Team:

- Client: Sterling Bank, Lagos Nigeria
- Project Developer: PriVida Limited
- EPC Company: PriVida Power Limited
- OEM: Onyx Solar
- Architect: TLL Consult Limited

Project Facts:

- Total Area - 6,500 m^2
- Electricity generated in 35 years - 24,094,796 kWh
- Total lighting points operating 4 hours per day in 35 years - 47,342 lighting points
- CO2 emissions avoided in 35 years - 10,433 Tons of CO2

- Barrels of oil saved in 35 years - 14,178 barrels

Figure 3.26 : Exterior View of Sterling Bank, Lagos
Source- (Google search)

Figure 3.27 : Exterior View of Sterling Bank, Lagos
Source- (Google search)

- There are 3,250 photovoltaic glasses in this installation, covering a total area of 6,500 m2 and 1 MW of installed power. This project sets a new milestone by being the largest photovoltaic integration (BIPV project) in the continent.

Figure 3.28 : Exterior View of Sterling Bank, Lagos
Source- (Google search)

- Each PV glass measures 2,000x1,000 mm, and contains a blue ceramic frit to match Sterling Bank's aesthetic requirements.
- The glass configuration on each unit is 4+4 mm.
- Originally built in the 1980's, this photovoltaic integration provides Sterling Bank with an innovative design while providing the bank's employees with ample free and clean energy for their use.

3.8.2 Building Appraisal

- Energy efficient design which successfully integrates various elements to achieve these goals.
- Reduction in GHG emissions.
- A comfortable building for users resulting in reduced sick days and potentially aiding in the retention of staff.

- A unique building which will be a landmark, lighthouse project.
- Education of professionals and public about environmentally and socially responsible design.

3.9 Case Study 6 – Gtbank Data Centre, Lagos.

3.9.1 Description of the Building

The new Data Center has been commissioned to replace an existing facility, the site, located in Ikoyi, Lagos has an approximate measurement of 1,342.5 m2. The proposed Data Center, has a GIA of 2,000 m2.

There are two primary function zones incorporated into the building, made up of;

- the Data Center Zone which is the core of the development, and
- and the Services/Support Zone.

To enhance the common basic looking facility structure, it is proposed that the building be externally finished with aluminum cladding to achieve a modern and interesting elevation.

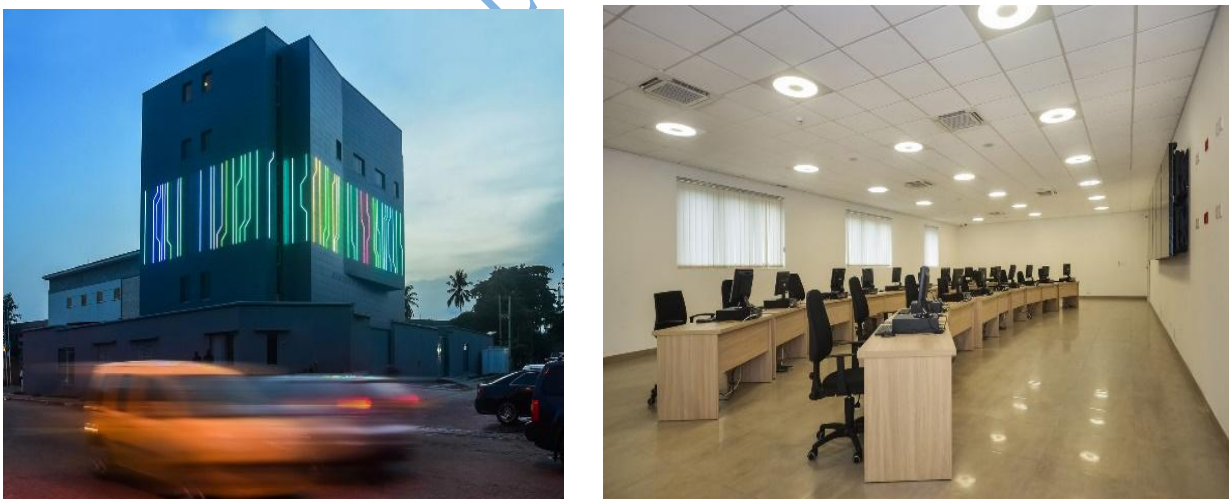


Figure 3.29 : Exterior and Interior View of GTbank Data Centre, Lagos
Source- (Google search)

Figure 3.30 : Exterior and Interior View of GTbank Data Centre, Lagos
Source- (Google search)

3.9.2 Building Appraisal

- Great scalability.
- Best flexibility.
- Maximum security.

3.10 Summary of Case Studies Findings and Deductions

Table 3.1 : Degree of Adoption of Environmental Sustainability Amongst Case Studies

Buildings	*Design Strategies*	*Degree of Adoption*			
		High Priority	*Moderate Priority*	*Low Priority*	*Not a Priority*
Maroc Telecom Tower, Rabat, Morocco	Sustainable Site Design		●		
	Water Conservation and Quality	●			
	Energy and Environment	●			
	Conservation of Materials and Resources		●		

Portugal Telecom Building, Lisbon, Portugal	Sustainable Site Design		●
	Water Conservation and Quality		
	Energy and Environment	●	
	Conservation of Materials and Resources		●
MTN Plaza Office Complex, Lagos, Nigeria	Sustainable Site Design		●
	Water Conservation and Quality		●
	Energy and Environment		●
	Conservation of Materials and Resources		●
Heritage Place, Lagos.	Sustainable Site Design		●
	Water Conservation and Quality		●
	Energy and Environment		●
	Conservation of Materials and Resources		●

Source (Researcher's Field Work)

Chapter Four

Site Analysis and Design Synthesis

4.1 Study Area

Lagos, situated in the southwestern part of Nigeria along the Atlantic Ocean, stands as one of the world's prominent cities and holds the distinction of being Africa's most populous, surpassing Cairo. It serves as Nigeria's largest city and serves as the nation's economic hub, commonly referred to as a "MEGACITY" due to its population of over double the required 10 million people. Diversifying its

economy beyond oil, Lagos boasts a varied economic landscape, with thriving industries in manufacturing, transport, construction, service, wholesale, and retail sectors.

In addition to its economic significance, Lagos plays a vital role culturally and economically, not only in Nigeria but also within the broader African context. Its strategic geographic location along Nigeria's Atlantic coastline facilitates excellent trade routes. The city also boasts a major airport and strong railway and road connections to other Nigerian cities, further enhancing its importance in regional and national commerce.

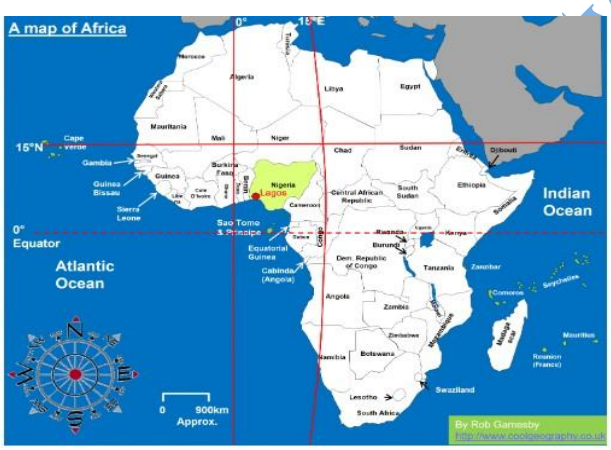


Figure 4.1 : Map of Africa
Source- (Google search)

The physical Geography of Lagos is dominated by its system of islands, sandbars, and lagoons. The islands are connected by bridges and the land is low-lying.

4.1.1 Site Location

The proposed site is at Falomo, Lagos State, which is located on the island in ikoyi at the heart of the Central Business District where most businesses are headquartered in Lagos. This is a strong and good advantage for the proposed development.

Figure 4.2 : Map of Lagos
Source- (Google search)

4.1.2 Site Selection Criteria

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

4.1.2.1 Economic Focal Point

- Lagos, being Nigeria's largest city, ranks as the second most populous city in Africa.
- As a significant economic hub in Nigeria, Lagos contributes approximately 10% to the country's GDP.
- The Central Business District on the Island serves as the primary center for commercial and financial activities, housing the headquarters of numerous commercial banks, financial institutions, and major corporations in the country.
- Additionally, Lagos holds a prominent position as the primary Information Communications and Telecommunications (ICT) hub in West Africa and has the potential to become the largest ICT market on the continent.

4.1.2.2 Land Use

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

4.1.3 Accessibility

The land should be accessible easily by most intended user of the facility through vehicle, water way and pedestrian.

4.1.4 Services

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

4.1.5 Topography

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

4.1.6 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.

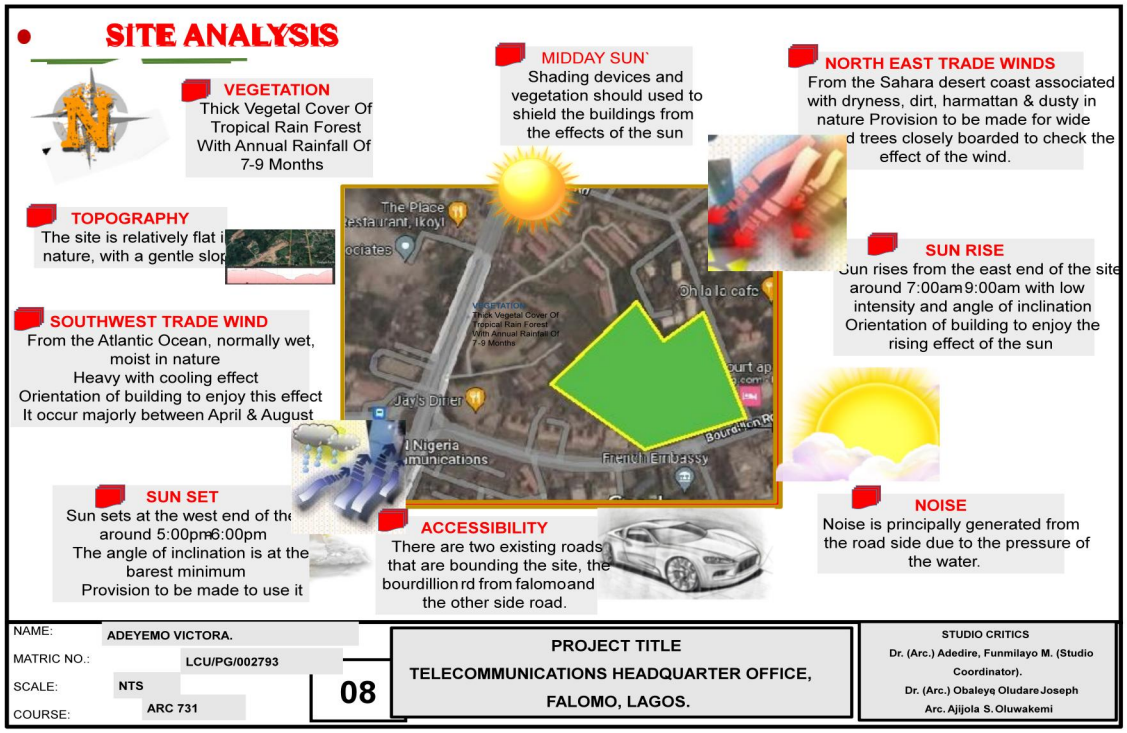


Figure 4.3 : Site Analysis
Source- (Researcher's Field Work)

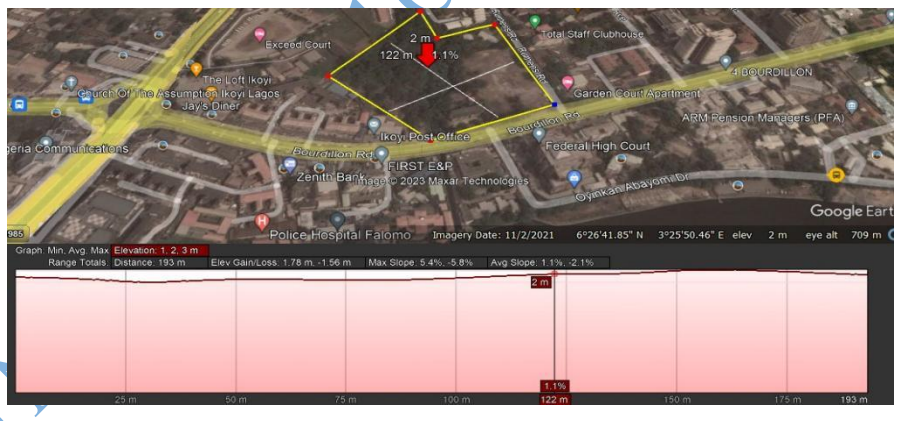


Figure 4.4 : Site Analysis Showing Site Section
Source- (Researcher's Field Work)

4.1.6.1 Site Accessibility

The site has easy and convenient access for both vehicular Water Way and pedestrian. The site is accessible from the major road that comes from the burdillion road in Lagos.

4.1.6.2 Nearness to Public Utilities

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

4.1.6.3 Drainage and Topography

The site has a gentle slope spread evenly throughout. Drainages are also in place for water collection which drains into the lagoon after the jetty terminal.

4.1.6.4 Vegetation

Lagos is located within the tropics, and 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.

4.1.6.5 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.

4.1.6.6 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 long sides (east and west) elevations are positioned such that they receive the maximum amount of air. The shorter sides of the proposed mall face the direction of the north-east trade wind

4.2 Project Analysis and Design Synthesis

4.2.1 Brief Analysis

There is a growing demand and concerns on the telecommunications industry to seek ways to reduce the emissions into the environment, however, the existing MTN head office which is a retrofitted building in Lagos, has not fully reduced their carbon footprints, thereby the need to design an environmentally sustainable telecommunication head office building.

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 the proposed design. These spaces are;

- Indoor parking
- Outdoor parking
- Convenience
- Reception
- Waiting Area
- Electrical Room
- Break out spaces
- Data Centre
- Circulation Area
- Restaurant
- Offices
- Outdoor Sitting Area
- Service circulation

- Security post

4.2.3 Design Considerations

- **BIPV (Building Integrated Photovoltaics) Solar Panels**

BIPV panels have been integrated on the facade and all the sides of the proposed telecom building and the data centre design, to generate clean and renewable electricity so as to reduce the heating and the cooling cost of running the building thereby reducing the carbon foot print of the proposed design. These solar panels have been incorporated directly into the building's design and construction, serving as both an energy-generating system and a structural element.

- **Sustainability**

Sustainable design principles have been adopted to minimize the building's environmental footprint which include energy-efficient materials, implement water conservation measures, optimize waste management systems, and prioritize the use of renewable resources.

- **Aesthetics and Branding**

MTN company's brand identity has been adopted on all the facades of the building's design. Considering architectural elements, signage, and interior design that align with the company's visual identity, values, and culture.

- **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.

- **Security**

The proposed telecommunication head office building has been designed to house critical infrastructure and sensitive data.

4.2.4 Conceptual Development

The architectural conceptual development for the MTN Telecom Nigeria's Telecommunications Headquarters in Falomo, Lagos, prioritizes environmental sustainability. The primary objective of this study was to create a facility that is environmentally friendly and reduces its impact on the planet.

To achieve this, several design strategies were carefully integrated during the planning stage. The first key approach involves the implementation of Building-Integrated Photovoltaic (BIPV) solar panels. These solar panels will be integrated into the building's design to harness solar energy and minimize reliance on fossil fuels and natural gas, thereby promoting renewable energy usage.

In addition to renewable energy, the traffic circulation within the building's vicinity was subjected to thorough analysis. The goal was to optimize the layout and minimize vehicular emissions, thereby contributing to improved air quality and reduced environmental impact.

Another crucial aspect of the design is the incorporation of efficient water plumbing fixtures. Water-saving fixtures will be utilized to promote water conservation and reduce unnecessary water consumption, supporting sustainable water management practices.

To further enhance energy efficiency, the building will be equipped with energy-efficient lighting equipment. These lighting fixtures will significantly reduce energy consumption and, in turn, lower the overall energy demand of the facility.

Overall, the combination of these sustainable design strategies ensures that the proposed MTN Telecom Nigeria's Telecommunications Headquarters will have a minimal carbon footprint. By

prioritizing environmental sustainability, the building will serve as a model for responsible construction and contribute positively to the surrounding ecosystem and community.

4.2.5 Functional Relationship

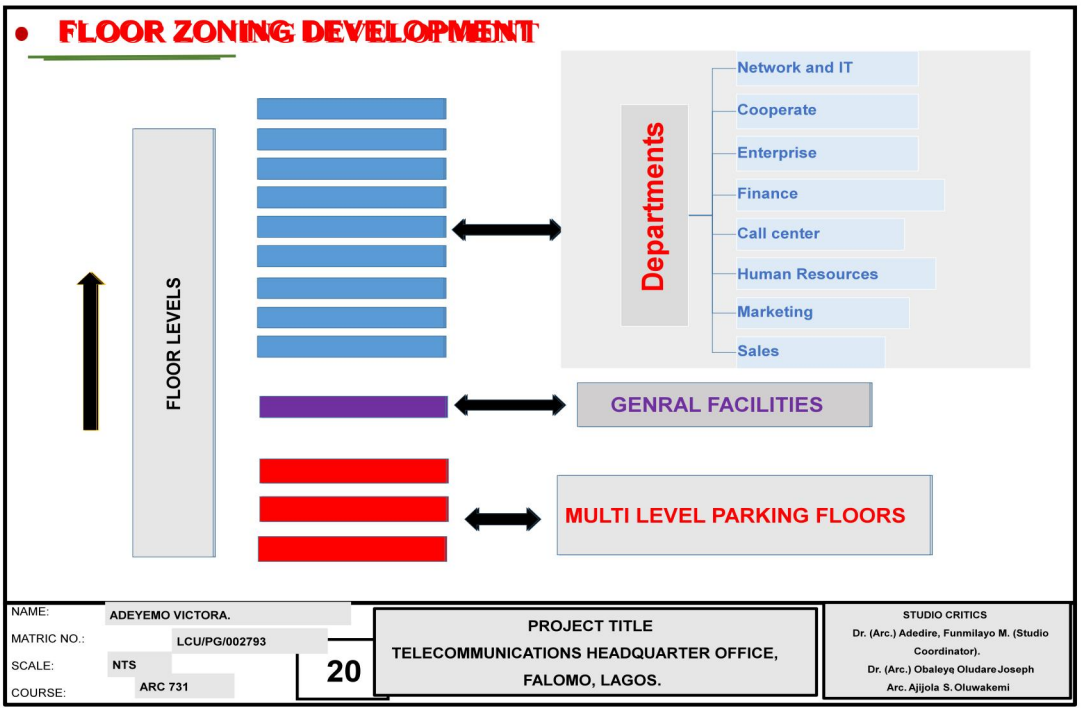


Figure 4.5 : Floor Zoning Development of the Proposed Telecom Building
Source- (Researcher's Field Work)

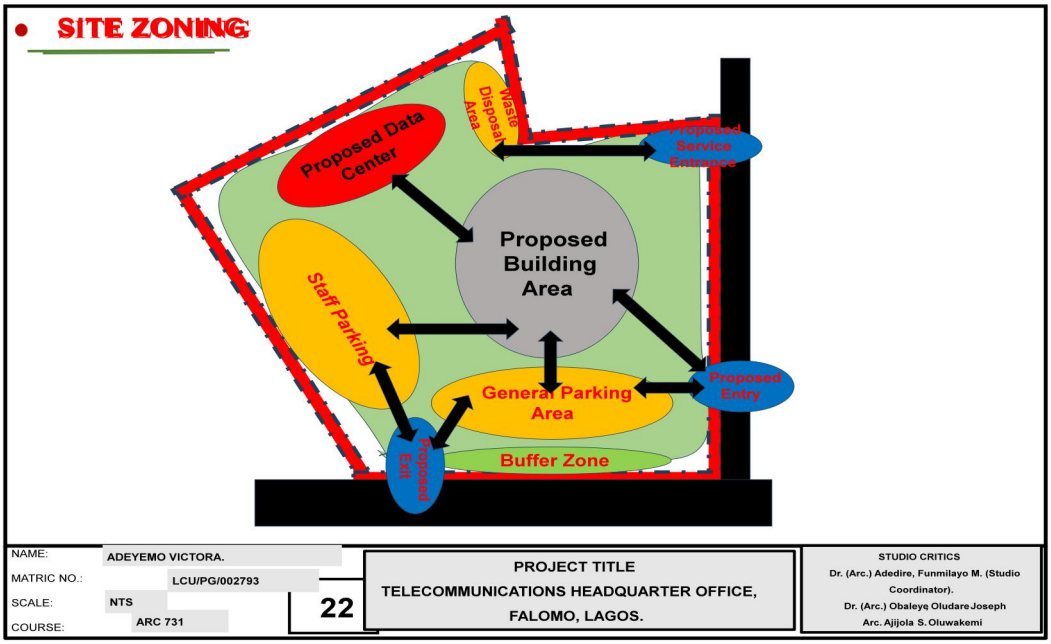


Figure 4.6 : Site Zoning of the Proposed Telecom Building
Source- (Researcher's Field Work)

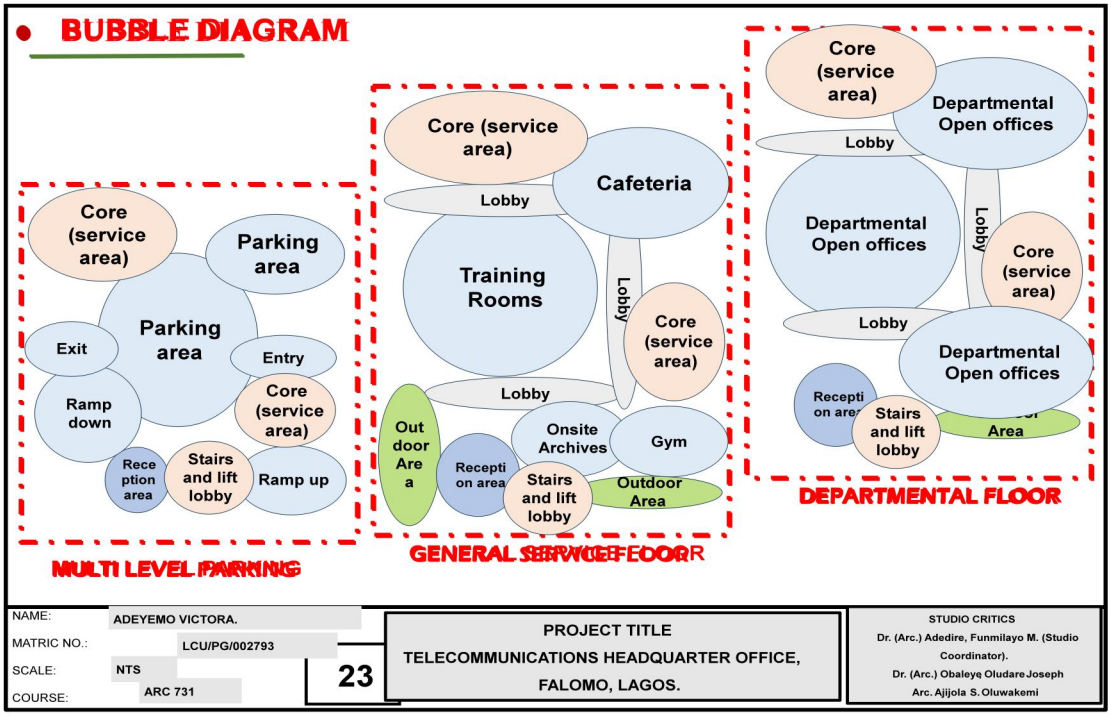


Figure 4.7 : Bubble Diagram of the Proposed Telecom Building
Source- (Researcher's Field Work)

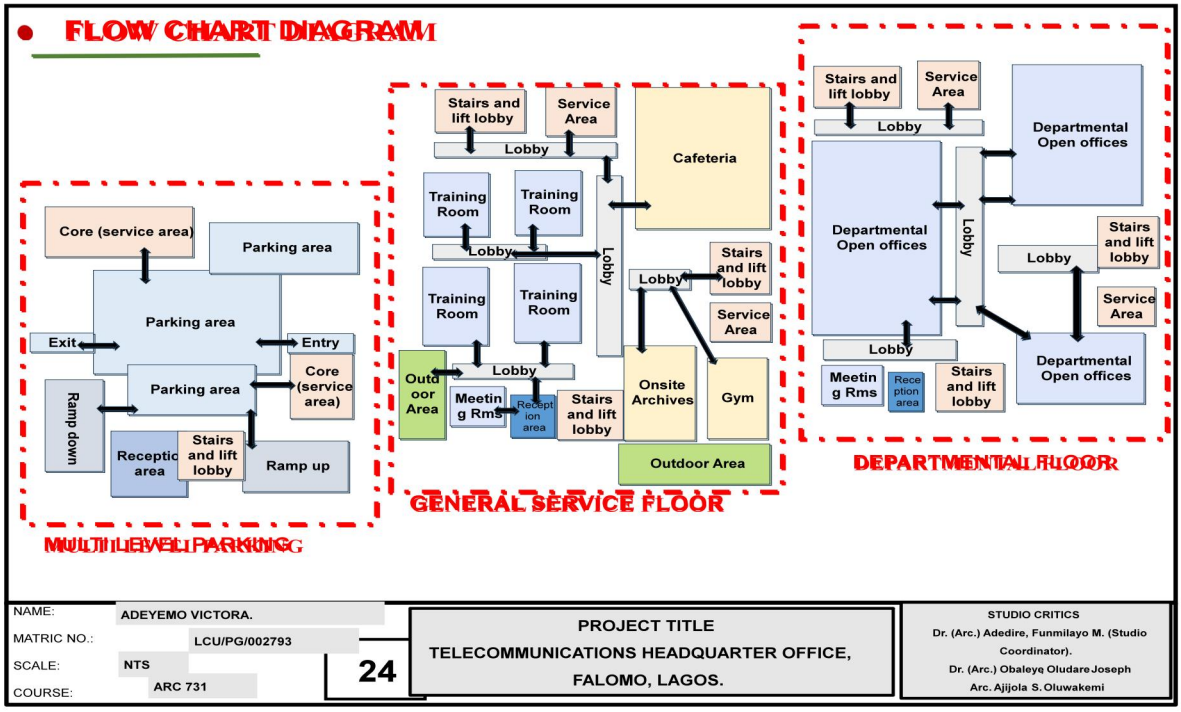
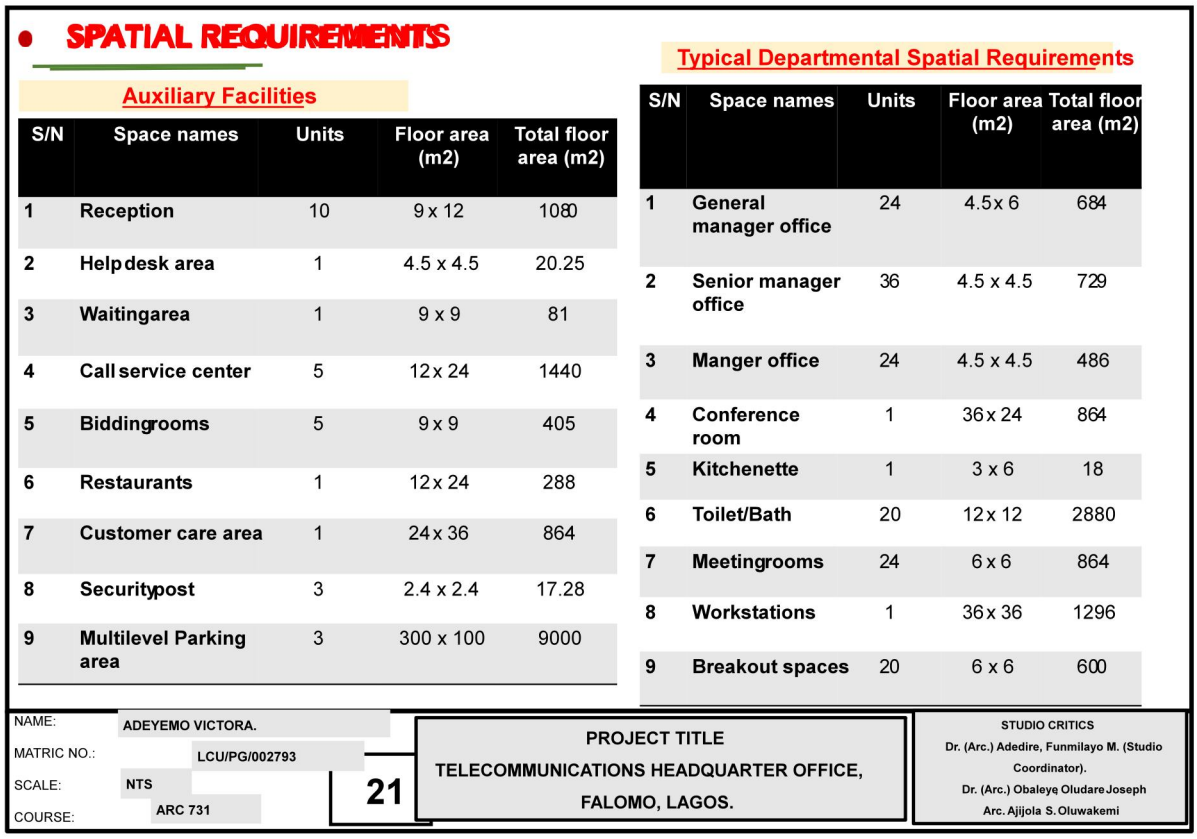


Figure 4.8 : Flowchart Diagram of the Proposed Telecom Building
Source- (Researcher's Field Work)

4.2.6 Space Allocation / Schedule of Accommodation



SPATIAL REQUIREMENTS

Auxiliary Facilities

S/N	Space names	Units	Floor area (m2)	Total floor area (m2)
1	Reception	10	9 x 12	1080
2	Help desk area	1	4.5 x 4.5	20.25
3	Waiting area	1	9 x 9	81
4	Call service center	5	12 x 24	1440
5	Bidding rooms	5	9 x 9	405
6	Restaurants	1	12 x 24	288
7	Customer care area	1	24 x 36	864
8	Security post	3	2.4 x 2.4	17.28
9	Multilevel Parking area	3	300 x 100	9000

Typical Departmental Spatial Requirements

S/N	Space names	Units	Floor area (m2)	Total floor area (m2)
1	General manager office	24	4.5 x 6	684
2	Senior manager office	36	4.5 x 4.5	729
3	Manger office	24	4.5 x 4.5	486
4	Conference room	1	36 x 24	864
5	Kitchenette	1	3 x 6	18
6	Toilet/Bath	20	12 x 12	2880
7	Meeting rooms	24	6 x 6	864
8	Workstations	1	36 x 36	1296
9	Breakout spaces	20	6 x 6	600

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COURSE: ARC 731
21
PROJECT TITLE
TELECOMMUNICATIONS HEADQUARTER OFFICE, FALOMO, LAGOS.
STUDIO CRITICS
Dr. (Arc.) Adedire, Funmilayo M. (Studio Coordinator).
Dr. (Arc.) Obaleye Oludare Joseph
Arc. Ajijola S. Oluwakemi

Figure 4.9 : Spatial Requirements of the Proposed Telecom Building
Source- (Researcher's Field Work)

4.2.7 Construction Methods and Materials

The chosen construction method for the civil work will be the framing system. While most other components will be fabricated on-site and positioned accordingly. The steel work will be prefabricated and installed on-site.

Considering the nature of the site soil, the building will be supported using a pile foundation with deep pile columns. To ensure safety and durability, all wiring and piping will be conducted through conduits, and water supply pipes will be made of PPR (Polypropylene Random) with fewer joints to minimize potential leakages. The external work will be meticulously finished, with the planting of trees that will

be well-guarded to promote healthy growth. Additionally, concrete paving stones will be utilized to create walkways. The major construction materials will be concrete, steel and glass.

4.2.8 Building Services

4.2.8.1 Water Supply

The site has access to water supply from the lagoon, however 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 each floor for easy maintenance.

4.2.8.2 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 as the BIPV solar panels have been integrated to cut down the cooling and power cost. Transformer will also be installed on the site because of the amount ofpower needed by the facility.

4.2.8.3 Refuse Disposal

The building refuse disposal shall be collected from floor to floor using the core area of services at the rear side and shall be stored at the waste disposal area at the back side of the facility where disposal agency will come for the final disposal.

4.2.8.4 Waste Water and Sewage Disposal

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

4.2.8.5 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 and Recommendation

5.1 Project Appraisal

The focus of this study was to design an environmentally sustainable telecommunication head office facility for MTN Telecom Nigeria. To achieve this, various design strategies were integrated during the design stage. These strategies include the use of BIPV solar panels to reduce reliance on fossil fuels and natural gas, careful analysis of traffic circulation to minimize vehicular emissions, incorporation of efficient water plumbing fixtures, utilization of energy-efficient lighting equipment, and the implementation of automatic sensors in spaces. Collectively, these measures have significantly reduced the carbon footprint of the proposed building.

5.2 Conclusion

In today's interconnected world, telecommunications play a pivotal role in connecting people and places, fostering the idea of a "global village." However, while they contribute significantly to development, telecommunications also contribute to growing concerns about greenhouse gas (GHG) emissions due to their reliance on non-renewable energy sources. This study has identified several design strategies that can promote environmental sustainability and reduce carbon emissions in telecommunication facilities. These strategies encompass sustainable site design, water conservation and quality, energy efficiency, and the conservation of materials and resources.

By incorporating these design strategies during both the design and construction phases, telecommunication companies can decrease their dependence on non-renewable energy sources, ultimately achieving environmental sustainability.

5.3 Recommendation.

i. **Promoting Sustainable Site Design:** It is essential to encourage widespread adoption of sustainable site design strategies in the telecommunications industry.

ii. **Enhancing Water Conservation Measures:** Emphasize the importance of water conservation in telecommunications buildings and implement water-efficient fixtures.

iii. **Improving Energy Efficiency:** Encourage the implementation of energy-efficient measures to enhance the overall energy performance of telecommunications buildings.

iv. **Prioritize Waste Management:** Promote the principles of reduce, reuse, and recycle in waste and water management practices.

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Appendices - Appendix 1 – Presentation Drawings

Drawings too heavy… cannot attcah (since I'm sending via email in word document).

Bio-data

A. Personal Data

1. Full Name:	**ADEYEMO Victor Adedeji,**
2. Address:	32, Animashaun Steet, Liberty Rd, Ringroad Challenge, Ibadan
3. Email Adress:	adeyemovictor253@gmail.com, adeyemo.victor@lcu.edu.ng
4. Phone Number:	09064433894
5. Date of Birth:	15th march 2001,
6. Place of Birth:	Oyo, Oyo state
7. Nationality:	Nigerian
8. Marital Status:	Single

9. Name and Address of Next of Kin: ADEYEMO Oluwaseyi Simeon

08101002057

B. Educational Background

1. Educational Institutions Attended with Dates and Qualification:

Qualifications	Institution	Date
MSc Architecture	Lead City University, Ibadan, Oyo State.	2021 - Date (Ongoing)
BSc. Architecture (First Class Degree Honour)	Lead City University, Ibadan, Oyo State.	2017-2021
Secondary School Certificate	Olivet Baptist High School, Oyo, Oyo State.	2011-2017
Primary School leaving Certificate	Faith International Nursery and Primary School, Oyo, Oyo State	2005-2011

C. Awards and Fellowships:

i. Best Graduating Student in the Faculty of Environmental Management and Design, Lead City University, Ibadan 2021
ii. Financial Secretary at the Department of Architecture, Lead City University 2020 -2021
iii. Most Popular Award 400 Level Male (Department of Architecture), Lead City University. 2021
iv. Certificate of Participation; Who wants to be an Architect? 2018
v. Certificate of Participation; 5th Annual OBA ADEYEMI Mathematics competition, NAOS, 2016
vi. Certificate of Honour, Senior Prefect Boy, Olivet Baptist High School. 2017

D. Work Experience: With Dates

Company/Institution	Description	Date
Lead City University, Ibadan, Oyo State.	• Graduate Assistantship	2021- Date (Ongoing)

Decent Design and Construction Limited, Abeokuta, Ogun state	• Site supervision • Interpretation of Drawings on site • Subcontractors' selection and payment • Procurements of Building Materials • Site meetings coordination and report writings • Client Negotiation	2019 – Date (Ongoing)
Project Office Bashorun under Living Faith Church, Ibadan, Oyo State.	• A year internship program	2018-2019
MOTECH Engineering and Construction Limited	• Site supervision • Interpretation of Drawings on site • Subcontractors' selection and payment	2019-2021

E. Publications –

1. An assessment of Environmentally Sustainable Design Strategies in selected Telecommunications Office Buildings.
Authors - Victor Adedeji ADEYEMO[1], Yetunde Olajumoke FASHEUN-MOTESHO[2], [3] Funmilayo Mokunfayo ADEDIRE
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2. Architectural Criticism: A Review of Types and Context
Authors – Yetunde Olajumoke FASHEUN-MOTESHO[1,] **Victor Adedeji Adeyemo**[2], Oludare J. Obaleye[3], Oluwatosin Dorcas Ayanleke[4]
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3. Understanding Categories, Credits and Prerequisite in Green Building Rating System.
Authors - Victor Adedeji ADEYEMO[1], Funmilayo M. ADEDIRE[1], Saudat O. AJIJOLA[3], Almustapha BAWA[4], Marvel Ewaoluwa OYEDEJI[5], Oluwatobi Benjamin ADELEKE[6], Oluwafemi A ADEWUMI[7]
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…… ……

Signature Date

The University Compliance Certification

This is to certify that the Thesis by Victor Adedeji ADEYEMO, with the matriculation number LG/PG/002793 in the Department of Architecture, Faculty of Environmental Design and Management Lead City University, Ibadan, is in full compliance with the University format and style of Thesis.

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