Sustainable Design Principles in the Design of Office Complex

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Certification

This is to certify that, Aliu Ayobami HUSSAIN with matriculation number LCU/PG/002752 carried out this research work titled 'Sustainable Design Principles in The Design of Office Complex.' in the department of Architecture, Faculty of Environmental Design and Management, Lead City University, Ibadan, Oyo State, for the award of Master Degree in Architecture. The thesis is an outcome of an independent and original work. I have duly acknowledged all the sources from which the ideas and the extracts have been taken. The project is free from any plagiarism and has not been previously submitted.

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Dr. (Arc) F. Adedire
(Head of Department)

Date

Dedication

I dedicate this research work to Almighty God and my loving family.

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Acknowledgement

My sincere and profound greeting goes first to almighty God for seeing me through right from the beginning of this program till this moment and given me the knowledge, wisdom and understanding in my research. Your wonderful name will be glorified forever (amen).

My appreciation goes to Lead City University who gave me the platform to engage in this MSc program. I will always be grateful for their guidance, and constructive criticism and for sharing brilliant knowledge with me throughout the duration of the program.

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Abstract

It is now essential to the creation of office complexes that sustainable design principles are incorporated, as it has become with modern architecture and urban planning. The importance and use of sustainable design principles in office complex projects are discussed in this essay. This study emphasizes the many advantages of sustainable design, including energy efficiency, less environmental impact, and enhanced occupant well-being, by studying numerous case studies and pertinent literature. The application of important sustainable design principles to the development of office complexes is examined, including passive design methods, effective building systems, the integration of renewable energy sources, and responsible material choices. Additionally, the financial benefits of implementing sustainable practices are looked at, with a focus on the higher market value and long-term cost reductions connected to green buildings. According to the study's findings, the application of sustainable design concepts in office buildings promotes environmental responsibility while also fostering the creation of healthier, more productive work environments and a more sustainable future. This research offers crucial insights and recommendations for architects, developers, and politicians in the development of sustainable and resilient office complex buildings as corporations and governments prioritize environmental stewardship and human-centric design.

Keywords: Sustainability, Office Complex, Sustainable Design, Design Principles

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Chapter One
Introduction

1.1 Background to the Study

The art and science of creating and supervising structures is know n as architecture. Any given design must take into account the need for the right amount of space for a certain activity (Spenser, Robert, Eunkyu, & Andrew, 2016). Performing arts, corporate operations management, decision-making, and the effective arrangement of personnel and other resources to focus efforts on shared objectives and pursuits are all included in administration. Ashmienetal. (2018).

Every university or college's administrative body serves as its primary academic organ, according to Perez-Lombardo et al. (2008). It is the governing body of all colleges and universities and is usually the highest authority in academia for all establishments. The administrative hub of the whole institution is the administrative building. The building's main purpose is to promote improved interactions between staff, students, and visitors. All of the school's senior executives as well as the supporting administrative personnel have offices in this facility. Major decisions pertaining to the organization are also made centrally at the Administrative building. The administrative chambers discuss matters of an academic nature that have an impact on the school as a whole, the institution's development, the decision-making process, approval of all study plans, calendar publication, decisions about how exams will be conducted, fellowship awards and terms, the institution's operating budget, the construction of buildings and other capital facilities that the school needs, and the creation of policies governing the central academic services of the institution. There are only a few people in the administration. According to Perez-Lombard (2008), Brown (2010), and Mu'azu (2012), this group of people creates a normative organizational framework that allows schools to carry out their function in college and university governance. They establish programs that stem from the institution's core purpose and develop particular goals for each program. They are required to handle the whole spectrum of academic and administrative issues. The administrative structure of an organization determines which units and levels are engaged in the planning process. A political structure, a collegium, or a bureaucracy may all be examples of the administrative building. Even though this means that school government cannot be entirely democratic, certain democratic institutions and tenets that have been suitably adjusted have been crucial to school governance. An underlying belief that the administrative staff is an essential component of a logical, hierarchical organization (bureaucracy) is suggested by the identification of the senate's role in decision-making and the focus placed on goal-setting, resource allocation, and assessment. In a political system, the administration is seen as a venue for the expression of viewpoints and as the place where compromise, diplomacy, and the building of alliances are used to decide on institutional policies and objectives. Although an office is typically a room or other space used for administrative tasks, it can also refer to a position within an organization with particular responsibilities (see officer, office-holder, and official); the latter usage is actually an older one, with office originally meaning the place where one was assigned to perform their duties.

An iconic building that has always enhanced city skylines, office complexes are a large variety of buildings that are essential to the economic development of metropolitan areas (Francis 1997). This may refer to a 100-story urban high-rise or a two-story suburban building. The building may be designed with pure speculation in mind, housing whichever tenants decide to occupy it, or it might be specifically designed to meet the requirements of a corporate headquarters. The office complex, in whatever size or shape, is a complex building typology that is influenced by a multitude of factors. Its primary function is to house tenants, guests, and office supplies while also enabling office operations; yet, the way it is designed has a significant impact on how well these functions are carried out (Stewart 1994). A speculative or corporate office complex involves a large number of people and companies in its design. Clearly, the kind of user—such as investment banks, professional businesses, or high-tech companies—determines the nature of an office complex (Stewart 1994). The building's idea, marketability, and floor plan are often determined by the

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demands of these customers. Given that most office buildings in developing and tropical regions may not have reliable access to enough energy, office complexes in these regions are starting to use more flexible layouts, flexible office supplies and equipment, integrated services, etc. As a result, the need of designing office complexes in an ecologically responsible manner is highlighted by including open-office layouts for more flexibility in office space, alternative lighting options, and adequate ventilation systems in buildings in case of a power outage. In 2013, Zhang, Athalye, Hart, Rosenberg, Xie, Goel, Mendon, and Liu. A place initially used to refer to the site of one's job, an office is often a room or other facility where administrative work is done, but it may also refer to a position within an organization with particular tasks associated (Long 2004). The word "office" may also refer to duties linked to business when used as an adjective. When it comes to legal writing, a corporation or firm is considered to have offices wherever it maintains an official presence—even if that presence is more akin to a storage silo than an actual office. Whether it's a little office like a seat in the corner of a very small firm, to full floors of buildings, or even large skyscrapers devoted to one company, an office is an architectural and design phenomena. Nowadays, an office is often defined as a place of employment for white-collar employees. According to business administrator James (2012), an office is the area of a company dedicated to organizing and directing its many operations. In the High Middle Ages (1000–1300), the medieval chancery emerged, which was typically the location where most official correspondence was written and where laws were copied in the administration of a kingdom. In classical antiquity, offices were frequently a part of palace complexes or sizable temples (Hamilton 2011). The first purpose-made office buildings were created in the 18th century when vast, complicated enterprises began to expand. The sectors of banking, rail, insurance, retail, petroleum, and telegraphy all saw significant growth as the Industrial Revolution accelerated in the 18th and 19th centuries. These businesses required a huge number of clerks, who in turn required additional office space to accommodate these operations. The "Modern Efficiency Desk," which has a flat top and drawers underneath, was created to provide supervisors an easy view of the workers thanks to F.

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W. Taylor's time and motion research, which was pioneered in the manufacturing industry. But by the middle of the 20th century, it was clear that privacy needed to be managed carefully in order for an office to function well, and so the cubicle system developed (Eugene and Paul 2002). Encouraging people to do their jobs is the primary goal of an office setting. Conventional office tasks including writing, reading, and using a computer are usually done in work areas. Cheshire and Hilber (2008) identified nine general categories of work spaces, each catering to a distinct set of tasks. Apart from private cubicles, the facility also has lounges, conference rooms, and areas for administrative tasks like filing and photocopying. Additionally, some companies feature a kitchen where employees may prepare their own meals. While there are many various methods to set up an office depending on its purpose, organizational styles and the culture of individual businesses may be even more significant. Although offices may be constructed in almost any area or structure, some contemporary requirements—such as those for networking, security, and lighting—make this more challenging. An office complex's main objective is to provide managerial and administrative staff members a location to work and live (Juriaan and Hermen 2010). These employees often operate in designated parts of the office building and are given access to desks, computers, and other necessary equipment. Therefore, this project centers on integrating the natural environment as a major element influencing the design of office complexes, it will also explore alternate ways of achieving safety, sustainability, adaptability and comfort in office complexes at the lowest possible cost.

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1.2 Statement of Problem

Building energy consumption is a major worldwide conversation topic due to sustainable development and its wider environmental implications. Several studies (Brown, 2010; Mu'azu, 2012; Perez-Lombard, 2008). One significant and frequent issue with office complexes is the building's reduced energy efficiency, which is a fundamental architectural aspect for office buildings and is now a worldwide issue, mostly in developing countries like Nigeria. Due to insufficient consideration of natural lighting and ventilation (tropical architecture) during the design stage, it has been shown that office operations in these office complexes come to a complete halt during power outages (Zhang et al 2015). In order to create an office complex design that works with our surroundings and adapts to its natural qualities, this study aims to identify best practices for using these natural aspects. (UNEP, 2022).

1.3 Aim and Objectives

The research aim is to explore the sustainability design principles suitable for office complex buildings.

The objectives of this research are to:

1. To identify architectural design elements influencing sustainability of office complex buildings.
2. To examine how architectural design elements can be manipulated to promote sustainability of office buildings in Nigeria.
3. To propose a design of a sustainable office complex/administrative building for Federal College of Education, Ekiadolor, Benin City taking into consideration modern technology and building materials to conform to modern day requirement.

1.4 Research Questions

This research intends to answer the following questions:

1. How do architectural design elements influence the sustainability?
2. How can architectural design elements be used in the design of an office buildings to promote sustainability?
3. To produce a design of a sustainable office complex

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1.5 Significance of Study

Recent architectural publications are focused on office design and space planning with emphasis on contemporary furniture in office complexes, but mention very little on sustainable concept in the overall aspects of office design and influences. Sustainable development in office design appears to be ignored. Designers are most concerned with the most expensive devices for heating and refrigeration, although there are exceptions where architects and engineers do consider sustainability in construction and design, but more in residential and commercial buildings, but a few on office buildings.

This paper will focus on the study and analysis of the sustainable office complex design, in the term of research, the innovation planning, construction methods and renewable energy sources used in Nigeria, to assess what level the office building in Nigeria is, how the office complex in Nigeria is developing, and what changes will need to be considered.

1.6 Scope of Project

Using case studies from existing office buildings, a thorough examination of early building design technology worldwide will be compared with modern designs. The various office buildings will then be examined in relation to sustainability and the buildings' capacity to adapt in the event of a power outage, which will also cause the air conditioners to stop working and cause visibility to deteriorate. Data from case studies is used in descriptive analysis, and research is done on the safety precautions that should be implemented in office buildings. A survey of current office buildings will be undertaken in order to collect crucial data on the technology used in the building's sustainability and flexibility. Throughout the research process, helpful literary resources including books, periodicals, journals, and the internet will be examined and proved to be quite beneficial.

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1.7 Definition of Terms

Sustainability: The ability to maintain and preserve the ecological balance and usability of a building over time, specifically with minimal or no ongoing costs. This encompasses the long-term viability of a building without compromising its environmental impact or user experience.

Sustainable Design: A design approach aimed at mitigating adverse impacts on the environment, as well as enhancing the well-being and comfort of building occupants to improve overall building performance. The core objectives involve reducing the consumption of non-renewable resources, minimizing waste, and creating environments that foster health and productivity. Embracing a sustainable design philosophy entails making decisions at each stage of the design process that curtail negative environmental effects and enhance occupant health, all while maintaining financial viability. This approach is integrative and holistic, requiring a willingness to make compromises and trade-offs.

Design Principles: The fundamental rules that guide the creation of effective and aesthetically pleasing compositions. These principles include Emphasis, Balance and Alignment, Contrast, Repetition, Proportion, Movement and Unity.

Office Complex: A large-scale building or group of interconnected buildings designed primarily for office work. Office complexes typically accommodate multiple tenants and may include shared amenities, such as conference rooms, cafeterias, and fitness centers.

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Chapter Two
Literature Review

2.1 Conceptual Review

Originally referring to the site of one's job, an office is often a room or other facility where administrative work is done, but it may also refer to a position inside an organization with particular tasks associated. Long (2004). The word "office" may also refer to duties linked to business when used as an adjective. When it comes to legal writing, a corporation or firm is considered to have offices wherever it maintains an official presence—even if that presence is more akin to a storage silo than an actual office. Whether it's a little office like a seat in the corner of a very small firm, to full floors of buildings, or even large skyscrapers devoted to one company, an office is an architectural and design phenomenon. Nowadays, an office is often defined as a place of employment for white-collar employees. An office is that portion of a commercial firm that is dedicated to the supervision and coordination of its many operations, according to business administrator James (2012). Encouraging people to do their jobs is the primary goal of an office setting.

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Although offices may be constructed in almost any area and in nearly any kind of structure, this is made more challenging by some contemporary office needs. These specifications may be technical (such as those pertaining to computer networking) or legal (such as the need that light levels be adequate). In addition, additional needs like security and flexible floor plans have prompted the development of unique structures intended solely or mostly for use as offices. (Ghillyer, 2012). A kind of commercial structure with spaces primarily intended for use as offices is an office building, often referred to as an office block or business center. An office building's main function is to house administrative and management staff members and provide them with a space to work. These employees often operate in designated locations of the office building and are given desks, PCs, and other necessary equipment for these spaces. Office buildings may be devoted to one firm or split into parts for many businesses. Either way, every business will usually feature a lobby, one or more conference rooms, individual or open-plan offices, and restrooms. Richard (2006).

While there are many various methods to set up an office depending on its purpose, organizational styles and the culture of individual businesses may be even more significant. One option is how many people will work in the same space. On one end of the spectrum, every employee will have a private room; on the other end, a large open-plan office may consist of a single main area where dozens or even hundreds of people work together. Multiple employees may work together in an open-plan workspace, and studies have shown that this can increase productivity in the near term—that is, within a single software project. In addition, a decrease in security and privacy may make theft and the loss of trade secrets more common. The cubicle desk, perhaps most famous for the Dilbert cartoon series, offers a kind of compromise between open plan and private rooms. It somewhat resolves visual privacy but sometimes falls short on sound isolation and security. Workers in walled offices almost always try to position their regular work seats and desks so that they can see someone entering, and in some cases, they even install tiny mirrors on things like computer monitors.

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Most cubicles also require the occupant to sit with their back towards anyone who might be approaching. Richard (2006).

2.1.1 New Office Space Requirement in Nigeria

In Nigeria and other African nations, the need for new office space rose by 29% in the second quarter of 2021 compared to the first, according to Knight Frank. The "flight to quality" trend, which has seen companies take advantage of lower prime office rates to inhabit office buildings that prioritize employee welfare, is said to be responsible for the increasing activity in the office market. According to data from Knight Frank, the industries that require the most new office space across the nine African countries are professional services (29%) followed by industrial and logistics (16%), financial services (14%), healthcare (12%), and non-governmental organizations (NGOs) (8%). These industries combined account for nearly 80% of the continent's need for new office space. Kenya, Uganda, Tanzania, Zambia, Zimbabwe, Malawi, Botswana, South Africa, and Nigeria are the nations in question. (Izzet and Tülay, 2019; Lechner, 1991).

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In an effort to attract and retain tenants, landlords are becoming more accommodating by offering discounted rents and lease concessions like extended rent-free periods, as noted by Knight Frank, which also noted that businesses that had previously put off their office requirements due to the pandemic were reactivating their searches (Izzet & Tülay, 2019). Office relocations from the Central Business District (CBD) to the suburbs have boosted occupier activity in Nigeria, as occupants have drawn toward areas that provide both higher quality accommodations and more inexpensive leasing rates. Nigeria's economy is heavily reliant on labor, thus business has subsequently resumed as normal. Even while the pandemic caused many businesses to close, it also allowed for the establishment of new ones, particularly in the IT and logistics sectors. The demand increased as a result of a change in the way people saw shared office space. Additionally, there was a rise in the construction of study rooms and workstations on residential property.

Occupiers in Nigeria are still committed to occupying top-notch workspaces with longer lease durations. Due to the trend, owners of somewhat older buildings have a great chance to update their structures to a contemporary level and successfully compete for tenants seeking premium office space (International Energy Agency, IEA, 2015).

2.1.2 History of Sustainable Office Building

It has been over 40 years, when the petroleum crisis of 1973 occurred. In developed countries, sustainable architecture has passed 3 phases. At the beginning, it was called “energy efficiency buildings”, then it became “energy conservation in buildings”, which means reducing the energy release in the building. Recently, it has evolvedto “energy saving in buildings”. It is to say, the energy has not been saved negatively, but has been actively improving efficiency. In China, it was called “building energy saving”, and it is now at the third of the stated phase. Sustainable development is a recent trend. Responsible architecture must take into account energy and ecology environment. In office building design, green design and sustainable code have become more and more popular and important. The architects’ aim is reasonable and effectively using energy (UNEP, 2022).

However, sustainable office design may also have some problems, during its development in some countries. Architects pay little attention in the past to the sustainable development of buildings. They are only working to achieve their design targets, ignoring sustainable principles. In the broadest scene, design just meets the client’s needs for good office use, but neglects the needs of offices and furniture generations. It does not consider the more protection of the environment, and a rational balance of the use of natural resources.

2.1.3 The Concept of Sustainable Building

The term "sustainability" has been in use since the 1970s (Grevelman & Kluiwstra, 2010), despite the fact that at that time, most practices still adhered to a preservationist worldview. The Brundtland

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Report, "Our Common Future," which was presented at the 1987 United Nations Conference on Environment and Development, is the sole source of the concept's international political acknowledgment (Lowe & Zhou, 2003). In order to create a new development model known as "sustainable development," the study was the first to specifically examine the connections between the social, economic, and environmental aspects of development and sustainability on a global scale. Since then, a number of forward-thinking international events have raised awareness of sustainability issues. The United Nations Framework on Climate Change (1992) and its Kyoto Protocol (1997), Agenda 21 (1992), The Rio Declaration on Environment and Development (1992), The Millennium Declaration (2000), and The Johannesburg Plan of Implementation (2002) are a few of the sustainability key documents that have been produced in order to realize the agenda.

The notion of sustainability is a flexible idea. At each given period and place, the phrase and idea of sustainability are actively modified for the intended use. Many sustainable principles are used in the construction sector, including green and sustainable building, green and sustainable construction, green and sustainable project management, and so on. The information demonstrates how often the terms "green" and "sustainable" are used interchangeably. But "meeting the needs of the present generation without compromising the needs of future generations" is what the 1987 Bruntdland Report defines as sustainable (WCED, 1987). The term "sustainable" and "sustainable development" have many definitions today due to the concept's flexibility. The majority of these definitions are based on the "triple bottom line" concept, which was developed in 1997 by John Elkington and comprises three pillars (Edward, 1998; Grevelman & Kleuwstra, 2010; Larsen, 2009; Magis & Shinn, 2009; Popea et al., 2004). To summarize, sustainable construction is seen as a strategy that the building industry may use to advance toward sustainable development by considering concerns related to the environment, society, and economy (Akadiri et al., 2012). Conversely, a "green building" is defined as one that demonstrates resource depletion, energy efficiency, environmental effect, and environmental and public health protection (Beatley, 2008; Lutzkendoft & Lorenz, 2006).

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Unquestionably, the majority of published works pertaining to the idea of sustainable building were impacted by the original notion of sustainability, which focused on technical issues like materials, building components, construction technologies, and energy-related design concepts in order to minimize impact on the environment and conserve limited resources (Md. Darus et al., 2009; Zainul Abidin, 2009). This idea is seen as leaning under the 1987 Bruntland definition. For example, the practice of sustainable building, according to Kibert (2005), is the development and operation of a healthy built environment based on ecological design and resource efficiency, with a focus on seven key principles that apply to all phases of the building life cycle: 1) reducing resource consumption; 2) reusing resources; 3) using recyclable resources; 4) protecting nature; 5) eliminating toxics; 6) applying life cycle costing; and 7) focusing on quality.

It was observed that the definitions are lopsided, with a tendency to emphasize environmental indicators—often referred to as "green building"—while neglecting other metrics of sustainable development. Furthermore, rather of focusing on the whole of the project life cycle, a lot of emphasis has been paid to green design and green construction (Wu & Low, 2010).

Building sustainability principles may be measured using a variety of approaches and procedures, such as BPASs. The BPASs were created to help produce buildings that are better adapted to their physical environments and that have a beneficial influence on sustainability, despite the fact that they are biased toward green metrics (Kaatz et al, 2006). Certain BPASs only take into account very certain elements of building performance, such waste produced during construction or operation, materials utilized, and energy use (such as Energy Star). By using a set of operational and design criteria, some attempt to adopt a more comprehensive approach. For example, BREEAM and LEED are the two most widely utilized standards for commercial buildings (CBRE, 2009). The 1990s saw the introduction of the first building assessment system (BPAS), known as BREEAM, which is where the development of BPASs began. In the wake of BREEAM's introduction, several more BPASs were created globally. According to Cole (2006), BREEAM served as the model for several

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other approaches, many of which shared origins with LEED (United States), Green Star (Australia), and HK-BEAM (Hong Kong). Nevertheless, the majority of them really include a variety of methodologies for evaluating the environmental performance of buildings (Todd et al., 2001; CBRE, 2009; Cole, 2006; Du Plessis, 2005; Kaatz et al., 2005). While the amount of criteria defined under each area varies, the BPASs often include comparable categories including energy, indoor environmental quality, site and waste management, water, building materials, and innovations. Similar requirements were often grouped under distinct categories by various systems. BPASs that tackle many non-environmental concerns, including appropriate placement and ease of access, are also associated with the fundamental environmental problem. A very small number of BPASs only deal with non-environmental concerns, such as economic factors, employment opportunities for locals, health and safety, and good labor standards.

According to Adler et al. (2006), the concept of sustainable construction should include much more than only environmental considerations. According to the three pillars of sustainable development—economic, social, and environmental—sustainable buildings have positive effects on life cycle costs, community health, environmental health, and personal well-being. Thankfully, non-technical factors including economic, social, and cultural dimensions are becoming more important today (DETR, 2000; Zainul Abidin, 2009). This technique benefits not just the environment but also the economy, stakeholder relations, and profitability; in other words, it benefits the social and economic facets of life. Social, economic, biophysical, and technological are the other four guiding principles of sustainable construction, according to Akadiri et al. (2012) and Hill and Bowen (1997). Integrating sustainable development principles into the construction process at every stage is another aspect of sustainable building (Gething & Bordass, 2006; Yudelson, 2009).

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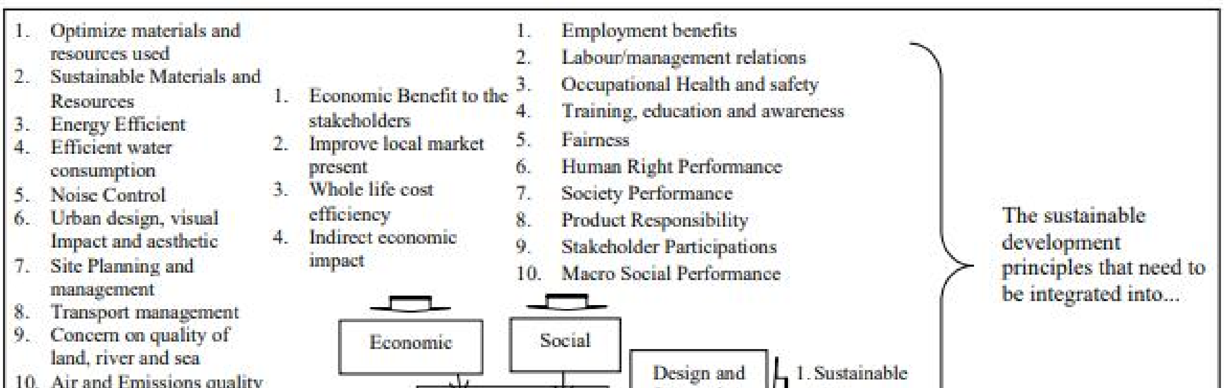

Figure 1: A theoretical framework of sustainability principles of building

2.2 Design Considerations

2.2.1 Principles of Sustainable Designs for Buildings

By minimizing detrimental effects on the environment, inhabitants' health, and comfort, sustainable design aims to improve building performance (Izzet & Tülay, 2019). Reducing the use of non-renewable resources, cutting waste, and establishing surroundings that are conducive to health and productivity are the main goals of sustainability. There are significant direct and indirect effects on the environment from the design and construction of buildings and associated infrastructure. As an example, in the US, buildings

39% of the energy used is consumed.

use 12% of the water that is consumed overall.

Utilize 68% of the world's power.

– are the causes of 38% of carbon emissions.

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In recent years, the idea of "sustainable design" has emerged in response to this expanding problem. Sadly, phrases that are not very precise are often used to characterize this approach, such as "integrated," "synergistic," or "holistic." Using a sustainable design philosophy promotes choices that, without sacrificing the bottom line, will lessen adverse effects on the environment and occupant health at every stage of the design process (Izzet & Tülay, 2019). This strategy promotes trade-offs and compromise. All stages of a building's life cycle—design, construction, operation, and decommissioning—benefit from such an approach.

All levels of government, along with a growing number of private businesses, are dedicated to integrating energy efficiency and sustainable design concepts into all of their construction projects. The finished outcome satisfies the goal and functions of the planned facility while striking an ideal balance between cost, environmental, social, and human advantages. It is preferable for sustainable design to be integrated as smoothly as possible into the current design and construction procedure.

The sustainable design road map is comprised of principles. Opportunities are actions that may be taken to recognize one of the Principles and maximize a particular project. Publicly accessible manuals, instructions, and databases are called resources, and they may help maximize the use of an opportunity.

2.2.1.1 The six principles of Sustainable Design

The sustainable design tenets are six.

I. Enhancement of the potential of the place

ii. Making the best use of energy

III. Water conservation and protection

IV. Choosing and using things that are better for the environment

v. Improvement of the indoor air quality

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vi. Enhancement of maintenance and operations procedures

I. Optimization of Site Potential

The first step in creating sustainable buildings is choosing the right location, which includes taking into account the reuse or renovation of existing structures. The location, orientation, and landscaping of a building affect the local ecosystems, transportation methods, and energy use. Physical security site selection is becoming a crucial factor in site design optimization. Sustainable site concerns including the placement of parking, vehicle barriers, perimeter lighting, and access roads must all be included into the design.

Prospects

By choosing disturbed land or retrofitting buildings, sustainable site planning should aim to minimize the development of open space; control erosion; minimize heat islands; minimize disturbance of habitat; restore the health of degraded sites; incorporate transportation solutions; and take site security into account concurrently with sustainable site issues. The following possibilities need to be taken into account in order to maximize site potential in a sustainable manner:

Keep Open Space Development to a Minimum

• Remodel and/or enlarge an already-existing structure

• Utilize previously cleared space

Manage Erosion Using Landscaping Techniques

• To reduce erosion, use vegetation, grading, and soil stabilization techniques.

• Collect and store stormwater runoff on the property, and include retention elements such pervious pavement in the project design.

• Use depressions and planted swales to reduce site runoff.

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Think About Energy Aspects When Choosing a Site and Orienting a Building

• Place structures to take full use of passive and active solar energy sources.

• Benefit from the natural ventilation system

• Make the most of daylighting chances

• Consider the possible effects that future construction close by might have on possibilities like daylighting and solar systems.

Reduce Heat Islands via Landscaping and Building Design

• Provide shade for sidewalks, parking lots, and other open spaces by using both new and old trees.

• If you live in a warm, sunny region, you should think about covering parking lots, sidewalks, and other places that are paved or made of materials with low reflectivity.

• To lower the cooling load, use roofing systems with a top layer made of light-colored, highly reflective, and highly emissive material.

• Make use of roofing materials that fulfill or surpass Energy Star criteria.

Reduce disturbance to the habitat

· Reduce land disturbance as much as possible and preserve good vegetation

• Minimize the pavement and building footprints

• Reduce any disruption to the area around the building, for example, by situating it nearer to already-existing facilities.

• In colder regions, position parking lots and pathways where they can get sunlight to help melt snow.

• Use non-toxic ice and snow removal techniques in frigid regions.

Restore deteriorated areas

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• Reduce disturbance of the land and preserve valuable vegetation

• Make the best use possible of native and drought-tolerant plants

Transportation Design for Sustainability

• Locate the structure to work with public transit networks

• When possible, use porous pavement materials.

• Decrease on-site parking to promote public transportation usage

• Include elements that promote walking, carpooling, and biking.

• Provide facilities for alternative energy vehicles to be refueled and recharged.

Sync up site sustainability with security and safety

• Retention ponds and berms, for instance, might be site elements that restrict access to a building.

• For security purposes, both new and existing trees and vegetation may hide individuals and structures.

ii. Optimizing Energy Use

Increasing energy independence requires upgrading the energy efficiency of existing structures. Reducing reliance on energy produced from fossil fuels may be achieved in part by operating net zero energy buildings. In the US, buildings use 39% of the country's energy and 68% of its power annually. They produce 25% of the nitrogen oxides, 49% of sulfur dioxide, and 38% of carbon dioxide that is present in the atmosphere. The great bulk of this energy is generated by fossil fuels, which are nonrenewable. Finding strategies to lower load, boost efficiency, and make use of renewable fuel resources in federal facilities is crucial given the depletion of America's fossil fuel reserves, growing worries about the security of the energy supply, and the escalating effects of greenhouse gases on global warming Geissler et al. (2018).

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Prospects

Building projects must reduce lighting, heating, and cooling loads through climate-responsive design and conservation practices; use renewable energy sources; specify equipment and systems that take utility interface requirements and part-load conditions into account; optimize building performance through the use of energy modeling programs and optimized system control strategies; and monitor building performance through metering and reporting during the facility design and development process. The following possibilities should be taken into account in order to optimize energy consumption in a sustainable manner:

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Utilize Conservation Practices and Climate Responsive Design to Lower Cooling, Heating, and Lighting Loads

• Make use of passive solar architecture

Size, align, and design windows to optimize energy conservation

• Use durable and thermally efficient high-performance materials in the building envelope.

• Consider building load needs and sun energy while placing landscaping.

Use Renewable and High-Efficiency Energy Sources

• Water heated by solar power

• Solar-powered equipment

• Plant matter

• Heat pumps that use geothermal energy

• Take into account acquiring power from low-pollution and renewable sources.

Indicate Energy-Saving HVAC and Lighting Systems

• Indicate which devices and systems adhere to or surpass 10 CFR 434.

• Lighting fixtures using less than 1 watt per square foot

• Products with Energy Star certification surpass DOE requirements.

• Take into account systems for energy recovery.

• Take into account thermal storage, fuel cells, cogeneration, etc.

Enhance Building Efficiency and System Control Approaches

• Use energy modeling software from the outset of the design process.

• Use sensors to program systems according to schedule, occupancy, natural ventilation, and daylight.

• Assess the utilization of modular parts to maximize part-load efficiency, such as boilers and chillers.

• Employ building automation systems and smart controls.

Track the Performance of the Project

• For the duration of the project, use an extension of the building commissioning plan.

• Throughout the project's lifespan, use metering to verify the building's energy and environmental performance.

III. Water Conservation and Protection

Resources for freshwater are becoming harder to come by. An environmentally friendly building design and construction minimizes its effect on freshwater resources by making optimal use of water. Every year, the United States spends billions of dollars on water and sewage systems. Two of sustainable design's main goals are preserving water quality and using less water. This is crucial because, in many parts of the nation, water usage surpasses the aquifer's capacity for self-repletion.

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Facilities should rely more on on-site collected, utilized, cleaned, and reused water to the greatest degree possible.

Prospects

Federal agencies must work to reduce, control, and treat surface runoff; use water efficiently; improve water quality; recover gray and non-sewage water for on-site use; establish waste treatment and recycling centers; and implement best management practices to conserve water. These efforts must be made throughout the life of the building. The following are some chances to preserve and safeguard water that need to be taken into account:

Cut Down on, Manage, and Handle Surface Runoff

• To minimize runoff, create depressions and vegetated swales.

• Diminish and strain surface runoff

· Reduce pesticide-related water contamination by using integrated pest control.

• Take into account adding green roofs to the project.

• Take into account brief storm occurrences while managing surface water runoff overall (e.g., by using retention and groundwater recharge basins).

Use the Green Infrastructure recommendations from the EPA.

Make Effective Use of Water

• Include efficiency in the requirements for construction

• Install water-saving plumbing fittings and incorporate other water-saving measures into the structure.

• Use drought-tolerant native plants in your landscaping

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• Track how much water is used.

• To minimize evaporation and drift, install water-conserving water towers with delimiters.

• Seal all plumbing fittings and pipes to prevent leaks, and inspect hoses and pipes once a year.

• Look for water-efficient items with the EPA Water Sense logo to protect water quality.

• As part of a runoff filtering system, install oil/grit separators or water quality ponds.

• Get rid of anything that might leak lead pollution.

• Make use of non-toxic cleaning supplies

Retrieve Greywater and Non-Sewage for On-Site Utilization

• When authorized by municipal authorities, use non-sewage waste water for on-site landscaping irrigation

• Use roof drainage water and groundwater for on-site use.

• Use sump pumps' groundwater

Create programs for recycling and waste treatment.

• Treat trash on-site using biological waste treatment technologies.

• Handle roof, ground, and gray water according to approved standards so that the site may be used again.

iv. Choosing and Using Products That Are Better for the Environment

Building composition plays a major role in the building's life-cycle environmental impact. Facilities need to use environmentally preferable materials and processes that don't pollute or add needlessly to the waste stream, don't negatively affect people's health, and don't deplete limited natural resources. With the demand for raw materials growing due to the expanding global economy, it makes no sense

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to discard much of what is considered construction waste; instead, by using a "cradle-to-cradle" approach, the "waste" of one generation can become the "raw material" of the next.

Prospects

Building projects must approach facility design and development from a holistic standpoint, aiming to renovate existing buildings, products, and equipment whenever feasible; assess products' environmental preferability using the cradle-to-cradle method; maximize recycled content in all new materials, particularly from a post-consumer standpoint; specify materials harvested with a sustained yield basis, like lumber from certified forests; promote the use of recyclable assemblies and products that are easily "de-constructed" at the end of their useful lives; limit construction debris, promote waste stream separation, and encourage recycling during the building process; and do away with the use of materials that are toxic or polluting during their construction. The following possibilities should be taken into account in order to maximize the utilization of environmentally friendly goods and procedures.

Renovate Current Equipment, Products, and Facilities

• Consider expanding or renovating an existing structure rather than creating a new one.

• Whenever it is inexpensive and resource-efficient, use refurbished goods, furnishings, and equipment.

• When constructing a new building or renovating an old one, take into consideration utilizing existing building components (such as windows, doors, etc.).

Determine Preferability for the Environment Using Life Cycle Assessment (LCA) Tools

• Take into account the trade-offs between various environmental implications, such as resource depletion and global warming.

• Make use of LCA instruments like BEES and ATHENA

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• Take trade-offs between the many life-cycle phases (acquisition of raw materials, manufacture, transportation, installation, usage, and waste management) into consideration.

• Take into Account USDA Biobased Products

Increase the Amount of Recycled Material in All New Materials

Use items with recycled material recognized by the EPA.

• Invest in the goods listed in the Environmentally Preferable Purchasing Program of the EPA.

• When making purchases, take the environment into account in addition to cost and performance (the "EPP "process").

• Make preventing pollution a priority while making purchases.

• Analyze various environmental factors at various stages of the product life cycle.

• When choosing items, consider the effects on the environment.

• Gather precise and insightful data on the environmental impact of items.

• Assess how items and materials with the greatest proportion of recycled content are used.

• Assess the utilization of low-energy materials and products.

List the Materials Harvested Based on a Sustainable Yield

• Make use of wood products sourced from forests that are sustainably managed.

• Consider substituting bio-based goods or materials (like sheathing made of agricultural fiber) with non-recycled or inert ones.

• Indicate materials that can regenerate in ten years or fewer, such as straw, bamboo, cork, and wool.

Promote the Use of Products and Assemblies That Can Be Recycled

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• Assess the use of demountable or deconstructible assemblies and goods.

• Create a waste management strategy with users in order to promote recycling.

• Take into account designating areas for the composting of organic waste at the project site.

Minimize Construction Waste

• Demand the creation and execution of a strategy for recycling construction waste sorting.

• Make use of goods with little throwaway storage and packing

• Rather of demolishing a building, think about constructing it for eventual disassembly.

Avoid Using Polluting or Toxic Materials in the Production, Use, or Reuse of These

• Make use of assemblies and materials with the fewest volatile organic compounds (VOCs).

• Get rid of PCBs, asbestos, and lead in materials and goods.

• Get rid of HVAC refrigerants made of hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs).

Avoid Using Polluting or Toxic Materials in the Production, Use, or Reuse of These Materials (continued)

• Take into account specifying goods and materials whose production does not harm the environment or put manufacturing workers in hazardous situations.

• To safeguard building occupants' health and avoid harming plants and ecosystems, keep ground-level ozone out of structures.

Give Locally Produced Materials with Low Embodied Energy Content First Preference

• Take into account locally made goods and resources to lessen the effects of transportation from far-off places.

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• Take into account using goods and materials with the least amount of embodied energy possible (the energy needed for production, harvesting, extraction, transit, installation, and/or consumption).

v. Improvement of the Indoor Environment

The comfort, productivity, and well-being of building occupants are greatly influenced by the interior environmental quality (IEQ) of the structure. It is simple to overlook the fact that an interior environmental quality (IEQ) assessment determines whether a project is ultimately successful or unsuccessful when constructing affordable and sustainable buildings. A high-quality interior environment inevitably results in happier and more productive workers and residents. Sadly, this powerful reality is sometimes overlooked since it is easier to concentrate on a project's initial costs rather than to calculate the worth of improved user productivity and well-being. Increasing interest in building sustainability makes it increasingly harder to concentrate on creating a high-quality interior atmosphere. It is essential that engineers and designers have a refreshed understanding of the significance of offering top-notch interior spaces to every consumer.

Prospects

Federal projects requiring facility design and development must have a holistic approach that aims to support excellent IEQ via sound design, building, and operating and maintenance procedures; respect artistic choices, such as the significance of viewpoints and the blending of natural and artificial materials; provide the highest level of individual control over temperature and ventilation to ensure thermal comfort; provide sufficient ventilation and outside air to guarantee the quality of the air within; prevent the growth of mold, bacteria, and other fungi in the air by designing HVAC (heating, ventilation, and air conditioning) systems to effectively regulate interior humidity and by designing the building envelope to keep moisture out; Refrain from using products that are rich in toxins or volatile organic compounds (VOCs); provide quality water; manage offensive odors through contaminant isolation and cautious product selection; ensure acoustic privacy and comfort through

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the use of sound-absorbing materials and equipment isolation; and create a high-performance luminous environment through the thoughtful integration of natural and artificial light sources. It is important to think about the following choices in order to enhance the indoor environmental quality:

Value Aesthetic Decisions

• Recognize the value of having windows for natural light and ventilation in inhabited areas in addition to regulatory requirements.

• Recognize the aesthetic value of structures.

Provide Thermal Comfort: • Recognize the significance of moisture control in roof and wall assemblies; • Consider the use of under-floor air distribution using an access-flooring system for flexibility, focused personal comfort control, and energy utilization efficiency; • Assess options and benefits to be derived from specifying high-thermal performance windows.

Provide Sufficient Ventilation and Outside Air

• Build ventilation systems to ASHRAE Standard 62: Ventilation for Acceptable Indoor Air Quality criteria, or beyond.

During construction, keep important ventilation system components clean (ducts, etc.). Commission HVAC systems to make sure they operate as intended (CFMs, temperatures, etc.).

Installing filters with a Minimum Efficiency Reporting Value (MERV) of 7 is recommended for HVAC systems.

Provide Sufficient Ventilation and Outdoor Air (continued)

Assess the potential thermal savings from having independent systems for the distribution of conditioned and outside air. • Verify that outside air intakes are situated far from potential sources of contamination, including loading docks and building fume exhausts.

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• Consider placing purge fans at pollutant sources, such as parking garage exist kiosks; • Avoid letting cars idle near outdoor air intakes.

Provide Sufficient Ventilation and Outside Air (continued) • Take into account installing a permanent air quality monitoring system to guarantee that appropriate air quality standards ($CO2 < 1000$ PPM, $CO < 2$ PPM, etc.) are maintained.

• Make sure that air filters are the right kind and are replaced or cleaned on a regular basis. • Take building security into consideration when placing and planning exterior air intakes.

Prevent Airborne Bacteria, Mold, and Other Fungi: • Verify that the HVAC system is built to regulate interior humidity at a mean coincident dry bulb temperature of 1% humidity ratio in both severe and low load scenarios. • Moisture barriers are necessary in the building envelope to prevent moisture penetration. Additionally, the number of spores in the interior air should be fewer than 700 spores/m3, which is the number in outside air.

Stop the Spread of Infections

• Make that appropriate maintenance protocols are followed in hospitals and other establishments where pathogen contamination is a possibility. Consider building restrooms without doors (with suitable access pathways and screens to hide sightlines from inhabited areas such as hallways, offices, and waiting rooms) in hospitals and other institutions at risk of pathogen contamination to lower the probability of contracting an infection.

Refrain from Using Materials with High Pollutant Levels: • Minimize the use of cleansers, paints, adhesives, and sealants that contain high levels of volatile organic compounds (VOCs) • Steer clear of formaldehyde-containing products like wall panels, cabinetry, and carpet • If asbestos is present in an existing building, remove it or contain it (by encapsulating it, for example) to prevent future exposure • In areas where radon is a significant presence, take steps to control and mitigate its buildup

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Steer clear of materials with high levels of pollution; provide safe and secure places to store cleaning supplies; consider isolating and maintaining negative pressure in a renovated portion of a building to prevent dust, fumes, and odors from disturbing the remaining occupants; and make sure office equipment doesn't emit any unpleasant noises, pollutants, or odors. Ensure Comfort and Acoustic Privacy

Use sound-absorbing materials to reduce noise, and install high sound loss transmission coefficient walls, floors, and ceilings. Think about "white-noise" or sound masking devices, which provide a subtle background sound to lessen interference from irritating office noise. Keep in mind that sometimes an HVAC system's subtle noise level might serve as an excellent sound masking mechanism.

Establish a High-Efficiency Lighting Space

• Use daylighting wherever it is possible. Use high-efficiency lamps, ballasts, fixtures, and controls to supplement natural light. Use magnetic fluorescent lamps with high-frequency electronic ballasts to minimize flickering. Reduce direct glare from artificial and natural light sources, especially when reflective surfaces, like computer screens, are in the field of view. Use task lighting and light colors on walls.

Provide Quality Water: • Adhere to the EPA Safe Drinking Water Act concerning the permissible levels of metals and bacteria in potable water systems; • Ensure appropriate flushing and decontamination during the commissioning of newly constructed and renovated potable water systems; • Perform routine maintenance flushing of potable water systems to manage problems related to drinking water quality.

• To avoid legionellae development, keep household water temperatures above 140° in tanks and 122° at faucets. • To minimize the risk of contamination, consider using a closed-loop system at cooling towers rather than an open one.

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Control Unpleasant Odors: • Make sure that maintenance procedures remove trash and recyclables on a regular basis and do not permit undue storage on site. • If smoking is not prohibited in a building space, make sure that it has a lower static pressure than adjacent spaces, complies with ASHRAE Standard 62, and is isolated from the return air system of surrounding spaces. • Directly exhaust copying and housekeeping areas and provide return air grilles to control odors and limit ozone generation. • For operations and products that produce odors and cannot be eliminated, provide architectural and HVAC isolation.

Be Aware of Exposure to Electric and Magnetic Fields (EMF): Although there isn't enough data to draw firm conclusions just yet, it's possible that EMF exposure is detrimental.

• The World Health Organization's electromagnetic fields website and EMF RAPID—Electric and Magnetic Fields Research and Public Information Dissemination Program—are good sources of information.

vi. Enhancement of Maintenance and Operational Procedures

The growing needs for sustainable building designs that combine safe, secure, and productive settings provide special difficulties for building owners.

Engineers, architects, and other site contractors may work together to design materials and systems that streamline operations and lower maintenance needs. These on-site and facility-wide procedures not only try to lower energy and water consumption, but also minimize the use of hazardous chemicals and lower life-cycle costs.

Of course, there are a lot of things that can be done to improve operations and maintenance procedures that will support sustainability principles; in addition, a lot of the design possibilities and resources that have previously been identified have positive effects on these procedures as well.

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2.2.2 A Sustainable Building's Advantages

According to Doyle et al. (2009), compared to conventional structures, sustainable buildings have less of an impact on the environment during construction, provide better living conditions for its inhabitants, and are more cost-effective overall. Measurable and intangible advantages must be shown for a building to be considered economically, socially, and ecologically sustainable in order to convince customers and developers to take a chance on novel ideas and make use of cutting-edge sustainable technology. The following are the overall advantages of sustainable construction, according to many authors:

1. Direct Advantages

Lower Fuel Bills, Operational Costs, and Energy Consumption for the Owner or Tenant

Choi (2009) states that many green and sustainable building components have low capital costs, and even in cases where they are more up front, lower operating costs may make up for them. According to research, using sustainable construction techniques may significantly lower the amount of energy that comes from the built environment (CBRE, 2009; Edward, 1998). These savings might be considerably above 50%, and they certainly go over 10% depending on the degree of improvement (CBRE, 2009). According to a study conducted on 99 sustainable buildings in the US, they use 30% less energy on average than traditional structures. According to The Economist (2004), further study conducted in the United States revealed that energy-efficient design has the potential to lower building energy use by up to 50%. The NMB headquarters in Amsterdam, which was erected in 1990 and is a prime example of a successful sustainable building, is designed to fulfill strict environmental and low-energy requirements while offering sufficient user control over the humidity and temperature of the working rooms. It was claimed to have saved more than £300,000 in energy expenses annually when compared to a comparable-sized traditional office building. The owner was able to determine that the extra cost of plant and equipment was compensated for in three months of

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occupancy since the building used one-twelfth the energy of the bank's previous location. Additionally, NMB discovered that the bank's performance has improved significantly due to a 15% decrease in absenteeism compared to the previous building. As so, it has shown financial and productivity success.

It's generally accepted that long-term cost reductions in operations and maintenance may somewhat offset the higher initial costs of sustainable building compared to traditional projects. According to USGBC (2006a, b), sustainable buildings should result in operational cost reductions of 8–9%, an approximate 7.5% rise in building value, and a 3.5% increase in occupancy rates. Table 1 provides other instances of successful sustainable construction projects around the globe. Gaining a competitive edge and reducing enduring exposure to environmental or health issues

Although there isn't much data to support this, research from the US suggests that sustainable buildings do command higher rents than conventional ones and have faster rates of rental growth (CBRE, 2009). Four-fifths of residents would pay up to £3,000 for each of a select group of green and sustainable features, such as solar PV tiles, solar hot water tiles, Powerpipe hot water heat exchangers, grey water recycling, and wind turbines, according to a survey conducted by developer St. James' on their Kennet Island sustainable residential scheme in Reading, England. Most Australian investors are ready to pay more for a Green Star building, according to a study conducted by Australian real estate professionals (Muldavin, 2010). The primary competitive benefit of sustainable buildings today is their increased marketability. These properties are simpler to rent and sell, which lowers vacancy periods and consequently revenue losses (McKee, 1998). In addition to providing user delight, the buildings also improve comfort and health, enhance a company's reputation, provide a financial reward for environmental ethics, are long-term value for money, raise building selling value, and are easier to re-lease in the future (Edward, 1998; and McKee, 1998).

Increased Workforce Productivity

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The health and happiness of building inhabitants are social effects of sustainable building design. Employee productivity has increased and absenteeism has decreased as a consequence of sustainable design elements. A survey carried out after the completion of Lockheed Martin's sustainable engineering and design center in Sunnyvale, California, revealed a 15% decrease in absenteeism in the newly constructed structure. children in classes with more natural light scored 29% better on arithmetic exams and 26% higher on reading tests than children in rooms with less natural light, according to a different California research that examined test results from 21,000 students (USGBC, 2003).

2. Adverse Effects

Better to Utilize

A sustainable structure uses more organic materials, solar energy, and natural light sources than a typical building, making it healthier overall. It has been shown that the building contributes to decreased rates of illness and absence, according to reports by Edward (1998) and USGBC (2003).

Advantage in Psychology

Buildings that are sustainable make people feel better. According to research conducted in the USA by Edward (1998), individuals report feeling better about themselves in addition to being healthier. A 1% decrease in absenteeism in the building may cover the traditional building's energy expenses.

Improves the Company's Image

A team of professionals, including the client, who share similar sustainable ideas typically produces sustainable buildings. These buildings spread from the company to the individual, the company to the building, and the building to the company, improving the company's reputation (Edward, 1998; & McKee, 1998).

3. Worldwide Advantages

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The idea behind sustainable construction is to take into account all possible effects on the environment and ecosystem. Global warming, ozone layer depletion, biodiversity, product miles, and recycling must thus be taken into account throughout the building's design and construction (Edward, 1998; Zainul Abidin, 2009).

Table 1: The successful sustainable building worldwide

Authors	Case Studies	Benefits of Sustainability
Edward (1998)	Student residences at Strathclyde University	- Contented student - The attraction of good quality academic staff - Improved output
Francis (1998)	Mixed-use development- Sheppard Robson's Helicon Building, City of London	- Energy running costs – £50/m^2 per year which is significantly less than that of conventional office buildings. - Displacement air-conditioning which uses water-filled panels at ceiling level for cooling - The system costs 15% more, but 16% cheaper to run.
Shuttleworth (1998)	Mistral Building, Reading	- Energy bills about 20% off those of a more conventionally design office.
Grut (1998)	Daimler Benz Building, Berlin	- Facade cost 20% higher than usual (facade costs are 9% of total building cost) but help to reduce running cost by 60%, annual energy consumption predicted as 75kWh/m^2 which is a quarter of that consumed by a typical building office. - Embodies energy and CO_2 emission 30% less than typical office building in Berlin.
Roy et al (2005)	LEO Building, Putrajaya, Malaysia	- Energy savings 100-150kWh/m^2 year compared to the design without the energy features. - Payback time – less than 10 years - Energy savings of more than 50% compared to conventional building design

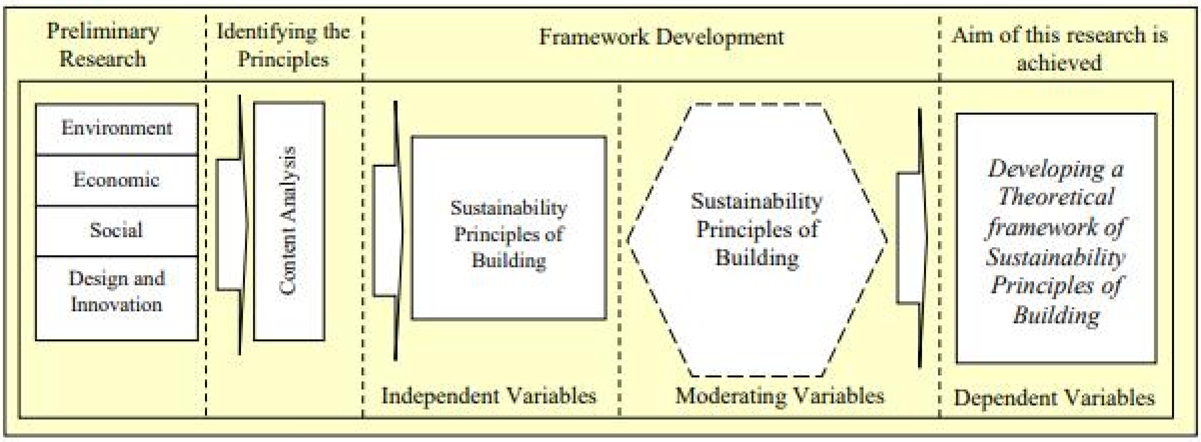

Figure 2: The research model for developing the theoretical framework of sustainability principles of building.

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Chapter Three

Research Methodology (Case Study)

3.1 Research Design

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

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

The goal of this study is to explore architectural design element for sustainable design in the design of in the office complex building. The explorative method is selected for the study because it is proper when the focusing study is to examine the peculiarity of a region.

In this study, it becomes clear that it is qualitative in nature; this is due to the difficulty of the subject and the difficulty by which perception is quantified. Thus, it is important to understand what makes an office building an energy efficient building before trying to quantify it and its underlying factors.

3.2 Case Study Method

Case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. It tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result. In order to fully understand the principle behind designing any building typology, an initial assessment of the existing building typology would have to be done. The initial assessment on the documented buildings was in terms of spatial, functional, equipment and operational efficiencies and standards which informs necessary provisions for future needs which may arise in such building typology

A case is a chronologically and geographically isolated event (Johansson, 2003). (Veal (2006) notes that a case study may refer to both a research method and an analytical unit since it involves the assessment of unique occurrences (cases) of the investigated topic. Understanding a complicated instance via in-depth description and examination of the instance in connection to its surroundings is the purpose of case studies (the United States General Accounting Office, 1990). This research will apply an empirical method to gather data on a small number of instances that meet some of the topic's distinguishing qualities. The basis for these conclusions is a mixed qualitative case study analysis and a thorough examination of relevant published and grey literature. In this case study, we analyses social interaction based on its qualities.

3.2.1 Case Studies Selection Criteria

Architectural processes depend on a knowledge repertoire of circumstances from direct experience or established precedents (Schon (1991),(Veal (2006) discovered that picking examples for a case study

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was comparable to sampling in quantitative research; in both situations, the cases were selected on purpose. In light of these studies, (Oluigbo (2010) suggested that identifying instances necessitates possessing certain intrinsic qualities that pertain to the issue under consideration.

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

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

3.3 Data Collection

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

3.3.1 Instrument of Data Collection

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

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3.3.2 Procedure for Data Collection

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

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

3.3.3 Operationalization of Variables

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

- Building Envelope
- Building Shape/Form
- Site Planning/Landscape
- Energy Efficiency Material
- Spatial Concept

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

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

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3.4 List of Selected Case Studies

The case studies were aimed out on four existing senate buildings in Nigeria and 2 international administrative buildings which are:

1) Obafemi Awolowo University Senate Building

2) University of Lagos Senate Building

3) Ladoke Akintola University of Technology Senate Building

4) Kashmir University Administrative Building

5) Dhaka International University Administrative Building

The criteria for each case study are discussed base on location, architect that designed it and the client, conceptual approaches to the design of the building, functions and spatial relationships, technological, environmental and sustainability solutions, aesthetic approach(es) to the design of the building and energy consideration.

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3.4.1 Case Study 1

Obafemi Awolowo University Senate Building

Location

The tallest building on campus sited at the university core, accessed through Adesoji Aderemi road (popularly called Road 1) from the university main gate. This makes it the focal point on approach to the campus; giving it a high hierarchy which a university senate building should possess.

Architect and Client

Obafemi Awolowo University's old Senate building was designed by an Israeli Architect, Arieh Sharon. The client was Late Chief Obafemi Awolowo.

Conceptual Approach

The underlying concept is proximity in spatial relationship void of clustered circulation and adapting the building envelope to the climatic condition of the location to achieve free air movement through the building thereby resulting in indoor thermal comfort. This was done by integration of different rectilinear forms with emphasis on the high-rise part of the building which gives rhythm, movement, balance, and proportion to the building as a whole.

Description

The building is characterized by a high-rise, point office block; and an L-shaped low-rise block with an entrance foyer. The high-rise office block has rectilinear, single banked floor plans which allow effective ventilation, linear arrangement of spaces with proximity where necessary. The ground floor (also known as 'Floor O') consists of the reception, exhibition hall, security post, two committee rooms, bookshop, toilets, and stair / lift lobby. The mezzanine floor is used for equipment storage and services. The first floor consists of accounts section (salaries, assistant business manager, expenditure control, projects, statistics, pensions and ledger); second floor houses the admissions (general office, senior assistant registrar, deputy bursar, secretary to the bursar and bursar) and examinations (assistant registrar, secretarial office, general office, administrative officer); the third floor consists of the registry; fourth floor – vice chancellor and deputy vice chancellor, while the fifth floor houses the council and senate.

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Functional and Spatial Relationship

The function of the building defines the character, the size and location of the building. The building contains the foyer at the south entrance used as exhibition area, thereby increasing impulse buying in the bookshop; a bank and post office providing a continually functioning and lively social core for the campus. The two arms of the building have an open court enclosed on its eastern side by a pergola leading to the humanities buildings, which terminates with a sculptured gate, descending to the road level. With double volume space created by the pilots, free movement of people through and within the building is encouraged. The repetitive floors are linked to one another with properly located stair cases and two lifts which run from the lower ground floor to the topmost floor. Also, a spiral stair case: detached from the building and located at the rear serve as means of escape in emergency situation. The arrangement of horizontal, structural elements on the upper floors and; vertical sun shading device round the ground floor, shades the building from sun and give a feeling of privacy in the building. It is also supported by other ancillary spaces which enhances its functionality.

Technology and Structure

The building is characterized by a point office block and service core which provide a strong vertical landmark to the entire campus: constructed with high level of technology through the use of concrete and iron. The finneton long window on the ground floor was made possible by structural columns making the enclosing wall unnecessary. Also, the structural frame, sculptured entrance, suspended repetitive floors, and the shading device were made of reinforced concrete – a very strong characteristic feature of modern architecture.

Aesthetics

The ordered arrangement of the sun shading device, proper integration of geometric forms and shapes, emphasis on the lift shaft achieved with variation in colour, and a focal point created by a sculptural piece: add to the aesthetic value of the Senate Building. The black and white lines created by elements on the approach view, harmonize the building with the adjoining buildings and the surrounding environment, creating a feeling of unity.

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Plate 1: Location of OAU Senate Building (Google earth image)

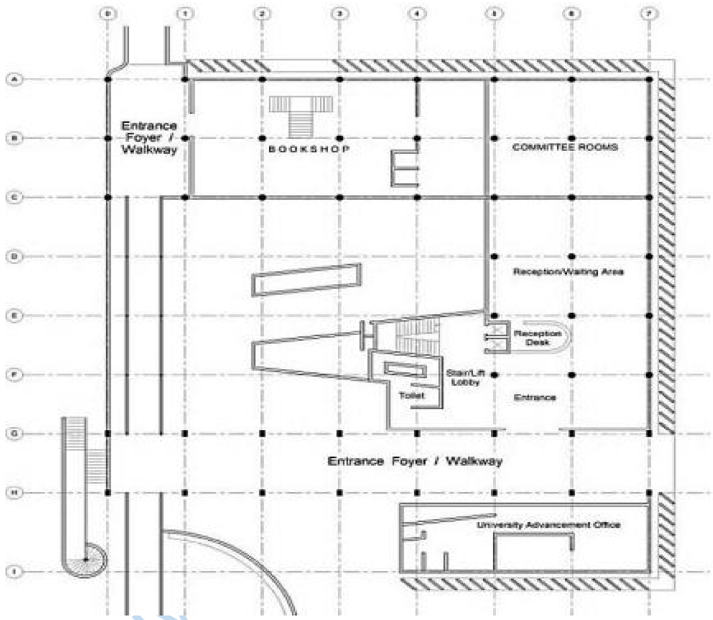

Plate 2: Ground floor plan of OAU Senate Building (Source Author's Field work)

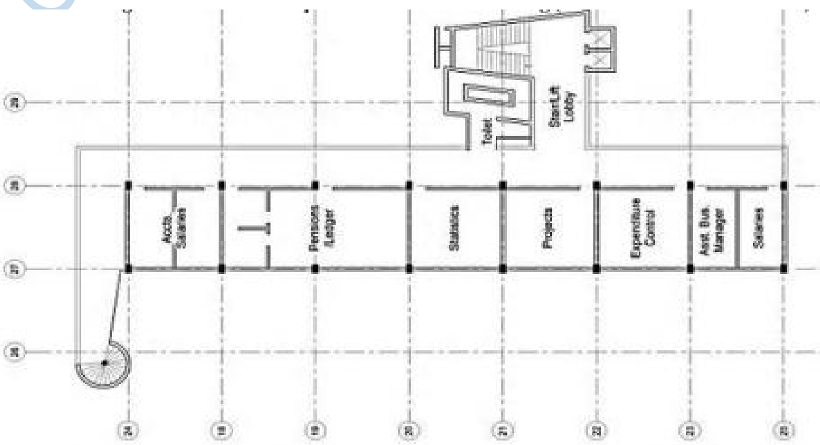

Plate 3: First floor plan of OAU Senate Building (Source Author's Field work)

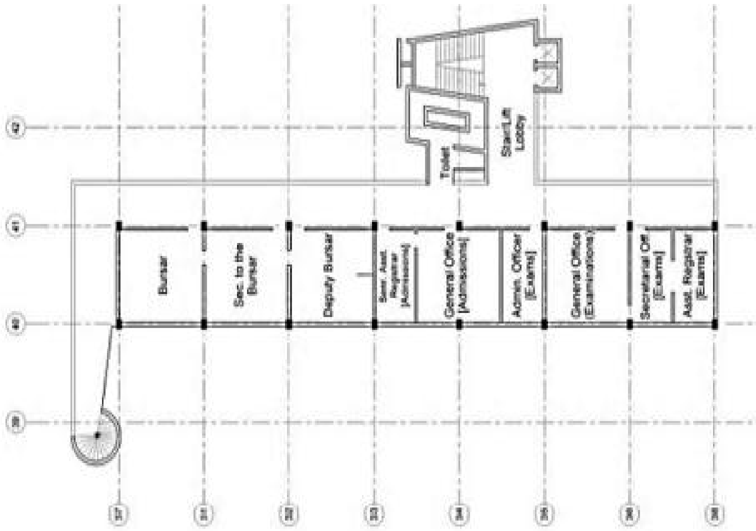

Plate 4: Second floor plan of OAU Senate Building (Source Author's Field work)

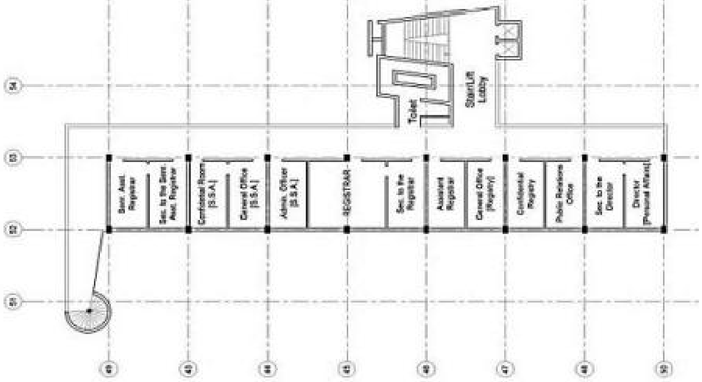

Plate 5: Third floor plan of OAU Senate Building (Source Author's Field work)

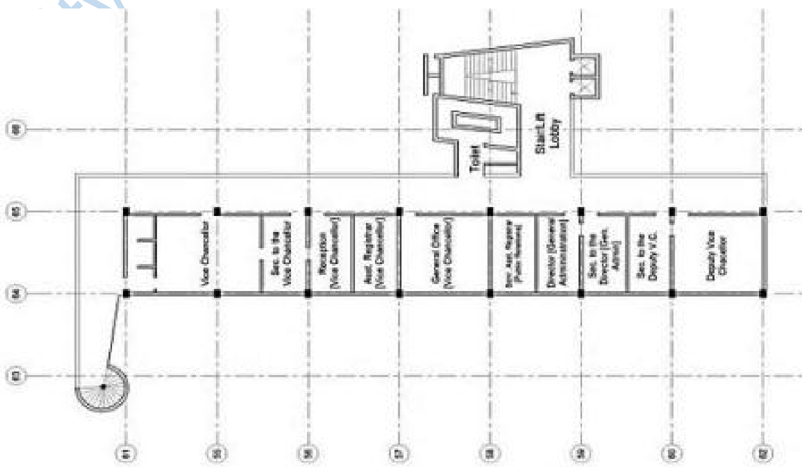

Plate 6: Fourth floor plan of OAU Senate Building (Source Author's Field work)

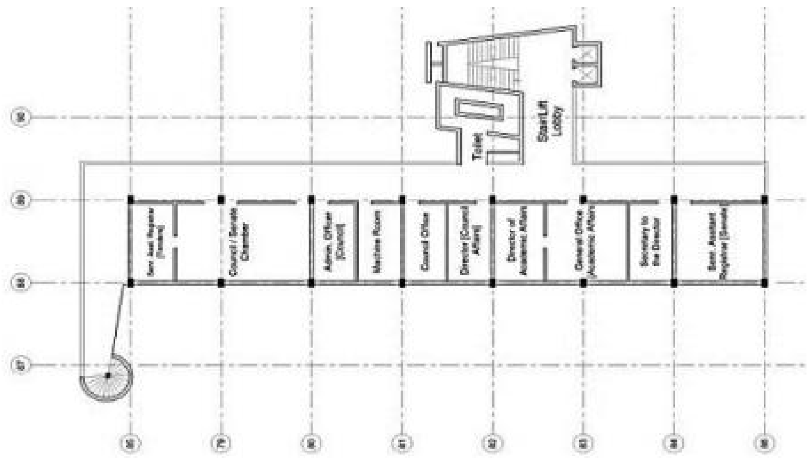

Plate 7: Fifth floor plan of OAU Senate Building (Source Author's Field work)

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Plate 8: Approac

Plate 9: Left side view of OAU Senate Building (Source Author's Field work*)*

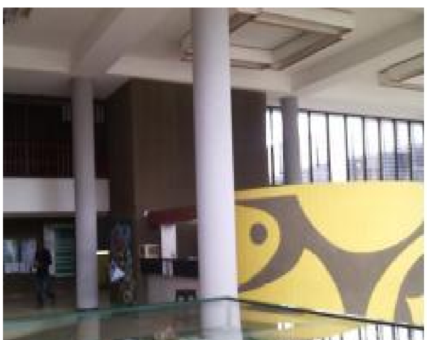

PLATE 10: Double volume space for reception, general waiting, and exhibition with 600mm diameter columns spaced @ 7m c/c (Source – Author's field work)

PLATE 11:Raised building mass with pilots for free access through the building

3.4.1.1 Appraisal of Building

Merits

- The ordered arrangement of the sun shading device, proper integration of geometric forms and shapes, emphasis on the lift shaft achieved with variation in colour, and a focal point created by a sculptural piece add to the aesthetic value of the Senate Building.

- The arrangement of horizontal, structural elements on the upper floors and; vertical sun shading device round the ground floor, shades the building from sun and give a feeling of privacy in the building.

Variables	**Adequate (*)**	**Inadequate (X)**	**Not Available (0)**
Architectural form	*		
Scope of Facility	*		
Construction Technology	*		
Building Material	*		
Sustainability of building		**X**	

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S/N	Variables	Checklist	Level of application 1	2	3	4	5	Remark
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope

		Use of external Insulation					●	
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally lit with large glazed panel
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of openable Windows			●			The use of openable casement windows,
4	Site and external spaces	Use of interwoven Landscape		●				Not enough landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			

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		Use of plants		●				
8	Existing energy source	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting.
		Use of natural gas			●			

3.4.2 Case Study

University of Lagos Senate Building

Location

Situated against the backdrop of the Lagos lagoon and surrounded by a lovely landscape featuring a park and a "love garden," the Senate House Complex is centrally located within the academic core of the university's Akoka campus. It is bordered to the west by the Arts lecture theatre, to the north by Advanced Legal Studies, and to the east by the old Administrative building and Auditorium. When entering via the gate, the Senate House closes the visual access. One may argue that the Senate's center placement is suitable given that it is meant to be a component of call to call.

The client and the architect

The Federal Republic of Nigeria provided funding for James Cubitt and Partners' 1984 completion of the Senate House Complex, which is made up of straightforward shapes. Conceptual Method The notion of double-banked corridors for office buildings was accepted. Additionally, rectilinear and curvilinear shapes were incorporated in the cellular office design. The elevation squares clearly show the interplay of rectangular and cubic prism with a hint of barrel vault (for the senate chamber). In the event that there were any hazards inside the building, there was also a conscious effort to limit travel to the high-rise levels in order to prevent exposing a sizable number of people to risk factors.

Description: It is made up of a semi-circular block and a series of rectangular shapes of different heights. There are four primary apartments that have different heights inside the twelve-story

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building. The last level is devoted to the machine room, which has a square layout. The senate chamber is located in the third unit, which is four stories high and has a square layout. The subsequent unit is eight stories high. Despite being semi-circular in form, it is contained inside a square. Fair floors, which have a more horizontal design, make up the fourth unit.

Relationship between Function and Space

The ground level is divided into two sections: partially open for pedestrian traffic, and partially enclosed to house the cash office, student affairs, and porters' lodge. The Senate Chamber is housed in its entirety on the first floor, while the establishment unit, staff welfare, and salary/wages sections of the Registry are located in the office building. Parts of the Registry, including Admission, Examination, and Records, are located on the second level. The Bursary department and Bursar's office are located on the third and fourth floors; the postgraduate unit is located on the fifth floor; the legal section of the Registry is located on the sixth floor; the university's continuing education center is located on the seventh floor; alumni offices, academic and physical planning units, and Unilag's consulting unit are located on the eighth floor; the information and protocol unit is located on the ninth floor; the deputy vice-chancellor's office is located on the tenth floor; the vice-chancellor's office is located on the eleventh floor; the machine room, which is smaller in size, is located on the twelfth floor. To be clear, although emphasis is being placed on the primary purpose, it should be noted that several of the floors covered above have additional roles as well. The former administration building, located around 10 meters from the senate building but divided by a road, houses the governing council chamber and other elements.

Structure and Technology

The Senate House at the University of Lagos is a high-rise structure that was constructed using a structural frame system consisting of cylindrical reinforced concrete columns and beams to create the building's primary structure. Because the walls are not load-bearing, the building's dead load is

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decreased and structural safety is achieved. The fins are made of 125 mm thick precast concrete with multicolored mosaic tiles. Every window has a horizontally rotating sash, and every entrance has a flush door. The inside walls are composed of painted and plastered blocks that are embellished with mosaic tiles. Sandcrete screed with 2mm rubber sheet finished type BS204 makes up the office floor. The building's extended floors provide structural and aesthetic balance, act as an anchor and support for the sun-shading egg-crate mechanism, and allow for regular maintenance.

Beauty

The primary components utilized to achieve rhythm and movement on the façade are the prominent circular columns and the egg-crate sun shading device. The sun shading device's use of color gave it a distinctive and alluring effect that set it apart from other buildings in the area, and the integration of various sized rectangular prisms with a barrel vault gives the building form and creates balance, unity, and proportion as well as emphasis (the barrel vault with mural painting on the curved wall to emphasize and differentiate the senate chamber) and hierarchy by placing the vice chancellor and registry units at the top of the high-rise.

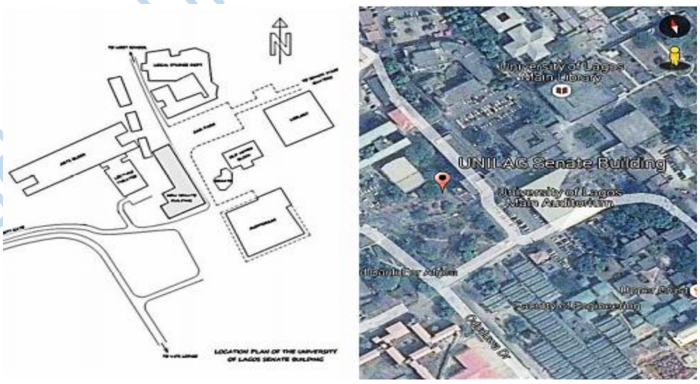

Plate 12: Location plan of Unilag Senate House (Source – Author's field work)

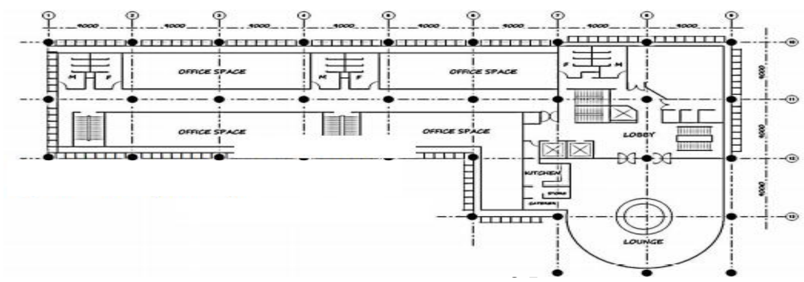

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Plate 13: First floor plan of Unilag Senate House (Source – Author's field work)

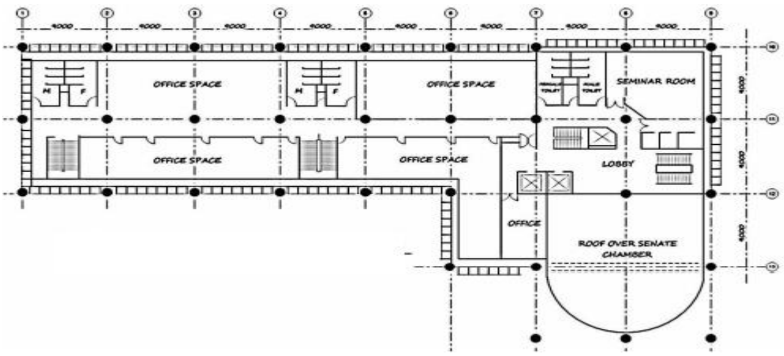
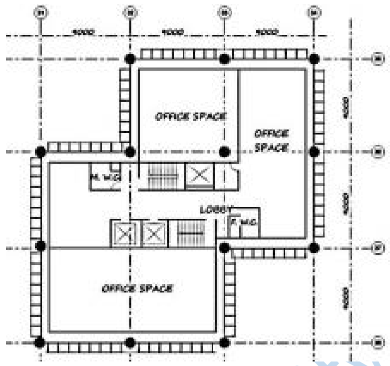


Plate 14: Typical second and third floor plan of Unilag Senate House (Source –Author's field work)



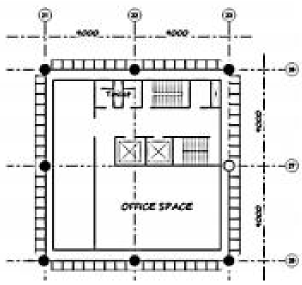


Plate 15: (a) Fourth to eight floor plan (b) Ninth to eleventh floor plan

(Source – Author's field work)

Plate 16: Approach view of Unilag Senate House (Source –Author's field work)

Plate 17: Aerial view of Unilag Senate House (Source –Author’s field work)

Plate 18: (a) Mural painting on the Senate Chamber (b) Landscape with sit-out called “love garden” (Source –Author’s field work)

Appraisal of Building

Merits

- The ground floor is half open which allow for pedestrians to transverse the site easily.

- The building has extended floors which gives it both structural and visual balance, serves as support/ anchor for the egg-crate sun-shading device and for consistent maintenance.

- The use of French windows in the offices reduces the use of electrical energy in form of lighting as natural lighting and ventilation is achieved within the spaces.

- Use of curved wall in the senate chamber which enhances sound distribution and absorption within the space.

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Variables	**Adequate (*)**	**Inadequate (X)**	**Not Available (0)**
Architectural form	*		
Scope of Facility	*		
Construction Technology	*		
Building Material	*		
Sustainability of building	*		

S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope
		Use of external Insulation					●	
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally lit with large glazed panel
		Use of spectrally selected glass					●	

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3	Natural Ventilation	Use of openable Windows			●			The use of openable casement windows,
4	Site and external spaces	Use of interwoven Landscape		●				Not enough landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			
		Use of plants		●				
8	Existing	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting.
		Use of natural gas			●			

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3.4.3 Case Study

Ladoke Akintola University of Technology Senate Building

Location

The Senate building of the institution is located at the core of the university, surrounded by motion ground, Urban and Regional Planning studio and Faculty of Engineering building. Its form gave it a clear distinction from other buildings on campus which makes it notable on approach from the major road coming from the university main gate.

Description

The building's round shape helps to identify it on campus. The building's focal point is its center, which has a conference room on the third story and a 200-seat senate chamber on the first floor. Through a lobby, the building's peripheral sections are connected to the center. The building is made of frames and is divided by walls made of hollow sand Crete blocks. Long span aluminum roofing sheets are used to cover it. The building, which has four stories and a circular floor layout, is known as a medium rise construction. The bursary department, accounting, security post, and reception hall are all located on the ground level. The kitchenette, pay roll office, senate chamber, and common area are all located on the first level. The deputy registrar's office, data management, register review committee office, deputy registrar council affairs, deputy registrar planning and budgeting, and registrar's office are all located on the second level. The vice chancellor's office, the corporate affairs office, the common room, the kitchenette, and general waiting are all located on the third level.

Relationship between Function and Space

The use of concentric floor layouts improves efficient movement across the building by placing offices of the same unit next to one another and to adjacent units. The main stair near the entry is broader to handle and disperse the incoming traffic, and the vertical access points are conveniently positioned and readily accessible. The senate chamber is located in the center of the building, with

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lower-ranking units to the highest executive members arranged in ascending order from the ground level to the third story.

Structure and Technology

The building has structural stability thanks to its structural frame of reinforced concrete beams and columns with projected flying buttresses, and it has dimensional stability thanks to its extended levels for balconies. The second and third stories' cantilevered section is elevated by the use of arched windows on the approach, which complement the ground floor's arches supported by columns. Additionally, the projecting fins' slanting distinguishing characteristics, which taper to the ground floor's end, accept and transmit the dead weight from the roof to the foundation. In addition, it acts as a barrier, shielding the structure from inclement weather like driving rain and glaring sunlight. Sandcrete blocks are utilized for the interior, partition, and external walls, while reinforced concrete is used for the columns and beams. Aluminum-framed sliding windows with glazing were used. The building is reliant on an active energy source for indoor thermal comfort because of the tiny area of window openings in the offices, which results in insufficient illumination and poor ventilation.

Aesthetics

The building gains strength and emphasis from the aggressive use of slanting buttresses with balconies on the exterior; the arches on the approach make the entrance bold and distinct, and the arched windows complement and unify the similar properties in contrast to other features on the facade. The projected slanting fins combined with the balconies, which in turn produce pattern and make the entry the building's line of symmetry, were another technique used to generate rhythm and movement.

Appraisal of Building

Merits

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- The concentric floor plans adopted enhances effective circulation within the building with high proximity between offices of the same unit and to other units.

- The aggressive use of slanting buttresses with balconies on the exterior gives the building dominance and emphasis.

Variables	**Adequate (*)**	**Inadequate (X)**	**Not Available (0)**
Architectural form	*		
Scope of Facility	*		
Construction Technology	*		
Building Material	*		
Sustainability of building		X	

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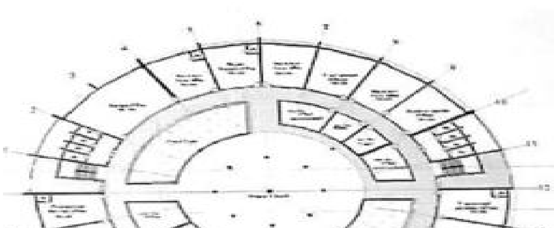
Plate 19: Location plan of LAUTECH Senate Building (Google earth)



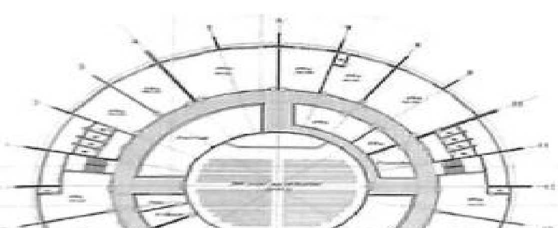


Plate 20: Ground and first floor plan of LAUTECH Senate Building (Source –Author's field work)

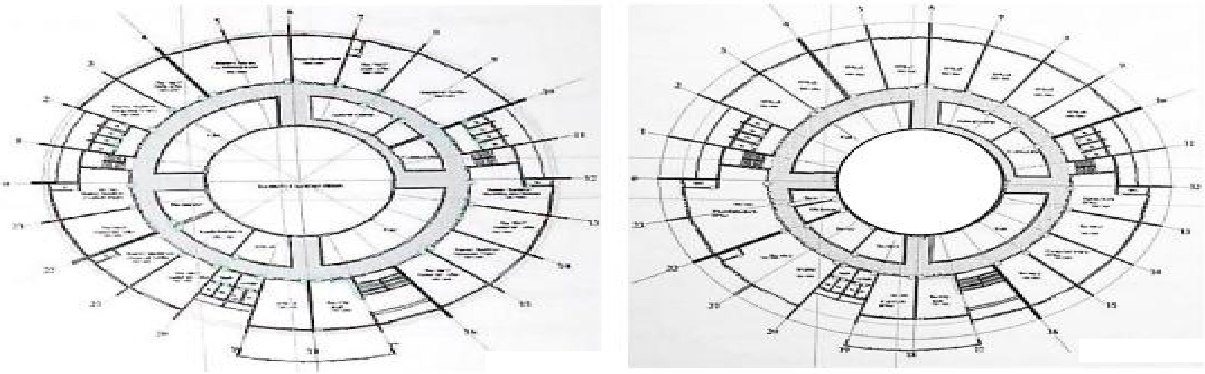


Plate 21: Ground second and third floor plan of LAUTECH Senate Building (Source –Author's field work)

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Plate 22: Approach view of LAUTECH Senate Building (Source –Author's field work)

Plate 23: Rear view of LAUTECH Senate Building (Source –Author's field work)

Plate 24: Courtyard view of LAUTECH Senate Building (Source –Author's field work)

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S/N	Variables	Checklist	Level of					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope
		Use of external Insulation					●	
		Use of smooth surface Finishes					●	

		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally lit with large glazed panel
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of openable Windows			●			The use of openable casement windows,
4	Site and external spaces	Use of interwoven		●				Not enough landscaping.
		Use of impervious			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			
		Use of plants		●				
8	Existing	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting.
		Use of natural gas			●			

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3.5.4 Case Study

Location of the Kashmir University Administrative Building

The structure is situated next to the Vice Chancellor's office in Hazratbal on the main campus. It faces the cricket field and provides an amazing view of Dal Lake and the Zabarwan hills in the distance. A "central" area was inspired by an existing Fir tree.

The client and the architect

ANA architecture created the structure with human connection, energy efficiency, optimal use of space and materials, comfort, and an appreciation of traditional wood architecture in a modern setting in mind.

Synopsis

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The building's operations are divided into two discrete components based on security level and organized around a central atrium area. Connecting bridges soar across the atrium area, creating a focal point formed by the tree that extends from the entryway. This atrium turns into a "all weather" venue for social events, impromptu get-togethers, dialogues, and the installation of transient exhibits. The majority of the offices are located in the two blocks on East and West. Every workplace has natural lighting. Glass and color are used extensively to create clearly defined and discernible "departments." Cabins and workstations are arranged to promote communication and teamwork. All-weather VRV air conditioning is used to independently regulate the temperature in each zone or department. Because the air conditioning system incorporates enthalpy control, only fresh air is pumped throughout the building when the outside temperature is agreeable, causing the compressors to stop operating. To maintain healthy interior conditions, enough fresh air is supplied, even in very hot and cold weather.

Relationship between Function and Space

Mechanical ventilation fans and heat sensors are installed in the center atrium. When heated air reaches a certain temperature, they turn on to flush it out. To enable use after dusk, the atrium is also equipped with high bay lighting, which is very efficient.

Structure and Technology

Steel that has been manufactured in a factory makes up the building's whole construction, including the façade panels, insulated roofing, and beams and columns. Glass wool is used as insulation between the dry walls that make up the interior partitions.

Aesthetics The structure honors the locality, culture, and environment while showcasing the University's innovation, openness, and modern character.

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Evaluation of the Building's merits: - Enough fresh air is supplied to guarantee hygienic interior conditions; - The façade allows light to enter but regulates heat entrance as well as heating loss during the winter.

- Workstations and cabins were planned to encourage interactions and collaborative working.

Variables	**Adequate (*)**	**Inadequate (X)**	**Not Available (0)**
Architectural form	*		
Scope of Facility	*		
Construction Technology	*		
Building Material	*		
Sustainability of building	*		

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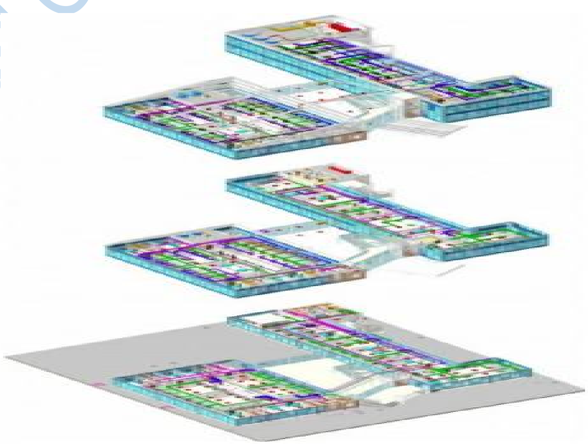

Plate 25: 3D Building Plan of Kishmar University Administrative Building (Google Search)

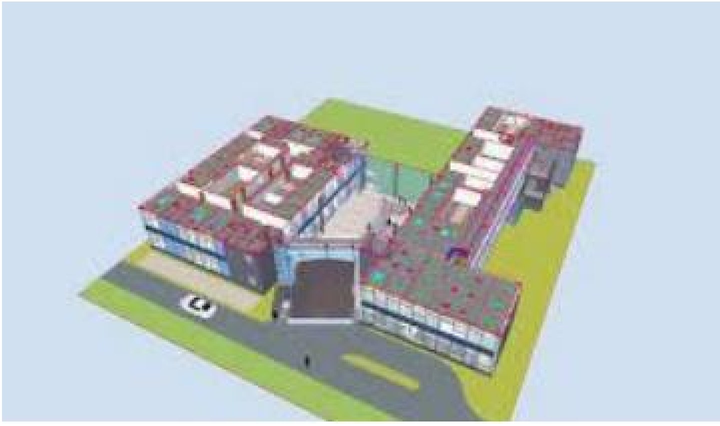

Plate 26: Aerial view of Building Plan of Kishmar University Administrative Building (Google Search)

Plate 27: Rear view of Kishmar University Administrative Building (Google Search)

Plate 28: a. Approach view b. Atrium view of Kishmar University Administrative Building (Google Search)

S/N	Variables	Checklist	Level of					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope
		Use of external Insulation					●	
		Use of smooth surface Finishes					●	
		Use of light colours					●	
2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally lit with large glazed panel
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of openable Windows			●			The use of openable casement windows,
4	Site and external spaces	Use of interwoven		●				Not enough landscaping.
		Use of impervious			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate

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6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			
		Use of plants		●				
8	Existing	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting.
		Use of natural gas			●			

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3.4.4 Case Study

Dhaka International University Administrative Building

Location

The building's history, which is situated in Bangladesh's Dhaka metropolis, is rather fascinating. The construction of a minimal maintenance building was a precondition for the project. It was determined that, initially, there would be a single facility with all the facilities needed to conduct the program because of the client's budget. After then, further work will proceed.

The client and the architect

Nabi Newaz Khan Shomin is the principal architect; Lutfullahil Majid, Md. Jubair Hasan, Saurav Dutta, and Mehnaz Chowdhury are the other associate architects. The administrative buildings in the subcontinent were referred to as "LAL DALAN" (Red Buildings), and the structure has stood for cultural power for ages. Since "LAL DALAN" has traditionally evoked images of power, it was difficult to satisfy the client's specific need while creating a contemporary academic building. The site's seismic susceptibility added to the difficulty of the task.

Synopsis

This "RED" building project is set up to serve as a meeting place and inspiration source for educators and learners alike. The primary goal of the building's design was to guarantee both the lowest possible plot occupancy and the greatest program compactness. This structure is an example of "Delicate Form of Craftsmanship" in bricklaying. Because the location is particularly prone to earthquakes, the building is mostly made of steel with bracing. The structural design method shortens the building schedule. The building's primary materialization is constructed of handcrafted brick chips whose surfaces have been pebble washed. The floor finish is a mosaic of red-textured brick chips. The wall surfaces with handcrafted brick chips and this red textured floor finish go well together. In addition to being maintenance-free and sustainable, the material is monolithic and has a set permanence. The building only operated from 2016 to 2018. In order to administer the academic program on a wider scale, a new academic building was constructed after that. However, this "RED" one is still recognizable and serves as motivation for everyone. Advantages: Large glass windows that may be opened are a feature that guarantees enough functional and spatial relationships.

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There are classrooms, conference rooms, multipurpose halls, and library facilities available in this three-story facility. Furthermore, this building's roof is intended to support students' outdoor activities, which is a significant aspect.

Structure and Technology

The structure is an example of "Delicate form of Craftsmanship" in bricklaying. Because the location is particularly prone to earthquakes, the building is mostly made of steel with bracing. The primary materialization of this structure is built of handcrafted brick chips that have been pebble washed. The floor finish is a mosaic of red-textured brick chips.

Aesthetics The building's brick walls were covered with a very thin coating of shell lime plaster, which served as weather protection and preserved the outside facade's decoration. This intricate decoration was an essential component of Bangladesh's ancient history and culture.

Evaluation of the Building's Merits

-Wide glass windows with adjustable glass were installed to allow optimal daylighting and air circulation, hence reducing energy usage.

Pre-owned furniture was organized in this building area in order to reduce the initial costs. - The layout of workstations and cabins was designed to promote communication and teamwork.

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Variables	**Adequate (*)**	**Inadequate (X)**	**Not Available (0)**
Architectural form	*		
Scope of Facility	*		
Construction Technology	*		

Building Material *

Sustainability of building *

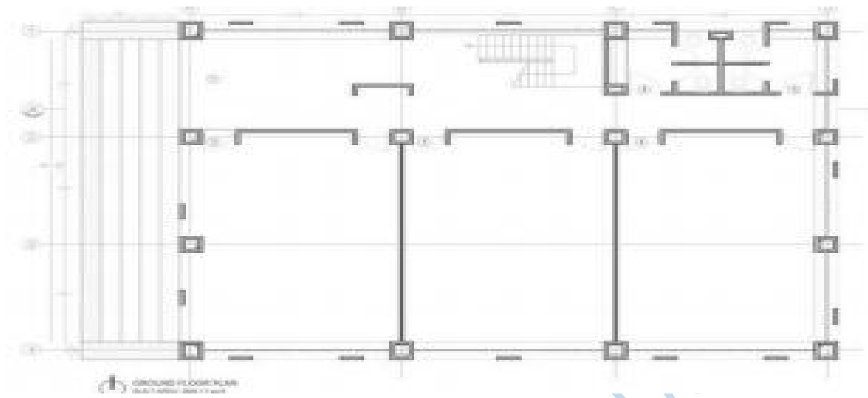

Plate 26: Floor Plan of Dhaka International University Administrative Building (Google Search)

Plate 27: Rear View of Dhaka International University Administrative Building (Google Search)

Plate 28: 3D Building Plan of Dhaka International University Administrative *Building (Google Search)*

PLATE 27: a. Roof Top for student activities b. Main stair hall of Dhaka International University Administrative Building (Google Search)

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S/N	Variables	Checklist	Level of application					Remark
			1	2	3	4	5	
1	Building envelope	Suitability of the materials to the climate					●	High efficiency glazing and external thermal envelope
		Use of external Insulation					●	
		Use of smooth surface Finishes					●	
		Use of light colours					●	

2	Natural lighting	Wall to window ratio (40%)					●	The interior naturally lit with large glazed panel
		Use of spectrally selected glass					●	
3	Natural ventilation	Use of openable Windows			●			The use of openable casement windows,
4	Site and external spaces	Use of interwoven Landscape		●				Not enough landscaping.
		Use of impervious Surfaces			●			
5	Building form	Large building surface Area					●	Appropriate building form based on climate
6	Building orientation	Sun orientation; E-W					●	The optimum orientation is NW-SE
		Wind orientation; SW-NE					●	
7	Wall/Window shading	Use of horizontal and vertical shading devices				●		There is outdoor area for green area and presence of overhang
		Use of interior blinds				●		
		Use of recessed walls		●				
		Use of overhangs			●			
		Use of plants		●				

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8	Existing energy	Use of PV cells			●			Automatic presence detectors/sensors and high efficiency lighting
		Use of natural gas			●			

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Chapter Four

Site Analysis and Design Synthesis

4.1 Study Area

4.1.1 Site Location

4.1.2 Site Selection Criteria

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

I. Land use:

II. Accessibility

III. Services.

IV. Proximity To another administrative Area.

V. Topography

VI. Expansion Possibilities

4.2 Site Analysis

Site Accessibility

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

Nearness to Public Utilities

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

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Drainage and Topography

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

Vegetation

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

Soil Condition

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

Wind Direction

The north-east trade wind brings cold, dust, harmattan and these cause discomfort. The south west trade wind brings cold humidity which gives comforting effect to the people. Proper ventilation is considered as part of the building effective arrangement. The building´s 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

4.3 Project Analysis and Design Synthesis

4.3.1 Brief Analysis

4.3.1.1 Brief Development

Some spaces were found to be common to all the five case studies examined in this study.

These spaces were studied critically to determine the standard required, the number of units per people, their capacity and exact function they perform in an Office design. These spaces are;

- Indoor parking

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

4.4 Design Consideration

4.4.1 Site planning and landscaping

The site planning was carefully planned to accommodate the outdoor activities in relation to the indoor facilities for easier use of both facilities simultaneously, vehicular movement and pedestrian movement were clearly separated. Longer Side of the building was positioned to Face North -South Direction to minimize solar gain into the building. Enough greens are also introduced to cool and also provide fresh air For the Office Complex.

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4.4.2 Spatial Organization

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

4.4.2.1 Energy Efficiency Strategies

Energy Efficiency strategies are used in the design of the office complex to a large ex

4.5 Conceptual Development

4.6 Space Allocation / Schedule of Accommodation

SPACES	AREA (m^2)	CAPACITY
INTERNAL SPACES		
Toilets & Urinals	364.26m2	51 toilets & 18 urinals
This is the account of all toilets & urinals across all floors		
Relaxation & Eating Areas	780.38m2	156 Seats
This is an account of all sit-outs, open terraces & restaurants		
Office Spaces	2182.43m2	62 Offices
Accumulation of offices across all floors		
Conferences & Halls	861.58m2	4 conferences & 2 Halls
All meeting rooms, chambers & conference hall		
Disability Considerations	160.2m2	Interior Ramp
Ramp @ 9 degrees inclination from ground floor to the second floor, the provision of three elevators eases disability access beyond the second floor.		
Stairs & Elevators	606.45m2	3 staircases & 3 elevators
This include Main elevators / staircase, service staircase / freight elevator, and emergency staircase. This analysis include the staircase landings and elevator waiting areas.		

SPACES	AREA (m^2)	CAPACITY
EXTERNAL SPACES		
Parking Lot	2,454.69m2	147 Vehicle capacity
Green Areas	12,115.34m2	Grasses, flowers & Trees
Drive ways	3,036.66m2	All drivable routes within the site
Pedestrian Areas	1361.37m2	All spaces where driving is prohibited
Relaxation Area	1114.46m2	56 Umbrella Canopy 224 Seats
Disability Considerations	64.82m2	All ramps outside the building

4.7 Construction Methods and materials

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

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

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

. **Reinforced Concrete**

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The high structural strength of concrete (especially when reinforced with steel) make sit the perfect‘material for the structural. The fluidity of reinforced concrete make sit a good construction material for curved, slanted wall.

Steel

Steel offers many advantages, primarily high strength hanductility. It is also durable if protected from corrosion. Relatively, the higher yield stress of steel allows for smaller sections and its lower weight reduces foundation requirement.

4.8 Building Services

4.8.1 Water supply

The site has access to water supply from Eko Atlantic water Board, 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 the back for easy maintenance.

4.8.2 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. There is provision for building integrated photo voltaic panel for alternative power source. Transformer will also be installed on the site because of the amount of power needed by the facility.

4.8.3 Refuse disposal

The building has as hoot for refuse disposal from each floor, this is an enclosed place where there fuse will be thrown form each floor and collected on the ground floor to avoid littering of all the space. From here it‘s going to be taking to site waste disposal prior to when the disposal agency will come for the final disposal

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4.8.4 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

4.8.5 Firefighting system

Fire hydrants for easy water collection by firefighters, fire extinguisher should be strategically located on the corridors, smoked etectors water sprinklers should be provide din each space and corridors

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Chapter 5

Conclusion and recommendation

5.1 Project Appraisal

The research work is built on the subject of sustainability efficiency in office Building, the problem definition being that architectural design elements can offer a better methodology towards achieving **Energy** efficiency within the Building. The argument draws its background to the study of Office Complex within and outside Nigeria.

Review of relevant literature on the issue of sustainable principles of architectural design in having a conceptual framework in which architectural design elements can be applicable. Certain key Strategies such as Site planning and landscaping, Building envelope and material types, Building Orientation, Form and ventilation among others were highlighted and discussed in the research to achieve Energy efficient office complex. Case studies were analyzed using specific variables directly related to the subject of the research as well as the use of structured questionnaire to user and maintenance staffs to aid in acquiring more information about the Study. Findings from the literature review, questionnaire as well as the five areas studied were thus used in generating a design and planning concepts for the proposed Office complex.

5.2 Conclusion

The problems associated with Energy efficiency in office Buildings has overtime not been addressed properly, thus architects and designers are beck on to address the issue from the design stage, as this will make the facility to consume less energy. This is first done by applying Energy efficiency strategies During design and Construction, there is possibility of achieving about 70% lesser drop in energy consumption within the facility.

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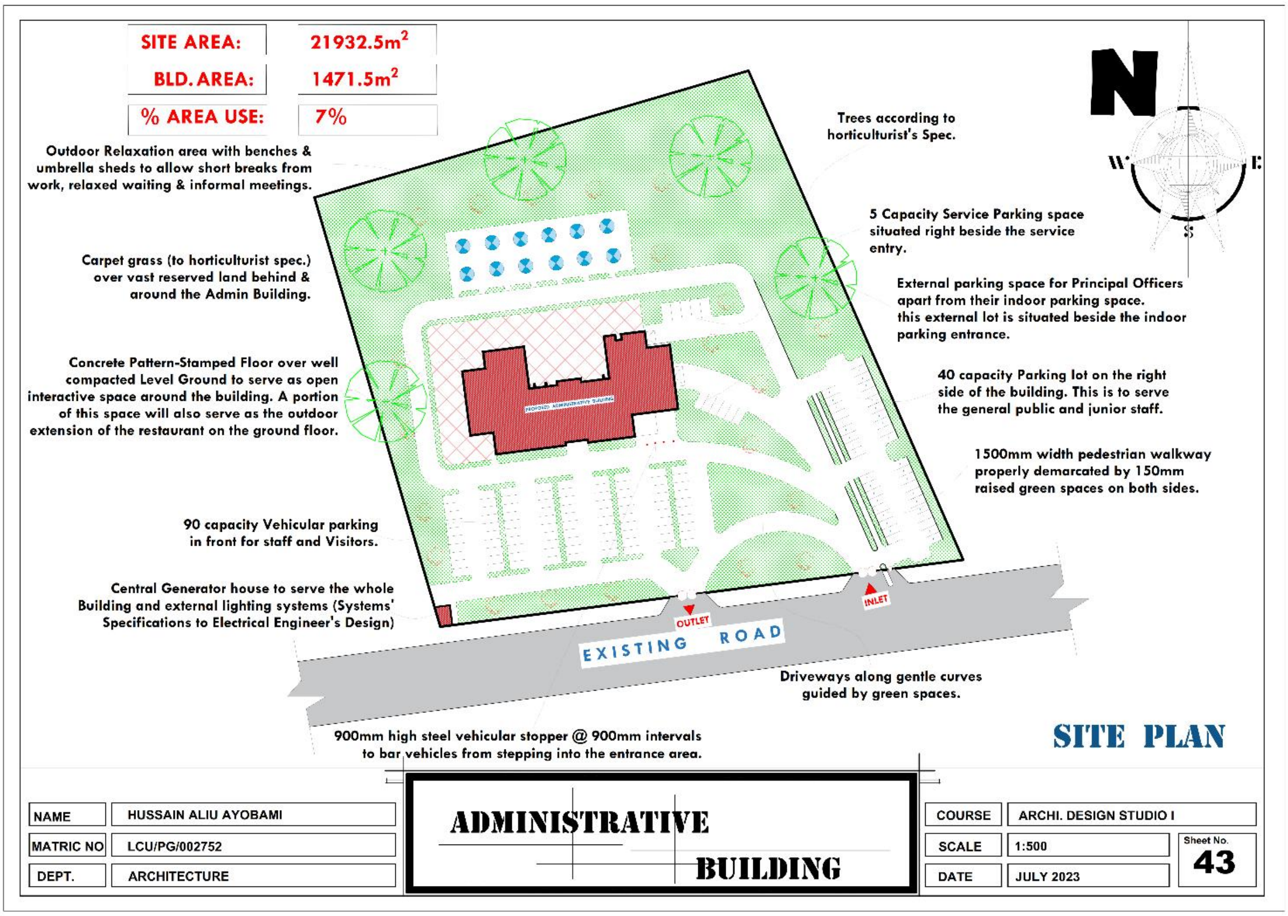
Appendix



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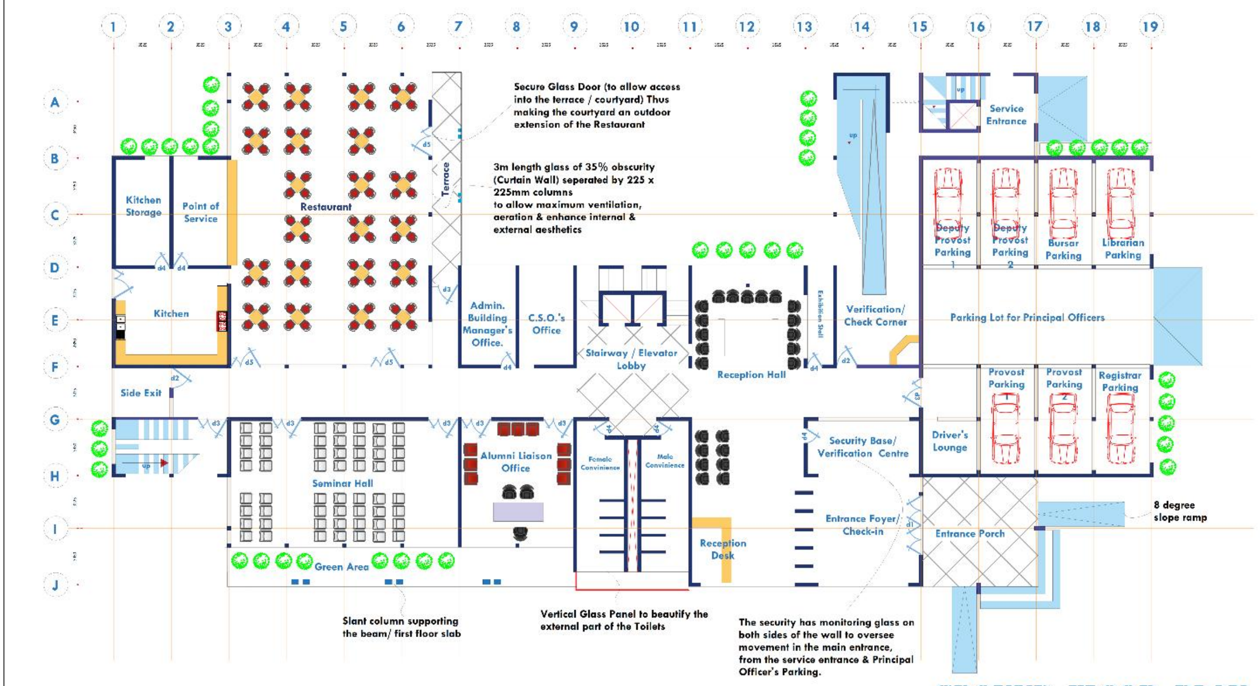

GROUND FLOOR PLAN

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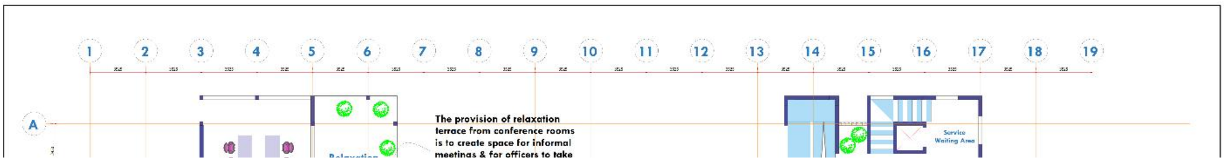

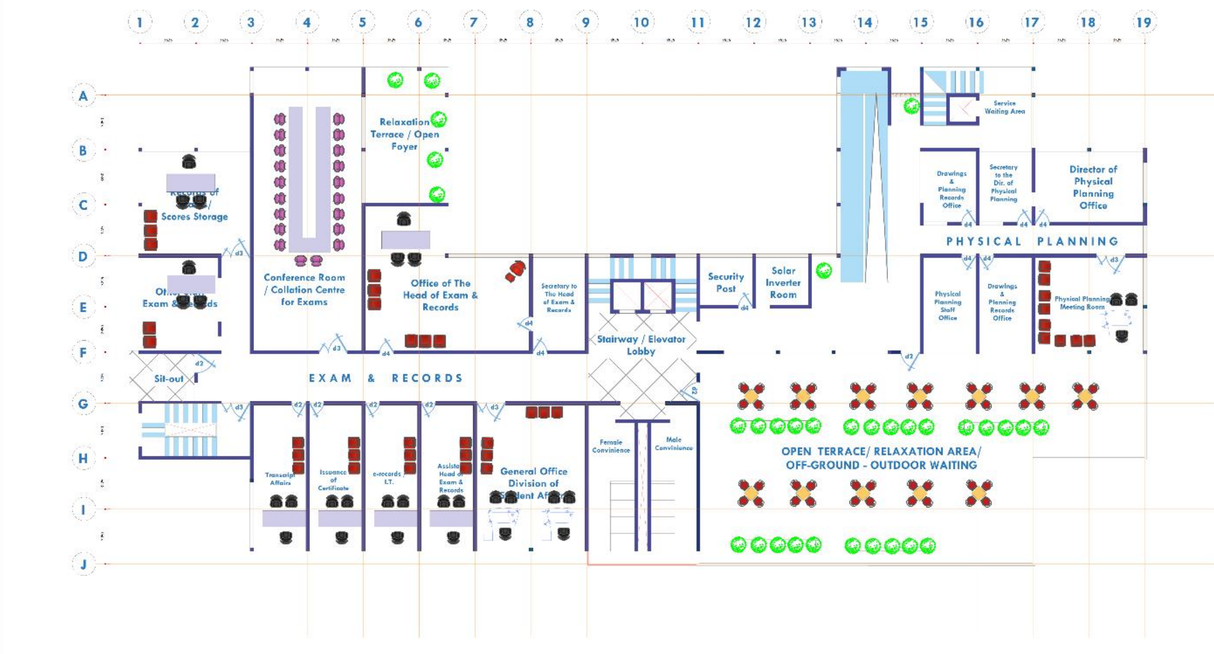

SECOND FLOOR PLAN

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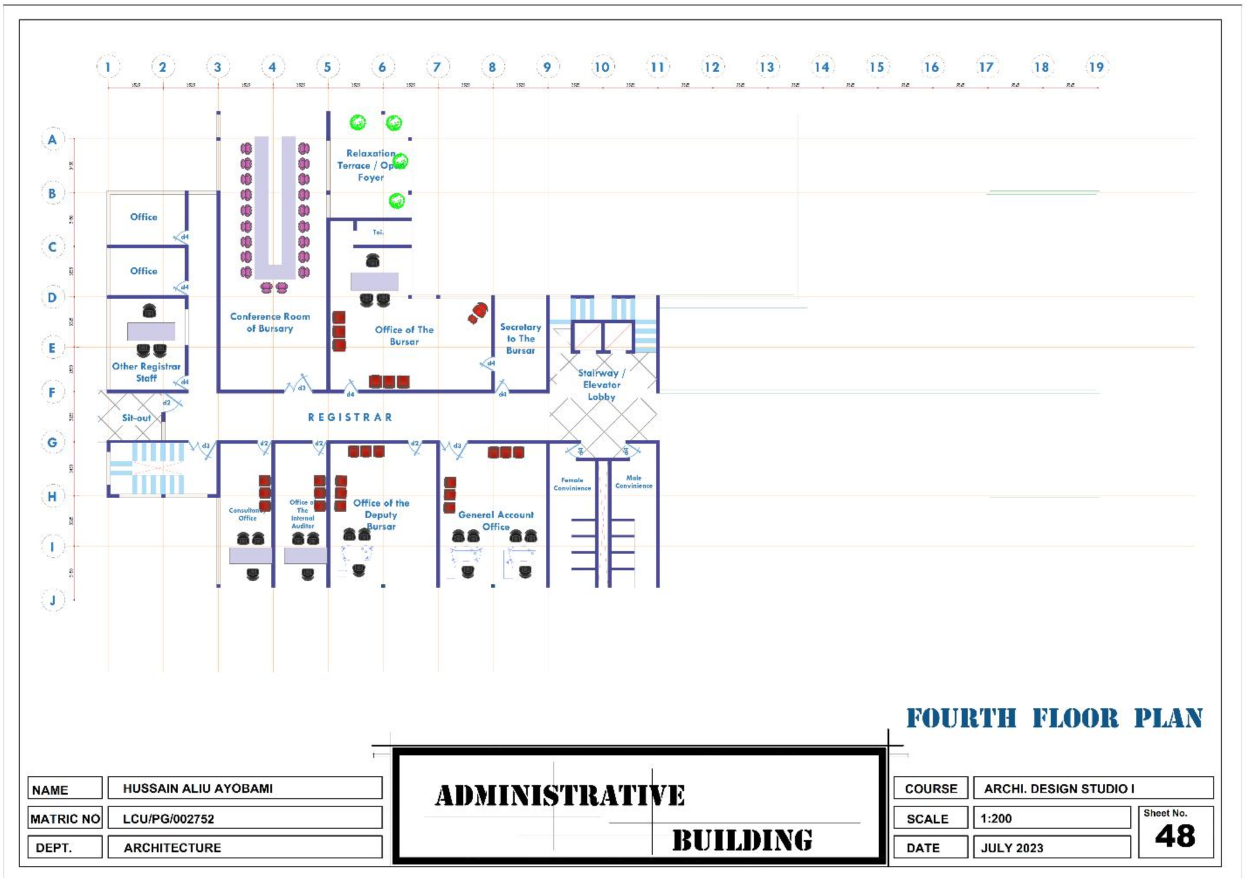
Office
Office
Other Registrar Staff
Conference Room of Bursary
Relaxation Terrace / Open Foyer
Office of The Bursar
Secretary to The Bursar
Stairway / Elevator Lobby
Sit-out
REGISTRAR
Office of the Deputy Bursar
General Account Office
FOURTH FLOOR PLAN
NAME
HUSSAIN ALIU AYOBAMI
MATRIC NO
LCU/PG/002752
DEPT.
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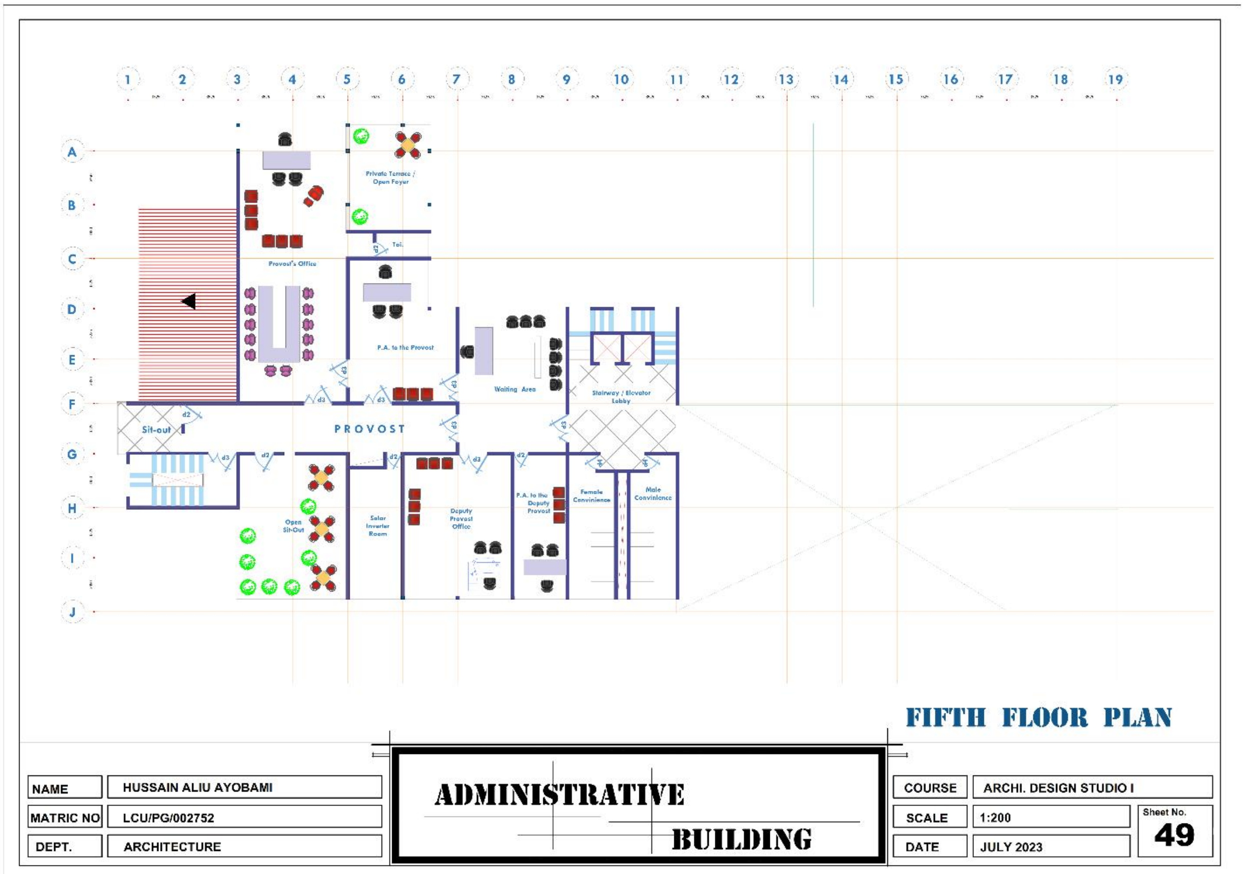
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Sit-out
Waiting Area
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DEPT.
ARCHITECTURE
ADMINISTRATIVE BUILDING
COURSE
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49

3D Image showing the Front / Right Sides perspective of the Building

Aliu Hussain Ayobami | Matric No: **LCU/PG/002752** | **76**

3D Image showing the Left / Front Sides of the Proposed Administrative Building

Aliu Hussain Ayobami | Matric No: **LCU/PG/002752** | **75**

3D Image showing the Rear end of the building from the Right side

Aliu Hussain Ayobami | Matric No: LCU/PG/002752 | 77

3D Image showing the Rear end of the Building from the Right Side

Aliu Hussain Ayobami | Matric No: LCU/PG/002752 | 78

3D DRAWING 6

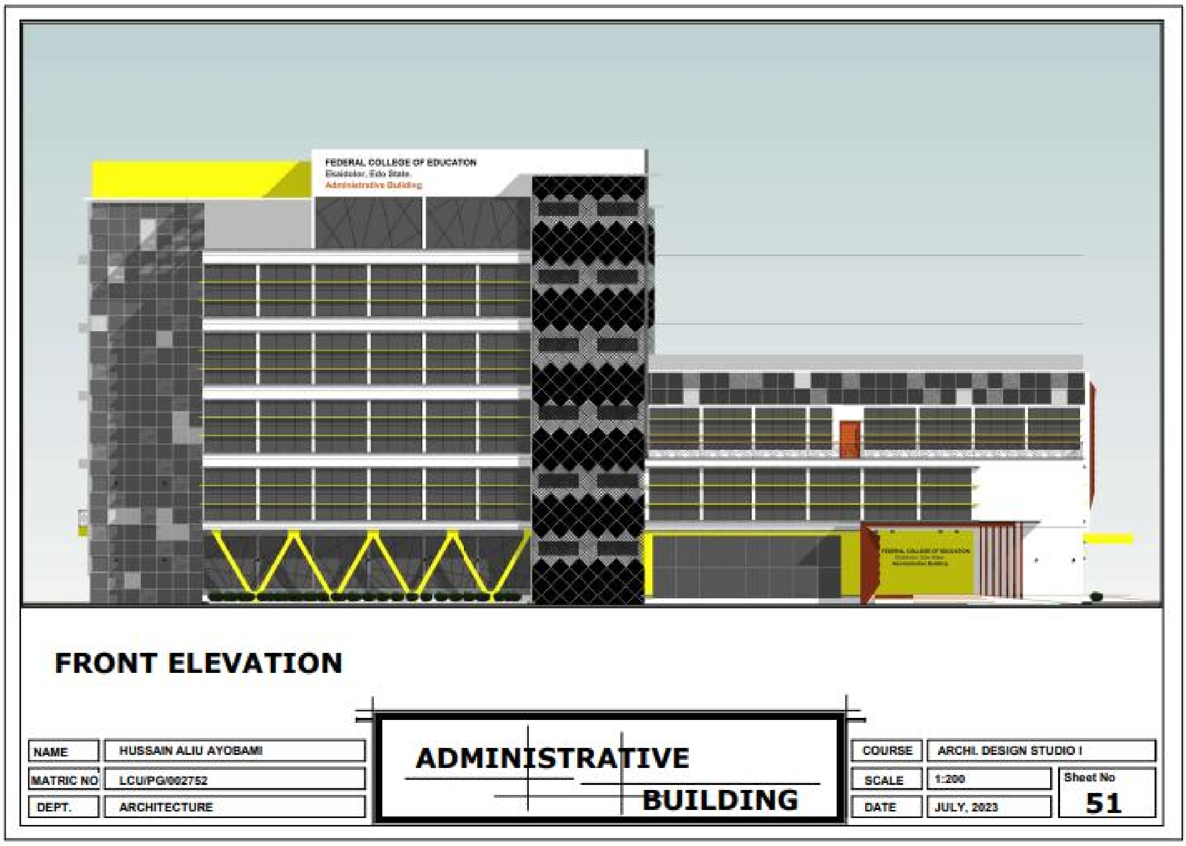
3D Image showing an overview of the Proposed Administrative Building

Aliu Hussain Ayobami | Matric No: **LCU/PG/002752** | **80**

3D DRAWING 5

3D Image showing the Rear end of the Building from the Right Side

Aliu Hussain Ayobami | Matric No: **LCU/PG/002752** | **79**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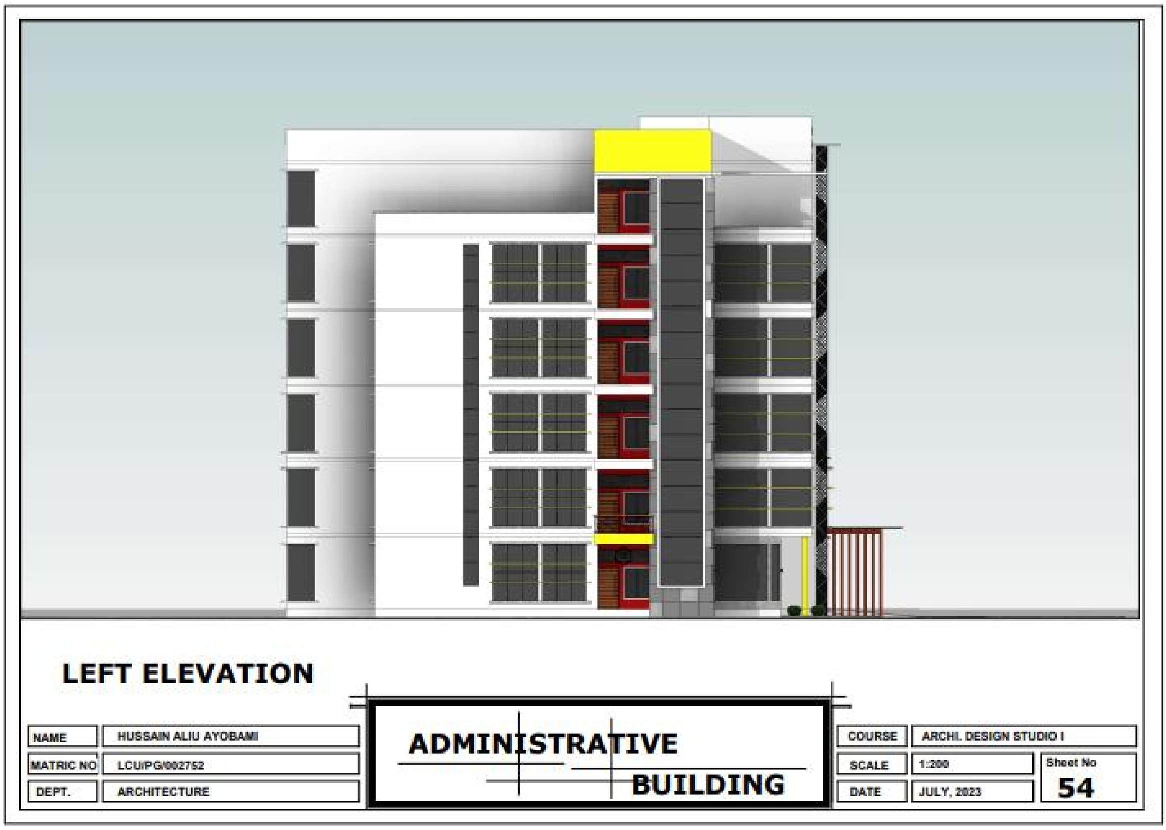
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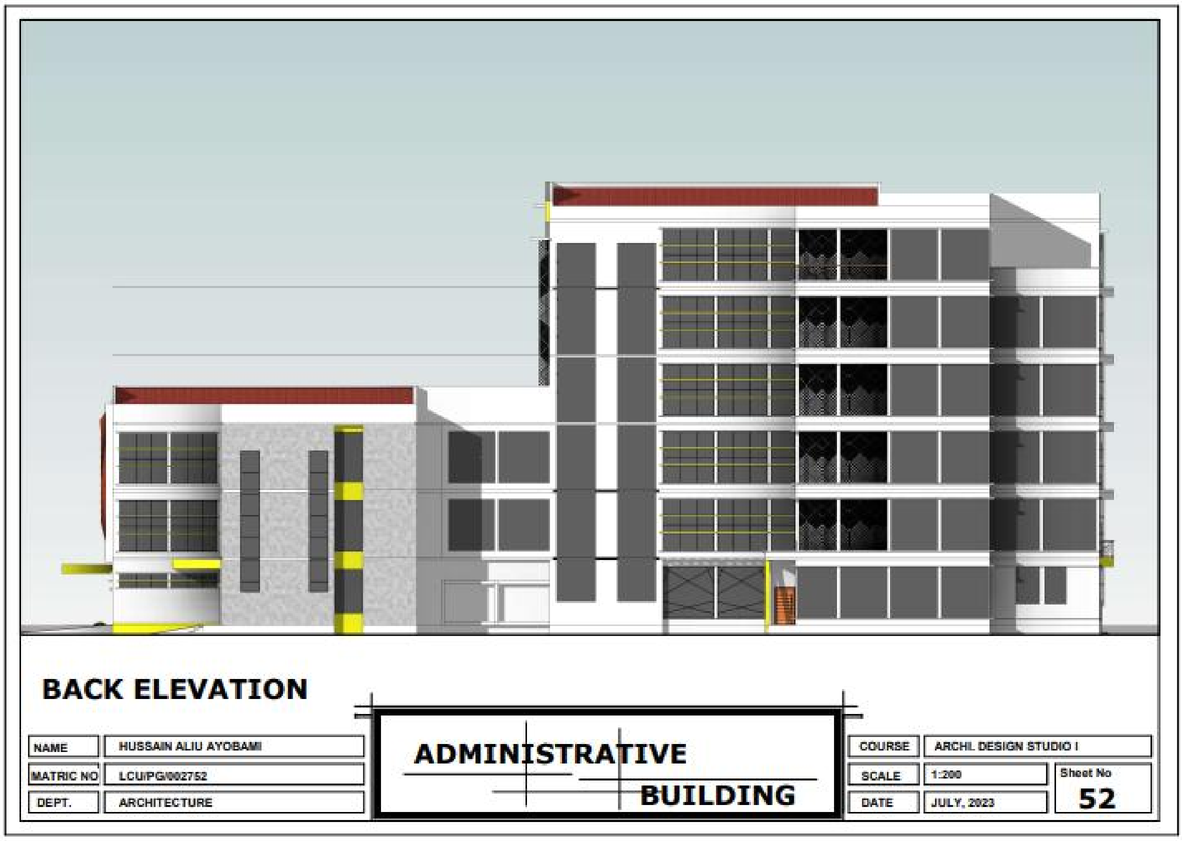
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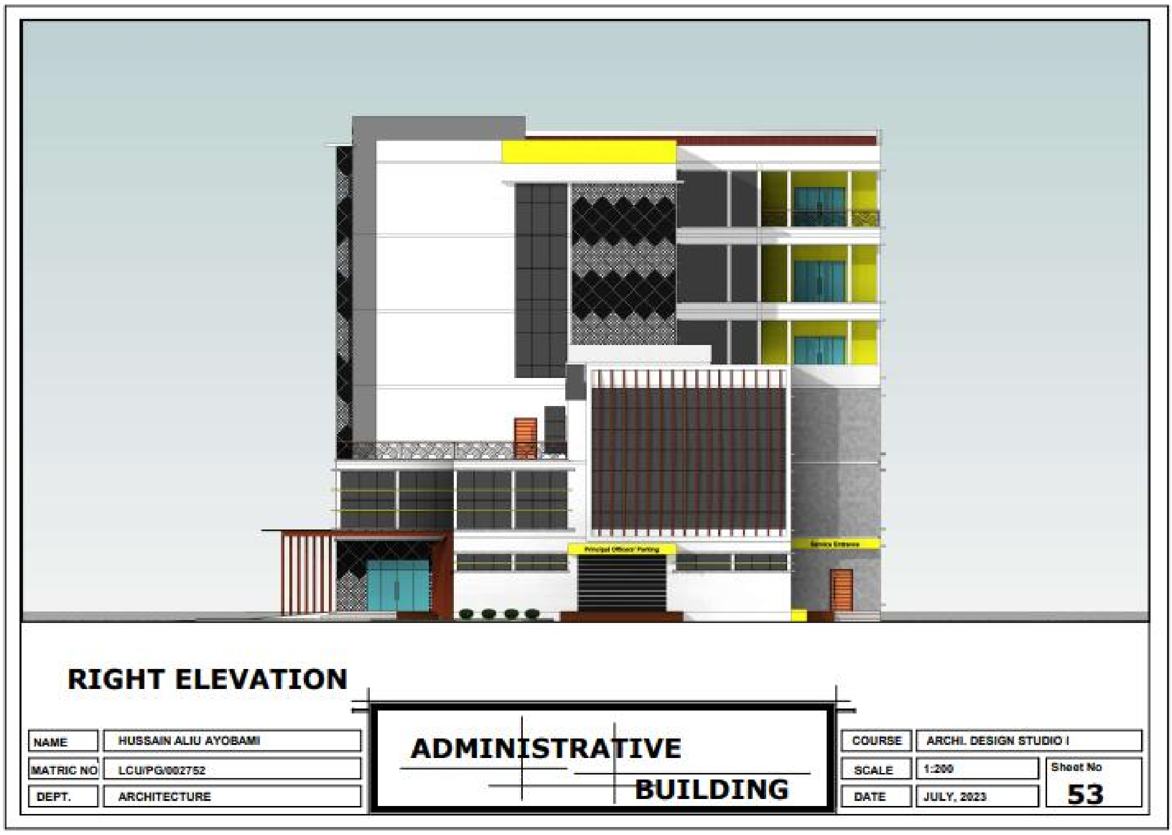
RIGHT ELEVATION
NAME
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Sheet No
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SECTION A-A

NAME	HUSSAIN ALIU AYOBAMI	**administrative building**	COURSE	ARCHI. DESIGN STUDIO I
MATRIC NO	LCU/PG/002752		SCALE	1:200
DEPT.	ARCHITECTURE		DATE	JULY, 2023

Sheet No **57**

SECTION B-B

NAME	HUSSAIN ALIU AYOBAMI	**administrative building**	COURSE	ARCHI. DESIGN STUDIO I
MATRIC NO	LCU/PG/002752		SCALE	1:200
DEPT.	ARCHITECTURE		DATE	JULY, 2023

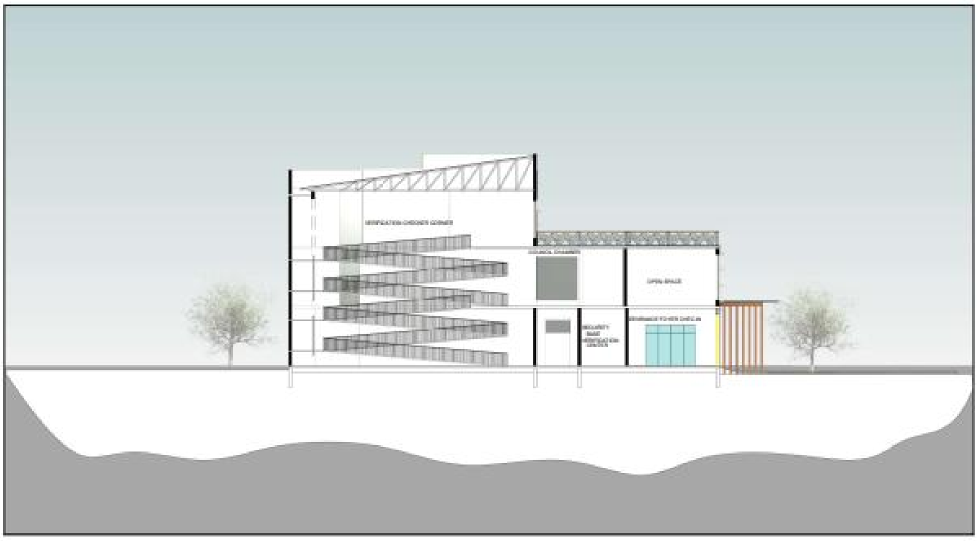
Sheet No **55**

SECTION C-C

NAME	HUSSAIN ALIU AYOBAMI	administrative building	COURSE	ARCHI. DESIGN STUDIO I
MATRIC NO	LCU/PG/002752		SCALE	1:200
DEPT.	ARCHITECTURE		DATE	JULY, 2023
			Sheet No	57

SECTION D-D

NAME	HUSSAIN ALIU AYOBAMI	administrative building	COURSE	ARCHI. DESIGN STUDIO I
MATRIC NO	LCU/PG/002752		SCALE	1:200
DEPT.	ARCHITECTURE		DATE	JULY, 2023
			Sheet No	58



SECTION B-B

NAME	HUSSAIN ALIU AYOBAMI	administrative building	COURSE	ARCHI. DESIGN STUDIO I	
MATRIC NO	LCU/PG/002752		SCALE	1:200	Sheet No 56
DEPT.	ARCHITECTURE		DATE	JULY, 2023	

SECTION A-A

NAME	HUSSAIN ALIU AYOBAMI	administrative building	COURSE	ARCHI. DESIGN STUDIO I	
MATRIC NO	LCU/PG/002752		SCALE	1:200	Sheet No 55
DEPT.	ARCHITECTURE		DATE	JULY, 2023	

Biodata

A. Personal Data

Full Name: Aliu Ayobami HUSSAIN

Address: No 3, Odekunle Street, Agbowo, UI, Ibadan

Email Address: haayobami0@gmail.com

Phone Number: 07033261495

Date of Birth: 05/08/1990

Place of Birth: Ibadan, Oyo State

Nationality: Nigerian

Marital Status: Single

Name and Address of Next of Kin:

B. Educational background

Educational Institutions Attended with Dates

a. Primary Education

Ad-din International School — 1996 - 2002

b. Secondary Education

i. Muslim International School — 2002 - 2008

c. Higher Education

i. Lead City University — 2019 - 2021

C. Academic and Professional Qualifications with Dates

i. Bachelor of Science (B.Sc) Architecture — 2021

ii. West Africa School Certificate — 2008

iii. Primary School Leaving Certificate — 2002

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D. Work Experience with Dates

Architect, Masad Consult	2009 - 2015

…………………………………..   …………………………………

Date   Signature

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