## APPLICATION OF ECO-FRIENDLY TECHNIQUES IN THE DESIGN OF A THREE STAR HOTEL, ABUJA

BY

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## DEPARTMENT OF ARCHITECTURE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

JANUARY, 2023

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN ARCHITECTURE

JANUARY, 2023

### ABSTRACT

*Ecofriendly practices* cannot be over emphasized as the growing rate of urban center in Nigeria is been considered with infrastructural development, the hotel industry in Abuja have witness setbacks regarding environmentally friendly practices over the years, thus the need in adopting Eco-friendly practices in limiting numerous factors that lead to global warming which poses a big risk to human habitation. The built industry has made numerous attempts towards environmental sustainability by building structures which are environmentally friendly thereby improving the quality of living while limiting its impacts on the environment. The literature review revealed eco-friendly design principles that are applicable to buildings in Nigeria, the application of these principles is not holistic unlike the developed parts of the world where eco-friendly buildings designs are well documented, applied and well adapted to. The aim of this study is to assess the Eco-friendly principles in the design of a hotel for its effective application in Nigeria. The methodology involves a cross examination of literature, local Case studies related to the subject topic. A random sampling technique was adopted in selecting thirty individuals out of every twenty persons form different establishment for an oral interview. The data obtained during the investigation showed that eco-friendly buildings require efficiency in design, choice of material and method of construction. The data was documented, analyzed and presented in tables, plates, charts, and figures. The research determined that there are eco-friendly design principles applicable to buildings in Nigeria. According to the result from the data analysis, based on individual perception, seventy-three percent (73%) said there is no risk in the application of the eco-friendly principle, thirty-eight Percent (10%) said the risk involved is high, and seventeen (17%) had no definite answer.

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#### **CHAPTER ONE**

#### INTRODUCTION

### 1.1 Background to the Study

1.0

A hotel is an institution that is specialized in providing lodging services for all individuals (Essays, 2018). The tourist industry is the largest sector that consumes a huge portion of energy for the provision of comfort and service for the visitor, the hotel infrastructure constitutes one of the most energy and resource-intensive features. Travelers are eager to pay for collective amenities, treatment, and entertainment, the energy optimization of several end-users in hotel services is often low, and the subsequent eco-friendly effects are far bigger than those caused by other building types with similar sizes (Ariffin *et al.*, 2012).

The building industry affects the environment from the type of structure been built daily, the choice of building material, and method of construction, this affects the people's way of life and air quality (Abidin, 2012). Gunnell (2009) ascertain that Eco-friendly buildings practices have transcended from the traditional building styles to a modern approach and they are not harmful to the environment. The knowledge of environmentally friendly practices had assisted building practitioners in erecting structures while using building materials that have little or no effect on the natural resources and the environment. UN-HABITAT (2006), ascertain the benefits of eco-friendly building practices include good healthy living, improved indoor environment quality, energy-efficient, material-efficient, operation, and maintenance optimization, and reduces wastages as well reduce environment impact all this listed benefit all sums up to the improvement of the urban biodiversity, therefore, shielding the eco-system through Sustainable land use.

UN-HABITAT (2006) affirmed that eco-friendly buildings incorporate the use of energy, water which includes recycled rain and wastewater, by combining energy and water efficiency systems, illuminating tactics, reduction of CO2 emission to the Indoor air quality systems, and the building envelope system in providing comfort for the end-users.

### **1.2** Statement of Research Problem

The hospitality industry in Nigeria is confronted with numerous challenges but the major issues is focused on the affordability of obtaining decent accommodation that are Eco-friendly with all the facilities for tourists (Nwosu, 2014). In Nigeria, the hospitality industry contributes about N680.1 million to the gross domestic product (GDP), although they have been an increase in the total revenue generated from the year 1984 to 2001, the amount rose from N492.4 million to N2,390.0 billion (CBN, 2006).

According to Price water house Coopers (PwC) (2018), Hotel Outlook for anticipated a 5.4 percent annual rise in the hospitality sector in Nigeria with the current rooms which were appraised from 9,700 in 2017 to 12,600 in 2022, this is the biggest growth, thus adopting environmental building practices in designing hotel will go a long way in helping the ecosystem. The need to adopt eco-friendly building principles will give rise to sustainable construction, this will assist the built industry in adopting an alternative measure that is efficient in designing with minimum wastage from the design stage to the building usage.

## **1.3** Aim and Objectives of the Study

The aim of this study is to design a hotel in the Federal Capital Territory integrating all Eco-friendly building principles to enhance comfort. The objectives are to;

a) Identify suitable Eco-friendly building principles in the erection of eco-friendly hotels.

- b) Examine the principles applicable to the design of eco-friendly Hotels.
- c) Determine the pros and cons of Eco-friendly elements in hotel buildings.
- d) Propose a design of the hotel with the Eco-friendly attribute.

### **1.4** Justification of the Study

This research is significant in accumulating information concerning eco- friendly building principles in the design of buildings; the discoveries would offer a direction needed in sustainability and the instruction that needs to be observed when implementing. Architects need the knowledge of eco-friendly building principles and it is paramount for the building professionals to distinguish, comprehend and present the results for an effective design, which can accommodate the precise tasks.

### 1.5 Scope of the Study

The design scope cover hotel building, this will give the researcher a view of what an ecofriendly building is all about and the needed resources that will be employed in achieving this principle. The design will integrate the following facilities;

- a) Accommodation,
- b) Business facilities
- c) Conference/meeting rooms
- d) Relaxation facilities

Elements and principles in eco-friendliness, sustainability practice will be employed while and provision will be made for auxiliary facilities such as sporting amenities and recreation spots for relaxation.

### **1.6** Limitation of the Study

During the course of the data analysis and visitation to some site, little or no information was gotten from the respondent due to security reasons while the inability to gain access to some certain area within the facilities visited brought about the constraints in getting accurate information on the subject matter. However, journals and the Internet will be used to acquire information regarding the research.

### 1.7 Study Area

The Federal Capital Territory Abuja, Nigeria, was built in the 1980s, the city is located at longitude  $6^0$  45' and  $7^0$  39'East and at latitude  $8^0$  25' and  $9^0$  25' North. It is sharing boundaries with other states, by the east with Nasarawa state, by the north Kaduna state, by the west Niger state, and by the South Kogi state. The state consists of area councils six in particular: Bwari, Abuja municipal, Gwagwalada, Kwali, Abaji and, Kuje area council. The state has five districts that are suburban: which are Jikwoyi, Kubwa, Nyanya, Gwagwalada, and Karu. However, the study area is located Aviation village on the way to the Airport, the site is about 10 min drive from the Airport and 35min drive from the train station. The site is bounded by a wonderful scenery of landscape with tall lush green trees and hilly structures.



Figure 1.1: Locational Map of Nigeria Showing Abuja Source: Federal Ministry of Lands and Housing (2015)



Figure 1.2: Locational Map of Nigeria Showing Local Government Areas Source: Federal Ministry of Lands and Housing (2015)

#### **CHAPTER TWO**

#### LITERATURE REVIEW

### 2.1 Hospitality Industry

2.0

Godwin (2018), stated that the hospitality industry particularly the hotels have boosted the economy of most countries to a larger altitudes and tourism have been the core of its positive effects in the generation of income. The industry offers services for individuals far away from home irrespective of the duration of stay, these facilities vary depending on a person's need away from home or the organization operating those services (Ayeni & Omogunloye, 2012).

Roundel (2007), describe hospitality as an approach to pleasing visitors with the sole aim of making them feel welcomed by providing accommodation, drink, sustenance, and pleasure. The United Nations World Tourism Organization (UNWTO) confirms that between 70% and 75% of international tourists' expenditure goes to hospitality services on annual basis (AAA Tourism, 2017). The need for modern and contemporary hotel designs has been the challenge encounter by the built industry, this has led to a change in demand from the diversity of hotel types and the wide range of products made available to the consumer to suit all tastes, prices, and preference. Gartner (2014), argued that the demand for erection of additional hotel buildings to cater for the needs of tourist is on the rise which also the affects the built environment.

### 2.2 Concept of Hospitality Industry

The word hospitality was gotten from "HOSPE" a Latin word meaning host or guest and hospitium, which also means space for tourists, guesthouse, or apartment (Hui, 2010). Services like convenience and beverages in the hospitality business offer a variety of services to the general public that cannot be gotten at home (George, 2016).

The lodging industry should not cover just the hotel and nourishment sector but rather other interrelated tourism sectors, for example, travel guides and pleasure parks thus it is necessary to integrate the hospitality business and tourism industry into a single business. The figures below show the basic connection and classification of the two:



Figure 2.1: Scope of Hospitality and Tourism Industry Source: George (2016)

Hospitality services take care of both travelers and non-travelers unlike tourism deduced from Figure 2.1 above. Similarly, the hospitality business is a part of a more complex economic sector called tourism, and not all hospitality establishments are not profit creating businesses.

### 2.3 Tourism

Tourism is defined as a socio educative phenomenon that has transformed evolving and underdeveloped nations towards the protection of the natural environment. These include the preservation of both plants and animals, reliefs, manmade art, natural's stonework, and the ancient site which are all components of the earth (Fred, 2014).

Tourism will impact the change in the operation of regular and communal assets in any given area around the world, it encourages the development of the hospitality business through new prospects, employment, and economic benefits (Eja *et al.*, 2011). Tourism is seen as a way to advance one's economy, the use of reasonable planning technique can draw speculators from numerous nations, Tourism cannot survive without the assistance of commercial enterprises, for example, inns, correspondence, and trade which offices and administrations are given to solace traveller at their craving destination. Hotels have transcended providing accommodation to playing a vital role in the global growth of the tourism industry for which hotels everywhere are improving their room standard in meeting up with the new trend by creating luxury as the modern standard. The outline of attractions and services the tourist chooses to see by visiting such a location is known as a tourism destination (TD) and Nigeria as a country qualifies as one on a global scale as a tourist destination (Baggio, 2012).

The presidential council on tourism constituted the (Baggio, 2012), the method established by the Nigeria tourism development corporation (NTDC) as a dedicated association of the government in governing and demonstrating skill that is feasibility through particular overview and help form the world travel society and global labour association (Bunz *et al.*, 2010).

### 2.4 The Hotel Industry in Nigeria

The Nigerian economy has been overwhelmed by an increase in inflation, the outcome of an abruptly denigrating Naira whose worth dropped by 45% against the United States dollar from 2015 and 2017, the weakening of the Naira made importations more luxurious, which led to the rise in inflation. Buyer charge went from 9.0% in 2015 to 16.4% in 2017 throughout the last quarter of 2017 and early 2018, however, the rate of inflation declined. It is expected within the next two years the rate of inflation will decline to solo figures starting in 2023, averaging from 9.7% and compounded yearly, for the whole predicted period (Awoseyin, 2014).

Notwithstanding these barriers, the country attracts patronage for intercontinental hotel brands due to its large economy, Hilton, Best Western, Sheraton, Radisson, Tsogo Sun, Sun International and City Lodge are amongst the key global and South African brands that have hotels structures situated in Nigeria. The number of rooms available rose from 21%, the increase is expected to 30% within the subsequent five years, Marriott, Radisson, Westin, Sheraton, Hilton, and Best Western are among the global brands listed to establish new hotel structures in Nigeria. Due to the difficult economy in Nigeria, some brands have deferred or stopped openings, for example, an African brand known as City Lodge South Africa is preparing for a major development in Africa but is presently picking Nigeria as a choice. The 2017 Hotel outlook journal, forecast in 2021 there would be 13200 available lodgings in Nigeria, we now expecting a sum of 11400 for the year 2022, for the predicted period the number of rooms available will increase from 9700 in 2017 to 12600 in 2022, a 5.4% compound yearly increase still the largest expansion of any country in the report (National Association of Nigeria Travel Agencies, 2015).

### 2.5 Types of Hotels

They are numerous types of hotels depending on their target market, most hotels are commercial or transient, resort types, residential hotels or motel.

### 2.5.1 Commercial or transient hotel

Minazzi (2010), stated that they are the most significant type of hotels, they are constructed to provide for the salesmen and businessmen. The initiation of chain stores reduced the ranks of the commercial tourist, the hotels made up for this decline with corporate managers and folks traveling for pleasure, these hotels do have numerous but moderately small accommodations, this is because the guests they accommodate travel unaccompanied.

Vagena (2012), affirm that the rooms can be used as offices for transacting business, they are mostly equipped with furniture, provision is made for a bigger room where traveling sales representatives can simply present samples of items they sell, they offer conventions services, ballroom gatherings facilities, meeting rooms for communities and groups, they have decent banqueting facilities, which can be informal, semi-formal, and formal dining spaces.

Niu *et al.* (2018), argued that the bedroom space in a commercial hotel gives the visitor their own isolated wash area, a receiver, phones, and television set, additional facilities seen in commercial hotels are a coffee store, brew lounge which offers the visitor beverage services. A disco club can be seen in huge urban hotels, washing, steaming, cleaning, valet services, medical care, and similar services are accessible. There are two new inventions found in this hotel, they are the studio guests-room and an automobile entering and registry desk, the studio room beds were planned to be comfortable during the day (Amadi, 2015).

### 2.5.2 Resort hotels

Ali and Hussain (2016), affirm that they are also known as seasonal hotels that provide services for a traveller and for those that come for recreational activities, a recent trend has shown that resort hotel is no longer used as the seasonal hotel they are used as regular lodging facilities and the duration of stay extend from a week to months thus defeating the purpose for its creation. They are cited far from the urban areas usually in a remote area close to the recreational element, an element such as mountains, lakes, or ocean (Juan *et al.*, 2011). The guests are entertained on the premises, the workers in the hotels include a social director, recreation director or entertainment director and a large resort maintains a complete department in this field (Ali & Hussain, 2016)

### 2.5.3 Residential hotels

Mcclure (1997), stated that residential hotels are planned to provide lasting housing space for individuals that do not want to own an apartment but require a comprehensive package than what they would find in an apartment. This kind of hotel is mainly seen in the United States of America, it is basically a residential hotel that offers room service, maid service, a dining area, and possibly a lounge used for cocktail services. Awoseyin (2014), ascertain in recent practices, banquet facilities are catered for within such an establishment adding to the huge food and drink business. The hotels are of different varieties ranges from expensive suites that incorporate a living area, a kitchenette or kitchen, one or more bedrooms, and restrooms, this hotel is usually located away from urban areas.

### 2.5.4 Motels

Berressem (2019), stated that motels are planned to attend to the needs of motorists and should offer services for parking cars with easy access from the freeway since they stand

laterally on the highways. They are located at junctures usually one or two storeys in height with rooms or detached chalets situated around a driveway or central court. Recently built motels are expensive, with exquisite carpeting designs, TV and phones, many motels have pools for swimming and a large expanse of land used as playgrounds, as motels cater mostly for individuals on the road, therefore they are located outskirts away from the cities where land is cheaper. According to Predari and Gulli (2020), the sites used for motel construction are fairly large, giving room for large parking areas, low or medium-rise construction, the hotel facilities are usually limited to a low scale and there is usually the presence of a petrol and garage centre attached to the motel (Sani, 2009).

### 2.5.5 City centre hotel

This comprises extravagance, convention, and city tourist hotels. They are considered by the high land ratio, multi-storey building, and often performs large function and accommodation this include stores and workplaces, City centre hotels are patronized by countless urban people. (Amadi, 2015).

### 2.5.6 Airport hotels

These types of hotels are mostly built for air travellers, there is an all-night reception, the catering service sometimes done at night, and they mostly provide services for conventions, for a global organization. They undergo similar planning approvals with that of a motel before and after construction. (Fred, 2014).

### 2.6 Hotel Classification

The classification of hotels is based on the following standards:

- i. Location
- ii. Market target

- iii. Amenities
- iv. Duration of stay
- v. Services rendered
- vi. Property size
- vii. theme

### 2.6.1 Star rating in hotels

The German started the earliest hotel profiling star system in which the European Hotel Stars Union adopted; this system has influenced the groupings hotels in European Community. The system considers management quality, lodging area recreational and fitness facilities provided. Each standard is accompanied by a point and each star level needs a minimal sum of points (Torres *et al.*, 2014).

Hotel star rating criteria:

- i. All rooms should have a shower, bathtub, water closet
- ii. Cleaning services should be on daily bases
- iii. Rooms should have a television system with a remote control
- iv. Chairs and table
- v. Reception service
- vi. Guest telephone located at a public area
- vii. Prolonged breakfast
- viii. Beverage offered to guest
- ix. Payment option

### 2.6.2 Superior tourist

Darwish (2011), ascertain that Superior tourist hotels provide extra deal and lodging provisions when other one stars rated hotel facilities are not sufficient. The conveniences

are the same level as for two stars hotels but constructed with cheaper building material. The charges for regular examination by autonomous associations are relinquished. Standard in addition to the single star (\*) hotels:

- i. Buffet
- ii. Light for reading positioned close to the bed
- iii. Provision of shower lotion and bath essence
- iv. Towels for bathing
- v. Provision of toothbrush and toothpaste, shaving items
- vi. Debit cards

### 2.6.3 Hotel Stars in Nigeria

Hotel investment and facilities are evaluated by numerous organizations worldwide, In Nigeria; it falls under Nigerian Tourism Development Corporation (NTDC). According to Rajaguru *et al.* (2018), Hotels are starred, the standards approved specify the smallest size in regards to the number of rooms, and they are as follows: -

- i. 5 star minimum 100 Bed space
- ii. 4 Star minimum 50 Bed space
- iii. 3 star minimum 25 Bed space
- iv. 2 star minimum 10 Bed space
- v. 1 star minimum 5 Bed space

The Nigerian tourism development corporation is responsible for the classification of a hotel in the country, they are classified into one, two, three, four, and five stars.

a) One-star hotel (\*): they are a small hotel with few rooms well-furnished all-in suite with facilities, a clearly defined reception, open 7 days a week, a restaurant

serving breakfast 7days a week and evening meals 5days a week, licensed bar with guest having access at all times

- b) Two-Star Hotel (\*\*): all the above facilities in a one-star hotel are present, a higher standard of cleanliness, hospitability, and maintenance.
- c) Three-star hotel (\*\*\*): all the above facilities in a two-star hotel are present, access without a key at 7 am 11 pm and without a key at all other times, dinner served 6 evenings a week with snacks on the 7<sup>th</sup> day, room service for drinks and snacks during daytime and evening, all bedrooms in-suites, internal telephone services and Wi-Fi in public spaces.
- d) Four-star hotel (\*\*\*\*): all the above facilities in a three-star hotel are present, 24hour room service with full breakfast and dinner, 24-hour access facilitated by onduty staff, restaurant is opened to resident and non-resident for breakfast and dinner every day of the week, in-suite bathroom with thermostatic showers, higher staff levels, enhanced services such as tea in the afternoon, luggage assistance or meal at lunchtime, Wi-Fi in bedrooms.
- e) Five-star hotel (\*\*\*\*\*): all the above facilities in a Four-star hotel are present, they are opened all year round, enhanced services such as valet parking, concierge and escort to bedrooms, proactive service and customer care, restaurant open every day for all meals, multilingual receptionists, bath in at least 80% of bathrooms, additional facilities such as a second dining area, business centre, spa, and permanent luxury suite. Further classification is based on the facilities provided such as all bedrooms should have a bathroom attached, and others may include a definite room structure specifying the smallest sizes: floor area for a category. The following are the requirements which concern the minimum room.

Туре	Double	Single
5-STAR	18 m2	16m2
4-STAR	14 m2	12m2
3-STAR	12 m2	10m2
2-STAR	10 m2	8m2
1-STAR	10 m2	8m2

Table 2.1: Minimum Sizes of Room that makes a Star

Source: Sepula and Bello (2019)

In 3–Star hotels, for instance, 50 percent of the total number of staff must be qualified and trained professionally in catering and management, with additional routine training on daily basis. Adequate and constant running water should be provided to maintain public sanitary fittings, detergent, automated hand driers, and toiletries are needed. A 24 hours telex, mailing, and room service should be provided; kitchen services must be kept hygienically with waste disposal facilities. The conference room must have minimum services to house 1,000 guests with smaller rooms for meetings, assembly (Sepula & Bello, 2019).

In the rooms, there should be a telephone, television/radios set, a fridge, air conditioners system. Outdoor facilities should include a swimming pool, saunas, sporting facilities, shops, and banking facilities. Additional degrees of comfort standards used in scoring or cataloguing by Nigerian tourist board include:

- a) Adequate Ventilation in Rooms
- b) The room should be soundproof
- c) Furniture should be provided
- d) A telecommunication system
- e) Lightning and Electrical facilities
- f) The guest should have easy access to information
- g) 24hrs cleaning and laundry services
- h) Well decorated lobby
- i) The toilet should be provided with a modern shower and a bathtub, water closet.

The items listed above are evaluated and the point is allocated, these represent the rating system.

# 2.6.4 Minimum standard for Three Star Hotels according to the Nigerian tourism development corporation act

Sepula and Bello (2019) stated that the lowest criteria for the classification of Three-star hotels

- a) The hotel should be situated in a services area, the building should be high class the material used in construction should be of world-class standard.
- b) The minimum number of rooms should not be less than 100 in three-star hotels.
- c) Bedchamber services such as clean towels, clean bedspread, blankets, pillow reading, and a dressing area should be provided.
- d) There should be an alternative source of power if and when there is a power failure. Control switches should be located to regulate bedrooms and public spaces' lighting.
- e) The provision of excellent culinary services should be inclusive.
- f) Treated and purified boiled water should be provided in a flagon with sparkling glass cups for all rooms, cafeteria, and dining space for drinking.
- g) The provision of fire escape routes and fire safety measures will be included in the design.

#### 2.7 General Approach to Hotel Design

Wu and Koskinen. (2021), affirm that the fundamental techniques in the design of a hotel have existed for fifty decades irrespective of the deviations in philosophy and technological trends, rooms are designed to provide satisfactory relief and perceptibility from the outward spaces. The market forces regulate the concept behind the arrangement of hotel spaces, they are planned essentially for a minimum of 40% to the building space devoted to the passageway, stairway, and elevator. Besides, useful spaces such as the dining area, lounges, fitness, bars, leisure activities, banquet area, and other services bring about a sense of balance to the hotel (Wills, 2009).

#### 2.8 Eco-Friendly Construction

Ellingham and Fawcett (2013), affirm that the construction industry is amongst the main and most active sectors around the globe representing 28.1% and 7.5% of employment respectively, in the trade and in the European economy with yearly revenue of about 750 million Euro. This division signifies 25% of all European engineering creation, being the major exporter with 52% market value, in total terms the building business will continue to rise rapidly. For instance, China needs a 40 billion meters square area of residential and commercial areas for the next 20year which is equal to adding one New York every two years or the area of Switzerland (Dobbs, 2010). Ecologically speaking, this industry accounts for 30% of carbon dioxide discharges and the building consumes 42% of the energy in Europe, the international building industry devours extra raw materials (about 3000 Mt/yr, almost 50% by weight) than any other economic activity, which displays a clearly unmaintainable industry. Moreover, many structures now suffer from issues associated with extreme dampness with fungus development, or humidity levels below 40% giving rise to respirational illnesses. Aktas (2013), stated that Sustainable construction considers the building's life cycle from construction stages, practical usage, and the Government should implement policies that enhance sustainable construction practices. Environmentally-friendly construction practices improve life qualities but it requires a larger mindset for the application, sustainable project uses a different method to an outdated plan, by recognizing the effect structure, the choice of the building materials to the natural environment (Suslick & Machado, 2009). A model of new design principles necessary for sustainability is exemplified by the "Bill of Rights for the Planet," developed by William McDonough Architects for Expo 2000 held in Hanover, Germany, which includes the following:

"Accept the responsibility for the consequences of design decisions on human well-being and natural systems." ii. "Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes to approach the state of natural systems in which there is no waste."

The World Congress of the International Union of Architects (UIA) approved these ideologies in June 1993 at the American Institute of Architects (AIA) Expo 93 in Chicago. This led to a pronouncement that places used as hospitality venues should be environmentally and socially sustainable and it should be the core responsibility of all building professionals. It also involves educating clients, and the populace about the importance of sustainable design, these happenings are an example of how the idea of sustainable design is supported on a global scale. There is a movement in the construction industry in accepting new ideals of Sustainable practices in construction projects both for residential and commercial buildings. According to Deodher (2011), Governmental bodies and private developers are beginning to accept the principles of green building and seek new designs for their buildings, there are many good reasons to adopt green building

practices in projects, and these include a possible fast return because of increased operating efficiency, electric, gas and water conservation, and improved indoor environmental quality.

#### 2.8.1 Eco-efficient construction and building materials

The idea of eco-efficiency was originally presented in 1991 by the World Business Council for Sustainable Development-WBCSD (2018) and includes "the development of products and services at competitive prices that meet the needs of humankind with quality of life, while progressively reducing their environmental impact and consumption of raw materials throughout their life cycle, to a level compatible with the capacity of the planet". This notion means manufacturing additional building material with fewer resources and less waste (Bidoki *et al.*, 2006), hence the eco-efficient building materials are those that affect the environment less, it is essential to evaluate all ecological impacts triggered by a specific building material from the commencement of the extraction of the raw material to the finish of its service life. The utmost significant ecological problems are associated with the manufacturing of building materials (Bidoki *et al.*, 2006).

For years numerous writers and establishments have cautioned about the reduction of building raw materials, and others pointed to early Armageddon, the most well-known that have been the reported "The Limits to Growth" (Meadows *et al.*, 1972) documented by the Massachusetts Institute of Technology (MIT) to the Club of Rome, a think tank started in 1968 by researchers, legislators, and businesspersons. While it is significant to identify that there are exhaustible non-renewable raw building materials with fewer emissions and those that contribute to the worsening of air quality.

The selection of material selection in construction is a compound procedure linking numerous variables; there is no precise technique to be used across for the selection due to each building material having diverse characteristics. As stated previously, environmentally friendly building material selection encompasses the evaluation of the building material life cycle and ecological effects. This procedure tracks the resources in their raw state, the manufacturing process, their conveying to the location where it is to be used, to the disposal, and recycle option.

Bougdah and Sharples (2010) listed the process that helps in identifying numerous ecologically friendly building materials attributes.

- Renewability- these are building materials that can be reused, they are derived from organic materials such as agronomic items and plants. Examples include natural linoleum, cork, bamboo, straw-based board products like cabinet-grade particle board, and some engineered wood products.
- Recyclability this shows how a building material reclaimed or recycled once the expected life cycle has been reached, building elements that can be dismantled and assembled easily should be considered as the best choice.
- Sturdiness this describes the projected care and life cycle of the building material used in construction.
- 4. Embodied energy a total of 70% of energy is invested in the building construction since the building is made up of a combination of numerous building materials. The energy is required to extract, develop, bundle, convey, fix, and transform or cart away the building materials and it is best to select materials that do not require long-distance shipping,
- 5. Ecological effect the materials used in construction should have little or no effect on both the indoor and outdoor air quality. This can be achieved by selecting products that do not have Hydrofluorocarbons (HFCs), halons, etc.

#### 2.9 Application of Eco-Design Principles

Yun (2014), ascertain that the principles and perception of Eco-design can be applied at numerous stages in environmental design and development. Extending from housing structures to a neighbourhood or industrial estates.

#### 2.9.1 Building design

The building design stage involves the application of Architectural techniques through passive means to solve environmental problems in buildings that are environmentally friendly (Blume, 2011), with regard to this ample improvement has been made. Nevertheless, it is imperative that consideration should be made in all stages of the building life cycle. The atmosphere is similar to that of the human body, it processes the greenhouse gases released into the air, Eco-friendly construction is aimed at these procedures, assimilating conservative means into structures to absorb, accumulate, filter, and cleansed the air (Ragheb *et al.*, 2015). Further instances comprise;

- 1. The property can be optimized by evading straggling structure and by resourcefully assigning interior spaces to serve several requirements.
- 2. The use of both passive and active solar heating skills in reducing energy emission and absorption, shading devices, surfaces that are reflective, insulation, large opening, LEED lights, and appliances. For the external purpose, planting of trees to provide shade, they also serve as windbreakers.
- 3. The application of green roofs on high-rise buildings in an urban area is an ecologically friendly solution, they long-lasting than modern roof design. The application reduces the costs of energy consumption, it also creates peaceful withdrawals for individuals and creatures. They help in absorbing rainwater, theoretically decreasing the construction of expensive or complex cooling and

drainage system. On a global scale, the application improves the quality of air, reduces the urban heat effect.

- 4. The maintenance and utilization of the existing landscape with the indigenous plants to emulate the normal conditions while preserving aesthetics of the building help to regulate the microclimate in that given region.
- 5. The selection of the appropriate building material and interior furniture to be sue in construction and as internal fittings should be manufactured with recycled building materials, this is done to reduce the amount pollutant released to the atmosphere
- 6. The incorporation of Old-style or vernacular building elements can be used to improve their energy and material effectiveness, aesthetics, and coziness without altering the existing cultural heritage.

## 2.9.2 Urban planning

Environmentally friendly principles can be used in the creation and planning of new or existing communities, Akpabio (2017), affirmed the very first step is by identifying the problem such as inadequacies in the material usage, excessive transportation distances which result in large consumption in energy, insufficient management between industries on what resource to use or not to. Further ecological problems consist of; ecological effluence and biodiversity conflict. TieZheng (2002), stated that further issues to consider are the shuttling distances, impartiality issues, and the expansion of economically unified areas. These enhancements can be included in an existing building in a city centre or applied when it is re-designed. TieZheng (2002), affirmed that these can be realized by the following means listed below;

- 1. The use of recyclable building materials minimizes the use of machinery that is high in carbon emission, the materials can be sourced locally which reduces the distance travelled in transporting theses promote local transporting means.
- 2. This can be achieved by the planting of trees and shrubs in an urban setting thus providing an ecosystem with fewer pollutants in the atmosphere.
- 3. By maintaining the native plant species in any given urban setting assist in providing environmental services that are related to cooling, heating, contamination extenuation, aesthetics, and carbon storage, while also providing economic benefit to the neighbourhood.

#### **CHAPTER THREE**

#### 3.0 RESEARCH METHODOLOGY

#### 3.1 Research Design

The descriptive research approach technique was used in sourcing data about Eco-friendly building techniques in hotel designs. The tool used in the research includes a crosssectional survey which involved data collection from a population.

# 3.2 Method of Data Collection

The method adopted involved physical observations to ascertain the existence of Ecofriendly practices and techniques, instruments such as observation schedule was used to capture Eco-friendly element. A random sampling technique was used to interview thirty participants (30) out of every twenty (20) persons on their perspective on the importance and application, consultations were also carried out to find out details of some features that were not expressly understandable and within reach of the observer. The sections observed were office compartments, public service areas, administrative areas, information service areas, and the guest room of different standard sizes and quality. Literatures reviews of related published and unpublished works were read and acknowledged to source for secondary data.

#### 3.2.1 Method of data analysis

Data was collected primarily through the use of an observation schedule and an interview guide was used on certain hotels while secondary information was collected from the interrelated works and books, conference papers, and journals. A purposeful sample method was adopted in data collection, five hotels were selected in Abuja

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# 3.3 Case Study

The investigation was conducted within the obtainable institution in Nigeria that provides hospitality service, but the emphasis will be focused on a hotel project in the federal capital territory Abuja. Inquiries on development compatibility to modern standard will be analysed to draw out conclusion with regards to Eco-friendly building practices, the itemized establishments below will be contacted for investigation:

- a) Star view palace hotel, located at 4<sup>th</sup> Avenue Gwarimpa estate Abuja.
- b) Sefcon suites and apartment, located at 4<sup>th</sup> Avenue, Gwarinpa estate Abuja.
- c) Nera hotel at jabi Lake, Abuja.
- d) Dire International Hotel, located at Awera Godana area near Adama Executive Hotel Ethiopia.
- e) Tokuma Hotel, located at Awera Godana area near Adama Executive Hotel Ethiopia.

## 3.4 Star View Palace Hotel, Abuja (Case Study One)

The Star View Palace hotel is an architectural master piece that is situate within the city of Abuja. The following sub-headings will be giving a detail understanding from the location of the hotel, to the description and architectural features.

## 3.4.1 Location of Star View Palace Hotel, Abuja

The hotel is 4<sup>th</sup> Avenue Gwarinpa Estate, Abuja the Federal Capital Territory



Plate I: The main entrance night view scene Source: Author's Field Work (2020)

a) Building description: The five stories courtyard building accommodates standard rooms, with 2 mini villas, bedrooms, the hotel has a human capacity of 450 people. With common spaces like the restaurant, seaside terrace, spa, beauty centre, bar, Internet centre, Conference Halls, and meeting rooms. Each of the rooms has, closet, private bathroom. The large conference hall has the capacity to hold around 450 people. While the small meeting room accommodates 40 people. The hotel lobby is an attractive and welcoming space to the customers with fine art decoration; they have a tent for additional space for occasions, additional facilities include Dry cleaning/laundry service, laundry facilities, Front desk and welcoming lobby,

Internet centre, conference, and meeting room with well-equipped sound system. Event catering can also be arranged. Bar and Restaurant, free Wi-Fi network, swimming pool.



Plate II: Meeting hall arrangement. Source: Author's Field Work (2020)

b) Facilities: The hotel offers 112 standard comfortable and well-equipped bedrooms.

- i 10 Suite: King Size bed, Bathroom, Wall fixed Cupboard, Balcony, and Living Room Space.
- ii 2 Mini-Suite: Queen Size bed, Bathroom, Wall fixed cupboard, Balcony.

- iii 64 First Class: Queen Size bed, bathroom, Wall fixed cupboard, most of them have Balcony.
- iv 18 Single Bedroom: 120 x 190 bed, bathroom.
- v 15 Twin Bedroom: 90 x 190 bed, bathroom.
- vi 3 Family room: 150 x 190(1), 90 x 190(1), Living Room Space, Terrace, Bathroom, Cupboard.
- vii The circulation cores are 1 elevator (4 Person), 2 Stair, and 1 Service Stair.

viii Multi-purpose backyard space is mostly used as parking space.



Plate III: Toilet arrangement Source: Author's Field Work (2020)



Plate IV: The bedroom Source: Author's Field Work (2020)

# 3.4.2 Merits of Star View Palace Hotel, Abuja

- i Rectilinear in shape.
- ii Proper use of landscaping elements in planning.
- iii The rooms and cafeteria services give an extensive variety of choices and

Gratification.

iv They are the presence of entertaining services for the satisfaction of sightseers and travellers.

# 3.4.3 Demerits of Star View Palace Hotel, Abuja

- a) Do not fulfil the 3-star standard.
- b) Zoning (Bedroom and Conference room)
- c) Landscaping is more of hard and not soft
- d) Service buildings are located outside of the building.
- e) Absence of Business shops like souvenir shops.
- f) Parking space inadequate

# 3.5 Sefcon Suites and Apartment, Abuja (Case Study Two)

Sefcon Suites and Apartment, Abuja will be discussed on the following sub-heading;

# 3.5.1 Location of Sefcon Suites and Apartment, Abuja

The hotel is at 4<sup>th</sup> Avenue Gwarinpa Estate, Abuja the Federal Capital Territory



Plate V: The main entry point to the site of Sefcon Suites and Apartment Source: Author's Field Work (2020)

a) Building description: The five stories courtyard building accommodates standard rooms, with 2 mini villas, bedrooms, the hotel has a human capacity of 370 people. With common spaces like the restaurant, seaside terrace, spa, beauty centre, bar, Internet centre, Conference Hall, and a meeting room. Each of the rooms has, closet, private bathroom. Additional service includes a large meeting hall that has the capacity to hold around 65 persons. While the small conference room accommodates 15 people. The hotel lobby is an attractive and welcoming space to the customers with fine art decoration. Dry cleaning/laundry service, laundry facilities, Front desk and welcoming

lobby, a conference and meeting room with a well-equipped sound system. Event catering can also be arranged. Bar and Restaurant, free Wi-Fi network, a swimming pool.



Plate VI: Sefcon Suites and Apartment swimming pool region Source: Author's Field Work (2020)

b) Facilities: The hotel offers 70 standard comfortable and well-equipped bedrooms.

7 executive Suite: King Size bed, Bathroom, Wall fixed Cupboard, Balcony, and Living Room Space.

- i 10 superiors: Queen Size bed, Bathroom, Wall fixed cupboard
- ii 12 Duplex suits: Queen size bed, bathroom, Wall fixed cupboard
- iii 18 Single Bedroom: 120 x 190 bed, bathroom
- iv 20Twin Bedroom: 90 x 190 bed, bathroom
- v 3 Family room: 150 x 190(1), 90 x 190(1), Living Room Space, Terrace, Bathroom, Cupboard
- vi The circulation core 1 Stair and 1 Service Stair
- vii Multi-purpose space is mostly used as parking space



Plate VII: The Restaurant Source: Author's Field Work (2020)



Plate VIII: The bedroom arrangement Source: Author's Field Work (2020)

# 3.5.2 Merits of Sefcon Suites and Apartment, Abuja

- a) Large packing space paved with interlocking tiles
- b) Building is rectilinear
- c) Good sign communication to all levels and space.
- d) Adequate natural lighting in spaces.

# 3.5.3 Demerits of Sefcon Suites and Apartment, Abuja

- a) Do not fulfil the 3-star standard.
- b) Zoning (Bedroom and Conference room).
- c) Landscaping is more of hard and not soft
- d) Service buildings are located outside of the building.
- e) Absence of Business shops like souvenir shops.
- f) Parking space inadequate

# 3.6 Nera Hotel, Abuja (Case Study Three)

Nera Hotel, Abuja, Abuja will be discussed on the following sub-heading;

# 3.6.1 Location Nera Hotel at Jabi Lake, Abuja

The hotel is located Off Jabi Lake, at No' 26 Alex Ekwueme Way, Jabi, Abuja.



Plate IX: The main entrance into the site of Nera Hotel Source: Author's Field Work (2020)

a) Building description: The 3 story with standard rooms, with 2 mini villas, bedrooms, the hotel has a human capacity 250 people. With common spaces like a restaurant, seaside side, spa, beauty center, bar, Internet center, Conference Hall and a meeting room. Each of the rooms has, closet, private bathroom. The large meeting hall has the capacity to hold around 65 people. While the small conference room accommodates 15 people. The hotel lobby is an attractive and welcoming space to the customers with fine art decoration. Additional facilities.



Plate X: The use of bamboo as a relaxation space of Nera Hotel Source: Author's Field Work (2020)

b) Facilities: The hotel offers 65 standard comfortable and well-equipped bedrooms.

- 3 Luxury Suite: King Size bed, Bathroom, Wall fixed Cupboard, Balcony, and Living Room Space.
- ii. 17 luxury: Queen size bed, bathroom, Wall fixed cupboard
- iii. 18 Single Bedroom: 120 x 190 bed, bathroom.
- iv. 20 Twin Bedroom: 90 x 190 bed, bathroom.
- v. 2 Family room: 150 x 190(1), 90 x 190(1), Living Room Space, Terrace, Bathroom, Cupboard.

- vi. The circulation core is 2 Stair and 1 Service Stair.
- vii. Multi-purpose space is mostly used as parking space
- viii. A pool arena
- ix. Native huts
- x. Boathouse panorama.



Plate XI: Restaurant seating in Nera Hotel Source: Author's Field Work (2020)



Plate XII: Typical bedroom seating in Nera Hotel Source: Author's Field Work (2020)

# 3.6.2 Merits of Nera Hotel at Jabi Lake

- a) Large packing space paved with interlocking tiles
- b) Building is rectilinear
- c) Good sign communication to all levels and space.
- d) Adequate natural lighting in spaces.
- e) Use of bamboo tent as shelter areas
- f) The lake serves as cold scenery and it is used for recreation activities.

# 3.6.3 Demerits of Nera Hotel at Jabi Lake

- a) Zoning (Bedroom and Conference room) not well defined
- b) Service buildings are located outside of the building.
- c) Absence of Business shops like souvenir shops.
- d) Parking space inadequate



# **3.7** Dire International Hotel, Ethiopia (Case Study Four)

Plate XIII: Nera Hotel exterior view Source: Author's Field Work (2020)

#### 3.7.1 Location of Dire International Hotel, Ethiopia

The hotel is located in the uptown, Awera Godana area near Adama Executive Hotel a) Building description: The five stories courtyard building accommodate standard rooms, with 2 Suite, 10 Mini-Suite, 37 First Class, 17 Single, 3 Twin, and 1 Family bedroom. With common spaces like the restaurant, bar, Internet centre, Conference Halls. Each of the rooms has, closet, private bathroom. Suite and Mini-Suite have balconies facing the main road, closet, private bathroom, and cupboard. The large conference hall has the capacity to hold around 400 people. While the small meeting room accommodates 30 people. The hotel lobby is an attractive and welcoming space to the customers with fine art decoration.



Plate XIV: The internal courtyard with plants and additional siting. Source: Author's Field Work (2020)

b) Facilities: The hotel offers 60 standard comfortable and well-equipped bedrooms.

- i 2 Suite: King Size bed, Bathroom, Wall fixed Cupboard, Balcony, and Living Room Space.
- ii 10 Mini-Suite: Queen Size bed, Bathroom, Wall fixed cupboard, Balcony.

- iii 37 First Class: Queen size bed, bathroom, and Wall fixed cupboard with shared Balconies.
- iv 17 Single Bedroom: 120 x 190 bed, bathroom.
- v 3 Twin Bedroom: 90 x 190 bed, bathroom.
- vi 1 Family room: 150 x 190(1), 90 x 190(1), Living Room Space, Terrace, Bathroom, Cupboard.
- vii The circulation core consists of 3 Stairwell and 2 Service Staircase.
- viii Basement: Store and parking (8 Cars)
- ix. Multi-purpose backyard space is mostly used as parking space.



Plate XV: A bedroom and a toilet arrangement. Source: Author's Field Work (2020)



Plate XVI: A bedroom and a toilet arrangement. Source: Author's Field Work (2020)

# 3.7.2 Merits of Dire International Hotel, Ethiopia

- a) The building is a box with a courtyard at the centre
- b) All staircases are exposed
- c) Adequate natural lighting in spaces.
- d) The use of vegetation in the courtyard to provide an internal microclimate
- e) A central courtyard is provided

# 3.7.3 Demerits of Dire International Hotel, Ethiopia

- a) Lack of specialty restaurant and there is only one central kitchen.
- b) There is no emergency exit.
- c) No swimming pool
- d) No Landscaping
- e) Lack of additional services like Gymnasium.
- f) Service buildings are located outside of the building.
- g) Absence of Business shops like souvenir shops.
- h) Absence of Staff Rooms
- i) There is no parking area

# 3.8 Tokuma Hotel, Ethiopia (Case Study Five)

Tokuma Hotel, Ethiopia will be discussed on the following;



Plate XVII: Exterior view of the structure Tokuma Hotel Source: Author's Field Work (2020)

# 3.8.1 Location of Tokuma Hotel, Ethiopia

The hotel is located in the uptown, Awera Godana area near Adama Executive Hotel.

a) Building description: The seven-story building accommodates standard rooms, with 3 Suites, 10 Corner Suite, and 14 Standard bedrooms. With common spaces like restaurants, bars, internet area, Conference Halls, Gymnasium, Beauty Salon, and Night Club. Each of the rooms has, private bathroom. Suite and Corner Suite face to the Aba Gada Geda Conference Hall and Oromia martyr Statue. In addition, the building has an emergency exit at the back of building. There is also room service available; the hotel boasts a 24-hour front desk service. Public areas at the hotel are comfortably air-conditioned. Other hotel amenities include a nightclub.



Plate XVIII: Gymnasium fitting and machines of Tokuma Hotel Source: Author's Field Work (2020)

- b) Facilities: The hotel total contains 5 meeting/ Conference Halls
  - i. The hotel offers 60 standard comfortable and well-equipped bedrooms.
  - 3 Suites: Living Room, Bedroom, Closed Balcony, Cupboard and Bathroom with Jacuzzi.
- iii. 10 Corner Suite: King Size Bed, Living Space and Bathroom with Bathtub
- iv. 14 Standard Bedroom: 150 x 190 bed, Bathroom with Shower plate.
- v. Night Club: 50-70 person at a time
- vi. Gymnasium: Exercise area, sauna Bath, steam bath, and shower.
- vii. Barber Shop and Beauty Salon
- viii. Conference Hall: Roof Top Hall: 50–70-person, Meeting Room 1 can accommodate 130-person, Meeting Room 2: 15-20-person, Meeting Room 3: 25-30-person, VIP Hall: 20 persons
- ix. Multi-purpose backyard space is mostly used as parking space.



Plate XIX: A meeting room and a typical toilet facility. Source: Author's Field Work (2020)



Plate XX: A meeting room and a typical toilet facility. Source: Author's Field Work (2020)

# 3.8.2 Merits of Tokuma Hotel, Ethiopia

- a) The building is rectilinear with a courtyard at the centre
- b) All staircases are exposed
- c) Adequate natural lighting in spaces.
- d) The use of vegetation in the courtyard to provide an internal microclimate
- e) A central courtyard is provided

## 3.8.3 Demerits of Tokuma Hotel, Ethiopia

- a) Lack of specialty restaurant and there is only one central kitchen.
- b) There is no emergency exit.
- c) No swimming pool
- d) No Landscaping
- e) Lack of additional services like Gymnasium.
- f) Service buildings are located outside of the building.
- g) Absence of Business shops like souvenir shops.
- h) Absence of Staff Rooms
- i) There is no parking area

# 3.9 Site Analysis for the Proposed Three-Star Hotel, Abuja

#### 3.9.1 Site location

The site is located at Aviation Village along the road leading to the Airport in Abuja it covers about 1500 hectares of land that is demarcated into numerous plots and is the government's approved commercial area specific for Hotel buildings within the Federal Capital Territory. The site is located behind the custom office on your way to the Airport.



Figure 3.1: Site location at Aviation Village, Abuja Source: Google Earth Map (2019)



Plate XXI: Site Use Source: Author's Field Work (2020)



Plate XXII: Site Use Source: Author's Field Work (2020)

# **3.9.2** Justification for site selection

The planned facility is located at a distance of fifteen-minute to the rail station and about ten minutes to the Airport, the building will be located within the commercial habitat after careful deliberation and consultation for the necessary authorities. Information on the climatic conditions, the humidity, temperature, wind, geology, and the topography of Abuja were collected and documented.



Plate XXIII: Showing the road to the Site Source: Author's Field Work (2020)

#### **3.9.3** Site selection characteristic

The location, topography, orientation, the climatic condition was an important feature in the selection of the site; these influenced the building choice, its placement, and alignment to other adjoining facilities. One of these considerations is in regards to the building concept and the interior spaces to be provided, this in return affected the material of choice, construction technique to employ, and the structural element to be established on the site.

# **3.9.4** Geology and topography

The site at Aviation Village is undulating, thus it is essential in considering the foundation system, and the bearing capacity of the soil is good for strip foundation. The building nature, the drainage to be employed will be mixed type which is the open and covered system, the landscape pattern is soft and hard landscape.



Plate XXIV: Slope on Site toward the North-East direction Source: Author's Field Work (2020)

# 3.9.5 Vegetation

The vegetation present on site is from the combination of tall trees such as cashew, palm, oranges, and mango trees and ground covers. The vegetation will be used in providing shades against solar rays, radiation, and windbreakers.



Plate XXV: Site vegetation consisting of trees and shrubs Source: Author's Field Work (2020)

#### 3.9.6 Climatic condition

The location of the site is within the federal capital territory, Abuja. Abuja is located in the middle belt of Nigeria and lies within longitude 7.3986'E East and latitude 9.076' North on an ecological map. (Google Map, 2020)

#### a) Temperature

The mean monthly temperature is about 26.3'C while in March the mean dry bulb temperature is about 35.2'C, December is recorded as the coolest month of the year. The building orientation and openings should reveal less, the use of a shading device will be encouraged in the affected area, this lessen is done in the discomfort brought by solar rays passing through glazing and opening.

#### b) Relative Humidity/ Rainfall

The annual average air moisture is about 48.9% and the monthly average varies from 20% to 73% in February and August while the rainfall average is about 1315cm, the month of March has the least amount of rainfall while in September it is about 2560mm water harvested will be encouraged for numerous activities.

#### c) Wind

The wind speed varies with an average of about 5-61km/h, with the presence of strong steady winds which are a result of the rainstorm from the month of December to April, and weak winds from June to October. The Southwest trade wind cut across the site which comes from the Atlantic Ocean, this brings about the rainy season and the Northeast trade wind that comes from the Sahara Desert brings about the harmattan season. The need for trees on the site will this serve as a windbreaker thereby reducing the pressure acting on the structure.

#### **CHAPTER FOUR**

#### **RESULT AND DISCUSSION**

# 4.1 Data Presentation

4.0

A case study approach was used in collecting data which was checked on the basic principles and practices of eco-friendliness in the built industry and will be represented in the form of charts, plates, tables, and figures. The investigation was directed to field survey and observation were duly noted, analysed and the results are compared to identify energy-efficient principles and techniques in hotel buildings, which are:

- a. Identifying the Eco-friendly building techniques.
- b. Accessing the adequacy Eco-friendly building techniques employedThe data analysed was on the basis of the following variable, which includes:
- a. Building material choice
- b. Landscape element
- c. Ventilation technique
- d. Water efficiency
- e. Lightening
- f. Reduction and waste recycled

# 4.1.1 Building material choice

Table 4.1. Displays the materials used in construction, Eco-friendliness can be enhanced through the appropriate application as documented in the research carried out with the use of an observation schedule.

S/No	Hotel Name	Location (Abuja)	Materials used for Construction
1	Starview Place	Gwarinpa Estate, Abuja.	Reinforced Concrete, Sandcrete Hollow blocks, and Bamboo
2	Sefcon Suite and Apartment	Gwarinpa Estate, Abuja.	Reinforced Concrete, Sandcrete Hollow blocks, and Bamboo stems
3	Nera Hotel	Jabi Lake, Abuja	Reinforced Concrete, Sandcrete Hollow blocks, and Bamboo stems
4	Dire International Hotel	Awera Godana, Ethiopia	Reinforced Concrete, Sandcrete Hollow blocks, and Bamboo stems
5	Tokuma Hotel	Awera Godana, Ethiopia	Reinforced Concrete, Sandcrete Hollow blocks, and Bamboo stems

 Table 4.1: Material used for construction

(Source: Authors Fieldwork, 2020)

# 4.1.2 Landscape element

Table 4.2 illustrates the use of soft and hard landscaping practices in achieving Eco friendliness in buildings as documented in the research carried out from the schedule of observation research.

S/N	Buildings	Soft	Hard	Water element
1	Starview Place	✓	✓	✓
2	Sefcon Suite and Apartment	✓	✓	X
3	Nera Hotel	$\checkmark$	$\checkmark$	$\checkmark$
4	Dire	✓	✓	X
	International			
	Hotels			
5	Tokuma Hotel	$\checkmark$	$\checkmark$	X

Table 4.2: Landscape element

(Source: Authors Fieldwork, 2020)

## 4.1.3 Ventilation techniques

Table 4.3 displays the mixed method in achieving Eco-friendliness in the buildings, this included mechanized and natural cooling means as documented in the research carried out from the schedule of observation research.

Table 4.5. Wethou adopted in cooling				
Buildings	Mechanized	Natural	Mixed	
Starview Place	~	✓	✓	
Sefcon Suite and Apartment	$\checkmark$	Х	Х	
Nera Hotel	$\checkmark$	$\checkmark$	Х	
Dire International Hotel	$\checkmark$	X	$\checkmark$	
Tokuma Hotel	$\checkmark$	$\checkmark$	$\checkmark$	
	Buildings         Starview Place         Sefcon Suite and Apartment         Nera Hotel         Dire International Hotel         Tokuma Hotel	BuildingsMechanizedStarview Place✓Sefcon Suite and Apartment✓Nera Hotel✓Dire International Hotel✓Tokuma Hotel✓	BuildingsMechanizedNaturalStarview Place✓✓Sefcon Suite and Apartment✓✓Vera Hotel✓✓Dire International Hotel✓✓✓✓✓	

Table 4.3: Method adopted in cooling

(Source: Authors Fieldwork, 2020)

#### 4.1.4 Source of water

Table 4.4 shows the use of both pipes borne water from the mains supply line or mechanized system (borehole). Eco-friendliness in the buildings makes use of recycled water, which involves the purification of already used water.

S/No.	Buildings	Mechanized	Main Supply	Recycle Water
1.	Starview Place	$\checkmark$	√	Х
2.	Sefcon Suite and Apartment	$\checkmark$	Х	Х
3.	Nera Hotel	$\checkmark$	Х	Х
4.	Dire International Hotel	$\checkmark$	Х	х
5	Tokuma Hotel	$\checkmark$	Х	Х

 Table 4.4: Source of water supply

(Source: Authors Fieldwork, 2020)

Sefcon Suite and Apartment During the investigation, it was noted that none practices the process of recycling their water system, the water used on-site drains into the central waste system except for Nera hotel soil water goes directly into the lake.

#### 4.1.5 Lightening system

The main source of electricity is from AEDC but due to inconsistencies the mechanized methods are used in the building to lightening the site, this involves burning gases that are used in powering generators at night and in the early hours of the day. The generators are used to operate heavy appliances; while in daytime solar panel takes over. Table 4.5 shows the various bulbs used to minimize gaseous emissions to the environment.

S/No.	Buildings	LEED Bulbs	Halogen Bulbs
1	Starview Place		✓
2	Sefcon Suite and Apartment	✓	X
3	Nera Hotel	$\checkmark$	X
4	Dire International Hotels	✓	X
5	Tokuma Hotels	$\checkmark$	X

Table 4.5: Lightening means adopted

(Source: Authors Fieldwork, 2020)

# 4.2 Data Explanation and Finding

Thirty (30) people were cross-examined, five (5) were building material sale personal at the Die-Die building market, and Five (5) from each establishment were cross examined.


Figure 4.1: Bar chart of the respondent on the knowledge of Ecofriendly principles and application Source: Authors Fieldwork (2020)



Figure 4.2: Bar chart of the respondent on the Challenges in the use of Eco-friendly principles and application Source: Authors field work (2020)



Figure 4.3: Pie chart of trials in the application of eco-friendly ideas and its application Source: Authors field work (2020)

The pie chart above state fourteen percent (14%) affirmed that the lack of information on eco-friendly principle, thirty-eight Percent (38%) said it is as regards to technical application, and forty-eight (48%) blames it on Building material constrain.



Figure 4.4: Pie chart of the respondent on the risk in Eco-friendly principles and application Source: Authors Field work (2020)

The pie chart above is based on individual perception of the risk on Eco-friendly application state Seventy-three percent (73%) said there is no risk in the application of the eco-friendly principle, thirty-eight Percent (10%) said the risk involved is high, and seventeen (17%) had no definite answer.

## 4.3 Design Brief

The hotel structure is aimed at offering both managerial and hospitality activities for workers and customers with additional facilities that are supportive. The hospitality section comprises the bedroom, meeting room restaurants to serve both indigenous and foreign dishes, shops, large Auditoriums, and sporting venues. The managerial spaces shall include office facilities such as cleaning services, hose keeping sections. The ancillary spaces will be car parks, relaxation spots, and business centres. Other public like reception areas, security post, services, and storage facilities

The overall projected population to be accommodated is 520 persons, other space requirements are-;

- a) Reception
- b) Offices
- c) Restaurants (for both indigenous and foreign meals)
- d) Shops
- e) Banking station
- f) Bedrooms (Presidential suite, classic suites, and executive suites.
- g) Meeting rooms
- h) Services floors
- i) Laundry section/ housekeeping sections
- j) Gymnasium

- k) Bar
- l) Changing rooms
- m) Bathrooms and toilet
- n) Beauty spa.
- o) Meeting room/conference room
- p) Kitchen/store

## **Auxiliary Facilities**

- a) Parking spaces
- b) Cybercafé /Business centre
- c) Large Auditorium
- d) Sporting venues
- e) Waiting area/ Sit outs
- f) Swimming pool section
- g) Indoor sporting venue
- h) Security post
- i) Generator section

## 4.3.1 Planning consideration and principles

a) Planning and Regulations

Planning standards will be used as a guide maximum the use of the site in planning and allocation of spaces. The minimum setbacks shall be adhered to; the list below is the guidelines set by planning authority and development control standards,

The criteria are as presented underneath;

- 1. Size of Not less than 300-600m<sup>2</sup>
- 2. Plot coverage 40% (the rest will be left for future development)

3. Set-backs- Front	-	Minimum 15m, Sides- 10m, Back 10m		
		Facade edge of plot to the access road edge – 3m		
4. Fence Height	-	1.8m maximum.		
5. Transitory structures	-	Acceptable inside outline borderline		
6. Landscape	-	Necessary to grow		
7. Tree's type	-	Mango, Palm trees, Cashew, cutting of trees is not		
		permitted unless if there is a threat to		
		Properties and lives.		
8. Commercial uses	-	Street transaction is not allowed.		
9. Industrial1uses	-	Strictly a commercial layout for hotels, industries		
		Are not to be sited on or around the site.		
10. Parking Space	-	Dual parking are not allowed, provision should be		
		Allocated on site.		
11. Change of uses	-	The land use is strictly for commercial (Hotel)		
		non will be entertained		
12. Accessibility	-	Entrance road of 9-12m wide.		

## Table 4.6: Setbacks for roads

Roads types		Minimum distance from the centre of the road in meters	Desirable distance from the centre of the roads in meters	
1.	Major	45m	50m	
2.	Collector	20m	25m	
3.	Local	10m	15m	

(Source: Guidelines and Planning Handbook, 2014)

Furthermore, some extra groups of standards are drawn within the framework of physical Architecture, it is imperative to develop the serviceable potentials of the structure while observing the planning rules and by-laws guiding the developmental program. Eco-friendly practices have been generally associated with the application of appropriate building material arrangement of spaces, utilization of the natural element which they incorporate into his proposal, the selection of a certain form after watchful deliberation of all facts as enumerated below by Paul Rudolf, a next-generation American Architect, refers to them as a determining factor of forms in relation to planning which are as follows:

### i Building Purpose

The building is for hospitality purposes; the spaces allocated will be determined by usage (Function) and by the number of people it will accommodate in any giving space. The entire space needed for a particular number function will be multiped by person adding the ratio of 40-60%, 40% for furniture 60% for circulation.

## ii Movement

This refers to the movement from one place to another inside the building and the surrounding. The addition of walkways connecting all rooms to the various facilities have been considered and provided on each floor.

#### iii Beauty

This refers to the aesthetic of the building, Symmetricity was achieved by placing what is on the left side on the right. The use of sit-out for each room enables the occupant to appreciate the environment and also gives room for adequate ventilation. The use of large window panels further added to the Aesthetic of the building.

#### iv Fire risk

The use of water riser, fire security devices, and fire protective mechanism as measures in the protection of life and valuables. The resources used in construction assist in combating fire, while the use of certain building materials is vastly not suggested because there are extremely flammable.

### 4.3.2 Schedule of accommodation

The spaces needed are planned as a separate component, the least standard was gotten from the Time-Savers handbook and Architect data handbook (Eight editions). The area needed was multiplied by the number of the occupant and a 60-40 % ratio was used to get the additional part wanted for furniture placement and circulation in each unit.

## 4.4 Design Concept

The concept to design came from the spinner toy, which is formed from the combination of three circles with a centre core and each circle having an individual core. The centre core serves as a meeting, waiting area, the reception, while the individual core serves as a courtyard for adequate lighting and ventilation. From the study of hotels, there are essential criteria needed when proposing the design of hotels, they are standards set by the planning authority to regulate any establishment that provides hospitality business in Nigeria. The listed item below is a summary of the condition on site.

a. **Accessibility**: The access in the location is from the main access road leading to the airport, additional Provision to accommodate earth moving vehicle on-site during and after construction.

b. **Geography**: the site has a gentle slope and moves toward the Northwest direction; the use of a drainage channel will be encouraging to facilitate water harvesting.

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c. **Foliage**: The flora and fauna on site consist of tall trees with broad leaves and bushes varying from 250mm -5meters tall.

d. **Noise source**: The driveway and adjoining buildings are the possible noise source available on site.

e. **Inventory**: they are provisions made for easy connection to the existing electrical poles additional provisions will be made for telecom services.

### 4.4.1 Material used in construction

The main structural materials are sustainable concrete for the wall that is load-bearing, wool brick as an environmentally friendly building material, aluminium frames with triple-glazing windows with 5mm thick tinted glass to allow adequate sunshine to penetrate into spaces. Raft foundation will be used for the foundation to allow easy distribution of load;

The exterior doors are both large screen doors with tint glasses to prevent viewing from out while those at the reception are automated sliding doors, kitchen exit doors are metal doors crafted with a metal sheet to prevent trespassers, and the doors used for all conveniences are flush doors. The sit-out region in rooms is made of large horizontal sliding frames, offices, gym doors are access control doors to restrict certain individuals and to monitor those that use the facilities. The floor comprises of granite floor, toilet tile is vitrified floor tile 450X450mm placed on cement grit, additional building element used are itemized below; -

## a. Composite

Composite has been one of the major building materials since its inception they are formed from the combination of two or more building materials with different or similar properties to form a single component.

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#### b. Sustainable concrete

Sustainable concrete is formed from a mixture of crushed glass, cement, reinforcement, coarse sand, stone particles, and water. The application of sustainable concrete decreases carbon dioxide emission to the atmosphere which will help in maintaining the Ecosystem and that given area.

### c. Foundation

The foundation is made of raft foundation laid on 150mm thick blinding, this is done to ensure the structure is physically steady on the floor, further works on constructional activities can commence after casting the foundation due to the earth having a good bearing capacity.

### d. Building shell

The structure comprises of sandcrete and wool brick as load bear walls which were embedded into the building structure, reinforced concrete for the structural system, Diagrid will be used around the building; it is a form of space truss which of multiple diagonal elements that form a diagonal grid on the face of the structure. The diagonal grid makes the structure stable and this system has been sued for ages in tall buildings

#### e. Roof

Solar roofing tile also known as photovoltaic shingles will be recommended, they are solar panels created to function and look like conventional roofing products while electricity is produced by them. Solar roofing tiles are a type of solar energy solution know as building-integrated photovoltaics (BIPV).

## 4.4.2 External works

A mixed-method of landscaping will be used on site but more priority will be given to the soft landscape, the planting of trees and shrubs will be used to regulate the microclimate around the building which will serve as windbreakers. The hard landscape will be used for paving, walkways, and road path.

### 4.5 Design Services

### a) Fire Safety

The use of wool block will be encouraged for building works, they are made by adding wool and a natural polymer found in seaweed to the clay of the brick. It gives 37% more strength than burnt bricks and they are poor in thermal conduction. The use of water riser, fire extinguisher installed at a strategic location will be used as a further preventive means.

#### b) Power

A 1000kva transformer will be installed by the establishment to support the initial transformer provided by Abuja Electricity Distributing Company (AEDC). Solar farms will be built to serve as an alternative power source when there is a power shortage and the provision of a 100Kva generator to supplement the solar farm. Solar appliances will be used within the establishment due to them being environmentally friendly.

## c) Ventilation

The natural means of ventilation will be achieved with the installation of wide widows that opens to all balconies, large courtyard areas while the Air conditioning system, fans will be the mechanical means.

#### d) Source of water

The water source will be from the water treatment facility and boreholes drilled on-site, water storage facilities, both buried and elevated tanks will be provided at a different location to ensure there is always water in the building.

#### e) Drainages and dirt disposal

A covered drainage system will be provided on-site to collect runoff and rainwater which will be diverted to the buried water tanks, further diversion will be to the water treatment facilities provided on-site. The mode of dirt/waste disposal will be by accumulating the dirt at a particular location for it to be catered away with the use of a waste van which will be provided on-site.

### f) Security

The protection of life and property is of paramount importance, this is done to ensure all properties owned by the hotel are protected and utilized in the proper way. The use of cameras for surveillance will be adopted and placed at corridors, lobbies and public spaces to monitor both staff and customer, hotel locking system (Access control lock and door) will in place to monitor when a person enters or leave a particular living space. The use of foldable burglaries will be wildly encouraged for additional security balconies.

## 4.6 Deduction

To achieve this study the aim and objectives were the main focus, hotels were visited and cross-examination was done on their facilities and infrastructure. Based on the investigation, analysis was done on the requirement, material selection, and space allocation, and drawings were produced.

#### **CHAPTER FIVE**

## 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

The term eco-friendly says a lot in the construction industry but numerous individuals only limit the application to the planting of trees and shrubs on site which can be referred to as soft landscape but it is way beyond that scope. eco-friendly building practices cut across all aspects of the building process and not just the landscape alone, the built industry has been transformed in numerous ways that building material of choice, constructional techniques that will be adopted in accomplishing eco-friendliness plays a key role to habitant residing in that environment. Therefore, practices that are Eco-friendly must be observed from the inception stage down to the building process.

### 5.2 **Recommendations**

It is highly recommended that the administrative bodies ought to enlighten building consultants on the adverse effect of developing buildings without taking into consideration materials suitability to the climate in which it used where some resources perform better in arid condition, chilly area but damage in the moist, scorching area. The building industry ought to impose a rule that stops investors from beginning any given construction without bearing in mind the ecological effect in the choice of building material and the application.

The project has shown that environmentally friendly building practices in the design of any given structure are significant, I commend further studies and ideas to be presented to any institution that wants to practice eco-friendly techniques in the hospitality industries.

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## 5.3 Contributions to Knowledge

Eco-friendliness building practices will assist planner in making the best choice in material selection and planning of hotel buildings and other structures, this research can help all stockholders in the building industry in having a better awareness of the condition by adding to the body of knowledge on eco-friendly principles in buildings, lastly, upon successful conclusion of the research, designs, ideas, and recommendations will be provided in expressing proposals in line with eco-friendly building technique in hotel facilities in the country Nigeria and the world.

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## APPENDICE

# Appendix A: Observation schedule on the application of eco-friendly principles in the design of a 3star hotel

Dear sir/madam

I am currently working on a research project on THE APPLICATION OF ECO-

**FRIENDLY PRINCIPLES IN THE DESIGN OF A 3STAR HOTEL.** Your assistance in accepting this questionnaire will be of great **import**ance for the study. The information you provide will be made confidential and anonymous, if you agree to participate in this survey.

Thank you so much for your assistance.

## **Section A: Demographic information**

- 1. Do you have a knowledge on ECO-FRIENDLY PRINCIPLE AND THE APPLICATION? (1) yes (2) no
- 2. Do you have any idea on the challenges in the use of eco-friendly principles?
- 3. What is the benefit to the application of eco-friendly practices?
- 4. Will there be the risk in the application of eco-friendly practices?

## **Choice of Building material**

## Table 1: Material used for construction.

s/no.	Hotel Name	Location	Materials used for Construction			
		(Abuja)				
1	Nera Hotel	Jabi lake	Concrete, Sancrete blocks,			
			Bamboo			

2	Starview Palace	Gwarinpa Estate	Concrete, Sancrete blocks
3	Crossover Suite	Gwarinpa Estate	Concrete, Sancrete blocks
4	Sefcon Suites and	Gwarinpa Estate	Concrete, Sancrete blocks
	Apartment		
5	Ivana Suite	Wuse 2	Concrete, Sancrete blocks

## Cooling and natural ventilation

## Table 3: Showing cooling means

Buildings	Mechanized	Natural
Nera hotel		
Starview Palace		
Crossover Suite		
Sefcon Suite and Apartment		
Ivana Suite		
Total		

## Solar control

## Table 4: Solar control devices employed

Building	Internal	External	Tinted
	shading	Shading	Windows
Nera hotel			
Starview Palace			
Crossover Suite			

Sefcon	Suite	and		
Apartmen	ıt			
Ivana Sui	te			
Total				

Green Roof technology and traditional or vernacular design element

## Table 5: Solar control devices employed

Building	Green roof	Traditional or vernacular
	technology	design element
Nera hotel		
Starview Palace		
Crossover Suite		
Sefcon Suite and Apartment		
Ivana Suite		
Total		

## Further criteria used for the study are tabulated below

S/no	Criteria	Case	Case	Case	Case	Case
		study 1	study 2	study 3	study 4	Study 5
1	Energy efficiency and conservation (A)					
2	Water efficiency and conservation (B)					
3	Material Conservation (C)					
4	Waste management (D)					
5	Humane Adaptation (E)					
	Percentage (%)					

**Appendix B: Design concept sheet** 



Appendix C: Site plan



## Appendix D: Ground floor plan



**Appendix E: First floor plan** 



**Appendix F: Second floor plan** 



Appendix G: Third floor plan



**Appendix H: Twentieth floor plan** 



**Appendix I: Roof plan** 



**Appendix J: Section** 



**Appendix K: Elevation** 



**Appendix L: Elevations** 



**Appendix M: Details** 



## **Appendix N: Exterior perspective**

