



## Assessment of Eco-Friendly Principles in the Design of a 3 Star Hotel at Life Camp in Abuja, Nigeria.

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### Abstract:

*A hotel facility is tasked with providing affordable comfort and services to customers, thus the need for Eco-friendly practices for it plays a key role limiting numerous factors that lead to global warming which poses a big risk to human habitation. The global task for adjusting building structures to the natural environment is sole to meet the world's growing needs, and at the same time limit its impacts on the environment. The review article revealed eco-friendly design principles that are applicable in buildings in Nigeria, and that the application of these principles in Nigeria 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 therefore to assess the Eco-friendly principles in the design of a hotel for its effective application in Nigeria. The methodology adopted includes a desk study of articles related to the study, local Case studies, deducing information regarding eco-friendly and hotel buildings, and field observation to obtain data on some of the selected case studies. 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, analysed and presented in tables, plates, charts, and figures. The research established that there are eco-friendly design principles applicable to building architecture in Nigeria, which is efficient.*

Keywords: Eco-Friendly, Hotel design, Sustainability, Environment.

### INTRODUCTION

The word "hotel" is derived from the French meaning a mansion or a palace, the hotel industry is a business established in providing lodging services, beverage, and food with other varieties of services that are intended for public service (Essays, 2018). Over the last century, the world has experienced technological revolution and industrialization, during this period the progress recorded mostly was for the sake of social sustainability disregarding the adverse effect to the human within such environment and the planet (Bunz, 2006). Eco-friendly techniques in the context of construction encompasses safety, the quality of living, occupational health and opportunities as a result of future development opportunities (Akadiri, 2012). However, consideration has been taken on the importance of balancing such advancement with future practices, thereby reducing the number of greenhouse gasses released to the atmosphere. Price water house Cooper (PwC) Hotel Outlook for 2018-2022 projected an increase in demand in Nigeria hospitality market to 5.4% annually for the next five years with the existing hotel rooms which has been evaluated to be 9700 in 2017 to 12600 in 2022. The demand in growth can be ranked, as the largest expansion of any country, thus there is the need to adopt Eco-friendly building practice in hotel design.

Burcu (2015), affirmed that a building contains numerous variables that constitute Eco-friendliness, these include choice in landscaping element, materials used in construction, cooling techniques and thermal installation. The built industry plays a major role in the built environment and has a substantial impact on people, their surroundings, the structures, the quality of air and the way of life of occupant, (Abidin, 2012) and it is paramount for the building structure to adopt more

Eco-friendly practices. Eco-buildings are known as organic buildings or green buildings and they have little or no effect on the environment, these types of structures are effective in the use of traditional and recyclable building materials (Gunnell, 2009). Therefore, the aim of this research is to identify the appropriate Eco-friendly building principles used in construction of eco-friendly hotels.

## LITRARURE REVIEW

Eco-friendly designs do not mean a loss of quality of life, but requires a change in a mindset in employing alternative approach to traditional design by recognizing the impacts of every design choice on the natural resources of the local, regional and global environments. 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.”
- “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) adopted these principles in June 1993 at the American Institute of Architects (AIA) Expo 93 in Chicago. This led to a declaration that places environmental and social sustainability at the core of professional responsibility. It also involves educating the building industry, clients, and the general public about the importance of sustainable design. These activities are an example of how the concept of Eco-friendly design is being supported on a global scale. Eco-friendly principles have advanced in response to the knowledge that building structures should have little or no impact on the environment and the natural resources.

Un-Habitat (2006), ascertain the benefits of eco-friendly building practices improves the quality of living, it assist in operation and maintenance optimization, and reduces environment impact thereby protecting the Eco-system. USGBC (2002) affirmed that an Eco-friendly building incorporates the use of sustainable building materials techniques in reducing CO<sub>2</sub> emission within a building envelope and the exterior surrounding.

According to Karolides (2002), Eco-friendly building principles and techniques are not an assemblage of 14 environmental’ components nor a piecemeal modification of an already designed standard building, rather, it is a building philosophy in which natural and resource efficient features are integrated in a building. The principles and techniques of eco-friendly building therefore are theories and practices in the construction industry that serve as the criteria for evaluating the impacts of the building project. The World Business Council for Sustainable Development WBCSD (2000) initiated The idea of Eco-efficiency building practices in 1991 it 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”. Eco-friendly building material practices is a growing field, it brings about new innovative product to choose on yearly bases. The materials that have been discovered and used in construction have been known to emit harmful gases that affect inhabitant, and they contribute to a decline in healthy

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living. The selection of the desired building materials is a complex procedure that involves several variables, through which several characteristics can be recognized in various construction materials which are;

- Reusability /recyclable
- Durability
- Environmental impact

Other criteria include the listed items below

- Energy Efficiency and Conservation
- Water Efficiency and Conservation
- Material Conservation
- Waste management
- Humane Adaptation

### **Energy Efficiency and Conservation**

Gillingham *et al.*, (2009) defines energy efficiency as the energy services provided per unit of energy input and energy conservation as the total reduction in the amount of energy consumed. Buildings consume energy and other resources throughout its life cycle, from design and construction through operation and demolition (Schumacher et al., 2011).

According to Lockwood (2006), an eco-friendly building can help generate 40% more savings from energy conservation and perform 40% better than traditional buildings (Lockwood, 2006). Improving the energy efficiency and energy conservation of a building will reduce the emissions of carbon dioxide (US Department of Energy, 2008). Carbon dioxide is an important source of energy for plant growth but too much of it is harmful to both plants and humans, this means that high CO<sub>2</sub> emissions from buildings are not environmentally friendly.

Therefore, it is advisable to cut the consumption of energy by using renewable energy sources such as solar, wind or water turbines.

### **Water Efficiency and Conservation**

Energy used to pump water and distribute to all sections of the building entail treatments and delivery which consumes energy (Kim and Rigdon, 2008). The increase of water efficiency will result in decreased waste production from water treatment, thus improving environmental sustainability. Excessive water use in buildings therefore means excessive use of energy, which will increase gas emissions endangering the environment. Water efficiency basically looks at the 5R principle as asserted by (Silva-Afonso and Pimentel-Prdrigues, 2011). These are i) reduction in consumption, ii) reduction in loss and waste, iii) re-use of water, iv) recycling of water and v)

resorting to alternative sources.

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In the long run, conserving and using water efficiently will result in energy savings and a reduction in greenhouse gas effects on the environment (Silva-Afonso and Pimentel-Prdrigues, 2011).

### **Material Conservation**

Eco-friendly buildings are infrastructures constructed with recyclable, renewable, reusable and nontoxic materials that have zero or low volatile organic compounds (VOCs) (US Department of

Energy, 2008). It is because of this that Akadiri et al. (2012) insists that material conservation should take into consideration i) design for waste minimization, ii) specification of durable materials, iii) specification of natural and local materials, iv) designing for pollution prevention and specification of non-toxic or less-toxic materials.

Ljungberg (2007) defines renewable materials as materials, which are formed again in a short time and give no or very little impact on the environment. In his view, wood for example is preferable to plastic since it can be renewed in a shorter time when compared to plastic also, Gustavsson and Sathre, (2006) stated that the use of wood for construction generally results in a lower energy consumption and carbon dioxide emissions. Furthermore, when the tree is burnt its ashes can be used as organic manure. This means the use of wood materials for buildings are environmentally sustainable compared to plastic materials.

Local, materials like straw, laterite, mud, bamboo, wood, etc. are renewable materials that if used helps to create a healthier and safer environment. Aside these, the use of local materials save on transportation energy (Kim and Rigdon, 2008).

## Waste Management

Treatment of the waste has been a major environmental issue. Reuse, reduction and recycling of waste are considered as viable methods of recovering waste (Tam and Tam, 2006). Designers have a significant role to play in the reduction of waste by focusing on designing out waste (Osmani et al., 2008). By this, the waste management ought to be considered at the design stage. It is for this reason that materials specified in design to be used for the construction should be reusable or recyclable and as much as possible waste reduced or eliminated. It is important to note that recycling of building waste can greatly reduce the need for energy and natural resources, at the same time decreasing the amount of materials to landfill sites (Thormark, 2006). An example is the use of aggregates from recycled construction for concrete (Rao et al., 2006).

## Humane Adaptation

Designing for humane adaptation looks at protecting human health and comfort as well as the protection of physical resources (Akadiri et al., 2012). One of the things to consider when designing to preserve the natural conditions is the topography of the site, the vegetation and the water table. Buildings should also be designed bearing in mind the climatic conditions of the area in which the site falls (Omer, 2008).

To achieve proper design for comfort, Kim and Rigdon (1998) phrases the methods of designing for human comfort as i) provision of thermal, visual and acoustic comfort, ii) provision of visual connection to the exterior, iii) provision of operable windows, iv) provision of clear fresh air, v) utilisation of non-toxic materials. (Akadiri et al., 2012) rephrases six major methods of achieving design for human comfort as i) thermal comfort, ii) acoustic comfort, iii) day lighting, iv) natural ventilation, v) aesthetics and vi) functionality. The above-mentioned methods help people to perform well in the building. Good lighting, acoustic privacy and thermal control are the key to occupants' productivity and satisfaction

The concept of eco-friendly principles can be useful at various levels in building and planning ranging from residential buildings, to neighbourhood or estate and industrial parks.

## Building design

Ecological design solves many environmental problems by the simple application of passive architectural systems integrated into the built form (Bidoki, 2016). Much progress has been made in this regard however, it is paramount in considering Eco-friendly practices in both constructional and operation phase in any given building facilities. The natural environment is like a human body, it can metabolize nutrients and waste whereby those that are useful are absorbed and unsafe elements are discarded. Eco-construction focuses on these processes, integrating ecological functions into the buildings to catch, store and filter, purify and processes other nutrients (Ragheb, El-Shimy, & Ragheb, 2015). Other examples include;

- The land can be optimized by avoiding sprawling building designs and by efficiently allocating internal space to various needs.
- Energy use can be reduced by passive or active solar heating technologies, use of shading overhangs and reflecting surfaces in summer and efficient insulation, windows, light and appliances; externally, trees can be planted or positioned to adequately provide shade.
- In urban areas dominated by high rise buildings, use of green roof is an Eco-friendly solution, green roofs last longer than conventional roofs, reduce energy costs with natural insulation, create peaceful retreats for people and animals, and absorb storm water, potentially lessening the need for complex and expensive drainage systems and cooling system.
- Landscaping can be naturalized by utilizing existing topography and only native plants in horticulture to emulate natural communities appropriate to local conditions while still maintaining pleasant aesthetics and low-impact recreational use (Yang, 2002).
- Building materials and furniture can be selected or specified to be efficiently manufactured from renewable resources, durable yet reuse or recycled and not to emit indoor pollutant.
- Traditional or vernacular design elements can be incorporated into buildings to improve their energy and material efficiency, aesthetics and comfort while still respecting cultural heritage.

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## Urban planning

Eco-principles can be applied to the development of existing town and communities as well as in the development of modern cities. According to Olomolaiye *et al.* (2012), improvement of existing urban areas starts with identifying the ecological problems such as inadequate on the right choice in materials applications, lack of technical knowledge in applying modern innovative building technique in Eco-design, climatic condition that are attainable for a particular building material, transportation distances, inadequate organization between the factions within the built industries or in the use and neglected resources commonly known as waste. Lastly, other ecological challenges include; environmental waste conflicts with indigenous biodiversity. Tiezheng (2002), added that, other factors to consider and dealt with include travelling distances, the growth of

sparingly integrated districts and equity issues. These enhancements can be addressed into structures that are in existence when it is re-designed.

## METHODOLOGY

To achieve the study's objective, hotel buildings were targeted for the research; a descriptive research method was used in this study. It involved a case study approach, where observation schedule was used to solicit data and desk study approach was applied on the subject matter. The qualitative research methods recognize the variables and their relationship, the case study assist the researcher in examining various environmental practices adopted in each building that selected for study. The building physical characteristics, building element, site organization was amongst the data to be obtained from the desk study.

The study population comprises hotel building in the Federal Capital Territory, Abuja and the subject matter covers the area of interest within the building and all result gotten can be generalized with various characteristics. The research made use of random probability sampling techniques; with a purposive selection method where building types were selected after cautious deliberation that suits the study of interest. The total numbers of hotels contacted for this research are Five (5) and Twenty-five-person (25) were interviewed at hotel venues and five (5) people that sales building materials.

## FINDINGS AND DISCUSSIONS OF RESULTS

The data obtained using a case study approach are checked on the basic principles and practices of Eco-friendliness in the built industry and was represented in the form of charts, plates, tables and figures. The investigation was directed to field survey and observations were duly noted, analysed and the results are compared in identifying Eco-friendly principles and techniques in hotel buildings, which are:

- a. Identifying the Eco-friendly building techniques.
- b. Accessing the adequacy Eco friendly building techniques employed

The data analysed was on the bases of the following variable, which include:

- Choice of building material
- The use of landscape element
- Cooling and natural ventilation
- Solar control
- Green roof technology and Traditional or vernacular design elements.

### Choice of Building Material

Table 1. Shows the types of building material used for construction as extracted from the observation schedule of the research carried out.  
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Table 1: Material used for construction.

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

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

### Landscape Element

Table 2. Below shows poor integration of soft landscape element as seen on the observation schedule carried out on the study area, less emphasis was given to tree planting while grasses was employed on most site. The data collected shows that one (3) building made use of trees, three (5) building made use of shrubs and three (2) of the five (5) building made use grass which were planted around the buildings for heat absorption.

*Table 2: Showing landscape element*

s/no.	Buildings	Trees	Shurbs	Grass
1.	Nera hotel	✓	✓	✓
2.	Starview Palace	✓	✓	—
3.	Crossover Suite	—	✓	—
4.	Sefcon Suite and Apartment	—	✓	—
5	Ivana Suites	✓	✓	✓
	Total	3	5	2

### Cooling and natural ventilation

Table 3. Shows the use of both natural and mechanized cooling techniques in achieving energy efficiency in the buildings as extracted from the observation schedule of the buildings studied.

*Table 3: Showing Cooling means*

Buildings	Mechanized	Natural
Nera hotel	✓	✓
Starview Palace	✓	—
Crossover Suite	✓	—
Sefcon Suite and Apartment	✓	—
Ivana Suite	✓	✓
Total	5	2

### Solar Control

Table 4. Below shows the different measures adopted in solar control used in buildings as extracted from the observation schedule of the research carried out. The method adopted in the five (5) buildings is window blind fixed internally while they were no application of tinted glasses or the use of both horizontal and vertical shading devices.

*Table 4: Solar control devices employed*

Building	Internal shading	External Shading	Tinted Windows

Nera hotel	✓	—	—
Starview Palace	✓	—	—
Crossover Suite	✓	—	—
Sefcon Suite and Apartment	✓	—	—
Ivana Suite	✓	—	—
Total	5	0	0

**Green roof technology and traditional or vernacular design element**

Table 5 below shows poor integration of Green roof technology and traditional or vernacular design element on the observation schedule on the study area less emphasis was given to tree planting while grasses was employed on most sites.

Table 5: Solar control devices employed

Building	Green roof technology	Traditional or vernacular design element
Nera hotel	—	—
Starview Palace	—	—
Crossover Suite	—	—
Sefcon Suite and Apartment	—	—
Ivana Suite	—	—
Total	0	0

Further Criteria used for the study are tabulated below

The results obtained from the study are presented below in tabular format. Visiting the selected structures in Abuja and Lagos collected data for this research. The data attained was examined using descriptive analytical methods. Each of the samples was tested against eco-friendly building criteria and sub-criteria.

S/no	Criteria	Case study 1	Case study 2	Case study 3	Case study 4	Case Study 5
1	Energy efficiency and conservation (A)	*	✓	X	*	X
2	Water efficiency and conservation (B)	✓	✓	X	*	X
3	Material Conservation (C)	X	*	X	X	X
4	Waste management (D)	*	*	X	*	X
5	Humane Adaptation (E)	*	✓	*	*	*
	Percentage (%)	67%	87%	40%	60%	40%

Table 6.0 shows the adoption of eco-friendly building criteria in the construction

The symbols adapted are as follows,

Absent = X, — Present = ✓ Average = \*

From Table 6.0, Case study 1 recorded a 69% application of the criteria with high water efficiency through a reduction in the waste of water, use of water efficient landscaping, reuse and recycling of water. It has average energy conservation, waste management and humane adaptation. Case study 2 recorded an 87% implementation of the criteria, with high water efficiency like Case study 1. It however shows higher Energy efficiency, conservation and humane adaptation due to low



operational energy and use of renewable energy sources and an average waste management process because only some of the waste is recycled. Case study 3 and 5 recorded a 40% adoption of the criteria. Both structures were designed and built without putting the environmental impact of the structure into consideration; therefore both buildings have low energy efficiency and conservation, inadequate water and material conservation, and poor waste management. Both buildings show an average humane adaptation, in the building design. Case study 4 shows 60%, a near average implementation of the criteria for eco-friendly design. All the case studies excluding Case study 2 show poor material conservation, because of inadequate recycling and reuse of materials and a negligence in the use of non-toxic building materials especially in the indoor environment. There is also an overall average to poor management of waste in the construction of all the buildings. A total number of thirty (30) people were interviewed, five (5) from each hotel establishment and five (5) building material sale personal at Die-Die building market

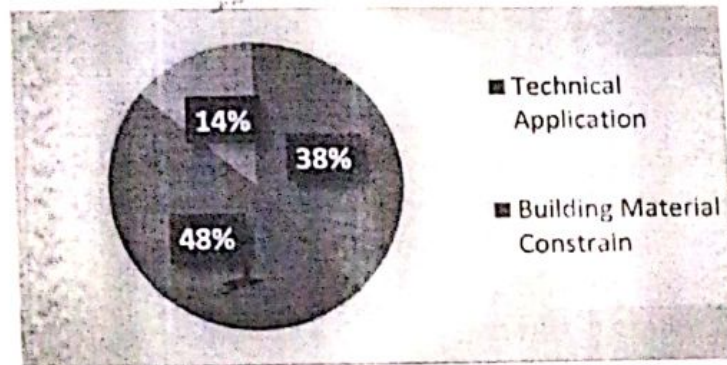


Figure 1: Challenges in the use of Eco-friendly principles and application

Overall, the people consulted stated that the lack of skilled personal in the field is responsible for decline in buildings that Eco-friendly; they went further in stating that this is a problem. The vast majority said that the type of building material is a main problem due the limitation in innovation in Abuja. They further stated that in Nigeria most building material are not Eco-friendly and the available one is either expensive or not readily available, the minor segment, which amounts to 14%, blamed it on the lack of knowledge on Eco-friendly principle.

Figure 2 illustrate that the vast majority of the individuals consulted agreed that there is no risk in the application of Eco-friendly principles in building and building built with theses are more durable, while 17% had no precise answer as to the impact be it negative nor positive and the minority which is 10% said there are risk in involved in the application stating that the right choice of building materials are the limitation hindering the application of Eco-friendly techniques in the State.

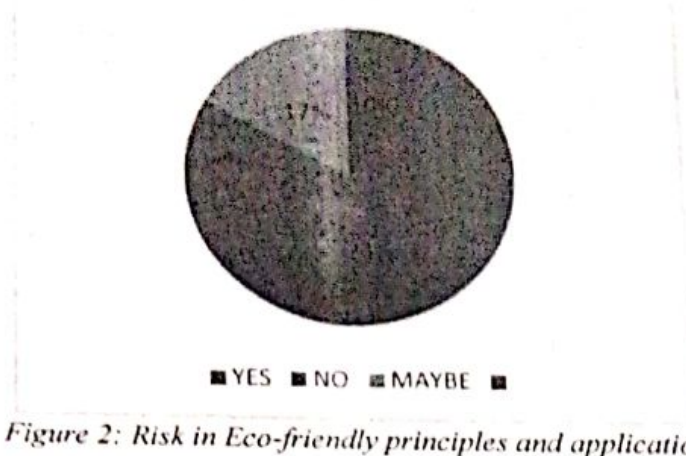


Figure 2: Risk in Eco-friendly principles and application

## CONCLUSIONS

This research shows that Eco-friendly building practices is not limited to the planting of trees and shrubs, it cut across all aspects of the building process from that choice the of building material to the mode of construction and techniques employed in achieving eco-friendliness. Therefore, Eco-friendly practices must be adhered to from the design stage to the construction process. The government should educate building practitioner on the negative impact in erecting structures that are not Eco-friendly, The built industry should implement and enforce rule that prevents investors from embarking on any given development without considering the environmental impact in material choice and application.

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