University of Nairobi

COLLEGE OF ARCHITECTURE AND ENGENEERING

SCHOOL OF THE ARTS AND DESIGN

ADOPTION OF GREEN SUSTAINABLE DESIGN IN THE RENOVATION OF SOLAI APPARTMENTS IN RUARAKA, NAIROBI

AUTHOR; MUTINDWA NICHOLAS MUNENE

REG B05/1090/2017

SUPERVISOR; DR. MICHAEL MUNENE

Project paper submitted in partial fulfillment of the required for the Bachelor of Arts in Design Degree, (B.A) submitted to the School of the Arts and Design, University of Nairobi

APRIL 2020

DECLARATIONS

STUDENT'S DECLARATION

I Mutindwa Nicholas Munene do hereby declare that this thesis, presented in fulfillment for an award of a Bachelor of Arts degree in design (BA DESIGN), is my own unaided and original work. The work has not been presented in this or any other university for academic qualification. Furthermore, the research provides my own opinions and not necessarily those of The University of Nairobi.

Registration Number; B05/1090/2017

Signed; ……. Date; …….

SUPERVISOR'S DECLARATION This thesis has been submitted for examination with my approval as the student's supervisor.

Dr. Michael Munene

Signed; …….. Date; …….

DIRECTOR, SCHOOL OF THE ARTS AND DESIGN

Dr. Lilac Osanjo

Signed; …….. Date; …….

DEDICATION

This research is dedicated to my loving family. Their encouragement, patience, unconditional love and unwavering support gave me immense strength throughout the study. I am truly blessed to have them in my life. And to Almighty God be great glory, for he supplied all the resources that I needed to accomplish this exceedingly difficult task.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the following people whose help made this thesis possible. \First and foremost, my study supervisors – Dr. Michael Munene at the Department of School of the Arts and Design, University of Nairobi for the support, incredible understanding and capability to initiate guidelines without being overbearing, always availed himself to me for consultation and timely critique of my research work.

I greatly acknowledge the staff at the School of Arts and Design for their support and friendship. I am also indebted to various construction industry participants, scholars, construction professionals, researchers, government officials among others who availed data and information for this study.

I would also like to acknowledge my fellow research students at the University Of Nairobi - people of various talents whom I spent long hours of intense work and discussion; I sincerely thank everyone else who may have played a role in any way to facilitate the execution of this study and acknowledge my own errors of omission and commission in this work.

TABLE OF CONTENTS

CHAPTER FOUR

LIST OF FIGURES TABLES AND CHARTS

9FIGURES

TABLES

CHARTS

ABBREVIATIONS

LEED - Leadership in Energy and Environmental Design

USGBC - The United States Green Building Council

AAK - Architectural Association of Kenya

EDGE - Environmental Design for Greater Efficiencies

RIBA - Royal Institute of British Architects

SWOT - Strengths Weakness Opportunity Threats

LED - Light Emitting Diodes

GHG - Green House Gas

VOC - Volatile Organic Compound

KPLC - Kenya Power and Lighting Company

NEMA - National Environment Management Authority

KGBS - The Kenya Green Building Society

GAF - Green Africa Foundation

US - United States

SA - South Africa

ICA - International Climate Agreement

UNEP - United Nations Environment Program

AFM - Atomic Force Microscopy

GDF - Green Design Framework

CFL - Compact Fluorescent Lamps

UN-Habitat - United Nations Human Settlement Programme

UV Light - Ultra Violet light

ASID - American Society of Interior Designers

IAQ - Indoor Air Quality

LRC - Learning Resource Centre

CHAPTER ONE

1.0 INTRODUCTION TO STUDY

1.1 Introduction

Society is becoming increasingly aware of the importance of environmentally responsible building and interior design. As a result, more and more clients seek to incorporate sustainability principles in their interiors. Interior designers have a tremendous impact on the sustainability of an environment because they are the ones deciding which materials and products will be used and how ecologically people will be able to interact with their surrounding spaces.

1.2 Background to the study

Sustainable design (also called environmentally conscious design, eco-design) is the philosophy of designing physical objects, the sustainability of the world is known as sustainable development. The intention of sustainable design is to eliminate negative environmental impact completely through skillful, sensitive design.

Green building, Eco-friendly, or ecological, construction is building a structure that is beneficial or non-harmful to the environment, and resource efficient. This type of construction is efficient in its use of local and renewable materials, and in the energy required to build it, and the energy generated while being within it. Eco-friendly construction has developed in response to the knowledge that buildings have an often-negative impact upon our environment and our natural resources.

The rapid population growth which increases demand for residential estates is one of the driving factors for environmental change in Nairobi County. Currently, the parameters of Nairobi and its outskirts are expanding to bursting point due to unprecedented demand for residential estates. The rising demand for quality housing is translating into innovative and futuristic multibillion-dollar communities and mini cities in Kenya. In addition to the already constructed buildings, there are yet mega projects to come in the housing sector Some of these projects are Northlands City, Tatu City which will accommodate 75,000 people, just to name a few. The residential estates weigh heavily on the environment and consequently play a noteworthy role in the current global environmental crisis especially with their contribution to greenhouse gases. The residential estates also have considerable impact on the environment as they exploit a lot of natural resources like water and timber. In Nairobi County, water is already a scarce commodity in many households. With the current inadequate number of houses in urban areas, Nairobi County is already grappling with environmental challenges like improper disposal of waste, poor

drainage system in many residential areas leading to flooding when it rains, high demand for energy and the already scarce water resource. The demand for more houses is and will therefore exacerbate the environmental problems if nothing is done to mitigate environmental impact caused by residential estates.

The adoption of green design in the housing industry in Kenya is very low. It is unsustainable when the environment, natural resources and communities are taken

into consideration. As the environment continues to worsen, it has become a persistent public concern

With the boom in residential estates, more water will be needed. Therefore, if we are to tackle issues of dwindling natural resources, global warming and climate change, residential estates offer one of the largest possibilities of any sector in terms of mitigation. The sense of urgency that now prevails for humanity to take actions against climate change has increased manifold in the past years. Climate change can be attributed to several faults; and improper design that doesn't take into consideration the environment is one of them.

Experience has now shown that there is no completely safe method of waste disposal. All forms of disposal have negative impacts on the environment, public health, and local economies. Attempts to control or manage wastes after they are produced fail to eliminate environmental impacts. The toxics components of household products pose serious health risks and aggravate the trash problem. The only way to avoid environmental harm from waste is to prevent its generation. Pollution prevention means changing the way activities are conducted and eliminating the source of the problem. It does not mean doing without, but doing differently.

1.3 Problem statement

The minimum dwelling type for the middle class/single dweller in Nairobi is a bedsitter, and towards this, the Government’s big agenda on housing is advocating to build affordable bedsitter with a maximum selling price of ksh.800,000. Many challenges arise when housing the Nairobi dweller namely, social isolation, poor quality of housing design and its environment, security risk, social stigma on housing dwellers in certain neighborhoods and stigma on a certain dwelling typology. The financial bar for living in certain areas is quite high, due to non-availability of other affordable options, high rent, scarcity of space and high demand for space by the dwellers, who would want to live in a middle-income neighborhood. Economics might dictate the living conditions at a particular area, but it does not account for the architectural response to the economic constraints.

This study will propose a suitable environment and a suitable ecofriendly dwelling unit for the dweller in a middle-income neighborhood, which architects and designers can respond to. This thesis has the aim of providing a Minimum dwelling unit which has its original living standards that meet to the psychological, economic, recreational and physiological needs of the middle-income dweller by learning from the already existing forms in their context.

1.4 Objectives of the Study

Main objectives

The study set to:

• To investigate the features of green design adoptable to the housing industry in

Kenya.

• To propose a model and/or framework of increasing the uptake and adoption of

green design in the housing industry in Kenya.

1.5 Research questions

• To what extent have Kenyan Housing developers adopted green design in Kenya?

• What are the features of green design adoptable to the housing industry in Kenya?

• Which model and/or framework (if any) can be used to increase the uptake and

adaptation of green design in the housing industry in Kenya?

1.6 Significance of the research

It is important for players within and without the housing industry to adopt green design. This would greatly lead to a reduction in energy use, improved solid waste management practices, proper water use, recycling, and ultimately all-round resource efficiency. This research is aimed at establishing various ways in which green design can be adopted in the housing industry in Kenya to have a positive impact on the environment and the surrounding communities. Beneficiaries range from home owners to business owners in the region and in the long run the surrounding environs

1.7 Limitations and assumption of study

This study's main assumption was that the housing industry in Kenya has not adopted green design practices. The study's limitations would also be time and cost related. The research involves travelling to the destination and trying to work against the time scheduled for the project

1.8 Scope of research

Geographically, the study is to be conducted in Alsops area, Ruaraka County. Alsops is located to the east of Nairobi city center and just off the Thika super highway, not more than 20 driving distance from downtown Nairobi and well within range of shopping areas. The Constituency covers an area of 2.60 square kilometers and has an approximate population of 25,354 with a population density of 4,515 people per square kilometer.

The research was based on the housing industry in Ruaraka in general. I ended up using the Solai Apartments as the case study to narrow the scope of the research.

Solai apartments are distributed within different Regions in Nairobi such as Pangani and Ruaraka. In regards to the geographical distribution of these establishments I therefore selected one of the apartments located in Alsops due to easy accessibility and the Geographical convenience. Alsops was suitable to conduct this study because of its many environmental challenges due to its large human population and many residential estate projects that are complete and ongoing.

1.9 Conclusion

The goal this environmentally responsible design is to transform the building industry such that the design and construction of the built environment enhances the health and wellbeing of both the current and future generations. Interior designers are responsible for the interior environments of homes, workplaces and public buildings. The decision made by the designer affects the health and wealth and wellbeing of both current and future generations and the environment on which they work and play

CHAPTER TWO

2.0 LITEREATURE REVIEW

2.1 Introduction

This chapter will highlight on the literature of how the sustainability and ecofriendly aspects can be adopted and how they affect the general urban area and, in the Kenya, as well as in the international arena. It also focuses on the sustainable urban environment emphasizing on the aspects of environmental sustainability

.

2.1.1 Design philosophy

The term "sustainable design" has been used in multiple disciplines, including product design, architecture design, interior design, and graphic design. Sustainable design refers to the design process that integrates an environmentally friendly approach and considers nature resources as part of the design. Sharlyn Underwood, American Society of Interior Designers (ASID) Virginia chapter president, defines sustainable design this way: "Sustainable design is the practice of designing buildings so that they exist in harmony with natural systems."

Sustainable design acts as a philosophy that is applied by different companies, governmental entities, and non-governmental organizations to achieve a better future for the human race through the wise and low-volume consumption of Earth's resources. Companies and governments that have advanced design strategies have more potential to apply sustainable design than others. Additionally, many governments that implement national design policies have provided positive steps toward applying sustainability.

2.1.2Principles of Sustainable Interior Design

In order for the designer to consider sustainable design throughout the process, the question becomes what are the stages of the design process and design development that you can consider changing in order to make a more sustainable product

- **Design for energy efficiency**

Energy consumption is one of the major contributors to climate change. Buildings are

responsible for a big share of the world's greenhouse gas emissions, caused by energy consumption. Interior designers can do a lot to improve a building's energy efficiency, mainly by reducing the amount of energy needed for heating, lighting, running appliances, etc., and by providing renewable, non-carbon-based energy to the building.

- **Design for longevity and flexibility**

To prevent materials and products getting discarded too often, interior designers should consider the lifespan of any material they plan to use, especially for those elements that experience a lot of wear and tear (such as flooring). The goal of designing for longevity is to design durable and timeless spaces and suppress the urge to change the whole design every couple of years. The best way to achieve timelessness is to choose quality over quantity, classics over trendy, and simplicity/functionality over embellishments.

- **Design for healthy environments**

People spend most of their time indoors; in offices, schools, at home, etc. Considering the health of an environment should be at the top of the interior designer's priority list. There are several factors to keep in mind when trying to design healthy spaces, such as the quality of the air, heating, ventilation, lighting and acoustics.

- **Design for low environmental impact**

From a sustainability perspective, it's very important to pick materials and products with the lowest environmental impact. Organic materials seem the obvious choice, but we mustn't forget that natural resources need to be treated responsibly. Choose materials that are quickly renewable and are extracted in an environmentally responsible way. There are labels, standards and certifications that give credible information about the products' origin and help you identify eco-friendly products. For example, an FSC label on wood products ensures that the wood used in the product was harvested sustainably.

- **Design for waste reduction**

Interior designers have a lot of power in their hands when it comes to waste reduction, and at the same time, a big responsibility to act sustainably. The planet's resources are limited, so the mentality of discarding products as soon as they go out of style and replacing them with those that are currently trendy is no longer justifiable. Fortunately, the world of design is becoming increasingly aware of the need for sustainable thinking and is experiencing a growing interest in sustainable trends, such as recycling, up cycling and repurposing. Instead of discarding ''old-fashioned'' objects while they are still functional, designers can and should come up with creative ways to give them a new life.

2.1.3 Application

Heating and lighting are the two most crucial factors interior designers have influence over. Since most of the buildings heat escapes through windows, it's important that the installed windows are of high quality and provide good insulation. Curtains and drapes keep both cold air and the sun's heat outside. Window coverings, blinds and shades enable residents to control the building's temperature in an energy efficient way by opening and shutting them as needed.

Another way in which interior designers can help reduce the depletion of natural resources is by opting for synthetic materials that were made from recycled waste or can be renewed/recycled at the end of their life cycle — when they are spent or people grow tired of them.

With this cradle-to-cradle approach, waste becomes raw material for new products and a circular loop of manufacturing is formed, effectively minimizing or even eliminating waste all together.

Innovation has brought many options for flexible design: walls that can be modified to create more spaces when children get bigger and need their own rooms, adjustable and mobile furniture that can be re-assembled to fit the needs of the flexible modern workplace, modular flooring that allows personalization and easy replacement of individual pieces, and so on.

Maintenance of spaces with lots of easy-to-clean materials and surfaces requires fewer cleaning products, which are often harmful for the environment. Therefore, investing in elements that are sturdy, durable and easy to clean or replace means that less renovations will be needed; and, consequently, less waste will be generated. Saving money that would go toward cleaning and maintenance cost is an additional benefit.

2.2 Review of Theoretical Literature

2.2.1 Green design and housing industry in Kenya

To improve Kenya's environmental performance, a better understanding of socio-economic and behavioral forces driving unsustainable production and consumption is required. Economic growth, as measured by per capita national income, affects environmental quality as economy expands, environmental damage increases. However, a number of variables vary monotonically with income and in different directions for example access to safe water, sanitation, clean energy like solar panels and sustainable building materials show improvement with economic growth whereas there is an indication that CO2 emissions and waste generation deteriorate. Evidently,

the richest countries' carbon emissions and resource consumption are continuing to increase beyond sustainable levels whereas some developing countries appear to perform better than developed countries from the environmental point of view. As such, economic growth may not necessarily be beneficial to environmental quality. Income distribution rather than average levels of income maybe critical determinant of environmental degradation.

While a project should start with absorptive capacities, there must be a deliberate effort to grow the project into a transforming and sustaining enterprise. The basis for sustainable income generating according to Levi,2012 is the logic of the enterprise. If a project is not financially and economically sustainable, it can have a negative impact on environmental sustainability too; for instance, if a residential estate is not financially and economically sustainable, maintenance of the surrounding environment and facilities becomes a problem. This in turn affects the environment.

2.2.2 Green certification

Green certification is the basis of most environmentally friendly initiatives in many industries especially in developed countries. The certifications ensure that there is no 'green washing' by the owners but rather they are really going green. Green washing in businesses or products refers to claims of the business or product being green while only one or two green practices have been adopted. This in short refers to a product or businesses masquerading as green while in actual sense most of the practices or elements are not green. Most businesses do this in order to mislead prospective customers as being environmentally conscious. Green certifications in most parts of the worlds are carried out by private organizations and bodies. Most governments however have started adopting this green practice especially within construction laws and policies,

The certifications also ensure that these establishments exhibit awareness of sustainability and in so doing also achieve balanced excellence in at least three critical areas: economic development, social responsibility and stewardship of the natural environment. Green certifications are not common in most of the African states but are very vital in other continents.

California's Department of Resources Recycling and Recovery (CalRecycle) points out key elements in green buildings and construction:

Have substitute energy sources that are not abusive to the environment.

The site should be well suited to take advantage of mass transit.

Consider alternative energy sources, minimizing the electric loads and installing high-efficiency lighting systems.

Select sustainable construction materials that promote resource conservation and efficiency.

Water efficiency can be attained by dual plumbing to use recycled water non-potable uses.

These are closely related to Leadership in Energy and Environmental Design (LEED), a rating system created by the U.S. Green Building Council (USGBC). It can be used to identify buildings as high performing on environmental and energy dimensions. Some of the key features of LEED include: pollution prevention during construction, community connectivity, alternative transportation for building occupants, habitat restoration and open space protection, water use reduction, energy performance tracking, refrigerant management, promotion of sustainable building materials, and improved indoor environmental quality.

In Kenya there are no set guidelines to be followed or green certifications required for establishment in the housing industry. However, Kenya is slowly joining the league of countries employing green or environmentally sustainable architecture in real estate development and housing. The move is largely informed by the dwindling natural resources such as fossil fuels and water, resources that were once thought as inexhaustible. Kenya although is set to get green building rating system by next year. This came out at the Architectural Association of Kenya (AAK) Annual Convention held in Mombasa. Kenya has been using foreign based green building certification tools like Green Star Rating System, American Leadership in Energy and Environmental Design (LEED) and Environmental Design for Greater Efficiencies (EDGE).

In conjunction with public, private, academia and civic sectors, Green Africa Foundation recently created the Green Africa Building Standards, Certification and Rating Systems aimed at mitigating the impact of buildings on occupants and the natural environment. Through their rating system a “Green Mark” award certificate can be given to all types and sizes of buildings which respect green best practices

.

2.3 Renowned Designer; Norman Foster and sustainable design

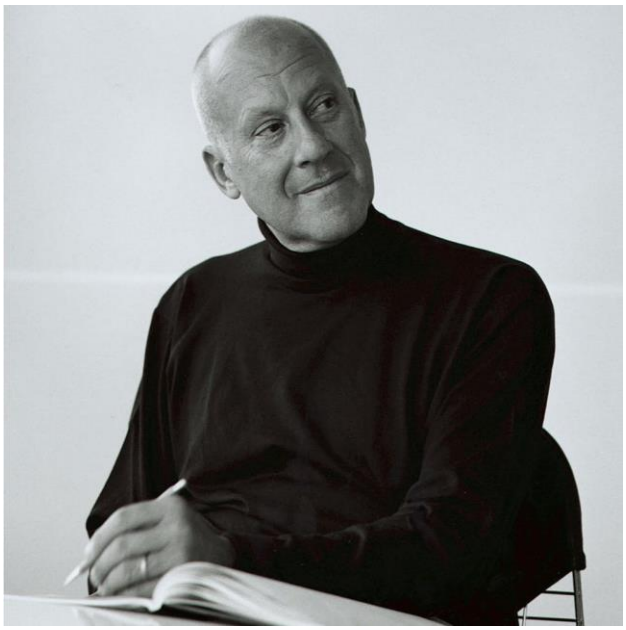


Figure 2.a; Norman foster

Source: www.archinect.com

Norman Robert Foster, is an English architect whose company, Foster + Partners, maintains an international design practice. He is the President of the Norman Foster Foundation. The Norman Foster Foundation promotes interdisciplinary thinking and research to help new generations of architects, designers and urbanists to anticipate the future. The foundation, which opened in June 2017, is based in Madrid and operates globally.

Norman, an international award-winning architect who pioneered structural expressionism and ecological design, The British architect has played an important role in shaping the High-Tech and environmental design movements. He is the recipient of several prestigious awards, including

the Pritzker Prize in 1999. Foster was knighted by Queen Elizabeth II in 1990; he is also known as the Baron Foster of Thames Bank.

Foster was born in 1935 in Reddish, two miles north of Stockport, then a part of Cheshire. The only child of Robert and Lilian Foster (née Smith), the family moved to Levenshulme, near Manchester. His father was a machine painter at the Metropolitan-Vickers works in Trafford Park which influenced him to take up engineering, design, and to pursue a career designing buildings. His mother worked in a local bakery.

In his teens, Foster had an interest in architecture, particularly of Le Corbusier. However, Foster's career in architecture was so unlikely. born in a suburb of Manchester in and the only child of his working-class family Foster once said, "In fact, the idea that anyone in the neighborhood where I grew up would go to a university was like saying I'd be the next Pope." But he had to leave school to work when he was 16. At age 21, Foster enrolled in the Manchester University School of Architecture. He earned several scholarships there, including one from Yale University.

In 1956, Foster began study at the School of Architecture and City Planning, part of the University of Manchester. He was ineligible for a maintenance grant, so he took part-time jobs to fund his studies, including an ice-cream salesman, bouncer, and night shifts at a bakery making crumpets. During this time, he also studied at the local library in Levenshulme. His talent and hard work were recognized in 1959 when he won £100 and a RIBA silver medal for what he described as "a measured drawing of a windmill". After graduating in 1961, Foster won the Henry Fellowship to Yale School of Architecture in New Haven, Connecticut, where he met future business partner Richard Rogers and earned his master's degree.

In 1962, Foster got his master's degree from the Yale School of Architecture. The following year, he toured the country to see architectural destinations.

In 1963, Foster returned to England and established his own an architectural practice, a team of 4, with Rogers, Su Bramwell, and sisters Georgie and Wendy Cheesman. The team earned a reputation for their high-tech industrial designs. After the four separated in 1967, Foster and Wendy founded a new practice, Foster Associates.

In 1968, Foster met architect Buckminster Fuller, who would deeply influence Foster's design philosophy.

From 1968 to 1983, Foster collaborated with American architect Richard Buckminster Fuller on several projects that became catalysts in the development of an environmentally sensitive approach to design, such as the Samuel Beckett Theatre at St Peter's College, Oxford. In 1999, the company was renamed Foster + Partners. Today, Foster + Partners has 25 offices around the world with more than 1,000 employees. Foster's portfolio includes more than 250 civic, cultural, office, and residential buildings in 40 countries.

2.3.1 Foster's Philosophy

Foster describes architecture as the expression of values. He says, it is "a balancing act of integrating and somehow responding to all the needs of a project: material and measurable; as well as the spiritual and intangible, the subjective; it is somehow about making all those value judgments." For Foster, "Great architecture should wear its message lightly." He believes a good architect should have "An open mind, energy, an appetite for hard work, a willingness to explore new solutions and push boundaries." Foster's design philosophy involves integration, sustainability, regeneration, adaptability, flexibility, technology, and ecology. His architecture is a combination of these principles.

2.3.2 Social Responsiveness

"Architecture is about the social agenda," Foster says. For him, how we build reflects how we live, and architecture is "the embodiment of our civic values." The London City Hall, for example, shows how Foster responds to societal values, like democracy. Foster designed the hall as a transparent, open, and accessible space. He used glass to express the uncensored dialogue of democracy.

Public spaces play a fundamental role in Foster's socially-responsive architecture. He says, "Public spaces are more important than buildings. They make a city alive." The Willis Faber and Dumas Building, for example, integrates such social dimension. Here, Foster created an office building where, at lunch time, employees could sunbathe or swim in the swimming pool. On weekends, the building served as a social facility and public space for the town. This was a revolutionary social design in the 1970s.

2.3.3 Adaptive Reuse

Foster has redesigned several buildings with historical background. For him, "Architecture is a connection with the past.'" Foster takes this connection as the revitalization and repurposing of historic buildings for new generations, which is called adaptive reuse. He says, "As an architect, you design for the present, with an awareness of the past, for a future which is essentially unknown."

2.3.4 Norman Fosters Reichstag

The Reichstag Building in Berlin, for example, is a full reconstruction through a deep respect of history. The new building is characterized with a glass dome addition, which symbolizes rebirth and political transparency. In early discussions about the transformation of the Reichstag, the theme that emerged most clearly was that it should be publicly accessible and “transparent,” both literally and symbolically – the resulting cupola of metal and glass is a very tangible expression of democracy. The main chamber of parliament is visible for all to see. Public and politicians meet and interact; they can see and be seen. This notion of glass as expression of democracy appears again and again in Foster’s work.

New York's Hearst Tower is another example of Foster's preservation and adaptive reuse projects. Foster redesigned the historic building with new materials and a new emphasis on sustainability. The Hearst Tower was the first building in New York that achieved the LEED Gold standard.

2.3.5 Advanced Technology

For Foster, "The history of architecture is the history of technology… And you can't separate technology from the humanistic and spiritual content of a building." Foster adopts the most cutting-edge technology available to architecture. He explores the science of materials and the aesthetic relationship between science, industry, and art. Yet, Foster takes technology as a means, not an end. For him, "The ends are social and always have been."

“Architecture is an expression of values.” a headlining quote by master architect Sir Norman Foster in a interview with The European Magazine.

The article makes for a good read, philosophically spanning how architectural design changes over time to accommodate changes in technology to how it communicates a city's past and present character. The conversation also touches on widely increasing efforts toward sustainability and the pervasive human fascination with "bigness" in architecture.

2.3.6 Sustainable architecture and examples of biomimetic design

Sustainable architecture: taking a leaf out of nature's book

Norman Foster's "Gherkin" is a striking 200-meter-tall office building that first pierced London's skyline over a decade ago. Clad in 24,000 m2 of triangular glass panels, the skyscraper stands out not only for its distinctive design but also for its energy efficiency. Taking inspiration from a sea sponge to dramatically increase structural strength and reduce energy requirements, engineers constructed open shafts between each floor to ventilate the building and allow passive heat and sunlight to penetrate deep into the building. The edifice consequently consumes just half the energy of a traditionally-built tower of similar size. Yet despite society's increasing awareness of the need to save energy, the Gherkin and similar buildings with energy efficiency embedded in their design – like passive and zero-carbon homes – still represent a tiny fraction of new construction.

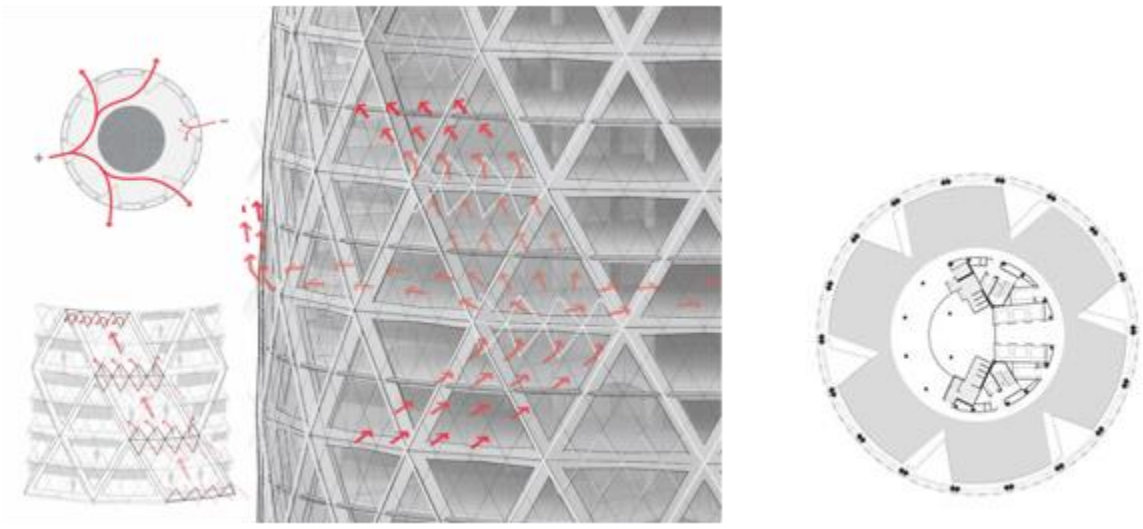


Figure 2.b; Norman fosters gherkin building design

Source lianaxiong.com

Around 40 per cent of all energy is consumed by buildings, which in turn account for one-third of all greenhouse gas emissions. Modern commercial and public buildings are sealed, artificially-lit containers, heated in winter, air-conditioned in summer. Winter heating requires substantial amounts of electricity, but air conditioning is equally energy intensive. Pumping hot air from trapped sunlight accounts for as much as half of a building's summer energy consumption and can even create the heat island effect that raises an entire city's temperature by up to 12°C.

Foster's earlier designs reflected a sophisticated, machine-influenced high-tech vision. His style has evolved into a more sharp-edged modernity.

In 2004, Foster designed the tallest bridge in the world, the Millau Viaduct in Southern France, with the Millau Mayor Jacques Godfrain stating; "The architect, Norman Foster, gave us a model of art."

In 2007, he worked with Philippe Starck and Sir Richard Branson of the Virgin Group for the Virgin Galactic plans.

Foster worked with Steve Jobs from about 2009 until Jobs' death to design the Apple offices, Apple Campus 2 now called Apple Park, in Cupertino, California, US. Apple's board and staff continued to work with Foster as the design was completed and the construction in progress. The circular building was opened to employees in April 2017, six years after Jobs died in 2011.

Foster currently sits on the Board of Trustees at architectural charity Article 25 who design, construct and manage innovative, safe, sustainable buildings in some of the most inhospitable and unstable regions of the world. He has also been on the Board of Trustees of the Architecture Foundation

.

2.4 Design exemplar(s)

Hansen Yuncken K2 apartments by Otto Yunken and Lauritz Hansen

Otto Johannes Wilhelm Yuncken was born in Lyndoch, South Australia on 22 June 1865. He trained as a carpenter under his German-born cabinetmaker father. Together they undertook simple building work throughout the Barossa Valley before Otto left home at the age of 18 to move to Port Adelaide.

In 1885 he moved to Melbourne, found lodgings in Richmond and began working with Clements Langford, one of the city's major builders of that period. During his employ he honed his skills studying at the Working Men's College attaining first class in architectural drawing in 1888 and carpentry in 1889 and 1891.

In 1918 he left Clements to start a partnership with Lauritz Hansen. Formed with a handshake and a short one-page agreement, this partnership led to the creation of some of the nation’s most iconic buildings. This partnership was the beginning of the firm Hansen Yuncken, which built some of Melbourne's most memorable buildings, including the Collingwood Football Club Grandstand, National Bank in Collins Street and the Port Authority building in Market Street. Both were driven by a hunger to construct a better world.

In 1929 Otto devised an innovative suspended scaffold to replaster the domed ceiling at the State Library of Victoria. Other projects included the United Kingdom Hotel in Queens Parade, Clifton Hill (now a McDonald's),

The company is still going strong today, having completed Australia's first six green star office building in 2006, the Melbourne City Council's CH2 on Little Collins Street. A century later, with thousands of projects completed, 600 staff across nine offices, and annual turnover exceeding $1 billion, the company has never lost sight of that original drive for a better way of doing things.

Company profile

Hansen Yuncken is a national Australian construction company, founded in 1918. The company claims to have completed over 4500 projects, and has managed the construction of several Australian landmark buildings

Since 2006, the company has specialized in sustainable architecture, completing Council House 2 in Melbourne, the world's first 6-star green building, K2 apartments, public housing in Windsor, Victoria and SA Water's headquarters in Adelaide.

The company is engaged in the delivery of PPP projects across Australia, including NSW Schools I PPP, SA Police and Courts, Orange Hospital, Monash University School of Pharmacy PPP and NSW Schools II PPP and SA Super Schools.

In 1925, the company opened a regional branch in Shepperton, Victoria. In 1937, Hansen Yuncken expanded into Hobart, Tasmania, then in 1939 an office in Adelaide, South Australia. The late 1960s saw the opening of its Northern Territory office. The company also operated an office in Queensland in the early 80s.

A permanent presence was maintained until 2000, at which time it was decided to target only the larger projects in the region. In 2006 Hansen and Yuncken opened an office in Newcastle to serve the Hunter Region. Since 2006, the company has specialized in sustainable architecture, completing Council House 2 in Melbourne, the world's first 6-star green building, K2 apartments, public housing in Windsor, Victoria and SA Water's headquarters in Adelaide. in 2007 a branch was started in Cairns and in 2009 they opened an office in Townsville.

In 2010 the grandson of Lauritz Hansen, Peter, announced his retirement as chairman of the company. Peter Hansen's son Richard was due to take on a greater management role and in the same year Hansen Yuncken was named Australia's Private Business of the Year in BRW Magazine (Business Review Weekly), for companies with more than $100 million turnover. The company also ranked 27 on BRW's 2010 list of Top 500 private companies in Australia.

2.4.1 K2 apartments Australia

The K2 Apartments project is a sustainable development. The sustainable apartments located in Windsor, Victoria, Australia by Hansen Yuncken features passive solar design, recycled and sustainable materials, photovoltaic cells, wastewater treatment, rainwater collection and solar hot water. Efficiency over the entire Life cycle of a building is the most important single goal of sustainable architecture. Architects use many different techniques to reduce the energy needs of buildings and increase their ability to capture or generate their own energy

The K2 Apartment block resulted from a competition run by the Victorian Office of Housing. The goal was to design a public housing development that would use only renewable energy, have a lifespan of 200 years and reduce water use by 50% compared with similar sized developments. About 150 people live in the K2 Apartments, in 40 one-bedroom and 56 two-bedroom units.

Each of its four buildings orients east-west, with heights calibrated for maximum winter sun access. Façade and roof pods are profiled and angled to optimise solar panel placement and shade the levels below.

Figure 2.c; K2 apartments by Hansen and Yuncken

Source: www.google.com

Equipped with rainwater harvesting, grey water reuse, solar water heating and photovoltaic panels for power, compared to a standard apartment, each K2 Apartment uses:

55 per cent less mains electricity,46 per cent less mains gas,53 per cent less mains water

The four buildings that make up the project are linked by a green spine that not only creates shared and private courtyards for the residents, it also encourages a communal awareness among the tenants, and promotes the sustainable functions of the building. The northern aspect features sun-loving balconies and solidwalled bedrooms, while on the more sheltered southern aspect, an opposite construction comes into play: the walls promote circulation, and feature integrated privacy screens instead of solid thermal-mass construction.

In Summer, cross ventilation allows for optimum cooling, although minimum ventilation during the day allows the apartments to retain cool air, so that warmer air can rise and escape at night through open windows and ventilation fans. In Winter, this same thermal mass helps to retain warmth within the development: a sustainable way to cut back on heating needs and, of course, increase comfort levels for the residents of each apartment.

Windows are ample and double-glazed to retain heat on the sunny northern aspect; and are otherwise limited on the south, east and west façades, to prevent midwinter heat loss.

The K2 Apartments have the technology to keep on selfsustaining – and, subsequently, sustaining the environment and the inhabitants – for as long as the sun may shine and the rain may fall

A $31.2 million apartment complex in Windsor shows the way for cutting edge environmentally sustainable design, the development, at a former Royal Victorian Institute for the Blind site in Raleigh St, consists of 96 modern apartments in four medium-rise buildings of four, five and eight storeys, linked by a unique green spine.

The many green features in this design delivers savings to tenants through lower energy and water costs and multiples benefits to the environment through lower greenhouse emissions. The design reduces energy consumption through the use of photovoltaic cells and solar hot water panels, as well as its east-west orientation, which maximizes winter sun and minimizes summer sun.

An increasing number of public housing tenants, are now contributing to a culture of sustainability and environmental awareness.

The building has an extensive water recycling feature. Rainwater is collected from all roof surfaces, stored, sterilized and pumped to two domestic hot water plants to supplement the building's hot water supply. Recycled water is also used for toilet flushing and irrigation of the building's gardens. environmentally friendly materials, such as timber from sustainable sources, have also been used in the construction.

The development complements other green housing initiatives introduced by the Government, including the requirement for all new housing to be five-star energy efficient, and the solar initiative that is providing solar-powered hot water to over 10,000 public housing tenants. The Residents are mostly locals with low- or middle-class incomes who meet public housing eligibility criteria.

2.5 The Design process to be adopted

Every design process is unique, and this generic step-by-step guide to the design process is indicative only. The number of steps varies depending on the complexity of the project

- Preliminary research

This first step is explained in detail in Preliminary research, which covers: examining your current home, developing your design brief, deciding your baseline budget

- Site analysis

Visit the site do a ‘SWOT’ analysis (strengths, weaknesses, opportunities and threats). On the site, also consider: climate responsive design and site-specific variables, orientation, solar access views, overshadowing by landforms, trees and buildings, slope, access and transport services (power, gas, phone, water, sewer).

- Generate a Concept design

Concept design is the first true design stage. It is the creative response to the project brief for the preferred option. Options, opportunities and constraints, and then separating to carry out more detailed assessment.

At the end of the stage, a concept design report should be made which records the basic design concepts for the preferred option. The project brief should be frozen on approval of the concept design and change control procedures introduced. An application for planning permission might be made during the concept design stage. This is likely to be an outline planning application if made at the beginning of the stage or a detailed planning application if made once the concept design is complete.

- Design development

After choosing the concept design that best suits your needs develop the concept into a preliminary layout. More than one concept can be developed in this. The decision-making process for materials selection also progresses during this step as external and internal finishes are considered. Complete this analysis before finalizing your design and choice of construction system. Later solutions or changes may be added.

- Final design

Make your final design and selection decisions of the following matters;

floor plan and building form, construction systems, shading solutions, external finishes heating/cooling system major appliances water systems, landscape design interior design and finishes. This stage is often the greatest test of commitment. Final design is usually the single greatest threat to the environmental sustainability of your home because sustainability features are often considered ‘optional’ and eliminated in the trade-off process.

2.6.1 Example Features of green design adopted in Kenya

Strathmore Business School wing was awarded the Best Green Building Development in Africa by the African Real Estate and Housing Finance (AREHF) Academy Awards.

Figure 2.d; Strathmore school business wing

Source: archidatum.com

Figure 2.e; Solar panels incorporated in the Strathmore business school

Source: innov8tiv.com

The building is completely fitted with indoor air quality designed to meet LEED standards with optimum relative air changes controlled using evaporative cooling air units. Rain water is utilized as it is collected and channeled to an underground tank. LED lighting is connected directly to Photovoltaic Solar Louvers.Designed by Lexicon Architects, the building is oriented for the climate with the major window facades in the North and South facing walls thus preventing excess glare to the users. There is sun shading on all windows. Natural lighting and ventilation, high thermal mass walls and a natural cooling tower are among the facilities that catapult this building to the top five. The architecture employs an energy efficient building management system. Rain water harvesting, waste water recycling technologies and a permeable landscape, light colour on the exterior reflects solar radiation and reduces heat gain to the building.

Pope Paul VI Learning Resource Centre at The Catholic University of East Africa has almost all the features of a green building including an intricate cooling system with no single mechanical air conditioning system in the complex.

Figure 2.f; Pope Paul VI Learning Resource Centre at The Catholic University of East Africa

Source: buildesign.co.ke

Designed by Architect Musau Kimeu, LRC was completed and occupied in 2012. It comprises a modern conference hall, a bookshop, an extensive library and a cafeteria.

The conference hall employs an intricate cooling system where air gets in through vents located at the basement level, passes over well arranged bedrock where it cools further before being released into the auditorium through another set of vents. This is the only rock bed cooling system in Kenya. To expel foul air, thermal chimneys are located at various intervals of the building. There are oxidation ponds for sewerage.

A high-roofed atrium with a narrow plan allows natural lighting to filter through the building. To prevent heat buildup in glazed areas, concrete fins and aluminum louver screens have been used It is also oriented for the climate with the major window facades in the North and South facing walls preventing excess glare to the users.

2.6.2 Enhancing green building in Kenya

In Kenya, several new buildings owned by large corporations have embraced the idea of green development.

Green building refers to a structure that is environmentally responsible and resource efficient throughout a building's life-cycle; from siting to design, construction, operation, maintenance, renovation and demolition. The practice expands and compliments the classical building design concerns of economy, utility, durability and comfort. Green building is simply the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout a building life cycle from sitting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns and economy, utility, durability and comfort.

Whether they meet all the requirements of a green development has been debated in the media and the academic circles. The National government in Kenya took the initiative of environmental protection by enacting the Environmental Management and Coordination Act of 1999. Other legislation is not specific in environmental protection.

2.6.3 Governmental regulations/ green certification

Almost all establishments visited confirmed that there are indeed international and local green certifications for housing industry but are not really mandatory when constructing apartments or houses in Kenya. the certifications are not mandatory and have to be applied for at a fee by the participating stakeholders.

Leadership in Energy and Environmental Design (LEED)

LEED, Green Building Services and Comprehensive Building Sustainability Audit. This involves an introduction to Green building services, Energy benchmarking and the Features of LEED. Purpose of LEED to evaluate environmental performance from a whole building perspective over a building's life cycle, providing a definitive standard for what constitutes a green building in design, construction, and operation. Introduction to the LEED rating systems designed for rating new and existing commercial, institutional, and residential buildings. Organization of each rating system into 5 environmental categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. An additional category, Innovation in Design (or Operations), addresses sustainable building expertise as well as measures not covered under the 5 environmental categories.

The critical features of a sustainable building are taken to include the following;

- Low operational energy,
- Low carbon emission,
- Use of renewable resources,
- Little or preferably no waste,
- Low maintenance,
- High durability and the use of appropriate technology.

The paper further goes on to present observations and results gathered through a field survey of a commercial development in Nairobi City within the Nairobi City County in Kenya. The purpose of the field survey was to ascertain the extent and level of incorporation of the key LEED factors and the sustainable building features in the selected buildings.

Sustainable real property development discussions are growing in importance in the advent of global warming and climate change. The interest is from all sectors, from the developer, the regulators and the occupiers. From research done it is apparent that buildings have a profound effect on the environment and changes in all stages of development, however small

will have an impact on global warming. The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of all energy. Given the massive growth in new construction in economies in transition, and the inefficiencies of existing building stock worldwide, if nothing is done, greenhouse gas emissions from buildings will more than

double in the next 20 years. Therefore, if targets for greenhouse gas emissions reduction are to be met, it is clear that decision-makers must tackle emissions from the building sector. Mitigation of greenhouse gas emissions from buildings must be a cornerstone of every national climate change strategy. The world's governments can successfully tackle climate change by harnessing the capacity of the building sector to significantly reduce GHG.

2.7 Conclusion

This section of the paper concludes off by discussing the concept of sustainability and the current building ratings systems applicable in varied attempts to classify buildings and their various aspects of sustainable building operations to qualify to be labeled as green buildings. A sustainable building maximizes operational efficiency while minimizing environmental impact. It goes on to explain the various fundamental measures that are critical to incorporate in the housing industry including the Leadership in Energy and Environmental Design (LEED) launched in March 2000.

CHAPTER THREE

3.0 RESRESCH DESING AND METHODOLOGY

3.1 Introduction

This section provides a view and explanation on the research methods that should be used to conduct the research. The chapter expounds on the design process used for the research and why, the population used and how the researcher will come up/ selected a sample from the same. The section also highlights the methods of data collection; analysis and presentation that guide the research.

3.2 Research Design

A research design is a conceptual structure, map or blueprint for conducting research in terms of instruments for collection, measurement and analysis of data (Selltiz, 1962). The study uses qualitative and a case research approach in undertaking the research. The research population is the residential/housing industry in Kenya. the researcher would not be able to carry out the research in the entire industry. In this regard the population sample was selected. Data to basically be generated using interviews and observations. The data collected is to be analyzed using thematic analysis and narrative analysis. Ethical considerations are also to be considered when conducting the research.

3.3 The population target sample

Target population as described by Borg and Grall (2009) is a universal set of study of all members of real or hypothetical set of people, events or objects to which an investigator wishes to generalize the result. The target population of this study will be residents of Alsops estate while the study population shall be households, developers in charge of developments, local residing residents and business owners, and the firm managing properties within the locality of the selected area. Mugenda and Mugenda (2003) explained that the target population should have observable characteristics to which the study intends to generalize the result of the study. This definition assumes that the population is homogeneous.

3.4 Sampling method

Sampling ensured that elements of a population are selected as riding representative of the population (Keya et al, 1989). Due to the time factor and the unavailable information on the exact number of the target population, the researcher chose random sampling technique in selecting the sample representatives. According to (Cooper et.al (2003), random sampling frequently minimizes the sampling error in the population and maximizes on time consumption. This in turn increased the precision of estimation methods used. Given that the researcher cannot be everywhere at once or take every possible view point at the same time, the researcher needed to get to the general population through a sample. Owing to the nature of the study; the tenants and estate development experts (real estate valuers, physical planners and property developers) were sampled through the random method. Random sampling was used purposely to choose households within Alsops area in order to avoid cost and time implications. Simple random sampling was used to pick out single house in each neighborhood. The sample households were selected bases on development blocks created by the road network. About 15 blocks were identified which covers part of the study area. In each of the 15 blocks identified, two interviews were administered. The sample size was approximately 20 houses. The interviews were administered to a single household representing the entire developed plot. The information sought here was be to know how sustainable is the current developments within the study area. Random sampling was used to choose the estate developers within Alsops area. These developers were identified based on the notices which had been set up within the study area and through online information. About 16 developers were identified in which 8 of them were randomly chosen. Out of the 8 picked, 5 gave back their responses. The statistics obtained were then used to make inferences.

These categories of respondents were identified randomly based on the roles they have played in the housing development within the area. Property managers and estate agents were picked based on notices for letting and property sales which had been set up and advertised within the study area. The other planners and valuers were identified for Nairobi city county's reported projects within the study area. About 25 individuals were identified in which 10 of them were randomly chosen to participate in the interview. Out of the 10 picked, 7 gave back their responses. The statistics obtained were then used to make inferences.

3.5 Logical framework layout for the research

Objective 1; To establish what extent have Kenyan Housing developers adopted green design in Kenya

Data source; Document analysis and interviews

Document analysis is based on existing sources, like government reports, personal documents and articles in newspapers, books or medical records.

Data collection tool; Publications, Earlier research Records and Mass media, reports published in newspapers, magazines and other media articles

Analysis method; Narrative analysis and thematic analysis

Expected outcome; acquire information on how green design has so far been adopted and used in the Kenyan building industry

Objective 2

get to know What are the features of green design adoptable to the housing industry in Kenya

Data source; Interviews. Design professionals Observation

Data collection tool; Camera, Notebook

Analysis method; Narrative analysis and thematic analysis

Expected outcome; get relevant information on what could be done to the housing industry that would encourage embracing sustainable design more.

3.6 Data collection procedures and analysis tools

Table 3.a; Data collection procedures and tools

Objective 1: To establish what extent have Kenyan Housing developers have adopted green design in Kenya				
Data needs	Data source	Data collection tool	Analysis method	Expected output
	Document analysis and interviews	Publications, Earlier research Records and Mass media, reports published in newspapers, magazines and other media articles	Narrative analysis and thematic analysis	acquire information on how green design has so far been adopted and used in the Kenyan bulding industry
Objective 2: get to know What are the features of green design adoptable to the housing industry in Kenya				
Data needs	Data source	Data collection tool	Analysis method	Expected output
	Interviews. Design professionals Observation	Camera, Notebook	Narrative analysis and thematic analysis	get relevant information on what could be done to the housing industry that would encourage embracing sustainable design more.

Source: author,2020

3.6.1 Considerations

For the purposes of this research the ethical considerations that the researcher applied were mainly;

• Obtaining free and informed consent.

• Maintaining confidentiality and privacy of research participants.

• Right to anonymity of research participants.

• Negotiating access.

• Using appropriate methodology.

• Reporting the research appropriately and completely

Obtaining free and informed consent This is the most common method in social research. Informed consent involves making sure that the research correspondents are adequately made aware of the type of information the researcher requires from them, why the information is being sought, what purpose it will be put to, how they are expected to participate in the study, and how it will directly or indirectly affect them. Research consent from any correspondents should be voluntary and without pressure of any kind

Maintaining confidentiality and privacy of research participants confidentiality is taken to mean that identifiable information about individuals collected during the process of research will not be disclosed. It also implies that the identity of research participants will be protected through various processes designed to anonymously use them unless they specifically opt to be identified. In a case where a researcher may not able to promise anonymity, he/she can address confidentiality. This involves the management of private information by the researcher geared towards protecting the subject's identity.

Right to anonymity of research participants King and Horrocks (2010) argue that as much as confidentiality and anonymity are often taken to mean the same thing in research, they are not the same. Though the ideas are similar, they have quite different meanings that are important in relation to qualitative interviewing. They define anonymity as the concealing of the identity of the participants in all documents resulting from the research, therefore actively keeping secret the identity of the research participants.

3.7 Data presentation

The analyzed data shall be represented in the form of frequency tables, graphs and pie charts. Textual descriptions of the findings shall also be used to further explanation to the results obtained by the researcher in his field survey. Qualitative data shall be presented as narratives. Tables were preferred for presentation since they present data in an orderly manner and are easy to interpret while reducing the explanatory statements to minimum. Photographs and Google images were used to present the past and present scenarios since images help present data in a better manner and can be understood easily without the need for a lot of explanation

3.8 Conclusion

A quantitative approach was adopted for the research conducted to get to the knowing of the extent of sustainability adopted in the housing sector, sustainable literacy among the locals, uptake and assessment as key contributors to the housing industry in Kenya. The target sample was key professionals and owners of these house developments and also the tenants and locals living around these establishments. The study sought to get their perspectives on aspects of sustainability literacy, uptake and assessment using structured oral and written interviews. The obtained raw data was entered into excel word program for descriptive statistics analysis. The sample households were selected bases on development blocks created by the road network. 15 blocks were identified which covers part of the study area. In each of the 15 blocks identified, two interviews were administered. The sample size was approximately 20 houses. About 16 developers were identified in which 8 of them were randomly chosen. Out of the 8 picked, 5 gave back their responses. About 25 individuals were identified in which 10 of them were randomly chosen to participate in the interview. Out of the 10 picked, 7 gave back their responses. The statistics obtained were then used to make inferences presented in the next chapter.

CHAPTER FOUR

4.0 SITE ANALYSIS AND INTERPRETATIONS OF FINDINGS

4.1 Introduction

Findings In this section the paper presents observations and results gathered through a field survey of some commercial developments within Nairobi City, Nairobi City County in Kenya. The document analysis and research were conducted based on non-Kenyan codes, that is the LEED Green Building Rating System (USGBC) and government regulatory bodies in the housing or construction industry in Kenya.

The purpose of the field survey was to ascertain the extent and level of incorporation of the key LEED factors and the sustainable features in the selected buildings. The building that was chosen for this study was an apartment located in Ngara Nairobi. Observations were made to see how sustainable the building is.

The discussions on the findings is made in the following paragraphs.

4.2 Qualitative Analysis

4.2.1Findings and data analysis

Overview

In this chapter the findings were based on respondents from the building suited in Ruaraka the researcher discusses the overall details of the respondents at different sections and in answering the research questions and meeting the objectives of the research the researcher discusses the findings. The chapter presents the analysis, interpretation and discussion of data obtained from the researcher's interaction with tenants, locals and apartment owners, conducted interviews and observations made with a view to drawing conclusions and recommendations to the study. The specific areas of interest covered in the study included adoption of green building concepts, the extent of their adoption, the challenges hindering their uptake and the strategies that can be put in place to promote their uptake

.

4.2.2 Details of the respondents

For the purposes of this research, the researcher engaged tenants and residents located in the building and senior staff members in the establishment. Neighboring locals' residents also formed part of the correspondents below. The respondents comprised of two (4) staff members and an average of four (8) tenants from each of the formed a group. From the guests interviewed approximately fifty eight percent (58%) were neighboring tenants or had businesses that operate near the apartments

4.2.3 Location

The location of the development was another concept considered as important in sustainable property development. The criticism against the site was that the location and its accessibility for non-tenants or the researcher in this case.

The site was located in Allsops which is in Ruaraka county. The apartment premises are directly off the outering road which is along Thika super highway

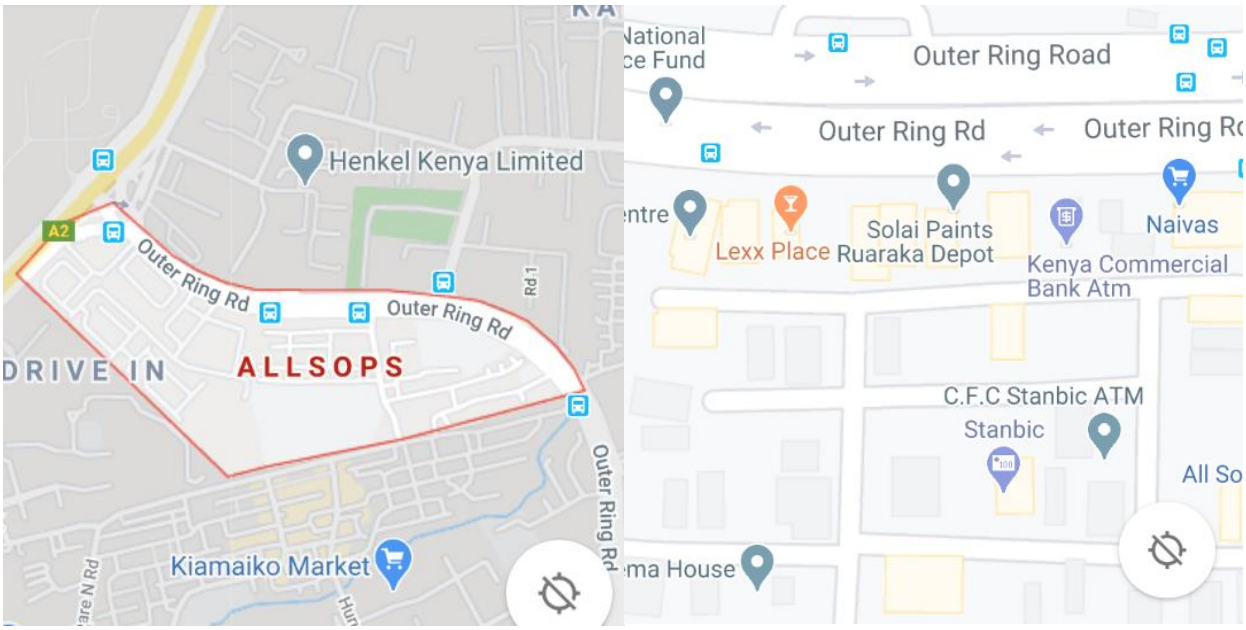


Fig 4.a; Alsops area map

Source: Google maps

The site in consideration was a one bedroomed apartment located on the first floor of the Solai apartment. This study focused on most, if not all rooms located in the house which include most parts of the living room, bedroom, kitchen area ,bathroom and balcony area.

4.2.4 SWOT Analysis

This section includes a detailed SWOT analysis of the residential apartment in question of the research

Table 4.1; SWOT analysis of site

SWOT ANALYSIS OF SITE	
STRENGTHS • lively and warm colors, orange and white • room orientation which allows for good lighting from outside • spacious enough to fit ones needs and desires • generally good circulation of air due to the balcony in the living room and the windows	WEAKNESS • walls have been painted with oil-based paints which are rather toxic and non eco friendly • no concepts of sustainability are in place in regards to energy, water conservation and also materials present in the site such as furniture and usable utensils • poor water conservation measures as it can sometimes be in scarcity
OPPORTUNITIES • improvising of better eco-friendly concepts such as, water conservation measures, use of non-oil-based concepts, etc. • re adjusting of the overall plan layout for a more appealing outlook • better use of eco-friendly materials in both the architectural and furniture areas	THREATS • water scarcity is a rather huge problem • high energy use especially during different seasons of the year • residents and surrounding locals are highly contributing to the overall environmental degradation

Source: author,2020

4.2.5 Site Outlook

The residence is evident with lively and warm colors, orange and white, as they form most parts of the living room and some parts of the bedroom

Figure 4.b; Interior walls 1 of space

Source; author,2020

Part of the living room is painted in a white creamy oil-based paint. This works perfect with the lighting conditions during daytime since it easily reflects light to other places inside the space. A good white room always meets three demanding criteria: They must have good light, harmonized proportions and a few attractive objects artfully arranged. Oil-based paints have an inherent sheen and gloss in them. Oil based paints usually require a single or at the max two coats to cover the wall surface. The disadvantage with these paints is that the sheen might actually accentuate the defects of the wall instead of concealing them.

However, some of the disadvantages of Oil-based paints are they contain a higher percentage of VOC's thus making these toxic and non-eco-friendly in nature. But certain brands have started coming up with solutions for oil-based paints, which are less harmful. Also, the oil-based paints are susceptible to cracking and tend to peel off from the wall surface too as seen in certain areas mostly with water related surfaces such as sinks, bathrooms and kitchen areas

Figure 4.c; Wall blemishes and discoloration

Source; author,2020

Orange can be one of the zippiest colors. Orange shares the attention-grabbing effect of red without as much aggressiveness. And it has many moods: It can be calming (peach) or earthy (pumpkin). Most oranges are warm, meaning they contain red or yellow, which gives them a friendly inner glow. A red orange like on the wall here feels graphic, so it works well with sleek furniture nicely contrasting with dark, rustic pieces.

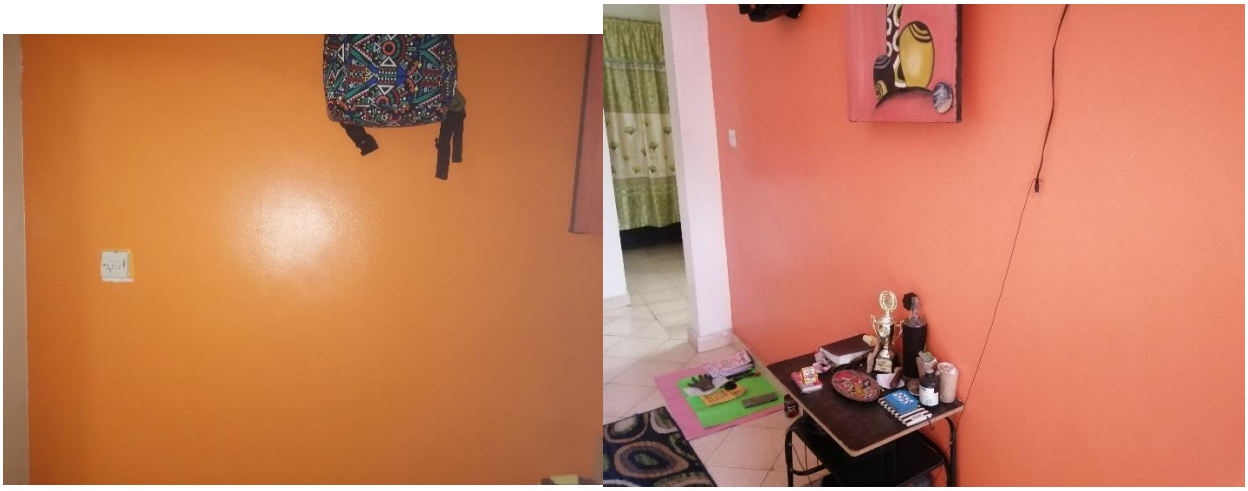


Figure 4.d; Interior walls 2 of space

Source; author,2020

The wall coloring in the apartment also works perfectly for artistic displays which also compliment with the walls to give an overall cool look and adds appeal to the existing space

Figure 4.e; Existing wall hangings on space

Source; author,2020

The living room space has a rather well distributed furniture plan and arrangement citing two chairs, one made of wooden pallets and the other one a 2-seat sofa made of grey soft fabric also a coffee table and a stand right in front of the orange wall that acts as a mini storage area.

The table like stand is basically made of wood material on the top coupled with some plastics and metal on the sides and the bottom.it is black in color

Bamboo is a popular choice in the making of most household furniture's, when the interior needs adding a bit of natural warmth and a rustic flair.it makes it easy to furnish any interior and promote coziness. This is the case with the coffee table which features a glass top and construction made of bamboo at the bottom which is closely interwoven together to support the tables weight. Its original design is a perfect addition to the living room which requires some freshness. Additionally, it's strong and durable.

Figure 4.f; Wall stand and coffee table

Source; author,2020

Wood pallets, used to transport freight and goods, are often discarded after the merchandise is delivered. You can upcycle these discards by creating cool, modern furniture pieces as the home owner has done. Pallets can often be found for free on the side of the road near industrial sites, at your local recycling center or by garbage dumpsters.

What's exciting about wood pallets is the many uses for them They're usually made of pine or other softwoods, although it's not unusual to find some made from oak or maple. They are sturdy, since they were designed to hold hundreds of pounds of weight. And some look aged and rustic, which is the perfect medium for your pallet furniture ideas and projects. The trend is big in Europe, and you're likely to find a pallet hiding somewhere in even the most upscale homes.

Figure 4.g; Wooden pallets stacked as seats

Source; author,2020

The sitting cushions are fitted with the green Maasai Shuka cloth is affectionately known as the "African blanket" and is worn by the Maasai people of East Africa. The Maasai identity is often defined by colorful beaded necklaces, an iron rod (as a weapon) and of course, the Shuka cloth. While red is the most common color, the Maasai also use blue, striped, and checkered cloth to wrap around their bodies. It's known to be durable, strong, and thick.

The pillows have tribal patterns and colors which compliments the Maasai Shuka and blends in together.as seen the wooden pallets are stacked together in a systematic way, two at the bottom in order to make the average chair height and one at the back that acts as the support and also a resting surface

The second chair is mainly made up of wood or a wooden frame covered in a soft grey fabric which rather blends in with the overall white colored wall that is right behind it.the cushion or seating area is also covered by the Maasai Shuka, which is red in color

Some of the other pieces of furniture which are in the apartment include a 4 by 6 mahogany bed, a plastic shoe rack which are located in the bedroom and corridor respectively

Figure 4.h; Existing sofa seat

Source; author,2020

The home owner has also improvised with his own storage facility for bags, a metal made stand which is white in color that is placed right below the window in the living room. The stand is not as big and does not take much of the space that's in the room. Citing that its white in color it also does no take away from the appeal created by the white walls. Taking in regards that the owner is a bag and fashion designer it is only needed that they have some extra space for storage or even for display due to their line of work

Figure 4.i; Bag storage stand area

Source; author,2020

Other storage areas found in the site include kitchen counter storages and a closet that's located in the bedroom area

Figure 4.j; Bedroom closet Source: author,2020 **Figure 4.k; Kitchen storage area**

Source: author,2020

lighting and ventilation

As far as indoor environment is concerned there is natural lighting and ventilation for the building. The natural lighting and natural extraction of foul air is important for the wellbeing of residents. It was however noted that circulation of air on the houses located in the middle seems inadequate because the design did not provide for space for a balcony or extra windows. The other aspect of the building that was criticized for was that the second glazing did not allow a good view of the outside.

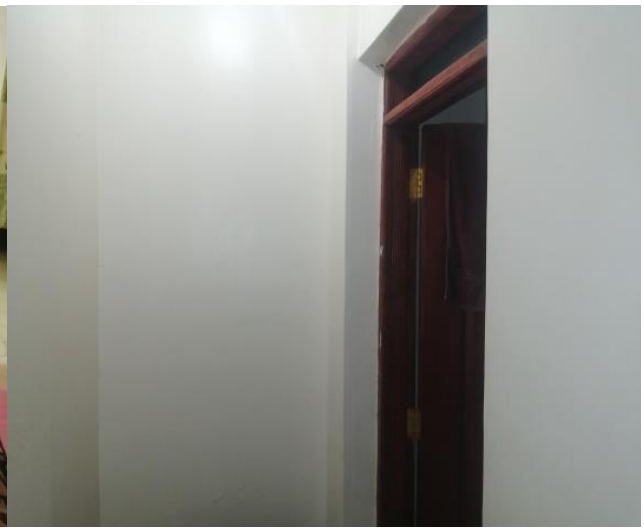


Figure 4.l; Living room space Source: author,2020 **Figure 4.m; Corridor area**

Source: author,2020

The key principle here is the provision of a healthy, comfortable and productive indoor environment for occupants and visitors. It was established that the location allows a lot of light into the building and also assists in the general circulation of fresh air

inclusion of other lighting materials or pieces such as a lamp of artificial wall lights could also be added to improve on some of the lighting features mostly during night time

the flooring of the apartment is mostly tiling which are evident in every room of the apartment apart from the bathroom and washing area.

4.3 Quantitative analysis

Results and Discussion

It was established that only a few developers are constructing eco-friendly structures. Green buildings, which are geared towards efficiency and sustainability throughout their life cycle, have failed to win the attention of local developers – most of whom argue that buyers are unwilling to pay the true cost of green homes.

"Green building is yet to be profitable (in Kenya) since the cost of putting up an eco-friendly structure is exorbitant,", a local contractor, who adds that the government has failed to offer incentives for developers who are willing to go green. Aspects of green buildings including the ability of structures to tap;

- solar energy,
- use of natural flow of air,
- use of natural light,
- harvesting of rain water

the government should also offer tax subsidies and incentives to importers of materials used in the construction of green buildings, with several banks over its proposal to have them provide green mortgages and construction loans at lower interest rates than current market rates for investors who wish to put up eco-friendly buildings.

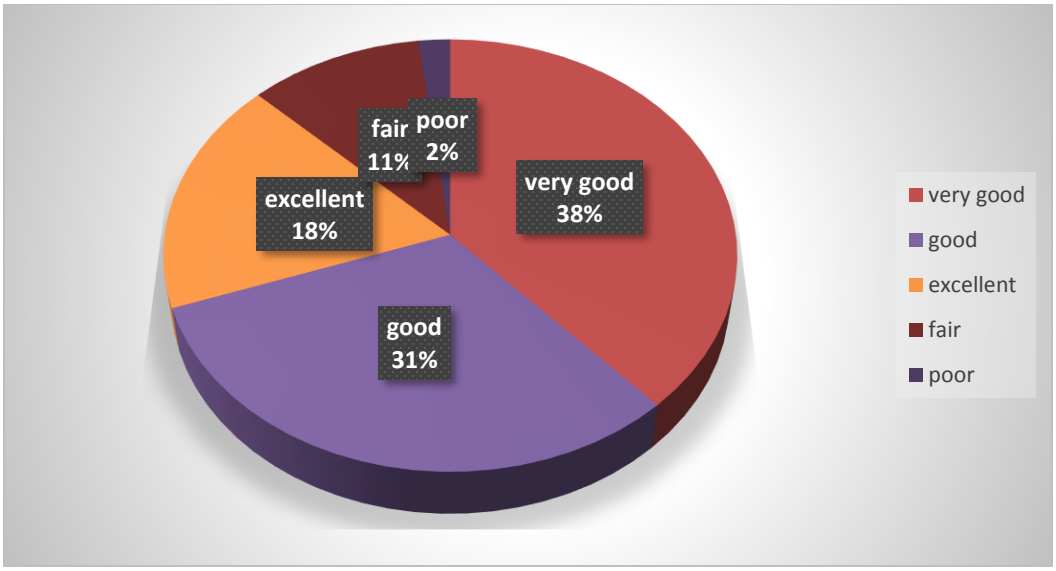
4.3.1 Bio-data of Respondents

The analysis on the demographic factors of the residents revealed that a greater percentage (37%) of the respondents are from the locality, male (51.58%) and between the age range of 20-50 years old, female (85.26%) and age range between 20-50.

4.3.2 Knowledge of Green Building

The locals were requested to quantify their level of knowledge on green building and its principles. Chart 4.1 depicts their responses

Chart 4.1.a green building knowledge



Source: Field survey,2020

Residents were also asked on the Perception on the Adoption of Green Building Principles. The variables used were based on the recommendations of the BREEAM and LEED. The analyses show their responses.

- On Livable communities; a green community is good and secure, has affordable and proper long-term results if efficiently placed and monitored
- On Energy efficiency; its better if one uses less energy to perform the same task e.g use of a compact fluorescent bulb than a traditional incandescent bulb, well located windows that aid ventilation
- On Indoor Air Quality (IAQ); The quality of indoor air within the vicinity is healthy and comfortable for residents and local business owners too
- On Resource conservation; Valuable resources such as trees, minerals, wildlife, water and others should be ethically used
- on Water conservation; There isn't any adequate preservation, control and development of water resources in and around the building

The analysis reveals locals view on adoption of green principles in building.

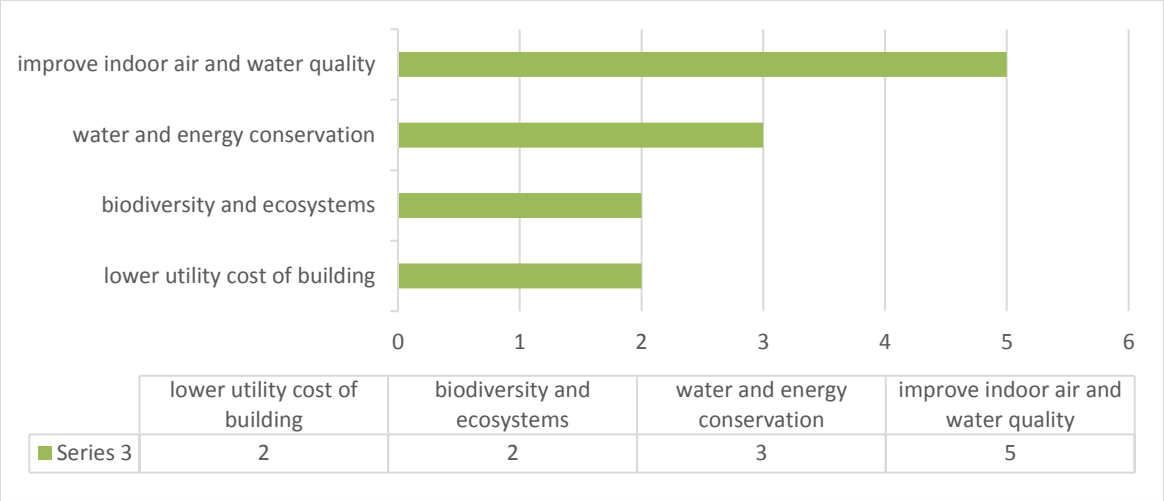
The locals strongly agree that more can be done by the owners of the buildings and also the community at large in order to incorporate a eco-friendlier working and living environment. Also, they agree that the adopt the principle of energy efficiency. However, they are not sure of the extent to which the buildings adopt the principles of indoor air quality

Views on the Gains of Adopting Green Principles in Buildings

- There will be a Reduction in pollution and environmental degradation
- Energy efficiency & water conservation will be highly utilized
- Improvement on the indoor air and water quality
- It will lead to better Protestation on biodiversity and ecosystems
- There will be a Minimized strain on local infrastructure
- Better protection of residents' health and comfort
- Improved quality of life
- Will act as a standards setter for future designs and constructions
- Facilitation of a culture of best practice sharing
- Reduction on overall operatorial cost
- Improvement in the occupants' productivity
- Will Lower utility cost of building

The results indicate the resident's perspective on the gains of adopting green principles in buildings. From the analysis, the five major gains were: to improve indoor air and water quality, to reduce pollution and environmental degradation, to conserve energy and water, to protect biodiversity and ecosystems and to lower utility cost of building. However, they are not convinced that adopting green building can minimize strain on local infrastructure and set a standard for future design and construction.

Table 4.2; sustainability gains



Source: Field survey,2020

Here are the locals and building owners Views on the Obstacles to Adopting Green Principles in Buildings within the locality;

- There's an Enormous price tag of green building technology
- Ignorance on expert knowledge and mastery on green buildings
- Ignorance on green building principles and merits
- Green technology in building is time consuming
- Resistance to change from the use of traditional principles/absence of interest
- Complex and strict requirements involved in adopting green standards in building
- Ignorance on green building principles promotion by government
- Risk and uncertainty involved in adopting green building principles
- Ignorance on demonstration projects
- Ignorance on information on green building principles
- Conflicts of interests among various stakeholders in adopting green building
- Ignorance on importance attached to green building principles by management of residences.

The research reveals what researcher identified as obstacles to adopting green principles in buildings within the locality. ignorance on green building principles and their benefits ranked 1st

with enormous price tag of green building technology and ignorance on expert knowledge and mastery on green building ranked 2nd with, ignorance on green building principles promotion by government and ignorance on importance attached to green building principles by management ranked 4th

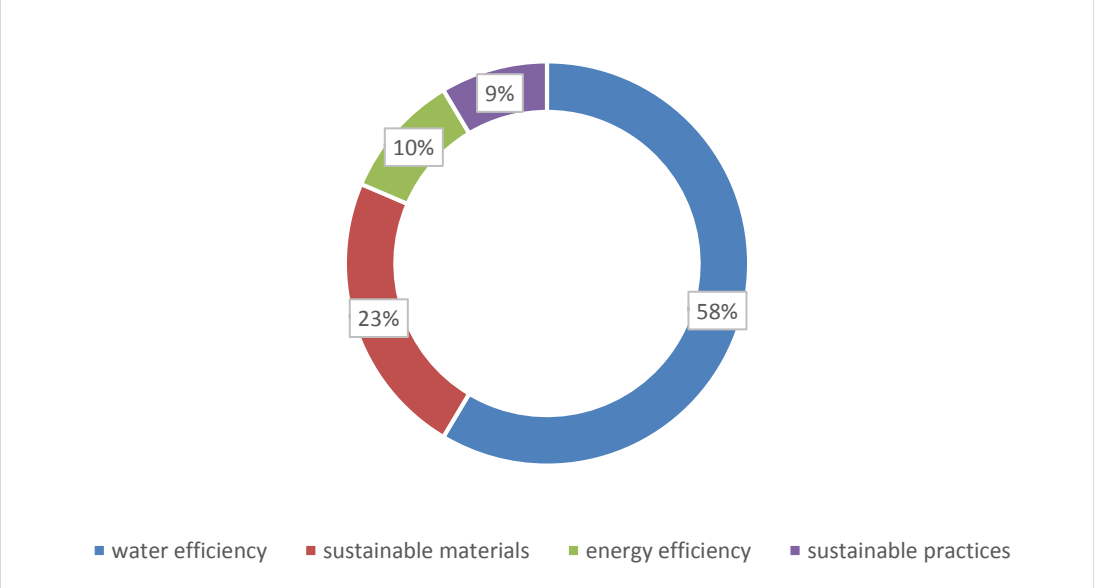
4.3.3 Extent of Adoption of Green Building Concepts

One of the objectives of the study was to investigate the extent to which green building concepts had been adopted within the commercial building with a view to determine the challenges faced by practitioners and developers in the adoption of these concepts. To investigate the extent of adoption, the green building concepts were grouped into five environmental categories namely water efficiency and conservation, energy efficiency, choice of site, material and environmental quality. The participants were initially asked if they were aware of the green building concepts and whether they had incorporated them in their projects(owners). Below are their responses on both awareness and incorporation of the concepts.

4.3.4 Awareness and Incorporation of Green Building Concepts in Projects

The study revealed that the professional and the practitioners in the sampled buildings were aware of the green building concepts under the five environmental categories. Water efficiency had the highest percentage of awareness at 77% whereas awareness on sustainable materials was 50%.

Chart 4.1.b; awareness and incorporation of green building concepts



Source: Field survey,2020

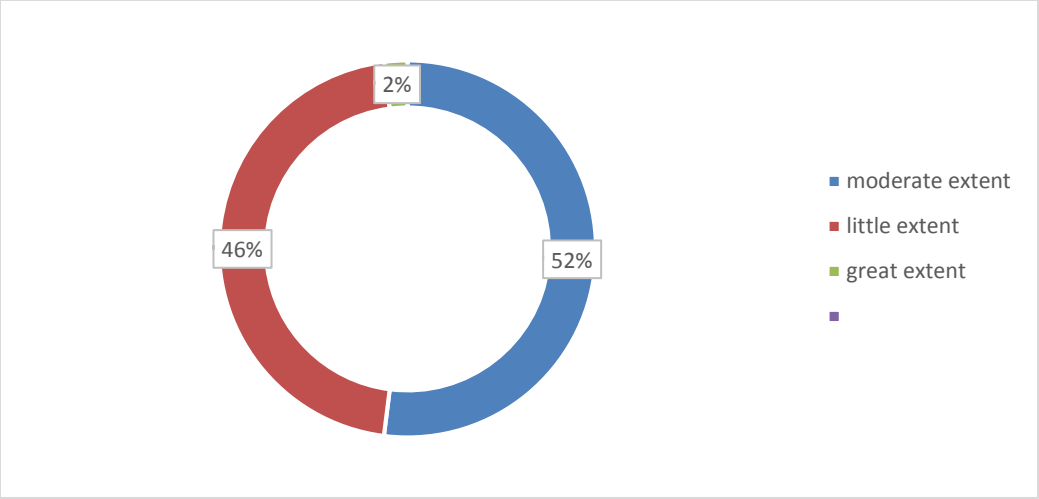
The study further revealed that 53% of the consultants and the practitioners in these buildings had incorporated some of the concepts in the projects they were involved in during the last 5 years. This was further confirmed during interviews with green buildings consulting firms who indicated that practitioners were aware and had incorporated the green building concepts in some of their homes. Other than the interviews, it was observations that various concepts such as rain water harvesting among others had not really been incorporated in some projects. The high scores in both awareness and incorporation of the concepts shows that the consultants and practitioners were in a position to indicate the extent they had incorporated the green building concepts in the homes.

4.3.5 Extent of adoption – Water efficiency and conservation concepts

The study sought to find out the extent to which water efficiency and conservation concepts had been incorporated in the commercial building, it was revealed that water and conservation concepts had been applied to a moderate extent, mostly through water storage tanks that are located at the roof top of the building. 46% of the respondents indicated that the concept had been applied to a little extent, 52% to a moderate extent while only 2% indicated a great extent.

These results indicate that the level of incorporation of efficiency and conservation concept in the sampled buildings was 46%. It was also observed that the building had installed water sub meters. it was revealed that the use of water sub meters had been incorporated to a great extent, rain water harvesting had been incorporated to a moderate extent, whereas water recycling was to a little extent. 60% of the respondents included use of bore holes as alternative source of water; this was observed during inspections of the buildings and it was noted that boreholes had been sunk in or around the buildings. One possible reason why the use of water sub meters had been incorporated to a great extent is that tenants prefer to have their own water bills for purposes of monitoring and control than paying a fixed amount incorporated in service charge. Sub metering is one of the ways that are used to monitor use of water in commercial buildings. The study suggests that sub metering offer incentive for cost savings that can only be realized by making water users aware of their consumption habits and linking their water bills to actual rates of consumption. In this study however it was observed that commercial buildings did not leave open spaces for landscaping. One of reason therefore why recycling of water was incorporated to a little extent

Chart 4.1.c; water efficiency and conservation concepts

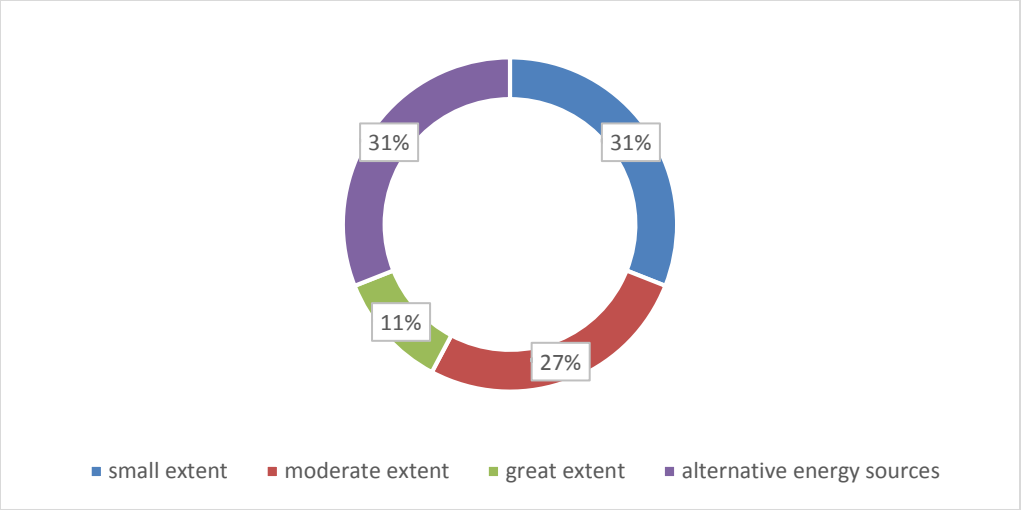


Source: field survey,2020

4.3.6 Extent of Adoption - Energy Efficiency

The study sought to establish the extent to which energy efficiency concepts had been incorporated in the commercial building, it was revealed that energy efficiency concepts had been applied to a little extent. 44% of the respondents indicated that they had applied the concept to a little extent, 38% to a moderate extent whereas only 16% had adopted this concept to a great extent. These results suggest that alternative sources of energy were not used or were used to a little extent (44%) in the sampled buildings.

Chart 4.1.d; energy efficiency adoption



Source: field survey, 2020

In the concepts, the study revealed that the use of alternative sources of energy such petrol, gas, charcoal, etc. was applied to a little extent; whereas the incorporation of energy conservation measures was applied to a moderate extent. The little extent of adoption of use alternative energy sources could possibly be attributed to lack of other stable sources of electricity supply other than the supply from the national grid; this is coupled with the fact that the initial cost of installing alternatives like solar panels and photovoltaic technology are very high except with increased volume of installed capacity. Reports from Kenya power indicate that electric energy is still the most reliable source of energy compared to other sources in most parts of the country. (KPLC, 2012).

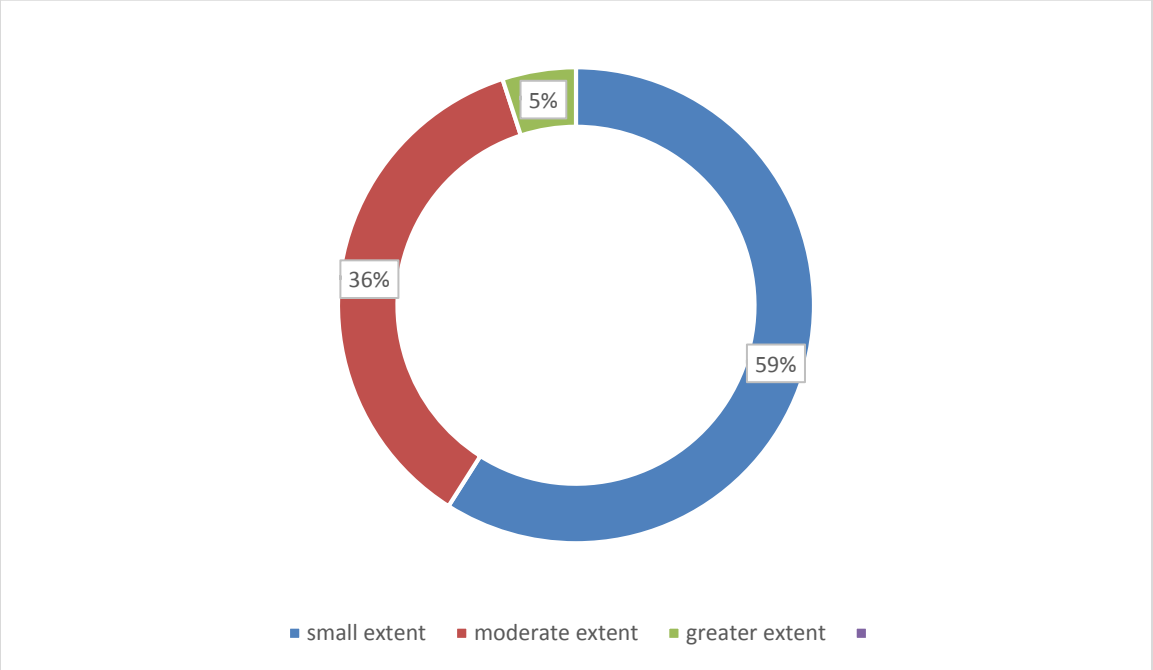
Other studies indicate that standby generation using generators are only used during black outs to avoid extra ‘peak demand’ whereas charcoal and gas are commonly used in hotels and business. The findings that the use of alternative sources of energy is applied to a little extent therefore concurs with other previous studies that commercial buildings rarely use other alternative sources of energy other than electricity especially because of complex demand for cooling, heating and lighting. Past studies suggest that conservation measures like smart meter that monitor how energy is used and light control sensors are measures that can go a long way to conserve energy. Even though the study revealed the use of meters in the buildings was to a moderate extent, it was noted that there was no particular metering on the equipment and other electronic gadgets in the buildings.

Metering equipment provides users with information on real time consumptions and has proved effective at reducing overall electricity consumption. These findings are also in line with the observation made during the study where it was noted that there was use of compact fluorescent lamps (CFLs) for lighting spaces as opposed to incandescent lamps. CFLs as noted in the literature review are known to consume less electricity than the ordinary lamps.

4.3.7 Extent of adoption – Sustainable sites

The study sought to establish the extent to which the concept of sustainable site had been incorporated in the commercial building; it was revealed that the concepts had been applied to a little extent. 59% of the respondents indicated that they had applied the concept to a little extent, 36% to a moderate extent whereas only 5% had applied the concept to a great extent. Figure 4.7 and table 4.3 shows the extent to which the concept of sustainable site had been incorporated in the commercial building.

Chart 4.1.f; sustainable sites



Source: field survey,2020

These findings indicate that adherence to the local zoning requirements, site landscaping, and preservation of existing vegetation and management of storm water are concepts which are not considered at either during design and construction or during building occupation and concurs with findings by Tesserae, et al (2010) and Adebayo (2000). Adebayo (2000) argues that many urban areas of Africa especially in cities the construction of buildings occupy the entire site with total disregard to natural environment.

In the four concepts of sustainable site, the study revealed that adherence to local zoning was the most incorporated concept with the least mean of whereas site landscaping and preservation of existing vegetation were the least incorporated concepts with a mean of and respectively. Incorporation of the concept of adherence to local zoning requirements to a great extent can be attributed local authority strict enforcement requirements for most of the areas. According to the Nairobi City County government, approvals cannot be granted if a plot has not been developed according to its intended use in the title.

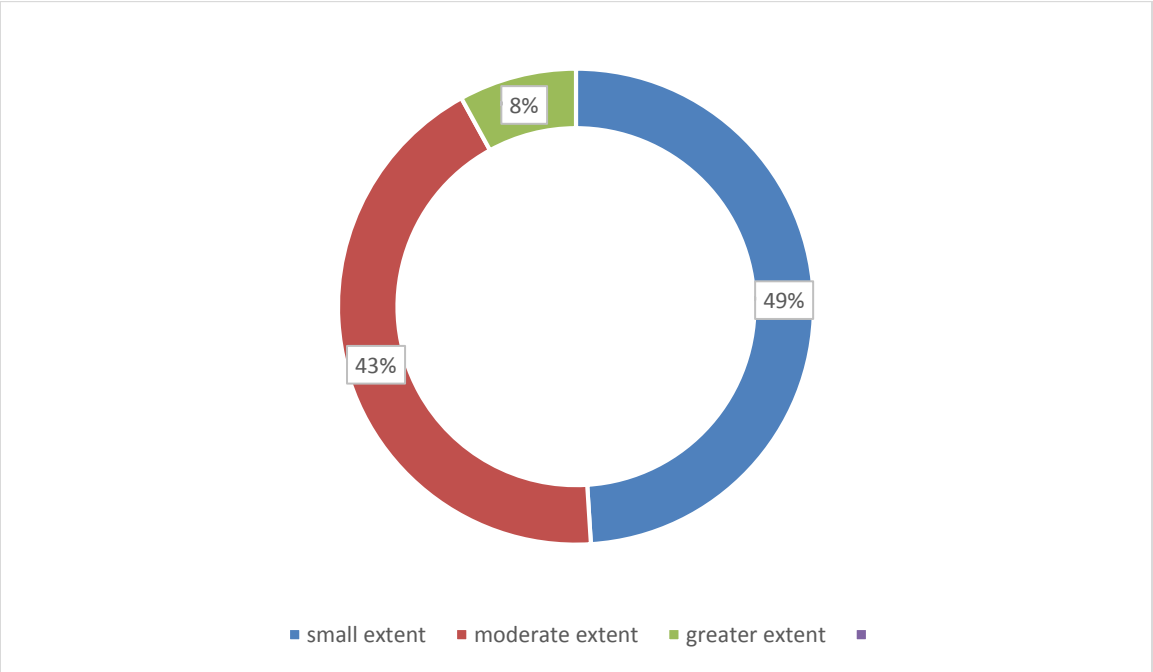
The approval manual indicates plot ratios to be observed among other requirements. Even though this finding concurs with the reviewed literature that strict enforcement can improve sustainability requirements, interviewees, however, indicated that normally the approved plans are not the same as the constructed facility because once the approvals are obtained the council in most cases do not adhere to the very strict approval conditions during construction.

The study revealed that site landscaping was the least applied concept under the concept of choice of site with the highest mean of followed closely with the concept of preservation of existing vegetation. Attempt to probably maximize the site for perceived ‘higher returns’ the practitioners found themselves with no open spaces to landscape nor to preserve existing vegetation. Adebayo (Sustainable Construction in Africa, 2000) argues that in many urban areas of Africa and especially in the cities, construction of buildings generally, but especially residential buildings has been carried out to occupy the entire site. These findings and observations are similar to studies undertaken by Tessema, et al. (2010) who argue that the occupation of entire site other than limiting landscaping, also interfere with ventilation and air movement.

4.3.8 Extent of adoption – Sustainable Materials

The study revealed that the concept of sustainable materials had been applied to a little extent with 49% of respondents indicating that they had applied the concept to a little extent, 43% to a moderate extent and 8% to a great extent. Figure 4.9 shows the extent to which the concept of sustainable site had been incorporated in the commercial buildings. The results indicate that practitioners do not consider (only 8% had applied sustainable materials to a great extent) the use of sustainable materials in their projects. The concepts under sustainable materials which were considered in the study included the use of Local materials and components, use of recycled materials and the use of materials with low environmental impact

Chart 4.1.g; extent adoption of sustainable materials



Source: field survey,2020

the use of materials with low environmental impact was the most incorporated concept under sustainable materials followed by use of local materials and components the use of recycled materials concept was least applied. The incorporation of materials with low environmental impact could be attributed to the fact that there has been introduction of various environmental laws under authorities like NEMA that require practitioners to conduct project environmental impact assessments before execution as revealed during the interviews.

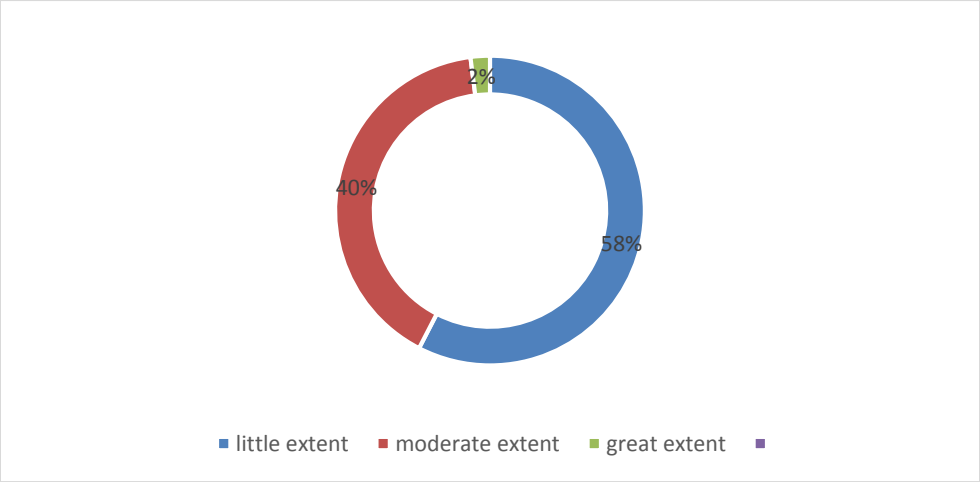
Other than such organizations, the ban on certain material like asbestos for roofing restricts the practitioners to use only acceptable materials for the projects to be approved by both the local authority and NEMA. This study revealed that the use of recycled material was least applied in the commercial buildings and therefore concurs with previous studies reviewed in the literature that recycling of building materials is a relatively new concept and has only been assessed in a few places. Despite these findings however, it was observed that a number of recyclable materials such as aluminum, and timber were used in the construction of the building

4.3.9 Extent of adoption – Environmental Quality

Six concepts under environmental quality which included ventilation to spaces, use of thermal control units, noise control, and provision of smoking areas, use of low emitting paints and use of low emitting finishes were considered in this study. It was revealed that the concept of environmental quality been applied to a little extent.

Figure 4.10 shows that 57% of the respondents indicated that they had applied the concept to a little extent, 40% to a moderate extent whereas 2% to a great extent.

Chart 4.1.h; adoption of environmental quality



Source: field survey,2020

These results indicate that only concepts which had adverse effect like paint were adopted by the stakeholders. In the six concepts under environmental quality the study revealed that use of low emitting paints and adhesive was incorporated the most with.

The incorporation of smoking areas in buildings is by and large a new concept and legislation that was introduced in the year 2007 by the county government of Nairobi, In regard to paint, it is a commonly used finish in commercial buildings especially the internal surfaces as observed during the study and therefore practitioners would be slow to use products which are harmful to users. Other than being a common finish, manufacturers would lose out in the market with products that do not meet the standards.

4.4 Presentations and findings

4.4.1 Adoption of Green building concepts in commercial buildings in Nairobi

One of the specific objectives of the study was to establish which green building concepts commercial buildings in Nairobi have adopted within the last five years. To establish these concepts, the green building concepts in each of the environmental categories were ranked after calculating the mean score for the concepts. A lower mean meant that the concept was most adopted whereas a higher mean meant that the concept was least adopted. the adopted concepts in each of the environmental categories.

Water, Energy efficiencies and environmental quality had the greatest number of concepts adopted whereas choice of site and use of sustainable materials had a few concepts adopted. Under water efficiency and conservation concepts, the results indicate that the most adopted concept is installation of water supply sub meters followed by rain water harvesting and installation of water efficient fixtures .In regard to energy efficiency the adopted concepts as revealed by the study included among other concepts installation of sub meters, use of day lighting and retrofitting old electrical fittings. The findings that Energy and Water efficiencies are the most adopted concepts strongly suggest that resources that are pegged to some kind of fee/charges are easily adopted than the ones which do not attract charges. This argument can also be advanced further for the concepts under choice of site, sustainable materials and environmental quality. It is evident that the concepts adopted in these categories which are subjected to regulations are mostly adopted than those that are not subjected to regulations. Adherence to local zoning under choice of site had the lowest performance perhaps because of local authority regulatory requirements. Use of materials with low environmental impact as a concept under sustainable materials and use of low emitting paint as a concept under environmental quality also emerged as top-ranking concepts that are adopted in commercial buildings. These concepts are part of requirements that are fulfilled under NEMA before approvals are granted.

4.4.2 Hindrances to the Adoption of Green building concepts

The study revealed that lack of enforcement on sustainable building policies posed a greater challenge to adoption of the concept. Lack of awareness had the highest result. Lack of enforcement of sustainable building policies suggests that enforcement is the foremost challenge in adopting the concepts. Studies suggest that it is difficult to enforce sustainable building policies as enforcement requires adequate education and training of building inspection teams. They suggest that improved enforcement can be laid through starting with voluntary schemes and use of incentives to overcome the challenge. Findings by McGraw- Hill construction smart market report (McGraw, 2013) differs with these findings and indicate that higher first costs for green building efforts is viewed as the most significant obstacle between current levels of adoption and the future growth, however, the report also indicate that the second most important challenge is lack of enforcement which varies from region to region. In our context, Africa and Kenya generally, lack of enforcement take lead as a challenge to adoption because of the inability and inefficiency of the county governments who are charged with responsibility of enforcement. These findings therefore are in line with both the McGraw – Hill report and Anderson Lyre and Huang (2004).

4.4.3 Sustainability cost myth

Beyond the health benefits, developers and building owners have been mulling over the business case of going green. In addition, there is the never-ending cycle of who takes responsibility for going green. Making business sense of green buildings was the subject of a meeting of global experts held in Nairobi. The backdrop of the event was the globally-held notion that going green is uneconomical due to exponential increase in construction costs.

This myth crumbles in the face of evidence. “Incorporate green technology early into design and keep costs to 1-3 per cent extra at most. Most passive green measures cost nothing and can even improve construction for net positive benefit”, says Prashant Kapoor, chief industry specialist on green buildings at International Finance Corporation.

But Kapoor says we do not need to go that far into the future to make crucial decisions on going green.

“Seven years from now, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two? Thirds of the world population could live under water stress conditions,” he says. “If we do not make the right investment choices today, we will be bound to high? Energy urban infrastructure for decades,”

Elizabeth Chege, the chairperson of the Kenya Green Building Society says the economic benefits of building green outweigh any extra financial costs.

“You have lower design and construction costs, rapid return on investment through quicker sales and higher sales price, and ability to secure financing. A green building has reduced vacancies, lower refurbishment costs resulting in increased market value,” she says.

“In Kenya, green buildings can be constructed at the same or even lower cost as a conventional building as the materials used save energy by as much as 30 to 60 percent. Strathmore, for instance, was able to save 20 percent of its projected budget on its first green building structure – Strathmore Business School,” said John Kabuye, vice chairman Kenyan Green Building Society.

Quest works Consulting, an engineering, procurement, and construction firm focused on real estate and renewable energy projects indicated that the solar energy system adopted in the Strathmore Business School project they managed, is saving close to one million kilograms of carbon dioxide, and Sh60m in electricity.

According to a study titled Greening Buildings and Communities: Costs and Benefits, supported by renewable energy investor Good Energies, about 50 percent of all green buildings studied, reported a payback of five years or less just from energy and water savings. However, that figure jumped to 90 percent when health and productivity benefits were included.

With technology improvements driving down capital costs, and green initiatives now improving efficiency and operating costs – alongside a proliferation of green financing instruments, and the increased impact of climate change on Africa’s countries, there is now a real opportunity for this cost-saving momentum

However According to Azmeena Bhanji, general manager in charge of real estate at PDM Kenya, there is little data in the local market to guide stakeholders in determining the exact return on investment. In Kenya, she says, such returns largely depend on whether the developer retains the projects, leases or sells it

“If we take the case of Vienna Court project, the first green certified commercial building in Kenya, it was basically built for retention by the developer. In such a case, the payback period will be longer as compared to a leased or project built for sale,” she says.

The matter of gauging proper returns on green investments becomes more acute when it comes to the housing sector

4.4.4 Green Building Concepts Strategies

The last objective of the study was to determine appropriate strategies for implementing green building concepts in commercial building.

The study revealed that strict enforceable urban land and planning policy was one of the fastest ways to promote uptake of green building concept, followed by improved enforcement of codes and regulation by other enforcement agencies like the local government, NEMA etc. Other strategies for promoting uptake in order of priority included Education and training focusing on sustainability, financial incentives such tax holiday and green loans. Promoting green procurement as a strategy leased promoted uptake of the concepts .Enforcements, whether in urban land and planning policies, building codes, energy efficiency obligation or procurement regulations fall under regulations and control mechanisms and studies have shown that enforcement of regulatory mechanisms can be a rapid way to implement effective technologies and best practices of cases conclude that regulatory and control measures are probably the most effective ways to implement green strategies. Conclusively these findings concur with the studies as both the first and the second strategy for uptake of green building concepts revolved around enforcement. A survey in the year 2009 by Price Water House (PwC) of European countries indicated that a number of developed countries are leading the way in green public procurement. The survey found out that where green procurement is applied, life cycle costs are reduced by 10 per cent (PwC, 2009). This survey, however, does not rank the green procurement strategy as driver to uptake. It can be argued that in our context green procurement is a relatively new concept which need to be understood through education and training for it to be a top strategy for enhancing uptake of the concepts.

4.4.5 Green building standards

The Kenya Green Building Society (KGBS)

The Kenya Green Building Society (KGBS) is an independent, non-profit membership-based society registered with the World Green Building Council as its Kenya Chapter. KGBS is mandated to certify the built environment, advocate for green buildings and train green building professionals. KGBS is the leading Green Building movement in the Kenyan market that ensure buildings are designed and built sustainably.

Currently, KGBS using Green star SA rating tool are a dedicated team of professionals working in collaboration with industry experts, leaders, government departments to develop modern day building best practices crafted to suit the Kenyan dynamic property industry.

Green Africa Foundation, (GAF) a local nongovernmental organization, has developed a "Green Mark" standards for buildings and provides guidelines for best practices for environmentally friendly design. The new standards cover the sustainability of building sites, water conservation, energy efficiency, construction materials, indoor air quality, innovation, operation and maintenance. GAF plans to start offering certification of green buildings in the near future. "You can't talk of (energy) conservation while ignoring buildings, because people spend 90 percent of their time daily in buildings, which generate 40 percent of carbon emissions," said Nickson Otieno, an architect with GAF and owner of a building company.

GAF works with the Kenya Green Buildings Society (KGBS), whose standards are benchmarked on South African ones. The building society also helps owners of old buildings retrofit them to improve energy efficiency and water conservation.

South Africa, Otieno explains, was the pioneer in sub-Saharan Africa in developing green buildings standards. Mutua Mweu, an architect whose firm also promotes green building construction, says that assessing the green rating of a building requires considering aspects besides energy efficiency, such as land use, ecology, emissions levels and handling of sewerage waste. He agrees with Otieno that public interest in adopting green standards is growing rapidly, and says that all architecture courses at Kenyan universities now include green technology in their curricula.

"The green moment is here and strong and no architect can ignore it," Mweu said. Peterson Karumi, principal superintendent architect at Kenya's Ministry of Public Works, which is responsible for designing and constructing public buildings, says the government prepared a draft policy on green building standards in 2013, which was to be approved by 2015.

According to Karumi, the policy will enable the private sector to play a key role in promoting green buildings by providing subsidies and clear guidelines. He believes the country has the technical capacity to successfully promote and construct green buildings.

The United Nations Human Settlement Programme (UN-Habitat) has been working with the Architectural Association of Kenya and other groups since 2011 under a four-year programe to promote energy efficiency in buildings in East Africa. The Green Mark Standard for Green Buildings provides a localized benchmark and guideline for assessing extent to which the development of new and existing buildings address climate change and environmental degradation.

It highlights best practices in building design and construction, operation and maintenance so as to reduce or eliminate the adverse climate change and environmental impacts on both the building and occupants. The Standard will provide a basis for assessing the sustainability performance of existing and new buildings holistically over the entire life cycle, thereby providing a definitive standard for 'greening buildings'. It also considers the fact that greening of buildings has a role in achieving sustainable development in Kenya and the Africa region given that shelter is a basic human need.

The Standard was initially conceived and developed by Green Africa Foundation in 2011 as the 'Green Africa Building Standard' which has been modified to the 'GreenMark' Rating Tool after a broad stakeholder consultation and incorporating various modifications by technical experts convened under the standing Technical Committee and independent GreenMark Standards Board. It takes into account the provisions of the Building Code, National Building Regulations 2014, the Physical Planning Act 2012, the Energy Management Regulations, the Environmental Management and Co-Ordination Regulations, the Environmental (Impact Assessment and Audit) Regulations 2003 and other IS codes, local bye-laws, other local standards and laws. The system, by its qualitative and quantitative assessment criteria, would be able to 'rate' a building on the degree of its 'greenness'. The rating will be applied to new and existing building stock of varied functions - commercial, institutional, and residential.

Internationally, voluntary green building rating systems have been instrumental in promoting sustainable design. However, most of the internationally devised rating systems have been tailored to suit the building industry of the country where they were developed. In Kenya the US based LEED rating system has been applied in rating a number of buildings, guided by individual accredited LEED professionals. The South African rating system, the Green Star SA, is being promoted by Kenya Green Building Society (KGBS) since 2015. Keeping in view of the Kenyan unique climatic and socio-economic conditions, a Kenyan Standard for Green Buildings - the GreenMark Rating System has been developed with consideration for all kinds of building in varying climatic zones of the country.

Green architecture, or green design, is an approach to building that minimizes the harmful effects of construction projects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing eco-friendly building materials and construction practices.

Until local, state, and federal public officials are persuaded to legislate green processes and standards—just like building and fire prevention practices have been codified—much of what we call "green building practices" is up to the individual property owner.

Common Characteristics of a "Green" Building

The highest goal of green architecture is to be fully sustainable. Simply put, people do "green" things in order to achieve sustainability. Some architecture, like Glenn Murcutt's 1984 Magney House, has been an experiment in green design for years. While most green buildings do not have all of the following features, green architecture and design may include:

- Ventilation systems designed for efficient heating and cooling
- Energy-efficient lighting and appliances
- Water-saving plumbing fixtures
- Landscaping with native vegetation and planned to maximize passive solar energy
- Minimal harm to the natural habitat
- Alternative renewable energy power sources such as solar power or wind power
- Non-synthetic, non-toxic materials used inside and out
- Locally-obtained woods and stone, eliminating long-haul transportation
- Responsibly-harvested woods
- Adaptive reuse of older buildings
- Use of recycled architectural salvage
- Efficient use of space
- Optimal location on the land, maximizing sunlight, winds, and natural sheltering
- Rainwater harvesting and greywater reuse
- Looking to a Sustainable Future

Green design has many related names and concepts associated with it, besides sustainable development. Some people emphasize the ecology and have adopted names like eco-design, eco-friendly architecture, and even arcology. Eco-tourism is a 21st-century trend, even if eco house designs might appear to be a bit non-traditional.

A building can look beautiful and even be constructed from very expensive materials, but not be "green." Likewise, a building can be very "green" but visually unappealing. How do we get go od architecture? How do we move toward what Roman architect Vitruvius suggested to be the three rules of architecture—to be well-built, useful by serving a purpose, and beautiful to look at? Kenya has the opportunity to set a benchmark for Africa in implementing cost-saving green technologies, as it pursues its development goals as a committed signatory of the International Climate Agreement (ICA).

As the 49th ICA signatory, Kenya has committed to reducing its greenhouse gas emissions by 30 percent by 2030, while achieving its housing, infrastructure, job and healthcare goals. But while the public-sector will be the driver of sustainability policy and regulation, the built industry (real estate and infrastructure developers) will be the key to achieving the government's ambitious goals, said the Kenya Green Building Council's (KGBS) Madhur Ramrakha.

In this, climate change is creating mounting pressure, as destructive weather patterns across Africa trigger consequences such as East Africa's record drought and the real possibility of Cape Town becoming the first ever city to run out of the water. This is seeing socially conscious customers beginning to demand principled green design in their homes and businesses, especially at the building sector which is estimated by the United Nations Environment Programme (UNEP) to contribute up to 30 percent of all greenhouse emissions. In this, the affordable housing initiative by the Kenyan government is an opportunity to use environmentally sound principles and products to build better homes. In East Africa, and Kenya in particular, ambitious warehousing projects, new retail centers and Kenya's growing importance as a global trade hub are all driving green innovation to reduce costs that will be covered at the EAPI Summit.

4.5 Conclusion

Strict enforceable eco-friendly building policy, improved enforcement of bylaws by local government as well as education and training focusing on sustainability are some of the appropriate strategies that this study concluded to be among the approaches that can be adopted to promote uptake. Strict enforcement of policies especially at the point of building plans approvals would drive the industry practitioners to embrace green construction in their practices.

Education training and research right from the lower school systems and to institutions of higher learning would produce environmentally focused graduates who will easily embrace sustainability concepts in their projects.

There is an urgent need to promote green building services and comprehensive building sustainability audits in all building developments undertaken in the urban centers in Kenya. The teaching of relevant courses to promote green building practices needs to be given more priority in all aspects of the training programmers.

There is indeed the need to enhance the efforts to promote the operation of the Kenya Green Building Council together with other partners willing to spear the development of an appropriate green rating system applicable to the local economy.

The government can promote sustainable real property development by educating the public on sustainable development practices and through the introduction of various forms of incentives on the sale and the adoption of environmentally sensitive materials.

CHAPTER FIVE

5.0 SUMMARY FINDINGS CONCLUSSIONS AND RECOMENDATIONS

5.1 Introduction

This chapter represents the summary of the research work undertaken and based on the study findings, draws conclusion and make recommendations on the aims and objectives

5.2 Summary of findings

Throughout the research the researcher's main guide was the primary research objective stated earlier in the introduction to the research. This main objective was to establish to what extent the Kenyan housing industry have adopted sustainability practices in their establishments. Guided by this objective the researcher sought to investigate features of green design adaptable to the housing industry in Kenya. The researcher selected 1 establishment within the chain of Solai apartments. The researcher interacted with both representatives of the establishment and tenants. The researcher was also able to interact with various guests through participatory observations and interviews.

Solai apartments uses energy and releases more waste than necessary. The group is but a small fraction of the housing industry in Kenya and is an indication that the industry is in due need of a more practically and environmentally friendly way of living. These various types of waste lead to a lot of environmental degradation.

The apartments also waste large amounts of goods and resources which could otherwise be recycled or reused. Large amounts of electricity and water are required to run. Through the research findings the researcher established that indeed there is a lack of awareness on green design practices and the way it affects the eco system.

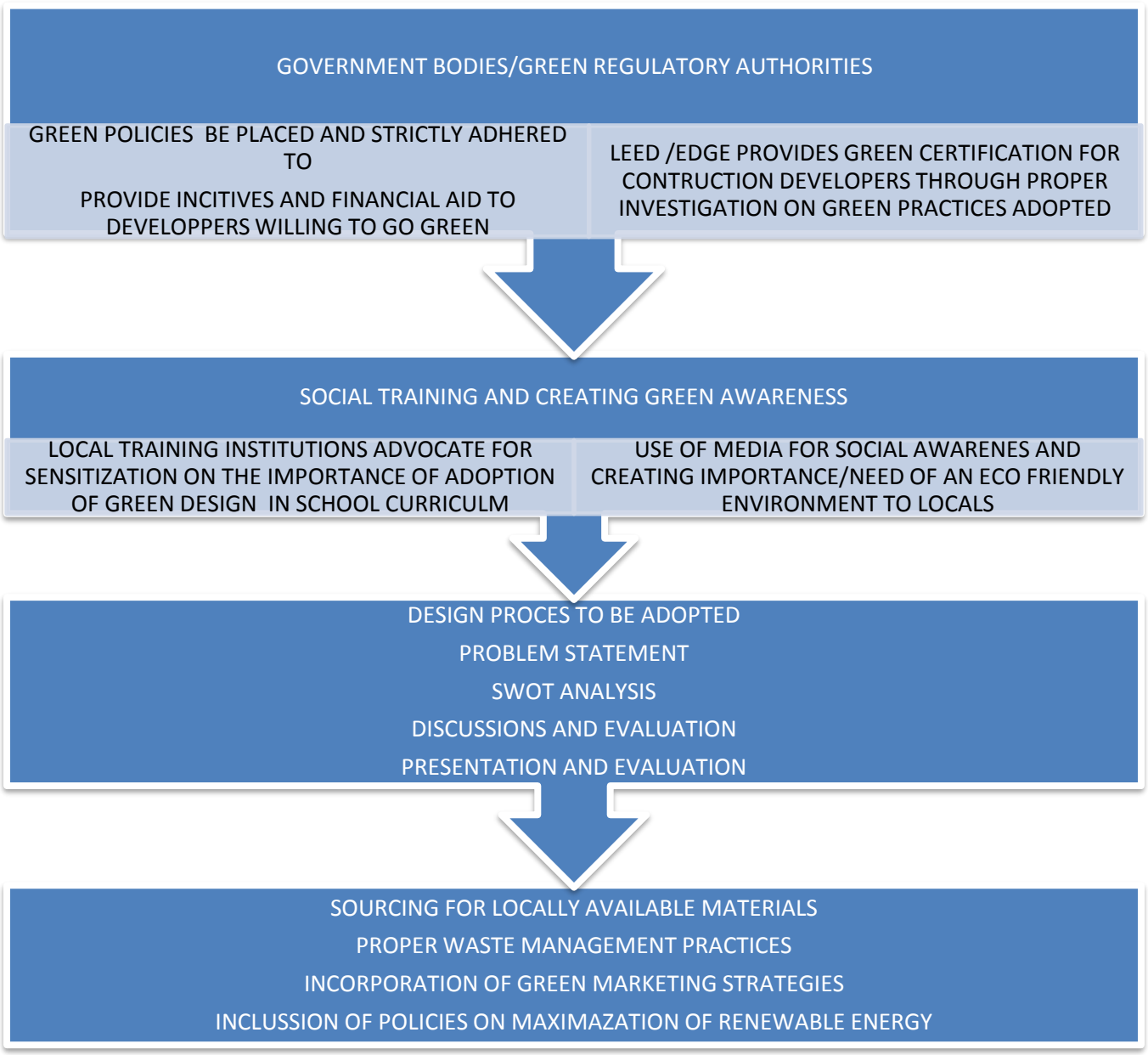
This can be taken as a not so positive sign and a resource that can be tapped into in the awareness of guiding frameworks towards increased adoption of green design.

Researcher also established that environmental policies or certifications were not mandatory for the operations within the housing industry in Kenya

5.3 Proposal and recommendations

Arising from the conclusions above, the researcher proposes a green design framework. This framework will act as a guide/model to be used in increasing the adoption of green design Kenya. the collaboration of relevant stakeholders and the community for the effective process would be required for the framework to become fully effective the researcher in proposing this framework that it would lead to an increase in the uptake of green design practices.

FIGURE 5.a; Green design framework for sustainability uptake



SOURCE: author,2020

From the research it is quite evident that the adoption of green design in the housing industry in Kenya would be an advantage both to the industry and consumers. It is also evident that there are not set guidelines or frameworks that govern or encourage the adoption of the same within the industry. Some of the highlights of this framework proposed in the research are;

5.3.1 On the space and immediate living environment

- More reliance on Sunlight and Solar energy

One of the biggest mistakes many of us make, when it comes to the environment, is to rely too heavily on artificial or man-made lighting. The way to rectify this is to make as much use of the sun as possible. Choosing curtains that aren't intrusive or heavy. In a case of remodeling extensively, you might even consider installing a skylight. This way your home will be flooded with natural light and will save money and converse much less energy.

Switching to LED light bulbs is highly recommended and has been found in a recent study to save the average home up to $1,000 over a 10-year period. These bulbs may cost more initially but they are long-lasting and of a high quality, so they represent an investment worth making.

You could also install Energy efficient bulbs these are similar to old incandescent bulbs that respond well to a dimer and emit just as good quality of light however, you can save up to 80% on your electricity bills and waste a lot less energy as they can typically use about 25-80% less energy.

Solar energy may also be installed in the event of an electricity fault or blackout which are highly experienced in the area

- Improved Insultation

Another way of saving money in the long run and be kind to the environment, is to improve the insulation in your home. With better insulation, made from natural materials, your home will require less heating. This could be loft insulation, cavity wall insulation, plasterboard and even floor insulation.

Unlike many conventional insulations, natural insulations made from materials such as sheep's wool, Earth wool, Thermal fleece, Warmcel etc. have low embodied energy and are all fully recyclable and disposable at the end of their natural use.

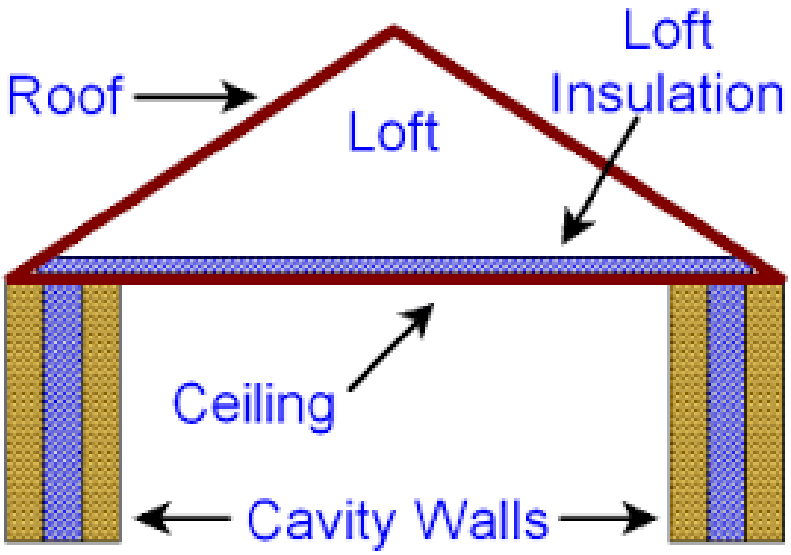


Figure 5.b; Loft and cavity wall insulation

Source: www.repairgas.co.uk

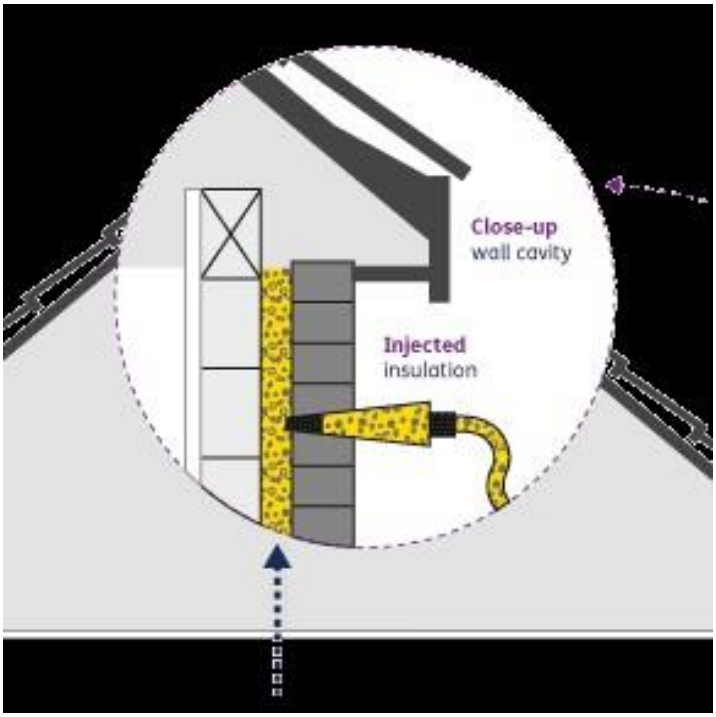


Figure 5.c; Cavity wall insulation

Source: www.repairgas.co.uk

- Focusing Attention to Labels and materials with low VOC

In the event of painting your interior spaces, one might want to carefully read the labels on paint tins or any associated products to make sure that you're making eco-friendly choices. Products with low VOC (volatile organic compounds) ratings are the ones to look for, as these will contain smaller amounts of harmful air pollutants. VOC ratings can also often be found on furniture, carpets and other household items.

Some product brands such as AFM Safe coat, Benjamin Moore aura and Natura, Yolo Color house, the old-fashioned Milk paint company and Sherwin Williams even emit no VOC, making these ideal for eco-friendly redecoration. Also opt for low-VOC carpets, rugs. When selecting rugs and carpets, seek out more green materials like sisal, wool, or organic cotton.

Figure 5.d; Sample low VOC emitting carpets

Source: basc.pnnl.gov

- Updating Flooring

It's also possible to choose eco-friendly options when it comes to the surface beneath your feet. Wooden, stone or marble flooring are all choices that are both natural and beautiful. This type of flooring may be expensive, but in the long-run it could pay for itself in that it might add value to your home. Plus, these materials are usually hard-wearing, which means that they will last longer.

Another advantage is that they are easy to clean, making them a good choice for families with children. Some other options for eco flooring are Cork (renewable material), reclaimed wool rugs, Bamboo flooring, reclaimed and sustainable hardwood, Linoleum flooring and recycled metal, glass and rubber tiles are all good options for an eco-friendly, durable nontoxic floor.

Figure 5.e; Cork flooring samples

Source: www.floorsdirectwest.com

Figure 5.f; Eco-friendly dura tile sample

Source: www.durablecorp.com

- Use UV film on windows

Clear window film helps keep your home cool during hot months and retain heat during the winter. It also saves your furniture, rugs, and floors from sun damage. An energy efficient solution that saves on some of your home features. In this case one would want window treatments for privacy and to set the tone of the space.

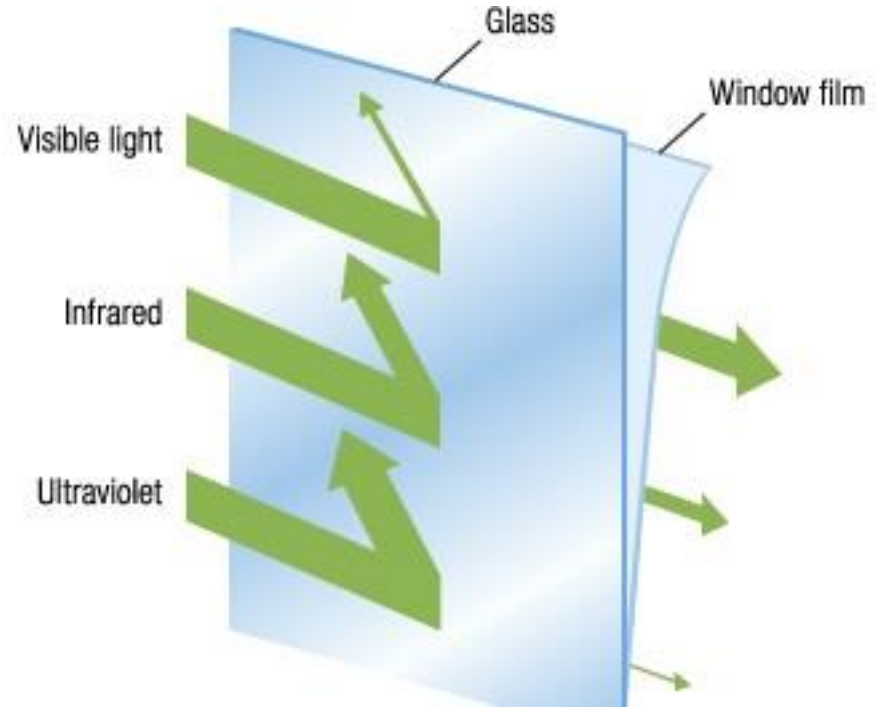


Figure 5.g; UV film window interpretation

Source: mlgw.bizenenergyadvisor.com

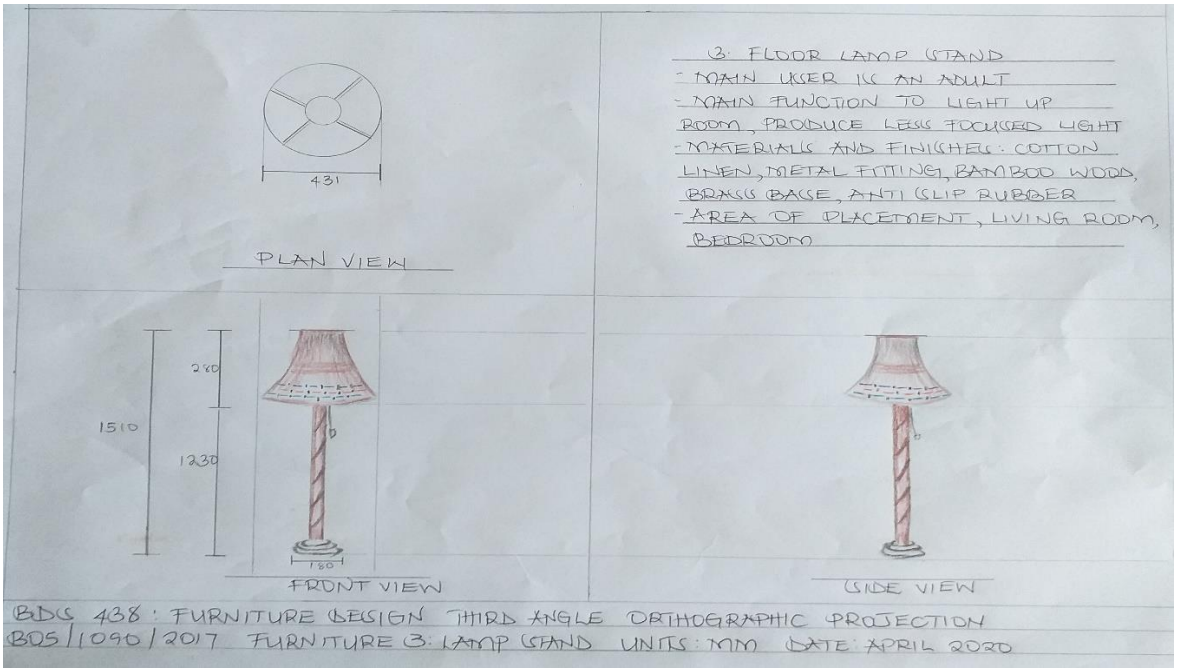


Figure 5.h; orthographic projection of proposed lamp Source; author,2020

- Enhanced artificial lighting

In the case of artificial lighting the researcher opted to use lamp stands which were to be strategically placed in the space preferably the living room area and also the bedroom and study area. This will illuminate the room and not pass out unnecessary light or too much light. The material used for the lamp shade is cotton linen which is also environmentally friendly. Other finishes of the lamp included some metal fittings, bamboo wood for the stand, a brass base and an anti-slip rubber at the bottom. The lamp shade was also to be fitted with colorful beadings and colorful fabric, this being a way of art which is majorly practiced by the Fulani people of west Africa who practiced pastoralism and wore hats with similar characteristics whenever they were out herding or on special occasions.

- Reuse antiques

Antique pieces are rich with soul, grit, and age. Plus, accessories and furniture with a past always have a story. The age-old concept of mixing old with new is a fun way to go green at home. First Dibs and Chiaris are excellent sites for vintage décor, furniture, and art.

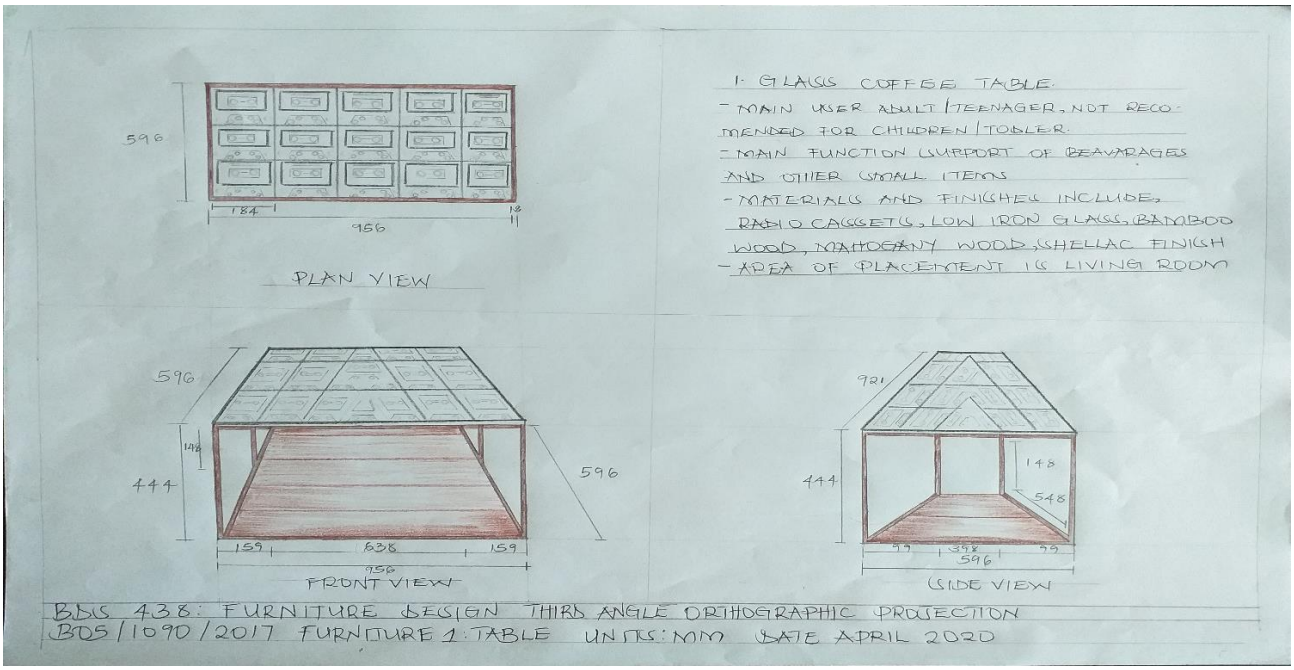


Figure 5.i; orthographic projection of proposed table

Source; author,2020

In the case of my study I recommended the use of old radio cassettes in the remaking of the coffee table. The cassettes are fitted on the top part of the table and are covered with transparent low iron glass that makes them visible. Other finishes on the table include bamboo wood, mahogany wood and shellac finish. This makes use of the unused commodity which has now become unwanted due to digital advancement in the music and entertainment sector. Not only is this environmentally friendly but also the table is aesthetically pleasing and brings out a sense of liveliness and style in the space.

- Eco-Friendly Materials for Furniture:

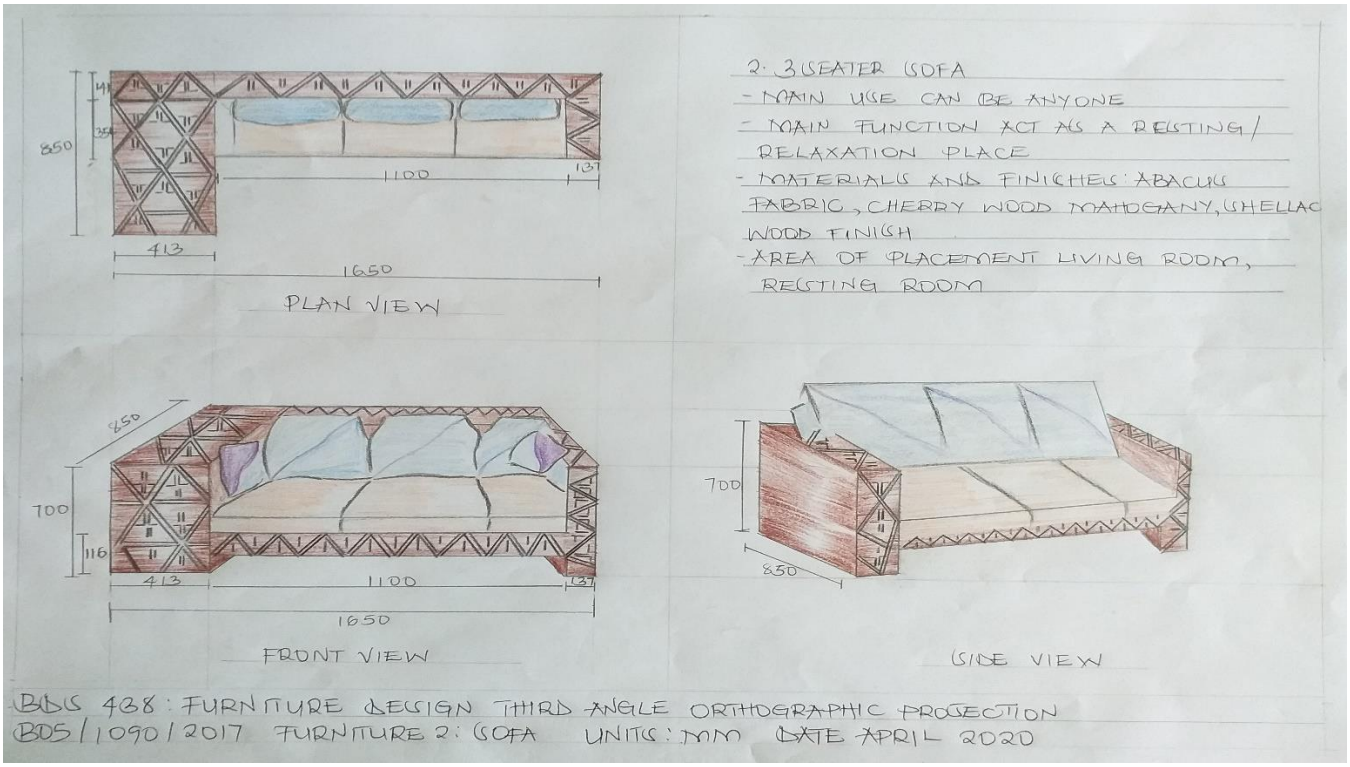


Figure 5.j; orthographic projection of proposed chair

Source; author,2020

Citing the already existing reclaimed wood used for the chairs in the space, the researcher opted to fully remake the chairs using eco friendly materials. Materials that were considered for this include abacus fabric for the cushions and seating areas, cherry wood mahogany for the wooden parts of the chair and a finish of shellac wood finish was also recommended.

The surface of the wood was also to be engraved with the Fulani curving technique which acted as the primary source of inspiration. It acts as a decorative element which is established by curving out of the wood to create a geometric pattern than goes all round the wooden area of the chair.

Other materials that could also be put into consideration include;

- Bamboo and wood

Due to its beneficial qualities and the fact that it originates from a sustainable source, bamboo is an ideal material to use for the production of furniture.

It is a versatile material that can be used to create many different pieces of furniture from rugs to privacy screens.

The durable nature of it means that it will last for a significant period and will not require replacement. You will also be safe in the knowledge that bamboo does not require the use of pesticides to aid its growth.

If you love the look of wood furniture, then you're well on your way to achieving a eco-friendly materials for your furnishings. Basically, you have two options here: You can select furniture made from reclaimed wood or sustainably sourced new wood. In the case of reclaimed wood, the manufacturer is essentially recycling wood from either old furniture or other pieces to create new tables, couches and more.

In addition to being a super green option, reclaimed wood tends to look cool. New wood from a sustainable source is also a solid option for furniture, as the manufacturer can usually confirm where it originated and how many trees were planted to replace the ones that were cut down to make the furniture.

- Reclaimed Materials

Whether it was used as flooring in a refurbished property or was previously a piece of furniture, making use of reclaimed wood is a way to endorse green furniture. There are a great number of circumstances in which wood is being thrown out or furniture is being sold cheaply or even being given away. Obtaining wood in this manner will allow you to prevent it from going to landfill or being used as firewood and using it instead to create a new item of furniture. Metals and plastics can also be recovered from existing furniture that is to be disassembled, recycled or thrown away and reused as part of the furniture you are to build.

- Hardy Hemp and Carbon Footprint-Friendly Cotton

For upholstery and furniture covers to make up part of your furniture, hemp or organic cotton that comes from a renewable source should be your first consideration. In the case of color is, make sure the dyes and paints used are natural and non-toxic. In addition to the eco-friendly of your furniture, you also want to find upholstery and coverings that are made from a renewable source.

If you choose furniture that's upholstered with either hemp or organic cotton from a renewable source, you'll be well on your way to meeting your goal of having only eco-friendly materials in your home.

Hemp, a super hardy and durable material, is grown without toxic chemicals and regrows quite easily. Organic cotton is also grown in a responsible and sustainable manner' it's also super comfortable and looks great as upholstery for chairs, sofas and other types of furniture.

Figure 5.k; Organic hemp upholstery samples

Source: 888lorna.wordpress.com

- Furniture Made from Recycled Materials

Buying new furniture made from recycled materials requires less processing and fewer resources than if you buy a couch made from all new fabrics, wood and more. Look for products that are certified “Cradle to Cradle” (C2C) and, if necessary, ask the salesperson for more information about what recycled materials were used to manufacture the piece.

By sticking with reclaimed and/or sustainably sourced wood, bamboo, hemp and cotton as much as possible, you’ll be able to fulfill your goal of reducing your carbon footprint while still having a beautiful home.

Landscaping and neighboring environment

Sustainable landscaping is a modern type of gardening or landscaping that takes the environmental issue of sustainability into account. According to Loehrlein in 2009 this includes design, construction and management of residential and commercial gardens. Sustainability can help urban commercial landscaping companies save money. However, using appropriately selected approaches may help to ensure that maintenance costs are lower because of reduced inputs. Factors such as lot size, house size, local covenants and budgets should be considered in the early stages of construction

The steps to design include a base plan, site inventory and analysis, construction documents, implementation and maintenance. Of great importance is considerations related to the growing conditions of the site. These include orientation to the sun, soil type, wind flow, slopes, shade and climate, the goal of reducing irrigation and use of toxic substances, and requires proper plant selection for the specific site.

Commercial and residential landscape maintenance in urban areas such as Nairobi can be challenging. Appropriate plant selection and thoughtful design early in the development process can be financially beneficial over the life of the project. Without the proper planning, landscapes can require costly maintenance from time to time to improve local health and general appearance. What many property owners may not realize is that with some advance planning and a modest investment, a sustainable approach will create a highly attractive landscape without the long-term maintenance burdens, thereby improving the community’s ecological health and water quality.

Some of these approaches to landscaping solutions include;

- Native plants

Sustainable landscaping practices have reached the mainstream and are transforming commercial properties, public spaces, and largescale residential development. Today, most landscape professionals are familiar with the benefits of using native plants. The selection of non-invasive, drought tolerant, pest resistant, salt tolerant and naturally beautiful plants is becoming more common. Landscape professionals and development owners should be eager to identify a variety of plants that attract different types of wildlife (e.g., hummingbirds) and provide a diversity of color and interest throughout the year.

- Reduced water usage and no water run off or puddles

Reduction of stormwater run-off through the use of bio-swales can be advantageous also use of rain gardens and green roofs and walls may help in the reduction of water use in landscapes through design of water-wise garden techniques (sometimes known as xeriscaping)

Irrigation using water from showers and sinks, known as gray water is also highly recommended.

Permeable paving materials also reduce stormwater run-off and allow rain water to infiltrate into the ground and replenish groundwater rather than run into surface water

- Minimal use of fertilizers and pesticides.

Integrated Pest Management techniques for pest control

- Soil management techniques, including composting kitchen and yard wastes, to maintain and enhance healthy soil that supports a diversity of soil life

- Integration and adoption of renewable energy, including solar-powered lighting

A more sustainable approach to landscaping has become increasingly accessible to property owners in recent years and provides a number of benefits to both the owner and the environment. Maintenance cost savings for these landscapes is significant and will quickly pay for any larger upfront costs associated with professional landscape design assistance.

From an environmental perspective, heat reduction, water quality, and wildlife benefits are well documented, especially where property owners go the extra mile to employ professional landscape designers. These features truly add to the visual appeal of any property with a variety of colors, textures, and pathways that soften what have historically been flat landscapes of asphalt, grass and mulch. Cost savings, environmental improvements, and property appeal

5.3.2 On government regulations and sustainable knowledge

The realization of the process depends on the collaboration between various stakeholders. These stakeholders include but are not limited to relevant government bodies and stakeholders like the environment and relevant government bodies; LEED, EDGE among others.

The media too is a major stakeholder that would play a very vital role in ensuring that through the various communication mediums relevant players are well informed on the GDF. The media can use means such as television and newspaper advertisements, articles and documentaries, social media channels and word of mouth for the same.

The research recommends that training and sensitization on the importance of adoption of green design within the housing industry is carried out. Communities found in areas where these establishments are to be put up should also be trained as they play a major role in ensuring that adoption of green design practices is successful. This they do mainly through being a source or labor, skill and raw materials and also through collaborative green practices with the establishments. Training not only on the importance of adopting green design but also of the benefits that each sector or person stands to gain from the same ensures that the concept of green design is owned by each individual.

Proper policies should be put in place and properly followed. This would ensure that minimum standards are set and adhered

Green marketing strategies should also be part of the guidelines put in place to encourage the housing industry players to adopt green design. This they can do by use of recycled material for marketing.

The industry players could also be encouraged to use the green strategies that they adopt at their respective establishments as a marketing tool. This can be encouraged through various incentives like awards or recognitions by relevant bodies to industry players doing the same. Within the guiding framework a policy should be put in place on renewable energy systems. This is especially because renewable energy like solar is readily available in Kenya as the country experiences sunshine throughout the year.

This therefore should inform a guideline and regulation that requires all housing industry players to adopt solar powered water heating systems within their establishments. This should already be a regulation within the construction industry in Kenya. Solar lighting systems should also be a requirement especially in establishment located within areas experiencing good sunshine.

Waste management systems should also be introduced as some of the major regulations and guidelines to be adhered to. This would especially be so for grey water and food waste which can be recycled and reused for other beneficial purposes.

The researcher recommends that industry players introduce treatment systems to treat grey water and recycle it within their premises either in the lavatories or in watering plants.

Recyclables like plastics should also have proper management procedures that are followed and seen to fruition. This may not necessarily translate to the recyclables been recycled. The government is also proposing that different counties manage their waste independently to avoid transporting them to different areas for the same. Proper recycling infrastructure and resources have however not been put in place in most counties. The researcher recommends that through community involvement proper recycling and other waste management infrastructure to be put in place in county levels to aid in reduction of carbon emissions as waste is transported to other areas for the recycling.

The researcher mainly used a qualitative approach in the research assisted by a survey approach. Through engaging directly with different subjects in various activities, the researcher was able to better understand the green practices already in practice and those still to be adopted. The research also aimed at proposing a model or framework of increasing the uptake and adoption of green design in Kenya.

Through the research a number of contributions to knowledge were achieved among them being;

1. There being little research that highlight green design practices within the housing industry in Kenya, the research provides new information that had not been available before. Through this research information on the various green practices that have being adopted, the drivers of these practices, their benefits and challenges facing their adoption has been highlighted.

2. Information on gaps in the implementation of government policies that would otherwise lead to an increased uptake of green design within the housing industry has also being highlighted.

3. The research also develops a green design framework that can be applied in increasing the uptake and adoption of green design within the housing industry in Kenya. This framework provides a new approach that can be successfully adopted to increase the uptake of green design with the collaboration of relevant stakeholders and following a design process also highlighted in the research.

4. The research also provides substantial data that updates existing literature and provides a basis for further research. The research provides a basis for further research cutting across various design principles like social design, training,

policies and government and institutional linkages.

5.4 Conclusion

The study found out that sustainability literacy levels is at a low in the Kenyan housing industry. However there was a mismatch between sustainability literacy levels for the three dimensions of sustainability and how they rank as key considerations in the housing sector .The established sustainability literacy levels were largely attributed to informal learning, construction professionals influence, collaborations among development owners and formal learning approaches amongst other avenues.as established via the research conducted, the impact of sustainability literacy on sustainable construction compliance in the Kenyan construction industry was below average. Sustainable construction recorded a small average uptake level. Social sustainability registered an at least average uptake followed by environmental sustainability and lastly economic sustainability. Organization related drivers, stakeholders, economic drivers and management related drivers were identified as key driver categories attributing to the established sustainable construction uptake levels.

On the other hand, economic related barriers, technology related barriers and societal related barriers were found out to be the key impediments to uptake of sustainable construction practices in the Kenyan housing and construction industry. Through the research conducted it was established that the impact of sustainability uptake on suitable construction compliance in the Kenyan housing industry was below average too. An overwhelming majority of construction practitioners did not typically asses the sustainable constraints related to sustainable construction in Kenya. They additionally registered a below average familiarity with sustainable construction assessments and evaluation standards. Despite that, the familiarity levels were at least average for social aspects, followed by environmental aspects and lowest for economic aspects of sustainable construction. A substantial portion of the respondents were not aware of applicable operational measures of the value for sustainable construction a sustainable practice.

Lastly an overwhelming majority of the respondents were not familiar with any sustainable construction assessment framework covering the dimensions of sustainability , however evidence through the research conducted the impact of sustainability evaluation on sustainable construction compliance in Kenya was found to be on an average with 2.5 out of 5 developers adopting these practices even though not on the highest desired level

The study concluded that jointly, sustainable construction literacy, uptake and evaluation have an average impact on sustainable construction compliance in the Kenyan housing industry.

5.5 Suggestion for further study

The research identifies various areas and fields that need further research including effectiveness of the proposed sustainability construction framework, government and institutional linkages and support in realizing the frameworks proposed, training and sensitization and the design process.

1. Further research to determine the effectiveness of the proposed green design framework (GDF) is needed. The GDF proposes a design process to be followed once guidelines and policies have been establishment on the adoption of green design in the housing industry. The research also proposes the collaboration of various stakeholders in coming up with these policies and guidelines and in training communities and industry players on the same. Research is therefore required to establish the effectiveness of the GDF in successfully leading to an increase in the adoption of green design in the housing industry in Kenya or any other industry.

2. The research only focused on Solai apartments. There are however many developers and players within the housing industry in Kenya whose green design practices have not been establishment. This is an area that requires further research.

3. The research established various collaborations between the establishments and the communities in their bid to co-exist. These collaborations as cited in the research have led to community development. Sustainable community development through literacy and or social design is an area of research that can be explored further. This list is however not exhaustive as the research provides a vast array of data that can be explored further. Waste management policies, sustainable energy systems and green marketing strategies are other areas of interest brought out in the research that can be researched further.

REFERENCES

Aggrey D. Maina T. (2013). Paper on "Impacts of Urbanization on Land Use Planning, Livelihood and Environment in the Nairobi Rural-Urban Fringe, Kenya". p13

Basiago A. D. (1999). Economic, social, and environmental sustainability in development theory and urban planning practice: Boston, USA.

Buildings Energy Databook, (2006). US Department of Energy and Annual Energy Review 2007. DOE/EIA-0384. Energy Information Administration, U.S. Department of Energy. June 2008.

C. N. Mundia and M. Aniya (2005). Paper on "Dynamics of Land use or land Cover Changes and Degradation of Nairobi City, Kenya". p 68

Civil Society, Urban Development Program (2011). Kenya Urban brief, "Vibrant, Dignified And Secure, Urban Living Environments"

Daly, Herman E. (1996). Beyond growth: The economics of sustainable development. Boston: Beacon Press. p 69-71

Ellen van Bueren (2012), Sustainable Urban Environments An Ecosystem Approach Springer Dordrecht Heidelberg. p 55-56

Emissions of Greenhouse Gases in the United States. DOE/EIA-0573 (2007). Energy Information Administration, U.S. Department of Energy. December 2008. p 13

Gayline Vuluku1 & James Gachanja (2014) a journal on: Supply Side Aspects of Residential Housing for Low Income Earners in Kenya p 14

Goodland, R. (1995). Environmental sustainability: universal and rigorous. Sustainable Development, (under review).

Government of Kenya (1996) Physical Planning Act Cap 286. p 69

Government of Kenya (1999). Environment Management and Coordination Act. p 34, p 69

Government of Kenya (2000). National Housing Policy p 14-15

Government of Kenya (2004). Sessional paper No. 3 on National Land Policy

Government of Kenya (2004a) Economic Recovery Strategy for Wealth and Employment Creation.

Government of Kenya (2007). Physical Planning Handbook.

Government of Kenya (2008). Kenya Vision 2030. "Unlocking the Future Potential for Kenya".

https://afroculture.net/maasai-shuka-traditional-kenyan-fabric/ (2012) p 50-51

https://archinect.com/news/article/150180077/norman-foster-pushes-government-to-hold-architecture-competition-for-a-new-house-of-lords (2016) p 28-30

http://buildesign.co.ke/the-lrc/ (2015) p 33

https://www.designorate.com/principles-of-sustainable-design/ (2015) p 18

https://en.m.wikipedia.org/wiki/Sustainable_landscaping (p 82)

http://en.wikipedia.org/wiki/Land use. June 2015.

https://www.greenhotelier.org/our-themes/sustainable-interior-design/

https://www.intechopen.com/books/advances-in-landscape-architecture/ecological-landscape-design

https://lianaxiong.weebly.com/blog/april-10th-2015 p 26-28

http://toolkit.smallbiz.nsw.gov.au/part/17/86/371.

http://www.google.com/search?hl=en&q=land+use+planning&btnG=Google+Search

Kahn, M. (1995). Concepts, definitions, and key issues in sustainable development: the outlook for the future. Proceedings of the 1995 International Sustainable Development Research Conference, Manchester, England. p 70-71

Katiambo Jumma Augustine (2016), the developments in real estate and sustainable urban environment of Kilimani area within Nairobi city county. p 17

Kimani, M. (2011). National Land Use Policy and Sustainable Development, Kenya National Land Use Policy Formulation Inauguration Workshop, Nairobi.

Kothari, C. R. (1990) Research Methodology: Methods & Techniques, New Age International Publishers, New Delhi, India. p 37

Lyle, J. T. (1994). Regenerative design for sustainable development. New York: John Wiley & Sons, Inc. p 69-71

Martínez, M. (2011), the Citizen Participation of Urban Movements in Spatial Planning: A Comparison between Vigo and Porto. International Journal of Urban and Regional

Pauline N. Irungu (2016), Adoption of green design in the hospitality industry in Kenya Research, p 14-19

Samuel Kamau Joseph (2019), Sustainability compliance in the Kenyan construction industry, a study of Nairobi city county

Mugenda, O. M and Mugenda A. G (2003) Research Methods: Quantitative and Qualitative Approaches, Acts Press, Nairobi p 37-43

Nairobi City Development Ordinances and Zones, (2009): A guide of Nairobi City Development Ordinances and Zones. Department of City Planning.

APPENDICES

Appendix 1; Questionnaire to participants and developers on sustainability in Ruaraka Naivas area

THIS QUESTIONNAIRE IS PURELY FOR ACADEMIC PURPOSES.

If you would be so kind in to fill it out in your spare time, it would prove to be an invaluable resource in my thesis research. (PS; There's no right or wrong answer in research)

1. Does the residence advocate or display any form of environmentally friendly practices?
2. Yes; ……. No; ……
   Kindly expound;
   ……
   ……
   ……
3. What would you say is your level of knowledge or know how of good environmental friendly practices?
   Good;……average;……poor;……
   Expound;……
   ……
   ……..

3. Do you experience any form of disadvantages in regards to water efficiency, electricity, environmental degradation in or around you working/living area?

Yes; ……. No; ……

Kindly expound;
……
……
……
……..

4.. How do you handle your waste products from your working/living area?

THANK YOU !