SITUATING THE DISCOURSE OF SUSTAINABLE DESIGN IN NAIROBI, KENYA

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DECLARATION

I, the author, confirm that the Thesis is my own work, I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-mean). This work has not been previously presented for an award at this, or any other, university.

……………………………..

Ng'eno Chelang'at Faith

02.02.2020

"we are all here together, at once, at the service of and mercy of nature, each other, and our daily acts"

(Hawken 1993, p.5)

This thesis is dedicated to my parents;

Alexander Ng’eno

and

Janet Ng’eno

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ABSTRACT

This research investigates the linguistic and material conditions which are currently shaping debate on sustainability and ‘green architecture’ in Nairobi, Kenya. Recently, there has been an ongoing discussion on sustainability and so-called 'green architecture' in Kenya. However, unsurprisingly, the discourse around sustainability is strongly influenced by theoretical concepts and legal regulations produced by and applied in Western Europe, the USA and Australia. This research argues that it is counteractive to discuss sustainable design without asking sustainable for who and by what means. Therefore, it explores the antagonistic relationship between contextual diversity and standardisation of the concept of sustainability within the built environment.

The current discourse depicts a disappointing lack of language, theoretical framework and cultural references embedded within the lives and common practices of Kenyans. Therefore, the need to develop context-based urban landscapes in and by Kenyans that are reflective of their contextual dynamics has not only become opportune but critical. The research argues that in order to construct a situated concept, there must be a critical understanding of contextual dynamics coupled with an appreciation of how these dynamics influence perceptions, assumptions, misconceptions and ultimately the articulation of this concept in the built environment. The research will engage with traces and examples of 'sustainable' practices both in popular discourse and in constructed artefacts (buildings, elements of infrastructure etc.) in order to propose a new (or very old) narrative of and for Kenya to face challenges of a dramatically changing climate and incoming ecological catastrophe.

Through a post- constructivist lens, the study adopted a grounded theory approach for data inquiry and analysis. Having gained an understanding of the context -Nairobi- through document analysis, exploratory focus group discussions with academia and industry stakeholders were conducted as a foundation for data collection. Subsequently, in- depth, interviews with key stakeholders in Nairobi’s building industry were conducted. Finally, data collected from the antecedent methods informed the selection and the analysis criteria for four case building in Nairobi. Taking a grounded theory approach, the research entailed a cyclic continuous comparative analysis throughout the data collection and analysis stages in an attempt to establish emerging concepts, commonalities and variations among the cases and consequently generate theories on the construction of the concept of sustainable design in Nairobi.

The study established an intersection between knowledge construction, power, legitimacy and the discourse of sustainability demonstrating the hegemonic nature of western knowledge when imposed and applied on other contexts, in this case Nairobi. Overally, this study offers a critique of the universal perspective demonstrating the importance of context in the construction and understanding of the concept of sustainable design.

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LIST OF ABBREVIATIONS

BREEAM – Building Research Establishment Environmental Assessment Method

GBCA – Green Building Council Australia

GBRT – Green Building Rating Tool

GHG – Green House Gas

IEQ - Indoor Environmental Quality

IOM – International Organisation of Migration

IPCC – Intergovernmental Panel on Climate Change

ITCZ - Inter tropical convergence zone

KCB – Kenya Commercial Bank

KNBS – Kenya National Bureau of Statistics

LEED – Leadership in Energy and Environmental Design

LRC - Learning Resource Centre

SBS – Strathmore Business School

WASREB – Water Service Regulatory board

UN – United Nations

UNEP – United Nations Environmental Program

UNFCCC – United Nations Framework Convention on Climate Change

UNDESA- United Nations Department of Economic and Social Affairs

USGBC – United States Green Building Council

NDC - National Determined Contribution

NCCRS - National Climate Change Response Strategy

NCCAP - National Climate Change Action Plan

KFS - Kenya Forest Service

CHAPTER 1

The production of knowledge, new knowledge and transformed 'old' knowledge, ideas about the nature of knowledge and the validity of specific forms of knowledge, became as much commodities of colonial exploitation as other natural resources.

Tuhiwai, 1999, p.59

1.0. INTRODUCTION

> *The globalisation of knowledge and Western culture constantly reaffirms the West's view of itself as the centre of legitimate knowledge, the arbiter of what counts as knowledge and the source of 'civilised' knowledge. This form of global knowledge is generally referred to as 'universal' knowledge…*
>
> *Tuhiwai, 1999, p.63*

1.1. GENERAL BACKGROUND

'Sustainable design'. What really is sustainable design? In order to fully appreciate this question, other questions must be asked. Throughout this research the study shall explore a number of questions; primarily, what is being sustained? Who is constructing these definitions, what group(s) do they represent, and what power and agency do those groups hold? Why is it being defined in that manner? What are the underlying biases, interests and evidence presented that support these constructions? And ultimately, how do these constructions influence the articulation of sustainable design? This research shall explore these questions by interrogating processes of knowledge production and their consequent influence with reference to sustainable design theories. Before seeking to provide prescriptive solutions towards sustainability, this research submits that perhaps more importantly the discourse on sustainability should be that of asking questions, the right questions.

Over the last century, several studies have indicated with certitude an impending cataclysmic environmental and more recently socio-cultural catastrophe, that threatens to obliterate human existence as humans currently know it. This predicament is fundamentally a consequence of industrialised and capitalistic civilisation. The vanguard of this catastrophe is arguably the built environment. Industrialisation, coupled with capitalism, has propagated the development of gigantic glass towers in mass concrete jungles as tributes to man's greed. These have little or no regard to ecological consequences or other intrinsic facets, not to mention the phenomenal cost that humans must now begin to pay for their survival.

At the most basic level, the requisite energy from fossil fuels to sustain this development (if indeed it is development) has led to the significant upsurge in atmospheric carbon dioxide concentration. According to the IPCC this has resulted in the rise of earth's global temperature by between 0.7^0 C - 1.2^0 C over the last century (Allen, *et al*. 2018). This rise in temperature is what is commonly referred to as global warming and its consequence, climate change, which is predicted to continue rapidly unless measures are taken expeditiously. Some have argued that the planet has crossed the "tipping point" and there might be nothing that can be done to avoid the impending disaster (Watts 2007). Williamson *et al*. (2003) refer to this plight as "manufactured risk", where humans have exposed themselves to unfamiliar predicaments and therefore lack orthodox knowledge to mitigate these challenges. Gardiner (2006) describes climate change as "a perfect moral storm" (p.398). This he ascribes to the fact that climate change is a culmination of a myriad of complex variables that are likely to affect humans criticality when handing moral questions that surround this phenomenon.

Popular discourse suggest that the challenge of climate change requires a global approach for significant results to be achieved. However, getting states to collectively agree and take responsibility is no simple task. Gardiner (2006) describes the global challenge of climate change as a "tragedy of the commons." On the one hand each state acknowledges the effect of climate change and therefore appreciates the logic of a collective approach to solving the challenge. However, when each state is left with the option then ultimately none of the states will participate, as each will consider personal interests and priorities, choosing to ride on (take advantage of) others irrespective of their involvement and the collective repercussions. This is particularly due to the fact that reducing energy demand and replacing energy sources with renewable energy will have a great social and economic impact on developed industrial countries whose economies depend on this energy, while conversely, it is argued to hamper the ambitions of developing states in terms of technological advancement and economic competitiveness.

These concerns on the effects of human activities on climate can be traced as far back to the early 19^{th} century when Joseph Fourier developed the 'greenhouse effect theory' in 1824. In 1905, Nathaniel Shaler in his book *Man and the Earth* (1905) noted;

> "We may be sure that those who look back upon us and our deeds from centuries to come will remark upon the manner in which we use our heritage and theirs, as we are doing, in a spend-thrift way, with no care for those to come" (p.01).

Jenks (1933) submits "…for the first time in history, humanity rather that the Earth has become the dominant background. The players have become the stage" (cited in Williamson *et al*. 2003, p.2). Humans have become their own worst enemy and now the question is, can humanity survive its self-destruction?

With this realisation, words like ‘preservation’, ‘conservation’, ‘sustainability’, ‘resilience’ and ‘regeneration’ have continued to infiltrate almost every discipline, with sustainability arguably becoming the most popular. However, more often than not, these terms are incorporated into day to day practices without a clear interrogation and understanding of the meanings, philosophies and biases that are embedded within them. What does it mean to be sustainable? What is the impetus to sustainability? What moral principles should guide sustainability? These are some of the questions that inspired this research.

With the increase of global environmental and social consciousness, there has been increasing interest in the discourse of sustainability in response to the continuing global climate and environmental change. Furthermore, there is a growing consensus that the construction industry has been, and continues to be, one of the main contributors to the environmental destruction the world is currently facing. Among other issues, the instigation of mechanical systems as part of building design has led to an enormous increase in the energy demand of buildings. Unfortunately, in some cases, this is due to the disregard of local climate conditions. The construction industry is said to be responsible for approximately 40% of the total global energy consumption. Ebohon and Rwelamila (2002) posit;

> “the construction industry accounts for one-sixth of global fresh water consumption, one-quarter of global wood consumption and two-fifths of global material and energy flows, and almost one-quarter of ozone-depleting gases come from air-conditioning units in buildings. Apart from global resource consumption, the industry also generates waste on a scale that dwarfs most other industrial sectors” (p.2).

This begins to explain why the discourse of sustainability has gained popularity in the building and construction industry. Over the last three decades, the discourse of sustainable design has propagated a profusion of constructs regarding its meaning, appropriate approaches and solutions through a diverse anthology of codes, guides, best-practice notes, standards and other documents. This research argues that these constructs must however resonate with the meaning attributed to them by the people and the environments within the particular context that they are prescribed. Therefore, any document that claims to prescribe solutions or assess a project against specific criteria, must be cautiously interrogated to establish the applicability of the assumptions upon which they are based, to the context they are being applied. Unfortunately, this is seldom the case, especially in ‘developing’ countries. The development of a design that responds to the local contexts hinges on the appreciation that these constructs are presumably going to vary (Williamson *et al*., 2003). In Nairobi, for example, there have been attempts to design buildings that conform to the United States LEED standards, or Green Mark standards originally from Australia, the premise of which is largely based on temperate climatic setting as well as considerably different social, cultural and natural environments.

McLennan (2001) argues that any building that claims to be sustainable must essentially epitomise place. He continues to describe place as the “complex interplay of climatological, biological, geological and topographical features that create the difference we see around us” (p.52). This research goes further to argue that it would be imperative to include the political cultural and economic aspects of a locality to this descriptions. Therefore, taking all these aspects into consideration, it would be impossible and undesirable to definitively determine a universal definition or approach to sustainable design despite continuous efforts of Western knowledge to standardise the concept. Schutz (1962) submits,

> “…strictly speaking there is no such thing as fact pure and simple… There are, therefore, always interpreted facts; either facts looked at as detached from their context by an artificial abstraction or facts considered in their particular setting. In either case, they carry along their interpretational inner and outer horizon” (p.5).

This research will seek to explore the ‘interpretational horizons’ of the concept of sustainability while focusing on the built environment through different contexts and through different time periods.

1.2. CONTEXTUAL BACKGROUND – NAIROBI

> *Sustainable architecture in tropical climate is still an unexplored field, and it is an extraordinary challenge for architects, who should be willing to integrate basic information about building physics and aesthetic, and to abandon the approach, (now old and out-dated) which imitate the architecture of developed countries.*
>
> *UN Habitat, 2014*

Africa's contribution to the global climate and ecological crisis is currently insignificant compared to the 'developed' world. In that regard, should African countries concern themselves with the sustainability discourse? Yes! The consciousness to the consequences of the current predominantly Western practices offers an opportunity for Africa and the rest of the 'developing' world to set out different growth trajectories from those taken by the global North. As Einstein (1946) famously said, "a new kind of thinking is essential if mankind is to survive the move towards higher level" (p.11). This is true in the case of the environmental, social and even economic crisis humanity is currently facing. There is thus an imminent need for the development of alternative wisdoms.

Kenya, like the majority of African countries, contends with the challenge of rapid population growth and rapid urbanisation. Through the last five decades, Kenya has undergone unprecedented growth and has advanced to become a dominant regional player. As Fig. 1.1. illustrates, in 1950, less than 5% of Kenya's population lived in urban areas, but by 2014 however, this figure had risen to approximately 25% and it is projected to get to 50% by 2050 (UNDESA, 2014). This has meant and will continue to translate into a significant growth in the urban built environment. Currently, the UN estimates that the built environment in East Africa is responsible for well over 60% of the energy consumption. Furthermore, it estimates that the building stock in developing countries will increase by 75% compared to European countries (25-30%), by 2050 (UN-Habitat, 2014). Therefore, developing countries have a significant potential, perhaps greater than that of the current developed world, to influence the global climate change scenario in future.

These countries' current capacity for development gives them the opportunity to do things right (different from the Western world); to extend their moral responsibility to the natural environment through design approaches that respect, respond to, and protect the natural and social environment.

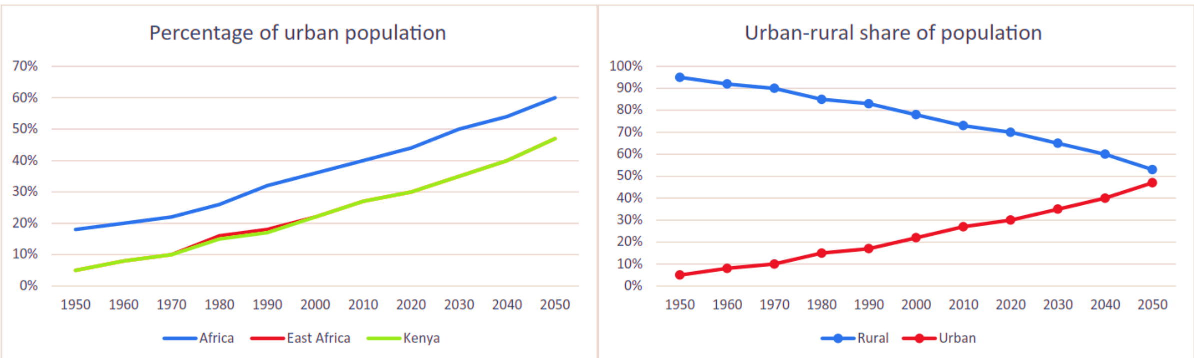

Fig 1.1: Projected urban population and urban – rural share population. Source: UNDESA, Population Division (2014)

Disappointingly however, there has been a considerable tendency to mimic development patterns from the so called 'developed' counties, whose development, as has now become apparent, took place largely devoid of ethical precepts, without reasonable consideration for the natural environment or of the consequences of their 'developmental' choices. This tendency is significantly evident in the building design and construction approaches in Nairobi. Dr. Vincent Kitio (Merab, 2016) the head of the Urban Energy Unit - UN Habitat in Nairobi, comments that the current buildings in Nairobi are "replicas of those designed for the Western world, whose climate is totally different" (para.9). As exemplified in Fig. 1.2, the city's skyline is characterised by juxtaposed glass towers highly unsuitable for the tropical

Fig 1.2: Examples of current building developments in Nairobi Source: kenyaforum.net, nairobiwire.com, constructionkenya.com. Left to Right: The Pinnacle Tower, Archgroup consultant, 2017-2020; Britam Towers, GAAP Architects and Urban Designers and TRIAD Architects, 2013-2017; The One, proposed 2015; Avic Towers, Avic International Real Estate Kenya, 2015-2020

climate and heavily dependent on the use of mechanical systems. These buildings, detached from their surroundings, have reduced the external environment to a "dumping ground" for unwanted air and noise through and from these machines. Olgyay warns against this eventuality in 1963, saying;

> "We must realise, however, that the wide dissemination of Western forms should proceed with caution. These forms evolved from the challenge of cool climates and can pose grave problems when adopted as undigested and inappropriate symbols of cultural progress" (p.9).

On a larger scale, African countries now grapple with two seemingly divergent forces. On the one hand, the desire to develop as modelled by the Western world, and on the other hand, the imminent need for environmental and social consciousness and responsibility. Furthermore, understandably, the ‘developing’ world is reluctant to sacrifice its development to make up for the developmental consequences on the environment of the developed world which evidently is not willing to sacrifice its current way of life.

Despite the growing interest in the discourse of sustainability within Nairobi’s building industry, there is still a considerable lack of understanding of this concept. In an interview (Muiruri, 2012), Musau Kimeu submits that the “lack of proper expertise in environmental design is largely to blame for the slow progress in green architecture.” He further adds that “most ‘experts’ in the field usually incorporate an element or two of green design and then label the project green resulting to misinformation of the general public” (para.5). This concept, referred to as ‘greenwashing’, is a bastardisation of the term “green” or “sustainable” to suit individual interests, with no honest attempt towards sustainability. This would explain the seeming increase in sustainability ‘experts’ in the country’s capital but less apparent real solutions within its building industry. The notion that sustainable design can be achieved through this simplistic approach is far from accurate. The dialectic of sustainable design necessitates a complete change in design thinking that brings design practitioners to the cognition of the complexities embedded within this concept. Unfortunately, for many architects in this region, sustainable design may mean a fundamental adaptation and expansion of their current expertise, or perhaps a more radical approach that involves a complete reshaping of the profession as it is currently known.

Furthermore, professional practice may just be one piece of the puzzle. Perhaps greater change will result from the nature of the training that produces these professionals. McLennan (2004) submits that for sustainable architecture, “the problem is not -necessarily- with the profession itself, but with the way professionals are taught” (p.211). Sustainability demands training that inculcates sustainable design thinking throughout the design process as a pivotal component of, or perhaps the impetus to, any design process. Often, as this research will demonstrate, the academic perception of sustainable design is divorced from the context and largely influenced by Western Knowledge. The development of an in-depth contextual understanding of sustainable design will therefore form the basis for relevant content that can be inculcated into the training of this discourse. This may require a more multi-disciplinary approach to issues that surround sustainable design.

Lastly, for several countries, governance holds a focal place in the quest for sustainable design. Musau Kimeu (Muiriri, 2016), postulates that one of the challenges Kenya faces is the lack of “pressure from the authorities in achieving meaningful green architecture.” He adds that “most government policies are silent on the matter” (para.5). This lackadaisical stance can be attributed to the lack of proper understanding and advocacy that would influence any consequential policy development as well as, and perhaps more importantly, the presence of other challenges that demand higher prioritization. Currently there is no government authority in place in Kenya whose purpose is to actively guide and regulate sustainable design as well as develop and enact legislation that outlines parameter, mandatory minimum building requirements, along with encouraging developers to adopt this concept. Furthermore, any form of framework and legislation would require a team of experts well conversant with this discourse, who can develop a contextual approach taking into account opportunities and challenges that characterise the locality.

Upon this premise, the research was keen to explore how stakeholders in practice, academia, and government construct this concept within the built environment.

1.3. PROBLEM STATEMENT

There has not been empirical research in Nairobi that critically interrogates the knowledge construction and understanding of the concept of sustainable design within the context of Nairobi, and the consequent effects of this understanding on its articulation in the built environment. Previous research areas have addressed issues in relation to sustainable design concerning; thermal comfort and overheating (Nkatha, 2017; Kiamba, 2016), passive design strategies (Kimeu 2016; Kimeu 2018), daylighting (Loki, 2010), building performance (Aste, *et al.,* 2017) and vernacular architecture (Kiamba *et al.,* 2017). Although the term ‘sustainable’ is used as though its meaning is apparent, its meaning is still largely ambiguous and to a great extent dependent on who is defining it. The term could refer to a spectrum of ethical imperatives, ideologies, techniques and approaches. This multiplicity in meaning is exacerbated by the fact that it “connotes both a critique of, and a perpetuation of established practices” (Hagan 2001, p.xiii).

Currently, in Nairobi, almost every design proposal brief includes sustainable design as a mandatory requirement. Similarly, almost every architectural design firm claims to be sustainable in one way or another. This however is not unique to Nairobi. As Sudjic (1996) underlines, since the term sustainability became a buzz word, “for any architect not to profess passionate commitment to ‘green’ buildings is professional suicide” (p.7). Similarly, Hart (2011) is concerned with the manner in which “‘green architecture’ is painted with such a broad brush today” (p.13). Even the slightest gesture towards environmental design is identified as green architecture. Yeang also expresses his disappointment in reference to current ‘green’ architecture practices when he compares it to his ‘lifetime’ devotion of developing the concept of ‘green’ design, protesting that “a lifetime of establishing a coherent theory of ecomimetic architecture can be confused for adding high-tech gadgetry to an otherwise standard structure” (Hart 2001, p.13).

The ambiguous nature of this concept means that it could be translated in various ways depending on who is interpreting it, based on their socio-political and philosophical positions. Therefore, when critically interrogated, there seems to be very little understanding of the concept of sustainable or ‘green’ architecture, not only in Nairobi but across the globe. This situation is exacerbated in ‘developing’ countries like Kenya where the introduction or imposition of international - predominantly Western - standards, techniques and approaches that are often incongruous with the local context is done without critical consideration. Currently, “there is very little information on issues of sustainable building that is adapted to the climate, socio-economic, and cultural context in African countries” (Guedes 2013, p.423).

Aside from the ambivalence and lack of proper understanding, there is an obvious bias within the sustainability discourse towards the developed world. As Du Plessis (1999) highlights, one of the fundamental gaps in the global agenda of sustainability discourse is “the almost complete absence of the agenda of the developing world and its problems” (p.378). Through Western literature, narratives have been told and retold that define and scope ‘global’ environmental and social challenges based on a ‘Western’ lens, while continuing to aggrandize Western knowledge, giving it legitimacy over other forms of knowledge. There is therefore a need to interrogate the place of Western science and technology as a global force that influences sustainability rhetoric.

Furthermore, the notion of globalisation has continued to perpetuate Western hegemony especially over developing countries. It propagates not only the claims that there is a possibility of understanding and explaining the world as a whole, but also that it is desirable to do so. Robertson (1992) describes globalisation as the “compression of the world and the intensification of the consciousness of the world as a whole” (p.8), that encapsulates a

"…massive two-fold process involving the interpenetration of universalisation of particularism and the particularization of universalism" (p.100). This idea of globalisation has resulted in the rise of Western cultural imperialism guided by a capitalistic system under the label of modernity, coupled with the simultaneous destruction of local cultures, ethics and values. The Agenda 21 for Sustainable Construction in Developing Countries (Du Plessis *et al.,* 2002) recognised that the construction of meaning of this concept is underpinned by ethical and cultural attitudes and therefore cannot be universal.

Western knowledge epistemologies, however, are often predicated on homogenisation and advancement of 'universal' truths that fail to appreciate global diversity while supressing other knowledge forms. African countries have experienced "numerous attempts at homogenisation: first the colonial 'civilisation' project, then 'modernisation' and now 'globalisation'…" (Du Plessis 2005, p.3). Consequently, the notion of knowledge transfer is typically discussed as moving from the West to developing countries and almost never vice versa. As a result, there have been deliberate attempts to universalise and globalise concepts like sustainability, and by extension sustainable design, through a profusion of standards, codes, guides and assessment systems. However, the idea that there exists a standard 'international' methodology to sustainable design is diametric to the essence of concept. The inefficacious nature of the attempts to generalise definitions and strategies is also highlighted in the 1999 International Council for Research and Innovation in Building and Construction (CIB) report, Agenda 21 on Sustainable Construction (Bourdeau, 1999). It has become apparent that often the implementation of these so called global agreements and approaches is far off the mark of what was intended.

Taken together, as Grosfoguel (2012) submits, "if universal truth is constructed through the epistemology of a particular territory or body…and through the exclusion of others, then… the global proposal that is constructed through this abstract universalist epistemology will be inherently imperialist/colonial" (p.94). Furthermore, Connell (2007) highlights that "the very generality of general theory (global theory), the aspiration to universal relevance, implies that the genre could escape from local determination" (p.28). This calls into question the relevance of 'universal' knowledge in different contexts. Evidence suggests that the current discourse of sustainability in Nairobi lacks local self-determination. There is, therefore need for a radical departure and reorientation from Western Eurocentric philosophical traditions of 'general' thought to the specificity that comes from situated knowledge through the reconstruction and revalidation of indigenous thought.

By way of conclusion, it is worth noting that having left her home country, Kenya, in pursuit of 'better' education in a Western institution, under the tutelage of two 'Western' supervisors, the researcher recognises her positionality with regard to the forgoing argument as an example of the systemic nature of the problem on the one hand and as part of the problem and on the other, as a victim of the problem.

1.4. CONCEPTUAL FRAMEWORK

The research shall argue that for sustainable design to be achieved, the environmental and social challenges that require solutions in a particular context, and the ethical precepts upon which the solutions shall be based, should be critically interrogated. This will therefore be governed by the following fundamental questions; what contextual environmental issues should be solved? And what ethical values govern the selection of these solutions? The research is cognisant that while there are several considerations in achieving sustainable design, the foregoing considerations are the most important. The take off towards any sustainable design thinking is an understanding of the contextual, ethical, and mental disposition that forms the premise for design thinking. Therefore, arguments on environmental ethics will draw from the works of philosophers like Aldo Leopold, Arne Naess, John Passmore, Peter Singer, and Paul Taylor among others.

Consequently, the research will draw connections between sustainable design philosophies and the diversity of contexts. The study shall explore the history, evolution and construction of sustainable design as a discourse, while establishing its plurality in meaning and understanding of the concept, drawing from the works of Jason McLennan, William McDonoughy, Simon Guy, Stephen Moore, Graham Farmer John Dryzek and Chrisna Du Plessis, among others. Furthermore, while taking into consideration the plurality of this concept as a consequence of its contextual construction in different contexts, the research will move to critically analyse different approaches to sustainable design while considering the ethical underpinnings and embedded biases that surround these approaches, focusing on climate responsive design, nature driven design, and influence of place and culture as well as the role of technology. These discussions will be influenced by the works of Ian McHarg, James Steele, David Lloyd Jones, Klause Daniels, Catherine Slessor, Rapoport, and Rudofsky among others.

The research shall also explore sustainable design as a complex and dynamic approach to designs, that should be viewed as a process (practice) rather than the product. In other words, a horizon to aspire towards rather than a set of goals to be accomplished. This therefore means that sustainable design does not take a linear progression but is rather characterised by a series of fragmented elements that interact with each other in a back and forth manner. In doing so, the research will try to understand how sustainable design relates to other processes within its environment. This will be done through exploring relational theories such as systems theory, integral theory and holism, and the way in which they can be applied to sustainable design.

1.5. RESEARCH QUESTIONS AND OBJECTIVES

It is not the ambition of this research to introduce yet another definition to the overabundant existing definitions of sustainable design, but rather, it is the intention of this research to interrogate the antagonistic and paradoxical relationship between contextual diversity and the standardisation of the concept that exists within the discourse of sustainable design through Western literature. This shall be done by critically interrogating the sustainable design discourse and practices in Nairobi, with the aim of identifying and understanding the implications of globalisation on, and embedded biases present in, the knowledge constructions of the discourse that have a consequent effect on its articulation within the built environment. In doing so, the evaluation attempts to establish the situatedness of this concept in the context of Nairobi.

1.5.1. ULTIMATE QUESTION

How does knowledge construction of the discourse of sustainability influence the understanding and articulation of this concept in the built environment?

1.5.2. SPECIFIC QUESTIONS

1. What local dynamics affect and influence the construction of the concept of sustainable design?

2. What are the various constructions of the concept of sustainable design according to different stakeholders in Nairobi?
3. How do the different constructions of this concept by competing stakeholders affect the process and outcome of sustainable design?
4. What are the embedded dynamics that influence the construction of the concept of sustainable design in Nairobi?

1.5.3. RESEARCH OBJECTIVES

1. Identify the local dynamics in Nairobi's built environment that would affect and influence the construction of the concept of sustainable design.
2. Interview key stakeholders in Nairobi's building industry to understand how they construct the concept of sustainable design.
3. Assess the influence of the stakeholder's construction of sustainable design and their power dynamics on existing approaches and processes in sustainable buildings in Nairobi.
4. Establish a theoretical analysis of the construction of the concept of sustainable design through the synthesis of data collected.

1.6. RESEARCH METHODOLOGY

The research takes a post-constructivist approach arguing that meaning is embedded in the complex relationship between society, nature and material reality within a particular context (Knol, 2011; Wehling, 2006, Asdal, 2003). Therefore, ontologically, construction of meaning is relative to the context in which it is constructed which epistemologically for this research translates to exploring the human and non-human actors that interact to shape the concept of sustainable design in Nairobi.

On this premise, the research adopted a flexible qualitative approach. While adopting a constructivist grounded theory approach, through use of reflective, comparative and inductive techniques, the research employed several methods to gather, synthesize and analyse context-specific data. This research employed four methods of data inquiry: document analysis, focus groups and interviews key stakeholders in Nairobi's built environment as well as case study analysis of four building selected through purposive sampling. Fig.1.3 summarises the research design and strategy.

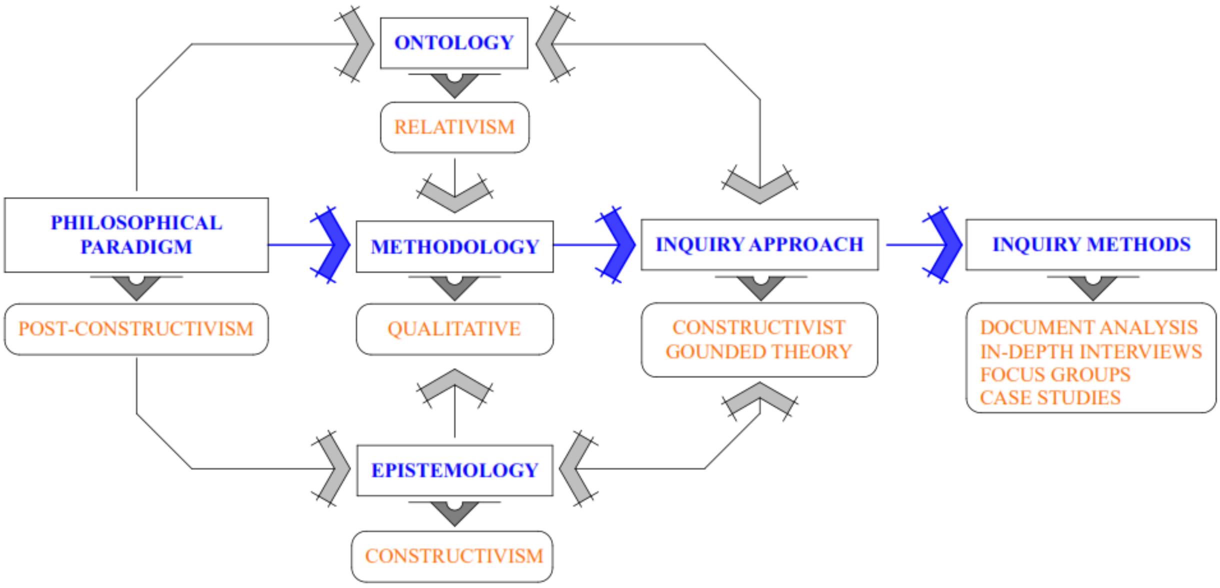

Fig. 1.3: Summary of Research philosophical paradigm and methodological approach. Source Author: 2018

Chapter 3 shall present a detail account of the philosophical stance and methodological approach

1.7. THESIS STRUCTURE

Following the introduction of the research, its conceptual framework and its objectives, this section presents a synopsis of the subsequent chapters that seek to address these objectives. The research will be divided into eight chapters as follows:

CHAPTER 2

Through a literature based review, this chapter begins with an attempt to understand the relationship between humans and nature. Are humans subjects, stewards or masters of nature? Or, are they equal parts of, and in, nature, with mutual dependency? Or instead, is 'mother nature' a wealth of resources for humans to exploit? This will be followed by an exploration of the global historical and evolutionary process of the concept of sustainability and by extension sustainable design. Subsequently, the chapter considers various constructs of this concept by evaluating different ideological approaches to sustainable design. This chapter concludes with a review of the multiplicity of the concept of sustainable design as a result of contextual diversity, advancing a justification for the need to establish the situatedness of this concept when applied in particular contexts.

CHAPTER 3

Gives a detailed account of the philosophical underpinnings that guided the research, as well as the selection and justification of the methodological approaches and inquiry methods employed in the research. It will also outline ethical considerations of the study. The research appreciated the plurality of sustainable design and adopts a post-constructivist perspective arguing that sustainable design should be understood as a practice and specific to the understanding and interpretation of a particular society within a particular natural context and material reality. Therefore, it cannot be universally similar. Against this background, the research adopted a qualitative methodology utilising a constructivist grounded theory approach. Through a reflective, comparative and inductive approach the study employed several methods to gather, synthesize and analyse context specific data. Four methods of data inquiry were employed; document analysis, focus groups, interviews and case study analysis.

CHAPTER 4

This chapter attempts to address objective one, by presenting a detailed analysis of the research context, Nairobi, with reference to the development of a sustainable built environment. It highlights the evolution of Nairobi's built environment, as well as the socio-cultural, political, economic and environmental dynamics that influence and affect the built environment. The chapter concludes with a comparative analysis of green building assessment systems present in Nairobi.

CHAPTER 5

In an attempt to address objective two, this chapter advances an analysis of various constructs of the concept of sustainable design from the perspective of different key stakeholders in the context of Nairobi's building industry. While doing so, the chapter attempts to understand the embedded local and global dynamics that influence these constructs of the concept.

CHAPTER 6

Engaging with objective three, this chapter moves to analyse four case buildings, both as processes and artefacts. Beyond analysis of the physical attributes of the buildings, the research identifies both the human and non-human dynamics that influenced decision making during the design and construction process and which resulted into the various solutions.

CHAPTER 7

Having analysed the contextual dynamics, the stakeholder constructions of the concept of sustainability, and the case study buildings, this chapter moves to address objective four by triangulating and synthesising the analysis from the foregoing three chapters, advancing a theoretical analysis of the constructions of the concept of sustainable design in Nairobi.

CHAPTER 8

This chapter begins with a reflection of the research objectives and questions and presents a synopsis of how the research responded to these questions. Finally, the chapter highlights areas for further research.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

The complexity of the concept of sustainability is compounded by the fact that beyond environmental issues, it is intimately bound up in several other broad issues, among which are, development, governance, globalisation, global economics, cultural diversity and ethics. This literature review attempts to evaluate aspects of ethics, time and place, and of actor agency and responsibility, that interact to influence the construction and articulation of the concept of sustainability, particularly within the built environment. Fig 2.1 illustrates the literature review conceptual framework. This research argues that in appreciating, interrogating and testing assumptions embedded in these aspects a situated understanding of the concept can be reached.

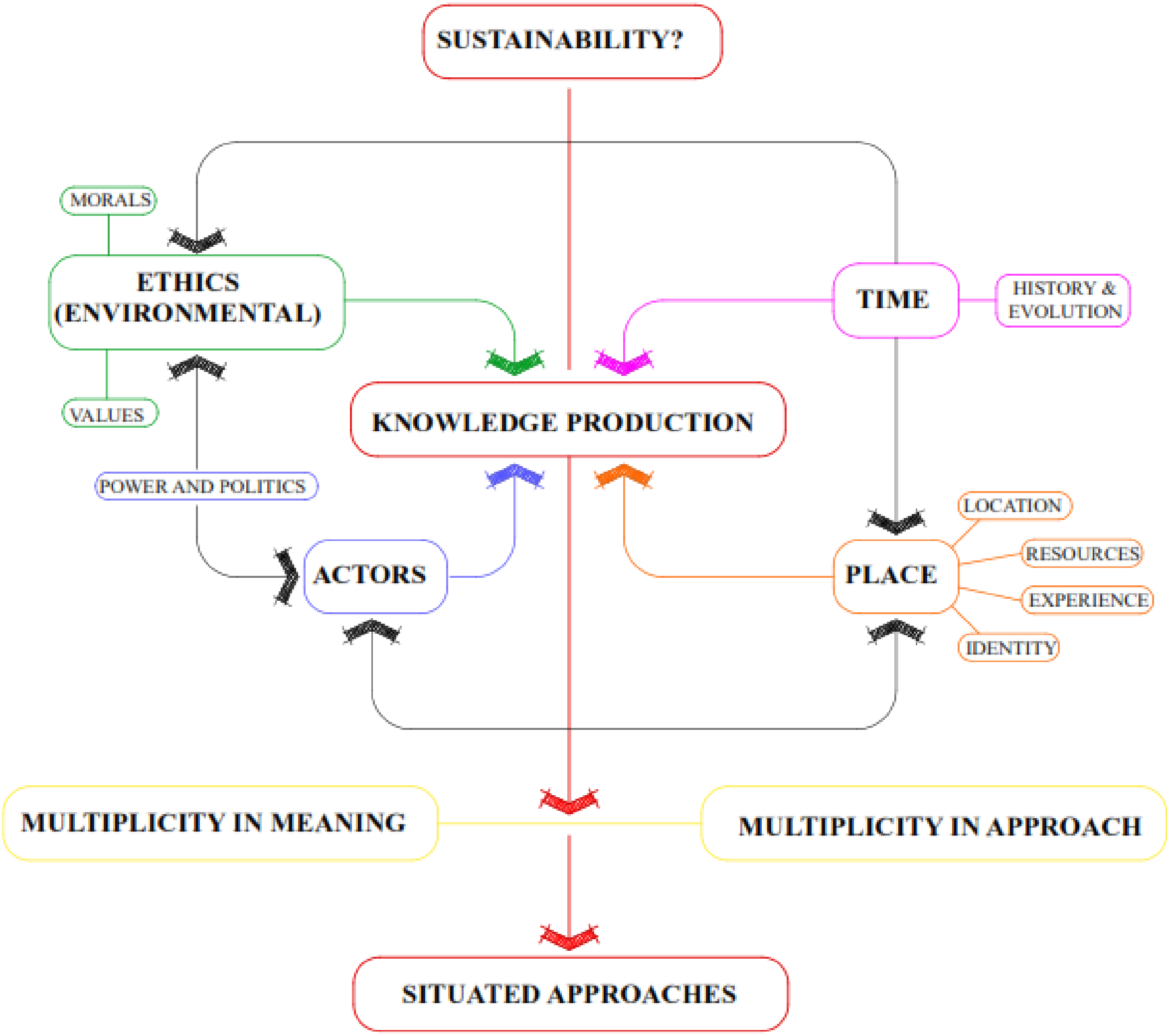

Fig. 2.1: Literature Review: Conceptual Framework. Source: Author (2019)

At its core, sustainability is an ethical and philosophical practice (McLennan 2004, Robinson *et al*., 1990, Fox, 2000, Brenda and Robert Vale, 1996). Therefore, this chapter begins by exploring the philosophical and ethical underpinnings that surround the relationship between humans and their environments, in an attempt to understand the values that inform the characterisation of the problem(s), guide the choice of solutions and the means to arrive to those solutions, and to provide a basis for questioning other decisions and solutions. Subsequently, the chapter shall explore the history and evolution of the concept of sustainability in relation to sustainable design while investigating how this concept has been constructed and transformed by science, global phenomena and political positions.

With this as the background, the chapter shall move to explore the plurality and contested nature of sustainability, highlighting various distinct (though possibly interconnected) ideological approaches to sustainable design. In response to the foregoing discussions the chapter will end with a justification for the need to situate this concept within an African ('developing' world) context.

2.2. SUSTAINABILITY AND ETHICS – MAN VS. THE ENVIRONMENT

> *"If ethics deals with the standard by which human actions can be judged right or wrong, appropriate or inappropriate, then the notion of a 'sustainable' architecture … is fundamentally an ethical issue."*
>
> *(Williamson and Radford, in Fox 2000, p.57)*

Humanity has for a long time ignored that with regard to man's relationship with nature, to fight for, is to fight against. As humanity fights for supremacy over nature it causes destruction to its very support systems; in essence humanity is fighting against itself. Humanity has viewed itself as independent of nature, notwithstanding how impossible it is to divorce humanity from the environment; any alteration of the environment has a direct or indirect effect on humanity. As Session (1977) suggests, "modern technological society finds itself in a highly precarious and unstable relationship with the whole of nature" (p. 482).

Robinson *et al.* (1990) refer to sustainability as a "normative ethical principle" (p.38), observing that on one hand humanity depends on the biosphere for survival but conversely there seems to be a lack of understanding of the intricacies, complexity and interdependent nature of the biosphere. Humans being as an integral part of nature requires a critical evaluation of humanity's place in and contribution to nature's fabric.

The built environment is in one way or another grounded in a particular view of nature. Sustainable design is predicated on, and demands an interrogation of, the relationship between the built environment and the natural environment. Hagan (2001) highlights the duality of nature as "material reality and as a cultural construct" (p.17). Nature as material reality refers to the objective, quantifiable dimension that is not bound by time and exists outside various possible lenses and interpretations. As a cultural construct however, nature is defined by a spectrum of ethical, political and linguistic nuances.

Before looking into the relationship between nature and sustainability or sustainable design, it is imperative to understand the relationship between humans and by extension between human activity and nature. This relationship is best explored in the discipline of environmental ethics. The term "ethics" is a derivative of the Greek word "ethos" that means "custom" and is focused on how man should behave. Leopold (1948) argued that the premise for all ethics is "that the individual is a member of a community of interdependent parts" (p.2). Ethics therefore dictates the manner in which humanity relates with these interdependent parts. This is made possible by humans' capacity to reason, which is what separates humanity from all else. He further asserts that man possesses a natural antagonistic relationship between his instinct and his ethics, where his instinct begets competition and his ethics, co-operation. For even inanimate objects exist through their capacity to deprive other objects the space they occupy, and their growth would necessitate either obtrusive displacement of other objects in their way or coercive assimilation. This is the presupposition that necessitated and continues to inspire the discourse of ethics.

Environmental ethics falls under the philosophical discipline of applied ethics which seeks to relate ethical principles to realistic contexts. Des Jardins (1993) postulated that "environmental ethics presents and defends a systematic and comprehensive account of the moral relations between human beings and their natural environment" (p.13). In that regard, it is "concerned with examining any and all questions that arise with respect to a moral agent's interactions with any and all aspects of the world around her or him" (Fox, 2000, p.1). Therefore, it can be argued to be the "link between theory and practice, (that) translates thought to actions, worldviews into movement…behaviours are thus guided by an underlying ethic" (Merchant 1992, p.62). This discipline is significantly influenced by the works of philosophers like Aldo Leopold, Arne Naess, John Passmore, Peter Singer, and Paul Taylor among others.

Morality, which is the knowledge of the variance between right and wrong, is justified under two main ethical theories; utilitarianism and deontology. Utilitarianism argues that right or wrong is judged by the consequence of the action. If the consequence is generally positive, then the action is deemed moral. The end therefore justifies the means. Deontology on the other hand argues that morality is judged by human intrinsic duty and responsibility to, as well as rights possessed by, an entity. According to Kant, human intentions are said to be ethically good if 'the maxim on which we act is a rational one' (Des Jardins, 1993). Ethical theory consciously and unconsciously influences the manner in which man cogitates his arguments and ultimately makes decisions, which will be apparent in the foregoing sections of this chapter. Thus, it is imperative that we acknowledge and understand these theories.

From an environmental perspective, the utilitarian argument that actions that have a greater benefit to humans are morally justifiable, can be argued to have been the impetus for the development that has resulted in the destruction of the environment. Man has viewed advancements such as electricity, speed engines, skyscrapers and other equivalents, as great benefits to the majority of humanity. However, this benefit has come with an even greater harm to humanity. If one takes a village, for example, that depends on a river that passes through the village for water and food, but does not have electricity. A proposal to use that river to generate electricity can be said to create a greater good for the village. This greater good however is a pyrrhic victory as the electricity generation will potentially destroy the village's source of food and water, and thus the justification of common good is challenged. Humanity is currently facing a similar conundrum on a global scale as a result of this outlook. Utilitarian theory also faces the challenges of defining what counts as a majority and how this greater good can be measured objectively. Furthermore, due to it is consequential approach, it may be difficult to predict all the consequences of certain actions.

It would be difficult to justify sustainable design using this approach, given that sustainable design, despite having a global impact, is largely local; hence the more general approach of greater good may not be relevant in this case. Subsequently this approach looks at one set goal and irrespective of other consequences the action may have, provided that the greater good is met the rest of the consequences are often not accounted for. This is contrary to the relational systems thinking approach, which this research argues should govern sustainable design.

Conversely, an environmentalist deontological approach would perhaps argue that man has a duty to nature and nature to man. From this perspective, taking care of nature is tantamount to taking care of man. This should, however, not be confused for an anthropocentric approach that argues nature should be taken care of for the benefit of man, but rather, man is nature and thus protecting nature is protecting man. This concept was well understood before modern technology, when a deep respect and reverence for nature existed. Unfortunately, the same cannot be said for the recent generations. For a long time, man has continuously 'raped' nature, and now nature is beginning to retaliate. The current generation's approach to nature should therefore be that of moral restitution and not humanity's salvation as is being championed; there should be advocacy for duty for duty's sake, and not because of the consequential benefit.

Ethical theories also inform and influence our perspective on nature's value. Man's ethical responsibility to nature has often been a consequence of the value man attaches to nature. This value can be explored through two distinct perspectives; 'intrinsic' value and 'instrumental' value. The intrinsic value perspective argues that nature has value in itself. It is value that is not derived from or accorded by an external entity. Des Jardins (1993) attributes intrinsic value to "symbolic, aesthetic, or cultural importance." He adds, "we value them for what they mean, for what they stand for, for what they are" (p.145). This argument is in tandem with the deontological ethics; just like duty is accorded for duty's sake, intrinsic value is value for its own sake. Because intrinsic value is not quite tangible it is harder to explain and often impossible to quantify, thus a great deal of scepticism surrounds the subject.

Conversely, the instrumental value perspective argues that nature is valuable only to the extent of its usefulness to man, thus making it conditional. This value could be economic or otherwise. For example, a plant's value can be based upon its ability to provide food or forest its ability to provide wilderness experience for man's pleasure and well-being. More significantly, mans industrialised, predominantly capitalist society's perception of nature gives far greater importance to the value of nature primarily based on its economic benefit to humanity. It thereby takes what Naess refers to as a "shallow approach" to resources, where the value of resources is assigned a market value and this value is used to conserve the resource because only those with the technological capacity and finances can exploit it. Aside from economic gain, emphasis on what is commonly referred to as the "wilderness experience" has gained popularity. There have been several theories on the positive effects humans experience through interaction with nature. The aesthetic, serenity and tranquillity of nature has often been associated with its ability to rejuvenate and revitalize, thus, once again perpetuating the anthropocentric approach.

Consequently, Taylor's (1968), in his book '*Respect for nature'* argues that environmental ethics will require a shift in man's view of nature, to what he terms a bio-centric view. He also posits that all living things have 'a good in their own', which he terms "inherent worth". He further proposes that if one can definitively suppose that an action is good or bad for something, separate from any other thing, then that thing has "a good of its own" (p.61). In his defence for his bio-centric approach he argues;

> "The central tenet of the theory of environmental ethics that I am defending is that actions are right and character traits are morally good in virtue of expressing or embodying a certain ultimate moral attitude, which I call respect for nature" (p.80).

His arguments assert that a living thing is said to have good on its own as a result of its ability to react to harm or benefit that it is accorded both directly and indirectly. A plant, for example, will grow and bloom if the benefits of pruning and watering are granted to it, and it shall suffer harm if they are denied; they therefore warrant duty from a moral entity. Des Jardins (1993) affirms that "having a good of its own makes it possible for a living thing to be the object of human duties" (p.156). The verity that they have life notwithstanding their consciousness to it, warrants protection of that life, thus proving that they have inherent worth following Des Jardins, argument, "to say that an entity has inherent worth is to make a normative claim that this entity deserves moral consideration and that moral agents have duties toward it" (p.153).

Man's trivialization and devaluation of nature has made it easier for the impetuous exploitation that has robbed nature of its intrinsic value. Similar to Taylor, Hagan (2001) explains:

> "Environmental ethics maintains that the instrumental exploitation of nature as a means to our ends must be replaced with a view of nature as an end in itself, with its own imperatives from which we cannot stand apart" (p.55).

This argument disapproves of man's superiority and dominance over all else – nature – and advocates man's symbiotic relationship with all else, as just one of the components of the environment. She further suggests that "the primacy of nature over culture is not derived from its value to us, but from value intrinsic to itself" (p.66). This reiterates the argument that nature's value goes beyond just its benefit, mostly economic, to humanity. Leopold (1948) suggest a much greater value of land – nature – that goes beyond economic value in a more "philosophical sense". Naess (1995) refers to this approach as "deep ecology". He, in the first of his eight points on "deep ecology", advances that "the well-being and flourishing of human and non-human life on Earth have value in themselves…these values are independent of the usefulness of the non-human world for human purpose" (p.68). His argument is relationship oriented and sees man as part of nature. Passmore (1974), after vividly describing the deplorable state of the post-industrial west, concludes that "only if men can first learn to look sensuously at the world will they learn to care for it" (p.189). Guy and Farmer (2001) share this position through their "ecocentric-logic" and argue that meaningful change would require a "radical configuration of values – given that – as a framework of analysis it emphasises both the epistemological holism implicit in ecology and the metaphysical reality of ecological wholes" (p.142).

The discourse of environmental ethics suggests a bio-centric approach in reference to man's relationship to nature. However, critics of this bio-centric approach and "deep ecology", like that of Watson (1991) argue that humans characteristically have significantly altered their environment and continue to do so. Watson suggests that the most effective approach to motivate humans towards ecological perspective is an anthropocentric approach. He posits that "there is a very good reason for thinking ecologically, and for encouraging human beings to act in such a way as to preserve a rich and balanced planetary ecology: human survival depends on it" (p.118). In his argument this approach is likely to be more effective because man's view of nature has become increasingly utilitarian. Man is in constant pursuit of ways to take advantage of natural resources for self-gratification, abandoning his moral responsibility that should ideally transcend self-interest. Similarly, some economists' and nuclear physicists' arguments are more optimistic concerning the depletion of resources. McRae for example, cited by Passmore (1974), writes "my own guess, is that we will have embarrassingly large fuel surplus"; he predicted that this will be the case by 2012. This evidently is not the case. He adds that "nuclear fusion should (by that time), give to mankind a virtually unlimited source of industrial power" (p.75). However, even with the optimistic approach that natural resources can be replaced by other substitutes, the need for natural resources cannot fully be supplanted nor its availability and reliability ascertained, but even greater is the unpredictable nature of its effects on the environment.

The epistemological complexity and diversity regarding the relationship between man and nature will continue to spur debate. The relevance, to this thesis, of the foregoing discourse on environmental meta-ethics is based on the presupposition that ethical and value precepts are the foundation of any decision-making process. Therefore, in the process of making decision towards a sustainably designed future it is imperative to interrogate the ethical and value precepts as the conceptual basis that influences these decisions. This research agrees with Des Jardins' (2001) argument that for change to occur there is need for a "radical change in our philosophical outlook" (p.215). Ultimately, significant change would require radical interrogation of existing ethical value precepts. Man must therefore embrace this reality and adopt the necessary mind shift towards a "new normal" that will involve a significant change in the human daily mode of operation basally as individuals, then as organisations and ultimately as states.

2.3. AN OVERVIEW OF THE HISTORY AND EVOLUTION OF SUSTAINBILITY

> *"who were the main antagonists, what were the means of transition, who were the agents of change and what was the vision they were striving towards, what/who was to be sustained…"*
>
> *(McManus, 1996, p.54)*

Sustainability and by extension sustainable design are still abstract and controversial concepts that would perhaps require a more philosophical approach in order to understand the discourse. Often this discourse raises more questions than answers, and thus, any attempt at understanding this concept would require a rigorous analytic process that explores the diversity imbued in this phenomenon through raising questions that more often than not beget more questions. Dryzek (1997) suggests that the essence of the concept of sustainability could be equated to that of democracy, as a concept that begs its understanding as a discourse as opposed to a distinct set of parameters. This research presupposes that sustainability should be understood as a dynamic course to strive towards. Thus, it is a process that may have a beginning – or many beginnings – but not necessarily a distinct end. This section will attempt to highlight some of the beginnings, theories and approaches that surround these two related concepts.

The term sustainability certainly did not originate from the field of architecture, and like many concepts, the origin of sustainability cannot really be traced to one particular time or place, and nor does its development take a linear progression, but rather a more collateral progression. McLennan (2004) explains that "no movement or idea has just one start but many threads of cause and effect that trickle down through centuries" (p.10). This is true for sustainability; even before the term sustainability was coined, the ethos of this concept was evident within indigenous communities. Furthermore, as Steel (1997) suggests, sustainability as a term is "coloured by the political, economic, social, and psychological climate of the here and now and makes it particularly prone to dating" (p. ix). The move towards sustainability, hinges, however, on two salient presumptions. One, humanity's increasing population, industrial and technological advancement, coupled with its way of life, all have atrocious ramifications for the environment and consequently humanity's existence. The other is humanity's responsibility towards the environment and its existence (McLennan, 2004). Kidd (1992) elaborately discusses seemingly independent but nonetheless concomitant ideological positions that have their roots in the discussions on "population growth, resource use and pressure on the environment" (p.5), which can be argued to have correlatively and cumulatively given rise to the contemporary concept of sustainability.

On a global scale, the concept of sustainability gained prominence through the notion of sustainable development that took root towards the end of the 20th century. Perhaps the most quoted definition related to sustainability is the definition of sustainable development established by the World Commission on Environment and Development (WCED) in 1987. This definition was put forward in the Brundtland report (1987) and is now commonly referred to as Brundtland definition, which postulates, "Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability for future generations to meet their own needs" (p.8). It is interesting to note that, before the Brundland definition, other similar ideologies had been developed. Ignacy Sachs (1977) cited in Kidd (1992) for example, coined the term "eco-development" which he defined as "an approach to development aimed at: harmonising social and economic objectives with ecologically sound management, in the spirit of solidarity with future generations" (p.12). By definition, Sachs' concept of 'eco-development' is almost identical to the Brundtland definition of sustainable development.

The Brundtland report subsequently posits that sustainable development is "a process of change in which the exploitation of resources, the direction of development, and the institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (p.46). Following this, Brennan *et al.* (2016) pose an interesting question; "what exactly does sustainable development seek to sustain?" (para 8). The answers to this question may begin to disambiguate this concept that is often perceived as vague and perhaps provide a clearer course of action.

Long before the Brundtland definition or sustainability as a discourse, environmental concerns had been raised for over a century of the suggested rise in atmospheric carbon dioxide, industrial chemicals and rapid population growth gave rise to environmental concerns and began the environmental movement. The commencement of the industrial revolution in the 18th century was perhaps the most significant beginning of environmental change as the demand for coal as a source of power began to increase. During the 19th Century, concerns about the effects of industrialisation on the environment began to rise. In 1824, Joseph Fourier put forward the "greenhouse effect theory" suggesting a relationship between the earth's atmosphere and the planet's temperature in advancing the global warming effect. Similarly, in 1844, Alexander von Humboldt argued that human activities were changing and would continue to change the global climate. Consequently, scientists such as Eunice Foote, who in 1856 ran experiments that suggested an increase in carbon dioxide in the atmosphere affected earth's temperature. John Tyndall, who in 1861 argued that atmospheric warming is directly related to the use of fossil fuels that increase carbon dioxide in the atmosphere which blocked infrared radiation, and Svante Arrhenius who in 1890 calculated the effect of carbon dioxide on climate change and hypothesised that a six degree increase on global temperature would result if the concentration of carbon dioxide in the atmosphere doubled, are among several scientists who advanced warnings on the effects of human activities and fossil fuels on the global environment. More significantly, the 'Keeling curve' produced by Charles Keeling in 1958, was perhaps the first definitive data set that revealed increasing concentrations of atmospheric carbon dioxide (Outrider Foundation, 2019).

In addition to concerns about the effects of the rise of atmospheric carbon dioxide, other significant contributions to the commencement of this environmental agenda arose from ecological concerns. The works of Rachel Carson, for example, in her book *Silent Spring* in 1962, drew attention to the significant effects pesticides and other industrial chemicals have on the environment's ecological system. Subsequently, in 1968 Paul Ehrlich in his publication *The Population Bomb* highlighted the negative consequence of rapid population growth, especially with regard to a strain on resources, and began advocating the use of renewable resources. Similarly, the Club of Rome under the leadership of Aurelio Peccei, argued against a market economy advocating for a collective global commitment to curb economic growth marked by Donella and Dennis Meadows's 1972 publication, *The limit to growth*. These sentiments were echoed by Riddle in *Ecodevelopment* (1981) where he reiterates the idea that the ecosystem has a specific "carrying capacity" that if exceeded would have adverse effects of the ecosystem (Kidd, 1992). In addition, Fritz Schumacher in his book *Small is Beautiful: Economics as if people mattered* (1973), underscored the destructive nature of humanity's quest for economic power and the pursuit of lifestyles based on accumulation of wealth with no regard for their consequences (McDonough & Braungart, 2002). Evidently, sustainability as a concept encapsulates a strong environmental agenda and a realisation of the limits that result from economic growth. Reports and publications of this nature were/are often not well received by economists and politicians, considering the implications of a 'zero – growth' economy.

Following scientific evidence, increased environmental literature and global concerns, the Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organisation (WMO) and UN Environmental Programme (UNEP), and has since become the central platform for international negotiations on environmental and climate change matters. In 1990 the IPPC published their first report that agreed with what scientists had argued since the beginning of the 19th century, linking human activities to increased concentration of atmospheric carbon dioxide. Consequently, the UN Framework Convention for Climate Change (UNFCCC) was formed as a global treaty that was adopted during the 1992 Earth Summit in Rio, where 196 international parties became signatories to the convention enforced in 1994. The UNFCCC outlined each party's responsibilities towards the reduction on carbon dioxide emissions and mitigation of the impacts of climate change, based on their capabilities. Following the UNFCCC, the 1997 Kyoto Protocol was another significant milestone for the IPCC as the first treaty aimed at reducing greenhouse gas emissions and outlined legally binding targets and timetables for developed countries that entered into force in 2005 (UNFCCC, 2019).

However, challenges with the Kyoto Protocol necessitated the development of an alternative framework, the Copenhagen Accord, which similarly could not be formally adopted as parties failed to reach an agreement. Several Commitment of Parties (COP) talks were held before the Paris Agreement of 2015 that compounded the Kyoto Protocol, the Copenhagen Accord and the interim Cancun Agreement, came into force in 2016. The Paris Agreement outlined common binding procedural commitments that required each county to develop nonbinding national determined contributions (NDC). However, it appears that the only legally binding aspect of the agreement is for countries to submit five – year plans and regular progress reports. The flexibility that arises from nationally determined targets translates to some countries having very ambitious plans while others have indolent targets. This flexibility coupled with no clear penalties in the event targets are not met, means the agreement relies on the hope that countries will genuinely cooperate.

During the same period, with regard to architecture, several local and global initiatives were developed to address environmental concerns. In 1989 Bob Berkebile, an architect from Kansas City concerned with the effects the profession had on the environment, partitioned the American Institute of Architects (AIA), through a resolution he termed "Critical Planet Rescue" (CPR), to establish a committee that would consider environmental matters in relation to architecture. Despite the resolution being initially declined by the AIA board, Berkebile managed to convince the board, with backing from other architects, during the 1989 AIA convention, resulting in the formation of the AIA Committee on the Environment (COTE). The influence of the committee gained market interest. In order to accommodate market interest while allowing the committee to focus on sustainable architecture as a science, the US Green Building Council (USGBC) was formed in 1993. Subsequently, the USGBC developed the US Leadership in Energy and Environmental Design (LEED) as a rating system for 'green' buildings. This currently has the greatest green building rating tool global footprint (Szczepanski C. 2008, Barth 2018). This was shortly after the UK Building Research Establishment (BRE) launched the Building Research Establishment Environmental Assessment Method (BREEAM) in 1990. Assessment systems have had a significant influence on how the concept of sustainable architecture is constructed, perceived and consequently articulated in the built environment. Chapter 4 of this thesis will further discuss assessment systems.

At a greater global scale, in tandem with the UNFCCC efforts, the International Union of Architects (UIA) has made efforts to propagate the sustainable design agenda in response to the global agreements outlined above. Following the 1992 Rio de Janiero Earth Summit, the International Union of Architects (UIA) held the World Congress in Chicago in 1993, the outcome of which was the "Declaration of interdependence for a sustainable future." This was a commitment towards the profession's environmental and social consciousness and responsibility, improvement of sustainability practices in the built environment through education, the development of government policies and regulations and the establishment of sustainable design standards. Subsequent to this declaration, during the 2009 UN Climate Change Conference in Copenhagen, the UIA initiated its Sustainable Design Strategy which was launched and adopted during the 2011 Tokyo UIA World congress themed "Design 2050: beyond disaster, through solidarity, towards sustainability". These efforts by the UIA culminated in the 2050 imperative that recognised the growth of urban areas and the consequent effect of CO2 emissions, underscoring the dangers of failing to act, that was adopted at the 2014 UIA World congress in Durban. The 2014 Congress was themed "Architecture Otherwise" and it explored "other ways of 'knowing' and 'doing', unlocking multiple voices of architecture…" aiming to demonstrate that "architecture is as much spatial and formal as it is political, ideological, economical and theoretical...reflecting people's aspirations, values and concerns" (UIA, 2014, para 1).

Prior to the global initiatives, sustainable design practices were evident in different parts of the world. Tabb and Deviren (2013) argue that green architecture – which they use interchangeably with sustainable architecture – can be traced back to the indigenous climate responsive strategies of ancient Greece, China, and Persia among many other ancient civilisations whose practices can be argued ended as result of the rise of the contemporary global culture instigated by the modern movement. However, even within the modern movement, architects like Frank Lloyd Wright, Le Corbusier, Hassan Fathy and Alvar Aalto incorporated nature and vernacular practices in their designs, advocating ideas such as regionalism and cultural authenticity which were contrary to the modern movement but could be viewed as being consistent with sustainable design practices.

Attia (2018) on the other hand, suggests that sustainable design can be traced through what he terms "influential paradigms" that he suggests shaped the discourse of sustainable architecture since the beginning of the 20th century (Fig. 2.3). The first, which he terms "Bio-climatic design" was from 1908 to 1968 influenced by the works of F.L. Wright, Le Corbusier, Meyer, and Aalto among others, who advanced ideologies on organic architecture, solar design and sun-shading strategies and well as bioregionalism. This period was cemented by the empirical works of the Olgyay brothers on bioclimatic architecture.

The second period he referred to as "environmental architecture", which between 1969 to 1983 was evidenced by the works of McHarg, Ehrenkrantz, and Schumacher among others. Their focus was on working with nature, ecological systems influencing design, and ideas in appropriate technology. During this period, the effects of the 1970s energy crisis also influenced design thinking, reflected in the energy-conscious ideologies of passive and active solar design geared towards the reduction of building's energy demand and a shift towards renewable sources of energy. This was advanced predominantly by the American Institute of Architects (AIA) and the Passive and Low Energy Architecture (PLEA) society.

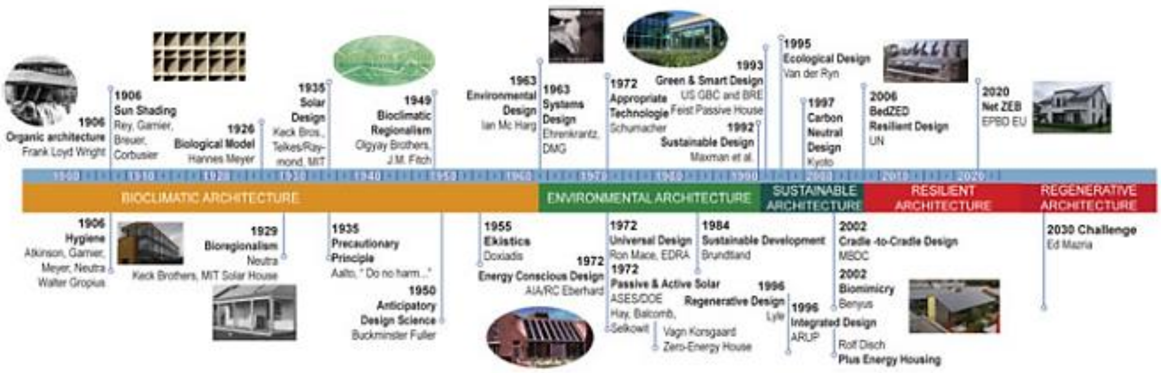

Fig. 2.2: Timeline of modern history of sustainable architecture. Source: Attia (2018)

The third period as described by Attia (2018) was the "sustainable architecture" phase between 1984 and 2006, the concept of sustainability became a global concern following the Brundtland report. This phase was characterised by carbon reduction ideas such as zero carbon design, carbon neutral design, energy plus buildings, and passive haus design among others that necessitated the evaluation of a building throughout all its stages; this is what Mc Dough (2002) referred to as "cradle to cradle." It is during this period that the use of green building assessment systems gained prevalence. The fourth and fifth stages, which Attia termed "resilient architecture" and "regenerative architecture" respectively, and which began in 2006 and continued into the future, is concerned with mitigating climate change and the introduction of design ideologies that would not only preserve and conserve the environment but would have a positive impact (Attia, 2018, p. 7-9). Figure 2.2 attempts to highlight and relate key dates in the history of sustainable design with the paradigms put forwards by Attia.

This research submits that, in understanding the history and evolution of the discourse of sustainability and by extension sustainable architecture, insights can be drawn into the embedded motivations and intentions of this discourse that influences the different ideological approaches. From the foregoing discussion it is evident that the sustainability movement has largely been driven by the 'developed' world. One could argue, however, that it is only an unsustainable society that requires a sustainability movement, which would therefore, explain why the western realisation of its unsustainable development inspired ideologies of sustainability and others related to it.

As discussed in the first part of this chapter, creating a sustainable environment would require a radical epistemological change. However, looking through the history and evolution of this discourse, on a global scale, there appears to be a much less genuine intent and attempt to realise this goal, but rather a more politically and economically motivated attempt to ensure development is not constrained. This reflects, the argument of Rees (cited in McManus, 1996) that "politically accepted policies for sustainability would be ecologically ineffective, while ecologically meaningful policies remain politically impossible" (p.68).

Taken together the foregoing discussion can be summarised into what Kidd (1992) refers to as the "roots of sustainability." He argues that the evolution of sustainability as a concept can be traced through six separate though related roots. First, "the ecological/carrying capacity root", which was concerned with the adverse effect the growing population would have on the physical ecological system, especially if it exceeded its "carrying capacity". Second, "the resource/environment root", that showed concern with the rate at which resource depletion significantly deteriorated environmental quality, creating shortages that would subsequently limit growth. Third, "the biosphere root", that focused its concerns on the effects of human activities on the global climatic environment, particularly with regard to increase in atmospheric carbon dioxide. Fourth, "the critique of technology root" that was centred on addressing social justice and equity and the environmental consequences of technological advancement. Fifth, "the "no-growth-slow-growth" root" that emphasised the unsustainable economic environment instigated by capitalism, resulting in inequitable accumulation of wealth and material possessions. Finally, "the ecodevelopment root", the main focus of which was to establish socially and environmentally responsible courses of action that will allow development to continue both currently and, in the future (p 5-12). These different roots influenced, though not distinctly, the different ideological responses to sustainability that will be subsequently discussed with reference to sustainable design.

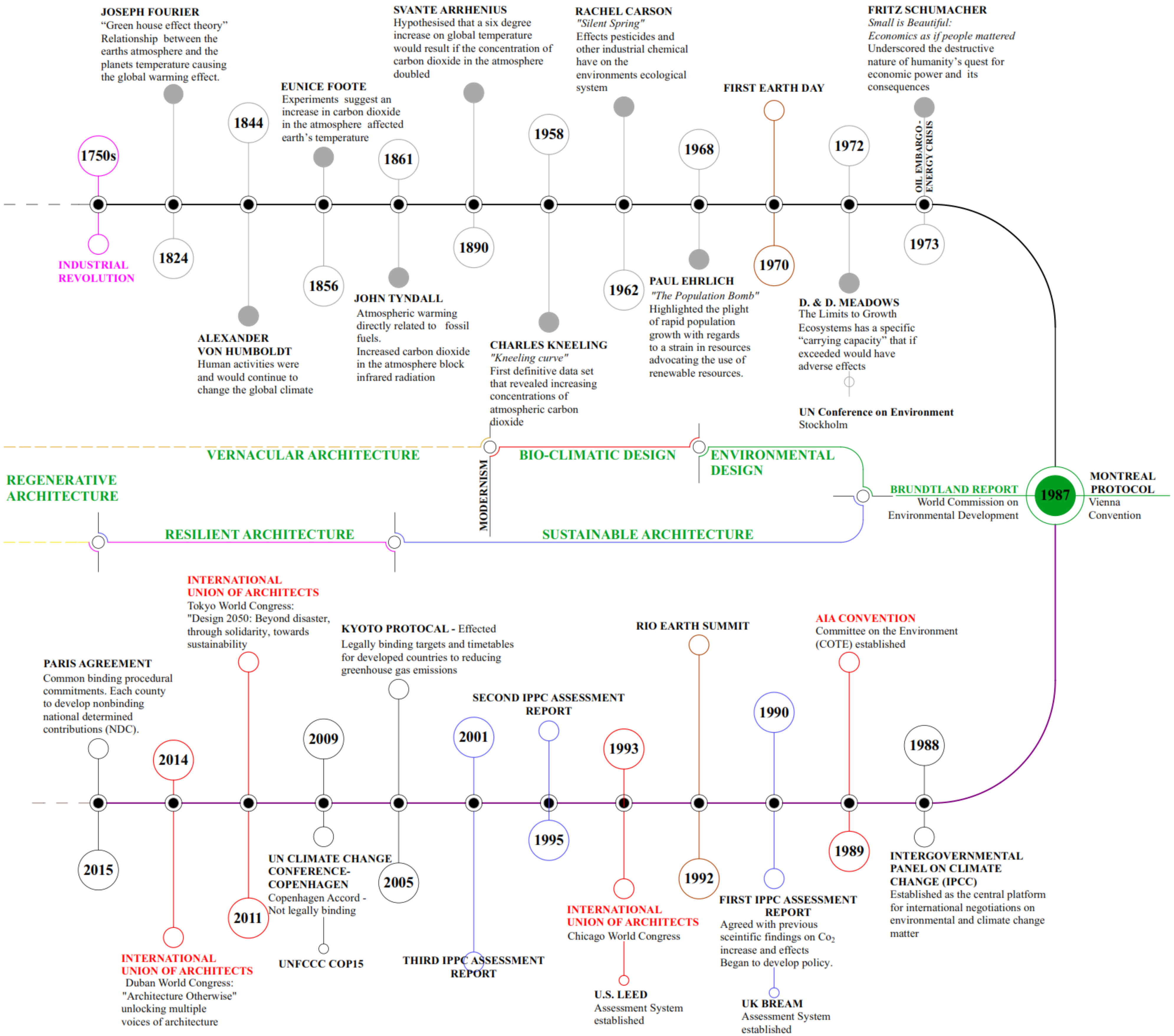

Fig. 2.3: Summary of the history of sustainability and sustainable architecture. Source: Author (2018)

2.4. MULTIPLICITY OF SUSTAINABLE DESIGN

> *"'Green' and 'Sustainability', the terms used to name the answers to the most pressing problems of our time, have become dangerously afloat in ambiguity and indeterminacy. Sustainable architecture is everywhere and nowhere."*
>
> *JAS Architects (Cited in Tabb P.J., Deviren S.A., 2013, p.1)*

The chapter began by exploring the correlation between philosophical and moral ideologies and the construction of meaning and values, and how this correlation translates to the relationship between nature and humanity. As discussed, ethical underpinning and values affect ideological and methodological pathways towards sustainability. Furthermore, despite the growing popularity of the discourse of sustainable design, no convergence has been reached regarding its meaning. It is evident that the discourse is embedded with considerable ambivalence with reference to its construction of meaning, as a result of contrasting social and political assumptions and interests. Acott and Gibbon (2007) for example, argue that "the concept of sustainability is a contested one that can be described along a continuum from ecocentric to technocentric perspectives" (p.199). They submit that the ecocentric perspective seeks to understand the environment through interdisciplinary, holistic approaches, while the technocentric perspective is more reductionist, as science and technology is used to explain and offer solutions to environmental challenges. Cook and Gloton (1994) on the other hand submit that "the designation of "green" is extremely wide ranging, encompassing many viewpoints and open to broad interpretation" (p.667).

It is no surprise, therefore that as a result of the multi-layered forms of diversity that exist, there has been a growing consensus against the possibility of standardisation of sustainable design practices. The universalisation of this concept is a consequence of the attempt to universalise the 'problem(s)', thus calling for a standard solution characterised by "radically simplified checklists that itemise 'best practice' or concrete things to do" (Guy and Farmer, 2004, p.132). This is exemplified by assessment systems such as 'LEED standard' or 'BREAM standards' or the UN sustainable development goals (SDGs), where approaches to solutions have been framed based on how specific problems have been defined. Dryzek (1997) submits that "the way we construct, interpret, discuss and analyse environmental problems has all kinds of consequences (p.9).

Hence, the question remains, can it definitively be said that this or that is sustainable design? Naess (1989) posits that "a word – in this case a concept – only takes life through its meaning and compatible interpretation" (p.6). He adds that "we can only etch out the meaning of a concept through its moving place in the field of other concepts and the way they are perceived" (p.6). Therefore, as the term 'sustainable' moves through different contexts and interacts with other concepts in these contexts, its perception and interpretation is transformed. Consideration of the multi-faceted dimensions sustainable design can manifest as a consequence of the plethora of constituents that interact and affect a particular context, creates an appreciation of the overwhelming nature of its plurality. This inherent characteristic has continued to inspire debate in this discourse since its inception.

Williamson *et al.* (2003) posits that there is "no class or style of design which unequivocally sustainable architecture is, and no fixed set of rules which will guarantee success if followed" (p.127). In a world that encapsulates different physical conditions, morals and values, how humans relate to nature (the environment) and each other and how they ultimately construct problems and consequent solutions, will certainly differ. Taking the differences in climate conditions, for example, Walter Gropius (1955) argues, "if you take… the basic differences imposed on architectural design by the climatic conditions … diversity of expression can result" (as cited in Olgyay 1963, p.10). This is augmented by the appreciation that sustainable design is not only a physical consideration but is a social and situational construct. As Guy and Farmer (2005) advance, a comprehensive understanding of sustainable design must "account for the social structuring of both the identification of the environmental problems and their resulting embodiment in built forms through multiple technical development pathways" (p.30).

The notion of a universal form of sustainability is idealistic. Edwards (2001) posits that "sustainability is leading not to a single universal style but to a rich and complex architectural order around the world" (p.7). Farmer and Guy (2001) further suggest that "a more appropriate way to understand this strategic diversity lies in abandoning the search for a true or incontestable definition of sustainable buildings and instead treating them in a relative rather than absolute sense" (p.140). This approach is seconded by McDonough and Braugart (2002) who propose that "all sustainability is local. We connect them to local material and energy flows, and to local customs, needs and tastes, from the level of the molecule to the level of the region itself" (p.123). The appreciation of this concept as part of other concepts within a particular locality is the basis of this approach to sustainable design.

Similarly, Cole (1998) argues that "standardisation implies consensus when environmental issues – social and economic alike – are not at all consensual…and may be antithetical to the whole environmental debate which places emphasis on addressing problems locally and at source" (p.14). These universal – international standards would therefore be counteractive to the objective of sustainable design, as they are inherently embedded with distinct influences from their countries of origin and lack contextual relevance. The assumption that occupants needs can be articulated in universal terms negates locally distinct solutions that would characterise a sustainable design. Standardisation assumes that ideal solutions can be pre-defined and consequently worked towards. However, this research concedes to the advent, coexisting and heterogeneity of interpretations that are shaping this discourse. The idea of a prescribed standard of practice is rigid and simplistic and fails to capture the dynamic nature both of a particular context as well as the "particular way of visualising the nature of the environmental problem" (Guy and Farmer, 2000, p.75). The move towards sustainable design should then begin with acknowledging the existence of what Guy (1999) terms as "contesting visions" of sustainability. Therefore, sustainable design cannot be rationalised and simplified into a standardised vision, but instead should be viewed as "a landscape of often fragmented, contradictory and competing values and interests" (Guy and Farmer, 2000, p.73).

These contesting views are well illustrated by Edwards in the 2001 issue of Architectural Design, in which he interviewed five prominent architects from different parts of the world on their thoughts on sustainable design in order to demonstrate the diverse interpretations of sustainable design around the world. When asked how he would define sustainable design, Lord Foster answered, "doing the most with the least means. 'Less is more' in ecological terms, exactly the same as the proverbial injunction, 'waste not, want not'" (Edwards, 2001, p.32). He advocates the use of passive design over mechanical systems as well as looking at sustainable design at the city level as opposed to a single building. Kaplicky on the other hand posits that "the major aspects of sustainable design are choice of materials and the performance of the building once it is built. Buildings have to be self – sufficient in energy" (Edwards, 2001, p.34). He further postulates that buildings are yet to be 'truly green' but are 'minor attempts at sustainability', arguing that a "completely new thinking is required" (Edwards, 2001, p.34). Lord Rogers explained that sustainable design "aims to meet present needs without compromising the stock of natural resources remaining for future generations…principles of social and economic sustainability as well as specific concerns of energy use and environmental impact of building and cities" (Edwards, 2001, p.36). For him, the key concern is "energy use and environmental impact" (Edwards, 2001, p.36). Ken Yeang on the other hand described sustainable design as "ecological design – design that integrates seamlessly with ecological systems in the biosphere over the entire life cycle of the built system…with minimal impact on the environment" (Edwards, 2001, p.60). His key consideration is "connectivity of all systems in nature" (Edwards, 2001, p.60). Lastly, Thomas Herzog defined sustainable design as "a working method, aimed at the preservation of our natural resources while using renewable forms of energy – especially solar energy – as extensively as possible" (Edwards, 2001, p.74). Of key concern for Herzog is the prudent incorporation of technology and the use of renewable energy essentially to run these technologies.

Moreover, the architects held different views with regard to the relationship between sustainable design and nature. Yeang holds that "nature should be imitated, and our built systems should be mimetic ecosystems" (Edwards, 2001, p.60). Herzog holds a different view, arguing that he does not think "architecture can be deduced immediately from nature, since the design process and functions of our buildings are quite different from what is found in most plants and animals" (Edwards, 2001, p.74). Kaplicky posits that there are lessons that can be learnt from nature, suggesting "nature can be used to model at many different levels…organic forms are far more efficient than man" (Edwards, 2001, p.34). Foster explains that he is guided by local vernacular architecture arguing that "very often there are rich architectural traditions that work with, and not against, nature…" (Edwards, 2001, p.32).

It is evident, even from this small sample, that various definitions and interpretations of sustainable design emerge due to the difference in priorities, perceptions of the relationship between the built environment and nature, the role of technology, resource management and the overall interpretation of the environmental and social problems. Guy and Moore (2005) suggest that rather than relying on a definition of sustainable design that is based on optimal performance or adherence to a clear set of static values, they prefer to treat the concept in a relational way that is capable of accounting for a wider spectrum of design possibilities.

Along the same lines, Robinson (2004) argues, sustainability should be viewed as a long-term approach that involves a process of dialogue centred on the community and revolving around environmental, social and economic aspects while appreciating the range of potential pathways towards a solution and the consequent biases. In this regard, this research argues that sustainable design as a concept should create a platform where constructive discourse on potential contextually relevant solutions is explored taking into account the interrelationship between nature, society and technology. This necessitates a process of construction, testing and reconstruction of ideas and values based on these considerations. The fluidity of this approach contrasts with the rigidity that is brought about by the standardisation of this concept.

All things considered, the process of construction of situated knowledge on sustainable design would then first require an interrogation of how knowledge of this concept is constructed. Jamison (2004) considered the efforts towards greening communities to be "a kind of *knowledge making* or cognitive praxis" (p.42), which he defines as "the way that human consciousness is acted out or put into practice, it is knowledge in the making" (p.42). He further adds that it is "situationally determined, or context specific and consists of both formal and informal types of knowledge making" (p.46). Furthermore, the process of making knowledge is reflective of different, often competing interests. "…it is much a struggle between various unconventional political coalitions, each made up of such actors as scientists, politicians, activists, or organisations representing actors…" (Hajer 1995, p.12-13 cited in Guy and Farmer 2005, p.134). Secondly, it requires a reorientation from a narrow goal-oriented approach to achieving sustainability to a more inclusive comprehensive approach that engages interactively with its context.

The foregoing discussion underscored the theoretical challenges embedded in the attempts to define sustainability in general, and sustainable design specifically, by illuminating how entrenched values, assumptions and interests influence its conceptual construction. The next section moves to explore how these conceptual constructs manifest in the built environment.

2.5. DIFFERENT IDEOLOGICAL APPROACHES TO SUSTAINABLE DESIGN

> *Despite the dogmatism of many of the specialists about what is and what is not an ecologically sensible approach to architecture, there can be no certainty. Like all new religions, there is an endless scope of doctrinal dissent. There are many different approaches, from those who believe in low-tech mud walls, to the enthusiast for hi-tech mechanisms. (Sudjic 1995, p.25)*

Having discussed the ethical underpinning that may influence sustainability, the history and evolution of the discourse, as well as the multiplicity of the concept of sustainable design, this section attempts to interrogate how this concept has been articulated in the built environment by highlighting several global ideological underpinnings to sustainable architecture that have been influenced by the foregoing discussion. However, it is imperative to note that when critically considered, it is evident that these approaches are eminently inter-related, and achieving sustainable architecture would perhaps involve converging these approaches as much as is feasible, rather than looking at them as competing ideologies.

2.5.1. NATURE AS A MODEL: BIO-CENTRIC APPROACH

> *I am a pessimist about the human race because it is too clever for its own good. Our approach to nature is to beat it into submission. We would stand a better chance for survival if we accommodated ourselves to this planet and viewed it appreciatively instead of sceptically and dictatorially.*
>
> *E.B.White (cited in Carson R. 1962, p.VII)*

The evolving relationship of humans and their natural environment was discussed at the beginning of this chapter. With that discussion as a background, the bio-centric approach traces its sustainable design roots to the environmental discourse and is largely concerned with how buildings relate to, react to and influence nature and ecological systems.

Furthermore, it argues that sustainable design should go beyond valuing nature just for its benefits to man, but more importantly, for its own sake. This approach gives nature greater value and thus demands greater consideration while dealing with the natural environment during the design process. Due to the intrusive nature of their presence within existing natural environment, from an eco-centric perspective, buildings may be viewed as parasites (Guy and Farmer, 2001). However, this environmentalist approach is not opposed to the use of natural resources, but as Leopold puts it, “it does affirm their right to continued existence” (p.2). It is how these resources are used and to what end that raises ethical concerns. Passmore (1974) further asserts that conservationists are not against man exploiting nature for economic gain but rather are against the “carelessness and wastefulness in doing so” (p.74). The last century has experienced an increasing shift from buildings as a protector of humans from the environment to the environment needing protection from buildings designed by humans for their grandiose lifestyle. This approach calls for those in the building industry to understand and appreciate the ramifications of their divorce from nature.

On the other hand, natural systems are inherently sustainable systems. Nature takes care of itself; in essence, nature nurtures. McDonough and Braungart (2002) suggest that "the vitality of ecosystems depends on relationships" (p.121) and liken it to "a tapestry"; an interwoven web of inter-dependent entities. This can be equated to the intricacy of an orchestra, for example, where the strings beautifully entwine with the woodwinds, brass and percussion to form a symphony. Each member acknowledges and deeply appreciates the role they each play and realise that the orchestra's success depends on each of them coming together seamlessly and meticulously. Naess (1989) emphasises this in his second platform of "deep ecology", where he asserts that "richness and diversity of life forms are value in themselves and contribute to the flourishing of human and non-human life on Earth" (p.29). Based on this argument there is need to be more acutely aware of all that humanity has taken for granted and adopt a more proactive approach to nature, as opposed to the reactive lackadaisical approach that humanity has become accustomed to. In this case, doing nothing is doing something too. Francis Bacon's philosophy suggests that "nature can be conquered only by obeying her" (Bennet and Chorley 1978, p.15).

The relationship between the built environment and natural ecological systems has inspired various theories with regard to their potential interaction towards establishing a sustainable environment. Benyus (1997) breaks this relationship first, into nature as a model, which involves studying natures processes and using her insights to inform human processes, second, nature as measure, where nature is applied as a datum for judging the appropriateness of innovation, and lastly nature as mentor, which she describes as learning from nature as opposed to exploiting nature.

I. LEARNING FROM NATURE – NATURE AS A SYSTEM

Girardet (2005) describes how the 'metabolism' of contemporary urban cities is characteristically linear with very little consideration of where resources originate and where waste is eventually deposited.

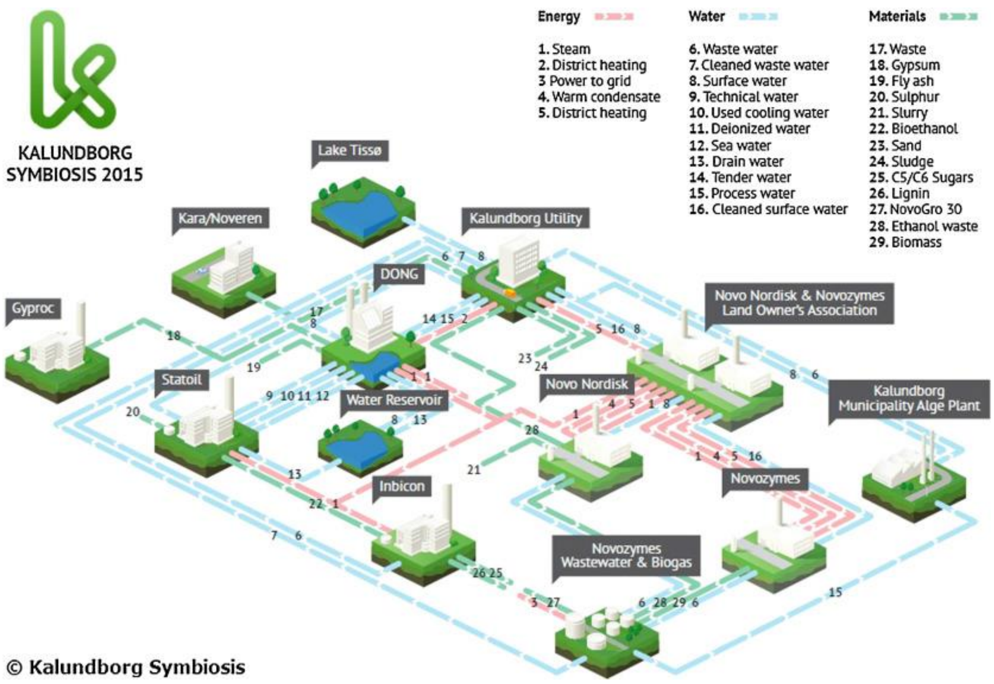

Fig. 2.4: The Kalundborg Symbiosis. 1972. Source: Stefan Gulipac, 2016

It is therefore "less of a system and more of a collection of linear flows" (Talbot and Magnoli, 2000, p.92). Conversely, Edwards (2014) argues that "nature creates the maximum richness and complexity with the minimum of resources and the maximum of recycling; whereas human kind creates the minimum of richness and complexity with the maximum of resources and minimum recycling" (p.189). He draws an analogy between "buildings (species) and cities (habitats)" (Edwards 2001, p.24) This approach considers the relationship of buildings to their greater environment, ensuring the city functions as an eco-system that produces resources it requires, utilises them and recycles them for reuse. The Kalundborg eco-industrial park is a good example of this approach. The eco-industrial park, located in Denmark, is a collaborative initiative by different industry actors to share resources as well as recycle all its waste (bi-products) thus functioning like a closed zero waste loop.

II. USING NATURE'S MODELS TO INFORM – BIOMIMICRY

McLennan (2004) suggests that "sustainable design principles are not invented but discovered… the true principles, for the most part, have existed in some form in nature already" (p.37). Nature holds the answers to many of life's questions. The behaviours of natural systems have been for a long time used to inform and inspire several man-made processes and innovations. Japan's 1997s Shinkansen (bullet train) for example, was inspired by the kingfishers' beak, whose diameter increases gradually towards its head, making the trains significantly quieter when leaving the tunnel. They are also faster and require less energy.

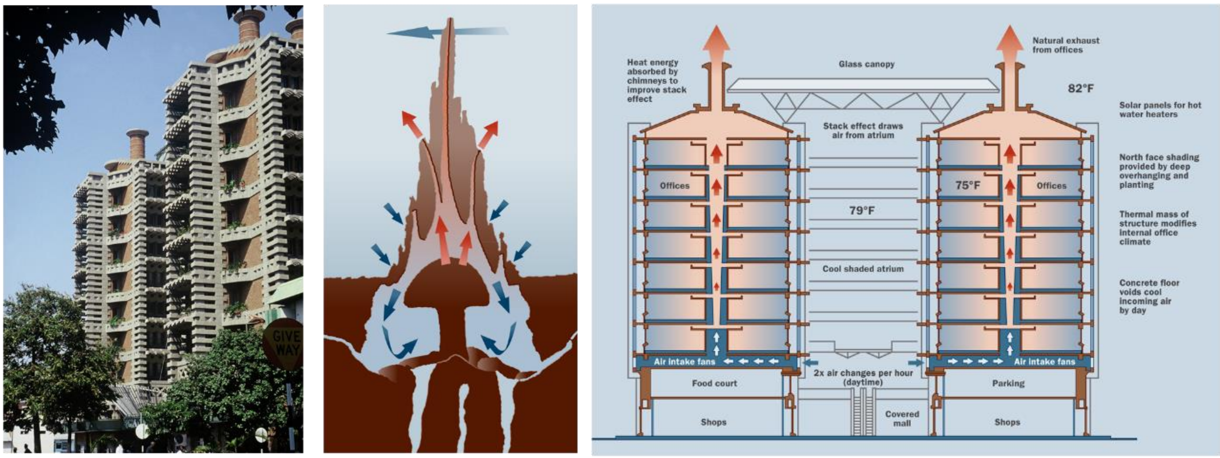

Fig. 2.5: Eastgate building in Harare, Mick Pearce, 1996. Source: era-kreativeindustries.eu, accessed 11.09.18, 21:15

Another famous example is the termite mound that maintains a constant temperature and humidity irrespective of the circumambient condition, resulting from the opening and closing of vents on the mound all through the day. This phenomenon has been studied and replicated to provide ventilation solutions. A good example is the Eastgate building in Harare (Fig. 2.6). Similarly, Rolf Muller, noticing that bats do not collide regardless of the break-neck speed at which they fly, even in tight spaces, sought to study this phenomenon. He discovered that the agility of their dynamic wings allows them to collect more sound data as it bounces off their wings. This discovery has been used to improve fabrication of systems that require sound to "navigate and detect objects" (Ferris, 2015). This process of using nature to inspire innovation has existed throughout human existence and has recently popularly been referred to as biomimicry, which Benuys (1997) defines as "the conscious emulation of life's genius" (p.2).

III. INCORPORATING NATURE INTO THE BUILT FORM

This approach goes beyond merely creating views to nature but ensures maximum interaction of the building with nature. Therefore, the utility of the building allows for a multi-sensory experience with nature. This is evident more recently in the works of Ken Yeang. (Fig.2.7b). Similarly, this approach is evident in the concept of organic architecture popularised by F.L. Wright (Fig 2.7a).

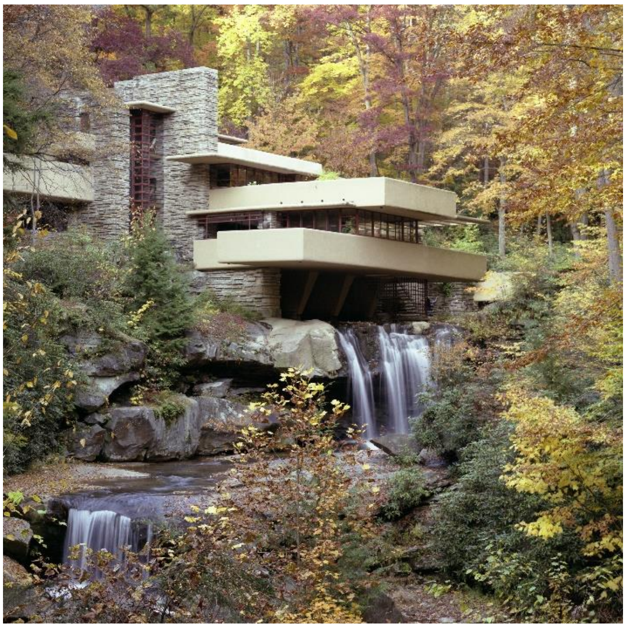

Fig 2.6: Falling Waters by F.L.W. 1935. Source: de zeen.com, 2017: Fig.2.7 Solaris Building, Singapore. By Ken Yeang, 2011. Source: share-architects.com, accessed 11.09.18, 21:18

IV. NATURE AND AN ECOLOGICAL COUNTER

Green building assessment systems evaluate buildings on the basis of their relationship and management of various aspects of nature. Solar radiation, water and site ecology are a few of the considerations apparent in assessment systems. These aspects are weighted according to priority, and different credits assigned.

2.5.2. CLIMATE RESPONSIVE DESIGN: BIO-CLIMATIC APPROACH

> *"For the style of the buildings ought manifestly to be different in Egypt and Spain, in Pontus and Rome, and in countries and regions of various characters. For one part the earth is oppressed by the sun in its course; in the other part the earth is far removed from it; in another it is affected by it at a moderate distance".*
>
> *Vitruvius in De Architecture (1960, p.170)*

This approach is closely linked to the bio-centric approach. There has been a growing discourse on the need to reintegrate building with climate. Climate responsive design is no new concept. Early philosophers and architects like Vitruvius (in a 1960 translation) put forward the significance of climatic considerations in design. In his sixth book (Book VI); *climate in siting and design*, he states "If our designs for private houses are to be correct, we must at the outset take note of the countries and climate in which they are built" (p.170). This principle not only pertains to private homes but buildings as a whole. Equally, subsequent to the depletion of their forest resource owing to their decadence and dependence on charcoal burners for heating, classical Greek cities resorted to climate responsive strategies to achieve a favourable indoor climate. Fundamentally, buildings are designed to alter microclimates.

Hyde (2000) suggests that traditional buildings "encapsulate thousands of years of unconscious research into the relationship between buildings and climate, and represent more holistic models for the development of climate responsive architecture" (p.19). Traditional builders did not have the luxury technology affords present day architects, that allows them to disregard climate. Climate responsive design was an absolute necessity not an option. Ancient civilisations were compelled to develop strategies for protection against harsh climatic conditions that developed as a result of decades of experimentation. Olgyay (1963) explains that even groups with similar backgrounds developed new strategies to deal with climate as they migrated into different climatic conditions. Those who experienced extreme cold temperature, for instance the Inuit, developed ways to insulate their shelters and conserve heat, essentially maintaining "a temperature of 60^{o} F inside when the exterior temperature is -50^{o} F" (p.5). Conversely, those in hot-humid areas encountered the challenge of heat reduction and shading from the extreme heat and glare from the sun. The Koppen's system of classifying climatic zones reflects global climatic differences. (Fig. 2.8)

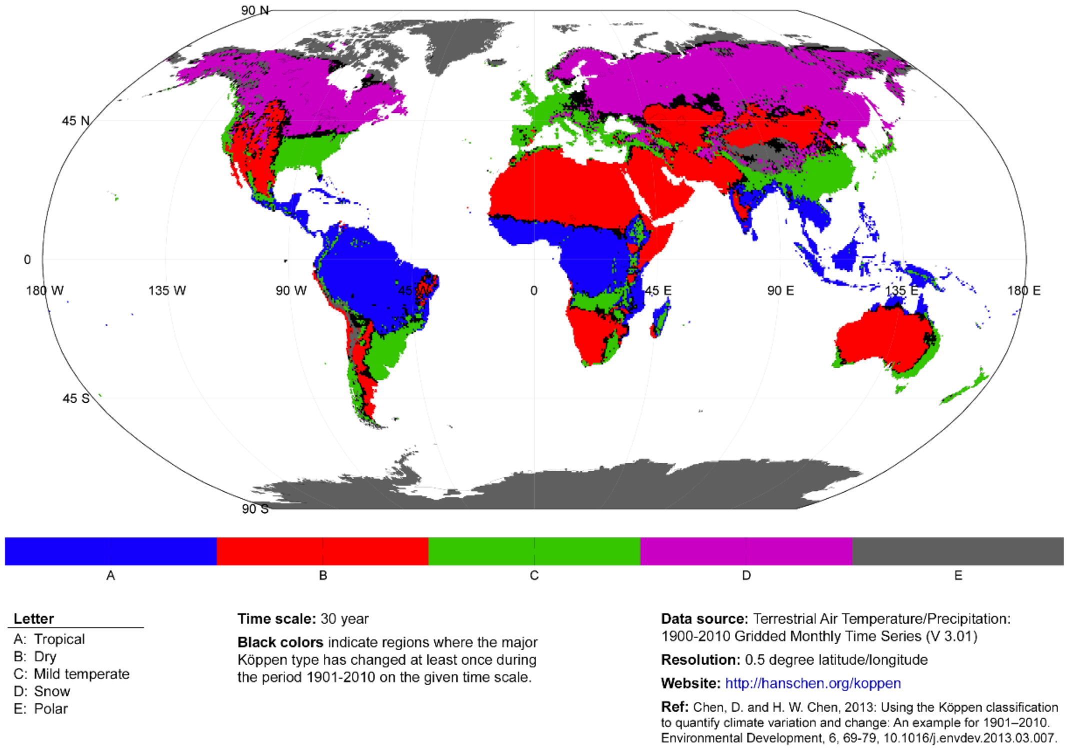

Fig. 2.8: World map of Koppen climate classification for 1901-2010. accessed 04.10.19, 17:43

Sorenson and Moller (2010) assert that climate adaptation and control strategies in vernacular architecture offer insight into climate responses that are appropriate for particular local conditions. Similarly, Fathy (1986) criticises the “thoughtless application” (p.7) of Western techniques in tropical and sub-tropical regions as antithetical to the very concepts that ascertained the appropriateness of vernacular architecture. The advanced complex mechanical systems developed in the mid twentieth century resulted in a complete disconnect between the indoor climate and the circumambient climate. In this regard, the bioclimatic considerations in vernacular architecture have been viewed as a starting point to achieving climate responsive sustainable design.

Perhaps the most significant influence on the birth of the ‘modern’ bioclimatic movement is energy, due to the concern that fossil fuels are not only finite but detrimental to the environment. With regard to energy, climate responsive design is geared toward reducing the building’s energy demand while achieving the desired comfort and health standards. Renewable energy sources are used to meet the building’s deficit energy requirement. In the 1930s, Fredric Clement and Victor Shelford classified regions into ‘biomes’ which were “natural habitats… shaped by climates” (p.218). The bioclimatic approach was first advanced through the works of Aldar and Victor Olgyay in 1951, Baruch Givoni in 1969 and Otto

Koenigsberger in 1973. Olgyay's 1957 book, *Design with Climate* was significantly influential in outlining the relationship between architecture, climate and humans. Kabre (2018), in reference to Olgyay's work posits, "he synthesised elements of climatology, human physiology and building physics, with a strong advocacy of architectural regionalism in terms of designing in sympathy with the environment" (p.4).

Similarly, DeKay (2011) describes architecture as "a structure that mediates between the external processes of solar energy and climate and the interior processes of human bioclimatic response and experiential delight" (p.72). Correspondingly, according to Jones (1998) "bioclimatic building design" is "an approach to design which is inspired by nature and which implies a sustained logic to every aspect of the project, focused on optimizing and using the environment" (p.35). Klaus (2005) submits that climate appropriate design involves creating "a building (or an urban structure) in such a way that an optimal (comfortable) or at least tolerable climate is created for the users, while employing as little energy and technical equipment as possible" (p.85). From these definitions, the bio-climatic approach is focused on the creation of comfortable indoor spaces with minimal energy demand and minimal mechanical intervention.

This approach is often achieved through 'passive solar design' developed in the mid-1970s which Jones (1998) describes as "harnessing the beneficial attributes of the climate, without recourse to mechanical systems" (p.37) The buildings should on one hand be shaded from excess solar radiation while on the other hand be oriented to take advantage of solar radiation as well as provide natural ventilation that ensures thermal comfort. Similarly, the design should allow for maximum daylighting while preventing excess heat gains and losses as well as solar glare. Materials with appropriate thermal mass that absorb heat during the day when it is warm and release it during the night when it is cold should be considered for the exterior façade.

For tropical climatic regions like Nairobi, Kenya, the most fundamental climatic consideration is solar radiation. The sun directly influences almost all aspects of design, from orientation to material choice and energy requirements. Tropical Architecture had its roots in climate responsive designs geared towards little or no mechanical control, particularly in developing countries after World War II between 1950 and 1960, though its footprints were evident up until the late 1980s. This concept was developed as a result of extensive research on tropical hygiene which was highlighted in several manuals before the two World Wars.

The hygiene manuals highlighted, among other issues, different climatic aspects, predominately temperature and humidity in tropical countries and their impact on the (European) human body. Buildings were designed to conform to the tropical climate as a way to protect the colonial Europeans against diseases and climate and this became the impetus for tropical architecture in the 1950s. In Nairobi for example, this is evident in the works by Amyas Connell a protagonist of the tropical architecture movement in Kenya between, 1950 and 1980.

2.5.3. PLACE AND CULTURE: ECO-CULTURAL APPROACH

> *Modern man becomes 'worldless' and thus loses his own identity, as well as the sense of community and participation… Moreover, he becomes 'careless' since he does not feel the urge to protect and cultivate a world anymore.*
>
> *(Norberg-Schulz 1988, p.12)*

Edwards (2001) posits that "there is no tenable argument which can separate environmental action from cultural action. Place is a statement about attitudes to geography, history and resources" (p.14). Robinson *et al.* (1990) suggest that the ethical consideration of sustainability should go beyond the ethical responsibility and relationship between human and nature, and consider the ethical correlation between sustainability and socio-political issues. These socio-political systems are "universes of meaning that structure the evolution of individual and collective practices, and the institutions that make such practices possible" (Robinson *et al.*, 1990, p.38). Its core is the recognition of culture and "loyalty of its adherents" (p.38), consequently, creating a feeling of ownership of the values. The socio-political aspect would require not only human behavioural change that involves choices and decisions that guarantee environmental sustainability but also a process that involves the community in making decisions that affect them and their environment. This ensures that the resultant pathways resonate with the community's "needs, values and cultural identity" (p.45). Sustainability should therefore nurture culture. This sense of belonging and identity created by culture fosters community cohesion and reinforces meaning to place. Place is not only created by local climate and ecology; buildings are an important part of place, and community involvement is imperative in reinforcing meaning.

This ideology is exemplified in vernacular architecture, where environmental considerations were at the core of indigenous culture. Dryzek (1997) suggests that "sustainable development is nowhere an accomplished fact, save in small scale hunter-gatherer and agrarian societies that have existed in harmony with their local environment at low levels of economic and technological developments" (p.123). Cultural values are reflective of people's ethical underpinnings, which influence how people relate to each other and to their natural environment, which in turn determines how they construct problems and their solutions. This concept of cultural ethics is exemplified by the *Maruwhenua* movement based on the Maori people of New Zealand whose strong cultural and spiritual relationship to nature influences their approach to sustainability (Merchant 1992, p.222).

The discourse of sustainable design has therefore, in the recent past, rekindled a spark to the typically disregarded topic of vernacular architecture that has often been considered primal and outdated. When architecture began as a response to the need for protection against harsh weather conditions and other imminent dangers, buildings were erected using locally available materials and rudimentary technology coupled with a deep reverence for nature and a response to climate that was passed down through generations, evoking a great sense of culture and fostering community cohesion. Jones (1998) explains that the shift from the aforementioned considerations occurred when architecture became an expression of power and wealth, and more recently an expression of technological advancement.

Vernacular architecture has therefore gained popularity as a discourse, perhaps due to the intelligible manner in which it manifests its context. The question however remains: do the concepts and methodologies of vernacular architecture have a place in our contemporary lifestyle? Now, it is true that vernacular architecture may not provide a set of directly applicable solutions, but it certainly can richly inform contemporary architecture. Sustainable design therefore seeks to attain a convergence between the wisdom of the past – the vernacular – and the knowledge and innovation of present day science and technology. McLennan (2004) suggests that "…many of the ideas discussed within sustainable design field are not new ideas, but those that have existed for centuries." He further adds that "for many this explains why our vernacular history is the true start of sustainable design" (p.16). Hosey (2012) describes sustainability as "apersonal and atemporal" thus it is detached from the individual as its essence lies in the concept of community and its inability to be bound by time. Therefore, perhaps vernacular architecture may be the truest form of sustainable design.

Vernacular architecture moulded itself within the fabric of its context, working with and not against the environment, as well as with and for the community. This approach thrives in recognising and promoting the diversity of different cultures. Rapoport (1969) describes vernacular architecture as a "direct and unself-conscious translation into physical form of a culture, its needs and value – as well as desires, dreams and passions of a people" (p.2). These sentiments are echoed by Glassier (1990) who also describes vernacular architecture as "the unconscious realization and embodiment of the culture of the society with the requirements of people in nature" (p.9). Thus, this architecture is inextricable from its context. As a result of this characteristic, "vernacular architecture does not go through fashion cycles. It is nearly immutable, indeed, unimprovable, since it serves its purpose of perfection" (Rudofsky, 1965, p.1).

Vernacular architecture is defined by place, which influences its characteristic distinctiveness. Currently however, architecture in African cities sush as Nairobi barely has any allegiance to place, let alone telling the tale of a place. Materials, technology, energy and even labour are sourced away – more often a great distance – from the site. Buildings have lost meaning attributed to them by place. Sustainable design, from this approach, is against this homogenisation of architecture and demands architecture that is informed by place and breaks the monopoly of both "Western cultural primacy and high-tech architectural solutions" (Edwards 2001, p.14) that has been propagated through the industrial philosophy of the Western world. McLennan (2004) propounds that "buildings, as the largest physical artefacts of our culture, have the most to draw from and respond to the uniqueness of place" (p.52). Buildings should be a manifestation and extension of place and its people.

Oliver (2000) argues that 'contemporary' vernacular architecture consists of "buildings of the people, built by the people" (p.116). He moves to question, "can the vernacular, the architecture of the people and built by the people be ignored, and can such rejection of the values and traditions of culture, however large or small, be ethically justified?" (p.118). The answer to this question remains a debate. He further argues that any successful sustainable design intervention must involve the active participation of the community and take into cognisance the "values, morals, building skills, experiences and wisdom" (p.125) of the people it is intended for. The active involvement of communities acknowledges the diversity and the specificity of local communities' knowledge of place and culture, and therefore, constructs an informed extensive understanding of problems and practicable solutions and resources to realise those solutions in response to complex contextual dynamics, while bestowing the community with a sense of ownership, empowerment and identity. This not only ensures environmental sustainability but also strengthens the social sustainability of design.

2.5.4 THE PLACE OF TECHNOLOGY: ECO-TECHNICAL APPROACH

"One has only to look at the proceedings of any conference on environmental architecture in the last twenty years to see the overwhelming emphasis on the scientific and quantitative dimensions of the discipline: thermal conductivity of materials, photovoltaic technology, computer simulations, life cycle analysis and so on."

(Hagan 2001:X)

Throughout history it is evident that architecture has been reflective of and reactive to technological innovation. As technology advanced, architecture can be said to have been reduced from a product of cultural distinction and diversity to a mechanical, minimalist product of function (Hughe, 2016).

The term "ecotechnic logic" as referred to by Guy and Farmer (2001), and also popularly known as a techno-centric approach, advocates the continuance of modernisation amid mitigation of environmental concerns through science and technology. This approach is inspired by the notion that "science and technology can provide the solution to environmental problems" (p.142), and takes a more global, generalised approach that attempts to tackle the larger issues such as the increase in carbon dioxide emissions, global warming and climate change. Rather than abandoning the path of industrial growth, the approach advocates the creation of more technically efficient solutions to mitigate environmental challenges. With regard to buildings, technology as a tool to achieve sustainable design has been employed in two main approaches. On the one hand buildings are completely divorced from the external environment and smart systems are used to optimise the indoor environment as exemplified in the Passive Haus concept. On the other hand, it is argued that technological intelligent systems should be used to interact and utilise the external environment to optimise the internal environment.

The techno-centric approach has faced criticism, as many have argued that technology has been the cause of much destruction to the environment and therefore cannot be the solution. Technology is not only largely responsible for constructing the environmental problem, but also constructing it as a global problem. Robinson (2004) argues that "what can and should be done to achieve a sustainable society is not fundamentally a scientific or technical issue…scientific analysis can inform but not resolve the basic questions posed by the concept of sustainability" (p.379).

Slessor (1997) in her book *Sustainable Architecture and High technology, Ecotech,* describes eco-tech as an "increasingly diffuse complex style" that she argues "now embraces wider concerns, including place-making, social responsiveness, energy use, urbanism and ecological awareness" (p.7). However, similar to Moore's (2000) concerns, in his review of the cases presented in the book, though aesthetically appealing are not apparently and critically reflective of this description of eco-tech. As is evident in this book, often the eco-technical approach does not pay much attention to the human – user – experience of the ecological systems and nature's cycles within and without the building, treating the building like an autonomous machine. Moore's (2000) review on Catherine Slessor's concept of eco-technology, points out that she "consistently refers to technology as a seemingly autonomous force that is distinct from both architecture and society" (p.246). Deleuze submits that "machines are social before being technical. Or rather, there is human technology before there is material technology" (1986, p.47, as cited in Bousquet, 2014, p.9). Therefore, it is impossible to appreciate technology outside its social context.

Unsurprisingly, the approach "tends to be overwhelmingly quantitative as success is expressed in numerical reduction of building energy consumption, material embodied energy, waste and resource-use reduction, and in concepts such as life-cycle-flexibility and cost benefit analysis" (Moore, 2002, p.142). Therefore, it often involves optimisation of building performance essentially through technological innovations and other intelligent systems that allow buildings to adapt to their environments. The focus is on aspects that are scientifically measurable against performance of the building. Therefore, in many instances, the approach reduces sustainable design to what Fisher (2004) refers to as "carbon accountancy" (p.230).

In addition, the technocentric approach often attempts to apply technological solutions universally. These 'solutions' are often mass produced, and mass distributed globally, ignoring the social, political and economic peculiarities of the contexts they are being introduced to. Bousquet submits:

> "The development of any technology within the social field must necessarily be grasped in terms of the wider ensemble within which it is inserted, since the multiple

relationship that compose the ensemble determine to a large extent the usage and meaning given to the said technology" (Bousquet, 2014).

Therefore, the production, meaning, value and usage of a technological innovation is not characteristically intrinsic and as a result, technology cannot be universal. Context is fundamental.

This approach is further criticised as creating 'greenwashed' variants of the status quo by manipulating gadgets in an attempt to maintain humanity's growth oriented way of life while avoiding the lifestyle changes that sustainability would demand. In this regard, technology is seldom used as an agent of change but rather as an 'add on' to existing practices and processes in an attempt to circumvent the need for alterations to existing processes. The most obvious conundrum is the relationship between technology and energy resources. In an attempt to reduce a building's energy consumption, as opposed to switching to the use of renewable energy sources or passive design strategies, 'smart' technological innovations that ultimately increase the building's energy demand are employed, becoming counterintuitive to the initial goal.

It is also difficult to ignore that often these technological innovations are not produced by African (non-industrialised) countries and therefore, aside from being culturally and environmentally inappropriate, they are often economically unsustainable.

2.5.5. 'THE MARKET' AND SUSTAINABILITY: ECO-DEVELOPMENT

"…it is impossible to guarantee qualitative changes that move towards sustainability under capitalism because the prime measure of success in a market-based economy is money"

(McManus, 1996, p.66)

Klein (2014) in her book, *This changes everything*, argues that the climate crisis is less to do with carbons and more to do with the socio-cultural and political capitalist, consumerist systems that exploit resources. In many ways, market forces have influenced how sustainability has been defined and articulated. The complex interaction between sustainability and economic market forces begs the question, are sustainability practices transforming the market or is the market transforming sustainability practices?

The ‘ecodevelopment’ approach to sustainability can be said to have been predominantly inspired by the Brundtland commission’s work, and is closely linked to the eco-technical approach. It’s focus is on growth (primarily economic), that is, “making development sustainable” (WCEB, 1987, p.8), driven by global political agendas, what Escobar (1992) referred to as “global ecocracy” (p.19). However, the move towards sustainable development outlined in the Brundtland report has faced several challenges. For instance, the WCED overview (1987) recognised that the main “ecological” and “developmental” problem in achieving sustainable development globally are that “developing countries must operate in a world in which the resource gap between most developing and industrial nation is widening, in which the industrial world has already used much of the planet’s ecological capital” (p.5-6). This gap can be argued to exist as a result of the rise of neoliberalism, where developed industrial countries compete to attain dominance primarily through technological advancements, often at the expense of other, developing, states and the global environment, ignoring the global consequences of their pursuits. Beyond this gap is the ambiguity embedded in what sustainable development really means, that appears to be largely dependent on who is defining it and what their interests are, as well at the context in which it is being defined. Unfortunately, as has become evident through this research, groups with special interests have often exploited these differences and disagreements to impede the process of effectual change in order to push their agenda.

Despite the evidence of the cost of the industrial capitalistic growth model on the planet, it is almost impossible to imagine a political system, that will consciously decelerate growth for the sake of planetary survival. Merchant (1992) would classify this ideological approach under, first, the “egocentric” ethic, which she argues is driven by Western ideas of liberalism and capitalism, the primary objectives of which are dominance and achieving maximum profits, and second, the “homocentric” ethic, characteristically a utilitarian ethic driven by political notions of social interests (p.63-74). She further discusses several examples of groups that have advanced this approach to sustainability as being not only growth-oriented and human centred but also privileging Western scientific knowledge over indigenous knowledge, as well as fostering Western interests.

It is evident that the crux of this approach is an attempt to incorporate “green” into a capitalistic market, which as Hawken (1993) posits, continues to be “maladaptive and predatory” (p.7). Hawken proposes a “restorative economy” that unlike the capitalistic industrial economy that is driven by continuous growth with “separated production process from the land, the land from the people, and, ultimately, economic value from personal values", would instead require markets systems to be ethical acts that "mimic the interwoven, complex, and efficient models of natural systems…through its… ability to integrate with or replicate cyclic systems in its means of production and distribution" (p.14). Thus, market forces need to reposition themselves within the wider socio-political and environmental context. Often however, protagonists of the capitalist market have argued that the effects of climate change are yet to be fully understood and therefore are yet to warrant a total reimagination of economic systems.

On the other hand, with the growing popularity of the 'green' and 'sustainability' discourse, market forces have been keen to align themselves to this concept and 'go green'. During the last two decades, in an effort to appeal to the market and create competitive advantages, market forces have responded with products and services tagged green or sustainable. The rush to acquire the 'green tag' has introduced the need for legitimisation of claims. For building this has come in form of green building assessment and certification systems. Unfortunately, this seemingly 'new' way of doing things (going green) is essentially quite similar to the 'old' industrial system barring, its 'green mask', as market value systems are still rooted in monetary value that does not really account for the cost of environmental destruction.

2.6. SITUATING SUSTAINABLE DESIGN IN THE 'AFRICAN' AND OTHER 'DEVELOPING' CONTEXT

> *"…a holistic process aiming to restore and maintain harmony between the natural and built environments, and create settlements that affirm human dignity and encourage economic equity"*
>
> *(Du Plessis 2002, p.8)*

The African context differs significantly from the Western world, not only in terms of its level of development but also with regard to its physical, political, socio-cultural and economic context. Furthermore, its capacity to influence and address ecological concerns varies considerably. Consequently, its approach to sustainability, and more specifically sustainable design, varies considerably from that of the Western world.

Du Plessis (2001) submits that Africa must contend with "the web woven by poverty, resource scarcity, rapid urbanisation and the social collapse brought about by colonisation, urbanization and decades of warfare" (p.375). These challenges are similar for many developing countries, and Othman and Ali (2006), in reference to South Asian countries, describe the challenges as "disparities in social and economic welfare…social and environmental pressures from industrialisation, and rapid urbanisation; and general degradation of the environment" (p. C-32). Similarly, Shah (2002) contents that India faces "massive poverty, fast industrialisation, rapid urbanisation…" (p.1). From these examples it is apparent that socio-economic challenges faced by developing countries transcend environmental challenges. Shafii *et al.,* (2000) contend that the economic challenges faced by these countries make it considerably difficult to prioritise environmental sustainability.

In general, only seven of 54 African countries are not considered low-income countries, with none characterised as high-income. This poverty status has a direct influence on environmental challenges. Despite developing countries having generally insignificant effects on the current climatic and ecological catastrophes, they are notably more vulnerable to their consequences. In these contexts, resource scarcity challenges include significant degradation of the already limited arable land and even more significantly, water scarcity. These challenges are augmented by the rapid urbanisation which reportedly "doubles every 20 years" (Du Plessis, 2001, p.375). This rapid growth precedes resource availability and planning. A sustainable process must therefore encapsulate these contextual physical and socio-cultural peculiarities.

Du Plessis (2001) further identifies core values that characterise 'African' socio-cultural value systems that differ from the West. First, the cyclic concept of time. African processes were – and still largely are – cyclic in nature, Du Plessis posits that "there is an unquestioning acceptance of the cycles of nature and the impermanence of everything," (p.377) including its built environment. This is contrary to Western culture which is often characterised by linear growth, unceasing expansion and dominance. Mbiti (1969, p.17) notes that "the linear concept of time in Western thought, with an indefinite past, present and infinite future, is practically foreign to African thinking" (as cited in Connell, 2007, p.100). Second, is the system of ethics that is expressed in their strong "sense of interconnectedness and interdependence… founded in their …reverence and respect for all nature that is expressed not only in ritual, but also in the way buildings are placed and resources used" (p.378). This concept of the relationship between man and nature is discussed in the first part of this chapter. Once again, this is in contrast to the Western capitalistic values that are individualistic and wasteful in nature. Similarly, the African philosophy of *Ubuntu* is in contrast to the individualistic and utilitarian philosophies of the Western world.

The above few examples of apparent differences reinforce the arguments that it is impossible to generalise or globalise problems and therefore even more impractical to attempt to develop standard solutions. The pursuit of sustainability therefore demands the development of local knowledge. Whereas often Western scientific knowledge tends to be "standardised, de-contextualised, and universal, local knowledge is strongly rooted in place" (Murdoch and Clark, 1994, p.118). Redclift's (1992) exploration of the relationship between knowledge and power highlights the potential of knowledge as an agency for dominance that has often supressed marginalised forms of local knowledge. Murdoch and Clark's (1994) recognition of the increasing distinction between local knowledge and universal scientific knowledge moves them to question the process of knowledge construction. They submit;

> "any consideration of the epistemological foundations of sustainability, as well as any attempt to achieve sustainability in practice, must make some attempt – this research would argue, every attempt – to understand how these boundaries are drawn and upheld" (p.118).

In Kenya, environment activists like Wangari Maathai, Nanga Tango and Gathuru Mburu argue that environmental and social consciousness and responsibility was embedded in native Kenyan (African) cultural and religious practices. Therefore, sustainable environmental approaches should not only acknowledge these practices and epistemological thinking but draw upon them. They advocate for a critical and reflective approach to the process of achieving environmental sustainability as well as the epistemological, ontological and ethical underpinnings that influence knowledge construction in an attempt to mitigate competing knowledge forms (Taylor, 2013).

Over the last five decades, however, development in 'developing counties' has been significantly influenced by "the world imported from the west, with its order, its advanced technology, and its emphasis on economic growth and material wealth" (Du Plessis, 2001, p. 374). As evident in the foregoing discussion on the history and evolution of the concept of sustainability, the concept is rooted and deeply embedded in the West. African countries, like many developing countries, have often been forced to embrace these concepts that are superimposes into their contexts. Evidently, these concepts from the West are often incongruous with social values and consciousness held by African countries, thereby as Ferazz posits “we -*Africans*- are alienated from our own development process” (DoH 2000, p.6, cited in Du Plessis, 2001, p.376).

Considering these circumstances, the process of reclaiming African (developing countries) development, especially towards sustainability requisites, a reorientation of thinking. This mode of thinking however, may not be entirely new. Perhaps it would involve reengaging vernacular philosophies to steer ‘contemporary’ thinking, as these philosophies were developed in the context, for the context, by the context.

2.7. SYSTEMS THINKING: THE THEORY OF RELATIONSHIPS AND SUSTAINABILITY

> *“The major characteristic of this new way of thinking of the green movement is holism: the belief that things are interconnected, that each problem is part of a larger one, and that solutions in one area can create problems for someone else to solve in another”*
>
> *(Fowles 2000, p. 103)*

Through this literature review it has become apparent that appreciating the interconnectedness of humans to their environments, problems to bigger problems, solutions to other solutions, actors to interests, along with other complexities, is at the core of sustainability. This therefore calls for a critical consideration of multiple perspectives and their embedded motivations and interests through different time periods, while establishing connections between people and politics, knowledge and power, actions and consequences. This way of thinking has often been referred to as “systems thinking” or “holism” (McLennan, 2004, DeKay 2011, Checkland 1981, Fowles, 2000). Naess (1989) refers to this approach as “relational thinking” (p.6) while DeKay (2011) refers to it as the “integral theory” approach and describes it as “an associative logic” (p.72). Checkland (1981) similarly describes systems thinking as an approach that “takes a broad view…tries to take all aspects into account…concentrates on interactions between the different parts of the problem” (p.5).

This school of thought acknowledges elements as parts of a whole that exists on account of the interrelatedness of those parts. Each part has its dynamic processes that undergo continuous evolution, transformation and adaptation while in constant interaction with other parts through various natural and human forces. In essence, “the whole is in the parts and the parts are in the whole, and this synthesis of whole and part is reflected in the holistic character of the function of the parts as well as the whole” (Smuts, 1926, p.86). This reciprocal characteristic inherent in holism transcends the characterisation of wholes as simply the sum of its parts. This concept of holistic thinking is certainly not a new concept. A number of ancient civilisations and religious philosophies acknowledged the interconnectedness of the ecosystem with humans being part of the ecosystem and therefore they understood that each action had an effect that could either be positive or negative.

McLennan (2004) suggests that sustainable design “differs from traditional design not only in its result…, its rationale…, but also its process” (p.218). He refers to this process as holistic thinking that requires an open flexible mind that constantly questions the interrelationship of various components. Williamson *et al.* (2003) submit that sustainability, from a systems point of view involves ensuring,

> “inputs to a system must be constrained within the ability of the wider system to continue to provide the same inputs without degradation – while- emissions from a system must be contained with the ability of the wider system to continue to assimilate them without degradation” (p.84).

This symbiotic cyclic process ensures an optimum relationship between systems and wider systems through the interaction of knowledge from each system across all the relating systems. Broadly, this approach recognises that every component that is part of, influences and interacts with the building design and construction process relates, to the other and therefore cannot be viewed or implemented in isolation. It interrogates the concepts as a continuum that requires an examination of its history, present and even its future in order to gain an understanding.

The previous sections of this chapter highlighted the multiplicity of components that interplay towards the knowledge production, understanding and practice of sustainability. The review further attempted to demonstrate how these elements; time, place, actors, ethics and science, are in constant reaction to each other, transforming and being transformed by each other while influencing the concept and process of sustainability. The consciousness of this interconnectedness demands a restructuring of the current systems that are characteristically linear and reductionist to a more holistic approach. This multi-faceted nature of holistic thinking calls for collaborative approaches that will create linkages in an attempt to broaden the scope of understanding as well as the ability to develop appropriate, well informed solutions.

2.9. CONCLUSION

Evidently, there is no definite description for the term 'sustainable' with reference to architecture, nor should there be a desire to develop one. Aside from the diversity inherent in human societies, this absence of homogeneity in meaning also stems from the fact that humans are yet to fully understand nature's cycles, and more importantly, have not resolved what the nature of their interaction with nature should be, if any at all (Moore 2000).

From an ethical standpoint, as highlighted at the start of this chapter, humans' characterisation of themselves distinct from nature (their environment) is perhaps the genesis of the environmental destruction as a result of human activities. According to Christian philosophy for instance, man was given dominion over the earth (Genesis 1:26) which therefore not only sets him apart from nature but superior to nature. This is contrary to the Buddhist philosophy of *'Esho Funi'* where the self is considered one with its environment. These distinct philosophies exemplify divergent theories with regard to humans' relationship to nature, the earlier often termed as an 'anthropocentric' perspective and the latter as the 'ecocentric' perspective. Du Plessis (2005) addresses this dilemma by asking, "are we saving the planet or are we saving the world – but more importantly she asks, - if we are saving the world, whose version of the world are we saving" (p.4)?

The anthropocentric perspective was advanced by and continues to prevail through the industrial economy and the growth of the capitalist market that is focused on economic growth and technological advancement. This literature review suggest that it will take much more than technological advancement for sustainability to be achieved. It is evident that in order to mitigate the ecological and social crisis brought about primarily by the industrial capitalist economy, there is a need to incorporate more deliberate, perhaps radical thinking across every aspect of the current human systems, potentially guided by complex natural systems. This demands a shift from the linear growth oriented system and perhaps a reinvention of a new value system that is not based on growth and profitability, and that is neither capital-centric nor anthropocentric.

Furthermore, this chapter contends that given the industrial capitalist market, the discourse of sustainability is embedded with competing interests that have the potential to reduce the agenda into a political, populist discourse. The standardisation and globalisation of this concept will continue to suppress local voices and reinforce the interest of particular groups that are often antithetic to the essence of the agenda. The concept of global thinking and global solutions is inexpedient. As Hawken (1993) submits, “it is the arrogance of that thinking that created many of the problems we have today” (p.173). The core of sustainable design therefore, celebrates diversity and advocates for contextual perspectives when defining the problem and developing appropriate solutions as well as the means to achieve those solutions.

In addition, Mc Manus (1996) contends, “it is accurate to say people choose, or mould a form of sustainability that to some degree fits their existing belief systems” (p.54). From the literature review it is evident that the knowledge construction of the concept of sustainable design is influenced by a variety of complex ethical, political, cultural, technological and economic underpinnings that result in its multiplicity of meaning. The review further illustrated this multiplicity through an evaluation of various ideological approaches to sustainable design. This evaluation suggests that in order to establish appropriate sustainable approaches, there should be a critical interrogation and understanding of the ethical values that underpin the political, cultural, technical and institutional processes within a particular context that would influence the establishment of situated solutions, cognisant of local opportunities and challenges.

From this review, there are those who argue that sustainable design is a philosophy, others have advanced it is a practice while others, a style. Fundamentally, however, two schools of thought seem to emerge. At one end of the spectrum are anti-capitalists advance radical restructuring of current human ethics, culture and relationship to nature, and at the opposite end are those who view themselves as progressive and champion the use of technological innovation as a solution to the current environmental catastrophe.

It is also evident that sustainable design requires the acknowledgement that different physical, natural, social and technological elements are interconnected, and therefore that a solution to one problem has consequent effects on other issues. The discourse of sustainability should therefore attempt to create an environment for a continuous, dynamic and inclusive process where the relationship between these seemingly conflicting ideologies can be interrogated. In other words, where nature, culture and even technology can interact.

Overall, through this literature review, it is evident that Western knowledge reflects an inherent regional bias, not only due to climatic differences between the Western world and the global south, but more so, as a result of disparities in cultural dispositions, technological advancement and market dynamics. Furthermore, Western knowledge tends to suppress other forms of knowledge, placing itself in a position of dominance and power to assess and legitimise what constitutes 'true' knowledge.

To reiterate, it is apparent that the point of departure for any discourse on sustainability, irrespective of approach, is the acknowledgement that sustainability is rooted, and cannot be divorced from its context, thus the knowledge construction of sustainability is predicated upon a profound and holistic understanding of contextual dynamics. The subsequent chapter therefore will outline the methodological process the research took in an attempt to interrogate contextual dynamics, within the context of Nairobi, which have underlying precepts that influence the construction of the concept of sustainability with the goal to evaluate the situatedness of the discourse of sustainable design in this particular context.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. OVERVIEW

Research methodology is the scientific process undertaken in order to answer research questions. This chapter therefore presents a comprehensive account of the research's philosophical stance, the methodological approach and design, as well as the various methods used to collect and analyse the data and the rationale for their selection. It will also outline ethical considerations of the study. There have been attempts to propagate the discourse of sustainable design in Kenya, and thus the research is not intended to chastise the existing efforts undertaken by key stakeholders towards sustainable design, but rather to create an environment for critical reflection where meaning and knowledge of this discourse can be constructed in an attempt to establish situated approaches to sustainable design.

3.2. PHILOSOPHICAL PARADIGM

The research will follow a flexible process arguing ontologically that meaning is situational, and therefore relative, which translates epistemologically to a process of understanding several views from participants, taking into account their particular context. The research adopts a post-constructivist perspective arguing that sustainable design should be understood as a practice which is specific to the understanding and interpretation of a particular society within a particular natural context and material reality. The research therefore appreciates the plurality of sustainable design and that it cannot be universally similar.

Post-constructivism differs from the more common constructivism approach which Groat and Wang explain "adopts a subjectivist epistemology whereby knowledge emerges as the researcher(s) and respondents co-create understanding of the situation or context being studied" (p.79). Post-constructivism on the other hand goes beyond the subjectivity that results from knowledge that is exclusively socially constructed. This approach argues, as Knol (2001) posits, that "reality cannot solely exist in social - that is human - interaction" (p.4). Similarly, Wehling (2006) argues that "the exclusive focus on (supposedly) "social factors" tends to marginalise or even (almost) completely negate the importance for the establishment of scientific knowledge of non-social, material factors and objects" (p.84).

Therefore, a post-constructivist perspective instead acknowledges the complex relationship between nature, politics and science, and advocates for the integration of both "human and non-human" aspects in the construction of situated knowledge. This more holistic approach attempts to generate theory simultaneously from nature, society (culture) and science, arguing that these aspects cannot be divorced from each other and any critical construction of knowledge must be cognisant of all three. Based on this premise; that the process of establishing situated reality involves tracing the human and non-human elements that influence and transform this reality within a particular context, the research will attempt to construct theories of the concept of sustainable design from social accounts as well as through the study of architectural artefacts - sustainable buildings - with awareness of the encompassing natural environment.

It is imperative to reiterate that the post-constructivist approach does not discredit socially constructed knowledge in totality. Rouse (1996) argues that “it can be perfectly appropriate to ascribe knowledge to a knower, so long as we understand that correct ascription of knowledge depends on how the knower is situated within ongoing practices rather than simply on whether the knower ‘possesses’ the right belief or skill or stands in appropriate causal relation to fact” (p.133). This means to know is to act as, as opposed to just the ability to act. Thus, this approach goes beyond focusing on the capacity of the knower to have and share knowledge, but rather explores the practicality of that knowledge within a given context. Rouse further adds that “practices always involve doings and doers, along with what these doings are done with and done on” (1996, p.143). Therefore, practice is not limited to the doings of the doers but includes the multifaceted interrelationship of the context in which they are done and understood. In studying the practice of sustainable design, it is imperative not only to study the doers – the stakeholders involved - but also the doings - the processes involved - as well as the deeds – buildings - of those doings.

Another aspect of post-constructivism (which differs from constructivism) is the interplay of global and local perspectives. Although the approach focuses on a local context, it does not entirely divorce itself from global perspective. Knol (2001, p.7) explains that the post-constructivist approach “aims to build systematic connection between the micro-worlds of scientific practice and the macro-categories of political (scientific and natural) thought.” The challenges that have given rise to the discourse of sustainability are experienced on both a local and global scale. The research will seek to draw connections between the discourse of sustainability in the context of Nairobi and existing global theories, by studying local practices in relation to global practices.

As mentioned earlier, and in line with a post-constructivist approach, the research will consider sustainable design as a process, and thus as a continuous situated pursuit and not a final product. This is what Rouse (1996, p.137) refers to as practice. He posits that “practice always include a horizontal future, as well as a history and an extended present”. Knol (2011, p.7) refers to this as “science in the making”.

3.3. METHODOLOGICAL APPROACH

Ontological and epistemological positions dictate appropriate methodological approaches, as the research methodology follows the research’s view of reality and the ways of knowing. Therefore, based on the foregoing philosophical stance, in an attempt to establish situated knowledge, the research will challenge the concept of knowledge production by interrogating how this knowledge on the concept of sustainable design is constructed, by whom, and where it is constructed. This echoes the scepticism of Asdal (2003) when she asks, “to whom are we giving voice and agency and at whose expense” (p.73). Knol (2011) shares Wehling’s (2006) argument that a post-constructivist approach studies science in practice and therefore needs to be positioned at “the construction site to study situated material and discursive practices” (p.8) Similarly, Fischer (2000) argues that “the natural setting is of great importance because knowledge is understood to be nested in context of time and local circumstances” (p.69).

With reference to sustainability, one of the objectives from Agenda 21 (Chapter 35.7f) is to “develop methods to link the findings of the established sciences with the indigenous knowledge of different cultures.” It further highlights that this method “should be developed at the local level…” Similarly, Dryzek (1997) suggests “a de-centred approach would see local experimentation as the essence of the search for sustainable development” (p.134). Guy and Moore (2007) echoed these sentiments, describing sustainability as “more a matter of situational specific interpretation than setting objectives or universal goals.” Thus, this approach does not consider knowledge as existing absolute truths to be found, but rather to be constructed within the particular context which the phenomena are a part of.

It is evident that there is a consensus in the acknowledgement of the importance of locally constructed knowledge. These arguments support the premise of this research; that before ‘developing countries’ rush to apply ‘international’ solutions and standards it is imperative to understand the socio-economic, environmental and technological forces at play in a particular context. The purpose of this study therefore is to explore and understand the concept of sustainable design in the local context of Nairobi.

Against this background, the research adopted a qualitative methodology utilising a constructivist grounded theory approach. Denzin and Lincoln (2011) posit that "qualitative researchers study things in their natural settings, attempt to make sense or interpret phenomena in terms of the meaning people bring to them" (p.3). Thus, qualitative research is fundamentally contextual and relational. This approach is in tandem with the argument that knowledge is subject to a particular interpretation, by particular people at a particular point in time. Des Jardins (1993) borrowing from Aristotle's arguments, elaborates that "to fully understand something is to understand the causes for its being the way it is…science involves more than simply describing what exists; scientific knowledge requires that we are able to explain why something is what it is" (p.25). This research moves not only to establish the perceptions of sustainable design in Nairobi but to further understand how and why these perceptions are constructed. A qualitative research approach allowed for a flexible, exploratory, reflective process throughout the research, as it sought to engage with artefacts (building) and popular discourse among stakeholders.

The core of constructivism rejects the idea of an objective reality, conversely arguing that reality is a social construct and therefore relative to those constructing it. Constructivism not only acknowledges the diversity of social (natural and material) realities, thereby assuming a relativist position, it further attempts to create an environment where, through interpretive approaches, the researcher and participant can mutually co-construct knowledge. Consequently, when the constructivist paradigm is applied to grounded theory, the positivist idea of emergent objectivity, characteristic of Glaser and Strauss's' traditional version of ground theory, is replaced with Charmaz's (2003) version of constructivist grounded theory that "considers research interactions to be a site for co-construction that may help bring to the fore an in-depth understanding of experience from the participant's standpoint through a more flexible procedure of negotiation of meanings or interpretation of shared experience" (Priya 2019. p.2). As Charmaz (2003) claims, "data do not provide a window on reality. Rather, the "discovered" reality arises from the interactive process and its temporal, cultural, and structural context" (p.273). This approach creates a space where the researcher and participant can mutually interpret how participants construct their realities "shaped within their relational, cultural or socio-political context" (Kumar 2019, p.4).

In addition, constructivist grounded theory also differs from traditional grounded theory with respect to meaning in relation to data. Whereas traditional grounded theory focuses on "explaining why things mean what they do and the consequences these meanings have for those in the setting", constructivist grounded theory focuses on "meaning and how meaning is constructed" (Gibson & Hartman 2014, p.46). This approach was appropriate for this research as the research not only sought to understand how the concept of sustainable design is understood, and consequently how this understanding affects its articulation in the built environment, but further sought to explore what influences the construction of the different perceptions.

3.4. RESEARCH DESIGN AND STRATEGY

The research began by establishing an understanding of the social-political, economic and institutional dynamics that have the potential to influence and affect the manner in which the concept of sustainable design is constructed, interpreted and articulated within the context of Nairobi. Consequently, the research moved to bring together ideologies and methodologies of different stakeholders in the building industry in Nairobi in an attempt to establish a situated understanding of the concept of sustainable design. Finally, the research analysed selected case buildings that have been considered sustainable among the stakeholders within the context. Fig.3.2 summarises the research design and strategy.

The post-construction approach appreciates the role of social cognition, cultural disposition and practices as well as contextual objectives and claims in the development of knowledge. The research also acknowledges the "diversity of actors, knowledge systems, social relations and networks involved in the creation in knowledge…" (Miller *et al.* 2017 p.2). It therefore provides an opportunity whereby the contributions of this knowledge(s) from different entities can be shared and discussed. Aside from the profound contribution of local social knowledge, the approach acknowledges the "ethical dimension of the need to include the knowledge of those people likely to be affected by the outcome of decision making' (Kerkhoff and Lebel, 2006 p.457).

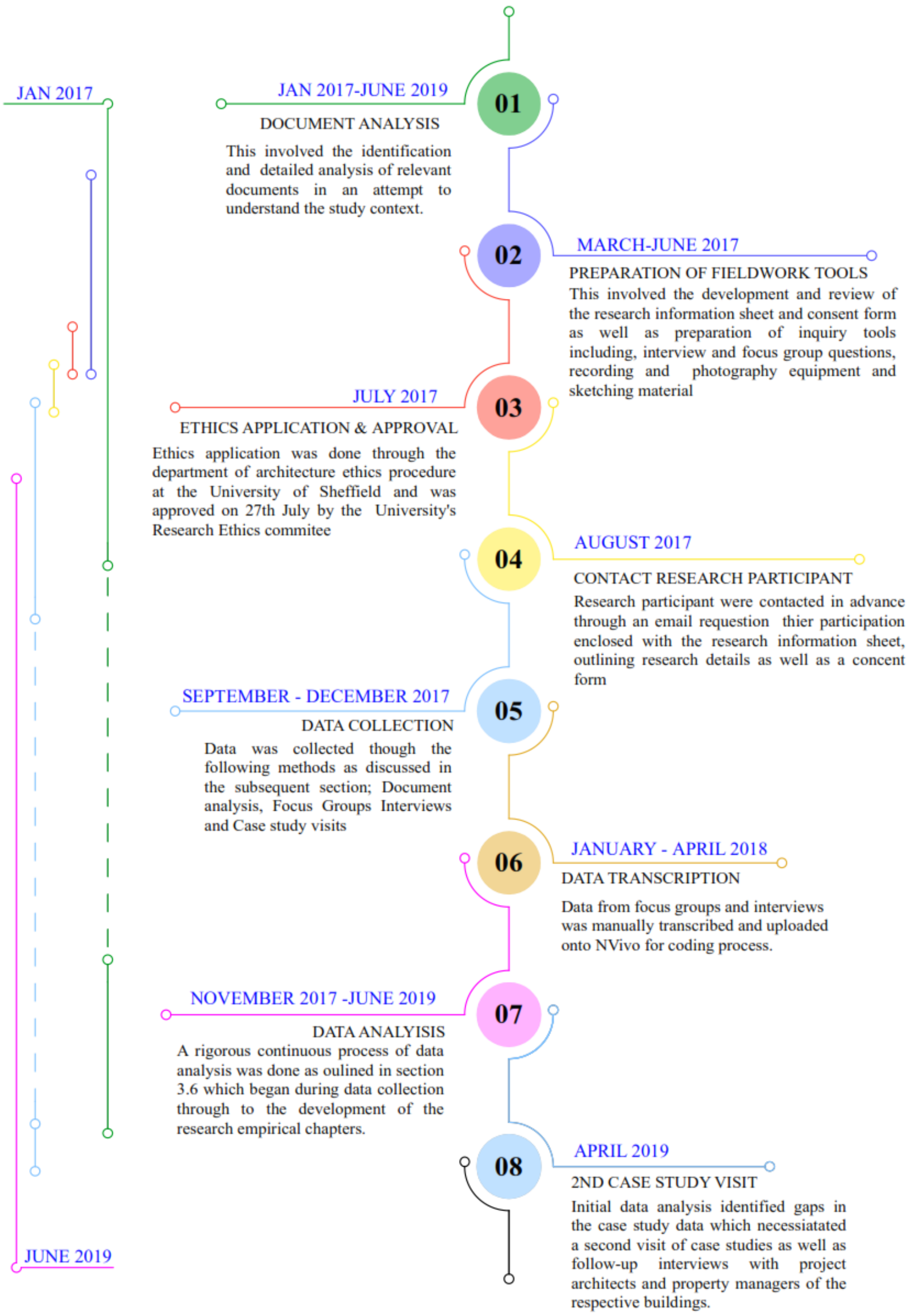

Fig. 3.1: Research Data collection and Analysis Timeline.

Contrary to traditional research design, a methodology that adopts a post-constructivist approach to knowledge does not necessarily have a fixed research design, but allows for the design to be informed and transformed by context through practice. This does not imply the absolute absence of antecedent theoretical stance, as comprehensive knowledge of the subject is imperative prior to undertaking the study. As Dey (1990) suggests, "there is a difference between an open mind and an empty mind" (p.251). The research acknowledged that, the intelligible express purpose and strategy notwithstanding, the research process was likely to yield transformation and possibly variations to the purpose and strategy previously outlined.

This methodological design will not only relate better to the contextual reality but will go further towards giving the participants an opportunity to question their reality and rethink ideas. It encourages fluidity in the exchange and construction of knowledge between the researcher and the participant, and thus views participants as partners and not subjects. Consequently, the research is "with", as opposed to "on", the participants (Horner 2016). This therefore requires a level of trust, along with mutual and often reciprocal relationship between the researcher and the participants which is time-intensive to develop. This is one of the reasons for the choice of Nairobi as a study context, as the researcher had prior relationships with some of the participants, and the development of new relationships would be considerably simpler than in a new 'foreign' context. This approach therefore entails an inclusive, dynamic, mutually collaborative relationship between the researcher and the participant in an attempt to understand a particular phenomenon within a particular context, in order to create transformative situated knowledge.

The research involved collection of data from three broad spectra. The first were from key stakeholders who are part of the discourse of sustainable design in Kenya through interviews and focus groups. Secondly, from selected existing buildings in Nairobi through interviews from architects and property managers, drawings analysis, observation, sketching and photography. Thirdly, from existing documents including but not limited to green building assessment systems manuals, legislative material, contextual statistics, through document analysis. The selection of "key stakeholders" was based on their capacity to influence sustainable design in Nairobi. Table 3.1 shows the list of stakeholders and their position within the discourse. While the study recognises that the movement towards sustainable design is a collective responsibility, it highlights the selected stakeholders in Kenya due to their role in policy development, advisory and training capacity, as well as practical skill and experience in the discourse.

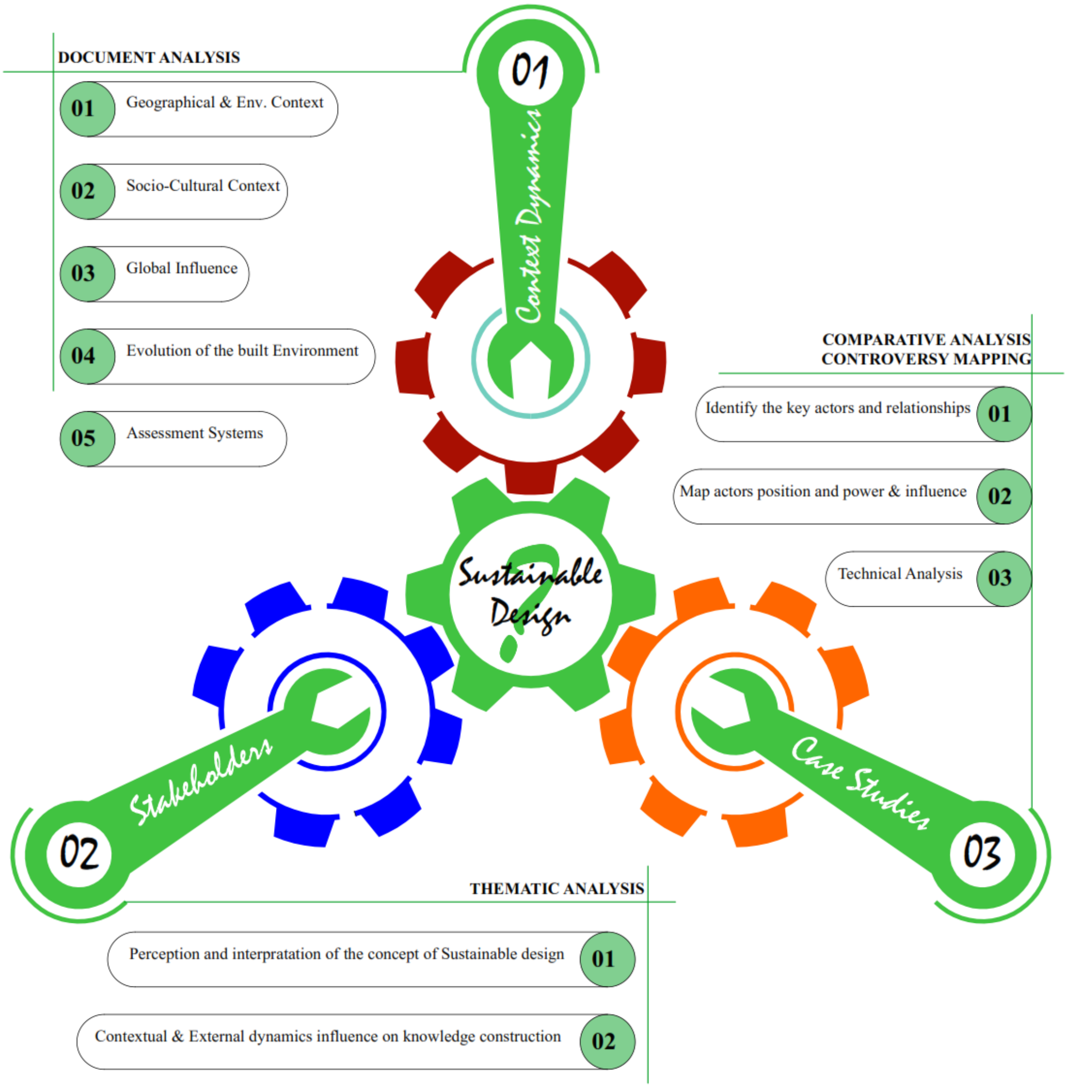

Fig. 3.2: Research Design and Strategy. Source Author: 2018

3.5. INQUIRY METHODS

While adopting a constructivist grounded theory approach, through use of reflective, comparative and inductive techniques, the research employed several methods to gather, synthesize and analyse context-specific data (Fig. 3.3). Charmaz constructivist grounded theory was chosen to develop a theoretical understanding of the process of knowledge construction in sustainable design in Nairobi. With this approach, theory is co-constructed between the researcher and the researched. This research employed four methods of data inquiry: document analysis, focus groups, interviews and case study analysis. Table 3.1

summarises the objectives for the use of each method. The subsequent discussions will elaborate on these methods and the implications of a constructivist grounded theory approach on data collection and analysis.

Table 3.1: Summary of inquiry methods and objectives. Source, Author, 2019

	METHOD	OBJECTIVE
01	Document analysis	Understand the contextual dynamics that affect the built environment in Nairobi with reference to sustainable design.
02 03	Focus groups Interviews	Explore popular discourse among stakeholders in Nairobi on the concept of sustainable design.
04	Case study buildings	Interrogate buildings in Nairobi as artefacts that are representative of design thought in regard to sustainable design

3.5.1. SAMPLING

Participants involved in the focus group discussions and interviews were recruited from the construction industry in Nairobi. The sample included purposively selected participants from three distinct groups: Academia, practice, and government. Two focus groups were conducted, one with academia and the other with practice consisting of 8 and 15 participants respectively. A focus group poster (Appendix F) was displayed at the JKUAT university school of architecture and building science inviting interested parties to register their interest through scanning a bar code. Interested parties were the emailed an information sheet detailing the research aims, process, and their role as participants. In addition, 21 interviews were conducted with participants from these different groups. (Appendix H). The sample size was influenced by both purposive sampling and theoretical sampling. Theoretical sampling "allows the researcher to follow leads in the data by sampling new participants or material that provide relevant information" (Tie et al., p.5). Therefore, initial participants in both the focus groups and interviews helped build the sample size, that means, the focus group discussions and initial interviews influenced the selection of other participants to be interviewed.

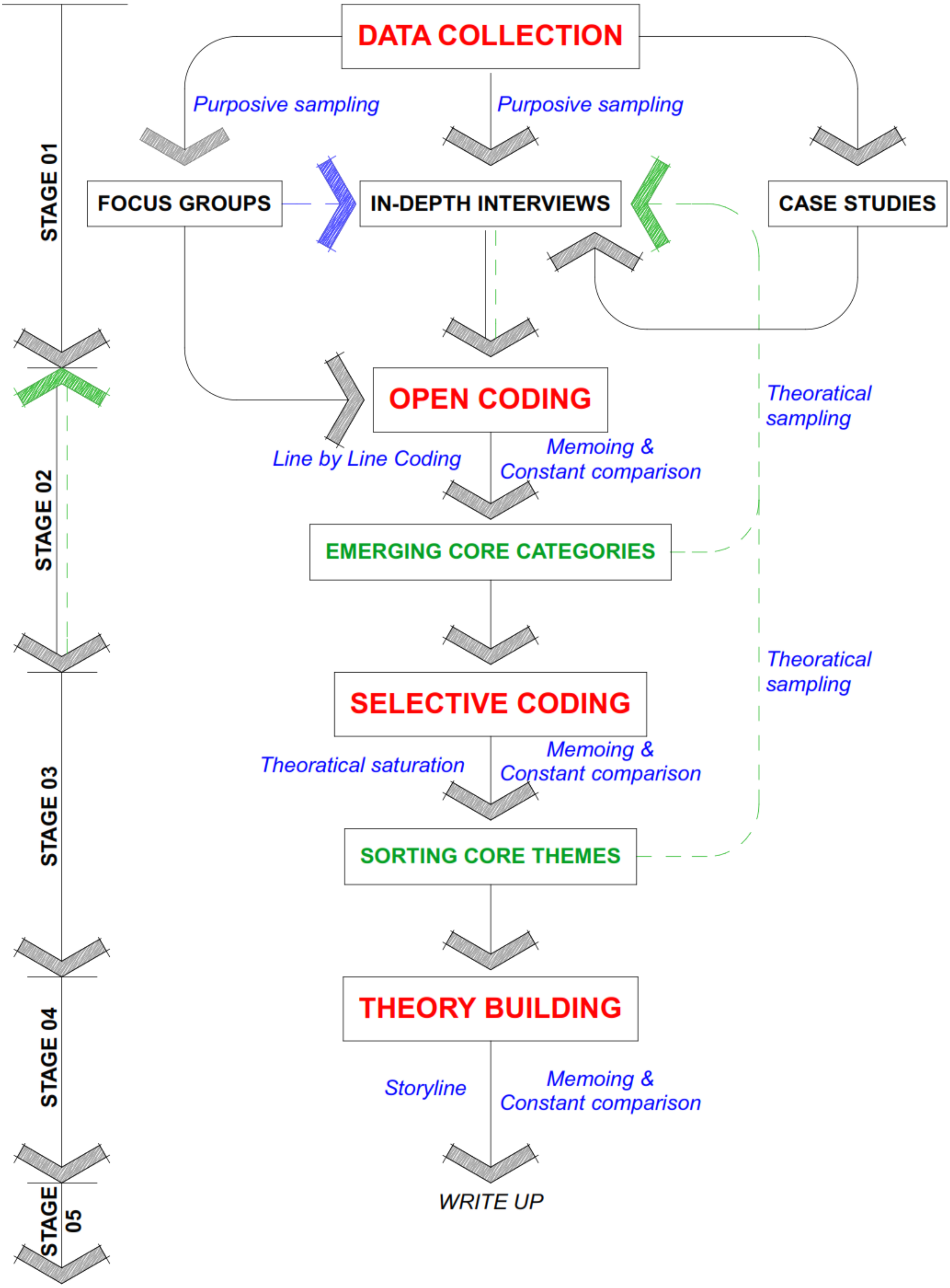

Fig. 3.3: Summary of data collection and analysis process. Source: Author 2020

3.5.2. DOCUMENT ANALYSIS

Flick *et al*. (2004) describe documents as "independent methodological and situationally embedded creations" (p.285). They exist for a specific purpose and are often a consequence and a reflection of a particular socio-cultural, political, economic and situational context. Documents can therefore be viewed as a lens through which one can begin to understand fragments of a phenomenon from different authors, as they are reflective of the different constructions of the concept under study by those who developed the documents. Glaser and Strauss (1967), referring to different publications, claim that "people converse, announce positions, argue with a range of eloquence and describe events or scenes in ways entirely comparable to what is seen and heard during field work" (p.163). They further suggest that "documents do much more that serve as informants and can, more properly, be considered as actors in their own right" (p.822). Documents present positions on a discourse that may be consistent or incongruous with the positions of those who interact with the document, often influencing their positions. Thus, "grounded theories of documents can address form as well as content, audiences as well as authors, and production of the text as well as presentation of it" (Charmaz 2014, p.45).

Before proceeding to and during work in the field, the research sought to gather preliminary insights from extant documents, such as but not limited to; public records, professional and technical reports, policy reports, conference papers, newspaper and magazine articles, as well as green building assessment systems. The research analysed the documents in an attempt to explore the intentions and interests of the authors, the implications of the documents, and the various interpretation of these documents. Of particular interest were the green building assessment systems that have a footprint in Nairobi's building industry (Table 3.2).

Table 3.2: List of assessment systems studied in the research. Source, Author 2017

	TOOL	COUNTRY OF ORIGIN
01	Leadership in Energy and Environmental Design (LEED)	United States of America
02	Green Star South Africa – Kenya	South Africa – Contextualised from Australia
03	Green Mark Kenya (Draft)	Kenya
04	Safari Green Building Index (Draft)	Kenya

Data collected from the extant documents were used to create a theoretical, discursive, and situated background that would support data collected from the focus group discussions, interviews, and case studies. The documents not only revealed the situational dynamics that influence the construction industry in Nairobi but also shed light on the key stakeholders within the industry. Data from documents were compared to data collected in the field study, with the intention of exploring the consistencies and inconsistencies between the positions and intentions outlined in the documents and the actual practices in the field.

3.5.3. FOCUS GROUPS

Exploratory focus group discussions with academia and other industry stakeholders were conducted as a foundation for the data collection process. Taking into account that sustainable design is a fairly new concept in Kenya, the primary aims of the research is to construct meaning and understanding for this discourse. Focus groups allowed for discussion where, as Warr (2007) describes, "meaning is being jointly created, contested, and reworked within processes of the group" (p.154). This process stimulated synergy of opinions and ideas from participants through the back and forth nature of the process. Lee and Stech (2011) point out that these participants "are not there for the sole purpose of providing information but, through the learning process, to take part in constructing their understanding of reality" (p.183). These sentiments are echoed by Morley (1980), who explains that focus groups allow researchers "to discover how interpretations were collectively constructed through talk and the interchange between respondents in the group situation, rather than to treat individuals as the autonomous repositories of a fixed set of individual 'opinions' isolated from their social context" (p.97). This allows for a level of consensus to be reached that will form a basis for further in-depth studies through interviews, document analysis and case study building analysis. The sessions will be digitally recorded for further transcription and analysis.

3.5.4. IN-DEPTH INTERVIEWS

Having developed a foundation through focus group discussions, the next research phase was conducting in-depth interviews. This section will highlight the justifications for selecting interviews as one of the methods of inquiry and will present the interview process undertaken in this research.

Charmaz (2014) suggest that interviews are particularly appropriate in conjunction with a grounded theory approach, as both are "open-ended yet directed, shaped yet emergent, and paced yet unrestricted" (p.85). She describes an interview as "a gently-guided, one-sided conversation that explores research participants' perspectives on their personal experience with the research topic" (p.56). Therefore, while focusing on core issues, interviews create an environment where participants' thoughts can become manifest. Similarly, Gray (2014) suggests that interviews are recommended when "the research objectives are based upon understanding, experiences, opinion, attitudes, values and process" (p.383). This is imperative as the research hinges upon constructing theory driven by participant opinions. This is reiterated by Roulston (2010) who argues that "in the constructionist concept of the interview, data provides situated accounting of the research topic" (p.61). Charmaz (2014) also explains that "a constructivist approach views interviews as emergent interactions in which social bonds may develop". Thus, the interview process is aimed at developing a level of reciprocity between the interviewer and interviewee. She further adds that rather than the interview being a mere action, "it is the site of exploration, emergent understanding, legitimisation of identity, and validation of experience" (p.91). Glaser and Strauss (1998) state that "participants in the study would all have experienced the process and the development of the theory which might help explain practice or provide a framework for further research" (p.63). The interviews are therefore more mutual conversation as opposed to a series of questions and answers. It is more an exercise of exploration rather than interrogation.

Interviews can be broadly grouped into structured, semi-structured and unstructured (Caswell 2007). Face to face semi-structured interviews were selected as they provide a level of focus while allowing for flexible interaction, probing and positive digressions to issues that may not have been foreseen during the design of the interview but are relevant to the study. Caswell (2007) explains "…we ask open-ended questions, wanting to listen to the participants we are studying and shaping the questions after we explore…our questions change during the process of research to reflect an increased understanding of the problem (p.43). This back and forth process of refining the questions is quintessential to a constructivist approach. The flexibility of semi-structured interviews also accommodated the difference in stakeholder backgrounds, expertise and knowledge on the subject.

The process began by constructing an interview guide. An interview guide is a flexible tool used to direct the interview process that can be revised as guided by the spontaneity created by the process. It sets out what Karp, in Charmaz (2014, p. 63), refer to as "domains of inquiry", which help focus the inquiry but still allow for flexibility. The questions asked, and how they are asked, "outline the context, frame and content of the study" (Charmaz 2014, p.63) and consequently dictate what responses are given and how they are given. This is therefore a fundamental stage in the interview process, as it has a significant bearing on the research outcome. Constructing the interview guide for this research therefore involved a rigorous process of reconstructing and refining the questions prior to conducting the interviews.

As earlier mentioned, purposive sampling was used to identify participants for exploratory but in-depth interviews with key stakeholders in the building industry. In this case it is worth noting that a fixed number and selection of stakeholders was not finalised until the completion of the research. The research began with theoretical sampling, where participants were selected based on their "theoretical relevance" to the generation of theory. However, during these interviews, some researchers provided details of other participants who they felt would further inform the research. Consequently, the research moved to theoretical sampling as emerging data necessitated. Appendix H provides a summary of stakeholders involved in the study.

Selected participants were contacted by email with documents outlining the research purpose and objectives, requesting their participation. While conducting an interview, a constructivist grounded theorist not only explores and documents participants' thoughts but more importantly begins to develop theories that can be built upon in subsequent interviews, which requires constant rigorous consideration of data collected. Therefore, each interview in one way or another informed the next. Charmaz (2014) highlights four theoretical concerns when conducting the interview; "theoretical plausibility, direction, centrality and adequacy" (p.87). Theoretical plausibility was developed in the earlier stages of the research as participants' key concerns and thoughts were identified and initial tentative theoretical interest began to emerge. During this phase, fewer questions were asked, allowing participants more time for reflection and more control of the content and direction of the research. As the interview phase progressed, these emerging interests began to shape the theoretical direction of the study. Consequently, theoretical centrality was reached as dominant patterns and theories became apparent. Finally, in the later stages of the process, theoretical adequacy was assessed by interrogating the robustness of the data already collected, which prompted subsequent interviews with more theoretical focus, as well as follow-up interviews with some participants interviewed in the earlier stages.

3.5.5. CASE STUDIES

Yin (2014) defines a case study as "an empirical inquiry that investigates a contemporary phenomenon (the case) in depth and within its real-world context, especially when boundaries between phenomenon and context may not be clearly evident" (p.16). In this respect, case study entails "studying a case in relation to the complex dynamics with which it interacts and from which the case itself is inseparable" (Groat and Wang 2014, p.421). This argument therefore proposes that the definition of a case is inextricable from its context. From this perspective, the research aimed to understand the contextual human and non-human dynamics surrounding the design and construction process of the case buildings.

The research documented and analysed four cases buildings (Table 3.4). These were selected within the context of Nairobi, as they were representative of different constructions of the concept of sustainable design in both their processes and resultant 'product'. Using purposive sampling (outlined in Chapter 6), the selection of these case buildings was informed by the data collected from the document analysis as well as from interviews and focus groups with stakeholders. As common with the other methods of inquiry, a case study questions guide was developed that would focus the research while still maintaining flexibility during the inquiry process.

Table 3.3: Case study building selected for this research. Source: Author 2019

	BUILDING	TYPE
CASE 01	Kenya Commercial Bank Towers – Upperhill	Office Block
CASE 02	The Catholic University, Learning Resource Centre	Educational
CASE 03	The Strathmore Business School, which is LEED certified.	Educational & Commercial
CASE 04	Anwa Junior School	Educational

Yin (2014) submits that "some theory development prior to the collection of any case study is desirable" (p.38). The cases in this study were analysed based on theoretical prepositions emerging from the document analysis, focus group discussion and interviews, in an attempt to establish areas of convergence and divergence between popular discourses explored during the focus group discussions and interviews and the actual practices evident in the case buildings as artefacts and processes in the attempt to create theories. Therefore, the case study was both exploratory and explanatory in nature; the exploratory aspect asked who, what and how, while the explanatory aspects sought to construe why things are and how happened. In doing so, beyond describing the physical attributes of the building, the analysis focused on who made decisions, why decisions were made and what implications the decisions had on the processes and final outcome of the case buildings. With regard, to the physical attributes of the buildings, visual images of the case buildings were recorded through observation, sketching and photography. Lucas (2016) refers to the use of these tools as "drawing attention" which he describes as "using drawings as a way to understand a phenomenon more directly" (p.183). Similarly, Chase (2011) suggests visual images can be used "empirically" as a record of actual observations or "symbolically" for critical analysis of meanings the images depict. Consequently, in order to understand the process that lead to the different outcomes, interviews were conducted with case study project architects and the managers of each property case.

3.6. DATA ANALYSIS

NVivo 11 and 12 software to visualise textual data from interviews, focus groups and documents that were transcribed, collated and organised, creating a kind of database that eased data access and aided data analysis. Adopting the inductive process of constructivist grounded theory (CGT), using these data, the research identified and analysed patterns that led to the development of codes, themes and ultimately theories. The CGT approach "seeks meaning in the data that goes beyond the surface, searching and questioning for tactics meaning about values beliefs and ideologies" (Mills *et al*., 2006, p.12). They further suggest that these meanings are characteristically abstract and take into consideration the participants' influence from the wider context on their construction of concepts. This entails constant questioning of data through a process of continuous coding and recoding of data that involves data selection, separation and sorting. Charmaz (2014) describes this process of coding as the “link between collecting data and developing an emergent theory to explain these data” (p.113). These codes create an analytical framework for the development of theories. The coding phase is divided into two main phases; the initial, or open coding, and the focused coding phase complemented by memo writing (Charmaz 2014).

3.6.1. INITIAL (OPEN) CODING

In is important to note that the analytic process according to the CGT approach does not begin once all the data is collected but rather as the data is being collected. The coding process is an iterative, comparative, interactive process, first with participants as data is collected and subsequently, repeatedly, with the data from participants. This interactive space inspires more questioning and may challenge original assumptions. For instance, the initial focus of this research was environmental issues relating to sustainable design; however, in the process of data collection, socio-political and economic issues seemed to shape participant construction of the concept of sustainable design more than environmental issues, compelling a shift in focus. Initial coding, therefore, “remains open to all possible theoretical directions” (p.114), and as a result, the research is open to unforeseen directions and hidden assumptions as guided by the data (Charmaz, 2014). This “closeness” to data occasioned by initial coding compels the researcher to consider data in ways that may be contradictory to initial perceptions and interpretations.

Broadly, initial coding explores what data is being studied, what the data suggests, whose point of view the data represents and what indicative theoretical categories are emerging. (Glaser and Strauss, 1967; Charmaz, 2014). This was done through examining the data line-by-line drawing preliminary code maps that identified emerging thoughts within the data. This involves selecting dominant ideas and properties from the data and organising them into as many preliminary categories as possible. Using NVivo as an aid, this was done separately for the data collected from the three methods – documents, focus groups and interviews (Fig. 3.4, Appendix J). Given that initial codes are “provisional, comparative and grounded in the data” (Charmaz, 2014, p.117), it allows the researcher to develop new ideas without trying to fit data into pre-determined classification, thus the researcher begins to critically analyse and interpret data from the outset of the process.

As this process is carried out simultaneously with data collection, it allows the researcher to collect more data on intriguing emergent ideas. This analytic process also helps identify gaps in the data early in the analysis, prompting areas where further data is required. For instance, initial coding of data from the case study buildings unearthed gaps that necessitated a second case study visit and follow-up interviews with project architects and property managers of the respective case buildings.

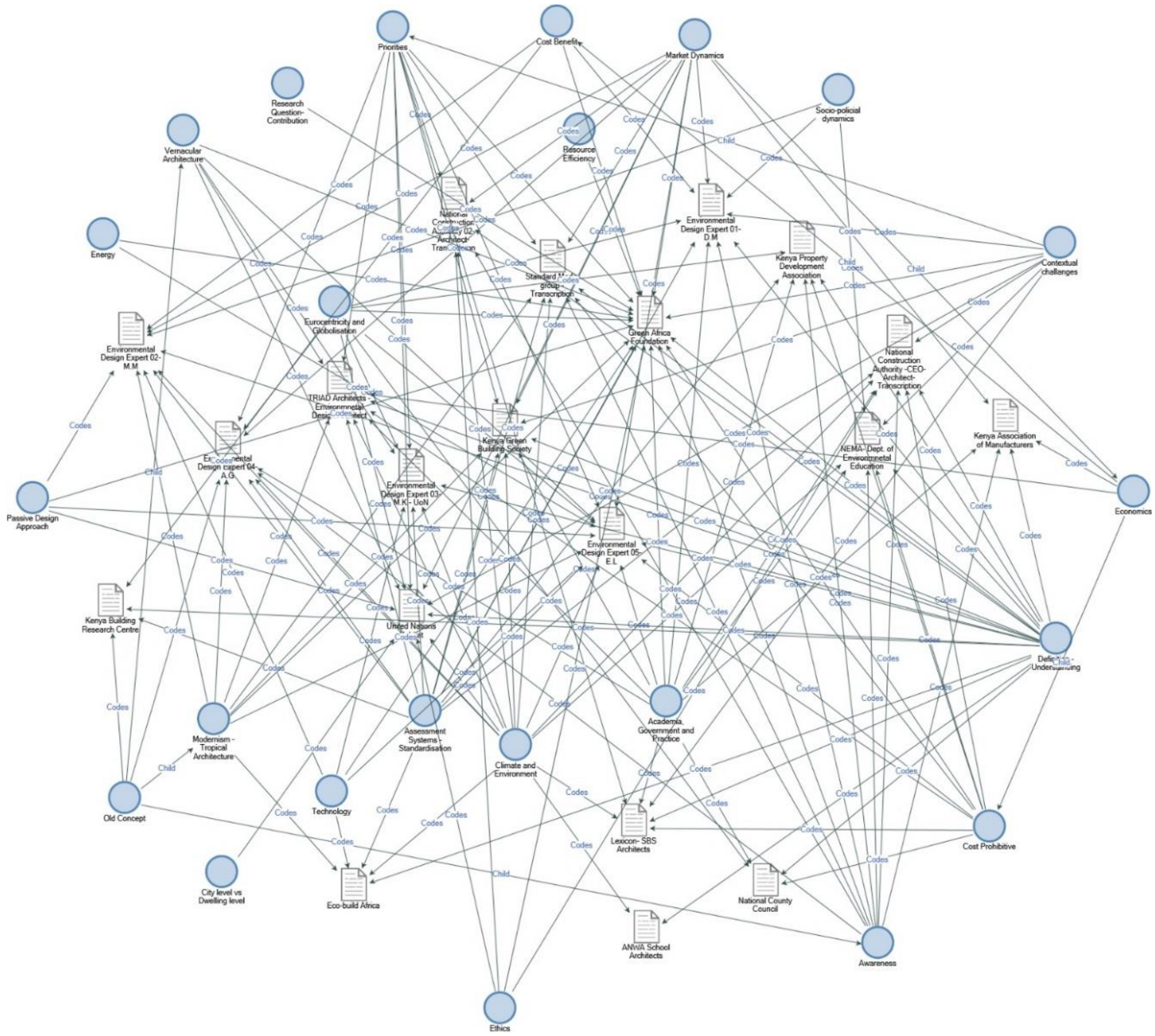

Fig. 3.4: Example of initial code maps. Source: Author 2019

Glaser and Strauss (1967) suggest that at this point a researcher should begin a reflective process of documenting emerging ideas through memos. Memos and maps assist the researcher to move from the descriptive writing to more analytical statements, scrutinising, classifying and comparing emerging codes while seeking to discover meaning and assumptions embedded in the data.

3.6.2. FOCUSED CODING

Charmaz (2014) defines the process of coding as "using the most significant and/or frequent earlier codes to sift through and analyse large amounts of data" (p.138), thereby advancing the research's theoretical direction. During this stage, patterns in the data that were identified in the initial codes were developed to more conceptual themes and concepts under different categories. This process involves making tentative decision that remain flexible. Whilst during initial coding the codes remain as close as possible to the data, focused coding begins to move away from the data to more conceptualised ideas.

This phase also advances the comparative process as the categories developed are then compared to establish interconnecting categories and causal conditions and consequences. Glaser and Strauss (1967) refer to this as "integrating categories and their properties." (p.108). This comparison identified patterns and established core concepts around which a narrative could be developed by relating the core concepts to sub-concepts. Yin (2011) refers to this process as "playing with data" (p.191) which he explains involves arranging and rearranging data under different themes, ultimately creating hierarchical arrays or designing arrays of matrices that group similar and divergent ideas under similar and divergent themes respectively, establishing the interconnections within the data. Focused coding also compares emerging themes with the initial research conceptions.

During this process of identifying and analysing codes and concepts, theoretical memoing was done to capture connections and emerging theoretical ideas. Corbin and Stauss (2015) argue that theory is built on the basis of the memos. Tei *et. al* (2018) describe memos as "reflective interpretive pieces that build a historic audit trail to document ideas, events and thought processes inherent in the research process and developing thinking of the analytics" (p.4). While memo's in the previous stages were more descriptive and case-based, memos during this phase became more conceptual and abstract (Appendix K).

3.6.3. BUILDING THEORY

At this point in the analysis, the research will have accumulated coded data, memos and emerging themes. The coded data is in different categories, and memos contribute to the underlying content of the categories. This phase moved to theorise data from the focused codes and categories and began to ascribe meaning to established themes and concepts. This as Yin suggest, requires “interpretive skill” in order to “develop a comprehensive interpretation, still encompassing specific data, but whose main themes will become the basis for understanding your entire study” (p.207). Charmaz (2014) refers to this as “theoretical sensitivity” which she defines as “the ability to understand and define phenomena in abstract terms and to demonstrate relationships between studied phenomena” (p.160). This can also be described as the “ability to recognise and extract from the data elements that have relevance for emerging theory (Briks and Mills 2015, p. 181). It is important to note that while theoretical sensitivity is particularly important in this stage, this sensitivity was continuously embedded within the research process. This required maintaining an open mind through the process of data collection, analysis and theory building.

Corley and Gioia (2011) define theory as “a statement of concept and their interrelationship that show how and/or why a phenomenon occurs” (p.12). Weber (2003) posits that “a theory is a particular kind of representation of some phenomena… it comprises constructs, relationships among constructs, and a boundary within which the relationships among constructs hold” (p.vii). A theory therefore presents a position or a possible explanation of a phenomenon within defined boundaries based on the relationships that emerge from the data. In this study these boundaries are defined based on the contextual dynamics of Nairobi’s built environment. Building theory is however not a step but a reflexive process. Theorising attempts to construct a coherent explanation based on interaction between data, memos and existing literature

According to the grounded theory approach, building theory involved consolidating emerging concepts into a narrative and developing hypotheses, both of which will be tested by cross-checking against data collected to ensure consistency. This was done until ‘theoretical saturation’ – “no emergence of new properties, classes, categories or relationships from data” (Gray 2014, p.620) is achieved (Gray 2014; Creswell, 2007). Glaser and Strauss also refer to this process as “delimiting the theory” (p.110), which involves developing boundaries to the theory. Through the storyline technique first presented by Stauss and Corbin (1900), categories were transformed into highly conceptual theories. A storyline is “a strategy for facilitating integration, construction, formulation, and presentation of research findings through the production of coherent grounded theory” (Briks and Mills 2015, p. 180). Using the story lines as a tool, categories were integrated in the process of constructing discursive theoretical positions.

3.6.4. RESEARCHERS BIAS

Finally, it is imperative to highlight the challenge of ensuring that the preconception and positionality of researchers are not imposed on the research during the coding process. Charmaz (2014) holds that the researchers' preconceptions and positionality may "influence what we (the researcher) attend to and how we make sense of it" (p.156). This required researcher reflexivity and awareness throughout the interactive analytical process. This influence often becomes apparent once it is challenged by those outside the research. In an attempt to address this challenge, aside from engaging colleagues and supervisory team, the research process and findings were presented to different audiences at different phases of the research through workshops and conferences.

3.7. RESEARCH ETHICS

This research was ethically reviewed and approved via the Department of Architecture ethics procedure at the University of Sheffield (Appendix A). The University's Research Ethics Committee monitors the application and delivery of the University's Ethics Review Procedures across the University. The research adhered to the four critical ethical considerations outlined in the University's Ethics Review Procedures echoed by Gray (2014); "avoid harm to participants, ensure informed consent to participants, respect the privacy of participants and avoid the use of deception" (p.73).

In order to ensure that the participants gave informed consent, an overview of the research was given to each participant outlining the research purpose, details of the researcher, other participants that may be involved in the research, nature of data required from the participant, duration of time requested from the participant, how the data would be used, and access, as well as emphasis on their participation being entirely voluntary (Gray 2014).

Participation in the research was entirely voluntary, however if participants chose to participate, they were requested to sign a consent form. A copy of the information sheet (Appendix B) and consent form (Appendix C) was given to the participants for their records. Even after signing the consent, participants could choose to withdraw from the research at any time without any negative consequences. Upon withdrawal, participants' initial responses would be discarded unless participants gave consent to their use.

The identity of the participants was not disclosed. Participants' names were not to be linked to results from the data in the Ph.D. thesis or any other academic publications. However, given that the research takes a co-constructed approach, participants' responses were discussed by other participants, although participants' identities remained anonymous. The name of the organisation participants represented may however have been mentioned.

Following participants' consent, the interviews were audio-recorded, and notes were also taken during the interview process. These recordings were only accessible to the researcher. For the case study buildings, where photography and drawings were methods of data collection, consent by formal letter was sought and a formal written approval requested. Photographs will be presented as taken, without any editing.

Results of the research were published in the researcher's thesis document as part of the researcher's fulfilment of a Ph.D. programme. The results may also be used by the researcher in subsequent publications in other academic platforms. Participants' response will however remain anonymous throughout all the publications. It is also important to note that due to the nature of this research, it is very likely that other researchers may find the data collected to be useful in answering future research questions. The researcher shall request participants' explicit consent for their data to be shared in this way and if participants agree, the researcher will ensure that the data collected is untraceable back to the interviewees before allowing others to use it.

3.8. LIMITATIONS

Using grounded theory this research attempted to construct context-specific theories based on contextualised understanding of human and non-human interactions. Therefore, generalisability and transferability of constructed theory may be a challenge. However, the methodology used to arrive at these theories is transferable.

One of the criticism of constructivist grounded theory is the flexibility embedded in the methodology that allows the research to guide the process. Thus, the researcher can be drawn to multiple directions. This process can become overwhelming if limits that would focus the process are not set. Theoretical sensitivity is therefore required all through the process. This was achieved through the use of detailed memo as a tool to reflect on decisions throughout the process.

3.9. CONCLUSION

This chapter presented a comprehensive account of the philosophical paradigm that influenced the manner in which the research was conducted, which is relativist ontologically and subjectivist epistemologically. Overall the research utilised qualitative research methods through a post constructivist grounded theory approach. As discussed throughout this chapter, the strength of the constructivist grounded theory approach is the ability to construct theories based on the different constructions of situated knowledge practices and dynamics.

This was the followed by a systematic description and justification of the research methods utilised (focus groups, interviews and case studies) as well as sampling and recruitment procedures for each research method. The chapter then moved to discuss the research process of data collection and data analysis as well us the ethical consideration made during this processes.

Against this framework, the subsequent empirical chapters will discuss the research findings, analysis and synthesis, and ultimately developed theoretical positions that explain these findings.

CHAPTER 4

THE CONTEXT OF KENYA – OVERVIEW

INTRODUCTION

The premise of this research as elaborated in the foregoing chapters is the appreciation of the diversity of contexts, as well as the appreciation that understanding context is imperative for the construction of applicable and appropriate solutions. Similarly, society's perceptions and priorities are shaped by these contextual dynamics. Therefore, this section will attempt to create an understanding of the contextual dynamics that would influence and affect the built environment in Kenya with a focus on Nairobi, its capital city. Furthermore, while focussing on the built environment, this section will highlight existing research, policy and national strategies proposed and adopted to mitigate the impact of climate change.

4.1. GEOGRAPHICAL CONTEXT

Located in East Africa, Kenya lies between 5^0N and 5^0S, with the equator almost cutting right across its centre. The country shares borders with Tanzania to the south, Uganda to the west, South Sudan and Ethiopia to the North, and Somalia to the East, with a coastal boundary to the Indian ocean on the south east boarder. Kenya has a total area of 591,971Km2 consisting of 580,609Km landmass and 11,362Km2 of water mass (IOM,2016). Kenya's capital city Nairobi lies at latitude 1^0S and longitude 36^0E with an approximate area of 696km^2 (Fig. 4.1).

Approximately 85% of Kenya is classified as an arid or semi-arid region. The county's relief is characterised mainly as a plateau region of between 1000m to 1500m across the country, with a low coastal plain at its south east extreme at the shores of Indian Ocean, and diverse mountain ranges, with the highest being Mt. Kenya at 5,199m.

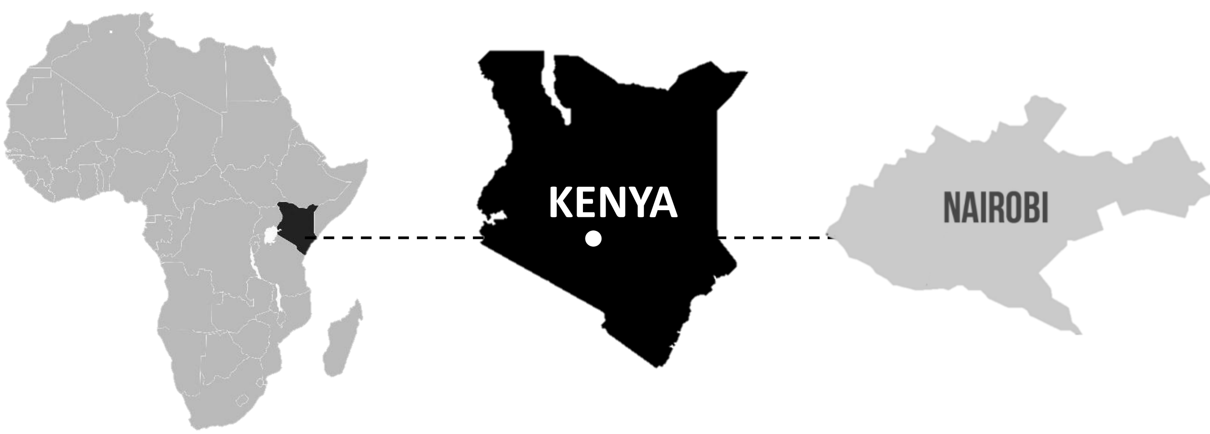

Fig 4.1: Geographical location of Nairobi. Source: Author drawn, 2018

4.2. SOCIO-ECONOMIC CONTEXT

Kenya's population has grown significantly from 10.6M in 1969 when the first census was conducted to 38.6M during the latest 2009 national census (KNBS, 2010). Ten years later in 2019, it is estimated to have risen to 47,564,296 (KNBS, 2019). Projections peg the population between 64.38M-71.26M in 2030 (IOM, 2016). IOM (2016) further posit that populations are greater in agricultural zones, followed by urban zones. According to the last official census of 2009, more than 10% of the population were living in Kenya's largest cities, Nairobi and Mombasa, with a population of 3.14million and 0.94million respectively. Despite covering only 0.1% of the country's total surface area, Nairobi is home to approximately 8% of Kenya's population, representing about 25% of the country's urban population and approximately 50% of its economic activity (UNEP, 2009). These numbers have increased significantly over resent years and are currently approximated as 4,397,073 and 1,208,333 respectively (KNBS, 2019).

Followings her independence in 1963, Kenya has experienced enormous economic and infrastructural growth, and has since become East Africa's economic giant. In 2013, Kenya was ranked the 9th largest African economy (Forbes, 2014). More recently, Kenya's economy has continued to grow, although 2017 showed a decline to a growth of 4.9% from 5.9% the previous year, due to uncertainty in the political climate. However, on average Kenya has shown a growth of approximately 5% annually for the past decade (KNBS, 2018). Quantum Global, a swiss-based research and equity firm, places Kenya as the 9th most attractive African economy to invest in according to their 2018 African investment index.

Subsequent to this growth, large government investment on road networks and infrastructure has increased migration, trade and expansion of urban areas. In 1960 only 7.4% of Kenyans lived in urban areas; this figure increased to 21.3% in 2007 and is projected to rise to 33% by 2030 (UNEP, 2009). Based on this growth rate, domestic demand for resources is expected to increase significantly by 2030. On the other hand, World Bank data indicated that in 2005, approximately 46% of the population lived below the poverty line, with 46% of them in rural areas and 34% in urban areas (IOM, 2016). This has reduced to 34-42% in 2014.

Vision 2030, Kenya's long-term development blueprint, aims to transform Kenya into a "newly industrialising middle-income country providing high quality of life to all its citizens" (Vision 2030, p.01). The current government has outlined its priorities in line with Vision

2030 under Agenda 4. These priorities include food security, creating affordable housing, expanding the manufacturing industry and the provision of affordable health care.

4.3. CLIMATIC CONTEXT

Climate consideration plays a pivotal role in ensuring that the built environment is sustainable. It is therefore imperative to understand the climatic conditions that characterise Kenya and more specifically Nairobi. Climate can be defined as "the atmospheric conditions of temperature, humidity, wind, vegetation and light specific to a geographical location" (Hyde, 2000, p.15). The nature of climate in Kenya is essentially determined by the differences in altitude and the movement of the inter tropical convergence zone (ITCZ), which is the belt of low atmospheric pressure along the equator (Fig. 4.2).

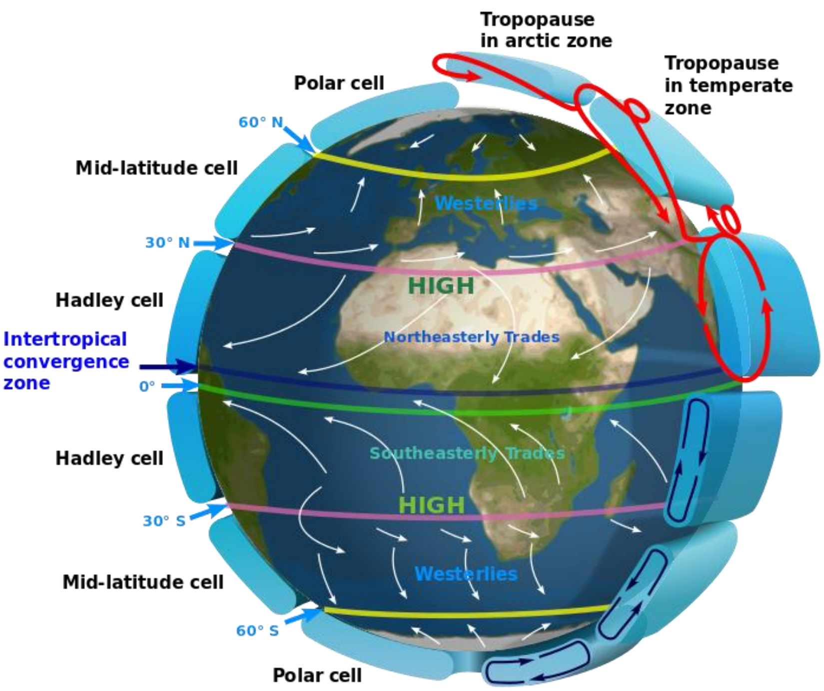

Fig. 4.2: Inter Tropical Convergence Zone. Source: www.carbonbrief.org. Accessed April 2018

The ITCZ location slightly varies and as a result, the tropics experience two main seasons, with wet seasons influenced by the northeast monsoon and dry seasons influenced by the south east monsoon, contrary to the cold and warm seasons in the higher altitudes. Severe variations may lead to droughts and floods (Koech, 2015). Kenya has an annual rainfall of 621mm, or approximately 360,000 million m3, during its two main seasons in March to May and October to December. The March-May season experiences higher rainfall due to the deeper convective activity relative to the October-December season (Koech, 2015). However, due to the variance in altitude across the country this rainfall is not spread evenly. Nairobi for example experiences an average annual rainfall of 900mm while Mombasa and Kisumu, other cities in the country, experience 1196mm and 1200mm respectively (IOM, 2016). Fig. 4.3. shows the average annual rainfall in Nairobi.

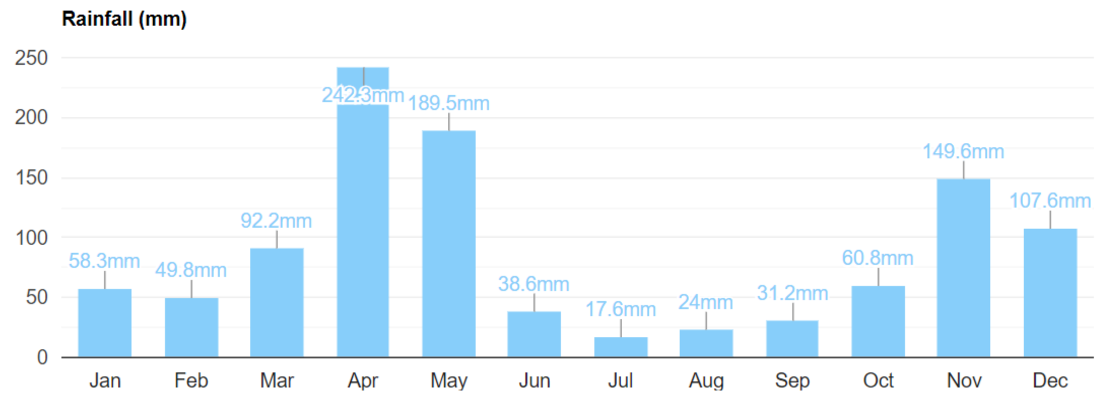

Fig. 4.3: *Average rainfall Nairobi, Kenya. Source:* www.weather-atlas.com. *Accessed June2019*

Temperature across Kenya is mainly temperate and tropical with minimal fluctuations throughout the year. Nairobi is situated towards the south at an altitude of about 1800mm, and experiences average temperatures of 18^{0}C, with highs of 22^{0}C during its hottest month, March and 17^{0}C during it coldest month, July. It has a mean relative humidity of 60-65% in the hot months and 60-75% in the cold months. Other regions like Kisumu to the west, close to Lake Victoria at altitude 1131m, experience higher temperatures of 28^{0}C on average. The regions at the coast of the Indian ocean to the south east experience highs of 28^{0}C with constant humidity. The northern end of Kenya experiences the highest temperature, with highs between 29^{0}C and 34^{0}C. Fig. 4.4. shows the average annual temperature in Nairobi.

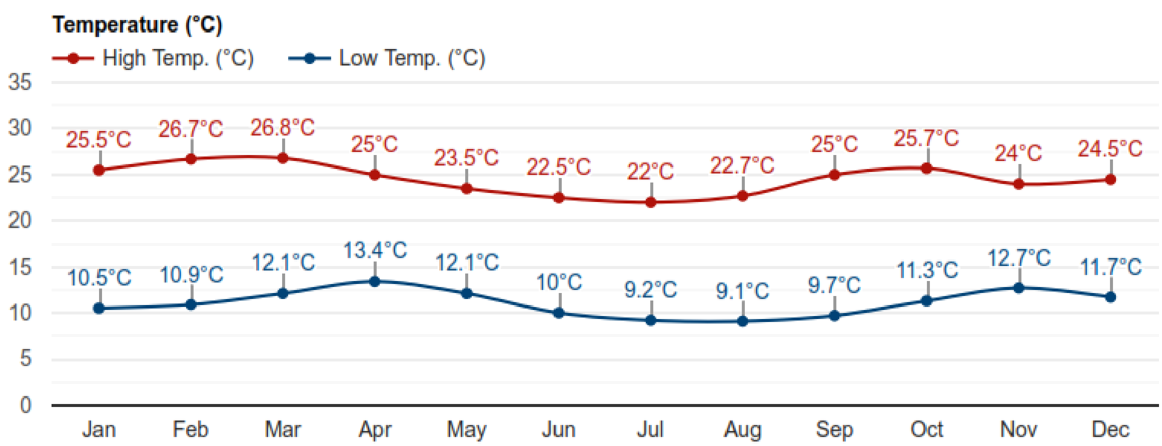

Fig. 4.4: Average Temperature Nairobi, Kenya. Source: www.weather-atlas.com. *Accessed June2019*

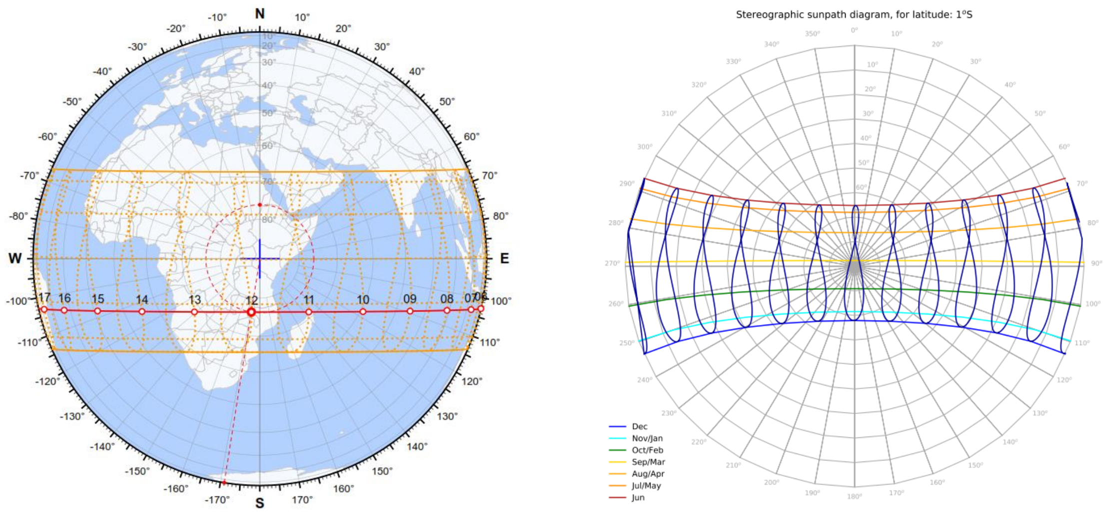

Fig. 4.5: Sunpath diagram Nairobi. Source: Author developed on http://andrewmarsh.com. *2019*

With a cloud cover value of 6-7oktas and an average cloud cover, Nairobi's sky can be classified as an intermediate sky (Loki, 2010). Nairobi experiences 12 hours of daylight on average all through the year, typically between 6:00 - 6:30a.m. in the morning and 6:00 - 6:30p.m. as shown in Fig. 4.6. The city therefore presents a significant opportunity for daylighting, as more than 90% of its external illuminance falls above 10klx during this period (Loki, 2010).

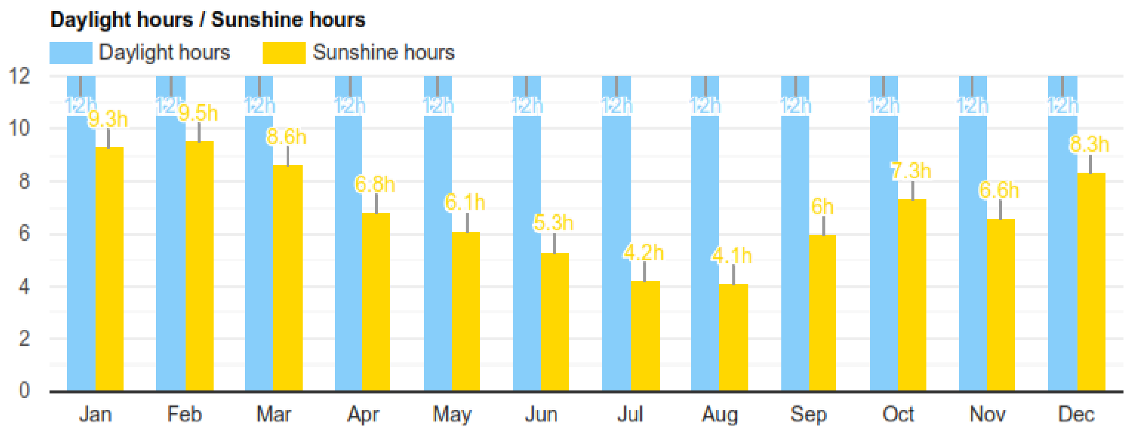

Fig.4.6: Average Daylight/Sunshine in Nairobi, Kenya. Source: www.weather-atlas.com. *Accessed June2019*

The climate data above present the challenge of ensuring thermal comfort by preventing overheating of indoor spaces while ensuring visual comfort, taking advantage of the natural day lighting.

4.4. ENVIRONMENT AND CLIMATE CHANGE

Kenya’s environmental consciousness has been significantly influenced by Wangari Maathati whose vision to unite environmental issues, democracy and social-cultural conditions led to her award of the Nobel Peace Price in 2004. Most notably, she founded the Kenya Green Belt Movement (GBM) that extended to other parts of Africa. The GBM’s main agenda is to protect, conserve and replenish the ecosystems through tree planting, condemnation of logging and raising awareness of the consequences of environmental destruction. Taylor (2013) referring to Wangari Maathai’s and GBM’s initiatives posits;

> *I have never seen as much concern, recognition of associated problems (declining water resources, biodiversity and food insecurity, for example), or meaningful action to reverse it, as what I saw in Kenya in 2009 (p.185).*

Wangari Maathai was also instrumental in the development of the 2005 Kenya Forest Act that advanced environmental sustainability, the preservation of the ecosystem and bio-diversity, as well as the reduction of greenhouse gas emissions, which Taylor (2013) argues is a “very progressive policy – compared to other environmental laws around the world -” (p.185).

Kenya has over the years been faced with several challenges attributed to climate. Most notably, there has been rise in the spread of diseases, drought and floods (UNEP, 2009). Fig. 4.7. shows the number of people affected by environmental disasters in Kenya between 1998 and 2017. In the recent past this already challenging situation has been augmented by the impact of climate change.

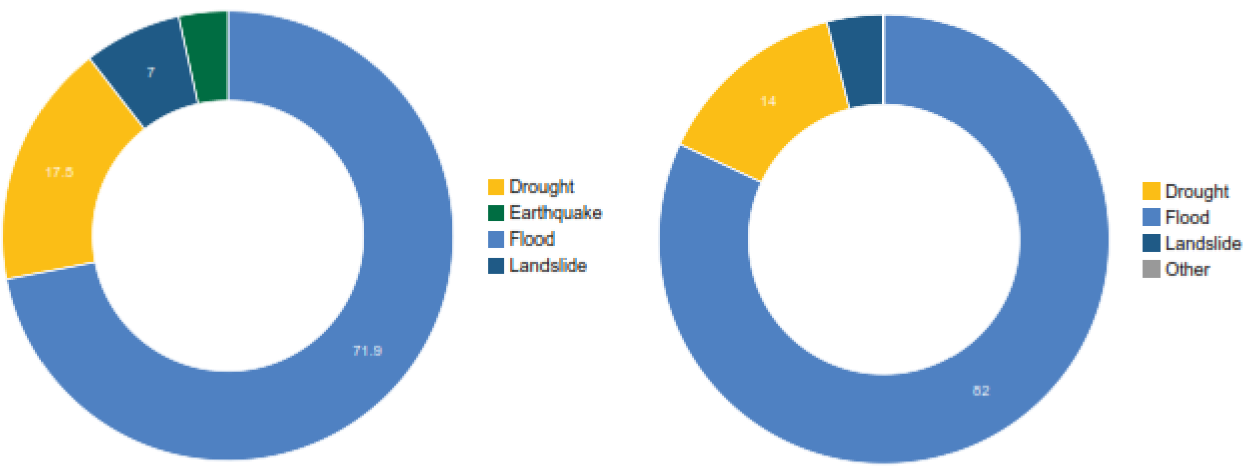

Fig. 4.7: Frequency and mortality data by disaster type between 1990-2014. Source: CRED, EM-DAT, 2015

Economies in developing countries are heavily reliant on sectors that are highly vulnerable to climate change, most notably agriculture and energy. One of the fundamental environmental challenges Kenya faces is its water scarcity. According to a report by the World Bank (2006), Kenya is among only 8.3% of countries globally that are classified as a "chronically water-scarce country" (p.1) with only $647m^3$ of renewable freshwater supply annually. The report posits that as such, "water ought to be treated and managed as a scare resource with real economic, social, ecological and political value" (p.8). This situation has been exacerbated by the impact of climate change, largely evidenced by the adverse effects of drought and floods in the recent past. In addition, McSweeney *et al.* (2010) estimate that between 1960 and 2003, Kenya's average annual temperature increased by $1^{O}C$. This temperature increase has resulted to a reduction in precipitation and therefore rainy seasons are shortened and dry spells prolonged. The drought, coupled with depressed long rains and early stoppages of short rains experienced in 2016 for example, have had a negative impact on agriculture and the generation of hydro-electric power (KNBS, 2018). According to WASREB, the water coverage in Kenya during the years 2015/16 and 2016/17 reduced from 18hrs to 14hrs as a result of the drought. Nairobi experienced a 50% drop from 18hrs to 6hrs (WASREB, 2018). Population and urban growth, coupled with the development ambition of Vision 2030, threatens to increase the strain on the country's water resources.

With regard to climate change, a study carried out by the BBC World Service Trust in 2010 on the perception of climate change by the Kenyan public, concluded that despite the Kenyan public's recognition of the changes in climate, there is little awareness of the global concept of climate change. The term climate change is not well understood, and its meaning is often lost when translated to local languages. Furthermore, the public's understanding of the relationship between climate change and human activity is vastly localised; they appreciate that human activities have an effect on the climate and environment but there is a distinct lack of awareness of the potential effects human activities outside their localities may have on their environment.

Climate change being a global challenge has brought together several countries, Kenya included, in an attempt to mitigate its impact guided by a number of international protocols and treaties lead by the United Nations. Consequently, Kenya's environmental dynamics are also influenced by international politics. Kenya is a signatory to the Montreal Protocol, the United Nations Framework for Climate Change (UNFCC), and the Paris Agreement, among other multi-lateral and bilateral agreements. The UNFCC aims to stabilize "greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (p.4). It outlines key sectors that require climate change mitigation from all participant members, such as; energy, transport, industry, agriculture, forestry and waste management. Although buildings are not mentioned directly, as discussed earlier, buildings are large consumers of energy and large producers of waste.

Kenya, like many developing countries, has a low-carbon intensive economy. Kenya being one of the non-annex I parties to the United Nations for Climate Change agreement, in accordance with the agreement, submitted her first National Communication (NC) in 2002 and subsequently the second NC in 2015. In addition to the NCs, Kenya has developed the National Climate Change Response Strategy (NCCRS 2010) that led to the National Climate Change Action Plan (NCCAP 2013 - 2017) and subsequently the National Climate Change Action Plan (NCCAP 2018 - 2022). Furthermore, to guide climate change action in Kenya, the National Climate Change Act was developed in 2016.

Kenya's GHG emission, was like many developing countries, is almost negligible. For example, in 2013, Kenya's GHG emission was 60.3 Metric tons of carbon dioxide equivalent (MtCo2e) which is 0.13% of the global GHG emissions (USAID, 2017). Having said this, it is important to note that with the ambitious development plan outlined in Vison 2030, this scenario is likely to drastically rise. The UNFCC acknowledges that the extent to which developing countries are able to meet their mandate is contingent on financial and technological support from developed countries. As such, as part of the agreement, developed countries are required to meet the full cost incurred by developing countries in meeting their commitment to climate change mitigation, meet adaptation costs for developing countries vulnerable to climate change as well as finance and facilitate access and transfer of technology that is environmentally conscious. (UNFCC, Article 3-7).

4.5. ENERGY CONTEXT

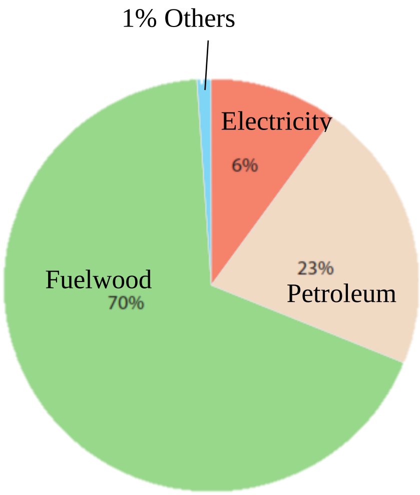

Fig. 4.8: Energy Situation in Kenya
Source: Author, modified from UNEP, 2006

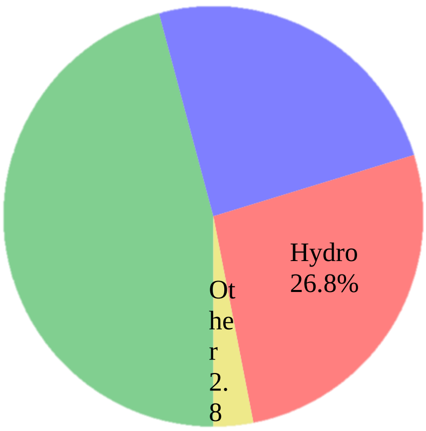

Fig. 4.9. Kenya's Electrical Power
Source: Author drawn from KNBS 2018

Kenya's domestic environment has been its primary source of energy. The Kenya Forest Service estimate that approximately 80% of the Kenyan population relies on wood in the form of charcoal and firewood as their primary energy source (KFS, 2018) most of which are in the rural areas. Similarly, a UNEP report in 2009 submits that fuelwood accounts for approximately 70% of the country's energy source, with petroleum and electricity accounting for 13% and 6% respectively and coal accounting for less than 1%.

Kenya's electrical power, however, is mainly from renewable sources. Figure 4.9. shows the proportion of electricity generated by source in 2017.

Over the past few decades, the increase in population and the rise in living standards has increased the country's energy demand. For example, the total domestic demand for electricity has increased by approximately 21% between 2013 to 2017 from 6,928.1GWh to 8,410.1GWh, necessitating a total electricity generation expansion of 22.6% between 2013 and 2017. With the prediction of significant increase in energy demand, developing countries like Kenya are facing the perceived conflict between environmental consciousness and economic development. As evidence suggests, energy is a critical driver for development, road networks, industry, rural electrification, agriculture among other sectors; all require energy to expand. A study by Nyangena (2014) attempted to model the correlation between economic growth in Kenya with reference to GDP, energy consumption and C02 emissions under strategies outlined in Kenya's Vision 2030. The study revealed that energy intensive industries will expand significantly by 2030. However, energy GDP would decline within the same period if things remain constant, hence the need to put in place measures towards energy efficiency. The study also predicted that CO2 emissions as a result of energy consumption are likely to rise by 127Mt-c.

Following the Paris Agreement of 2015, as part of the National Determined Contribution (NDC) submitted in 2016, Kenya pledged to cut carbon emission by 30% by 2030 relative to the baseline scenario (NCCAP, 2018-2022). In so doing, Kenya has embarked on several strategies in an attempt to mitigate energy demand, exemplified by the process of developing its electrical generation capacity through various geothermal, wind and solar projects, and is expected to increase its capacity by approximately 30% by 2030 (KNBS,2018). Most notable is the Lake Turkana Wind Farm, currently the largest wind farm in Africa, producing 310MW at full capacity.

In the recent past, the government, through the ministry of Energy and Petroleum has introduced several energy frameworks, among which are the Energy Regulations of 2012, Solar PV Systems, Energy Management and Solar Water heating, which put emphasis on renewable energy. To that effect, several strategies have been put into place, among them Vision 2030, Kenya's 5000+ MW plan (2013-2016), Last Mile Connectivity Project (2015-2017), Least Cost Power Development Plan (2013-2033), Scaling-up Renewable Energy Programme (SREP) Kenya, and Rural Electrification. Furthermore, in 2010, the government put into place the 'Green Energy Task-Force' whose mandate is to expand clean energy generation. Similarly, in 2015, the government introduced tax reduction and exemptions for the importation of equipment to be used in the generation of renewable energy, including solar cells, PV semi-conductors, wind engines, hydraulic turbines and water wheels (IEA, 2016).

Contrary to the use of renewable energy, the government had identified coal reserves 200km east of Nairobi and was putting plans in place for mining to begin. Its significant potential environmental and social impact is yet to be comprehensively understood and quantified. What is certain is that with this move Kenya would increase its global percentage share in GHGs emission. However, following several protests and petitions in June 2019, the project was stopped by court decision.

4.6. EVOLUTION OF NAIROBI'S BUILT ENVIRONMENT

A significant part of appreciating context is understanding how its built environment has evolved over a period of time. This section will focus on the city of Nairobi as this is where there has been the greatest change in the built environment. In Nairobi, the total number of private buildings completed and issued with a certificate of occupation by the Nairobi County Council, increased by 77% from 6,323 in 2013 to 11,202 in 2017. According to current prices and the GDP from construction and real estate in Kenya, there has been an increase of 111% and 53% respectively in the last five years (KNBS, 2018). Among many challenges, waste management is becoming one of the most critical environmental challenges in the city. Nairobi struggles to contend with the rapidly increasing solid waste generation resulting from its population growth, rapid urbanisation and industrial expansion (UNEP, 2009).

Nairobi, originally referred to as Enkare Nyirobi, a Maasai colloquial term for "cool water" was a swamp area before it became the British East African Protectorate capital as well as Kenya's capital in 1905. Before the British invasion, it was mainly inhabited by the Maasai, Kikuyu and Kamba communities of Kenya. Nairobi's early landscape was typified by structures made from locally available materials and resources, with great consideration for the environment.

The Kikuyu traditional structures (Fig. 4.10 & 4.11) for example were made from 15mm thick walls constructed with timber poles, filled with mud and plastered with cow dung. The

conical roofs were approximately 8mm thick, constructed with poles covered with a thick layer of grass thatch. The thickness of the walls and roof increased their thermal mass properties therefore improving indoor thermal comfort. The huts were approximately 5-6 metres in diameter with a central fireplace surrounded by sleeping spaces, both for humans and livestock, as well as storage spaces. The narrow open plan allowed for natural light and ventilation across the structure. The roof overhang protected the walls from direct solar radiation, ensuring durability. During the day, in the event indoor temperature exceeded comfort, the external courtyard was used as the living space. At night however, the thermal mass of the structures' envelopes together with the central fireplace ensured the house was warm.

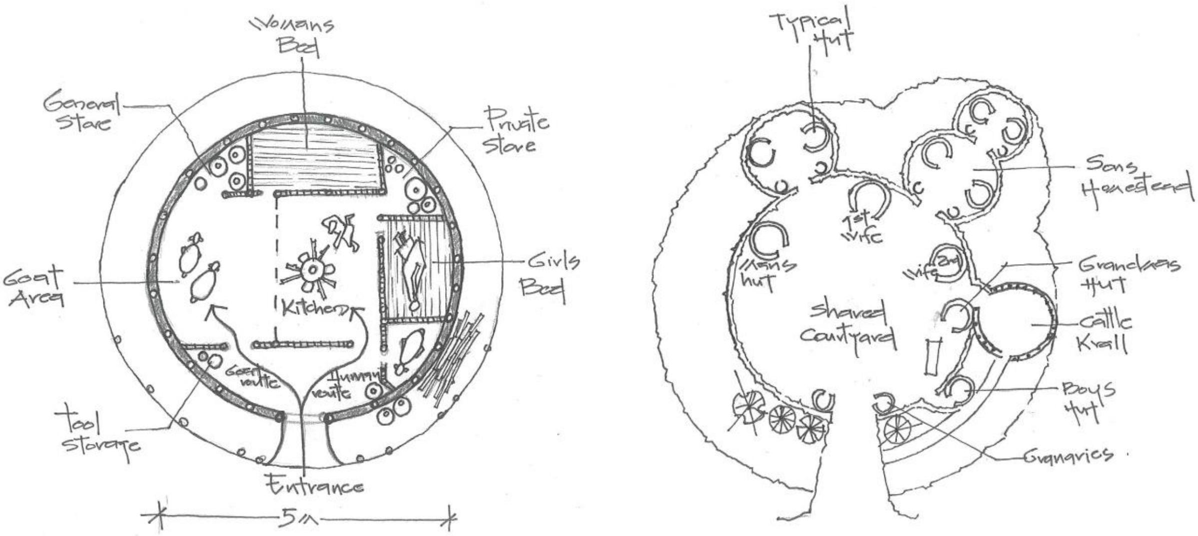

Fig. 4.10: Plan showing typical Kikuyu hut and homestead. Source: Author drawn, 2018

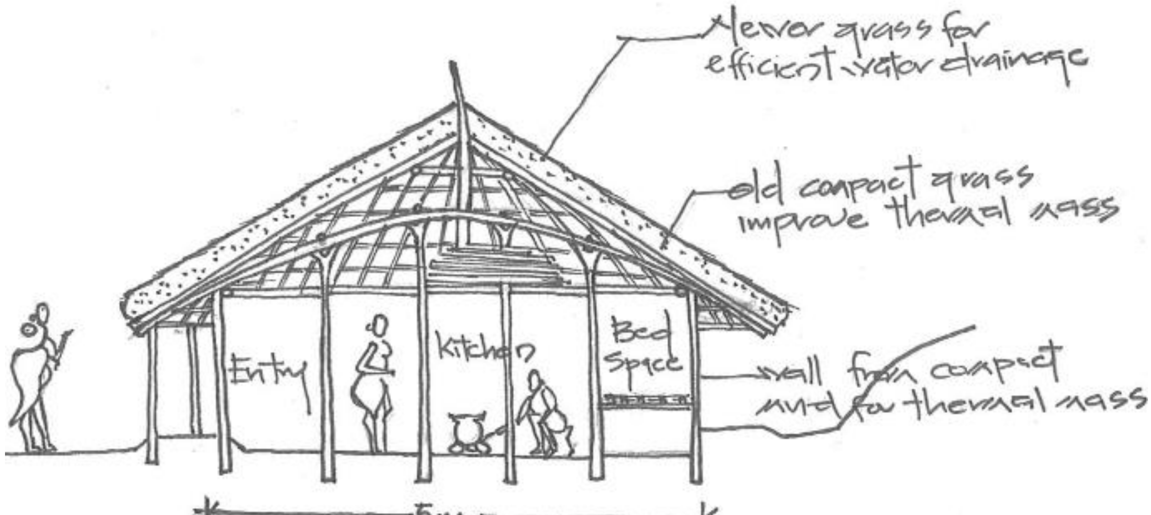

Fig. 4.11: Section showing typical Kikuyu hut Source: Author redrawn, 2018

With the growth of the city as a railway camp (Fig.4.12), corrugated iron sheets began to emerge. Furthermore, the construction of the railway line from Mombasa through Nairobi city in 1899 significantly influenced its growth, and the original street grid was based upon the orientation of the railway line in the 1920s (Fig.4.12). Four major streets emerged as business and administrative hubs as a result of these developments; Victoria street (present day Tom Mboya Street), Bazar Street (present day Biashara Street), Delamere Street (present day Kenyatta Avenue) and Government Road (present day Moi Avenue). The buildings on these streets exemplify the diverse building styles that characterised the birth of the city. As a result of economic and population growth the area of Nairobi was also gradually expanded twice from 1,813ha in 1906 to 2573ha in 1928 and finally 68,945ha in 1963 to date (Fig. 4.13).

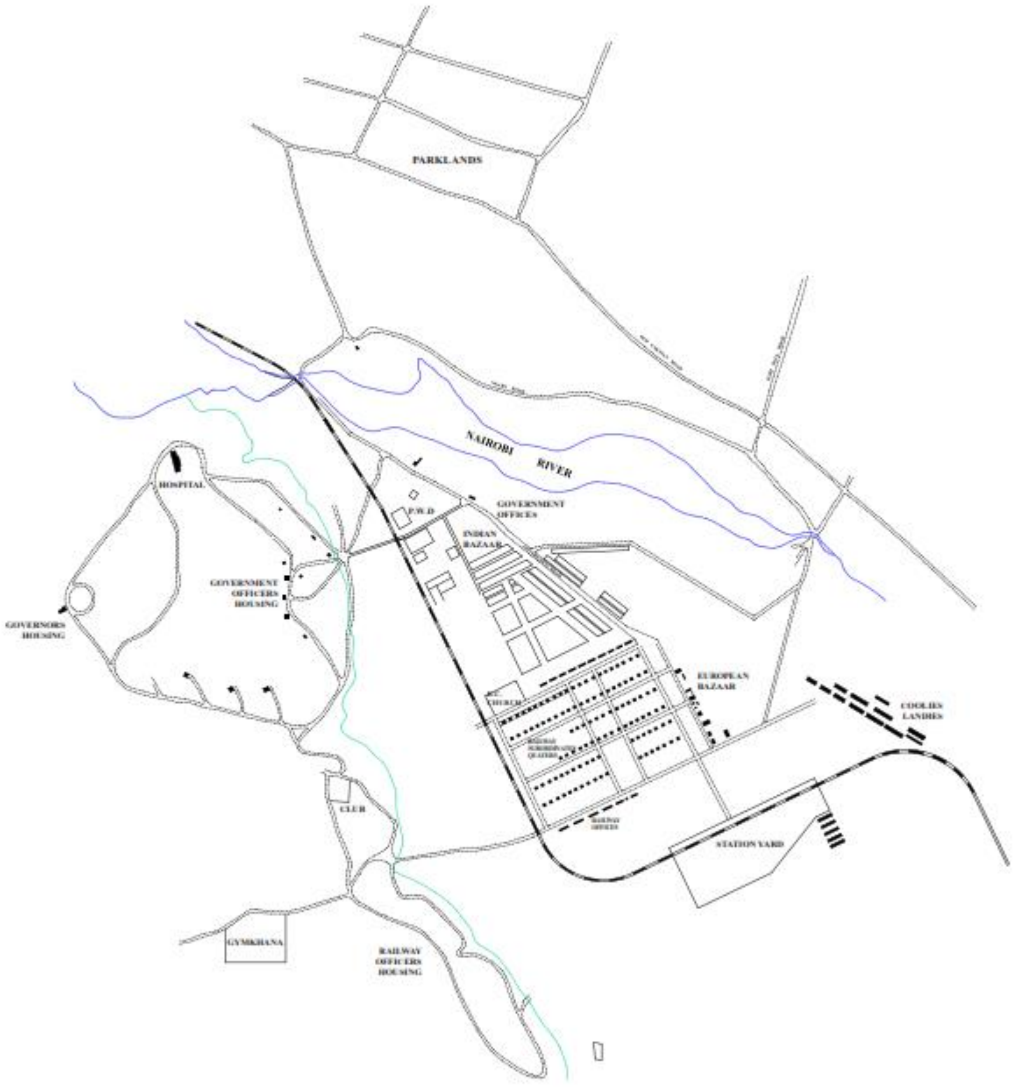

Fig. 4.12: Central Nairobi 1906, street geed beginning to develop. Source: Author redrawn, 2018 (from Morgan, 1967)

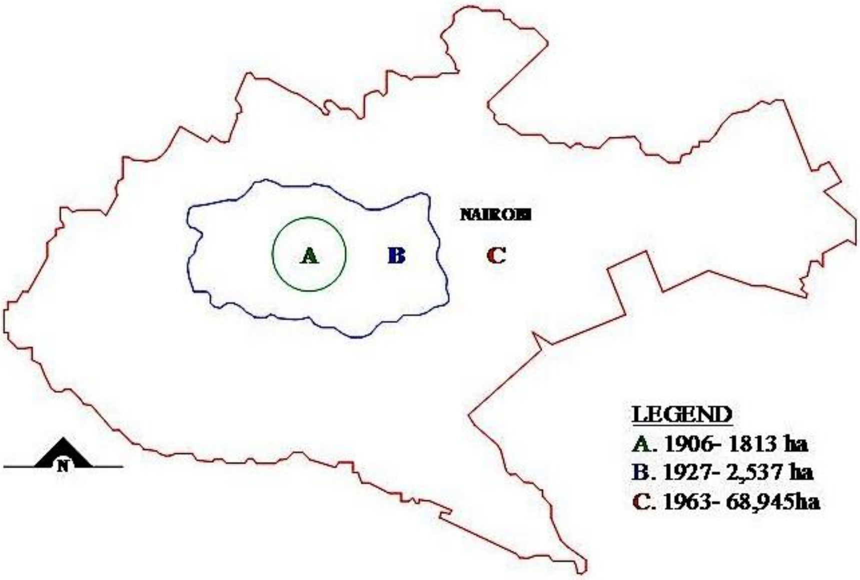

Fig. 4.13: Growth of Nairobi City boundaries from 1906 to 1963. Source: Author drawn, 2018

Prior to colonisation, formal education and white-collar occupations did not exist in Nairobi and therefore buildings that housed these activities also did not exist, hence the lack of apparent vernacular typologies for buildings of this nature. The beginning of the1900s saw the rise of iron sheet structures (Fig.4.14), first as railway sheds, workshops and employee residential quarters, and soon after as business stalls and hotels. However, the thermal properties of iron sheet did not provide a conducive indoor environment for the tropical climate.

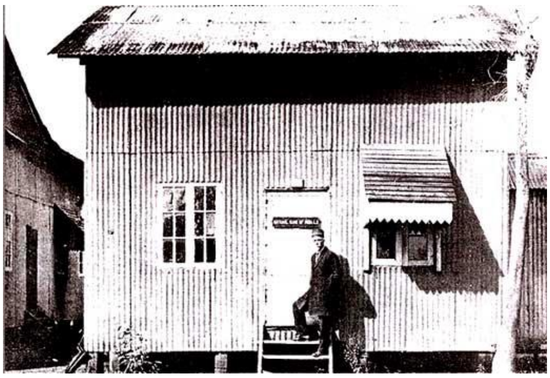


Fig.4.14: (a) National Bank of India. Source: Grayson in [sikh.heritage.co.uk.](sikh.heritage.co.uk) (b)Rossenrodes & MacJohn's building Source: Mills in Loki 2003

During the period between 1900 and 1950 several architectural styles emerged in Nairobi. Deisser and Njuguna (2016) posit that the Classical, Renaissance and Georgian styles as well as the English Gothic and Tudor revival styles were evident in Nairobi. These styles were best exemplified in buildings like the City Hall, Westminster Building, All Saints Cathedral, Kipande House, Norfolk Hotel and the Old P.C. Office building. A few existing buildings show evidence of the Beaux Art traditions as well the ‘art deco’ style, perhaps before the modern movement (Fig. 4.15).

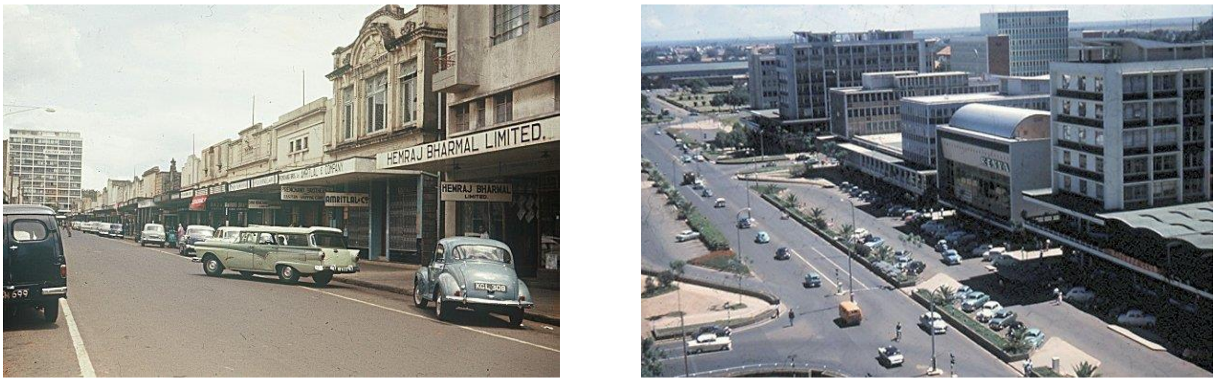

Fig.4.15: 1960- Bazar Street. (left) and Government Road (right) Source: East Africa Memories. Accessed 03.04.17. 15:34

Fig. 4.16: 1960s Delamere Road. Source: East Africa Memories. Accessed 26.05.17. 12:47

Fig. 4.17: The Nairobi Law Courts - Renaissance style. Source: lakadvocates.com, accessed 27.05.17. 13:59

The modern architecture movement in Kenya began with the entry of Dr. Ernst May from Germany in 1934 and Amyas Connell from England in 1947, who localised the ideas of Le Corbusier and significantly influenced Nairobi's architectural landscape, and both set the scene for its development. Amyas Connell had a greater influence in Nairobi and became the founder of TRIAD architects, one of Kenya's oldest architectural firms which exists to date. Connell's practice grew after his design of several private homes. It was after that that he was commissioned to design Aga Khan buildings that "adopted Le Corbusier's 'brise-soleil' ideas for its facades…their design bears some resemblance to the idea that Le Corbusier developed earlier for his Salvation Army building in Paris" (Sharp 1983, p.321). Following the growth of his practice, he and Thornely Dyer were commissioned by the British administration to design the new parliament buildings in Nairobi in 1954, which also portrayed the influence of Le Corbusier, notably in the Assembly chamber and later the crown building – now Sheria house.

The modern movement in tropical countries was labelled 'tropical architecture'. Tropical architecture was based on climate responsive designs geared towards little or no mechanical control, particularly in developing countries after World War II in the period between 1950 and 1960, though its footprints were felt up until the 1980s.

According to Vandana (2008, 2012) the discourse of tropical architecture was promulgated through a series of "inter-colonial conferences" that took place in both the imperial and colony capitals of India, Uganda and Nairobi. The first of these took place in Paris. This created a platform where architects would discuss ideas in an attempt to consolidate and synthesize the concept of Tropical Architecture. The main protagonists of this discourse were Otto Koenisberger, Jane Drew, Maxwell Fry and George Atkinson among others. One major development was the establishment of a department that dealt exclusively with tropical architecture in 1954 at the AA School of Architecture, London. Fig.4.18 illustrates examples of buildings developed during this period.

Buildings completed during this period were characterised by narrow building plans oriented east-west to minimise solar heat gain and maximise the use of daylight. Facades were made from concrete and stone due their high thermal mass, while sun shading was achieved through the use of concrete horizontal and vertical shading fins as well as honeycomb grills. The use of indoor and outdoor courtyards was also common.

Fig.4.18: Norwich Union house (left) Source: cretum properties accessed 27.05. 17 – 15:46, Electricity House (centre) International house (right). Source: structurae.net accessed 27.05.17 - 18.52

Perhaps one of the best examples of tropical architecture is the Parliament Building designed by Connell and Thornely and constructed in 1963 (Fig. 4.19, Fig. 4.20). The building housed the debating chambers, council chambers and other support facilities.

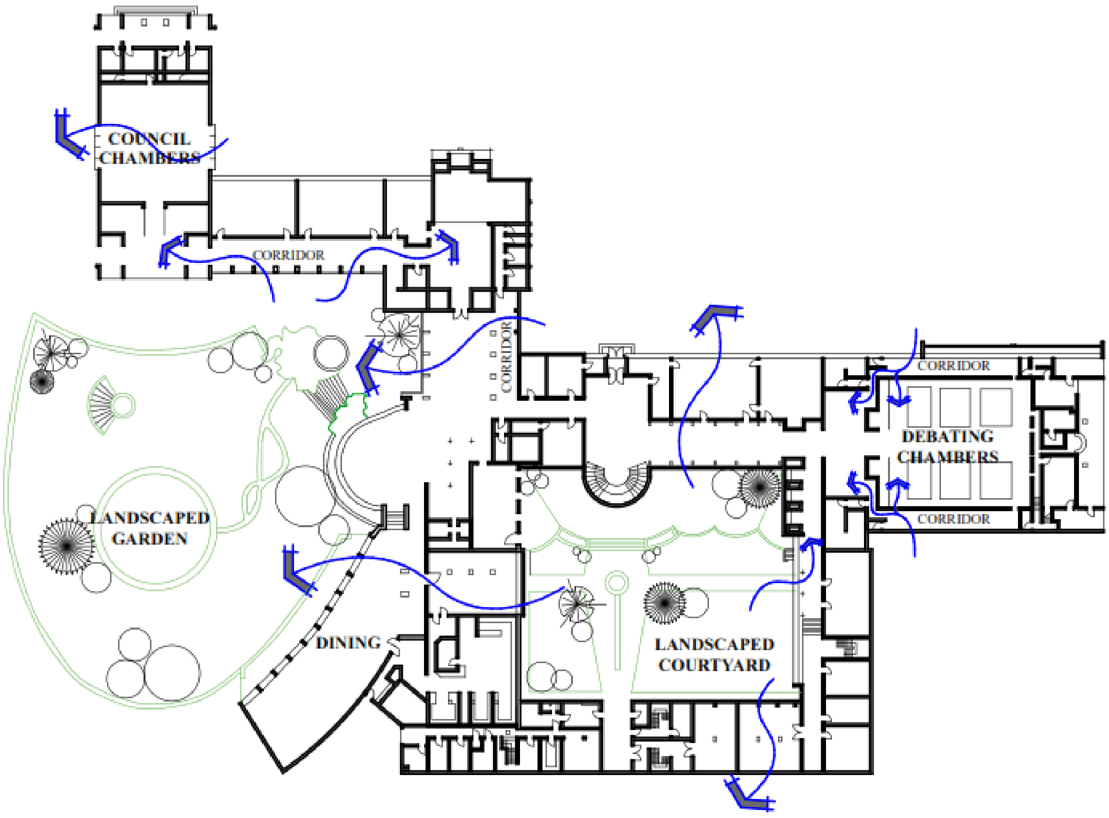

Fig.4.19: Ground floor plan of the parliament building showing air flow through the building, Nairobi Kenya. Source: Author 2019, (based on Loki 2003)

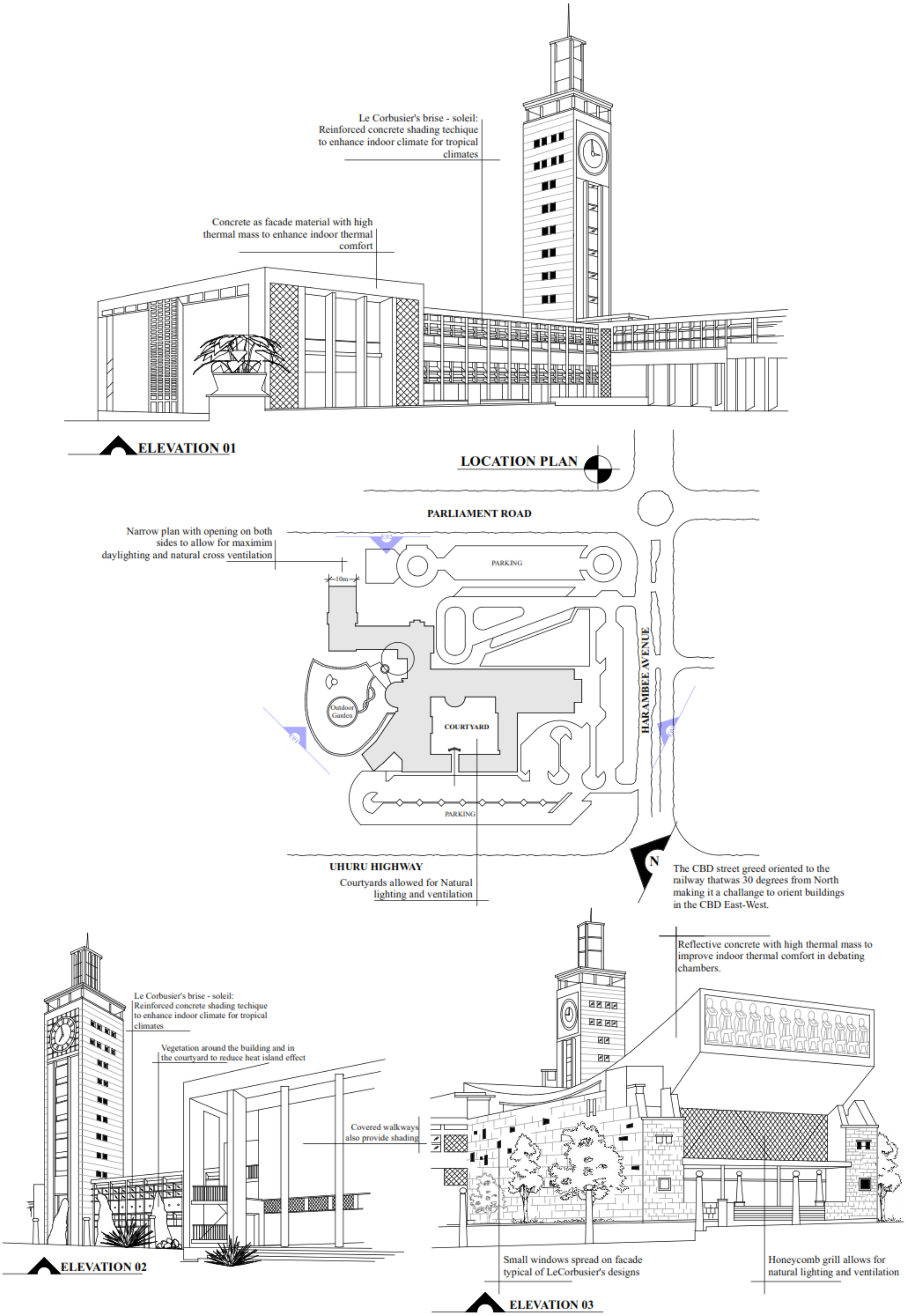

Fig.4.20: Location and Different views of the parliament building, Nairobi Kenya. Source: Author 2019

The 1980s and 90s saw the beginning of the "glass tower" movement that continues to thrive in Nairobi to date. Buildings like the Co-operative Bank tower, 1981, Lonrho House, 1991, Anniversary Towers in 1992 and the I &M Building in 2001 (Fig. 4.21) exemplify the genesis of this movement. These glass towers are replicas of buildings in temperate climate and are not suitable for the tropical climate, thus with them came the dependence on mechanical ventilation in Nairobi where solar radiation and thermal comfort are the greatest challenges.

Fig. 4.21: Lonrho house (left) I&M Building (centre) Source: Planning systems services Ltd. View Park towers (right). Source: pintrest.com accessed 27.05.17 – 19:35

Furthermore, unfortunately, the 'glassification' of buildings applies not only to new buildings. In the recent past, several existing buildings have undergone modifications to incorporate glass facades (Fig.4.22).

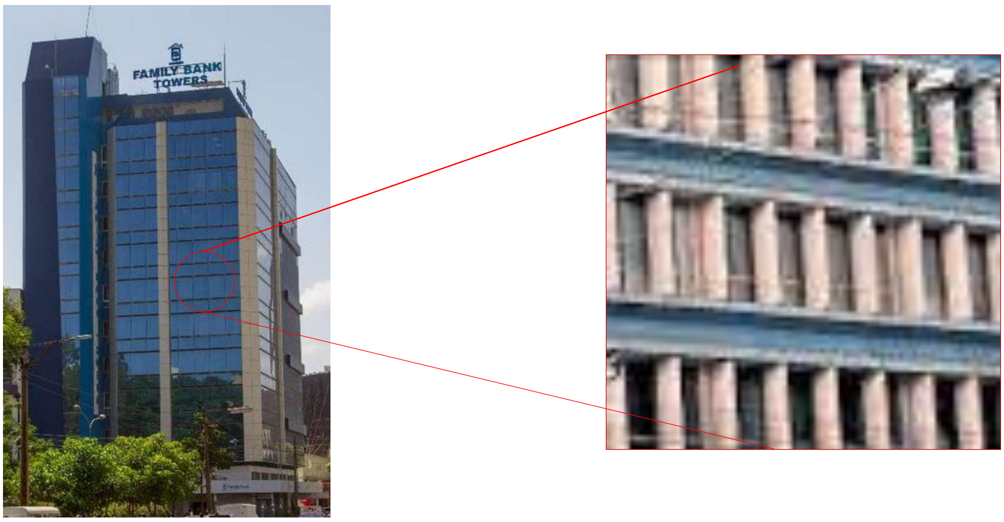

Fig. 4.22: Family Bank Towers, recently fitted with glass façade (left), Source: the-star.co.ke accessed 29.05.17. 17:40, façade before glass curtain wall (right). Source: google.co.ke accessed 29.05.17. 17:39

4.7. SYNOPSIS OF NAIROBI'S BUILT ENVIRONMENT

Having examined the evolution of design in Nairobi (Fig.4.23), coupled with the increase in population and standard of living, rapid urbanisation as well as the changes in climate, the need to rethink design of the built environment is imminent. The quest to achieve economic growth means that developing countries have the capacity to increase their building footprint significantly. Urban centres are expected to expand and even sprout in places they are yet to exist. An increase in the building footprint will translate to significant demand in energy among other resources, Currently the UN estimates that the built environment in East Africa is responsible for well over 60% of the energy consumption. Furthermore, it estimates that the building stock in developing countries will increase by 75% comparative to European countries at 25-30% by 2050 (UN-Habitat, 2014). Therefore, developing countries have a significant potential to influence the global climate change scenario in future.

Despite their current low global carbon emission share, as highlighted at the beginning of this chapter, developing countries have a considerably significant potential to influence the future climate change scenario is especially if development take a similar trajectory to that of the industrialised countries. Therefore, while mitigating local environmental challenges should be the priority, it is imperative to develop consciousness to the impact the growth of the built environment will have on the natural environment both at the local and global scale. Whereas issues search as carbon emissions may not be significant challenges currently, the increase in the building stock will significantly increase energy demands necessitating innovative energy management strategies that will ensure low carbon emissions.

With local and global pressure to combat climate change there has been a recent growth in the introduction of design regulations, policy and standards into the built environment, along with incentives to build "green" instigated by different sectors. However, a number of challenges still face the construction industry in Kenya, as in many developing countries, with regard to adoption of sustainable building strategies. The lack of accurate local data on issues that surround the built environment, for instance contextual design challenges and priorities, building material performance, energy data and building environmental performance on which policy decisions can be based, continues to hamper the move towards a sustainable built environment as this is a significant prerequisite to its development.

Furthermore, Ebohon and Rwelamila (2014) suggest that one significant difference between developing countries and the developed world is their "capacity to initiate and implement effective policies" (p.02). They further argue that the establishment of local institutions that guide the construction industry towards sustainability are largely lacking in developing countries which has led to the imposition of "policies that are largely incongruent with the peculiarities of these (developing countries') economies" (p.02). Du Plessie (2001) also argues that "not only are the problems and their scale different, the development priorities, the capacity for local industry and governments, as well as the skill level are often radically different." She further argues that "there are also certain cultural and worldview differences between the developed and developing world countries that impact the understanding and implementation of sustainable development and construction" (p.01). This argument will be examined further in the subsequent chapters.

Another dominant force that shapes the construction industry in African cities such as Nairobi, is the external (Western) influence resulting from globalisation, evidenced by the evolution of architectural design in Nairobi. After gaining independence between the 1950s and 1960s, these cities - Nairobi included - experienced massive development, largely influenced by their former colonies. Architecturally, this was manifested in their building and infrastructure using technologies, materials and design philosophies developed predominantly by the Western world in an attempt to assert their presence in the global world. This influence and chase for global recognition is evident to date. This however has come at a price; local social, cultural and political identities can hardly be located in these cities. The unabating deterioration of local cultural diversity in developing countries can be attributed to the homogeneity instigated by Western cultural imperialism embedded in colonialism, the Western idea of modernity and more recently globalisation that has affected how these countries build. There is a strong implication that the Western world – developed - has mapped out a path for the rest of the world – developing - to follow (Herz, 2006). Data collected in this research, discussed in the subsequent chapters, explore in detail the effects of international (Western) influence on Nairobi's built environment.

Moreover, the influx of these architectural designs that are representative of the Western lifestyle in African cities not only changed the urban built environment but also, and perhaps more importantly, imposed a new social order and new ways of thinking. The adoption of this design thinking often fails to take into consideration place, which transcends physical boundaries and far more importantly is embedded in people's consciousness, memories and their cognitive ability to construct meaning. It is therefore worth deeply interrogating how Western construction of meaning and concepts that infiltrate developing countries affect local perceptions and articulation of concept. The question is therefore, should there be a total neglect of Western ideologies in favour of local ideologies? If not, how (if possible, or desirable) can these two seemingly discordant ideologies co-exist? These questions will be explored in the subsequent chapters.

Having gained an overall understanding of the built environment in Nairobi and the different dynamics that affect its development, the subsequent section will explore the growth of the concept of sustainable design in Nairobi's building industry.

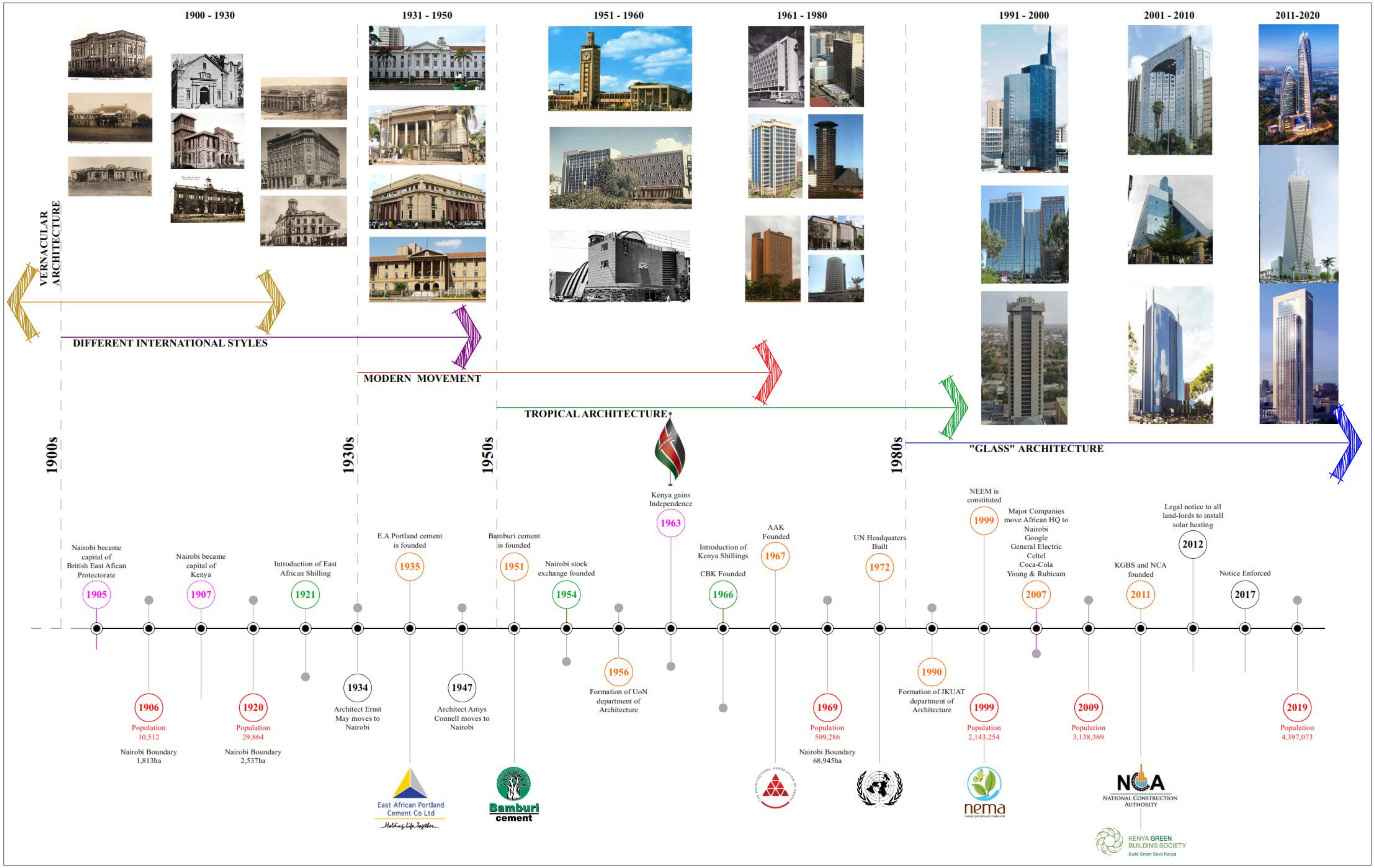

Fig. 4.23: Summary of the evolution of the built environment with key milestones in Nairobi

4.8. SUSTAINABLE DESIGN IN NAIROBI-KENYA

4.8.1 INTRODUCTION

As illustrated in the first part of this chapter, the construction industry as a driver of development is constantly undergoing change, driven by the changing local and global market dynamics. In Nairobi for example, if one examines the works done by architectural firms that have existed since the 1960s, it is evident that design philosophy has been influenced largely by market demands as opposed to practitioner design philosophy. This is no different for the concept of sustainable design. The discourse of sustainable design in Kenya has conspicuously been propagated by the introduction of international assessment systems into the local building construction market. These systems often do not take into account the diversity inherent in different contexts that will affect how the tool is perceived, interpreted and applied as well as its overall relevance.

Taking into account the significant influence of assessment systems in driving the sustainable design agenda in Nairobi, this research attempted to analyse and compare areas of convergence and divergence of motivations and major emphasis of two international assessment systems and two locally developed draft systems, taking into consideration how they frame the environmental - as well as other issues - problem and the implication of these decisions. The research will also analyse the extent to which these systems address the broader issues of sustainability beyond environmental issues. The research hopes to offer a platform for discussion on the further development of local assessment systems and how they can be made more relevant to Kenya's environmental, socio-political and economic context.

When discussing assessment systems, it is interesting to note the difference and implication of the terms 'green building' assessment systems and 'sustainable building' assessment systems. Cole (1998) argues that the "distinction between 'green' and 'sustainable' is critical in framing the environmental assessment debate" (p.231). While the terms 'green' building and 'sustainable' building have been used interchangeably, the two terms differ in meaning and methodological approach and therefore influence how assessment systems are developed and applied.

A 'green' building approach tends to be building centric and assesses the building's environmental performance against and relative to existing building practices. Thus 'green' maximises environmental performance, which involves mitigative measures the building has taken in response to the environment, often focused on energy performance and resource efficiency while creating a healthy environment for its users. The practice of sustainability on the other hand is considered to take a more holistic complex approach. It not only considers environmental aspects but also social and economic aspects with equal importance, often referred to as the triple bottom line. According to Dwaikat (2015), Cole (2005), and Campbell (1996), sustainability considers the broader aspects and consequences of buildings to the biosphere, both at a local and global scale, throughout its life cycle. Timber for example can be considered as a 'green' material, however in an area where timber is not indigenous, the processing and transportation of the material could deem the material unsustainable much as it is green. Similarly, a triple glazed window may be a 'green' solution in a temperate climate but in a tropical climate it may not be sustainable given the climate and the unavailability of that technology.

Cole (1999) describes green building as the use of strategies that are less environmentally and ecologically damaging when compared to typical practice. Yudelson (2008) defines green building as "a high-performance property that considers and reduces its impact on the environment and human health" (p.4). Kibert (2008) describes sustainable construction as "…creating and operating a healthy built environment based on resource efficiency and ecological design" (p6). The GBCSA defines a green buildings as a "resource efficient, energy efficient and environmentally responsible building that reduce its direct and indirect impact on the environment throughout its life…" (Windaop 2014, p.1). These definitions allude to building performance being measured against environmental impact of the building with reference to typical practice. These difference in definitions bring to question the competing interpretations and perhaps the ease with which the assertion that a building is "green" or "sustainable", based on these selective interpretations of this concept, can be reached.

A study on green building rating systems by Zuo and Zhoa (2014) on the other hand, argues that green buildings take into consideration a wide range of environmental issues but do not give equal consideration to social and economic aspects of sustainability. Dwaikat (2015) argues that green buildings should be assessed using the life cycle approach and defines green building as "an eco-friendly economic facility that uses fewer natural resources to build and operate …and… positively impacts productivity, health, and welfare of human beings throughout its entire life cycle (p.397). Cole (2005) suggests that "natural systems and processes together with the requirement of accounting for social and cultural needs and aspirations should equally inform the design of assessment methods" (p.460). Cole further argues that in order to achieve a homogenous inclusive assessment system, it is not enough to merely add social or economic issues to the existing environment-oriented systems, but more importantly to recognise the points of interaction between the environmental, social and economic aspects and how they inform and influence each other.

While social and economic aspects are not new considerations in design, very little has been done with regard to creating matrix that measures performance in these two aspects. The majority of rating systems encompass detailed methods of evaluating the environmental impact and mitigations but are yet to fully incorporate the social and economic aspects of sustainable design. It is worth noting that some of the environmental mitigations have a direct impact on the social and economic aspects of the building, and thus these aspects should not be considered as interdependent.

Mitigation of environmental impact of a building would not, for example, necessarily render an enhancement in the quality of wellbeing of its occupants. This bias was illustrated in a study by Shari and Soebarto (2012) where a case study building in Malaysia was assessed using Singapore's Green Mark, a green building assessment system, and the Malaysian Office Building Sustainable Assessment (MOBSA), a system structured to take into account the three aspects of sustainability – environmental, social, economic – with equal importance. For example, "16% of the criteria assess aspects at a scale broader than the site level i.e. global and community/regional levels" (p.3). The results showed the building attained an overall higher score with Green Mark compared to MOBSA. A high score was achieved with both systems on environmental performance. However, when the building was subjected to the social and economic criteria in MOBSA, the building scored poorly. In light of this, the research argues that when analysing any assessment system, it is important to analyse the extent to which it considers not only the environmental performance but also the social and economic implications and considerations.

4.8.2. GLOBAL OVERVIEW OF GREEN BUILDING RATING SYSTEMS

Assessment systems can be described as a convergence of metrics that create a reference point that outlines a particular group's understanding of the extent and strength of performance of a particular architectural development as well as mitigative measures, while creating a framework for authentication. Rating systems primarily seek to define, guide and measure the "greenness" of buildings by awarding points for environmental performance in pre-defined priority categories. These systems have distinct frameworks that assign points and weights for different issues classified under separate categories based on environmental performance. Moreover, assessment systems offer accepted standards that can be authenticated, allowing actors in the building industry to demonstrate environmental commitment. These systems also act as decision making tools and offer a basis for measurement of the environmental impact of buildings (Cole 1998).

The introduction of rating tools began in 1990 with the development of the Building Research Establishment Environment Assessment Method (BREEAM) by the Building Research Establishment (BRE). This led to the development of LEED in 1999 by the United States Green Building Council. Since then, over the last twenty-eight years, many countries have developed different rating systems for "green" buildings (Fig. 4.24). It is estimated that there are over 600 green building rating system across the globe (Doan *et al.,* 2017).

Despite these systems being standards of measurements, they are not static systems. In response to changing needs of the "occupiers, investors, level of acceptance, utilisation and development of the country" (Ting, 2012), these systems continuously evolve, evidenced by their continuous "upgrades". Furthermore, as each country differs in attributes such as climate, technology, culture and economics, the assessment criteria may differ from country to country. Given their voluntary nature, these systems are largely adopted by market players in an attempt to achieve a credible competitive advantage through recognition of their efforts to enhance building performance.

Assessment systems currently adopt one of two methodologically distinct approaches. The first, and most popular, is the multi-criteria-based system which allocates points to different categories based on performance. Among these systems are BREEAM, LEED, Green Star, and Green Mark. The second, and more complex of the approaches is the Life Cycle Assessment approach, where the environmental impact of a building is 'scientifically' measured for each of the different stages through-out the life of the building. This approach allows for assessment of the long-term impact and benefits of the building (Ali and Nsairat, 2009; Hu *et al.,* 2017; Mattoni *et al.,* 2018).

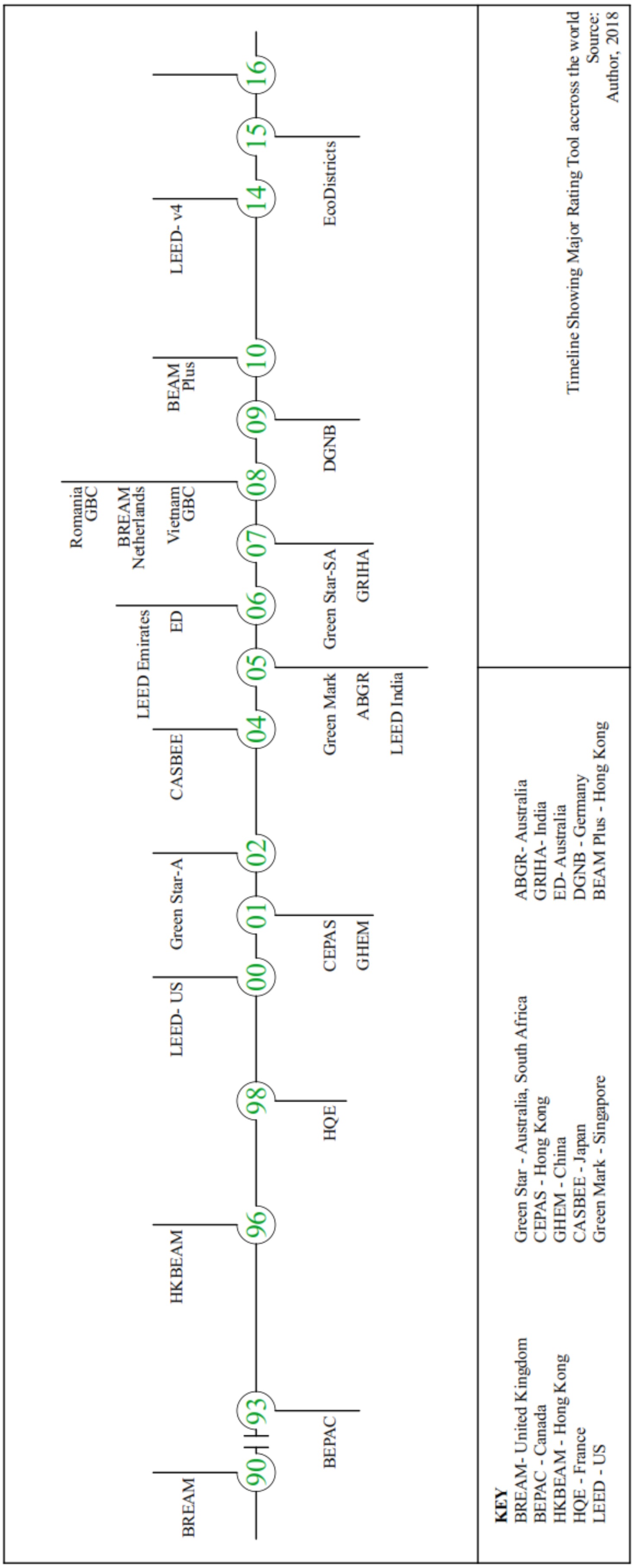

Fig.4.24: Timeline showing major Assessment Systems across the world.

4.8.3. CONTEXTUALISING ASSESMENT TOOLS

Guy and Farmer (2005) highlight a weakness in rating systems, arguing that their development is often hinged on two major assumptions; one, that the environmental concerns are "physical in nature and global in scale" and two, that "rational science can and will provide understanding of the environment necessary to rectify environmental bads" (Macnaughton and Urry in Farmer and Guy, p.20). Therefore, they do not take into cognisance local environmental problems and reduce measurement of "greenness" to the physical aspects of the building, failing to take into account other qualitative (human) aspects of sustainable design that emerge once buildings are "nested into a particular social or physical context" (p.23). For instance, energy performance is rated by unit of energy or area rather than per person.

Guy and More (2004) posit that "acknowledging the plasticity of culture and nature means that we need to recognise and analyse green buildings as a series of contingent hybrids, an understanding of which is inseparable from the encounter with people and places that shaped their design and development" (p.3). These sentiments are shared by Cole (2005) who argues that the "context within which an assessment method has been designed to operate profoundly affects the effective scope, emphasis and rigour of an assessment" (p.458). For example, while there is now somewhat a global agreement that 'environmental' performance of buildings is inextricably related to global climate change, Cole (2005) suggests that economic and social issues are of higher priority in developing countries compared to developed countries, and therefore there is a qualitative contrast when assessing environmental considerations against local impediments. Gibberd (2002) similarly argues that living standards in developing countries are far lower than those in developed countries, and therefore, while the emphasis for developed countries is being environmentally responsible while maintaining standards of living, developing countries should focus on ways to improve their standards of living without causing harm to the environment. Based on these arguments, perhaps a sustainable building in a developing country should be one that contributes to the social and economic development in a particular context, while maintaining environmental responsibility.

There have been attempts to develop systems that would adopt to local environmental scenarios, however, there is still a challenge with adaptation of assessment systems to local social, economic and technological advancement levels (Gou & Lau, 2014). Not only do international systems fall short in addressing local issues, of greater concern would be their potential to stifle local innovation within a particular social context (Farmer and Guy, 2005).

The proliferation of rating systems is evidence that there is not yet a single system that can be applied universally nor should there be. International rating systems have therefore been criticised for their failure to address local concerns. The attempts to address these concerns began during the Green Building Challenge (GBC) of 1998. The GBC highlighted three major challenges of existing rating systems. One, their inability to handle different levels of assessment; two, their design was not explicitly geared towards handling “regional-specific issues”; and lastly, they were not designed as design tools, yet they are being used as such, to a level that one could argue that they are to some extent deliberately designed to dictate (or limit) design options, are for instance natural ventilation over mechanical ventilation. From an economic perspective (as these tools have become more capitalistic), it can also be argued that there are greater profits in expanding the sale of limited number of approaches/strategies/ systems than there are constantly developing new ones.

However, globalisation dynamics have increased the tendency for these rating systems to be applied interchangeably across the large global market. It is imperative to ask, if a building instructed by one rating system would achieve a similar “green” reputation when subjected to another rating system? A study by Roderick *et al.* (2009) compared the energy performance of a typical building using LEED, BREEAM and Green Star. The same building received a BREAM low energy rating but scored high when Green Star was applied. The same building on the other hand did not meet energy certification under LEED criteria. Another study by Xi Chen *et al.* (2015) analysed the passive design approaches of five green building rating tools (BREEAM, LEED, CASBEE, BEAM and GBL-ASGB). The study concluded that most green building rating tools do not accord passive design strategies equal weighting measures compared to traditional whole building energy simulation approaches. Furthermore, LEED reduces available credit for the passive design strategies therefore creating a bias towards mechanical ventilation. This would therefore be punitive to a country like Kenya, whose climate would favour passive design strategies over mechanical ventilation. Perhaps an interrogation of the persons behind the development of these systems and their agenda is necessary, as one could argue that these systems are developed to benefit manufacturers of these technologies and professionals who stand to gain from prescribing these technologies. Similarly, a study by Reed (2009) revealed that GBRTs show great disparities within the same ‘grade’. A building type that attained BREEAM Excellent, LEED Platinum and 6 star

Green Star rating, would likely not be similar in their degree of sustainable design consideration and mitigations.

From these studies, it is evident that the assessment of building performance can vary significantly based on the tool that is applied and the context in which it is applied. This is as a result of the difference in the assessment method and performance criteria. The difference would also be as a result of inconsistencies in the baseline assumptions. Comfort for example, as argued by Chappell and Shove (2005) is a "highly negotiable socio-cultural construct," yet standards like ASHRAE have continuously been used universally, which when interrogated often lead to the universal use of mechanical systems to achieve thermal comfort.

Aside from the environment (physical, social and political), building codes and standards differ across countries. Not only do some have far more stringent regulations than others but also regulatory priorities differ. The foreign nature of these assessment systems makes a number of 'goals' abstract and often out of reach, not to mention the perpetual need for validation from the countries where these systems are developed, before any meaningful change can be made to these systems and their applications.

4.8.4. OVERVIEW OF RATING TOOLS IN NAIROBI

By 2018, two international tools have penetrated the Kenyan building construction market; LEED-US and Green Star SA-Kenya. However, even with these systems available in the market, very few buildings have been certified under these tools. By 2018 only three buildings in Nairobi had been LEED certified: Eaton Place attained LEED certification under LEED BD+C Core and Shell V3. 2009; while World Bank Group - Delta and Citibank Gigiri Branch and COB both attained LEED Gold under LEED ID+C Commercial Interiors V3. 2009.

From Fig 4.24 it is interesting to note that the most difficult category for which to attain points for projects in Nairobi is the Indoor Environmental Quality, with projects attaining 5%, 32% and 28% respectively of the total attainable score. This is closely followed by the material and resource category where projects attained 15%, 0% and 35% respectively.

By 2018 only one building in Kenya had attained Green Star SA-Kenya Certification. The Garden City Village Phase 1 residential project attained Green Star 4 star rating in 2017.

Table.4.1: LEED Certified buildings in Nairobi and the point attained by 2018. Source: Author 2018

	EATON PLACE		CITIBANK GIGIRI BRANCH		WORLD BANK GROUP	
Classification Sort	LEED BD+C v3 2009		LEED ID+C v3 2009		LEED ID+C v3 2009	
	TOTAL	ATTAINED	TOTAL	ATTAINED	TOTAL	ATTAINED
CATEGORIES						
Sustainable Site	28	14	21	19	21	18
Water Efficiency	10	6	11	6	11	11
Energy and Atmosphere	37	16	37	22	37	20
Material & Resources	13	2	14	0	14	5
Indoor Environmental Quality	20	1	25	8	25	7
Innovation	6	4	6	5	6	2
Regional Priority	4	4	4	4	4	4
Total Score	110	47	110	64	110	67
Certification Attained		Certified		Gold		Gold

The development of a local assessment system for Kenya is still in its infancy and therefore both local assessment tools analysed in this research are still in their draft stages. Having acknowledged this, these draft systems may begin to give an indication of the local philosophical and methodological approaches to sustainable design, as well as local priority issues.

4.8.5. INTRODUCTION TO RATING TOOLS IN NAIROBI

By comparing the latest versions of their new buildings construction manuals, the research sought to analyse the rating systems - LEED, Green Star SA-Kenya, Green Mark Kenya and Safari - in order to not only establish commonalities and divergences in their approaches but also to establish priorities based on their different contextual dynamics and their effect on how the concept of sustainability is framed.

I. LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

LEED is a voluntary green building rating tool developed by the US Green Building Council. The pilot version, LEED 1.0 was launched in 1998. Subsequent to the pilot version, the tool has undergone several upgrades, with the current version LEED 4.0 launched in 2013, which has had a recent update in 2017. LEED is currently the most widely adopted green building rating system, adopted by more than 135 countries with a total of approximately 600M gross square metres of space certified globally in 2017 (USGBC, 2018, Fig. 4.25).

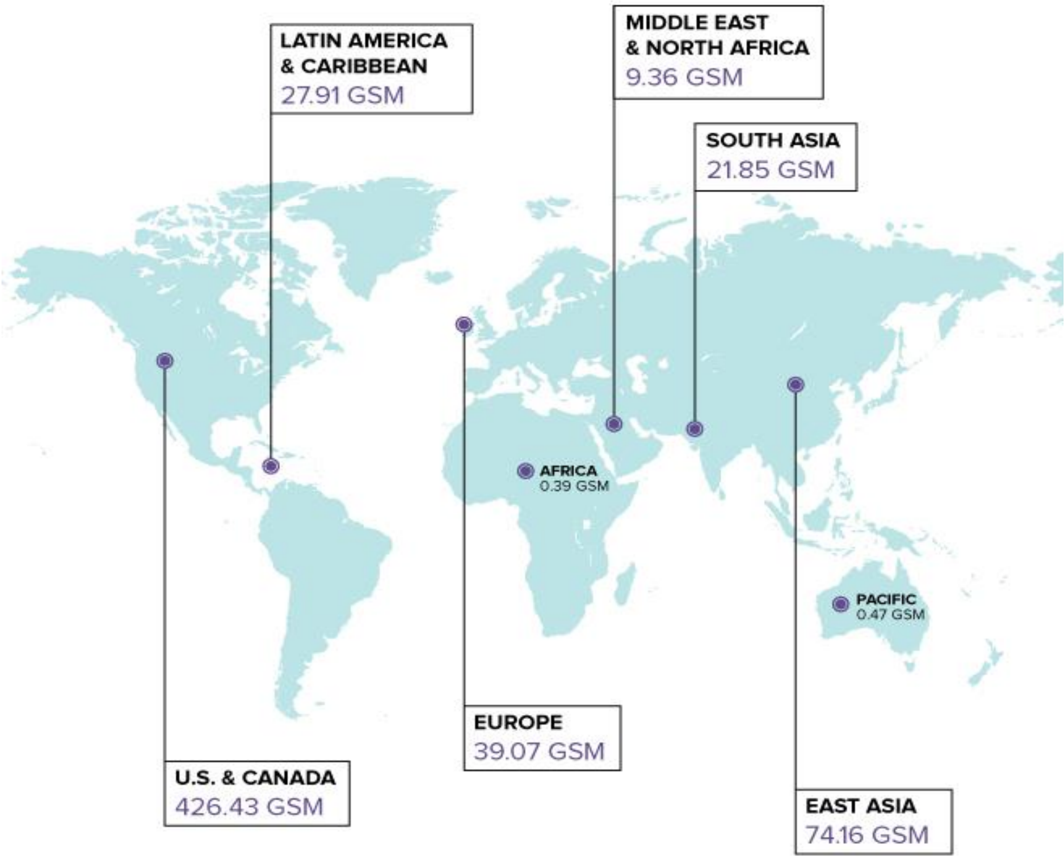

Fig. 4.25: LEED Certified spaces by region by 2017 Source: USGBC 2018

Certification can be sought under five different schemes; Building Design + Construction (LEED BD+C), Interior Design + Construction (LEED ID+C), Building Operation + Maintenance (LEED BO+M), Homes (LEED Homes) and Neighbourhood Development (LEED ND).

II. GREEN STAR SA – KENYA

The Green Building Council Australia (GBCA) issued a licence to the Green Building Council South Africa (GBCSA) established in 2007, allowing the use of Green Star SA (Office, Retail Centre, Multi Unit Residential and Public & Education Building) in Kenya. Prior to this, the GBCA has issued a licence to GBCSA allowing the use of the tool only in South Africa (Office, Retail Centre, Multi Unit Residential and Public & Education Building), Ghana (Office), Namibia (Office) and Mauritius (Office). The certification in Kenya is managed through the established processes of GBCSA. It was agreed that "the category weighting system should remain the same as that of the Green Star SA rating tools, until such a time as the KGBS has the capacity to facilitate a revision of the category environment weighting system." Furthermore, "no adaptations shall be made to the spatial differentiation, space use and timing of certification eligibility criteria of the Green Star SA rating tool" (WSP, 2014.p7).

III. GREEN MARK RATING TOOL

The Green Mark Standard for green building ("Green Mark") was developed under the management of the Green Africa Foundation (GAF) who brought together a team of technical experts from Kenya. The project was sponsored by the Green Africa Foundation together with the Government of Kenya under the Low Emission and Climate Resilient Development Project, implemented by the Ministry of Environment and National Resources and funded by the United States Agency for International Development (USAID) through the United Nation Development Programme (UNDP).

The tool was conceived in 2011 and benchmarked using a number of existing international tools, including Green Star SA, US LEED, UKs BREEAM, India's GRIHIA, and Singapore's Green Mark among others. The tool attempts to take into account the local context incorporating local laws and standards.

IV. THE KENYA GREEN BUILDING RATING TOOL- SAFARI

The Kenya Green Building Rating Tool is a voluntary tool currently in its draft stage developed as a collaboration between the Environmental Design Consultants chapter of the

Architectural Association of Kenya, The University of Nairobi, and United Nations Habitat. The tool is said to have been developed from "first principles" and later enhanced after a review of existing international tools; LEED, BREEAM, GRIHA, Green Star, Green Mark and the Green Building Index. The tool will be applied to construction works exceeding 2,000m^2 including; new buildings, additions and extensions to existing buildings as well as retrofitting to existing buildings.

4.8.6. CATEGORIES & WEIGHTING

I) LEED

A maximum of 100 points distributed between nine categories; integrative process, location and transport, sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality, with an additional 10 bonus points given to innovation and regional priority.

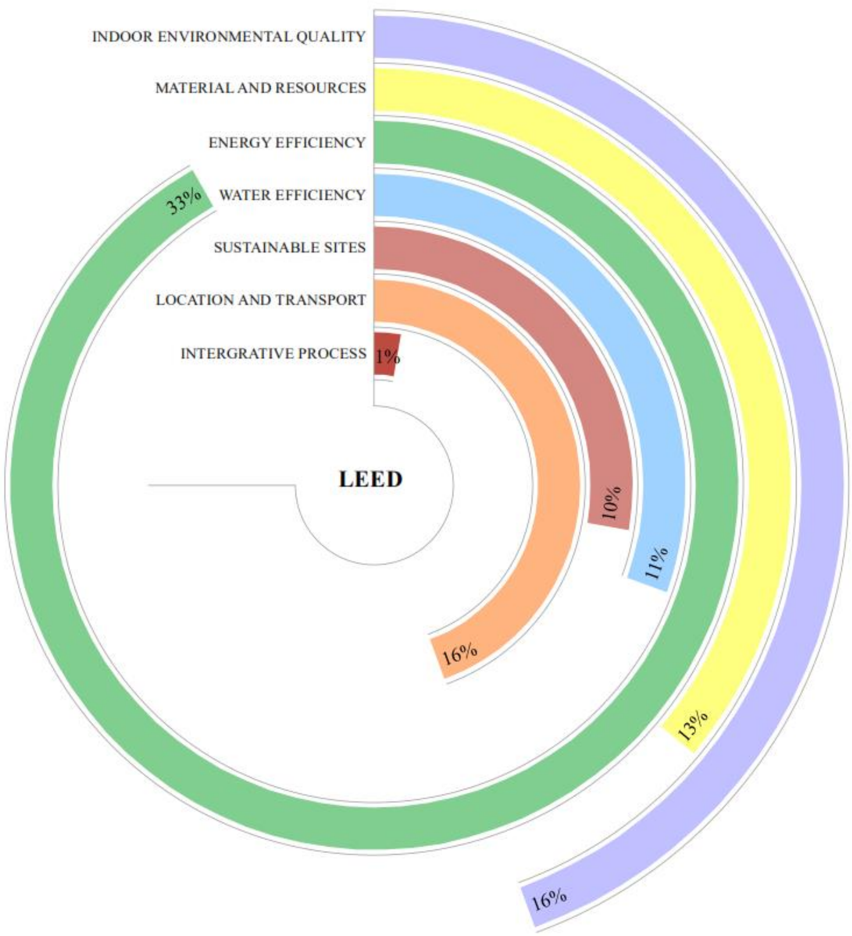

Fig. 4.26: Percentage credit distribution by category for LEED assessment system. Source: Author 2018

II) GREEN STAR SA – KENYA

The current version awards a maximum of 149 points distributed between nine categories; management, indoor environment quality, energy, transport, water, materials, land use and ecology, and emission with a bonus of five points for innovation. These points are weighted to a percentage, except for innovation which is not weighted.

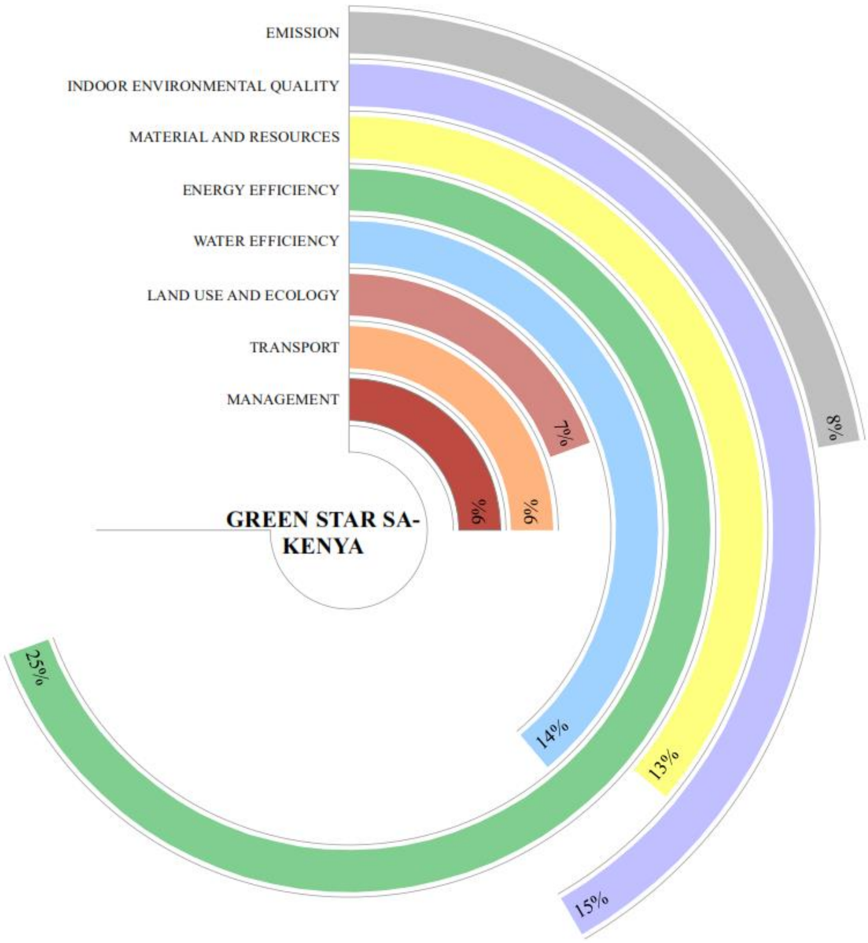

Fig. 4.27: Percentage credit distribution by category for Green Star SA Kenya assessment system. Source: Author 2018

III) GREEN MARK KENYA

The current version (still in its draft stage), awards a maximum of 100 points spread across seven categories; sustainable site, planning development and management, water efficiency, sustainable materials and technology, indoor environmental quality, maintenance and management, and innovation.

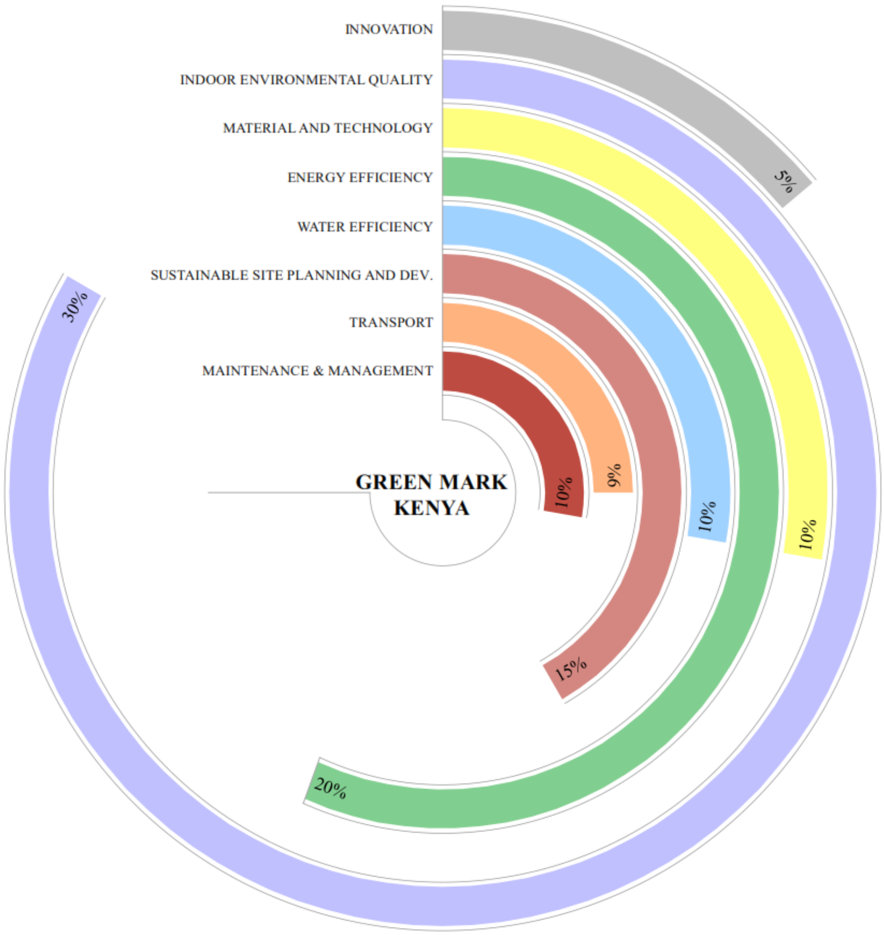

Fig. 4.28: Percentage credit distribution by category for Green Mark Kenya assessment system. Source:

IV) THE KENYA GREEN BUILDING RATING TOOL - SAFARI

The current draft version awards 100 points as the highest possible score, distributed across six categories; general description/recommendations, passive design strategies, energy efficiency, resource efficiency, noise control, and acoustic design and innovation. A mandatory prerequisite requirement category is also included in the tool, although no points are awarded for this category.

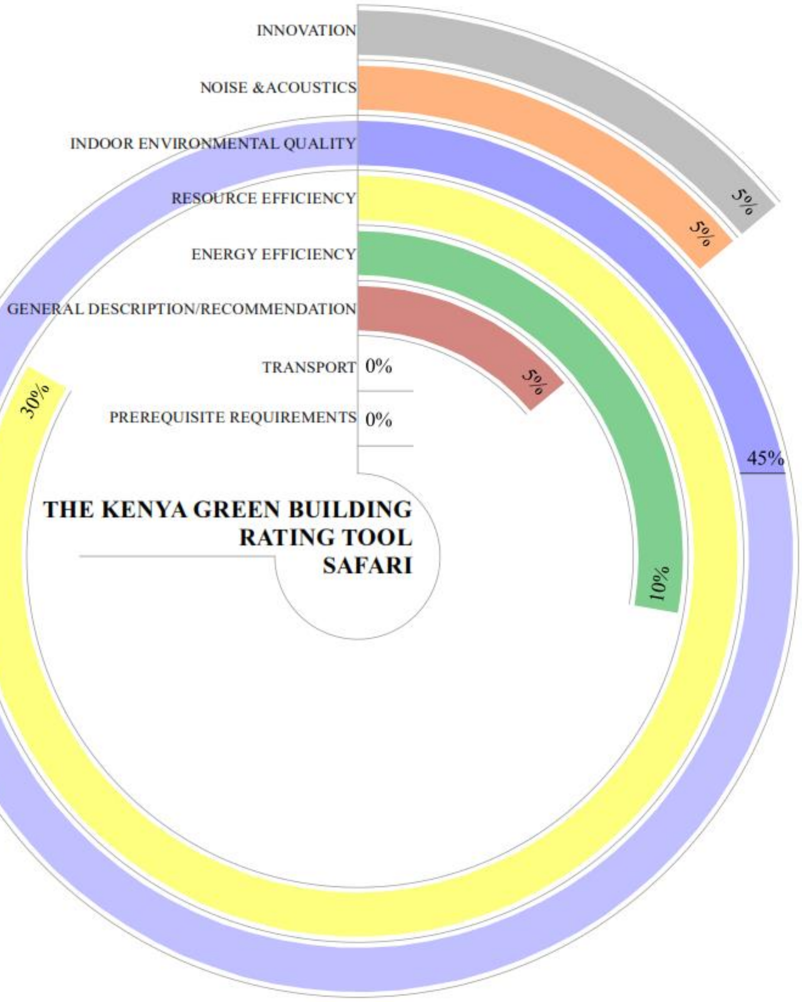

Fig. 4.29: Percentage credit distribution by category for Safari assessment system. Source: Author 2018

It is apparent that in all four rating systems, categorisation is based on environmental aspects regarding different design and construction practices and processes. These categories may differ in terminology, but they generally have similar motivations, objectives and environmental concerns, and thus a relationship between the different categories in the different systems can be established. However, there appear to be significant differences with regard to the weighting of each category, suggesting differences in priorities. The energy and indoor environmental quality categories show the most significant weighting differences. Fig. 4.26, 4.27, 4.28 and 4.29 highlights the different categories under each system and the weighting percentages.

Table 4.2: Comparison of the rating systems categories and weighting. Source: Author 2018

LEED	%	GREEN STAR SA- KENYA	%	GREEN MARK (KENYA)	%	SAFARI	%
Integrative process	01	Management	09	Maintenance and Management	10	Prerequisite requirements	00
Location and Transport	16	Transport	09	*(Under SS)*		-	-
Sustainable Site	10	Land Use and Ecology	07	Sustainable site, planning dev. & Man.	15	General description/ recommendation	05
sWater efficiency	11	Water	14	Water Efficiency	10	Water supply and Drainage	10
Energy and Atmosphere	33	Energy	25	Energy Efficiency	20	Energy Efficiency	10
Materials and Resources	13	Materials	13	Sustainable Material and Technology	10	Resource Efficiency	20
Indoor Environmental quality	16	Indoor Environmental quality	15	Indoor Environmental quality	30	Passive design strategies	45
Innovation	-	Innovation	-	Innovation	05	Innovation	05
Regional Priority	-	Emission	08			Noise and acoustic design	05

4.8.7. ISSUES UNDER EACH CATEGORY

Each of the categories have "issues" distributed under them. As indicated earlier there is a strong correlation between the categories of all four systems in spite the difference in terminology, however, the issues under the categories indicate significant variations. The concept of energy efficiency for instance is relatively applied depending on local conditions and therefore different strategies will be required to respond to these conditions. Table 4.3 highlights the various issues under each category for each of the rating tools.

LEED and Safari Green Building Index have prerequisite issues, although they differ in nature and focus. For LEED, each category has a few mandatory (prerequisite) issues that should be met before attempting the other issues. Safari on the other hand has these prerequisite issues under their own category. LEED prerequisites are performance based, whereas in Safari it is focused on features and procedures. Green Star SA-Kenya and Green Mark Kenya do not have any prerequisite issues.

The issues in each rating systems were then categorised into the three pillars of sustainability; environmental, social and economic. All four tools predominantly assess environmental impact by measuring environmental performance. However, not much emphasis is given to social and economic performance. Approximately 80% of the issues assess environmental aspects. Although it has been argued that sustainability assigns equal importance to all three pillars, rating systems are yet to fully incorporate social and economic aspects. An average 16% is given to social aspects and only about 4% given to economic aspects.

4.8.8. AGGREGATION

All four rating systems have optional ways of attaining points. Each issue is assigned different maximum weighting scores by comparing the importance of each category to each other, then assigning weighting based on their relative importance. Based on the weighted score attained, a project may be awarded these rating levels in each of the rating systems:

Table 4.3. Aggregation of rating systems in this study. Source Author 2018

LEED	**GREEN STAR SA-KENYA**	**GREEN MARK KENYA**	**THE KENYA GREEN BUILDING RATING TOOL- SAFARI**
Platinum (80+ points),	Six star (75+%)	Diamond (91-100 points)	Platinum or Five Star (80+ points)
Gold (60-79 points)	Five Star (60-74%)	Platinum (85-90points)	Gold or Four Star (70-79points)
Silver (50-59 points)	Four Star (45-59%)	Gold (75-84 points)	Silver or Three star (60-69points)
Certified (40-49 points)		Silver (65-74points)	Bronze or two star (50-59points)
		Bronze (50-64points)	

LEED								
INTERGRATIVE PROCESS	**LOCATION AND TRANSPORT** LEED for Neighbourhood Development Location Sensitive Land Protection High Priority Site Surrounding Density and Diverse Uses Access to Quality Transit Bicycle Facilities Reduced Parking Footprint Green Vehicles	**SUSTAINABLE SITES** Construction Activity Pollution Prevention Site Assessment Site Development – Protect or Restore habitat Open Space Rainwater Management Heat Island Reduction Light Pollution Reduction	**WATER EFFICIENCY** Outdoor Water Use Reduction Indoor Water Use Reduction Building – Level Water Metering Outdoor Water Use Reduction Cooling Tower Water Use Water Metering	**ENERGY AND ATMOSPHER** Fundamental Commissioning and Verification Minimum Energy Performance Building – Level Energy Metering Fundamental Refrigeration Management Enhanced Commissioning Optimize Energy Performance Advanced Energy Metering Demand Response Renewable Energy Production Enhanced Refrigerant Management Green Power and Carbon Offsets	**MATERIAL AND RESOURCES** Storage and collection of Recyclables Construction and Demolition Water Management Planning Building Life-Cycle Impact Reduction Building Product Disclosure and Optimization – Environmental Product Declaration Building Product Disclosure and Optimization – Sourcing of Raw Materials Building Product Disclosure and Optimization – Material Ingredients Construction and Demolition Water Management	**INDOOR ENVIRONMENTAL QUALITY** Minimum Indoor Air Quality Performance Environmental Tobacco Smoke Control Enhanced Indoor Air Quality Strategies Low – Emitting Materials Construction Indoor Air Quality Management Plan Indoor Air Quality Assessment Thermal Comfort Interior Lighting Daylighting Quality Views Acoustic Performance	**INNOVATION** Innovation LEED Accredited Professional	**REGIONAL PRIOROTY** Regional Priority: Specific Credit
GREEN STAR SA- KENYA								
MANAGEMENT Green Star KE Accredited Professional Commissioning Clauses Building Turning Independent Commissioning Agent Building Users' Guide Environmental Management Waste Management	**INDOOR ENVIRONMENTAL QUALITY (IEQ)** Ventilation Rates Air Change Effectiveness Carbon Dioxide Monitoring and Control Daylighting Daylight Glare Control High Frequency Ballasts Electric Lighting Levels External Views Thermal Comfort Individual Comfort Control Hazardous Materials Internal Noise Levels Volatile Organic Compounds Formaldehyde Minimisation Mould Prevention Tenant Exhaust Riser Environmental Tobacco Smoke (ETS) Avoidance Energy	**ENERGY** Energy- Conditional Requirement Greenhouse Gas Emissions Energy Sub-metering Lighting Power Density Lighting Zoning Peak Energy Demand Reduction	**TRANSPORT** Provision of Car Parking Fuel Efficient Transport Cyclist Facilities Commuting Mass Transport Local Connectivity	**WATER** Occupant Amenity Water Water Meters Landscape Irrigation Heat Rejection Water Fire System Water Consumption	**MATERIALS** Recycling Waste Storage Building Reuse Shell & Core or Integrated Fit-out Concrete Steel PVC Minimisation Sustainable Timber Design for Disassembly Dematerialisation Local Sourcing	**LAND USE & ECOLOGY** Ecology – Conditional Requirement Topsoil Reuse of Land Reclaimed Contaminated Land Change of Ecological Value	**EMISSIONS** Refrigerant/Gaseous ODP Refrigerant GWP Refrigerant Leaks Insulant ODP Watercourses Pollution Discharge to Sewer Light Pollution Legionella Boiler and Generator Emissions	**INNOVATION** Innovative Strategies & Technologies Exceeding Green Star KE Benchmarks Environmental Design Initiatives
GREEN MARK – KENYA								
SUSTAINABLE SITE, PLANNING DEVELOPMENT AND MANAGEMENT SS1: Life cycle cost and service planning SITE PLANNING AND DEVELOPMENT SS2: Site Selection SS3: Building Development Density SS4: Building Orientation and Form SS5: Maximising Usage of Built and Green Spaces SS6: Protect or Restore Habitat SS7: Reduce Heat Island Effect SS8: Erosion Control and Landscape Management SS9: Responsible Construction SS10: Light Pollution SOCIAL VALUE MAXIMIZATION SS11: Inclusive and Accessible Design SS12: Emergency Response WATER ECOSYSTEM MANAGEMENT SS13: Storm Water Design and Management SS14: Integrated Pest Management SUSTAINABLE TRANSPORT SS15: Non-Motorized Transport SS16: Mass, Efficient and Low-emitting vehicular Transport	**WATER EFFICIENCY** Water Use Management Water Harvesting Water Efficient Fixtures and Fittings Grey Water Recycling Water Efficient Landscaping and Irrigation Systems Water Quality Life cycle cost and service planning Site Planning and Development Social Value Maximisation Water Ecosystem Management Sustainable Transport	**ENERGY EFFICIENCY** Optimize Energy Performance Commissioning and re-commissioning of building energy systems Energy Efficient Equipment, appliances, fittings Energy Monitoring Renewable Energy Light Zoning	**SUSTAINABLE MATERIALS AND TECHNOLOGY** ENVIRONMENTALLY RESPONSIBLE MATERAILS Rapidly Renewable Materials Low-Emitting Materials Locally Sourced Materials and Products Responsible Sourcing of Materials RESOURCE EFFICIENT AND TECHNOLOGY Reused and Recycled Materials Appropriate Building Technology Construction Waste Management		**INDOOR ENVIRONMENTAL QUALITY** VENTILATION AND THERMAL COMFORT Climate Responsive Design Natural Ventilation, Heating and Cooling User- friendly heating and ventilation systems Air Change effectiveness LIGHT AND VISUAL COMFORT Natural Lighting User-friendly Lighting Systems Glare control and view out Efficient Artificial Lighting Fittings INDOOR AIR QUALITY Minimum IAQ Performance Tobacco Smoke Control Indoor air quality testing and monitoring INDOOR AIR POLLUTION Mould Prevention ACOUSITIC COMFORT Internal Noise Level		**MAINTENANCE AND MANAGEMENT** COMMUNITY ENGAGEMENT Stakeholder Consultation Building User Manual Post Occupancy Evaluation Green Procurement Policy SITE WASTE MANAGEMENT Operation Waste Management Building Exterior Management	**INNOVATION**
SAFARI GREEM BUILDING INDEX								
PREREQUISITE REQUIREMENTS Environmental Laws (NEMA) Space and Occupation Building Development or distances and Zoning Site Boundary Universal Accessibility Building User Manual/Building Information	**STRATEGIES GENERAL DESCRIPTION/RECOMMENDATION** Sustainable Site Planning Landscaping and Irrigation	**PASSIVE DESIGN STARTEGIES** SOLAR CONTROL Building Orientation Space allocation within the building Building form and shape Openings Natural Lighting Sun Shading/Solar Control Thermal Mass Passive Heating or Passive Cooling Building Finishes NATURAL VENTILATION Natural Ventilation & Cooling		**ENERGY EFFICIENCY** Energy efficient Equipment/ appliances/fittings Renewable Energy	**RESOURCE EFFICIENCY** MATERIALS Choice of Building Material (External) Choice of Building Materials (Internal) WATER SUPPLY AND DRAINAGE Water Supply Storm Water Drainage WASTE MANAGEMENT Solid Waste Management Waste Water Management		**NOISE CONTROL AND ACCOUSTIC DESIGN** Noise Control and Acoustics	**INNOVATION** Sustainable design Innovation

Table 4.4: Summary of categories under all four assessment systems. Source: Author (2018)

4.9. COMPARISON OF GREEN BUILDING ASSESSMENT TOOLS IN NAIROBI

4.9.1. HARMONIZATION OF CATEGORIES

For detailed comparative purposes, harmonisation of categories was done in order to create a system of common categories. Some original categories had to be relocated to fit the developed categories.

The harmonisation involved renaming the passive design aspect in the Safari tool to Indoor Environmental Quality (IEQ) and adding its acoustic category the new IEQ. The issue of water supply and drainage was removed from resources efficiency and was made a category on its own. Similarly, the transport metric in the Green Mark tool was removed from the sustainable site, planning development and management category and was made a category on its own.

Finally, the 'management' category present in Green Star and Green Mark, the integrative process and regional priority of LEED, as well as emissions category in Green Star, were clustered under others/operations because they include bureaucratic and administrative aspects which are more complex to measure and compare. The innovation category was not taken into account.

Consequently, in order to compare the points from each category, a normalisation process that scaled all the categories to a common whole (100%) was done. The four rating systems were compared based on these categories:

1. Sustainable Site / Land Ecology
2. Energy Efficiency
3. Water Efficiency
4. Materials and Resources
5. Indoor Environmental Quality
6. Transport
7. Operations

Fig. 4.30 shows the resultant distribution of credits; this was achieved by analysing the issues under each category as shown in Table 4.4

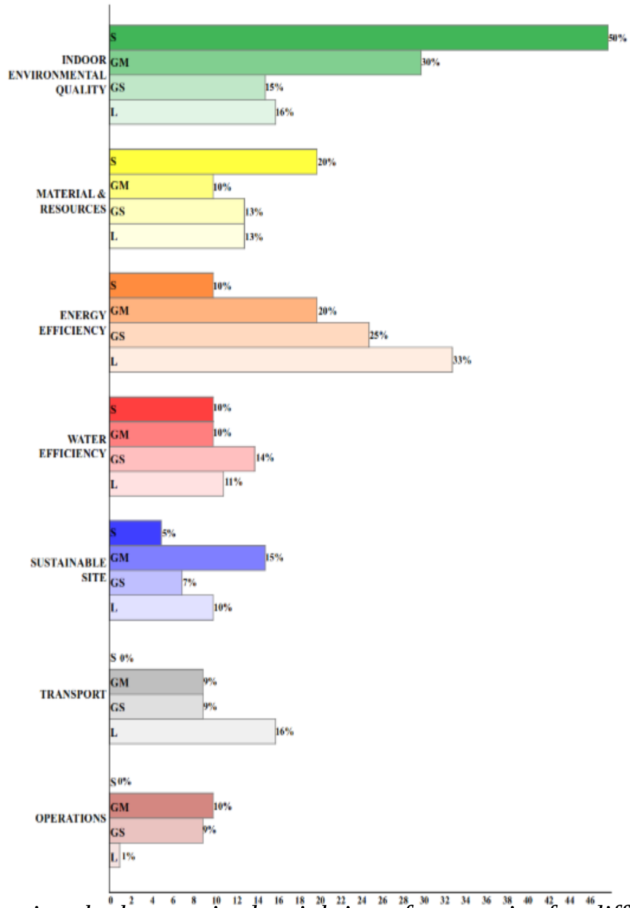

Fig. 4.30: Graph showing the harmonised weighting of categories for different rating tools.

Table 4.5: Harmonised weighting of categories for different rating tools. Source: Author 2018

HARMONISED CATEGORIES	LEED	GREEN STAR SA-KENYA	GREEN MARK (KENYA)	SAFARI
Sustainable Site/ Land Ecology	10%	07%	15%	05%
Energy Efficiency	33%	25%	20%	10%
Water Efficiency	11%	14%	10%	10%
Materials and Resources	13%	13%	10%	20%
Indoor Environmental quality	16%	15%	30%	50%
Transport	16%	09%	09%	00%
Operations	01%	09%	10%	00%

4.9.2. COMPARATIVE ANALYSIS OF HARMONISED CATEGORIES

SUSTAINABLE SITE/ LAND ECOLOGY

A study done by the United Nations showed that approximately 60% of eco-systems assessed globally indicate significant degradation or unsustainable use (Zhang *et al*., 2016). Thus, it is crucial to assess the impact of buildings on existing eco-systems and the manner and extent to which the building will influence and be influenced by these systems. The sustainable site category, therefore, is concerned with the protection and conservation of existing land ecology as well as site management processes such as reduction of heat island effect, creation of open spaces, landscape management and contamination of land. This is reflected in all four rating systems.

ENERGY EFFICIENCY

This category shows significant differences. In LEED and Green Star SA-Kenya - the international systems -, the energy categories are assigned the greatest importance, with about one-third of the assessment score in LEED and one-quarter in Green Star SA-Kenya, whereas the converse is found in Green Mark Kenya and Safari, where energy is assigned 20% and 10% respectively. On the other hand, Indoor Environmental Quality for both Green Mark and Safari are given the greatest emphasis, with approximately half of the assessment score for Safari and about one-third for Green Mark Kenya.

A general analysis of heating and cooling degree days, Fig 4.31 below, suggests that there would be not only a significant difference in the base temperatures, but more so in the heating and cooling degree days for the cities in the four countries. The heating and cooling degree days give an indication of the energy demand for heating and cooling for buildings in particular regions. Graph a (Nairobi) suggests that the energy demand for Nairobi would be biased to cooling all through the year. Whereas the rest of the cities would require both heating and cooling and different proportions at different times of the year.

As earlier suggested, for Nairobi, passive design strategies can be utilised, to significantly reduce the energy demand for cooling and achieve desired thermal comfort. Careful consideration however should be given to establish an appropriate comfort zone for Nairobi's inhabitants.

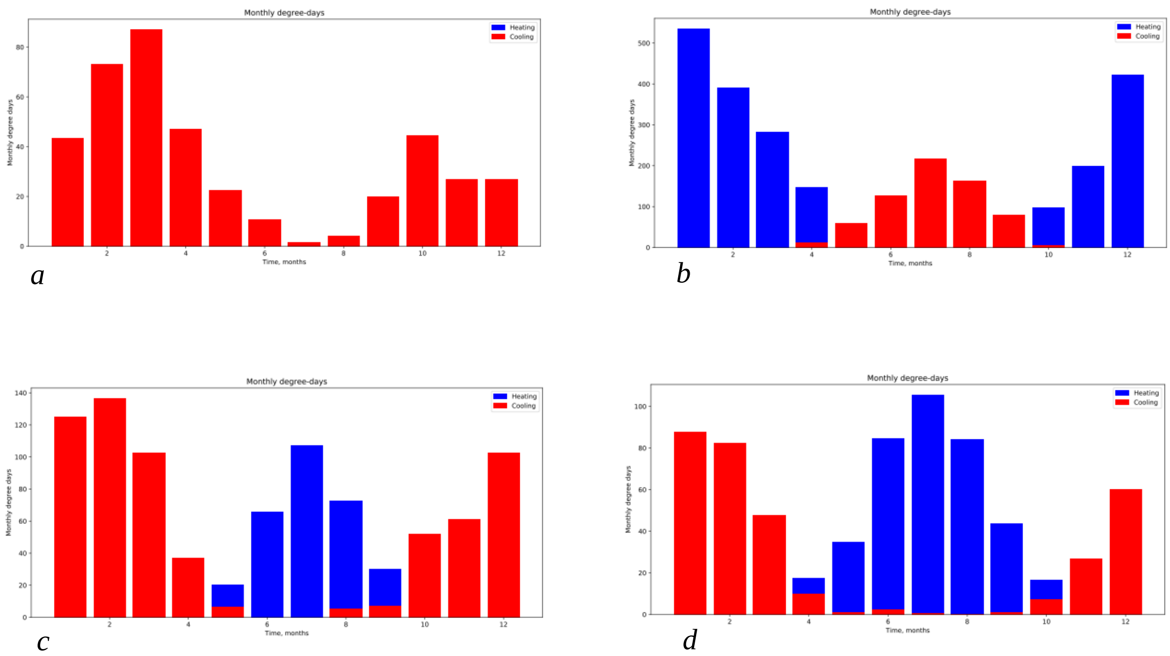

Fig. 4.31: Annual Heating and cooling degree days for Nairobi-Kenya (a), New York- USA (b), Sydney - Australia (c), and Cape Town -South Africa (d) Source: Author 2019

Further analysis of the energy category consideration reveals that for Safari and Green Mark Kenya, aside from the emphasis on the use of passive design strategies, emphasis is also given to the energy efficiency of equipment/appliances/fittings and the use of renewable energy, with Green Mark having an additional issue on optimisation of energy performance and use of building energy systems. Understandably, given Kenya's climate, the heating and cooling loads can be reduced significantly using passive design strategies and therefore the main energy load becomes that of equipment/appliances and fittings. These passive strategies approach also favours the economic context as they are less capital intensive, especially when compared to the potential energy savings.

Closer examination of LEED's energy performance category on the other hand reveals a bias towards active strategies for minimum energy performance, which would not only be capital cost intensive but also high in embodied energy, as these systems are neither produced nor assembled in Kenya. In spite of the presence of a passive approach alternative, fewer credits are available, and thus the selection of this path offers fewer points, preventing projects from seeking additional points for optimization of energy performance. LEED takes into account a greater number of issues given the extreme weather conditions it is designed for, which increases the building's energy load for both cooling and heating.

On the other hand, Green Star SA-Kenya focuses on reduction of demand and monitoring of energy, with lighting being a key consideration. This could be due to its adaptation from Green Star SA. South Africa has suffered an energy supply crisis that has, resulted in a series of disruptive outages and load shedding since 2008 and from this point there has been a gap between electricity demand and supply.

It is worth noting that the energy mix in these countries where the systems originate differs significantly. Approximately 70% of Kenya's energy is from renewable sources (Power Africa, 2018). This is significantly high when compared to South Africa, where energy generation is dominated by coal power at approximately 89%, with renewable energy constituting about 3% (Power Africa, 2018). In the United States of America however, renewable energy constitutes only approximately 17% of the energy mix. It is no surprise therefore that the energy consideration in these counties (U.S. and South Africa) is emphasised.

WATER EFFICIENCY

Water efficiency takes into account the harvesting, consumption, reduction in use, monitoring and storage, and recycling of grey water. Analysis of all four rating systems reveals a relatively similar weighting allocation to water efficiency. However, a careful analysis of the context would suggest that the water requirements, and challenges differ across the different countries. As previously highlighted, not only is Kenya a water scarce country, especially in comparison to South Africa and the United States, but also, Kenya's greatest environmental challenge is flooding. Therefore, when designing as assessment system for Kenya, more weight and greater credit points should perhaps be allocated to buildings that mitigate these challenges.

RESOURCE EFFICIENCY

This category takes into account relatively similar issues including the management processes involved in the choice, sourcing, use, storage and recycling of building materials throughout the building process. The toxicity of materials as well as waste management are also considered on all four systems. The weighting in this category similarly shows marginal differences in three of the systems, with both Green Star SA-Kenya and LEED allocating

13% and Green Mark Kenya 10%. Safari however allocated 20% to this category, making it its second most significant category after IEQ.

INDOOR ENVIRONMENT QUALITY

The indoor environmental quality category assesses thermal, visual and acoustic comfort as well as ventilation, air quality and pollution. Whereas international systems tend to prioritise energy, Kenya's locally developed systems seem to prioritise IEQ. Safari allocated about half of its credits to IEQ while Green Mark Kenya allocated approximately one third. This is in contrast with LEED and Green Star SA-Kenya, which allocate 15% and 16% respectively to IEQ. Furthermore, the issues within this category where greater emphasis is placed similarly differ. LEED for instance emphasizes air quality while Safari focuses on passive solar control strategies. The difference in climate and in this case, more importantly, temperature, in the three countries where these systems originate would perhaps explain the difference in areas of focus.

Table 4.6: Annual Temperature comparison Source:www.weatherbase.com

	KENYA	SOUTH AFRICA	USA
Average annual temp (ºC)	20.8	17.0	11.5
Average high annual temp (ºC)	26.9	23.1	17.2
Average low annual temp (ºC)	16.1	10.6	9.2

Kenya experiences significantly higher temperature throughout the year, for longer periods of the year when compared to South Africa and USA. Solar shading therefore becomes an imperative part of design as a way to ensure thermal comfort and reduce the cooling load with the building.

TRANSPORT

The transport category looks at access to mass transit systems, the use of non-motorised transport and energy efficient transport. This is reflected in all rating systems except Safari, though with different weighting. LEED prioritises transport when compared to the other rating systems, allocating 16% which is its second highest category, whereas Green Star SA-

Kenya and Green Mark Kenya both allocate 9% to transport. Interestingly, 53% of CO_2 emissions in Kenya are produced by transport. This is significantly high compared to 12% in South Africa and 33% in United States (World Bank, 2018). This is because as discussed earlier, the use of renewable energy for other purposes is significantly higher in Kenya compared to the other countries. The use of electric cars is still in its infancy in Kenya and therefore the infrastructure to support this technological advancement is yet to be developed and may take a while before it is a priority.

4.9.3. GREEN VS SUSTAINABILITY

The research attempted to analyse and classify each issue under the different categories into the key pillars of sustainability; environmental, social and economic. An extra two classifications were created for issues that did not strictly fit into the three pillars. This classifications are, cross-pillar, which characterised issues that overlapped between pillars, in this case environmental and social and another category, and administrative, with issues such as having an accredited professional or regional priority.

Table 4.7: Showing weighting under to key pillars of sustainability. Source: Author 2018

	LEED		GREEN STAR		GREEN MARK		SAFARI	
	No.	%	No.	%	No.	%	No.	%
TOTAL	53	100	96	100	54	100	28	100
Environmental	39	74%	72	75%	41	76%	23	82%
Social	1	02%	11	11%	7	13%	2	07%
Economic	1	02%	2	02%	1	02%	1	04%
Cross - pillar	5	09%	8	08%	4	07%	-	00%
Admin	7	13%	7	07%	1	02%	2	07%

As shown in Table 4.7 the number of issues varies significantly. Green Star had a comparatively much higher number of issues, while LEED and Green Mark had more or less a similar number. Safari on the other hand had significantly fewer issues.

From the analysis it is evident that all four assessment systems distinctly prioritise environmental considerations with each allocating over 70% and perhaps 80% if shared issues are considered under the environmental issues. Minimal consideration is still being given to social issues despite the popularity it is gaining in sustainable design discourse. Perhaps due to the complexity that come with attempting to measure these issues Currently, an elaborate metrics is yet to be developed that can definitively measure social issues. Green Mark and Green Star allocated the highest propositions, approximately 20% and 19% respectively (including shared categories), LEED approximately 11% and Safari with the least at 7%. Economic considerations, however, are still barely considered in all systems. LEED, Green Star and Green Mark allocated the same proportion, while Safari allocates a slightly higher proportion. On average the rating systems allocate less than 3% to economic issues. When considering these issues, it supposedly would significantly vary and depend on how one selects what data to consider and how to measure and interpret that data. One could argue however, given the complexity involved in the quantification of as well as the diversity embedded in social issues attempting to develop this metrics especially one that is universal in nature may be futile.

4.9.4. OVERARCHING CONCERNS ON INTERNATIONAL SYSTEMS

Although it is evident from the comparison that the systems encapsulate similar fundamental themes under the different categories, the distribution of weight varies as a result of local concepts and constructs of sustainability, thereby reinforcing the need to prioritise credits to address local conditions. The analysis demonstrates how contexts influence the development and application of these systems, consequently highlighting the importance of appreciating contextual diversity and its overall influence on the concept of sustainable design. The locally developed systems show clear disparity in their prioritisation of issues when compared to international systems. They attempt to prioritise local issues, although this can still be improved.

Sustainable development is largely driven by the realisation of the environmental impact that human practices continue to have, such as climate change, global warming and ozone depletion. This would explain the focus on environmental issues when discussing any aspect of sustainable design. It is worth appreciating however, that the compromise on other sustainability considerations resulting from a focus on environmental performance is common in several international systems.

This analysis suggests that perhaps the focus for sustainability in developing countries like Kenya should be on the social and economic concerns which cannot be fully assessed using current assessment systems. This does not suggest that the environmental considerations are less important, but that while addressing environmental concerns the social and economic wellbeing of the people who interact with these buildings is crucial to the realisation of sustainable design. One way of achieving this is through prioritising use of passive design strategies. It is evident from the analysis that most international systems do not prioritise – and in some cases disadvantage - the use of passive design strategies. This approach however is comparatively cost-effective against active strategies with a far smaller carbon footprint, especially for countries where these technologies are not available. In a country like Kenya where climate does not pose as big a challenge as economics, passive design strategies would be more sustainable, barring highly specialised buildings.

When developing an assessment system, the homogeneity of criteria should be considered. It is worth noting that together, the two categories given the highest importance in three of the systems represented constitute more than 50% of the total available score. This therefore translates to the ability to achieve their lowest labels by meeting mandatory requirements – where applicable – and attaining a high score in two of its categories; Energy and Indoor Environmental Quality for LEED and Green Mark Kenya, and resource efficiency and Indoor Environmental Quality for Safari. For Green Mark SA- Kenya, no two categories together can achieve a minimum score. This system appears to have the most equitable weighting of categories. Therefore, in order to achieve a high rating using the Green Star tool, the building must strive to achieve a good score in each category. The least balanced system is Safari, which assigns 50% to one category while overlooking others.

One of the fundamental reasons why the transferability of international assessment systems may not be appropriate is their view of the environmental problem from a global and not regional perspective. The major global environmental challenge is currently climate change, the main mitigation of which is to reduction of CO2 emissions across the globe. For building this translates to the reduction and efficient use of energy, and as a result building performance assessment is hinged on energy efficiency as evidenced in the assessment tools studied. These models could be appropriate for the “Western” more industrialised countries, however, for less-industrialised countries like Kenya, whose energy is largely from sustainable sources, the focus on energy as a main performance indicator would be far from accurate.

A general oversight in green building rating systems is that buildings are assessed against predicted performance as opposed to actual performance. Therefore, this does not consider the numerous unpredictable variables resulting from the building's utility. With this in mind, the assessment metrics and transferability of performance assessment comes into question, as people interact with buildings differently based upon a variety of embedded socio-cultural influences which then affect the building's performance.

4.10. CONCLUSION

The first part of this chapter highlighted different dynamics that would influence and affect the built environment in Kenya, with a focus on Nairobi, its capital city. The data suggests that Nairobi faces contrasting climatic, social, economic and technological realities when compared to the Western world, which would demand a different construction of the problem, and consequently its solution and standard of measurement centred around a Kenyan agenda and reality. The prescriptive international solutions are not only centred around but are representative of the Western construction of the problem, and therefore of the concept of sustainable design as a solution to those specific contextual problems. For example, environmental considerations have been and continue to be the dominant rhetoric when discussing sustainability. From a global perspective, the environmental crisis is presented through climate changed attributed to increasing carbon emissions and therefore, mitigation would involve finding ways to reduce emissions. While Kenya faces the consequences of climate change, for a country whose global carbon emission share is approximately 0.13% this may not be the immediate environmental crisis. While the research is cognisant that Kenya should commit to global environmental responsibility, the characterisation of the environmental local environmental challenge differs significantly for the western and global characterisation of the problem. Therefore, framing the actual local environmental challenge will ensure that mitigative measures are relevant, appropriate and effective. Through a critical interrogation of the context the research found that water – particularly flooding- and waste management are the fundamental environmental challenges facing the build environment in Nairobi.

This was followed by an analysis of the evolution of Nairobi's built environment through different periods, culminating at the introduction of the concept of sustainable design to the built environment. It is evident, from the analysis of this evolution, that Nairobi's colonial history as well as the Western image of modernity has a significant influence on the development and evolution of the urban built landscape in diverse ways. This image of modernity was designed as a container for social and cultural practices and later for the global capitalist system. Subsequently, the concept of globalisation, exemplified in the global treaties, global standards and global assessment systems, crystallised the ideologies of the colonial/modernity systems.

The study suggests that assessment systems have a significant role in the construction of the concept of sustainable design in Nairobi. Following this premise, the second part of this chapter through a methodological qualitative and quantitative approach, analysed and compared four green building assessment systems. One, LEED was international, another was adopted from an international tool – Green Star SA-Kenya - and two locally developed systems were used – Green Mark and Safari - still in their draft stages, in an attempt to understand how context influences the definition and articulation of sustainable design and how this in turn influences the development and application of assessment systems. This was done after a category harmonization and credit normalisation process, that identified key categories for comparison.

Fundamentally, it is evident that international systems are inappropriate when applied in the context of Nairobi. Furthermore, the analysis suggest that locally developed systems have largely been influenced by international systems. However, despite this influence, there are apparent attempts to contextualise these systems and incorporate local dynamic. From the analysis, as synthesised in section 4.9.4, three fundamental considerations emerged for the evaluation of the green building assessment systems. One, is the identification of issues which can be translated into the identification of local problems, challenges or objectives. Second, is the weighting of issues which involves the prioritisation of issues based on local condition or dynamics and third is the homogeneity of criteria, in essence, how balanced the assessment system is with regards to the selection and weighting of issues. While the locally developed systems (Safari and Green Mark Kenya) begin to accommodate these considerations in different ways, the analysis suggests that none of the four assessment systems in this study when evaluated based on the above criteria are comprehensibly adequate for the context of Nairobi.

Having gained an understanding of these key contextual dynamics, the research in the subsequent chapter will move to explore how key stakeholders construct and perceive these realities that surround and create Nairobi's built environment based on focus groups and interviews conducted with key stakeholders. Consequently, how these constructions interact or counteract with their construction of knowledge and perception of sustainable design in the building environment in Nairobi, and subsequently the articulation of this concept in the built environment through a case study analysis whose selection is informed by the stakeholders.

CHAPTER 5

STAKEHOLDER PERCEPTIONS AND INFLUENCES IN NAIROBI

5.1. INTRODUCTION

In the foregoing chapter, the research argued that in order to construct a situated philosophy of sustainable design, there must be a critical understanding of the contextual dynamics that influence perceptions, assumptions and misconceptions of the concept. The chapter also highlighted international influence embedded in the concept of sustainable design. With that as a background, this chapter, through the analysis of interviews and focus group discussions with key stakeholders, attempts to explore how these contextual (local) and global (Western) dynamics influence different actors' perceptions and interpretations of sustainable design, and consequently how these stakeholders' perceptions and interpretations may influence the development of a sustainable built environment.

To that end, this study defines stakeholders as entities who would influence and would be influenced by different aspects of the process of constructing a sustainable built environment. As elaborated in the research methodology chapter, through purposive sampling, the research selected initial stakeholders for the study. Consequently, during the data collection process, more stakeholders were introduced as informed by the data collected. The study grouped the stakeholders into six categories (Fig. 5.1); Design Consultants (in this case the research focused on architects), academia, the private sector which includes developers, investors and corporates, International Bodies, predominantly the Kenya green building Society and the United Nations Habitat, the Government of Kenya, and the Society (general public opinion).

These groups were chosen due to the different roles they play in shaping the discourse of sustainability in Nairobi's building and construction industry. Government as a stakeholder was selected due to their role in the development, enactment and enforcement of regulation and policy that would influence sustainable design as well as their role in outlining local priorities. Academic stakeholders were selected due to, one, their pivotal role in social transformation and their critical role in sustainable design as highlighted in chapter 31, 35 and 36 of Agenda 21, three, their ability to spearhead research, create awareness and influence policy.

Practice -architects- and private sector developers were selected as stakeholders due to their role is testing different design approaches on the built environment, consequently influencing society's perceptions on sustainable design or green buildings. Similarly, given that sustainability and by extension sustainable design is a global endeavour, international entities have an influence on how the concept of sustainable design is constructed locally as highlighted in Chapter 4, thus, understanding their perception and influences would benefit this research. Lastly, this study also benefitted from an attempt to understand the general public's perception portrayed in popular media and media personalities as well as what influences these perceptions.

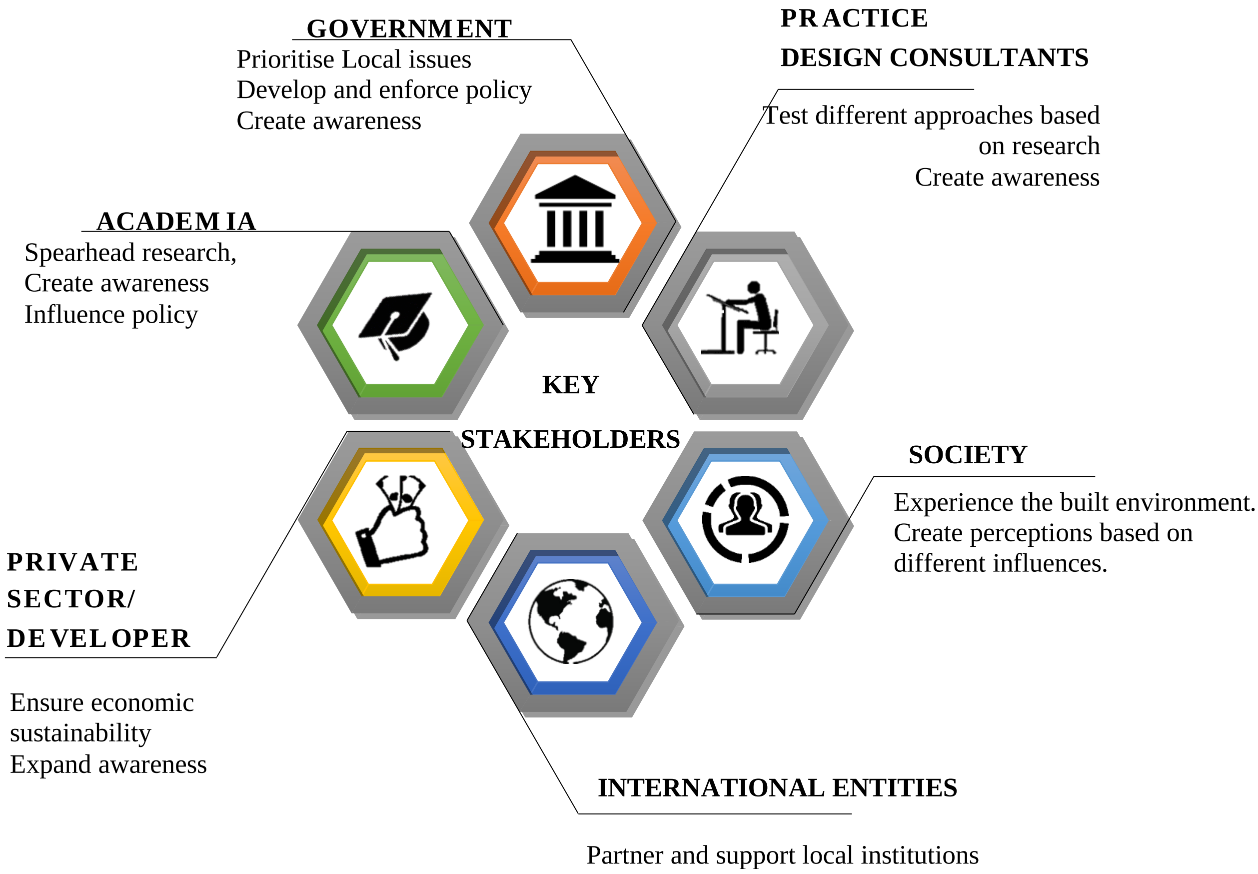

Fig. 5.1: Diagram showing the key stakeholders in the building industry in Nairobi. Source: Author 2019

Through the analysis of the data from stakeholders, the study hoped to develop an understanding of why and how decisions are made concerning the built environment within the context of Nairobi. It is also important to note that the study is cognisant of the fact that different ways of seeing by different actors does not imply that other views are not considered during the process of decision making. However, it highlights the underlying priorities and biases that would manifest during the process of negotiations and compromise at different stages of design and construction.

The investigation presented in this chapter indicates evidence that there is growing concern among the stakeholders in the construction industry regarding current development and building trends in Nairobi. The rapid unplanned growth of the city, increased resource demand and consequent resource depletion, poor waste management, traffic congestion, and frequent flooding, delineates a gap between socio-economic development and environmental considerations, thereby rendering the city's development unsustainable. Similarly, there is consensus that creating a sustainable built environment would lay the foundation for a solution to many of these challenges. However, the construction industry as a driver of development is constantly undergoing change as a result of transformation in resources, technology, user needs and other market factors. Du Plessis (2007) points out the potential complexity that arises when the concept of sustainability is intertwined with the already complex construction industry. The study attempts to unpack this complexity in the context of Nairobi.

In general, this study suggests not only that there are conflicting views as to what sustainable design would look like, but also questions whether it is an emerging concept that has yet to be fully understood, or simply an old concept - embodied in existing vernacular design principles - masquerading with a new name imposed by Western ideology gaining momentum predominantly as a marketing strategy. The research also found that the absence of a clear contextualised philosophy strengthened by localised approaches applicable towards a sustainable built environment renders the current attempts either knee-jerk reactions, or narrow or self-serving greenwash.

5.2. DIFFERENT WAYS OF SEEING - MEANING AND UNDERSTANDING OF SUSTAINABLE DESIGN

It is improbable that practitioners, developers or investors deliberately set out to produce a development that is unsustainable. The resultant development is a consequence of exertive apparent or indeterminate environmental, socio-cultural, economic and regulatory dynamics, as well as actor biases and priorities within a particular context. Having looked at the different dynamics that affect and influence the construction industry in the previous chapter, it is imperative to understand and appreciate how different stakeholders within this context construct and articulate the concept of sustainable design and construction in the move towards a co-constructed situated approach to sustainable design. Before presenting the in-depth interrogations of each stakeholder's influences and perceptions independently, this section will begin by presenting a general understanding of the concept from the stakeholder's collective responses.

As part of the interview and focus group inquiry, each participant was asked how they would describe the concept of sustainable design. In response to this question, a variety of perspectives emerged that focus on different aspects, some sharply divergent and others closely related. For instance, some respondents argued that sustainable design should not be considered a new concept as it is well practiced in the rural parts of Kenya which makes up approximately 70% of Kenya's population. They further submit that as a result of an inherent reverence for nature and the use of locally available resources, over a period of time, vernacular architecture intuitively arrived at solutions that are environmentally, socially and economically conscious. These practices involve using locally available and appropriate technology to solve contextual challenges with minimum negative impact on the environment, while creating positive impact on society. This is what this group described as sustainable design, and thus advocated for using these old practices to inform current designs. On the other hand, others argue that it would be impossible to judge the city at present based on the understanding of the city in the past. While sustainable design as a concept may not be new, the challenges, opportunities and technologies that characterise and encapsulate the present built environment have evolved, and continue to evolve over time, and therefore the concept of sustainable design should evolve.

Furthermore, from this study, it is evident that currently, there is no particular consensus regarding the meaning of sustainable design and consequently how the concept would be articulated in the design and construction process in Nairobi. The varied descriptions of this concept could be compared to the parable of the elephant and the blind men. In this parable, conceptualisation and consequently their descriptions of the elephant were based on their limited experience of the elephant. Using this analogy, all these descriptions can be termed as "half-truths", none of which are totally wrong but none of which totally describe the elephant and in this case none of which totally describe the concept of sustainable design.

A possible explanation to these variations in perception could be attributed to the external influences on each stakeholder as well as the differences in their interests. By way of example, according to Participant V.K, a respondent from UNEP, "sustainable building is really a building that reduces the demand of resources and also minimises the impact, the carbon footprint, and then in the process reduces expenditure, so, it makes sense when you look at it from a financial perspective but also ultimately from an environmental perspective." Participant G.F., an architect and environmentalist, on the other hand tends to focus on nature and society, arguing that "sustainability is so inherent in the natural fabric of the society, basic systems, we are looking at the ecological systems, we are looking at social systems and now economy is just playing within these two fundamental systems." Another architect who takes a more abstract wholistic approach submits that, "sustainable architecture is design that takes into account as many conditions surrounding whatever site you are designing for. I would call it an all-inclusive design" (Participant O.O). These variations are a clear demonstration of a lack of consensus.

Moreover, the research indicates that even within the varied constructs, sustainable design is still inextricably entrenched in environmental issues. Several respondents focused on environmental concerns when describing sustainable design, which could perhaps stem from the global (Western) agenda of sustainability. Among the key issues under the environmental concerns was the building impact on the environment, predominantly waste which was a number of participants focused on. Closely related to environmental impact was environmental management, described as taking into consideration materials extracted and placed into the environment. Other participants on other hand referred to climatic issues, describing sustainable design as that which is conscious of the climate, which generally translates to the utilisation of passive design strategies as well as bio-climatic design principles. Other issues cited under environmental concerns were, resource efficiency and reduction of building's carbon footprint, although only by very few participants. While most participants focused on negative impact that would be mitigated by sustainable design, about two participants described sustainable design as one that would improve the environment to which it is introduced.

Barring environmental issues, the use of locally available materials when describing sustainable design was also considered. Although there appears to be a consensus that building materials should be sustainable, what this translates to was not very clear. The research reveals that material selection is primarily based on familiarity, cost and aesthetics rather than environmental considerations. Beyond local availability, other participants suggest that the materials used should create a healthy environment for its users. However, other than the reduction of VOC substances on paint products, very little consideration is given to material's sustainability credentials with regard to health and wellbeing of building users, perhaps as a result of the tenuous, rather abstract relationship often attributed to materials and the health and wellbeing of building users.

Furthermore, a few participants emphasised on contextual socio-cultural issues as key consideration in achieving sustainable design. However, it was not apparent how these would be incorporated into design as they seemed more abstract ideas. Other issues cited by participants were, energy considerations focusing on the reduction of building energy demands through the use of passive design and the use of renewable energy, predominantly solar energy. Another was economic considerations in this case ensuring that approaches are made affordable, water efficiency seemed to be of great concern given the water challenges Nairobi faces (highlighted in chapter 4). Other participants focused on the use of technology while for others community involvement was fundamental to sustainable design.

It is worth noting that only few participants felt that the concept of sustainable design is a universal concept and there should not be a deviation from, universal definition of the concept. While only a few participants outrightly regarded sustainable design as a universal concept, the understanding of this concept by the rest of the participants seem to be biased towards a global agenda.

The foregoing discussions distinctly reveal that even within a particular context, different actors have contrasting views on sustainable design based on their different influences, interests and priorities. All these varied constructs have a consequence on how the concept of sustainable design is perceived and articulated collectively. The subsequent discussion will seek to gain a deeper understanding of each stakeholder influences, perceptions and underlying interests.

5.3. STAKEHOLDER INFLUENCES, PERCEPTIONS AND PRIORITIES

5.3.1. THE PRIVATE -CORPORATE SECTOR/THE DEVELOPER

The investigations in this study highlight that in a context like Nairobi, where there is minimal regulation regarding sustainable design, developers control the building industry market and therefore, economic consideration often supersedes environmental or even socio-cultural considerations. This is also reflected in cases where initial environmental and socio-cultural intentions were clear, in that when projects face financial challenges, these intentions are easily eliminated during the process typically referred to as 'value engineering', as they are considered add-ons to the project which often lead to high cost overruns on the operational budget. This can be attributed to the lack of thorough investigation on cost differentials during the pre-construction phases of the projects, as well as the vague and tenuous initial motivation for sustainable design. The research therefore revealed the lack of holistic approach to project cost as the majority of investors would prioritise capital cost and immediate returns over long term returns. Very little consideration is given to operational and maintenance costs as more often than not, tenants bear this cost. There is therefore an apparent gap between building for the developers and building for the tenants. One respondent from the private sector argues that,

> "the private sector is driven by one aspect – profits - and as long as the private sector is the one driving this (construction industry), sustainable design will just be a one-off affair, one building there another there, it's a hit and miss" (Participant SMG).

This perhaps best describes the current situation in Nairobi's building industry.

Typically, the private sector evaluates any form of investment based on two fundamental criteria; economic risk and opportunity. Therefore, it is no surprise that when considering and evaluating sustainable design, these criteria will play the most significant role. According to a respondent from the Kenya Property Development Board (KPDB), developers in Nairobi are yet to fully understand the concept of sustainable design, adding that developers are 'greedy' and claim sustainable design is expensive. He first submits that architects should educate developers on sustainable design as a way to create awareness of the value (monetary or otherwise) of sustainable design. By way of example, he compares water management against electrical energy management. He submits that developers would be inclined towards solutions that manage electrical energy costs, due to the high cost of electricity in Nairobi compared to the low cost of water. This is despite the evidence highlighted in Chapter 4, that Nairobi faces a water crisis. According to Nairobi Water and Sewerage Company acting MD, Eng. Munga (Quoted in Construction Review online, 2018), "water rationing (in Nairobi) is set to continue until that time when the dams we are currently building are complete. According to the master plan of water sources development in the city, it will be done by 2026…" Thus, the shortage of water will continue in Nairobi for years to come. This example illustrates that the developer's priority is not to solve an existent challenge but to ensure maximum profits with as little investment as possible.

Increasingly, since the introduction of the concept of sustainable design to Nairobi's building industry, a number of developers in Nairobi have begun to understand and appreciate what they consider as the "business sense" of sustainable design and its direct impact on their bottom line. Data from the study suggest that these developers will attempt to meet the minimum regulatory requirements and anything beyond that is evaluated based on economic implication. One respondent, when asked to describe the impetus for industries to adopt green solutions, posited that "for industry that (cost) is usually the first consideration. You look at money. So, it is usually an economic discussion…they look at the bottom line, what am I getting out of investing in sustainable design?" Further discussions with representatives from the private sector reveal an antagonistic relationship between the perceived prohibitive cost and the cost-benefit claims of sustainable design. Whereas the prohibitive cost aspect comes from the initial investment, the claimed benefits would be as a result of the long-term savings and the potential marketing value currently inherent in the concept of "green."

Following this argument, the private sector evaluates cost-benefit resulting from sustainable design in two main ways; cost saving and competitive marketing potential discussed below:

Cost Saving

The investigation suggests a strong conviction within the private sector that it is cheaper to run a green building, and therefore, there is evidence of a strong drive from the private sector because as earlier highlighted, corporates have begun to appreciate that a sustainably designed building has a direct impact on their bottom line, which was often referred to as the "business sense" of sustainable design. One of the representatives from the Kenya Association of Manufacturers (KAM) in charge of energy audits reports that many manufacturers have reduced energy consumption by 20-30%. He argues that this has been done through minimal intervention on existing buildings, for example by installing transparent sheets as part of the building roof cover to allow natural light into the buildings, naturally ventilating buildings, and use of renewable energy as alternative energy sources.

The Kenya Association of Manufacturers (KAM) is an example of a private sector leader who through several initiatives has encouraged manufacturers towards energy efficiency, which has influenced, although minimally, design considerations of their buildings. Through their annual energy management award, KAM attempts to;

> "encourage the culture of energy efficiency and conservation and recognise enterprises that have made major sustainable gains in energy efficiency through applications of modern energy management principles and practices and in the process made significant energy and cost reduction" (KAM, 2018).

The award is divided into different categories for small, medium and large consumers; electricity saving, fuel saving, energy management and water efficiency. However, in 2014, the Energy Management Awards introduced the green building and green architect categories. Two of the buildings discussed in the subsequent chapter, the Learning Resource Centre at the Catholic University of East Africa, and the Strathmore Business School, were awarded first and fifth place respectively.

Overall, discussion with the private sector suggests a bias towards energy reduction strategies that translates into minimal post-occupancy design intervention as a cost saving strategy through the use of energy efficient systems and use of renewable energy. In this context this translates to solar energy which from a design point of view has minimal significance on the overall concept of sustainable design.

Market Potential

Considering the marketing potential, developers seem to suggest that the idea of 'green', irrespective of what that would mean, sells space and therefore there is an increasing desire to tag a building as 'green'. From a marketing perspective, going 'green' is becoming associated with profitability and competitive advantage. Participant M.M., in describing the current sustainable design trends, submits "it's a marketing tool, you want to say mine is the greenest, not just green". The obvious danger is the potential greenwashing effect this "label" oriented competition has had, where gadgets such as PV panels, or the unused bicycle racks or even the unnecessary air-conditioning systems are installed with very minimal effect on the underlying building performance with regard to sustainability.

Furthermore, as a result of the so called best practices imposed by Western ideology adopted globally, especially for those targeting the global market, sustainable design practices are seen to be used as a way of self-branding in an attempt to gain global legitimacy. One respondent from the industrial sector reiterates the influence of global policy, citing the example of the global compact network which advocates for sustainable growth, where industries are being ‘forced’ to sign into these agreements in order to trade. He argues that this “is now driving people to realise that there is something called sustainability and I need to be part of this for me to trade or do business” (Participant N.D.).

On the contrary, the research reveals that despite the growing consensus that the cost of running a green building may be lower, the initial investment still proves prohibitive. This is exacerbated by the lack of studies, especially in Nairobi, showing how and when this cost saving is achieved. Therefore, the idea of long-term saving in green buildings is still rather vague and surrounded by scepticism. The complexity of quantifying some of the benefits of sustainable designs, such as indoor environmental quality, adds to the scepticism. Furthermore, in most developments, this is augmented by the fact that these benefits are unlikely to be experienced by the developers who hand over the buildings to different tenants, who then take over the running costs of the building. This however is not unique to Nairobi.

Taken together, there are dangers that may arise when this kind of economic focus is adopted in the drive towards sustainable design. First, not only does it have the potential to encourage greenwashing but also has the potential to mislead social perceptions, given the lack of genuine underpinning and consequent attempts towards sustainable design. One architect suggests that “when you look at Kenya, what people have been trying to do is commercialise green, the moment you commercialise it, then things begin to crumble. It is now becoming impossible to tell someone this is green and this is not” (Participant M.M.). These sentiments are echoed by another architect, who argues that “solar is being put in the industrial areas by companies that couldn’t give a hoot about their green credentials. You look at the company name and you go like, no, they don’t care, clearly, they are doing it for financial reasons, and this is growing exponentially” (Participant G.M.).

Secondly, from the research, certification of buildings in Nairobi is inspired primarily by its marketing potential. The investigation revealed that there are several buildings in Nairobi that have attempted to achieve LEED certification, have gone through the registration process, but have been unable to complete the process as a result of its complexity and expense. F.G., one of the participants, posits that the question should be, “how can we set standards that are achievable for more buildings instead of very high standards that can be achieved by very few buildings that are going just for the budge?” This is not to suggest that green building standards should be lowered but rather contextualised so that they are more flexible and therefore achievable within the local dynamics. There is concern that commercial interests are driving the certification agenda not only in Nairobi but globally. As discussed in Chapter 4, only four buildings in Nairobi have attained LEED certification out of the 24 that applied and began the process by 2018. These four buildings have been constructed for an international client and designed by architects with significant international influence. Currently, no local client working with a local architect has achieved LEED certification given the expense and complexity that is attached to these systems.

In summation, the foregoing arguments based on views from private sector stakeholders seems to suggest that a narrow perspective of cost, largely influenced by global capitalist dynamics, plays an overriding role in the decision-making process regarding sustainable design strategies. The motivation towards sustainable design appears to be not only devoid of genuine concern for environmental and socio-cultural issues, but is more a means to further individual or organisational interests driven by the desire for maximum profits and to gain global legitimacy. There would therefore seem to be a definite need for rethinking the value systems within the built environment which would go beyond monetary value.

5.3.2. ACADEMIA AS STAKEHOLDER

Academia's pivotal role in social transformative change is evident throughout history. Its critical role in sustainable development is highlighted in Chapters 31, 35 and 36 of Agenda 21. Similarly, participants in this study agreed that academia has an enormous role in driving the sustainable design agenda. Academic institutions, especially those of higher learning, are "places of knowledge production, knowledge perpetuation and knowledge dissemination" (Stephens *et.al.*, 2008, p.320). Their distinct position offers a platform for synthesis and integration of diverse knowledge forms, the application of which has the potential for transformative change.

Academia's significant input to sustainability, and by extension sustainable design, is effectuated by their ability to focus on local and regional challenges. In Nairobi however, the study seems to suggest that the training of architects predominately takes a Eurocentric approach. One academic respondent explains;

> "we spent years teaching about history of architecture of the Europeans and Americans and the books we are using in the school are all European and American

> and the model we as architects are talking about are all European and American" (Participant M.K).

It is therefore not surprising that when concepts such as sustainable design are introduced, predominately by the Western world, they are taught with reference to Western epistemology largely devoid of local underpinning. This has a direct impact on the perception of 'Western' solutions as superior, especially to local solutions creating a tendency to mimic that which they are taught.

However, discussions with representatives from academia revealed a critical in-depth understanding of the local challenges facing the local built environment. A significant number of socio-economic and environmental challenges highlighted in the foregoing chapter (Chapter 4) were issues of concern in relation to the built environment raised by these participants. However, it is not evident to what extent this understanding influenced their teaching practice and consequent architectural practice. The research suggests a disconnect between academic knowledge and actual translation of this knowledge to the teaching and architectural design practice. This can be attributed to the current curriculum, which still has its roots embedded in Western and, in this case British outdated, epistemology.

This is exacerbated by the alarmingly minuscule research, especially in architecture taking place in these institutions. One respondent, whose sentiments are shared by a large percentage of participants including those in academia, expressed this concern, saying; "I mean there is nothing that has been done, even thermal comfort standards for Kenya for instance…U-values of this walling…so nothing has been done, it's not an issue of research gap, there is no research. The universities should be blamed" (Participant D.M.T.). Aside from training, institutions of higher learning are considered to inspire, support and produce objective and rigorous research that has potential transformational, systemic and societal change. This research is often geared towards the appreciation of the complex societal challenges that would require the development of multi-disciplinary innovative solutions to these challenges, however this appears not to be the case in Nairobi.

As a result of Western influences, the current training of sustainable design in academic institutions in Nairobi appears to focus on environmental issues, predominantly issues around climate, which, as has become apparent, may be the least of the challenges in Nairobi. This suggests that the curriculum is yet to frame local 'problems' that sustainable design strategies would address. The current training takes a climate (solar) focused approach embedded in the

Western framing of the problem as the climate. Despite the fact that climate consideration is pivotal for sustainable design, the danger is the reduction of this concept to a form of building physics technical approach to design. One respondent from academia argues, “most people here define green buildings as buildings that are bio-climatic” (Participant D.M.). Bio-climatic is in this case reduced to solar design, suggesting that bio-climatic design is becoming synonymous with sustainable design in Nairobi, largely because current designs have created a climatic problem. Therefore, just getting solar design right has become a sustainable design goal and consequently good examples of sustainable design have become those that have managed to get these basic principles right. This is not to negate the consideration of climate conscious design but to encourage a further interrogation of the discourse beyond sun shading and natural ventilation to an appreciation of the broader multiplex nature of sustainable design by providing a curriculum that engages with the complex web of emerging local and global challenges and fosters the potential for innovative local solutions through the synthesis of these different challenges.

On a different note, there appears to be a consensus among academics that Kenya’s vernacular architecture and post-colonial architecture (pre-1980s) was congruous with their understanding of current sustainability principles. For buildings constructed between the 60s and 80s in Nairobi, this is attributed to their climate consciousness inspired by the concept of modern tropical architecture as highlighted in Chapter 4. Vernacular architecture on the other hand was not only conscious of the climate but of resource limitations and socio-cultural practices embedded within communities. However, it may be counteractive to judge Nairobi city now, based on the understanding of the city in the ‘70s’ because technology and ways of living are changing. As a result, perhaps the question should be, how can sustainability help us arrive at the idea of a city that is cognisant of the local changing environment?

There is a divide however, regarding the appropriateness of the training offered in academic institutions in addressing sustainability issues. Some argue that the current curriculum does not incorporate the dynamic nature of building technology and emerging local and global needs and challenges. Barring the challenges within existing curricula, the growing capitalistic nature of the construction industry, coupled with political challenges and changing building trends have a greater effect on the articulation of building design when compared to the training of architects.

Interestingly, with regard to current practices, participants from academia draw a distinction between dwelling scale and city scale in terms of design approach, arguing that sustainable design principles are largely practiced at a dwelling scale. This however is more a result of the consciousness of individual financial and resource constraints as opposed to the awareness of the academic or global concept of sustainable design. At dwelling level, resources are often strictly monitored and managed effectively, primarily due to their cost implications. Rainwater harvesting for example is common in dwelling units, sustainable energy sources like solar and biogas are utilised, and local materials, technology and labour are employed due to their cost competitiveness. Design also takes into consideration social and cultural norms such as privacy and community interconnectedness with each other and with nature. Contrary to the dwelling level, this awareness seems to be lost at the city level where for example developers design buildings without consideration of future running costs of the building as they do not bear the costs. Users of these public and private office city buildings on the other hand do not utilise resources such as lighting, air conditioning or water efficiently, as they are hardly involved in decision making and therefore feel no sense of responsibility, nor do they bare the financial implications. Corporates in turn increase the cost of services to cater for these cost overruns and the vicious cycle continues.

Taken together, four main challenges faced by the construction industry that would impede sustainable development were highlighted by the participants in academia. The first concern was that current development has by far preceded planning (this is also highlighted in Chapter 4) and therefore resources are strained and not distributed equitably. This is exacerbated by the disconnect between planning, politics and people’s day-to-day activities. Therefore, perhaps given the constant change in governments and consequent changing visions, emphasis should be placed on people centred and managed solutions that are simple to understand and are maintained amid changing governments. Secondly, the intermittent nature of elements of existing infrastructure such as power supply, water and drainage systems, transport and waste management, render them unreliable, necessitating alternative measures that are only accessible and affordable to a few. Third, there is a lack of local legal and institutional frameworks that would guide and support sustainable development, and thus existing attempts are sporadic individual initiatives. However, in this regard, the greater concern was the lack of enforcement systems for existing laws within the construction industry. Finally, the Western influence on the curriculum coupled with the global capitalist market continues to impede sustainable design.

5.3.3. THE DESIGN PRACTITIONERS AS STAKEHOLDERS (ARCHITECTS)

The research established consensus among architects that Nairobi is characterised by what they termed as 'best climate', 'mildest climate' or 'easy climate', and therefore responding to and designing for this climate should not be complex, as it would require minimal interventions to achieve a comfortable indoor environment. Consequently, the view of sustainable design as simply design that responds to the site and more specifically climate conditions is largely shared by architects, some terming it 'common sense' architecture. Which then begs the question, why are the buildings in Nairobi not reflective of this 'common sense'? As climatic evidence suggests, when sitting under a tree in Nairobi, one's views are often superior, temperature is comfortable, air circulation is good, so what happens when design "experts" are involved and millions or billions of shillings is spent that the spaces created become almost impossible to inhabit? Why can this buildings not function like trees? Interestingly, there appears to be consensus that vernacular architecture in communities (mostly rural) developed by non-professionals seems to be more sustainable, as these building are designed to cater to communities local needs more effectively, manage resources more efficiently, taking into account technological and socio-economic dynamics.

Furthermore, from the interviews, design practitioners also seem to agree that the architecture developed between 1960 and 1980, typically referred to as tropical architecture as highlighted in Chapter 4, was climate responsive. One architect referring to this architecture posits that;

> "they were able to create buildings that we agree without any fear of contradiction perform better environmentally than what *chaps* who have been trained even now to do environmental design are doing" (Participant EBA).

Often, architecture from this period in Nairobi has been referred to as bio-climatic architecture, "green" architecture or sustainable architecture. As another architect submits, "… looking at the buildings of the 80s and 70s…I think Nairobi as a city was on a sustainable design pathway some decades back" (Participant O.N.). This too begs the question, what influenced the significant change in Nairobi's built environment? However, it is also difficult to ignore the paradox, as the architects who hold this opinion are the same architects who are redesigning Nairobi's skyline. Accordingly, the question then is why is their practice not reflective of this opinion?

Perhaps a possible explanation for this is that, as earlier discussed, the construction industry in Nairobi is largely driven by both global and local market forces, and therefore architects' design tends to conform to these forces. Clients'/developers' power during decision making often overrides the architect's power given the clients'/developers' position and financial capacity. This power dynamic influences the design outcome. One architect, whose sentiment sums up these dynamics, says "if the developer is driven by a capitalistic view and that is the brief, they (developer) deliver, you (architect) either deliver that or you are out of the job…" (Participant O.N.). Thus, striking the balance between clients' demands and architects' knowledge becomes a complex practice. This could further stem from the conspicuous lack of evidence pointing towards any overriding design philosophies for the majority of architects in Nairobi. The lack of normative ethical practices within the construction industry allows for market dynamics to control the industry.

In addition, when describing sustainable design, passive design strategies was the biggest consideration, attributed to Nairobi's climatic context as well as the technological and economic context. One architect argues that "climate is a big thing because people have made it a problem so just getting it right has almost become a sustainability goal" (Participant L.D.). Another architect argues that "I'm biased more towards a passive building, because I also understand our economic context because you don't want to limit access to green buildings to those who have" (Participant O.N.). However, despite the appreciation of these issues, mechanically ventilated, artificially lit buildings – especially commercial and institutional - have significantly become the norm in Nairobi. Design practitioners are solving problems they have literally designed. It is certainly possible to have, for example, the most efficient mechanical ventilation system in Nairobi, but how did one arrive at this solution, especially in a country within the tropical climate zone?

The bias towards passive design is compounded by scepticism towards technological solutions, some architects referring to it as "*gadgetification*" or "*gadgetary* architecture." Questions arise such as, why would a design in Nairobi's context have thermal sensors that turn on a cooling system when one could simply open a window? Meanwhile, the architect attempts to convince everyone that the design is energy conscious because the cooling system only turns on when "necessary". It is difficult not to wonder if technology in this case is being used for technology's sake. A number of questions arise with regard to the use of technological interventions to achieve sustainable design in Nairobi. First, is the skill or expertise that would support these interventions available locally? Second, are these interventions socially and economically sustainable for developing cities like Nairobi? Third, does their embodied energy justify their use as sustainable solutions? Lastly, does the climate justify the solution? These questions should therefore be considered and addressed before adopting any technological intervention. Fundamentally, if the technological intervention is not cognisant and reflective of the local socio-economic realties and norms, then it becomes an isolated product of science rather than part of a sustainable solution. This, however, does not negate the place of technological gadgets and complex interventions in a sustainable built environment; on the contrary, it calls for interrogation of technical solutions to ensure appropriateness to context.

Design practitioners also raised major concerns with regard to the lack of rules and regulations that govern sustainable design in Nairobi. Similar to stakeholders in academia, design and construction practitioners argue that the development and enforcement of stringent rules and regulations is pivotal in creating a sustainable built environment. A strong rhetoric among architects is that the government, through regulation and policy, has the greatest potential to influence change towards sustainable design. One architect, who currently works with the government, posits, "in Kenya the most important thing I would say…unless you have a legal framework on anything and accompanying penal consequences… it is very difficult to enact even a good idea" (Participant M.D.). These sentiments are shared by another architect who says, "I think policy may be the solution…sometimes in Kenya you need to draw a line and give an ultimatum" (Participant O.N.). Similarly, architect Participant M.M. agrees, stating "I think unless we have a legal framework it will be difficult to transfer that to the private sector." However, currently, laws and regulations in the construction industry are often unenforced and frequently disregarded. This therefore increases scepticism regarding the extent of the impact rules and regulations would have.

Another concern closely linked to rules and regulations is the proliferation of the use of international assessment systems in Nairobi. Some design practitioners have argued that in an attempt to create a niche for themselves, practitioners in the built environment have intentionally made the concept complex and elitist by driving the agenda towards assessment systems while neglecting the broader issues of sustainability. One respondent asks when referring to assessment systems, "what they are trying to say is that your building is sustainable, but does it have to be said with such complexity and cost?" (Participant M.M.). The investigation suggests that the use of assessment systems has become counterproductive to sustainable design. Another architect submits, “I think what deters people from going green is this Strathmore way (certified buildings), it seems very expensive, because people feel for me to have a green building, I need to install these funny gadgets” (Participant O.A.).

Finally, and perhaps the greatest concern, is the tendency for the built environment practitioner to mimic Western design and ideologies. A number of design practitioners attributed this to the client brief; a growing number of clients consider, Western image of modern buildings aesthetic and therefore insist on replicating these designs.

5.3.4. THE GOVERNMENT OF KENYA AS A STAKEHOLDER

The governments’ main role in sustainable design would be that of the development and enactment of regulation and policy that govern sustainable design. This investigation not only sought to find out what the government’s perception of the concept of sustainable design is, but also if the government considers it an imminent priority. From the discussions with government representatives, the research indicates a consensus that policy and regulation would play an important role in the move towards sustainable design and would be achieved under a more stringent regulatory framework. Previous research (Fisher and Guy, 2009; Imrie and Street, 2009) indicates that for several countries, legal interventions have been successfully used to influence human behaviour, with significant change achieved through regulations. Kenya is no exception. In 2012, the Energy Regulatory Commission (ERC) legislated a new law requiring building owners to install solar heating systems for hot water requirements for a capacity exceeding 100 litres per day, which came into effect in 2017. Similarly, in an attempt to protect the environment, the government legislated a ban on plastic bags that came into effect on 28th August 2017 after much opposition.

A possible explanation would be that as a result of influence from a variety of both global and local factors and players, the government’s way of seeing is characterised by dynamic visions that change over time based on different priorities entrenched in relevant player interests, which puts government in a position of constant negotiation between their own interests and external interests in different capacities.

As highlighted in Chapter 4, in Kenya, global agenda such as Sustainable Development Goals (SDGs), and Agenda 21 as well as climate change agreements, have been part of government dialogue. Local organisations with both global and local interests, such as Kenya Green

Building Society, UN Habitat Kenya, and the Green Africa Foundation have initiated dialogue with government towards developing strategies, policies and assessment systems for sustainable design. However, there is no evidence to suggest that these dialogues have translated into a tangible sustainable design framework, agenda or policy. Local authorities are yet to begin dialogue processes with communities with regard to the construction of sustainable design knowledge and the development of a sustainable built environment.

Local policy gives a broad guide on environmental concerns (E.G.). However, due to the vagueness of these policies implementation is a challenge. For instance, the constitution of Kenya under Article 42 outlines the rights of citizens to a clean and healthy environment. Their rights are summarised as the right;

(a) to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and

(b) to have obligations relating to the environment fulfilled under Article 70.

Consequently, some of the state duties outlined in article 69 include the need to ensure "sustainable exploitation, utilisation, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefit (as well as) protect genetic resources and biological diversity and eliminate processes and activities that are likely to endanger the environment." Other than the constitution, the EMCA and the EIA are other environmental legislations in Kenya. However, the study suggests that overall, the development of a sustainable built environment is not yet a priority for the government.

Furthermore, the social pillar of Medium-Term Plan III of Kenya's Vision 2030 entitled, environment, water, sanitation and regional development, gives an indication of the government's key priorities as; rehabilitate and protect five water towers, increase tree coverage, water projects – safe piped water 3.6M – 9M, access to potable water 60% - 80% by 2022, land under irrigation increased by 518,000 acres and finally, land reclamation and rehabilitation of areas that are prone to landslides, floods and heavy soil loss. Once again, water availability and management appear to be an imminent challenge. The above suggests that government priorities are inclined towards water related issues. This is consistent with the participant responses concerning environmental challenges facing Nairobi.

Furthermore, typically governments are impelled towards development of policy through compelling data, evidence and research that is critical for decision making, which design practitioners and government representatives argue should primarily come from academia. Having said that, the question is, will more rules and regulations necessarily bring about the desired outcome? There is need for critical analysis and refection on the role of regulatory systems in driving an agenda. Previous studies have shown that the use of regulations has its dangers and could potentially be counteractive to the move towards sustainable design. Often, they fail to take into account socio-cultural considerations. Furthermore, in an attempt to meet prescriptive regulations that often fail to take into account unique or emerging unforeseen situations that require creativity, there is the potential to stifle innovative solutions, and this could result in the adoption of a much less optimum solution. These regulations often sway the focus from environmental value to a more obsessive and mechanical exercise of checking boxes.

Environmental assessment systems are examples of regulations that have been used in the attempt to achieve sustainable designs. The research found that more than 80 percent of the respondents were sceptical about the introduction of assessment systems into a construction industry where the discourse of sustainable design is still in its cradle phase. E.L. argues that,

> “this creation of tools is creating a new profession. First you create a tool, make sure no one understands it… then you have all these accredited people, accrediting them costs money, so first you are going to charge a premium to train them and accredit them and then they will be charging money to guide all these people on what exactly is very basic of what (sic) architects should be doing, in order to tick that box.”

This gives an indication of the complexity that surrounds some regulations that would be counteractive to the move towards sustainable design.

Finally, there is also concern, which is shared by the previous stakeholders of the danger that buildings that appear to have followed some of these regulations and, consequently branded “green” or “certified” would mislead public perception of this concept. Buildings do not become green because they are certified. In Nairobi, just like many other places, rated buildings are beginning to define what sustainable design is as they are becoming reference points for the discourse. Given that these assessment systems are yet to incorporate local context in totality, it becomes difficult to tell what is genuinely green and what is a green wash. M.K. remarks, concerning assessment systems, “now do we have LEED localised for

Kenya? No! Therefore, when I hear people saying my building is LEED certified, it's rubbish! As soon as you publish this information you are distorting the thoughts of the public."

5.3.5. SOCIETY AS A STAKEHOLDER

This research indicates very little consideration and involvement of building users and society in general as key stakeholders in the process of creating a sustainable built environment in Nairobi. The importance of incorporating society and social issues towards a sustainable built environment has been discussed in several research papers and forums (Cooper, 1999; Hoffman and Henn, 2008; Zua and Zhao, 2014). On the other hand, previous studies suggest that even with this increased dialogue, social issues are yet to be fully integrated with the design of the built environment (Cooper, 1999, Hoffman and Henn, 2008). In keeping with this, responses from all key stakeholders suggest a consensus that dialogue concerning this discourse is currently very elitist and held only in academic and professional circles, and therefore detached from the people the designs are intended for. It is evident from analysis of the stakeholder's responses' that the integration of social issues receives nominal consideration during the decision-making process of construction projects.

The interviews conducted in this research suggest that the general public holds two basic perceptions regarding sustainable design. One, it is too expensive and two, it is too complex. However, when asked to describe sustainable design, their general descriptions were rather vague and uncertain, suggesting a lack of proper understanding of the concept. A possible explanation to this bias could be, as highlighted earlier, the elitist factions within which this discourse is situated in Nairobi, which means it is divorced from the general public. As a result of the lack of awareness, perceptions and misconceptions of the concept of sustainable design appears to be a barrier to its achievement, as often efforts that do not give much consideration to socio-cultural issues and involve the community are counteracted by the greater majority who are not only unaware, but simply do not care, or do not know that they should care, and why and what they should care about. A good example is the aftermath of the ban of plastic bags in Kenya. In spite of the prohibitive fines associated with the use of plastic bags, it is not uncommon to find people 'secretly' using plastic bags in violation of this law. This can be attributed to the lack of public involvement when developing these regulations. Society was not adequately sensitised to the considered dangers the uses of plastic bags pose and the consequent benefits that the ban would have. The challenge therefore is the creation of social awareness in a manner which society can understand and appreciate.

Furthermore, from the research this lack of awareness appears more significant when considering the correlation between individual activities and the environmental consequences of those activities, especially when these consequences are not apparent and directly tangible. For example, in Nairobi, concepts such as climate change, carbon emissions are only once again discussed in very elitist spheres but even within those spheres, these concepts are yet to be fully understood. Unfortunately, more often than not, even for those who understand these concepts, the extent to which the level of awareness translates into tangible practice is minimal.

Another challenge related to this lack of awareness is the lack of appreciation of what ‘green’ mean for the users in those buildings that have been tagged as “green”. This is evident from the utility of these buildings that are considered green by their users once construction is completed. The research though interviews with property manager of these buildings found that the users of these buildings tagged “green” do not understand and appreciate the “greenness” of these buildings, thus their behaviour is hardly influenced by virtue of inhabiting these buildings, as this would require the users to understand and perceive the building as green, only then will their perceptions directly influence their behaviour. As a result, these buildings may not function as well as intended.

The failure to take into account the perceptions and needs of the people for whom the design is intended has the potential to render even the most environmentally conscious solution inappropriate and difficult to implement. It is therefore important to understand the people’s perceptions and how they influence and are influenced by the discourse of sustainable design. In doing so, one can begin to develop ways to influence society’s perceptions in a manner that would facilitate the co-construction of an image of a design that reflects society and is socially responsible. The research argues that developing methods that create dialogue with the community and derive solutions from the community, as opposed to imposing solutions, would benefit the process, as this investigation found that people understand when they can relate to issues that affect them directly. This is evidenced from vernacular practices that intuitively follow sustainable design principles.

Aside from public awareness, the research found that in Nairobi, it is difficult to isolate social issues when looking at sustainable design, as social wellbeing often tends to be dependent on the state of people's environment and more significantly their economic status. When discussing social wellbeing, issues such as health and safety, standards of living, and sense of community and identity, were often raised. These issues are directly related to individual economic status and the environment one is a part of.

The societal concept of sustainable design is also highlighted through the general media. Headlines search as "Green revolution in Kenya" (Muiruri, 2012) asks "how green should a building be to be environmentally friendly?" This suggests that green buildings are environmentally conscious buildings and goes on to advocate for design that is centred on climatic conditions, attributing the current glass structures to lack of environmental design as well as Western influence. Similarly, in March 2014 a headline in the construction business review read "Green building takes off in Kenya, but challenges abound." The article suggested that green building is the "process of putting up structures using processes that are environmentally responsible and resource efficient right from the design stage to construction, maintenance and demolition" (Nduri, 2014). Once again, the concept of green building has been linked to environmental considerations. This suggests that the perception of sustainability in the built environment is only constructed and fairly understood in relation to environmental facets.

On the other hand, others suggest that this concept is not entirely news, and headlines such as "Will Kenya regain its golden era of green architecture" (Muiruru 2016) or "Where we lost the plot on sustainable architecture" (Muiruri, 2016) argue that architecture in Kenya was sustainable until the 1980s. He cites building such as Attorney General's' Chambers and the Parliament Building, the articles attribute the "lost plot" to Western influence and lack of guiding policy framework. Others have suggested, "Green building: Too much talk backed by little action" (Muema, 2016), attributing the lack of uptake of green design to what they term as "myth" that "green" is expensive given its association to prohibitive technological investment and the lack of legislation that guides green buildings. These sentiments are echoed in other headlines that read, "Why we need laws on green architecture" (Bwire, 2016) or "It's time we developed a green building code" (Muiruri, 2015).

5.3.6. INTERNATIONAL ENTITIES AS STAKEHOLDERS

From the foregoing discussions, it is evident that for each stakeholder, international influence has had a significant impact on their perception of sustainable design in distinct ways. This section highlights two significant entities that are shaping sustainable design in Nairobi. Arguably, the global entities that have had the most significant influence on the construction and the perception of sustainable design in Nairobi are the World Green Building Council (WGBC) through the Kenya Green Building Society (KGBS) and the UN habitat through the UN-Habitat Nairobi. The construction of their perception of the concept of sustainability is appears to be influenced by who is behind these institutions, what their interests are, and who stands to benefit.

For instance, the KGBS through several initiatives has attempted to further the agenda of sustainable design largely through the launch and 'marketing' of the Green Start South Africa – Kenya green building rating tool, and more recently the EDGE rating tool. Their strategy is highlighted in their mission outlined on their website as;

> To promote and improve the awareness of green building design practices, programs, technologies and operations. To enable the objective measurement and recognition of green building practices by developing and operating a green building rating system. (Kenya Green Building Society, 2016)

> The KGBS overarching mission is to make sure we transform how we build the built environment as well as get behavioural change towards sustainable building. We try to achieve this through education and training, we do that by rating/ certifying the green environment as well as advocating for green building and through advocacy (Participant KJ)

Unfortunately, this evident focus on assessment systems has begun to create the mentality that green buildings are certified buildings, which may not necessarily be the case, especially when referring to the current assessment systems in Nairobi as is evident in Chapter 4. This bias and advocacy towards international assessment systems that are not context appropriate serves the interests of those involved in the assessment process, often at the expense of local communities who not only do not understand the process but cannot afford to undertake the process.

Furthermore, seemingly, international bodies tend to adopt a more global perspective on sustainable design. Broader issues such as climate change, global temperatures and carbon emissions tend to be the focus. The WGBC goals, for example, as outlined in their website include;

- Limit global temperature rises by 1.5 degrees Celsius
- Reduce the building and construction sector CO2 emissions by 84 gigatonnes
- Ensure all buildings have net zero emissions. (World Green Building Council, 2016-2019)

The research showed some similarities to the overall understanding of the concept with regards to the global framing of the problem.

> I as an individual and as a professional, how can my profession contribute to reduce the carbon footprint? Then you start realising that the main objective of our existence in terms of UN Habitat which it the housing is responsible, has a bigger share on climate change, because according to the statistics, the international energy agency statistics, building alone consume 40% of the total energy consumption. Therefore, we need to ask ourselves, what can we do to reduce that. If we reduce consumption, we reduce demand, so that is the entry point (Participant UN).

> So for us, when we start talking about sustainable building, is really a building that reduce the demand of resources and also minimise the impact, the carbon footprint, and then in the process reduce expenditure, so, it makes sense when you look at it from the financial perspective but also ultimately from the environmental perspective (Participants UN).

Often as a result of this global purview, local priorities and challenges tend to fall through the cracks despite the semblance of progress. Taking assessment systems as an example, the increase in footprint of assessment systems or even certified building in Nairobi, advocated for by the KGBS does not necessarily translate to a sustainable built environment, especially if they are not designed to address local dynamics.

However, all participants from both KGBS and UN-Habitat Nairobi recognise the need to contextualise the concept of sustainable design and consequently design approaches and assessment systems (Participant UN, NJ and KJ). UN-Habitat Nairobi has been involved in various attempts to contextualise sustainable design that have culminated in several publications, including climatic analysis of every zone in Kenya. This analysis shows how even a similar wider context in this case Kenya, several micro-climates exists that would influence sustainable design approaches. Appendix M shows the examples of the climate analysis and recommendations by the UN Habitat Nairobi. Unfortunately, it is not clear however if and how these recommendations made by the UN-Habitat Nairobi have affected the build environment. Aside from the publications, UN-Habitat Nairobi have been involved in the attempt to develop both local draft assessment systems discussed in Chapter 4.

Overall, similar to the other participants, both organisations recognise the limited knowledge on sustainable design among various stakeholders in Nairobi. They also recognise that achieving a sustainable built environment is dependent on collaboration and inclusivity. The acknowledgement that everybody is a stakeholder and therefore all voices must be included in the development of this discourse. The extent to which this is happening however is unclear.

5.4. PERCEPTION OF SUSTAINABLE DESIGN VS. CONTEXTUAL DYNAMICS

The aim of this chapter was to investigate and present each stakeholder's perception of sustainable design and the underlying influences. However, when considered together, what is interesting to note is that there seems to be a disconnect when the understanding of sustainable design by the different stakeholders is compared to the contextual dynamics as discussed by the same stakeholders and corroborated in Chapter 4. The research suggests that the understanding of the concept is not directly based on contextual issues. There is certainly an appreciation and consensus on the issues that characterise the context and would affect and influence the sustainability of the built environment in Kenya. However, this understanding and appreciation of context does not entirely translate to the construction of the concept of sustainable design. A possible explanation is the global influence evident in each stakeholder's construction of this concept, that tends to bear focus on global environmental issues and is often not in the least cognisant of local challenges.

For instance, from the analysis, stakeholder understanding of sustainable design seems to focus on environmental issues surrounding climate, geared towards achieving thermal comfort and natural ventilation, particularly through passive design strategies. However, when discussing the contextual dynamics, climate, generally referring to temperature, was considered fairly simple to design for whereas other climatic issues like rainfall and consequently flooding appearing to be of greater concern in Nairobi. On the contrary, the issues of flooding and water management was mentioned by very few participants when describing sustainable design. Similarly, economics is another issue where discrepancies are evident. Few participants mentioned economics when defining sustainable design, which was mentioned as a relatively 'soft' issue after all other considerations. In contrast, when discussing contextual dynamics, economic issues seemed to play the most important role in influencing decisions towards sustainable design and conversely in creating barriers to sustainable design. Issues such as energy efficiency, water management, choice of materials and technology tended to have more of an economic underpinning rather than environmental concern.

The challenge in developing counties is much more complex that lack of political will, but rather existing developmental challenges faced by developing countries like Kenya necessitates focus on socio-economic issues. In the developed world, sustainable design and construction is largely driven by an environmental agenda, however, the research revealed that in Nairobi similar to most developing countries, economics – that is affordability – and social – quality of life – are likely to greater drivers to sustainable design and construction. This does not negate environmental issues, but rather, calls for solution that are fundamentally socially responsible and economically viable while ensuring environmental consciousness and responsibility.

This analysis highlights the need to re-evaluate the premise upon which these perceptions of the concept of sustainable design are built. This would perhaps be the first step towards developing contextual approaches. Given the global nature of the concept of sustainability, 'developing' cities like Nairobi should question the roots of the concept, why it is packaged the way it is and who is really gaining. Manuel Herz (2015) argues, when referring to the modern movement, that "whenever architects came from former colonies…or any other country, there was always a political dimension. An architect's origin was never neutral, never innocent" (p.13). This too can be said about standardisation of the concept of sustainable design. For instance, when a global standard, best practice or assessment system advocates for one strategy over another e.g. active cooling over passive cooling, who stands to gain? How many of these systems are developed in Kenya, or Africa? As shall be evidenced in the case study chapter, if well designed, a building in Nairobi would not require active cooling, yet these systems are now found in almost every office building. Therefore, who are these cities really sustaining?

5.5. THE INFLUENCE OF ASSESSMENT SYSTEMS

There are foreseeable dangers that comes with the imposition and infiltration of green building rating tools into the construction industry in Kenya without the presence of establishment of appropriate sustainable design strategies and certainly without a clearly outlined guiding philosophy. Rating systems are becoming part of common practice in developed countries where substantially, basic needs in the built environment have been met, the level of awareness on the concept of sustainability is comparatively higher than in developing countries, moreover, systems have been put into place to facilitate enforcement. However, even in these countries the success of these systems is arguable.

The research suggests that currently, assessment systems may be a counteractive to the move towards sustainable design. From chapter 4, by 2018, a number of building design teams had attempted to achieve LEED certification, however, only three (Elton Place, Citibank Gigiri branch -interior fitout- and World Bank Group- interior fitout) had achieved certification. Several questions begin to arise based on this statistic and the concerns raised by stakeholders in this chapter. First, why certify buildings? The research suggests that the certification agenda is driven by commercial interests and not necessarily a genuine interest for green/ sustainable buildings. This however is not unique to Nairobi but is a representation of the global scenario. This begs the second question, does certification need to be that cost intensive? The study suggest that the cost burden of the certification process is a deterrent to the choice to certify.

Third, and perhaps more importantly, how can standards that are more achievable for more buildings be developed? This is not to say standards should be lowered but rather should be made more context specific. The lack of contextualisation of these assessment systems raise another concern which is the potential greenwashing that surrounds this “label – oriented” competition which intern has the potential to mislead or disorient public perception.

5.6. CONCLUSION

This chapter sought to interrogate the perceptions of sustainable design from different stakeholders in an attempt to understand the underlying influences that shape knowledge construction of the discourse. The combination of the findings from this chapter suggest five fundamental themes that interact and compete to shape the perceptions of the key stakeholders (Fig.5.2). First, and most significant is international (predominantly Western) influence that is manifested in language, educational and governance systems and structures, the aggrandisation of the Western image (aesthetic), and lastly the use of international assessment system as a means to seek global legitimacy. Second are the market dynamics, that is, local economic constraints as well as global capitalistic forces. Third are the stakeholder personal and institutional interests. Fourth are the local dynamics, which as this chapter suggests, have a weak link with the stakeholder perception. The final theme is the level of awareness to the concept of sustainable design.

One of the more significant findings that emerged from this investigation was the apparent overall disconnect between the stakeholder perceptions of the challenges, priorities that characterise the building industry in Nairobi and the perception of the idea of a sustainable built environment. This inconsistency could be attributed to international influence, the lack of situated knowledge and understanding of this concept, and the present strength of global economic market forces.

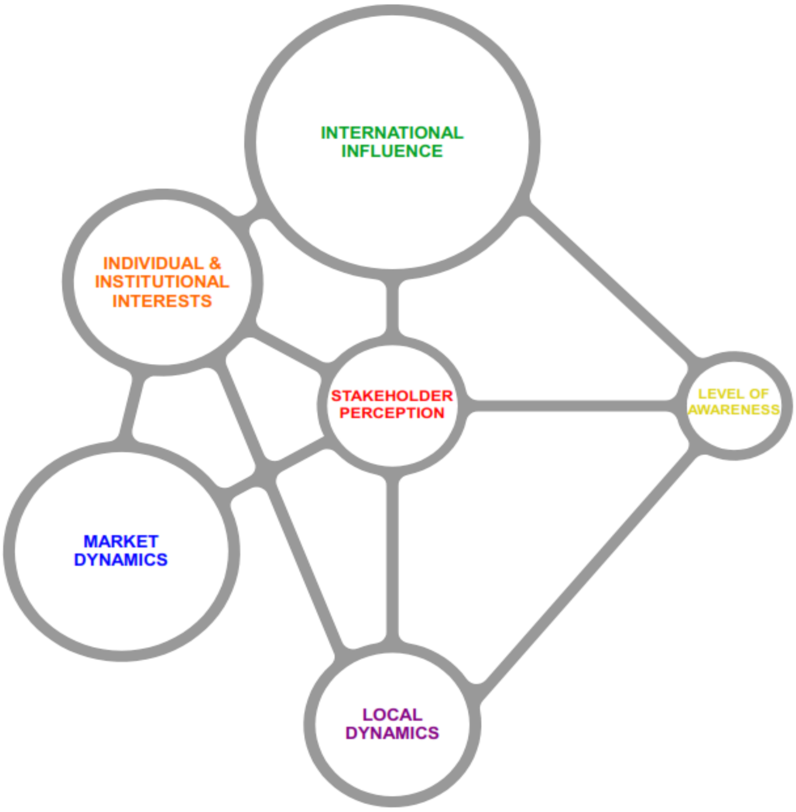

Fig. 5.2: Summary of factors that influence stakeholder perceptions.

Having investigated the stakeholder influences and perceptions, the subsequent chapter therefore moves to explore how these constructions of the concept of sustainable design, and the underlying influences, shape the articulation of the concept in Nairobi, through the analysis of four case buildings considered sustainable by the stakeholders.

CHAPTER 6

CASE STUDY BUILDINGS IN NAIROBI

6.1. INTRODUCTION

In the recent past, within Nairobi, there have been isolated attempts to articulate sustainable design through different approaches that will be highlighted in this chapter. This chapter's investigation inductively analysed four buildings that took different approaches towards achieving what have been referred to in Nairobi as sustainable designs. Buildings as 'products' are representations of a design team's influences, understanding and interpretation of concepts, and often give an insight into the thought process through which these "products" were realised. They highlight the social, economic and institutional values and systems that lead to the adoption and exclusion of various architectural - sustainable or otherwise – practices. It is interesting to note that, notwithstanding a common geographical context (Nairobi), the case studies will attempt to highlight the differences in the construction of the meaning of sustainable design, as well the construction of the problem, approaches and implementation strategies. The investigation is particularly interested in who decides and why.

In her book *Mapping Controversies in Architecture* (2012), Yaneva seeks to interrogate the process of architectural design and the resultant building as an artefact, while critically questioning who and what makes a building possible. She argues that it is impossible to divorce the technical skill that goes into a project from the politics that surround a project. Beyond the physical technical performance of the building, it is important to understand the institutional, social and economic context within which buildings are constructed, used and assessed (Janda and Von Meir, 2005). Therefore, a more comprehensive approach in understanding and assessing the extent of the sustainability of a project would be to understand "how and why particular issues have been addressed and on what the relative prioritisation of those issues has been when compared with other design issues" (Guy and Moore 2005, p.24). As such, one cannot look at a building as an end without interrogating the means by which that end was created. Bearing this in mind, the analysis seeks to identify the key actors in each case building, and, map their position and the power changes that occurred through the different stages of the project's significant decision-making points.

Through sketches, photography and memos, the case study begun by investigating the technical (non-human) aspects of the selected case study buildings in an attempt to understand the physical characteristics of buildings as artefacts that have been referred to as sustainable or green by stakeholders in the building industry in Nairobi. The investigation will focus on materiality, construction technology, environmental considerations and other considerations that rendered the building sustainable. Subsequently, through interviews with the architects and property managers of these buildings, the research attempted to investigate the socio-political (human) context in which these buildings are situated, taking into consideration the main actors and matters of concern. This investigation further seeks to ask pertinent questions regarding the prejudices and political dynamics that led to the different constructions of competing definitions of sustainable design that ultimately shaped the design of these buildings within this context.

6.1.1. SELECTION CRITERIA

During the interviews with key stakeholders six buildings in different locations (Fig. 6.1) were mentioned by stakeholders as sustainable building; The Strathmore Business School, the Kenya Commercial Bank headquarters, the Catholic University of East Africa's Learning Resource Centre, the KDI Anwa Junior School, the Coca- cola headquarters and the UN Habitat building in Gigiri. Purposive sampling was used to select four case study buildings based on their theoretical relevance and technical design criteria outlined below (Table 6.1), which was developed through the interviews with the buildings architects and the analysis of assessment systems in Chapter 4.

Table 6.1: Case Study Technical Criteria. Source: Author, 2018

01.	**SITE AND CONTEXT**	Takes into account the location of the building and its orientation to immediate context.
02.	**MATERIAL SELECTION**	Highlights major materials in each case building and investigates issues that led to their selection
03.	**INDOOR ENVIRONEMNTAL QUALITY**	Explores ventilation, lighting, thermal comfort and acoustic strategies in relation to issues that led to the adoption of these strategies.
04.	**RESOURCE EFFICIENCY**	Examines energy and water efficiency as well as waste management strategies put in place for each case in relation to factors that influenced these decisions.

The four buildings selected for this research are:

1. The Catholic University of East Africa's Learning Resource Centre. (LRC)
2. The Kenya Commercial Bank headquarters (KCB Towers) - Upperhill
3. The Strathmore Business School (SBS)
4. The KDI Anwa Junior School

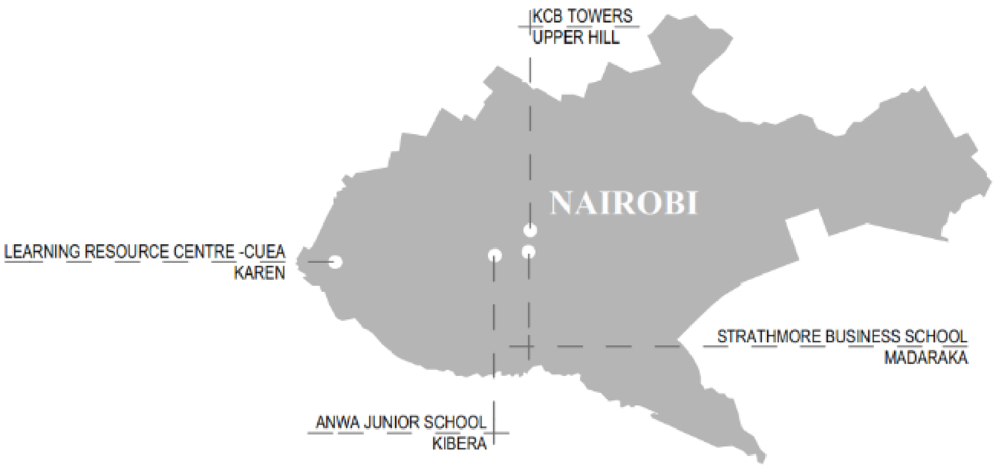

Fig.6.0: Map showing location of case study buildings in Nairobi. Source: Author 2019

Following the selection of case study buildings, initial interviews with project architects was conducted. This was followed by a site visit to each case building. A second interview was conducted to establish stakeholders involved in the design and construction process as well as then power dynamics between the stakeholders. Fig. 6.1 summarises this process.

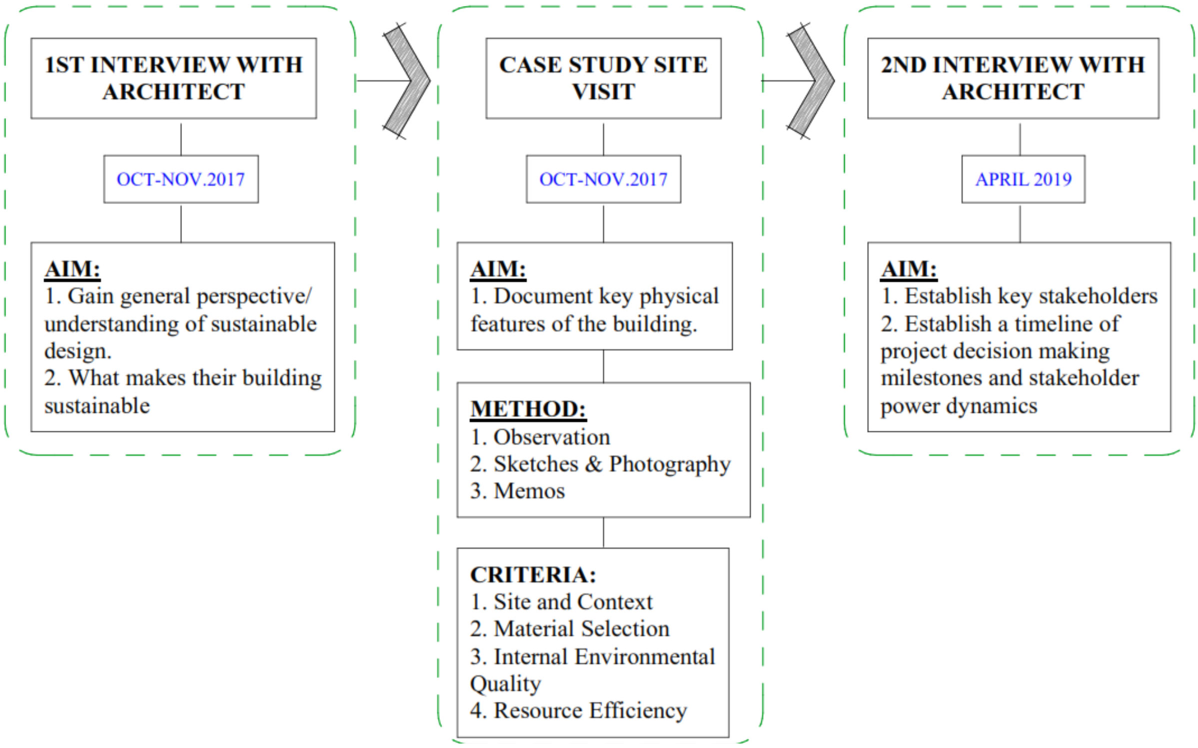

Fig. 6.1: Summary of case study design

This chapter shall be divided into three main parts. The first part will introduce the case study buildings and discuss the technical aspects (physical attributes) of these building based on researchers observations using the criteria on Table 6.1. The second part of this chapter will discuss the socio-cultural issues that influenced design decisions based on interviews with projects architects of each case study building**s.** The third part is a synopsis of key issues that emerged in the first two parts.

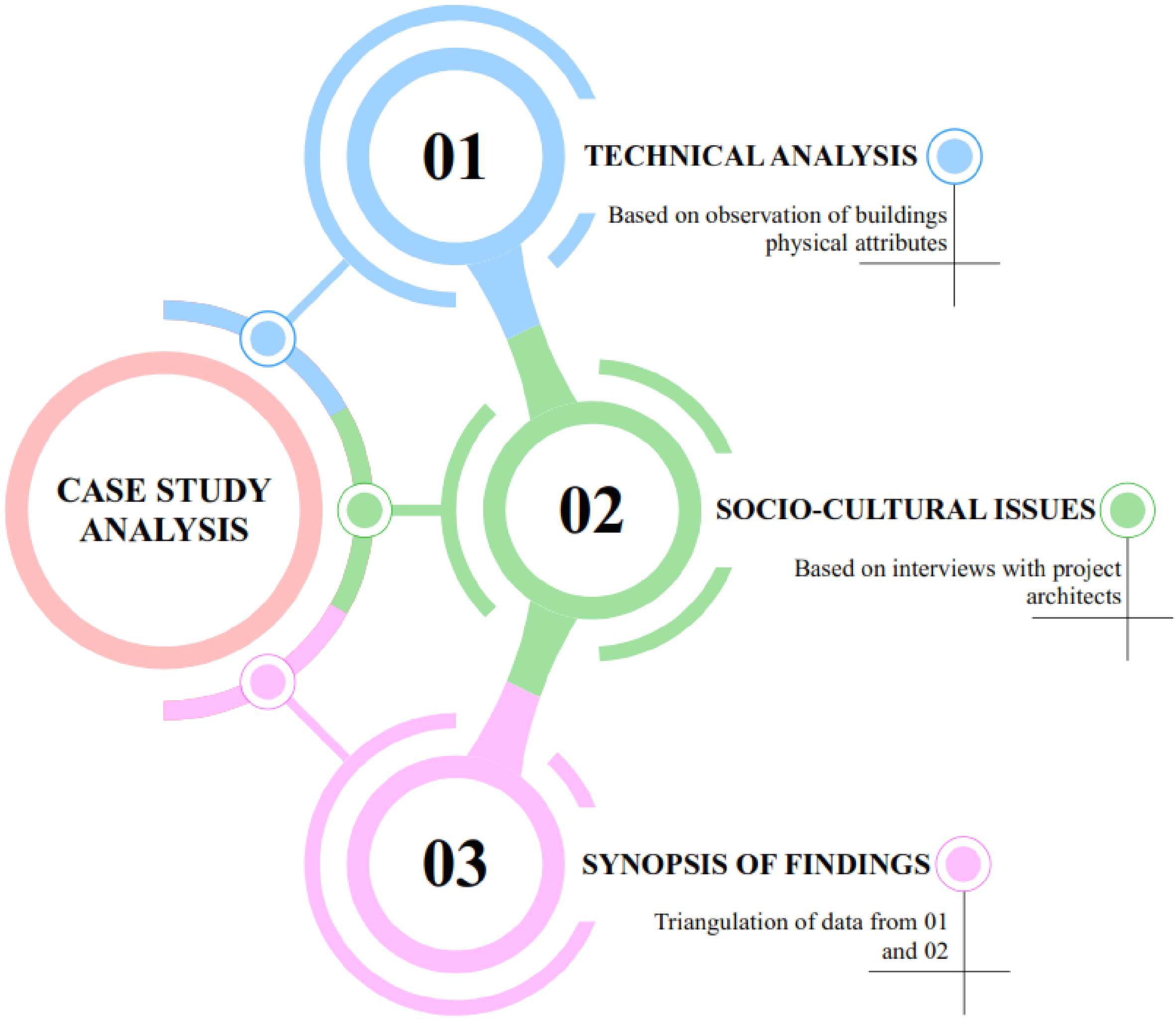

Fig. 6.2: Breakdown of case study analysis.

6.2. INTRODUCTION TO CASE STUDY BUILDINGS

This section will provide an introduction to each case study buildings and comparatively discuss the technical aspects (physical attributes) of these building based on researchers observations using the criteria on Table 6.1.

6.2.1. KENYA COMMERCIAL BANK TOWERS

Fig. 6.3: Kenya Commercial Bank Towers. Source: Planning Systems 2012

Table 6.2: KCB Towers project data and design team. Source: Author 2018

PROJECT DATA	CONSULTANCY TEAM
Construction Start Year: 2010	**Architect:** Planning Systems Services
Completion Year: 2015	**Quantity Surveyor:** Armstrong & Duncan
Gross Internal Floor Area: 800SQM	**Structural Engineers:** Baseline Associates
Client: KCB Staff Pension Scheme	**Elec. & Mech. Engineers:** EAMS
Construction Cost: Ksh. 2.6 Billion	**Project Mangers:** Pinnacle Project
Category: Office Space	**Environmental Consultant:** ARUP

Accessible from Kenya Road, the 21 storey building is located in the fast growing Upperhill business hub, approximately 2.5 km east of the central business district in Nairobi. The tower is accessible by both private and public transport (Fig. 6.4). One of the reasons KCB intended to move its headquarters to Upperhill from the central business district was to avoid the traffic congestion experienced when accessing the building during peak hours. With a main entrance located at the podium, the building has five levels of parking, sufficient for about 400 vehicles, and 16 subsequent triangular shapred floor levels of approximately 800sqm each (Fig. 6.5). The building includes, a conference facilities that host different types if events, a banking hall with other support facilities including administrative offices. Access for the disabled has also been provided through ramps and lifts.

The project design began in 2004, after Kenya Commercial Bank contracted Planning Systems, a Kenyan based architectural firm, to design its new headquarters in Upperhill due to their experience in designing high-rise buildings in Nairobi. Among other requirements the client brief stated that the building must be “green” and environmentally friendly.

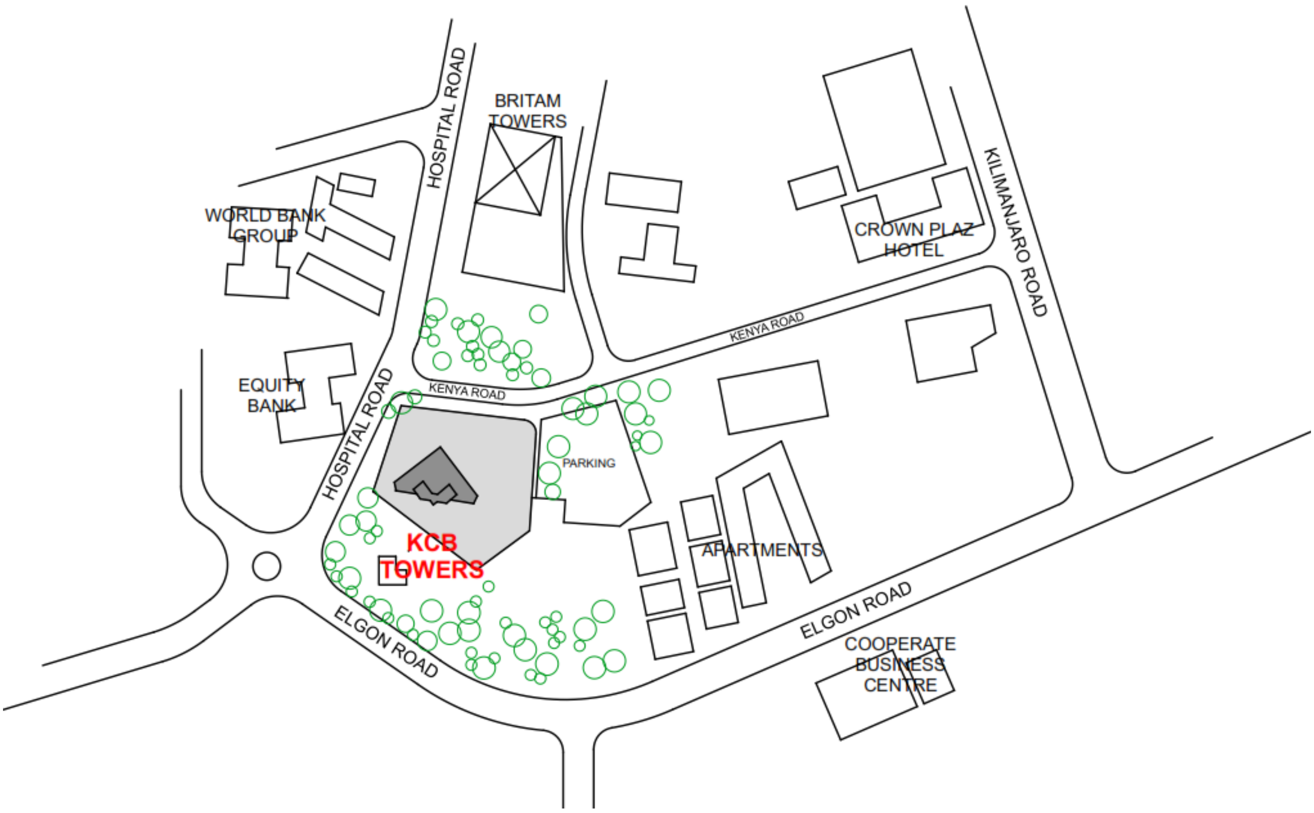

Fig. 6.4: KCB Towers location plan. Source: Planning Systems 2008

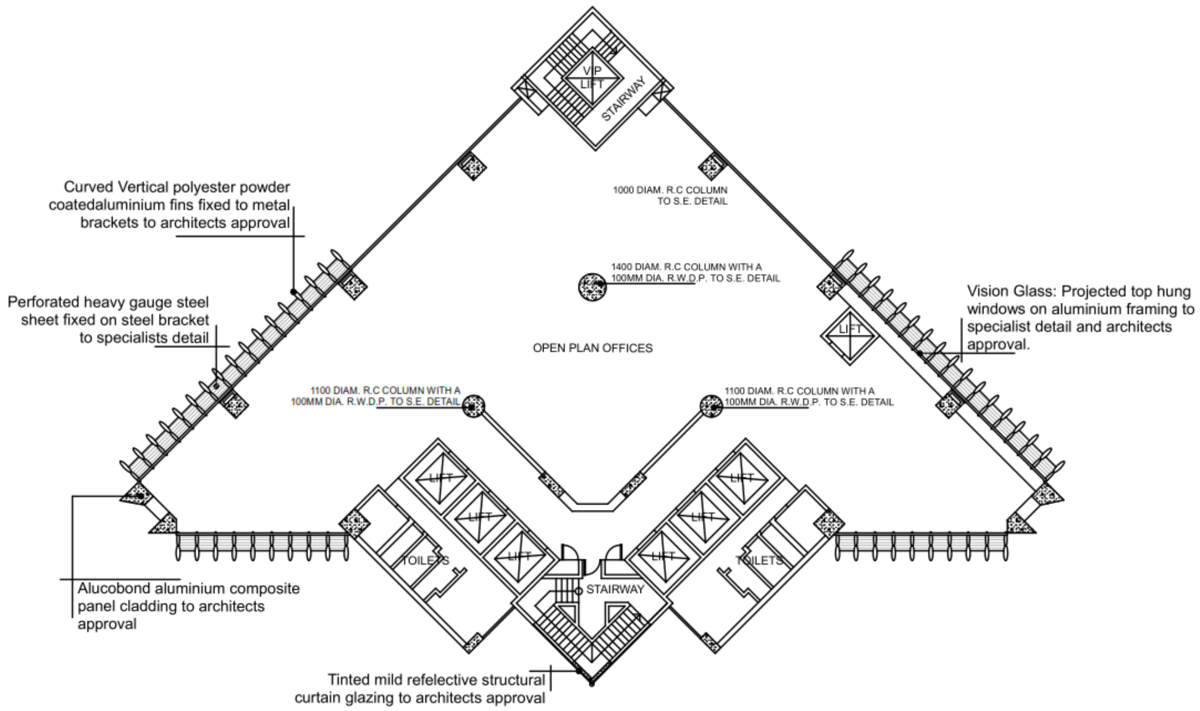

Fig. 6.5: KCB Towers typical tower plan. Source: Planning Systems 2008

6.2.2. LEARNING RESOURCE CENTRE – CATHOLIC UNIVERSITY

Fig. 6.6: The Learning Resource Centre. Source: Author 2017

Table 6.3: The LRC project data and design team. Source: Author 2018

PROJECT DATA	**CONSULTANCY TEAM**
Construction Start Year: 2008	**Architect:** Musau Kimeu
Completion Year: 2013	**Quantity Surveyor:** Musymi & Associates
Gross Internal Floor Area:	**Structural Engineers:** Novaya Engineers
Client: Catholic University of East Africa	**Elec. & Mech. Engineers:** Geomax Consulting Engineers
Construction Cost: Ksh. 780Million	**Project Mangers: -**
Category: Education	**External Consultant: -**

In 1984, the university was founded as a graduate school of theology by the Association of Member Episcopal Conferences in East Africa (AMECEA). Since its inception the university population has significantly grown. As a result, there was a need to expand the school's facilities. In February 2005, the university commissioned an architect primarily based on his expertise as an environmental design expert and prior successful working relationship. The initial brief was a library that would comply with the Commission of Higher Education

(CHE) regulations, requiring a capacity of at least 1/3 of the student population, which at that time was about 6,000 students.

The project is located in the Karen of area in Nairobi, accessible through Bogani E Road off Langat Road by public and private transport (Fig 6.7). Minimum parking as per Nairobi building regulations was provided. However, there is no provision for alternative transport parking such as parking for bicycles, and parking and charging for electric cars.

The Learning Resource Centre (LRC) is made up of three main buildings organised around a courtyard (square) as shown below (Fig. 6.8, Fig. 6.9).

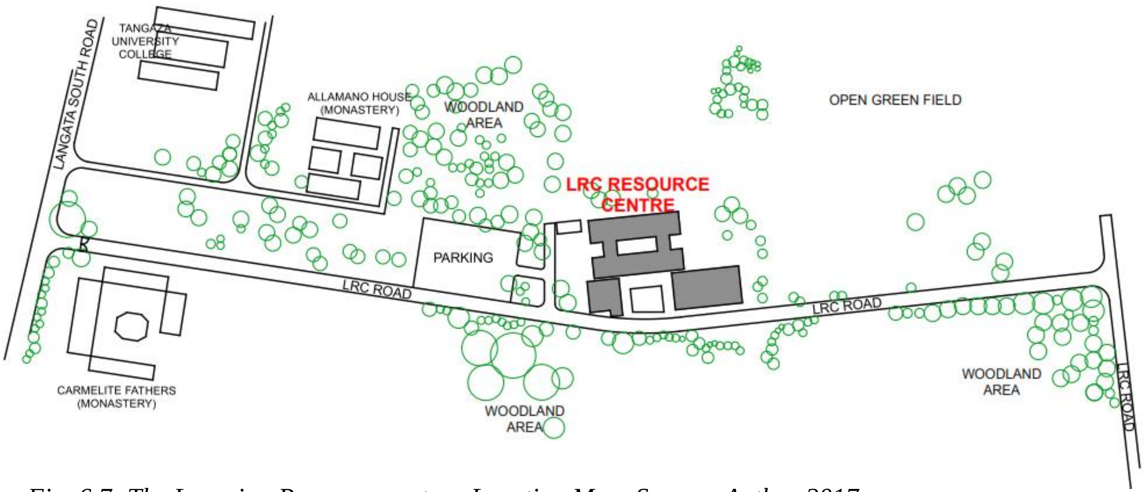

Fig. 6.7: The Learning Resource centre. Location Map. Source: Author 2017

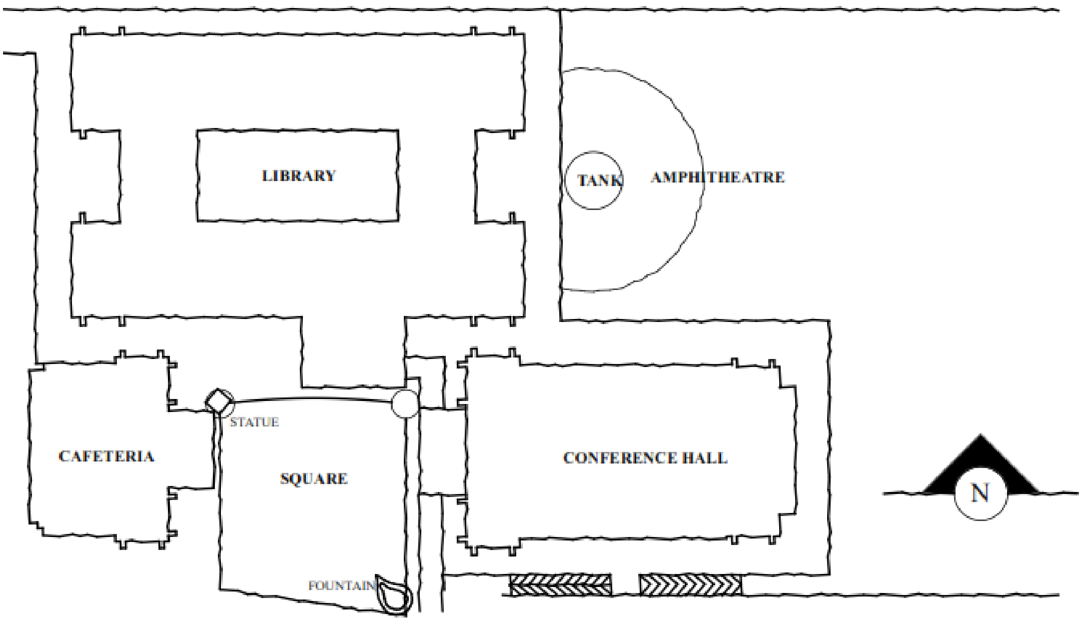

Fig. 6.8: The Learning Resource centre. Site Plan. Source: Author 2017

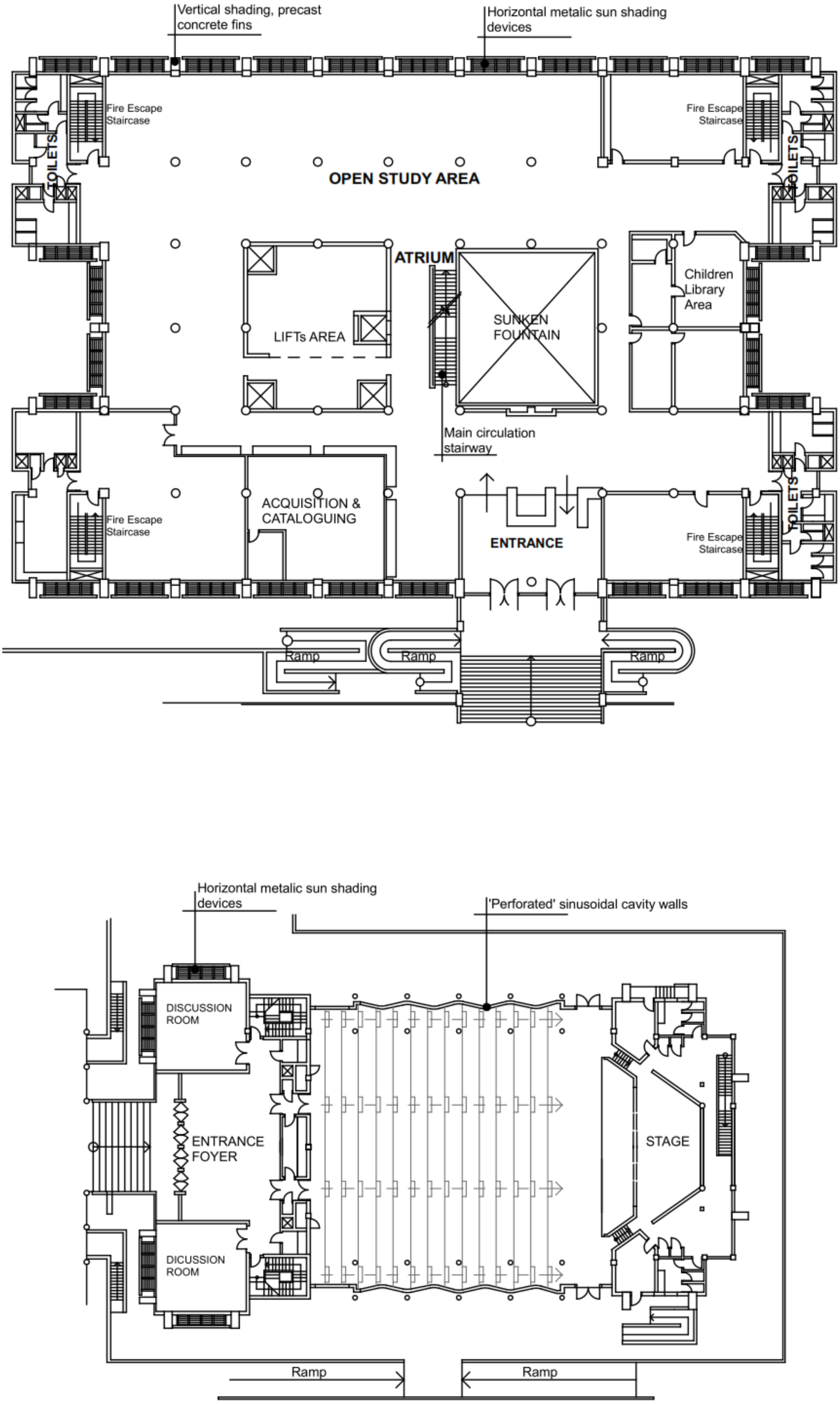

Fig. 6.9: (top)The LRC Library, (bottom) LRC Auditorium.

6.2.3. STRATHMORE BUSINESS SCHOOL

Fig. 6.10: Strathmore Business School atrium. Source: Author 2017

Table 6.4: SBS Project data and design team. Source: Author 2018

PROJECT DATA	CONSULTANCY TEAM
Construction Start Year:	**Architect:** Lexicon + Ion
Completion Year:	**Quantity Surveyor:** Tandem & Stark
Gross Internal Floor Area: 10,037SQM	**Structural Engineers:** Apex Engineering
Client: Strathmore Business School	**Elec. & Mech. Engineers:** Asahi Consulting Ltd.
Construction Cost: Ksh.	**Project Mangers:** Raul
Category: Education	**External Consultant:** LEED AP

Strathmore was founded in 1961 as an advanced-level sixth form college by a group of professionals inspired and encouraged by the founder of Opus Dei. It became a chartered university in 2007. The university campus is 15 minutes' drive from Nairobi's Central Business District. It is accessible from Ole Sangale road, Langata Road and Mbagathi Way (Fig.6.11). There are at least six bus stops close to the building site that can be used to access the building. The project provided minimum parking as per Nairobi's building regulations, and considered alternative transport by creating bicycle racks and changing room facilities for those cycling.

The project master plan consisted of three buildings with a total area of approximately 21,000sqm; the Strathmore Business School, the Management Science Building and the Cafeteria (Fig 6.12). The analysis will focus on the Strathmore Business School (SBS) which was declared the best green building in Africa by Africa Real Estate and Housing Finance (AFREHF) in March 2012. The Strathmore Business School (approximately 10,037m^2) is a four-storey building that houses executive lecture theatres, flexible classrooms, an auditorium (150 people), discussion rooms and administration offices (Fig.6.13).

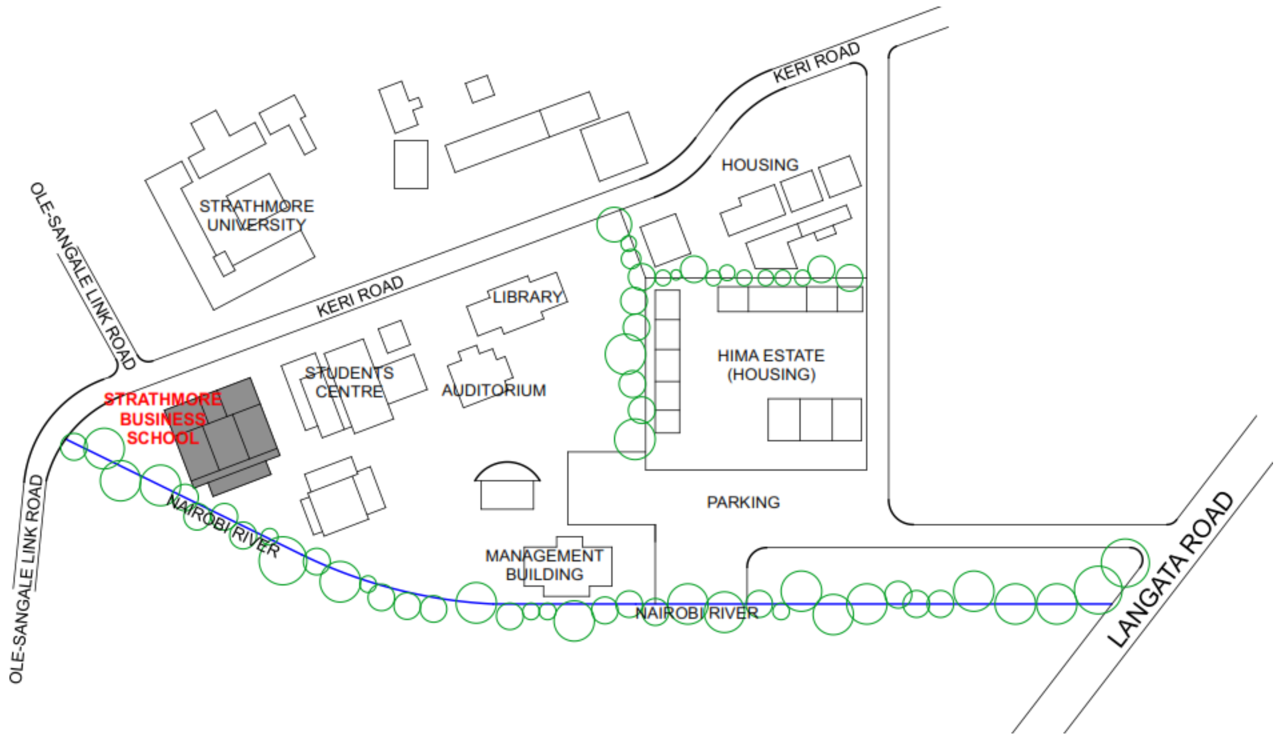

Fig. 6.11: SBS Location Plan. Source: Author 2018

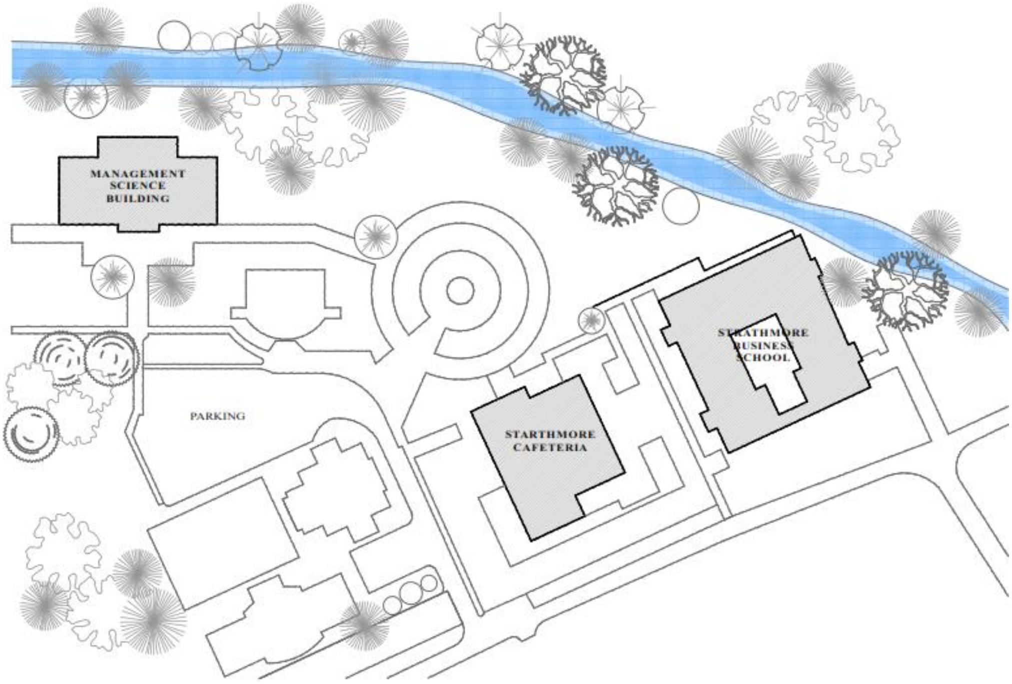

Fig. 6.12: SBS Expanded brief site plan including Management Science building and Students Cafeteria

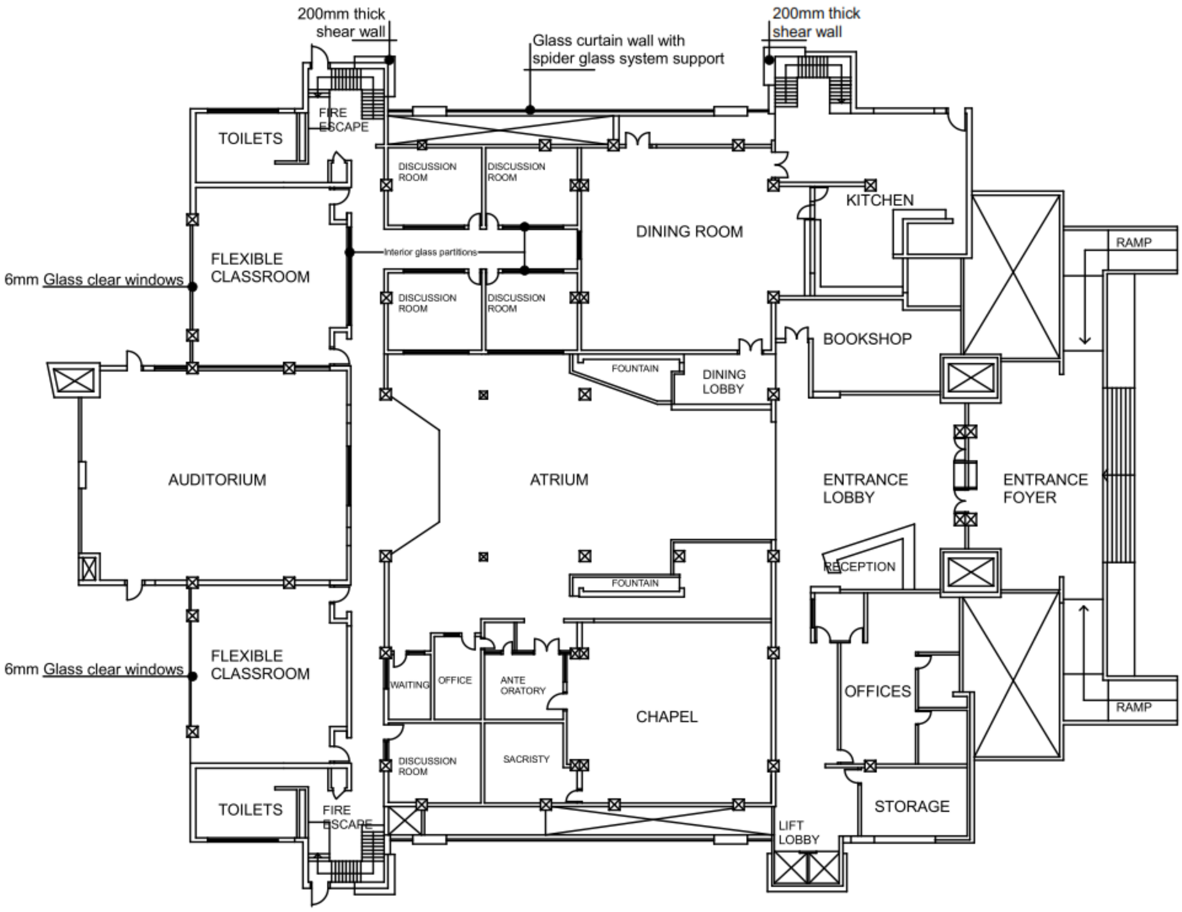

Fig. 6.13: SBS Ground Floor Plan

6.2.4. THE ANWA JUNIOR SCHOOL

Fig. 6.14: Anwa Junior School. Source: KDI, 2019

Table 6.5: Anwa Junior School project data and design team. Source: Author 2018

PROJECT DATA	**CONSULTANCY TEAM**
Construction Start Year: December 2017	**Architect:** Kounkuey Design Initiative - KDI
Completion Year: 2019	**Quantity Surveyor:** -
Gross Internal Floor Area:	**Structural Engineers:** ARUP
Client: Anwa Junior School / Welthungerhilfe	**Elec. & Mech. Engineers:** -
Construction Cost: Ksh. 13Million	**Project Mangers:** KDI
Category: Education	**External Financier:** Welthungerhilfe

The Anwa Junior School design and construction was led by Kounkuey Design Initiative (KDI) who are a "non-profit design and community development" organisation established in 2006. KDI "partners with residents of impoverished areas to develop and implement design solutions that improve physical, economic, and social quality of life" (KDI, 2016). For KDI, sustainable development is achieved through a participatory process throughout the conception, design and construction of the project. KDI "builds on their ideas, enhances them with technical knowledge and design innovation, and connects them to extant resources. In so doing, KDI empowers communities to advocate for themselves and address the major physical, economic and social challenges they face" (KDI, 2016). In doing so, KDI focuses on projects that are geared towards public function and through the participatory approach, and which develop a community's capacity and skill ensuring that architectural solutions are contextual. The projected is located in Kibera, Nairobi – the largest urban slum in sub-Saharan Africa with a population of approximately 250,000 within a 2.5km square area. Kibera's architectural landscape is characterised mainly by shanty like structures made from iron sheets. The distances to the main service roads are approximately 130m to the south and 250m north of the site.

According to KDI, sustainability requires the ability to build upon the understanding of people's cultural and social preferences whilst still taking into consideration the physical and natural environment. As such, KDI initiated a design process that began by seeking to understand the functions, needs, and preferences among other issues, of schools within the community, guided by a request for proposal (RFP) document they issued to schools within the community. Anwa Junior school was selected as the first school for redevelopment. The project involved the demolition and reconstruction of the existing school that served approximately 400 students from very low-income backgrounds (Fig.6.15). The existing structure was a two storey ramshackle building made of old mismatched *mabati* (steel sheets), timber, cardboard and sandbags.

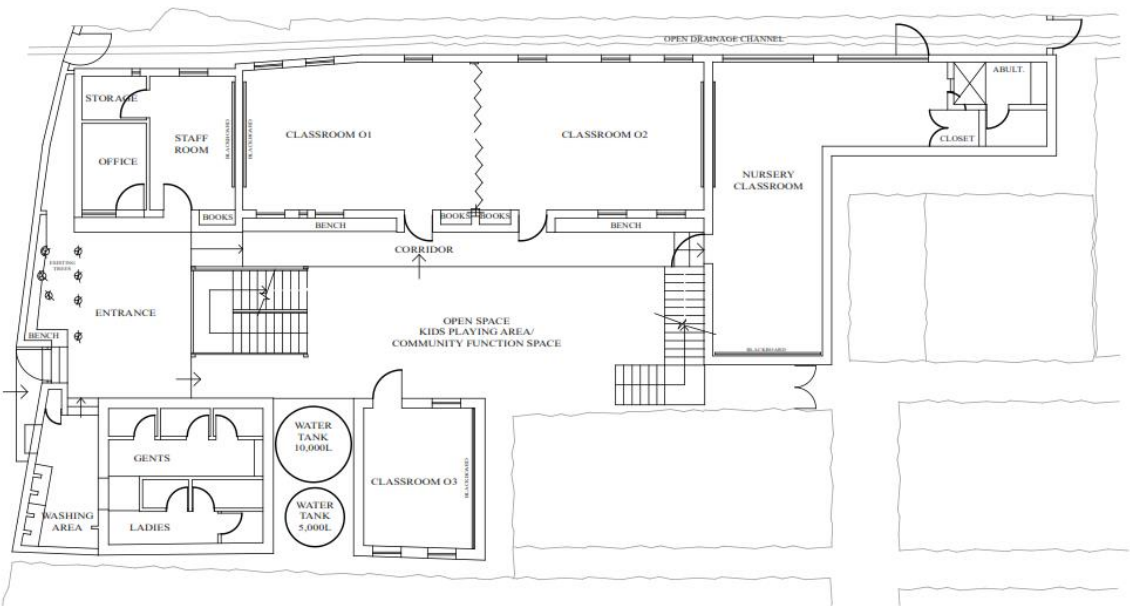

Fig. 6.15: Anwa Junior school floor plan Source: Author, 2017. Modified from KDI drawings

6.3. TECHNICAL COMPARATIVE ANALYSIS

6.3.1. SITE AND CONTEXT

All four buildings are located in distinct urban contexts which had a direct implication on the design decisions made. Whereas the KCB Tower building is located in a prime urban cosmopolitan district, and SBS and LRC are located in middle income and suburban residential zones respectively, Anwa Junior School on the other hand is located in Kibera, Africa's largest urban slum.

ORIENTATION

	KCB TOWERS	**LRC**	**SBS**	**ANWA SCHOOL**
ORIENTATION	North West & North East	East - West	North West – South East	Northwest – South East

For KCB Towers, the client desired a building that would be prominent from all directions. The architects argued that a triangle has no front and back, and therefore a triangular plan would give prominence to each façade. However, the choice of this shape resulted in several design challenges that will be discussed in the subsequent sections.

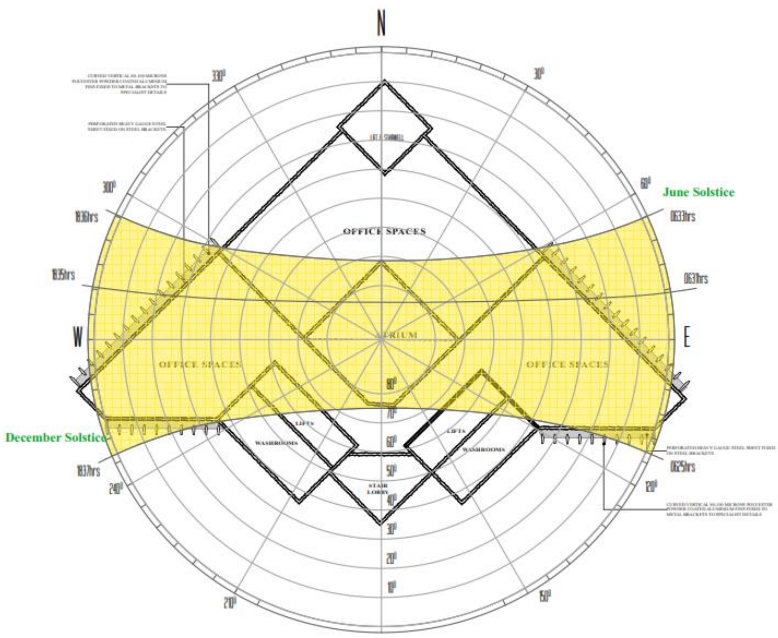

Fig. 6.16: KCB Towers sun path diagram. Source: Author, 2018

The LRC orientation on the other hand was determined by the architect's desire to achieve maximum space use as well as maximum daylighting and natural ventilation. Therefore, after the architect's consideration of several geometric form options, he opted for a long and narrow design. This long and narrow design was oriented East-West, minimising the building's solar gain which in turn enhanced thermal comfort at a reduced lighting and ventilation cost. Although the architect initially proposed the use of solar energy, the client feared the

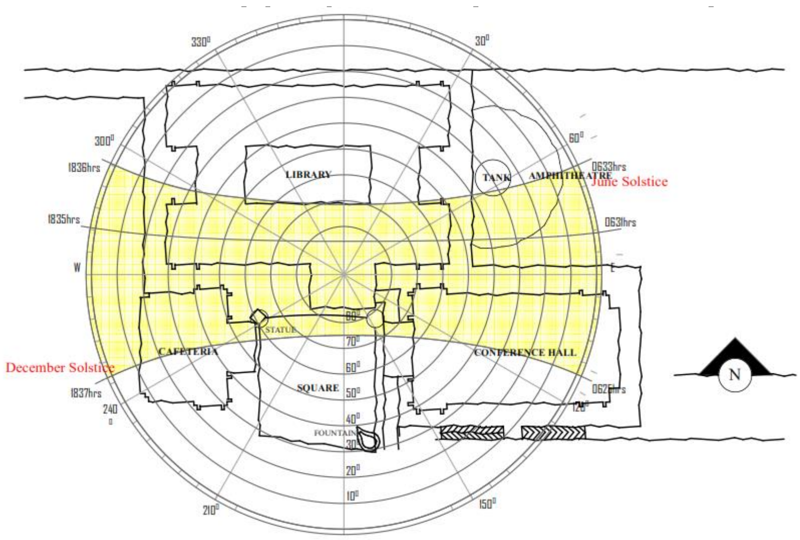

Fig. 6.17: The LRC Sun path across site. Source: Author

Prior to construction of the SBS project, the proposed building had to be relocated and resized within the campus grounds due to land disputes. This affected the initial intentions of the design with regard to access, orientation, parking provision and breakout areas. However, the site was considered reclaimed land, therefore gaining LEED points for the sustainable site category.

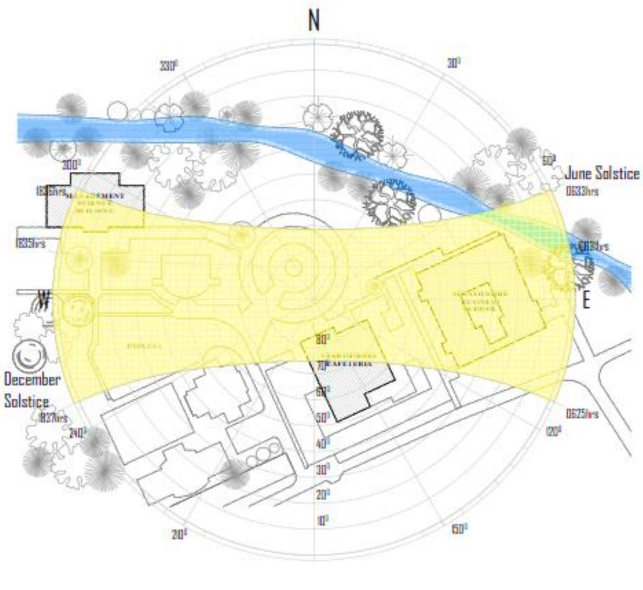

Fig.6.18: SBS sun path diagram Source: Author 2017.Modified from Lexicon +Ion Drawings 2018

The buildings of Anwa Junior academy are oriented to the North-West and South-East, with openings on the North-East and South-West facades, letting in sufficient natural daylight during the day. However, this orientation was influenced by the shape and size of the plot and the need to maximize land use, and not necessarily by environmental considerations.

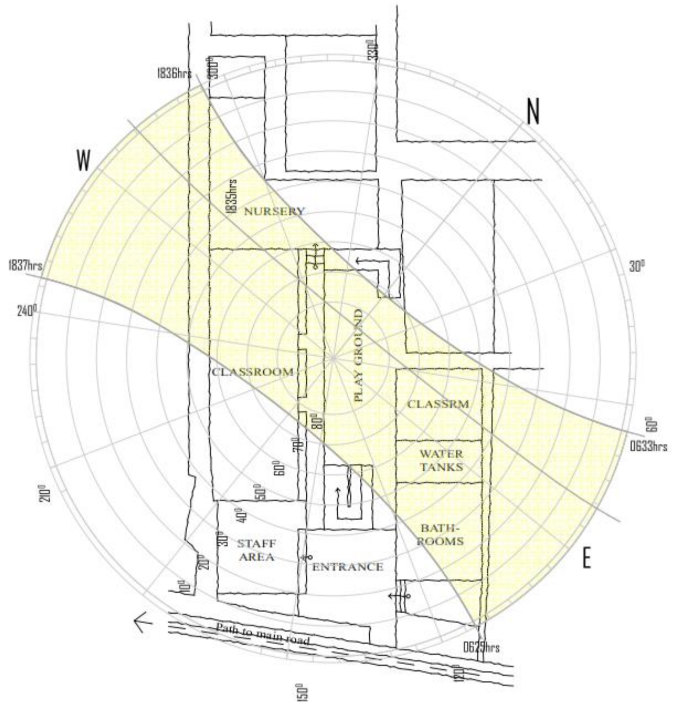

Fig. 6.19: Anwa School sun path diagram. Source: Author, 2018

The case studies suggest that the site configuration and size have much greater influence on the orientation of the buildings compared to the sun path or other environmental considerations. This is typical for most buildings in Nairobi, especially within the urban zones. Only the LRC had the luxury of space and flexible boundaries and thus orienting the building East - West was straightforward. Anwa School on the other hand had to contend with site size constraints on a site oriented South – East, North-West and this dictated the overall orientation of the building. KCB Towers completely ignored the site configuration with regard to orientation, as the buildings major facades were oriented Northeast – Northwest, subjecting the building to the highest solar gains, which occasioned the need for a heavy investment in solar shading that would otherwise have been reduced significantly if the building's design and orientation reflected the sun path.

The immediate urban and social context also influenced the design approach. For instance, given the location and function of Anwa Junior School, a greater priority was given to community participation and a sense of ownership throughout the project. For KCB, its location in an urban context, where the urban heat island effect is the greatest of the four sites, as well as the high cost of artificial cooling and lighting in Nairobi, necessitated the prioritisation of passive cooling and lighting systems.

6.3.2. MATERIAL SELECTION

	KCB TOWERS	LRC	SBS	ANWA SCHOOL
SOURCES	50% locally sourced 50% imported	Approximately 90% locally sourced. Floor tiles and rubber floor imported	90% building finished imported	100% locally sourced

The choice of material for KCB towers was dictated by availability, cost and thermal properties. The primary construction materials were locally sourced cut stone and reinforced concrete. Typically, especially in the West, concrete is often not considered a sustainable material. However, the architect considered concrete sustainable as it is locally available and is the most commonly used material in Nairobi, hence the technology is well known and also due to its longevity. Other materials (aluminium, glass and tiles) were imported from around the world, as these materials were either completely unavailable or unavailable at the required standard locally.

In the case of the LRC project, the material selection was a significant consideration for the architect, and therefore the project extensively utilised locally available materials. Hand-dressed blue stone was used as the most predominant construction material with surfaces finished with light coloured render. The entrance steps and ramp were cladded with mazera stone paving all of which were locally sourced. The floor tiles were sourced from China and rubber finish in the auditorium from Germany.

Considering the SBS's building, its shell was completed using locally sourced building stone, while recycled wood was used for the formwork during the construction process. However, 90% of the building's finishes were imported from China due to a significant cost difference compared to locally procuring these materials. The cost saving allowed for hiring of a representative from China to train local construction workers on installation of the materials imported, in order to comply with the LEED local component criteria that gives credits for the use of local labour. However, there was a challenge with standards of different components, which necessitated redesign in order to install these components. One significant material is the slab material. The decision to use the U-boot bio-directional hollow flat slab made from recycled plastic imported from Italy was made in an attempt to meet the LEED criteria of percentage recycled materials. This material also reduced the dead weight of the structure and allowed for large span (13.5m) classrooms. However, not only did this come with importation costs, it also introduced training costs for the structural engineering team who travelled to Italy for a one-week training, as well as a contractor training course on the technology, and significant investment on concrete pumps which were uncommon in the context.

In contrast, Anwa School took a different approach to material selection, that was guided by the community's perception of materials, cost, as well as KDI's effort to use what the architects termed as sustainable materials. Through the community-based workshops, KDI sought to understand the community's perceptions and preferences in terms of materials as well as their desired overall aesthetic. After several consultative meetings the community settled on mud (wattle and daub) on the ground floor and "patchwork" *mabati* (iron sheets) on the first floor, characteristic of the context (Fig.6.20), both using timber framework (Fig. 6.21). All materials were locally sourced and therefore had low embodied energy. The timber was sourced in Nakuru, approximately 140 km from the site, having been certified by the Kenya Forest Service. The clay bricks used for the first 500m of the ground floor were sourced approximately 25km from the site. Bamboo was also locally sourced and certified by the Kenya Forest Service. Materials from the existing school were recycled, some used to put up the site office and the rest for hoarding. As a means to minimise waste during construction, exact measurements and qualities were established before fabrication.

Fig. 6.20: Example of buildings within Anwa Juniour school context. Source ANWA, 2017

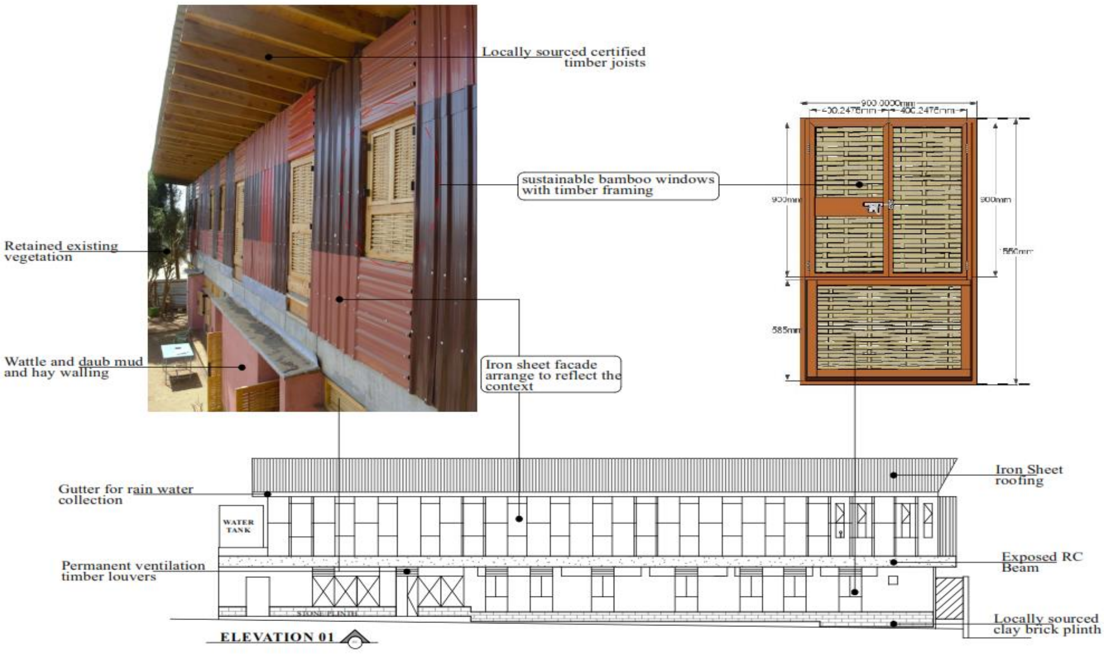

Fig. 6.21: Anwa School Elevation detail. Source: Author, 2017. Modified from KDI drawings

All things considered, natural stone is the most conventional building material in Nairobi, typically classified into machine cut stone and manually cut stone. For three of the case buildings, locally sourced natural building stone was predominantly used. However, despite iron sheets being the more conventional material within Anwa school's micro-context. Initially the proposal used stone as the primary material before the interference of the Nubian Council. Natural stone is therefore considered a sustainable material by consultants in all four cases due to its local availability, durability, recyclability, non-toxicity and its low maintenance. It is worth noting however that for these case studies, material choice seems to be influenced more by availability and cost and not necessarily sustainability properties.

Similarly, importation of materials is influenced by local unavailability as well as the cost saving for procurement from international sources. For example, the SBS solar glass façade proposal was abandoned due to procurement and cost challenges, despite having been considered due to its sustainability properties during the design stage. KCB on the other hand imported all its aluminium cladding, glass, service equipment, fittings and fixtures as well as floor and wall tiling, because they were unavailable in the specified standards and were much cheaper to import. Only stone, steel, sand and cement were sourced locally. This, according to the architect, translated to approximately a 50-50 percentage ratio in terms of quantity for local versus imported materials against a 40-60 percentage ratio in terms of cost.

Furthermore, this investigation suggests that despite some examples of reliance on imported building materials, it is evident that in Nairobi a building can almost effortlessly achieve upwards of 50% locally sourced material use, using conventional building materials and technology. Thus, this would suggest that a building that is claimed to be sustainable should aim to achieve a significant percentage of locally sourced materials. Furthermore, material importation significantly increases its embodied energy and could be counteractive in terms of sustainability. For instance, the U-boot slab system that earned SBS points for being a recycled material had to be imported from Italy, and a number of consultants and construction workers had to fly to Italy to learn the technology, and the contractor had to purchase new equipment. Therefore, ultimately, considering just the resultant materials embodied energy, the argument that it is produced from recycled plastic and therefore sustainable, can be challenged.

6.3.3. INDOOR ENVIRONMENTAL QUALITY

SOLAR SHADING & THERMAL COMFORT

This section investigates the strategies adopted to achieve thermal comfort and solar shading.

	KCB TOWERS	**LRC**	**SBS**	**ANWA SCHOOL**
STRATEGY	High Thermal Mass Façade Horizontal and Vertical Shading	High Thermal Mass Façade Horizontal and Vertical Shading	High Thermal Mass Façade Horizontal Shading	High Thermal Mass Façade Cross Ventilation

For the KCB building, as previously alluded, the triangular shape brought about the challenge of significant heat gain, as large areas of the building facades were exposed to direct solar radiation. The three façades experience different levels of solar radiation at different times. The North-West façade has the highest exposure to solar radiation during the afternoon and therefore would have required greater consideration of solar shading. The North-East façade on the other hand would require less shading to perhaps take advantage of the less harsh morning sunshine. The South façade would require the greatest shading from potential afternoon solar gain.

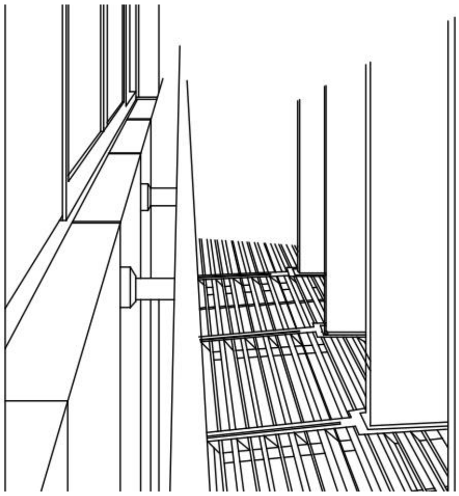

Fig. 6.22: Aluminium vertical shading

Source: Author 2018

Consequently, the solution to solar shade the building using vertical and horizontal aluminium fins was adopted (Fig. 6.22). This required a heavy investment in solar shading at a cost of 260 million Kenya Shillings. This level of investment may not be economically affordable for many local investors, not to mention, unnecessary if the design was done differently.

Given that heat gain was seemingly unavoidable due to the design, to further enhance thermal comfort, the Planning Systems architect proposed the use of materials with high thermal mass. This led to the use of exposed concrete on the walls together with an exposed concrete coffered ceiling that absorbs daytime solar and internal heat gains and cools the building during the night.

Similarly, LRC employed several methods to sunshade glazed areas on the building façade, including pre-cast concrete fins, concrete egg-crates, and horizontal aluminium elements (Fig. 6.23).

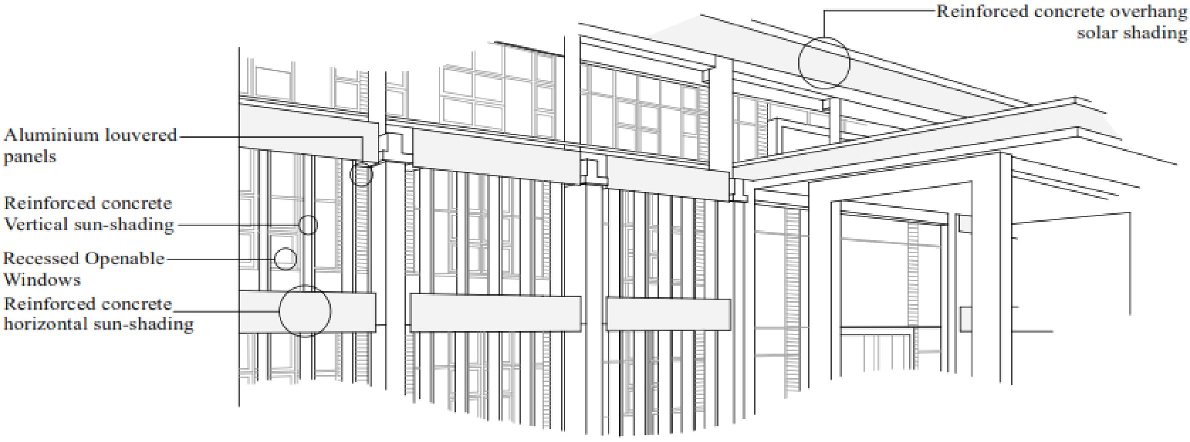

Fig. 6.23: The LRC Solar shading strategies. Source: Author 2018

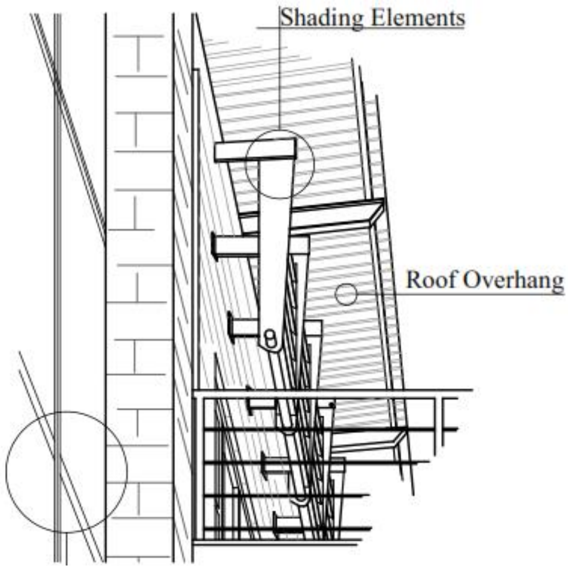

Fig. 6.24: SBS Solar shading strategies.
Source: Author 2018

SBS, on the other hand, set the aluminium framed 6mm clear glass windows into the wall. Together with the roof overhang, this reduced direct solar radiation into the building (Fig.6.24). In order to minimise heat gain from the roof slab, the use of reflective aluminium foil finish coupled with a tar and polyethene coating was used, thus, enhancing the thermal environment even during the hot seasons.

Anwa Junior School did not employ shading devices. To enhance thermal comfort however, the design comprised the use of mud walls that act as good thermal regulators due to the high thermal mass, and therefore the building is cool throughout the year. Furthermore, 12mm thick plywood was installed between the timber and *mabati* on the walls as well as between the rafters and purlins as an insulator as per ARUP specifications. This was not included in the initial scoping and became cost intensive and was perhaps over specified as a result of a lack of clear understanding of the context.

VENTILATION

	KCB TOWERS	**LRC**	**SBS**	**ANWA SCHOOL**
VENTILATION STRATEGY	Cross Ventilation Stack Effect	Cross Ventilation Stack Effect	Evaporative Cooling System	Cross Ventilation

KCB towers design utilised passive design ventilation strategies throughout the building. The windows on the façade are divided into four compartments vertically; the bottom compartment is fixed, and the subsequent compartment, which is about table height, is manually openable, controlled by the occupants (Fig. 6.25). The next compartment is fixed and the top most compartment has semi fixed louvres – semi fixed because they can only be controlled by maintenance crew - that generally remain open. Cool breezes flow into the building via the openings to naturally ventilate the spaces. Warm air is exhausted out of the building via stack effect (Fig. 6.26). The triple storey sky courts and the large atrium enhance this effec

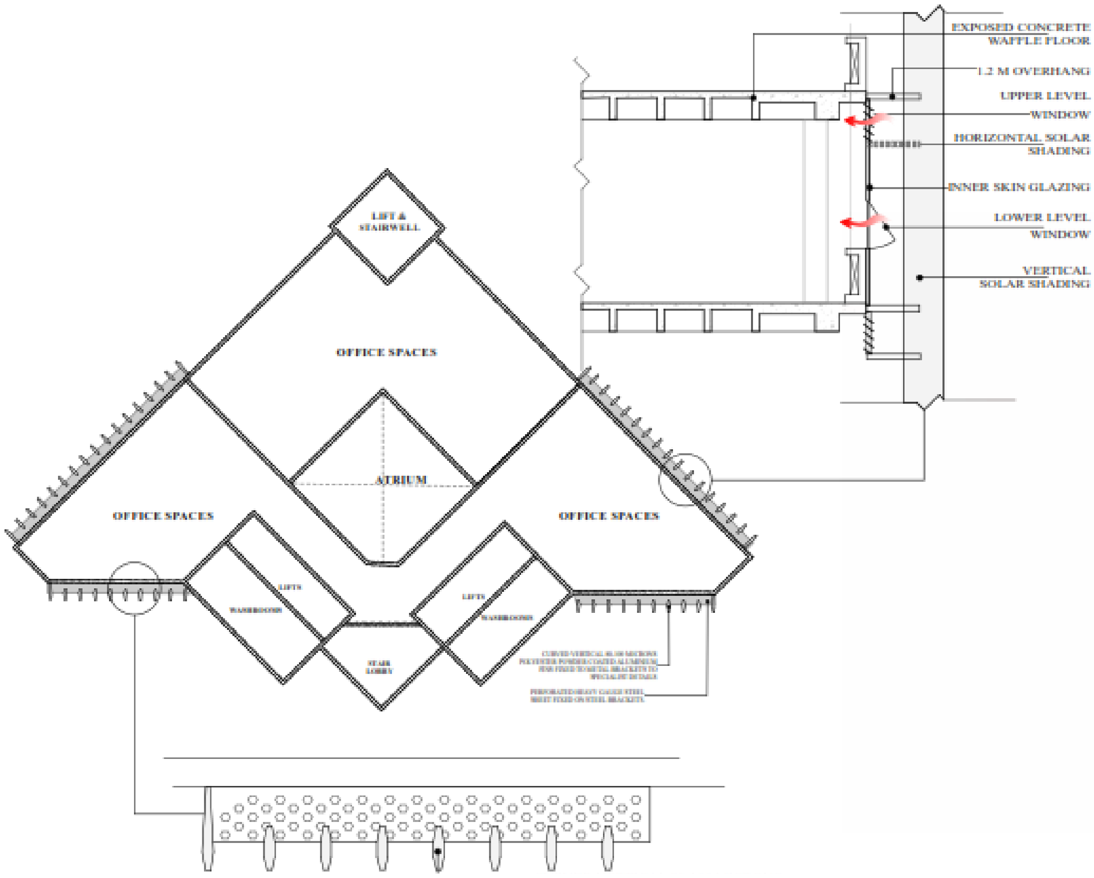

Fig. 6.25: KCB Window detail. Source: Author 2017.Modified from Planning System drawings

The sky courts have a triple function, apart from enhancing air movement, they also increase the penetration of natural light into the building.

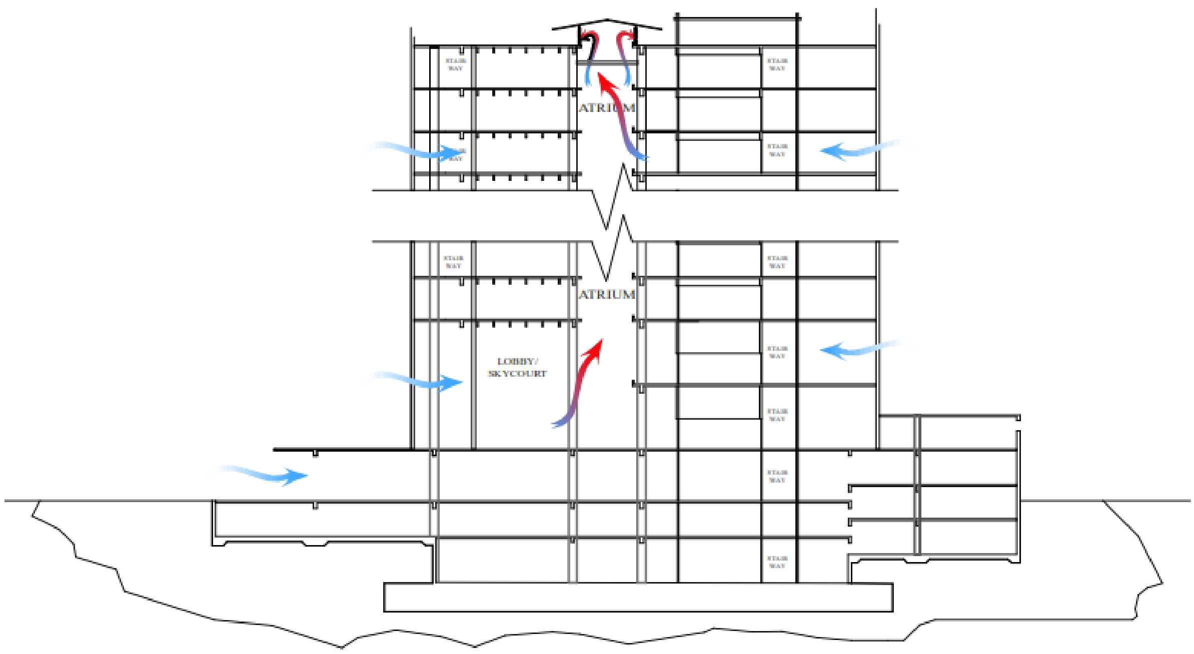

Fig. 6.26: KCB ventilation strategy -section. Source: Author 2017.Modified from Planning System Drawings

As with the KCB towers, LRC utilised passive design strategies to for ventilation. This involved air intake through the windows and on either side of the external column’s 600mm wide aluminium double louvred panels. Hot air exhaustion was achieved through a pattern of air shafts on the attic floor that protruded above the roof acting like thermal chimneys (Fig. 6.27, Fig. 6.28). This ‘'stack effect" principle is used to cool all three buildings. Through convective buoyancy the hot air rises and is passively exhausted without any use of mechanical ventilation. Protruding from the library and conference hall roof tops are "exhaust chimneys" capped with ventilation cowls that are driven by wind to improve passive ventilation. Internally, to enhance ventilation, double louvred panels are included in all the glazed partitions (Fig. 6.27).

Fig. 6.27: Louvered panels and exhaust chimneys. Source: Author 2017

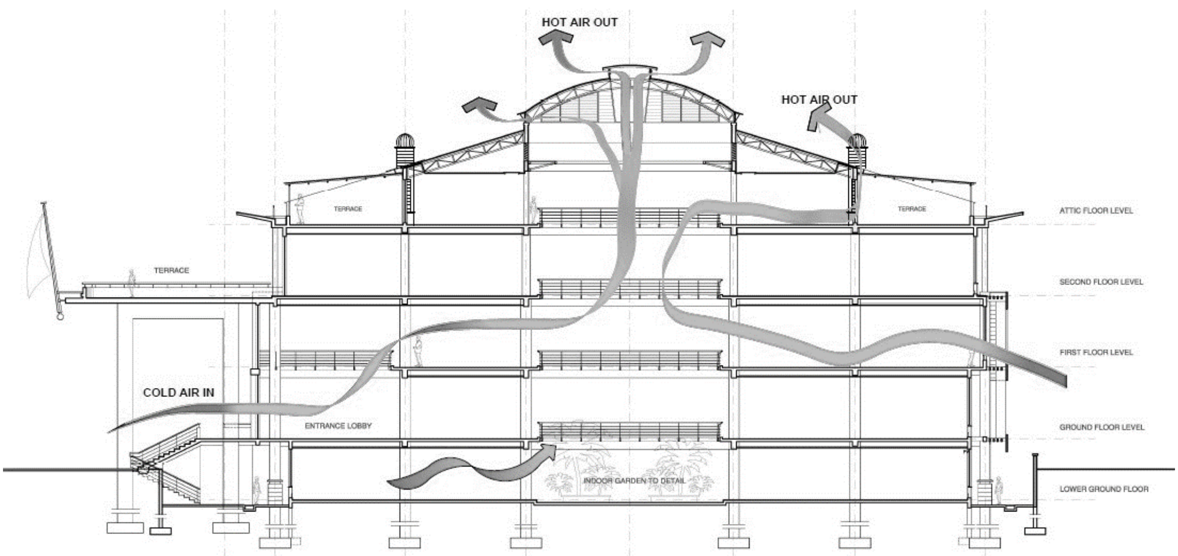

Fig. 6.28: Section through the LRC library. Source: Kimeu 2013

This passive strategy was taken further in the auditorium, which has Africa's largest rock-bed installed as part of cooling strategy. The design relies on granite rocks that have been arranged beneath the raked seating. The step risers beneath the seats has louvred openings that allow air into the space. These work together with openings on the sinusoidal walls that channels hot air to the rock bed for precooling. In essence, air from the outside passes through the rocks that have captured the night time 'coolth' or coldness in the rock surfaces. The rocks then absorb the heat thus precooling the air before it is induced into the hall through louvres beneath the seats (Fig. 6.29).

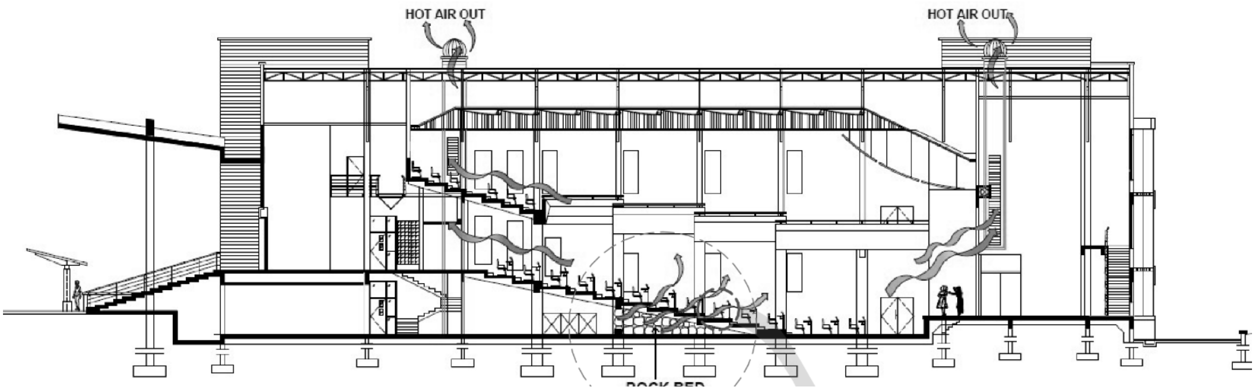

Fig. 6.29: Section through the conference room. Source: Kimeu 2013

SBS, however, took a more active approach to ventilation and thermal comfort. In an attempt to meet LEED minimum standard, the design utilised evaporative cooling units imported from Italy that were installed at the building's rooftop connected to opening in the building interior walls (Fig. 6.30).

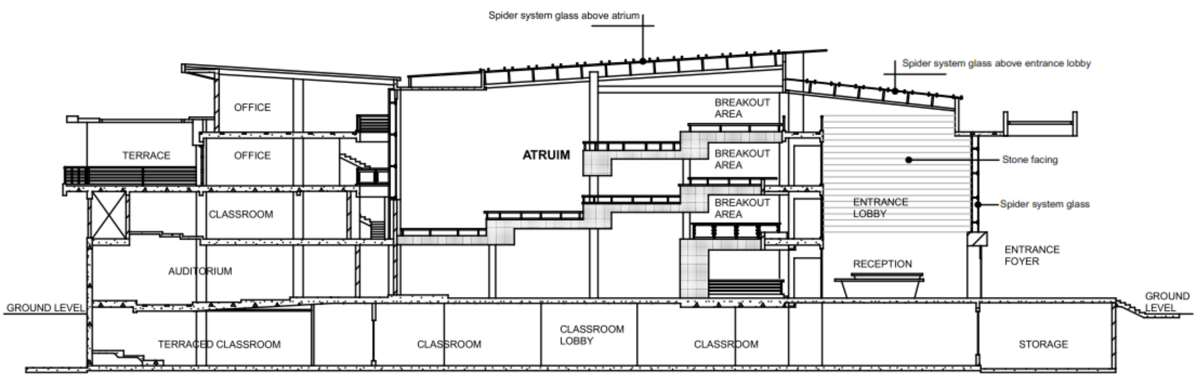

Fig. 6.30: Section through SBS building. Source: Author 2018

In the case of Anwa Junior School, the bamboo weaving design on the windows and doors allows air to penetrate the classroom, thus facilitating cross ventilation. The ground floor wall material allowed for an adequate number of windows for maximum ventilation. However, this was a challenge on the first floor, as ARUP advised that having fenestrations to the extent the architect advised would compromise the structure (Fig. 6.31).

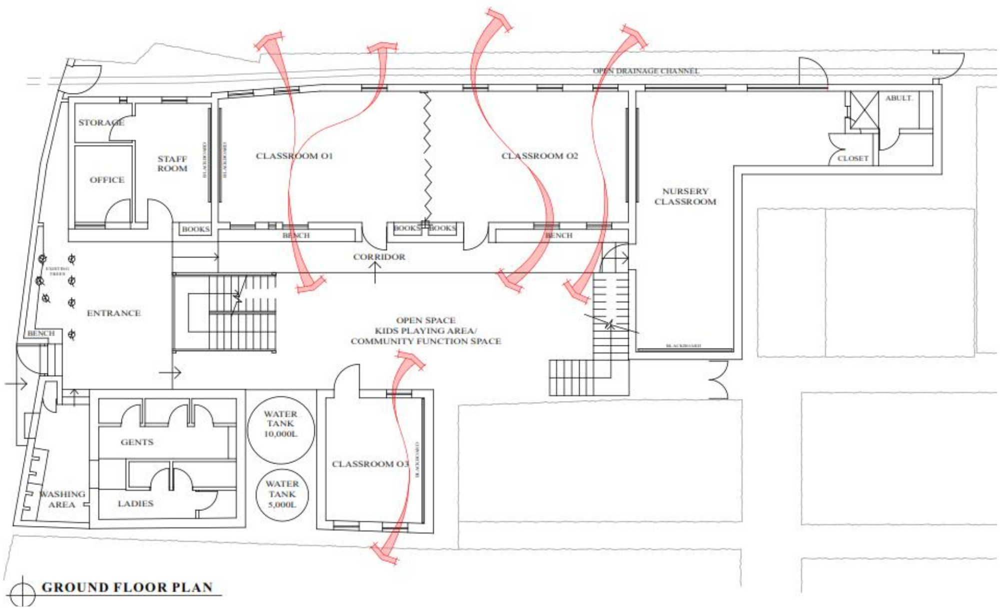

Fig. 6.31: Diagram showing cross-ventilation strategies in Anwa Junior School. Source: Author 2018

LIGHTING

The architect of KBC towers considered the office depth of 9m and the floor to ceiling height of 4m “perfect” for daylighting. From his experiences with design in the context of Nairobi, he argues that lighting energy load is the biggest energy consumer in Nairobi. There was therefore a debate on the consequences of solar shading on the amount of daylight the office space would receive. The option of saving energy required for lighting through full air-conditioning with daylighting optimisation was compared with full shading which might have resulted in artificial lighting. The planning system architect and ARUP agreed that the energy cost for mechanical ventilation would be too high and thus a solution to optimise daylighting without compromising thermal comfort was sought. Nairobi’s position relative to the equator translates to the sun’s zenith being constantly overhead. The architect argued that buildings in Nairobi rely on the blue sky or the partially clouded sky which does not reflect much light, and therefore much as the building is receiving daylight, the spaces may not be sufficiently lit, and occupants tend to have the lights on. To enhance daylighting, high transmittance glass was used, coupled with silver metallic coating on the solar shading fins that reflected light into the building. Furthermore, a skylight was installed at the top of the atrium, bringing light to what would have been the darkest spaces within the building. According to the architect, “daylighting was very successful.”

Similarly, in the case of LRC, the large clear glass windows that run through the North and South façades together with the narrow depth open plan floor spaces allowed for maximum daylighting throughout the day. In the library, to further enhance natural lighting, a glazed roof that runs across the atrium was installed. Light colour renders were used for interior spaces to maximise lighting effectiveness.

On the other hand, the architect of SBS building report that in order for the SBS design to meet the LEED daylighting and light level criteria, the glass to solid wall ratio increased comparative to standard buildings within the context. The use of a spider glass system on the façade, and internal glass partitions, allowed for natural light to penetrate the building. Furthermore, user defined lighting systems combined with motion detectors regulate lighting fixtures within the buildings. These fixtures include efficient fluorescent tubes with electronic ballast. The entrance lobby was initially designed to be covered using flexible automatic Roman blinds over clear glass that automatically move based on the sun’s position to allow for maximum daylighting while minimising heat gain from direct sunlight. However, the cost implication led to the use of clear glass with film coating, which has resulted in overheating of the lobby space during the warm seasons.

With reference to Anwa Junior School, the bamboo weaving design on the windows and doors allowed for natural light to penetrate the classrooms even when the windows were closed. An adequate number of window were placed on the ground floor to allow for daylighting. On the first floor however, despite the reduced number of windows, sky lighting was installed to enhance natural lighting.

In summation, with regard to indoor environmental quality, the study revealed that issues of indoor air quality, thermal comfort, visual comfort and acoustic properties cannot be discussed in isolation, as they influence and affect each other, but also cannot be discussed in isolation of the building’s context. Loki (2010) for example, posits that for tropical climates where 50% of solar radiation is infrared, “cutting direct sunlight to reduce overheating results in a dramatic decrease in daylight levels” (p.vx). The case study buildings reveal the intricate balance when addressing these issues. For tropical climates, where solar radiation is perceived as the main climatic design challenge, the tendency for emphasis on solar shading and high thermal mass materials may have a counteractive effect on the thermal comfort or visual comfort. This is evident in both KCB Towers and the LRC, where solar shading strategies adversely affected the thermal comfort of the building. Occupants in these building commented that the building gets “too cold” during certain periods of the year. The architects of KCB Tower admitted that the building was “over-shaded”. It is worth noting that it is no coincidence that the architect who designed the LRC also spearheaded the development of the Safari Green Building assessment system discussed in Chapter 4, which focuses on passive design strategies that are directly reflected in the buildings designed by the protagonists of this system.

The cases also demonstrate that irrespective of the scale of the project, buildings in Nairobi can entirely rely on passive design strategies for cooling. Three of the case buildings (LRC, KCB Towers and Anwa Junior School) rely on passive design strategies for cooling, with only SBS utilising both passive and active strategies, a strategy which was influenced by the LEED scoring system bias towards active cooling strategies. Passive design strategies not only translate to low embodied energy but also require much less economic investment and are therefore more appropriate in the context of Nairobi, where cost seems to be the overriding consideration during decision making.

6.3.4. RESOURCE EFFICIENCY

ENERGY EFFICIENCY

As discussed in the previous section, KBC Towers, LRC and Anwa Junior School all relied on passive design strategies to improve the energy efficiency of these buildings by significantly reducing energy demand. In addition, appliances and equipment with low energy ratings were specified and installed. According to the architect, KCB tower’s energy use would be approximately 40% less than that of a similar building. Similarly, the LRC property manager reports that the building utilises much less energy compared to other similar CUE University buildings.

SBS on the other hand combined passive design with active systems with the aim of improving energy efficiency and to meet LEED criteria. Approximately 90% of the SBS building’s roof was fitted with photovoltaic cells and solar panels, and this, the property manager reports, allows the building to provide 100% of its own power, with excess energy that could be fed into the grid. The LED lighting is directly connected to the photovoltaic solar louvres. It is worth noting that the installation of the PV cells cost approximately 10 Million Kenya Shillings (100,000 USD), which is a significant amount for a project of this magnitude and therefore would be unaffordable for many developers in Nairobi. However, this was a priority for the client, and also earned LEED points on the renewable energy criteria. It can, however, be argued that there was a significant potential to reduce the building's energy load and therefore the building's design may have created an energy "problem" in order to solve it and earn points, which came with significant cost implications. For example, some of the spaces are airtight, and would have benefited from natural ventilation given their shallow depth. In addition, SBS installed a Building Management System that provides ongoing accountability of the building's energy consumption. During LRC's initial design phase, the use of solar panels was proposed and was subsequently included in the contractors initial tender bid, but was later discounted by the client due to cost implications.

WATER MANAGEMENT

KCB considered rainwater harvesting, however, the architect argued that the building's footprint compared to its water demand did not justify the harvesting of rain water. The design did provide, however, for the recycling of all grey water to be used for landscape irrigation. In the LRC design, rainwater predominately used for cleaning and irrigation of landscaped areas, is harvested and stored in underground tanks. Aside from rain water harvesting, the entire university main campus is supplied with water from a borehole and hence it is not connected to the national water grid. The sewage system consists of oxidation ponds that use sunlight, bacteria and algae to treat waste water. In the SBS building, as part of the certification requirements, the construction process minimised the use of potable water and maximised the use of rain water harvested on site and stored in an underground tank. During occupancy, according to the architect, the stored water harvested from the building's roof meets approximately 90% of the building's water requirements. Furthermore, the project utilised efficient fittings to minimise water use. There was an application for a LEED credit interpretation ruling for fittings appropriate for the region, which was granted. During the design process, the option of water recycling was considered but became too expensive to achieve.

Similarly, rainwater harvesting was designed for use in the Anwa Junior School building. Its roof was slanted in one direction to maximize rainwater harvesting into existing water harvesting tanks (Fig. 6.32). However, based on previous feasibility studies and post construction analysis, the water can only support the school for two weeks during the rainy seasons, thus alternative sources of water are required as the school is not connected to the national grid.

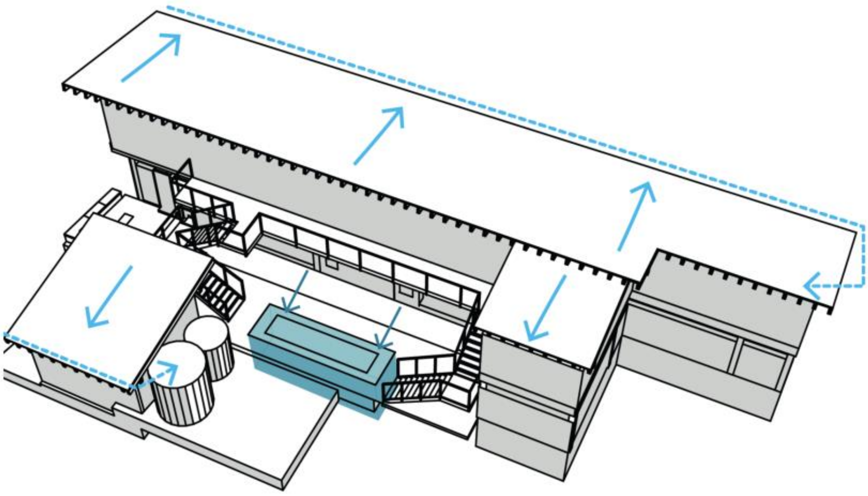

Fig. 6.32: Slanting roof to collect rainwater into storage tanks. Source: KDI, 2018

Furthermore, due to sites the propensity to flooding, underground retention storage systems were installed in the courtyard using locally available materials to allow surface runoff to seep into the ground (Fig. 6.33).

Fig. 6.33: Construction process of the underground water detention storage system. Source:KDI, 2019

All four projects have attempted to incorporate softscapes to allow water to infiltrate the ground and replenish the underground water. SBS, the LRC and KCB have also installed sanitary fittings that encourage minimal use of water.

Taken together, the investigation suggests that notwithstanding the cost implications, the use of technology appears to face challenges due to the lack of local expertise to properly service equipment. Furthermore, the analysis suggests that the active strategies' cost implication would not only be difficult to justify but most clients/developers could not afford it. For instance, the cost investment for the use of solar panels or PV cells was prohibitive for both KCB Towers and the LRC, while Anwa Junior School's budget did not allow for the consideration of this option, nor would it be economically sustainable when the cost of solar panels installation is compared to the overall cost of the project.

WASTE MANAGEMENT

Whilst solid waste management in construction sites is an increasing challenge not only in Nairobi but globally, the research indicates a lack of deliberate consideration of this issue. None of the case studies had an elaborate documented construction and post construction waste management plan. This is no surprise, as currently in Kenya the policies or regulations that stipulate how waste should be managed are vague and hardly implemented, with none specific to construction waste. Due to the lack of regulation and lack of documentation, quantifying the cost of waste management is difficult. It is not included in the bills of quantities, and contractors are therefore under no obligation, and thus disposal of waste is often done in the cheapest and most convenient manner.

6.4. SOCIO-POLITICAL ISSUES THAT INFLUENCED DECISION MAKING

Having reviewed the technical aspects of the cases, the research moved to investigate the socio-political aspects in each case, by identifying key stakeholders and establishing their relationships. This was done through interviews with project architects of each case study building. The investigation attempted to understand stakeholders' powers, interests (stakes), and contributions (obligations). Exploring the origins of each stakeholder's power was also of interest, as well as what influence these powers have on the decision-making process throughout the project.

6.4.1. KCB TOWERS

The KCB Towers design and construction process brought together several stakeholders with different interests and obligations. Fig. 6.34 summarises the stakeholders involved in the project, as well as their key obligations.

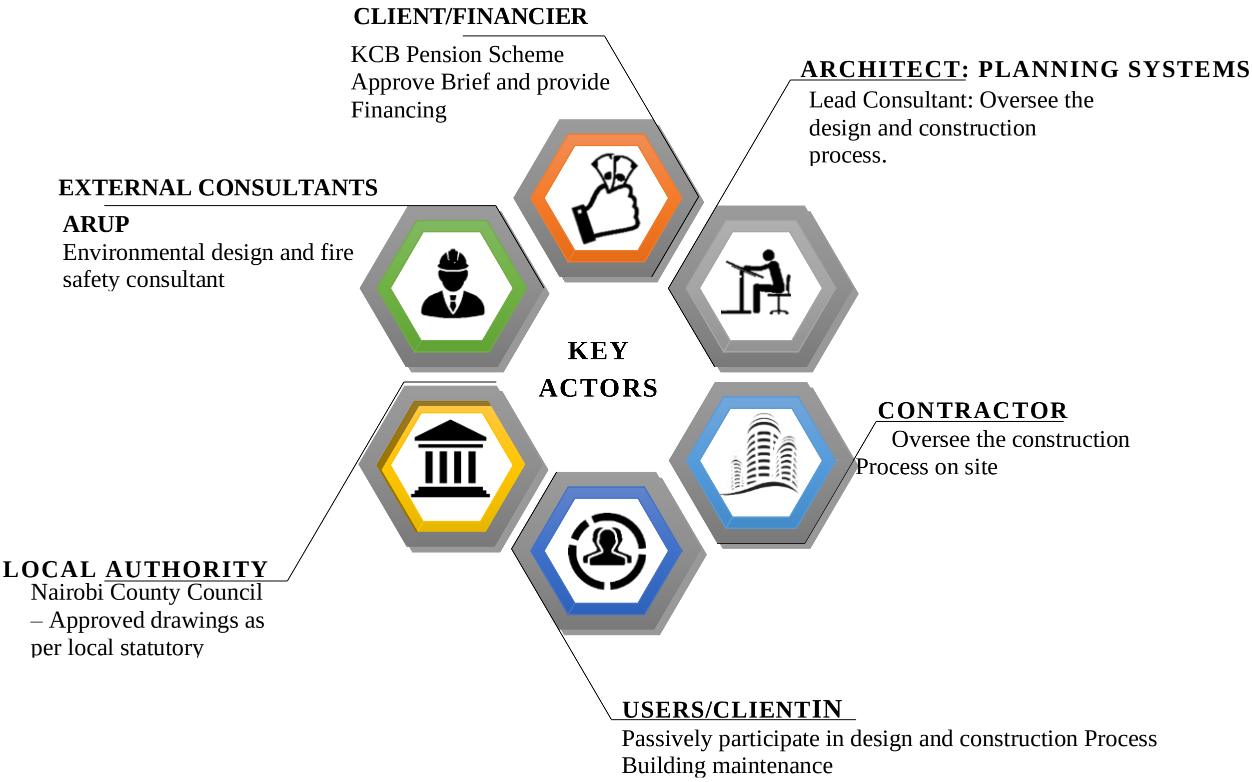

Fig.6.34: Summary of human actors involved in the KCB Towers project. Source: Author 2019

Fig. 6.35 illustrates the power changes of each stakeholder throughout the different stages of the project. At the onset of the project in 2004, three main stakeholders were involved; the client (KCB Bank), who at this point was also the financier, and the architect, who was the main design consultant. At this stage the stake and power of the client were at the highest level as he outlined his desires and had the power to appoint consultants to see those desires to fruition. In this case the client desired, among other things, a green building. However, what that meant was unclear and was left to the discretion of the architect to advise, as the 'expert' on design matters. It is important to note that often, as will also be clear from the other cases, the client does not fully understand what a green building means or what intricacies constitute a green building. However, they are aware of the competitive advantage (mostly economic) embedded in the green label, and thus would like to be associated with the label.

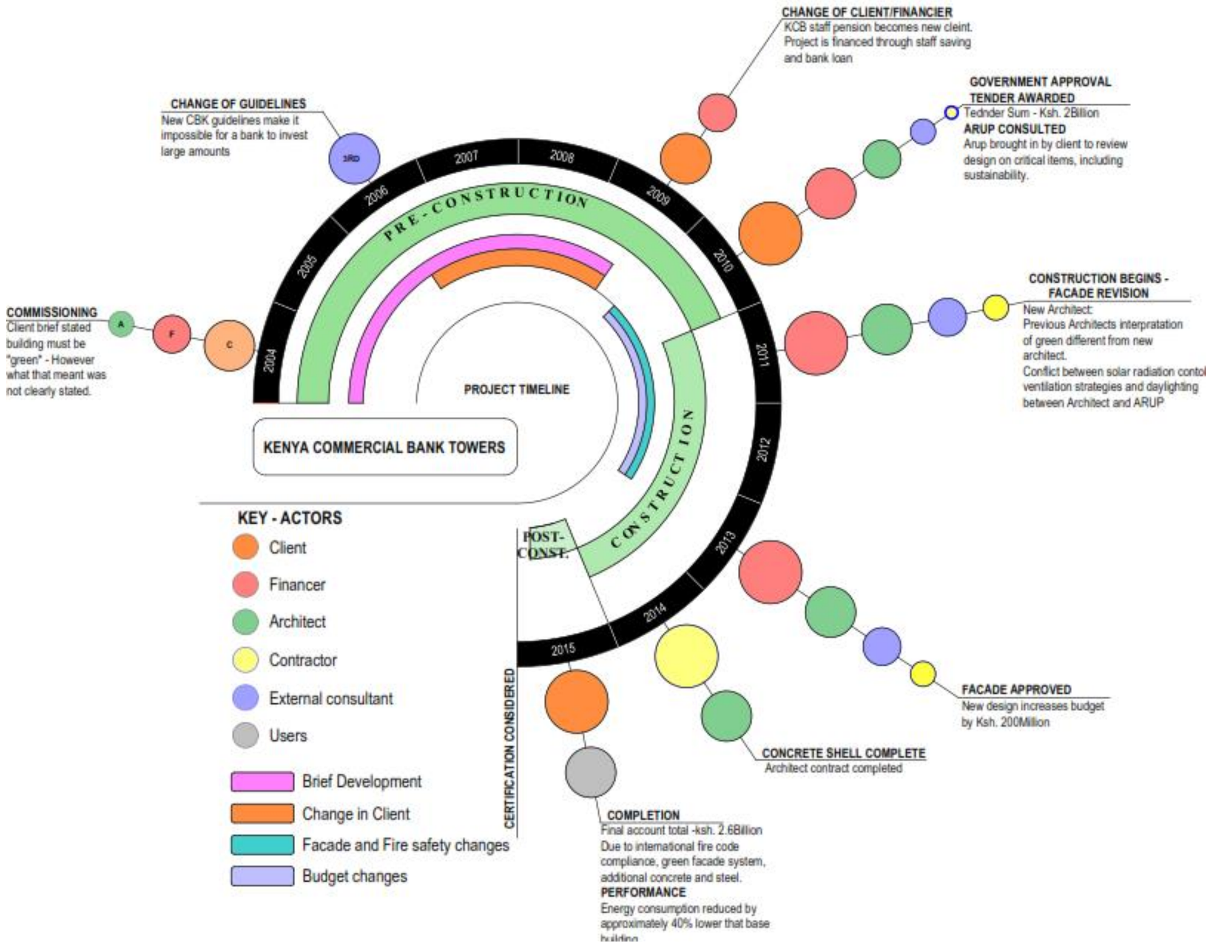

Fig. 6.35: Summary timeline of the KCB Towers design and construction process. Source: Author 2019

The first major challenge of the project came in 2006, when the Central Bank of Kenya made it impossible for banks to invest large amounts, causing the project to stall. In 2009 however, the project was taken over by the Kenya Commercial Bank staff pension scheme, which became the new client. This meant the project would be financed through staff savings and a bank loan. In 2010, the tender was awarded at a tender sum of Ksh.1.8 billion.

Construction began in 2011, with several revisions being made to the project. During this period two major changes occurred to the project design team. First, the project lead architect changed and second, the client invited ARUP, an international engineering and design company, to review critical items including the sustainability of the project. The indoor environmental quality was the greatest matter of concern, specifically thermal comfort and lighting. The main question was how to minimise heat gain while maximizing daylight without the use of mechanical systems. The building façade was revised in an attempt to answer this question.

These revisions were mainly centred around solar shading; Arup proposed a double skin façade, an inner skin of low-E glass with a visible light transmission of 60%, solar energy transmittance of 45% and a shading coefficient of 0.62. The amount of solar radiation reaching the inner skin would also be reduced by the external skin and the 1.2m slab cantilever. Several materials were proposed for the outer skin with solar energy transmittance of between 30%-50%. These included; mirror glass, coloured glass, glass with ceramic frit and 50% perforated aluminium screen. The architect argued that solar control glazing may not be appropriate given the cost involved as well as the requirement by the clients to incorporate their corporate colour scheme (green) to the façade. The use of mirror glass would lead to daylight reduction and obstructed views to the exterior. He proposed instead the use of a high thermal mass material to mitigate the seemingly unavoidable heat gain. ARUP also proposed the use of 1100m wide horizontal shading fins aimed at reducing the mid-day solar, which they argued was the most powerful. The architect on the other hand argued that the early morning and evening solar gains are also significant in Nairobi, and therefore proposed the use of vertical shading together with the horizontal shading proposed by ARUP.

There was also variance with regard to the ventilation design strategy. The project architect recommended that the building should be naturally ventilated, however ARUP, despite agreeing that this would reduce energy costs significantly, recommended the use of mechanical air conditioning, cautioning that during certain occasions the building may become hot and the open atrium would complicate any future retrofitting for cooling. However contrary to ARUP's concern, on reviewing the building during occupancy, the architect admits that the building may have been over shaded, and this is corroborated in the interviews carried out with the building users, who indicate that the building gets too cold during certain occasions, requiring the use of portable electric heaters.

This process of negotiation and compromise between the local architect and the external consultant (ARUP), illustrates a difference in design approach that can be argued is a result of contextual understanding. A case in point is that in the Western world, where the weather is characterised by extreme temperature conditions, interventions such as double or triple facades, as proposed by ARUP, are a typical solution. Whereas these solutions could work in

Nairobi, they may be inappropriate for the climate, not to mention unnecessarily expensive and therefore not economically sustainable. Local availability of these materials is also a challenge, thus creating a bias towards importation, which as discussed in the previous chapter stifles local innovation. Similarly, the recommendation of the use of AC by ARUP, when post occupancy review suggests the building was overcooled, shows a detachment of the solution from the context.

Finally, the project was completed in 2015 with a final account sum of 2.6 Billion Kenya Shillings, an increase of Ksh.600,000 from the original tender sum as a result of the changes in façade design as well as compliance with international fire codes. This case corroborates the perception that sustainable design options are likely to increase the initial cost of the project. However, as mentioned earlier, the building's energy demand is reported to be approximately 40% lower that similar buildings, and therefore the cost of running the building is lower, perhaps making the initial cost investment justifiable over a period of time.

It is worth noting that whereas the building was designed to utilise passive ventilation strategies, mechanical air conditioning systems were installed in top management office spaces as per client (user) instruction once the architect handed over the building for interior fitouts. These systems however remain largely unutilised as they were an unnecessarily costly investment. The place and importance of user understanding was discussed in the previous chapter. This case presents a good example of an instance in which design intentions were either not well understood or not appreciated by the building users, which has the potential to affect predicted building performance.

6.4.2. ANWA JUNIOUR SCHOOL

KDI brought together several stakeholders to work with members of the community to design and construct the Anwa Junior School. KDI's approach placed the community as the main stakeholder. Fig. 6.36 summarises the stakeholders involved in the project as well as their key obligations.

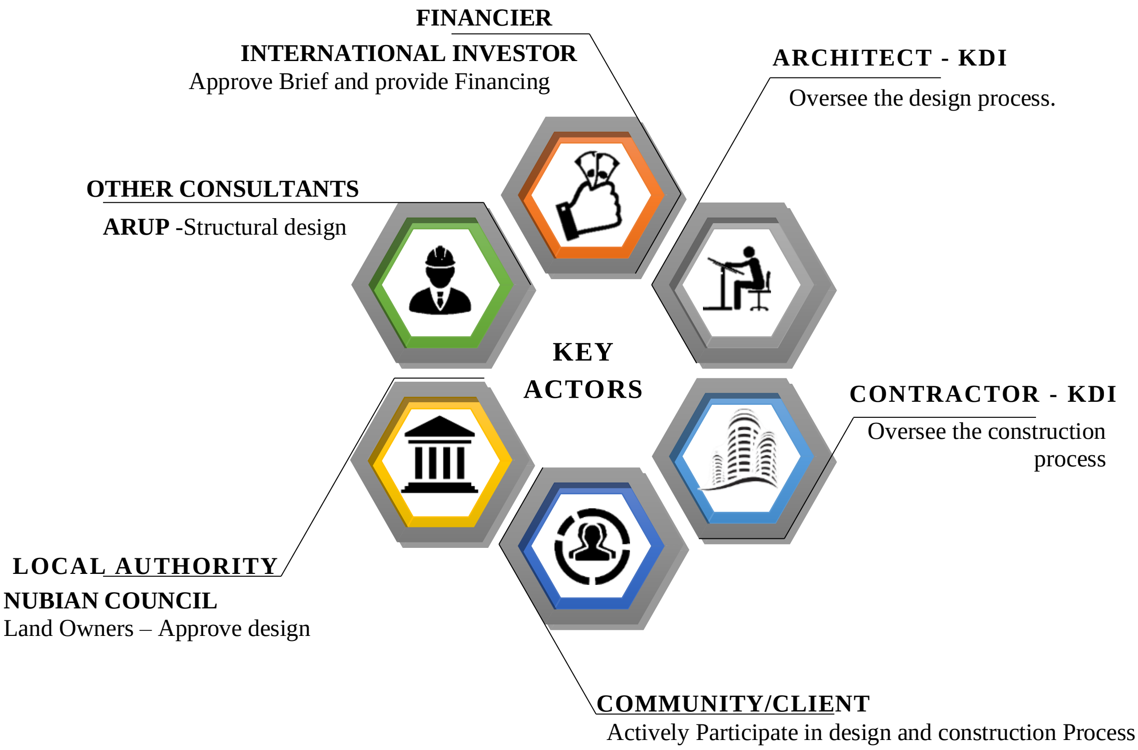

Fig.6.36: Summary of human actors involved in ANWA junior school project. Source: Author 2019

Fig. 6.38 illustrates the power changes of each stakeholder throughout the project and how each stakeholder influenced the design and construction process. In 2015, after analysis of the proposal developed by different schools in the Kibera community in response to KDI's request for proposal (RFP), KDI presented a proposal to an external German donor who was interested in constructing 100 schools across Kenya within a short period of time and within a fixed budget of approximately 13 Million Kenya Shillings per school. The donor approved their proposal and commissioned KDI to rebuild two schools within the Kibera area.

In order to develop an appropriately detailed design brief, KDI held a total of seven consultative meetings (Fig. 6.37) with ANWA school stakeholders and members of the community that allowed them to outline their priorities, participate in the development of the spatial layout, material selection and construction process. There was an ongoing debate with the project architects team, from a technical point of view, as to whether material selection should be discussed with the community. They agreed to stretch community engagement in an attempt to expand their material palate. The community was presented with different materials previously used within the context and was asked to score them in terms of preference. Despite the architect's reservations on the use of concrete, the community preferred concrete and masonry stones, due to the perceived prestige they attached to these materials.

Fig.6.37: Consultative meeting held with the community. Source: KDI, 2013

Construction began in 2016, but almost immediately stopped for a period of four months due to land disputes. Apparently, the site is located in what is termed as Nubian land, and the title deed is held by the Nubian Council who were opposed to non-Nubians building permanent structures, in this case the use of concrete and stone. This necessitated rethinking the material selection. The engineers (ARUP) insisted however, that the load bearing structure must be reinforced concrete. After several consultative meetings the Nubian council agreed to the use of concrete only for structural elements. From the workshops, several proposals were made on the alternative walling material. The community wanted a structure that would be unique on one hand but blend in with the surroundings on the other. The architects, through an experimental process, prepared prototypes based on case studies of buildings within the context for the community to approve. This led to the selection of mud (wattle and daub) on the ground floor and “patchwork” *mabati* (iron sheets) on the first floor, as is characteristic of the context, both using timber framework. This allowed construction to resume.

Fig.6.38: Summary timeline of the ANWA design and construction process. Source: Author 2019

In this case, the community were active participants in the construction process. There was a debate as to whether to have a contractor manage construction, however, due to KDI’s intention to involve the community extensively which may not have been a priority for the contractor and contextual dynamics, cost constraints as well as quality assurance, KDI opted to manage the construction process. KDI, organized onsite training on the preparation and construction technology. This training had a significant cost implication that was not anticipated during the scoping stage of the project. Furthermore, the labour-intensive preparation and construction using mud as well as prototyping and fabricating the timber and bamboo works significantly slowed down the process.

During the construction it became apparent the project would not only not be completed on time but that the initial budget would only complete the first phase of the project. It appears that the initial donor did not fully understand or appreciate KDI's vision of community involvement in creating a sustainable learning environment, or the cost and time implication embedded in this approach. Having built other schools, in a much shorter time and with less financial investment, they were not keen to embark on the second school as earlier proposed. KDI had to seek further funding to complete the project, as they felt they had an obligation to the client. The main construction work was completed in 2017 and phase II began. However due to post-election political unrest in the country, the project was put on hold until 2018.

Phase II of the design was completed in 2019. The architect points out that the slow construction allowed for extensive community engagement and that therefore the community has reported that the design meets their needs as presented all through the design and construction process.

Similar to the other cases, this project demonstrated that initial cost investment may be higher for a sustainable design approach due to several foreseeable and unforeseeable contextual dynamics. It further demonstrated that the practice of achieving design solutions involves a process of negotiation and compromise during the construction, based on different interests and sometime unpredictable circumstances, and that therefore initial design intentions may not be realised. In addition, it suggests that international stakeholders may not understand contextual challenges. Therefore, prescribed (standard) solutions may be divorced from the dynamic nature of the context.

6.4.3. THE LEARNING RESOURCE CENTRE (LRC)

Fig. 6.39 summarises the stakeholders involved in the LRC project as well as their key obligations. For this case, having worked with the architect on several other projects, according to the architect, the client gave him full discretion to make design decisions towards a sustainable building, thus the concept of sustainability was defined and articulated from the architect's autonomous perspective.

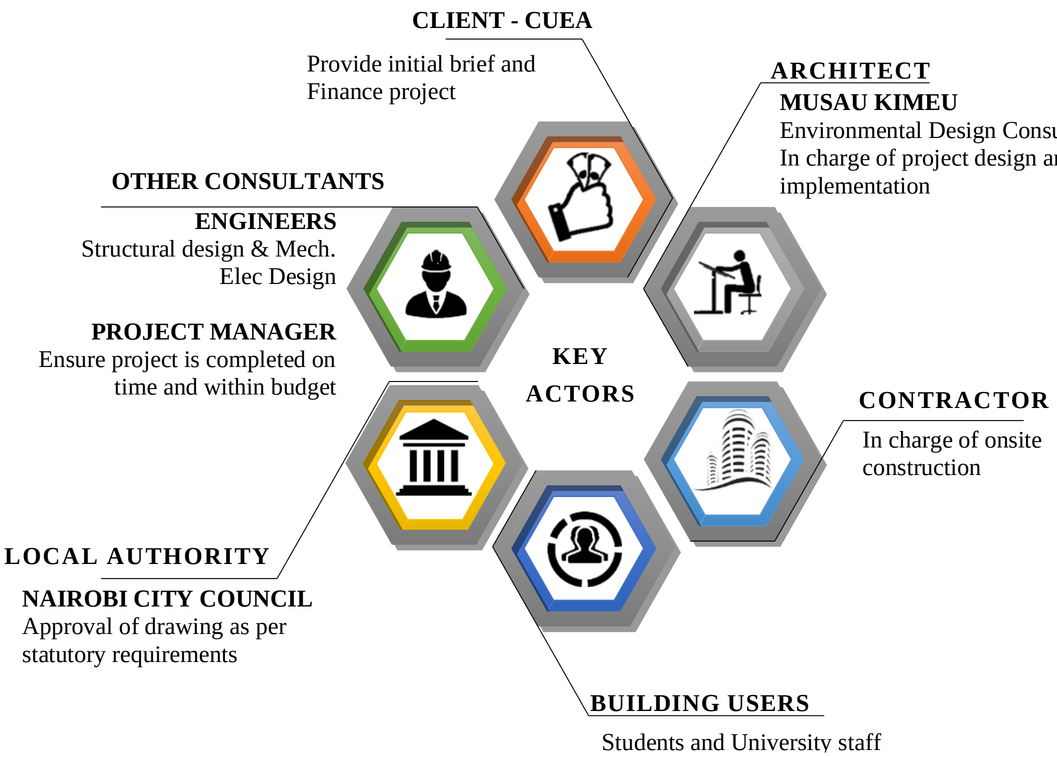

Fig.6.39: Summary of key stakeholders involved in the LRC project. Source: Author 2019

Fig. 6.40 illustrates the power changes of each stakeholder throughout the project and how each stakeholder influenced the design and construction process. The initial proposal was for a library, however in August 2005, the proposal was expanded to include a conference hall and a cafeteria. The new Learning Resource Centre (LRC) vision was conceived and driven by the then CUEA Vice Chancellor. Together with the architect's expertise as an environmental designer, the goal towards a sustainable building was fostered. The project architect explains that "the brief was for a development with acceptable comfort levels without air-conditioning and without compromising on the aesthetics of the overall quality of the spaces. The client's bold concept was matched by the architect's passion for quality environmental design" (Musau 2013-16). It is not clear however what acceptable comfort levels are in Nairobi.

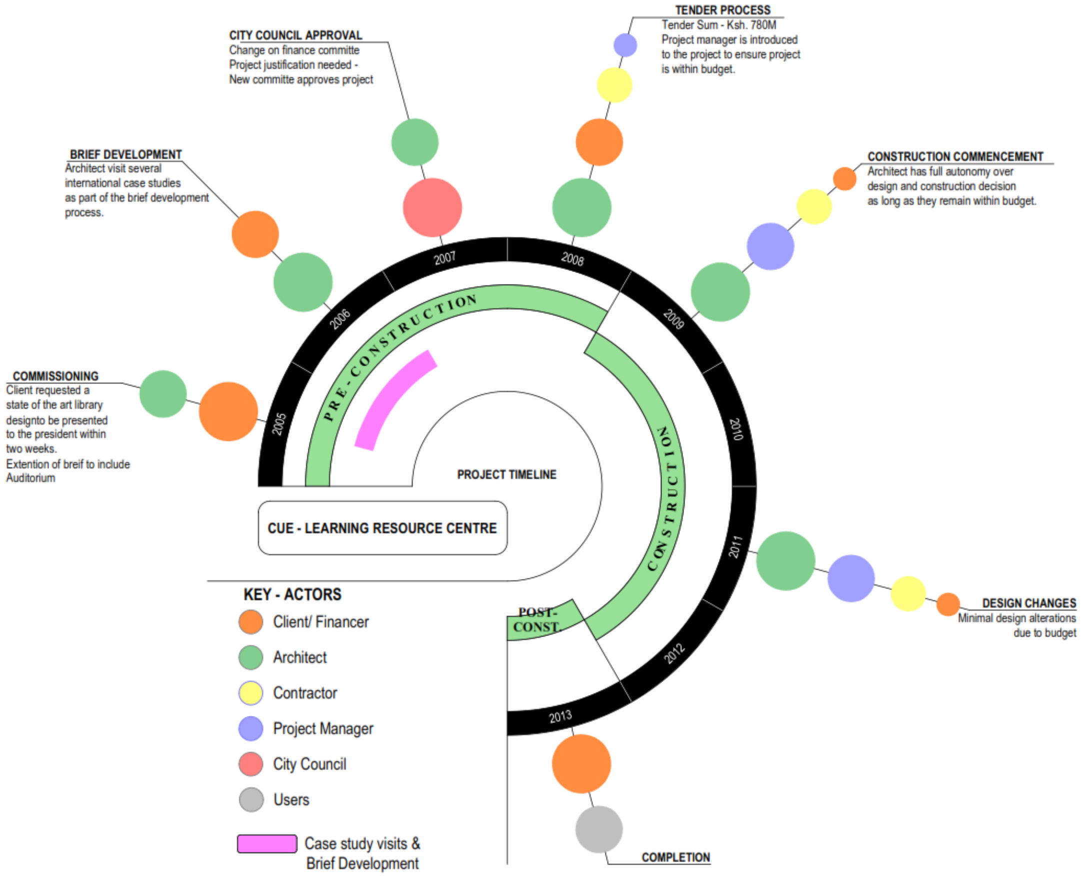

Fig.6.40: Summary timeline of the SBS design and construction process. Source: Author 2019

Following their commissioning, the architect visited several case study buildings across different cities, including Cairo, Alexandria and Rome which influenced his design. The design stage was completed at the end of 2006 and drawings submitted to the council for approval. The approval process took several months, until 2007.

In 2007, there was a change in the University’s finance committee, and therefore the architect was required to justify his design decisions and the cost of the project, as the cost was relatively high when compared to projects of a similar nature. Following the approval from the newly constituted finance team, the contractor tender process began and was completed in January 2008 with a tender sum of approximately Ksh. 780M.

A project manager was appointed to ensure that the project remained within budget. Construction commenced in April 2008. The majority of the decisions made towards achieving a sustainable building were implemented, with minimal changes made to ensure the project remained within budget. The property manager recalls the only change was the acoustic details in some of the library spaces, and this was influenced by cost.

The project was completed and completely handed over to the client in April 2013. Similar to the KCB Towers project, the research suggests that the library may have been "over-shaded." The LRC property manager reported that occupants have complained that some of the spaces get "too cold" even when the outside temperature is comfortable. Another post-occupancy similarity is the user understanding and appreciation of design decisions. In this case the auditorium was acoustically designed to function without the use of a public address system, however, after handover the client installed a public address system that has not been in use.

It is important to note that the LRC won the Green Building of the Year award by the Kenya Energy Management Awards in 2014, and the project architect, Musau Kimeu, won the Green Architect of the Year in 2015. The design's main feature, the LRC auditorium, has since been used as a case study building for several projects, not only in Kenya but also internationally. According to the architect, the auditorium acoustics exceeded performance expectations. Interestingly, when asked why he (the architect) did not seek certification for his design, he submits that whereas he appreciates the value of certification, he argues (aware that his sentiments could be controversial) that his building speaks for itself. In his words, "when you have a good product you don't have to market it…quality cannot be hidden, it is obvious" (Kimeu, 2019). His greatest apprehension to assessment systems is the commercialisation and expense that is entrenched in the assessment systems and process.

6.4.4. STRATHMORE BUSINESS SCHOOL

Fig. 6.41 summarises the stakeholders involved in the SBS project as well as their key obligations. In this case the project manager acted on behalf of the client to ensure the project was completed within time and budget, and they had the power to make or change design decisions to ensure these were met.

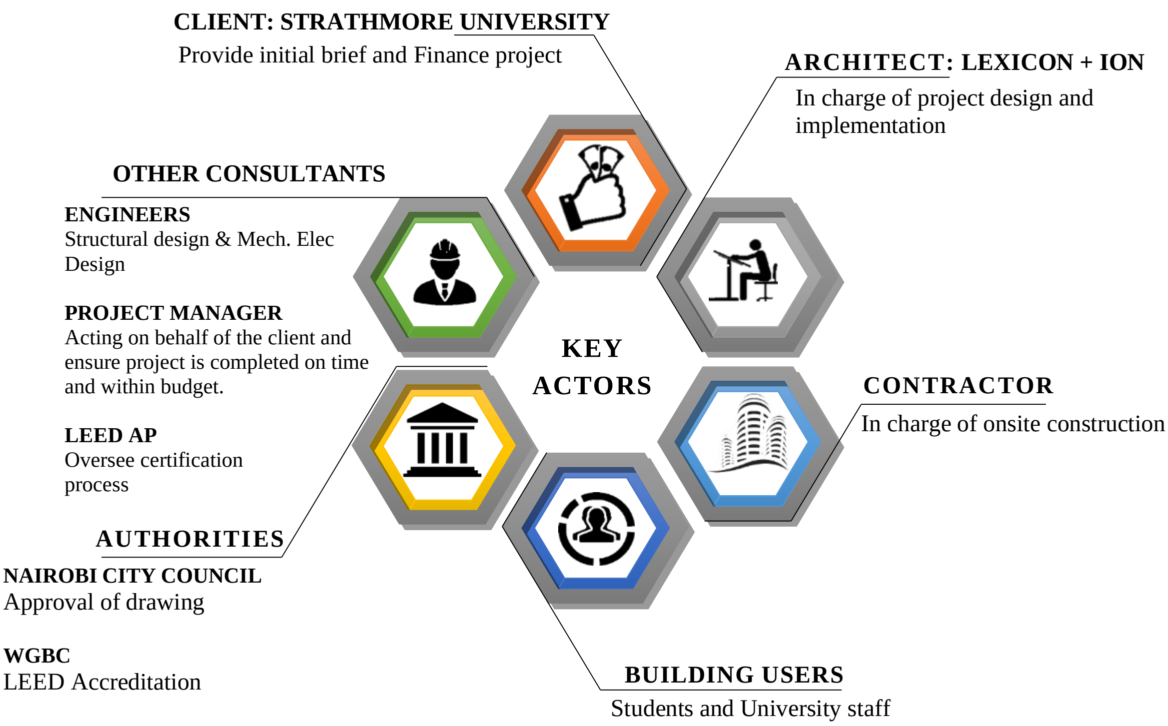

Fig.6.41: Summary of Key stakeholders involved in the SBS project. Source: Author 2019

In 2006, the architects, Lexicon + Ion, were selected after a tender process having presented the lowest bid, despite being a small firm at that time. The P.M. who was the client representative backed their bid to the management board, who initially felt that Lexicon+Ion did not have the capacity to deliver a project of that magnitude. The project manager also argued that none of the firms had designed a business school before, and so with regard to experience, none of the firms had an upper hand.

Having been awarded the project, the architect suggested to the client that the business school should be benchmarked with international business schools given the lack of local case studies. Therefore, the architects visited several schools around the world, including Lagos Business School, IESE Business School, Harvard Business School, and London Business School. The architects report that they noted a conspicuous shift from the Harvard model of opulence and age to a simpler, easier to maintain model, notwithstanding the similarity in a more inclusive circular classroom alignment layout, provision for smaller meeting rooms, as well as open spaces and lobbies. From these case studies the architect began to revise the client brief.

Influenced by the case studies, the architect made three significant changes to the initial brief. First, they recommended a change in site from an off-campus location to an on-campus site. This change brought about a significant cost saving that inspired an expansion of the brief to include the management science building and the student's cafeteria. The analysis here focuses on the Strathmore Business School (SBS) due to its 'green' recognition. Second, a change in floor area size based on the spatial requirements gathered from the case building. As elaborated in the first section, the Strathmore Business School (approximately 10,037m^2) is a four-storey building that houses executive lecture theatres, flexible classrooms, an auditorium (150 people), discussion rooms and administration offices. Third, and perhaps most significant to this study, the architects noticed the LEED certified logo on several of the schools visited, and as a result were inspired to seek certification.

With the decision to seek LEED certification approved by the client, this became the first building in Kenya to attempt this process. Before the contractor's tender process, the architect had to make a presentation to the contractor who was not aware of the LEED certification process. One immediate implication from the contractor's end was a significant increase in the tender sum, especially on the 'preliminaries sums' compared to projects of the same nature and magnitude in the same context given the lack of understanding of the implications of the LEED process.

Before the project began, the site was changed twice. First, it moved for Lavington area to Madaraka area first due the distance from the 'mother' university which is in Madaraka, second, it would require a lot of infrastructure and support buildings to make it independent, third, it would allow for the building to house other activities when the business school was not utilising the buildings full capacity. This however had significant design implications. While the overall design form did not change, the area was reduced significantly. The second change of site was due to land disputed on a section on the Madaraka site where the building was originally located. This has a significant effect on the access of the building and the original building orientation.

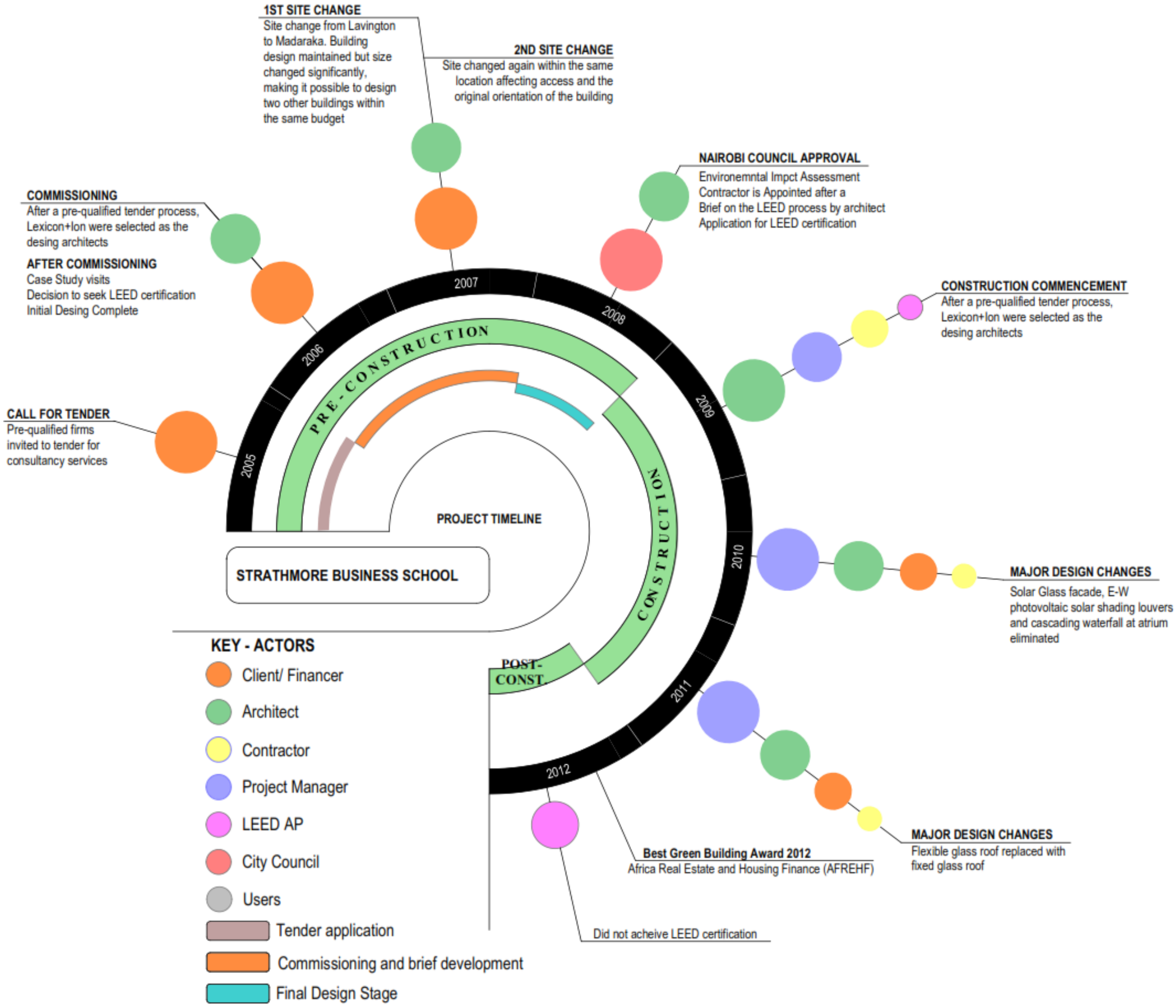

Fig.6.42: Summary timeline of the SBS design and construction process. Source: Author 2019

The project construction phase began in 2009. During construction, several design changes were made. First, the initial design proposed the use of solar glass on the façade to meet the LEED criteria for the use of renewable energy. However, the cost implication was approximately 40% more that using regular glass. This resulted in the decision made by the project manager, who fully represented the client, to use 12mm thick glass curtain wall instead. Second, the LED lighting was designed to be connected to photovoltaic solar louvers that would also act as shading devices on the East-West façade which were replaced by aluminium solar lovers. Third, the atrium was originally designed to utilise a flexible glass roof that would open and close depending on the solar radiation. However, a fixed glass roof cover was installed, also in an attempt to cut costs as well as challenges in procurement, as the project had already exceeded its completion date. Fourth, two cascading waterfalls proposed for the atrium were eliminated. These changes significantly affected the performance of the space and as result the atrium space feels like a “greenhouse” given Nairobi’s climate. The project manager’s interest was focused more on ensuring the project was achieved within budget and on time, and not necessarily on achieving the architect’s “green” building ambitions.

The project was completed on October 2011. Like the LRC project, the Strathmore Business School (SBS) has also received green building recognition. In March 2012, African Real Estate and Housing Finance (AFREHF) recognised LRC as the best green building in Africa. Since its completion it has received media attention as a pioneer in green building in Kenya and even Africa.

Unfortunately, SBS did not achieve LEED certification despite the decision to seek certification being made during the conceptual phases of the project. The implications of seeking LEED certification in terms of cost and otherwise, were not well anticipated beforehand. The lack of clear understanding by the consultants and contractor at that time, given it was the first project in the country to seek LEED certification, as well as the complexity embedded in the process, created a major challenge.

Some of the decisions taken in order to achieve certification, despite being possible solutions, may have not been appropriate for the context. For instance, the bicycle parking and changing rooms were not appropriate for the context as cycling is not a common means of transport, especially for the SBS’s target market. Therefore, the changing rooms are now used as storage spaces. Similarly, the evaporative cooling units have faced maintenance challenges given the lack of local expertise.

Reflecting on the project, the architect posits that he would only recommend LEED certification to clients who have to partner with international companies, but not to local investors targeting the local market given the significant cost and time investment, the complexity that comes with the lack of contextualisation of the tool and the general complexity of the process. It is worth noting that Lexicon + Ion have since designed another building, the Wrigley’s Headquarters in Nairobi, which achieved LEED Gold standard. Based on this design, he (the architect) holds that seeking LEED Gold is a major financial investment that has more to do with marketing than environmental concerns. He points out that often decisions were made in order to “tick the LEED box” and may not necessarily add value to the project. For instance, the use of double-glazed windows and heavily insulated walls in the newly constructed Wrigley's building is not necessary for tropical climates but was done to meet the LEED criteria.

6.5. CASE STUDY SYNOPSIS

Despite a relatively similar geographical context, the approach and implementation – demonstrated through the case studies – of green buildings appears to take different trajectories. The question remains, what is a sustainable or green building in Nairobi? Is it a building that is certified? Or one that actively or passively responds to climate, or perhaps one that involves the community during design and construction? The answer to these questions appears to depend on who is defining it. So, perhaps the question should be who decides and why? This investigation on the case studies was divided into two sections; the first sought to understand the physical attributes of the buildings as artefacts while the second part attempted to interrogate the "human" (socio-political) processes through which these artefacts were realised.

Table 6:6: Summary of the technical strategies in all case buildings. Source: Author 2019

	KCB TOWERS	**LRC**	**SBS**	**ANWA SCHOOL**
				
ORIENTATION	North West & North East	East - West	North West – South East	Northwest – South East
MAIN MATERIAL	Natural stone and concrete	Natural stone	Natural stone	Mud wall and '*mabati*'
SOLAR SHADING STRATEGY	High Thermal Mass Façade Horizontal and Vertical Shading	High Thermal Mass Façade Horizontal and Vertical Shading	High Thermal Mass Façade Horizontal Shading	High Thermal Mass Façade Cross Ventilation
VENTILATION STRATEGY	Cross Ventilation Stack Effect	Cross Ventilation Stack Effect	Evaporative Cooling System	Cross Ventilation

With regard to physical attributes, the following conclusions can be drawn. First, buildings should as much as is possible be oriented East-West to minimise direct solar gains. Second, the cases seem to advocate the use of materials with high thermal mass for the exterior façade, together with horizontal and vertical shading devices, as a solution to thermal comfort.

Third, three of the case studies demonstrate successful ventilation through the use of passive strategies - cross ventilation and stack effect – while active strategies seem to present challenges in terms of procurement, cost and maintenance. Fourth, all case studies attempted to take advantage of Nairobi's daylight hours by maximising daylighting. To compliment natural lighting energy efficient LED lights together with sensor lighting were employed. Fifth, the selection of materials seems to depend more on availability and not necessarily sustainable properties.

Although all cases attempted to use locally available materials, clients' decisions to import materials were influenced by quality and cost. Sixth, concerning resource efficiency, passive methods of reducing the buildings' energy demands were preferred due to Nairobi's climate conditions and the prohibitive cost of active systems. Rainwater collection on the other hand seems to be a possible solution for water management, but further study is required to ascertain feasibility. Finally, despite waste management being one of Nairobi's biggest challenges, very little consideration seems to be given to this issue.

From this case study investigation, one could argue that conventional standard building practices in Kenya have the potential to outperform those in Western contexts with more developed certification systems. For example, the non-specification of air conditioning due to climatic conditions and cost implications, coupled with the use of renewable energy, would not only lead to a significant initial and running cost saving but would also reduce carbon emissions. Similarly, the common use of local materials due to the geographical difficulty and cost of importing construction materials, plays a significant role in the performance of the building.

6.5.1. EPISTEMOLOGICAL DIFFERENCES

As discussed in Chapter 2, the sustainable design debate tends to take distinct though interconnected ideological approaches; the bio-centric approach, the climate-centric approach, the eco-cultural approach, and the techno-centric approach. If these buildings are examined under these lenses it would suggest that SBS took a more techno-centric approach when compared to the other buildings, while the LRC and KCB Towers opted for a more climate responsive approach, similar to the tropical architecture that is characteristic of the modern movement in tropical countries. Anwa Junior School took the more radical eco-cultural approach. As concluded in Chapter 2, neither of these approaches are right or wrong but their use is determined by various factors that influence and affect the project. Moreover, this does not suggest that each building took a distinct pure ideological approach. A close study of the buildings would reveal an overlap in these approaches. The distinctness of the end product is the result of different contextual technological, socio-cultural and economic considerations. This investigation supports the argument that sustainable design cannot be divorced from both the physical and human dynamics of the context.

From the case studies, it is evident that the epistemological approach is fundamentally influenced by the way in which the concept of sustainability is constructed and interpreted by those making decisions on the project. In addition, the availability of resources (predominantly financial) has a significant impact on the definition and approach. For these cases, the approach seems to be exclusively influenced by the architect's understanding of the concept. The research found that these architects' constructions of the concept of sustainability are derived from distinct influences.

As illustrated in the Anwa Junior School case, KDI strongly believe that sustainability is achieved fundamentally through community participation. However, their bias towards projects that involve communities living in extreme poverty influences their approach by placing socio-economic considerations at the forefront during decision making. It is therefore no surprise that the Anwa School design and construction took a more eco-cultural approach. While being cognisant of environmental issues, KDI attempted to work with the community to develop a solution that would not only appreciate but celebrate the local context, create much needed vitality within the community, and would be resilient to contextual challenges.

SBS on the other hand was driven by the vision to have a “benchmark” building both locally and globally, and the client’s financial capabilities allowed the architect to explore several solutions. Consequently, the architect’s proposal to have the building certified as a way to gain global recognition - especially given that no other building in Kenya had gained green certification at that time - was embraced by the client. The choice to seek LEED certification led to a more techno-centric approach prescribed in the LEED system. A case in point is the choice of evaporating cooling systems as a ventilation strategy, influenced by the bias towards active strategies evident in the LEED systems highlighted in Chapter 4.

The architects’ background as environmental designers in the LRC, and KCB projects influenced the approach each building took and is evident in the similarities between the two projects. The location of the two buildings influenced the execution of the approach: KCB is in an urban context where space is limited and therefore maximum use of space is a priority, coupled with the microclimate created in an urban context. The location of LRC however, in the leafy suburbs of Karen with its flexibility of space, meant significantly fewer site constraints.

It is worth noting the challenges that may be associated with a technological approach. The research suggests the need for a more critical evaluation of the use of technology as a sustainable solution. As exemplified in both the LRC and SBS, not only does this approach present procurement challenges, but more significantly there are also maintenance challenges that come with the use of foreign technology. In the LRC project for instance, the fountain in the library designed to improve the thermal comfort was only functional for a short while after occupancy. Similarly, the IEC units that support displacement ventilation in the SBS building also remained functional only for a brief period after construction. The malfunctioning of these systems has had an effect on the predicted performance of these buildings. Therefore, it is important to ask whether the technology used can be maintained with ease and, if technology is imported, is there local capacity to replace, repair and maintain this technology? But more importantly, is the use of technology necessary?

6.5.2. STAKEHOLDER POWER AND RELATIONSHIP DYNAMICS

These cases clearly illustrate the extent to which the approach and outcome of the project is dependent upon the interests and power to influence of each stakeholder involved in the project. This study suggests that the advancement of a sustainable design solution is contingent on establishing a shared vision among the stakeholders that ensures a convergence towards final objectives. Similarly, the integration of stakeholders to this shared vision increases the mutual understanding of objectives as well as creating a platform for exploration of ideas. Notwithstanding the difference in their construction of the concept of sustainable design, all four projects sought to develop a “green” (sustainable) building explicit in the pre-construction stages and outlined in their designs. However, none of the projects achieved their goals in their entirety. The study suggests that this could be attributed to the lack of shared vision towards the development of a sustainable building as a priority.

As is characteristic of any design construction project, due to its complexity, several challenges arise during design, construction and occupancy of the building that require decisions to be made. It follows that the decisions made are influenced by the powers held by each stakeholder. For instance, in the SBS project, although the architect’s vision was to deliver a green building as per LEED standards, the project manager’s priority was to deliver the project within the prescribed time and more importantly on budget. In this case, the project manager had more power and therefore the architect’s design had to be compromised to fit within the budget and time. Similarly, in the Anwa Junior School project, KDI’s intention to have a community led sustainable design approach as a priority was not shared by the financier, whose main priority was to achieve a fixed number of schools within a fixed budget.

This study shows that the role of building users as stakeholders is often neglected, yet they play an important role in the performance of the building. Cole (1999) explains that “beyond external factors, such as specific weather conditions during specific time periods, the actual performance of the building depends on the behaviour of occupants, tenants and the actions of buildings operators” (p.237). Therefore, the predicted performance of the building is likely to differ from the actual performance of the building in use. The LRC library, for example, is designed to utilise natural light during the day, but occupants still turn on artificial lighting. This is exacerbated by the lighting design that did not take into account that often only small sections of the library will be in use at different times, as it is designed for optimum use only. The library might have less than half occupancy with almost 90% of the artificial lighting turned on. Another example is the LRC auditorium, which despite the outstanding acoustic performance of the space, requiring no public-address system, one was installed because the client did not fully comprehend that it was possible to use the space without a public address system. Similarly, in the KCB tower building, despite the building being designed to function without any form of mechanical ventilation, the client installed air conditioning systems during the fit-out stage in the high-level management offices as part of the office requirement. These systems have remained largely unused as they were not required. This suggests that the overall efficiency of the design and technological innovation or installation cannot be divorced from the user. It is therefore important to ensure that the occupants of these buildings are cognizant of and appreciate the green benefits of the design and technology incorporated within the building: only then can the building's performance potential be achieved.

6.5.3. INTERNATIONAL INFLUENCE

The previous chapter revealed a disconnect between the stakeholder perception of the concept of sustainable design against the understanding of contextual dynamics fundamentally as a consequence of international influence. This chapter attempted to reveal the impact of that disconnect, highlighting the tensions between appropriate local responses and different forms of international influence. Taken together, the international influence evident in the case studies in this research can be categorised into three broad sources; international case studies as "benchmarks", the presence of international stakeholders, and the use of international standards and assessment systems. Table 6.7 summarises the different ways in which international influence was present in each of the case studies.

Considering case studies, the use of international case studies is not limited to sustainable design as discussed in the foregoing Chapters (4 & 5). Right from architectural training, there is a distinct bias towards the use of international, often Western buildings and approaches as case studies. This is exacerbated with the introduction of "new" concepts, often from the West into the local building industry. For the SBS project for example, the idea to seek LEED certification arose entirely from the case study visits. In the project architect's words, "we saw these badges on the walls of many of the case studies we visited and wondered what they were about."

On the other hand, as evidenced in the KCB tower project and Anwa Junior school, when international stakeholders in this case ARUP are introduced to a project it is important not only for them to fully understand the local context to ensure the contextual appropriateness of the solutions they propose, but also to ensure the solutions are beneficial to the intended users and local community and not self-serving. Furthermore, the introduction of these consultants into this project carry an additional cost, especially since they are often paid comparatively more than local experts.

Similarly, with international assessment systems, as evidenced in the SBS project, the appropriateness of certain solutions chosen in an attempt to check the criteria boxes can be challenged.

Table 6.7: Summary of the socio-political issues in each case study. Source: Author 2019

	KCB TOWERS	**LRC**	**SBS**	**ANWA SCHOOL**
				
APPROACH	Bio- Climatic	Bio- Climatic	Techno-Centric	Eco-cultural
INTERNATIONAL INFLUENCE				
CASE STUDIES	International Case Studies (Introduced by ARUP)	International Case Studies	International Case Studies	International Case Studies
MATERIAL SELECTION	50% Locally sourced 50% Imported	Approximately 90% Locally sourced. Floor tiles and rubber floor imported	90% building finished imported	100% Locally sourced
CONSULTANTS	External Consultants (ARUP)	-	External LEED Accrediting Professional	External Consultants (ARUP)
FINANCING	-	-	-	International Financier

6.5.4. COST IMPLICATIONS AND VALUE ENGINEERING

All four projects, irrespective of scale, indicate a relative increase in initial cost investment in realising their sustainable design strategies. Furthermore, in all four projects, it is not explicit how and how long this initial cost investment would be recuperated. As Janda and Von Meier (2005) suggest, this saving "depends in part on what is being counted and who is doing the counting” (p.35). With reference to KCB towers, the LRC and SBS, the architects and property managers report a decrease in the building’s energy demand which translates to a saving in running costs. Similarly, there is no evidence of a clear performance measurement matrix for any of the projects. Often, even with the attempt to apply financial models to argue projected future cost benefits, these models are devoid of capacity to project future overall benefits of green practices, partly owing to the dynamic nature of different variables over a period of time. Thus, the value addition for these sustainable solutions may be difficult to appreciate and therefore this could explain why initial cost implications may be prohibitive.

With reference to initial investments costs, KCB’s initial budget of Ksh. 2 Billion for example increased by about 200 Million as a result of the façade design change to a more sustainable solution. The project cost eventually rose to 2.6B Ksh. as a result of the revision of fire safety standards as advised by external consultants ARUP and a few other changes. Similarly, according to the architect, the LRCs auditorium cost approximately Ksh. 85,000 per square metre which at that time was about Ksh. 10,000 more per square metre compared to a conventional design. Anwa Junior School encountered an increase in labour costs as a result of the process of training the community and prototyping the various components of the building, forcing the architects to seek alternative funding in order to complete the project. Even with the appreciation that any building design undergoes changes during construction, it appears that the changes are magnified in projects that aim to be sustainable.

The LRC attempted to break the misconception that green buildings are expensive. However, despite the initial contract having solar installation, this was eliminated in favour of furniture installation which was not included in the initial tender. This is similar to SBS, where changes had a significant overall impact on the performance of the building. The glass façade was initially designed as a solar glass curtain wall, however due to challenges in procurement and the costs associated with this technology, this was abandoned and 6mm thick clear glass was used instead.

From these studies, it appears that not only is anything referred to as “green” practice (despite its definition) still considered as an add-on to conventional building practices and therefore when cost challenges arise, they are easily stripped, leaving the building with its basic utility, but there is also a lack of comprehensive understanding of the cost implication of these sustainable design decisions from the onset of the project, thus rendering the solutions unsustainable.

6.6. CONCLUSION

This chapter sought to analyse the human (stakeholder) and non-human (physical attributes) dynamics that influence the building as artefacts. The first section documented and comparatively analysed the physical attributes that render the four buildings sustainable. The second part sought to describe and map out the design and construction process of each case highlighting key decision making points in the process and the power dynamics of stakeholders at this points. The third part collated the findings of part one and two.

From the analysis it is evident that the epistemological approach to sustainable design is shaped by the way in which dominant stakeholders involved in the design and construction process working within the context of Nairobi construct the concept. Moreover, these stakeholders different interests and influences affect their interpretations of sustainable design.

With reference to the buildings physical attributes, given Nairobi's climate, this study indicates a consensus that in order to minimise direct solar gain, wherever possible, buildings should be oriented East – West. Second, material selection should be biased towards material with high thermal mass, local availability, predominantly building stone for the case of Nairobi. Third, indoor environmental quality can be achieved through passive approaches. From the analysis, the comparatively low energy demands for cooling and heating capacitated by the relatively mild climate in Nairobi would dictate unless unfeasible, the reduction of energy demand in the built environment through the use of passive design strategies barring specialised spaces. This would include the use of horizontal and vertical shading devices, natural ventilation through cross ventilation and stack effect and the use of natural lighting through narrow building plans, open plan design and roof lighting. Where this is impractical, the use of renewable energy alternatives with energy efficient systems should be considered.

Aside from the physical attributes, the case studies demonstrated the extent to which contextual dynamics, stakeholders relationship and power dynamics, international entities (external consultants, case studies, international assessment system) and cost implication (market dynamics) influence the construction of sustainable design. This furthers the argument that sustainable design approaches are contextual social constructs and therefore should not and cannot be standardised.

Having investigated the contextual dynamics in Nairobi in Chapter 4, followed by an investigation of the stakeholder's perception of the concept of sustainable design in chapter 05, and finally this chapter's investigation of the different ways in which sustainable design has been articulated in Nairobi's built environment. The subsequent chapter moves to triangulate and theorise the findings from Chapters 4 through to Chapter 6.

CHAPTER 7

SITUATING THE CONCEPT OF SUSTAINABLE DESIGN IN NAIROBI, KENYA

"If universal truth is constructed through the epistemology of a particular territory or body (whether it be Western, Christian, or Islamic), and through the exclusion of others, then the cosmopolitanism or global proposal that it is constructed through this abstract universalist epistemology will be inherently imperialist/colonial.

Grosfoguel, 2012, p.94

7.1. INTRODUCTION

This chapter attempts to theorise the findings from the foregoing Chapters, 4, 5 and 6. What really is sustainable design? Who and what are being sustained? Why is it /they being sustained and ultimately how is it /they being sustained? These are the questions that this research began by asking.

Chapter 4 discussed several contextual dynamics that influenced the discourse of sustainability in Nairobi highlighting climatic, social, economic and technological realities that would shape the problems, process (approach) and ultimately the solutions (building) for a sustainably built environment. The analysis of Nairobi's existing built environment demonstrated how Nairobi's colonial past, the "Western" image of modernity and the current globalisation has and continues to influence it's evolution. Consequently, the comparative analysis of the assessment systems indicated through the variations in weight distribution in different categories, the prioritisation of issues based on the variations in local conditions. The inappropriateness of the transferability of international assessment systems was apparent as a result of the diversity in local problems, dynamics and priorities. Chapter 5 and 6 demonstrated how different stakeholders epistemological differences shape the construction of sustainable design and ultimately the building as an artefact. It also highlighted consensus among stakeholders on several physical attributes that would constitute a green building in Nairobi. Furthermore, these foregoing chapters underscored several ways in which international influence through precedent studies, external stakeholders and assessment systems and global market dynamics shape sustainable design in Nairobi. There was an apparent disconnect between local problems, priorities and solutions on the one hand, and the perception and construction of the concept of sustainable design on the other hand.

Following these discussions, this chapter engages with the larger discourse of the politics of knowledge and its construction in relation to sustainability, seeking to confront Western constructions of the concept of sustainability, and by extension sustainable design imposed on developing cities specifically Nairobi. As epistemology is the theory that dictates what counts as knowledge and why it is believed to be true or valid, the chapter investigates the Western epistemology of knowledge construction and its influence on other epistemologies. In doing so, the research continues the arguments around anti-Eurocentric thinking previously submitted by scholars such as Ngugi wa Thiongo (1981), Chinua Achebe (1958), Wiredu

(1992), Tuhiwai (1999; 2006), Mignolo (2007; 2009; 2010; 2018), Escobar (2004; 2007; 2010), Quijano (2000; 2002; 2010) and Dussel (2000), who critique epistemological impositions of knowledge and knowledge construction processes, in this case with reference to sustainability. Fundamentally, the research established an intersection between knowledge construction, hegemony, legitimacy and sustainability.

“Modernity’s Eurocentrism lies in the confusion between abstract universality and the concrete world hegemony derived from Europe’s position as centre” (Dussel 2000, p.471). From this research, there is a distinct antagonistic relationship between western epistemologies and local epistemologies. Local knowledge construction has significantly been influenced by Western epistemology to an extent that one could argue has become Western, which does not benefit local society. In the case of sustainability, knowledge is constructed in terms of global warming and climate change, which is grounded in Western science and thus proposed solutions, prioritise adapting wealthy, culturally rich Western lifestyles, without endangering that wealth. In doing so, other contexts, especially African contexts, are deemed irrelevant and often excluded. Discordantly, as this chapter will demonstrate, Western epistemologies seek dominance and supremacy, while as this research (Chapters 4-6) found, local construction of knowledge struggles to deal with local challenges and priorities on one hand, while seeking legitimacy from the West on the other hand. This pursuit for legitimacy from the West stems from what ‘Western’ represents for developing countries like Kenya. Overall, two fundamental issues, that are in part correlated and in part competing emerge; Western intention and Southern response. By way of example, as demonstrated in Chapter 4, in the case of the assessment systems predominantly developed in the West, besides the obvious economic (capitalist) gain from establishing a global footprint, like any other standard, the Western intention is to establish authority and control, to define, dictate and determine what counts as ‘green’ or ‘sustainable’. Unfortunately, the response by cities like Nairobi, on the other hand, plays into these intentions by adopting these systems without interrogating them. As evident in the stakeholder perceptions and in the case study analysis, there is a clear disconnect between the local priorities and challenges and those addressed in these assessment systems developed in the West. Thus, disappointingly, as Chapter 4’s exploration of Nairobi’s skyline, as well as the Euro-centric education and political systems discussed in Chapter 5 suggests, as the West creates structures that negate, devalue and exclude knowledge from cities like Nairobi, these cities continue to legitimise these structures. This section examines how historical and present global conditions and systems create and continue to influence this position in which cities like Nairobi finds themselves inextricably entangled.

This research's critical argument on contextualising knowledge, highlighted that the theory of knowledge is not politically neutral, nor can it exist outside of politics. Consequently, if politics is not standard then standard knowledge cannot exist, nor can it be applied universally. Thus, there is the imminent need to interrogate and engage with knowledge from a less pretentious universal standpoint to one that is "more aware of its limitations, its partiality, its interests and motivations, and its positionality" (Reiter 2018, p.8). As this research found in Chapter 5, through the interviews with the stakeholders, and Chapter 6, through the case study analysis, the construction of the concept of sustainable design in Nairobi is considerably influenced by Western constructions of this concept as well as global market dynamics. Consequently, this chapter seeks to theorise how and why international influence continues to repress countries in positions similar to Kenya and builds on the dialogue around epistemological change towards a situated construction of the concept of sustainability.

Finally, the chapter concludes by exploring the notion of decolonial thinking, together with Haraway's concept of "situatedness". Both these concepts present processes of unmasking the hegemonic nature of Western modernity and knowledge construction towards self-determination. In essence, it is the process by which cities like Nairobi construct their own meaning, in their own language while cognisant of their priorities and contextual dynamics and challenges. In this case, in an effort to create a situated sustainable built environment.

7.2. INTERNATIONAL INFLUENCE ON CONSTRUCTION OF KNOWLEDGE

> *"Decolonisation...does not mean and has not meant a total rejection of all theory or research or Western knowledge. Rather, it is about centring our concerns and world views and then coming to know and understand theory and research from our own perspective and for our own purpose"*
>
> *(Tuhiwai, 1999 p.39)*

The analysis done in the previous three chapters highlighted several ways in which international influence affects the knowledge construction of the concept of sustainable design as well as decision making, as evidenced by Nairobi's built environment. It is evident that, for each stakeholder and each case building, international influence has a significant impact on the perception of sustainable design in distinct ways. As evidenced in Chapter 4, this influence on the built environment is not limited to sustainable design and construction practice, Nairobi's built landscape and its relationship to its environment (nature) has been radically transformed by Western images of spatial form and order.

Considered together, the analysis of the data from the stakeholder discussions and case study buildings distinguish three phenomena that contribute to international influence in Nairobi's building industry; coloniality, modernity and globalisation (Fig. 7.1). Therefore, it is imperative to question how the formation of 'new' concepts such as sustainable design sit within the existing colonial, modernity and globalisation matrix in order to avoid the creation of variations of Western epistemology. Instead, develop de-colonised epistemologies, as Mignolo (2009) submits, the use of Western epistemology would result in "reforms not transformation" (p.15).

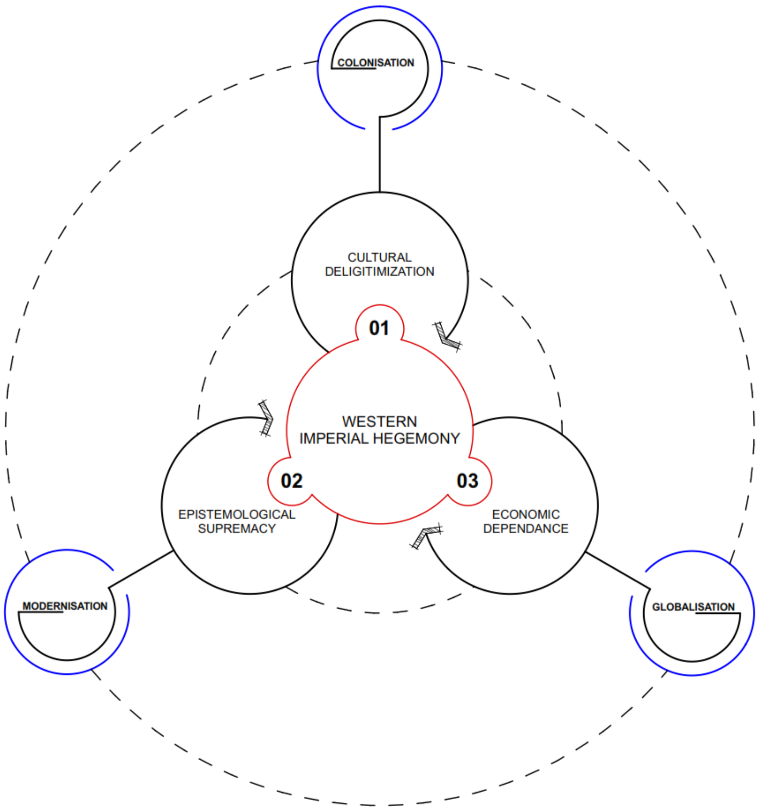

Fig. 7.1: Relationship between colonisation, modernisation, globalisation and Western imperial hegemony. Source: Author 2019

7.2.1. THE LOOMING SHADOWS OF COLONIAL HISTORY

In order to understand the process of knowledge construction, in this case with reference to sustainability in Kenya, like other African countries, it is imperative to begin by situating the process of knowledge construction within the country's imperialist colonial history in an attempt to conceptualise its continued impact. Colonisation represents, as Tuhiwai (1999) posits, the "imposition of Western authority over all aspects of indigenous knowledges, languages and cultures" (p.64). From this research it is evident that colonisation has had far reaching effects not only on Nairobi's built environment but, its language, culture and identity. Beyond territorial control, colonisation meant the destruction and delegitimization of not only indigenous cultural but also established cultural and scientific knowledge ontologies and epistemologies. This involved the imposition of a world system in which as Grosfoguel (2011) asserts, "a European/capitalist/military/Christian/patriarchal/white/heterosexual/male arrived in the Americas (in this case Africa) and established simultaneously in time and space several entangled global hierarchies" (p.7-8). This thereby created what Escobar (2007) termed a "privileged epistemological and political space" (p.185).

Since the inception of post-colonial 'modern' African cities like Nairobi, Western influence has been a predominant driving force for development (Manuel, 2015). Incipiently, from the analysis in Chapter 4, modernisation of Nairobi cannot be divorced from colonisation which was imbedded with external hegemonic influences from its former colonial powers. As in Nairobi, the presence of European influence is evident in the landscapes, regulatory systems and education systems of several African cities. One respondent in this study explains that, "I feel that our being colonised by the British and by extension Europe brought about our current thinking that what comes from the West is good, what is home grown is bad" (Participant MK). Kenya, like many African countries were socialised to believe in the aggrandised concept of the West. This imposition of Western superiority and positionality is evident in how the Western world referred and continues to refer to African countries as "the ancient world, … the primitive world, the third world, the underdeveloped world, the developing world and (more recently) the global south" (Comaroff & Comaroff 2012, p.144).

The Western world actively created distorted narratives that misrepresented African realities as knowledge from indigenous societies was collected to advance the colonial agenda. In one of his speeches, *"Native policy of Africa"* delivered in 1929, Smuts describing Africans, asserts, "it (Africans) has largely remained a child type, with a child psychology and outlook…No indigenous religion had been evolved, no literature, no art…no architecture…" (Scheub, 2010, p.59). In this (like several other similar narratives) Western contestation and disregard for indigenous forms of religion, art and architecture, Africans were robbed of their identity, legitimacy, and knowledge forms, which paved, way for the imposition of Western forms of knowledge.

This research through the analysis of Nairobi's built environment and stakeholder dynamics, suggests a strong link between knowledge construction, identity and legitimacy. The latent Eurocentrism embedded in Western knowledge epistemologies renders it difficult to dissociate knowledge from power, identity and legitimacy. It follows that, perhaps the most significant consequence of colonialism was the deprivation of Nairobi's local identity, global legitimacy and recognition. This appears to be the case for other similar cities across Africa. Western epistemology of knowledge sought and continues to seek to impose "universal truth", through homogenisation of knowledge using language, narratives, design standards, and assessment systems among other ways. It further seeks to regulate how this knowledge is interpreted, applied and consequently legitimises its application based on the West's own assessment. The universalist notion as Grosfoguel (2008) posits, presents itself as a "disembodied" impartial global design disguising the epistemological position of its origin. However, despite the aim of the Western epistemology of knowledge construction that the knower assumes the position of a detached neutral observer in pursuit of objective truth, the politics engrained in knowledge construction suggests that the knower is inextricably linked to the known. From the study, this is manifested in the clear antagonistic relationship between the struggle to understand, prioritise and mitigate local challenges on one hand, and the pursuit for legitimacy from the Western world, which as highlighted often does not understand or even care to understand the context as they carry their own vested interests.

Furthermore, the entrenchment of Western epistemology is exacerbated by education systems in several countries in Africa that largely remain as colonial products entrenched in Western ideologies (Ngugi wa Thiong'o 2009; Ntarangwi 2004). Previous arguments have place universities as "the most enduring colonial institutions" (Nhemachena *et al.*, 2016 p.12), and data collected in this study presents a similar picture within academic spheres. In several developing countries, many of the Eurocentric theories remain unquestioned, and this is not only limited to architecture or higher education for that matter. In Kenya for example, primary school students are still being taught that Mt. Kenya, which has existed for more than three million years, was discovered by Ludwig Krapt, while in fact the indigenous Agikuyu people lived at the foot of Mt. Kenya long before the Western Invasion. This is a reflection of Du Bois' (1946) argument that "education was so arranged that the young learned not necessarily the truth, but the aspects and interpretation of the truth which the rulers of the world wished them to know and follow." Maathai (2010) similarly argued that the removal of culture from the school systems "contributes to the trivialization of anything African and lay the foundation for a deeper sense of self-doubt and an inferiority complex" (p.60). This imposed perception of the supremacy of Western theory is influenced by the idea of what "Western" represents. The tragedy is that some books now published by Kenyan institutions like the Kenya Institute of Education and Kenya Literature Bureau still reflect some of these Western ideologies. Thus, it is no surprise that when the Western world introduces 'new' concepts such as sustainability and by extension sustainable design or green buildings, African cities - Nairobi included - are quick to adopt this concept without critical interrogation.

With reference to sustainability, the challenge is that the concept is posited primarily as a technical and scientific problem and therefore requires a universal truth, when in fact it is as much embedded in local culture and politics.

7.2.2. WHAT "THE WEST" REPRESENTS – THE CHASE FOR LEGITIMACY

"Modernity" was imagined as the house for epistemology.

Mignolo 2006, p.93

There is an apparent link between colonialism and the Western concept of modernity. The Western construct of modernity was, and still is, an extension of the Western hegemonic legacy that came to fruition as a result of coloniality (Quijano 2002; Mignolo 2007). Modernity as a Western concept gained popularity during the second half of the twentieth century, often attributed to the European Renaissance, European Enlightenment and later the industrial revolution, as a descriptor of Western civilisation and consequently as a pathway for the rest of the world to follow. "Europe and America mutually produced themselves as the historical and the first two new geocultural identities of the modern world" (Quijano 2002, p.552).

Although the Eurocentric concept of modernity was presented and imposed on countries like Kenya as an emancipation from a barbaric, immature way of life, it is however difficult to ignore what Dussel (2000) refers to as "the hidden "other side" of modernity" (p.473). Western modernity was (is) part of the larger colonial legacy whose epistemology was not only to deculturalise the global south but more significantly, to portray and replicate Western culture as superior, in an attempt to produce a homogenous Western culture that would ensure their continued hegemony. These 'modern' values were systematically entrenched in the language, governance, religious and education systems established by the West in their colonies in the global south.

Through disguised narratives, modernity subjectively divided the world into the modern and those seeking modernity (Mignolo, 2018), those who have developed economic and knowledge structures and those that are underdeveloped, creating a false hierarchical measure of progress and civilisation, primarily based on cultural identity. Therefore, legitimacy of African culture and knowledge forms was/is measured and determined only against or in terms of Western knowledge forms (Appia, 1992; Eze, 2010; Etieyibo, 2016). Thus, in the words of Etieyiobo (2016), Africans began to "define themselves through the eyes of the West" (p.85). As Chinua Achebe submits, "until the lion learns to write, the narrative will always glorify the hunter." If, as is becoming apparent, modernity is an imperialist Western construct, especially from the perspective of countries like Kenya, then certainly, delinking from this form of modernity cannot be achieved using Western epistemologies. These countries must therefore deconstruct, reconstruct and rearticulate their own narratives to dispel the false narratives that have been propagated by the Western world.

Furthermore, as Western culture through the concept of modernity was and continues to be presented as an aspiration, these narratives continue to colonise indigenous imagination, crippling local innovation and increasing reliance on 'foreign' knowledge and solutions. Western epistemologies relegated other (especially African) countries to being consumers of knowledge generated in the West, unable to generate their own knowledge. The West's successful monopolisation and commercialisation of technical knowledge makes it difficult for the rest of the world to make meaningful contributions. In essence, this positionality and knowledge imposed through colonisation, and later modernity, has created the phenomenon that Ngugi wa Thiong'o referred to as "colonisation of the mind." In seeking this Western prescribed form of modernity, the global south began to reject their own culture, religion, art and other knowledge forms as their ambitions became entrapped in the web of Western presentation of modern knowledge and culture.

A number of researchers from countries that bear the Western characterisation of 'developing' (Ngugi Wa Thiong'o 1986; Wiredu 1992; Chatterjee 1998; Suresh 2002; Mignolo 2002, 2009) have contested the hegemony embedded in the Western modernity epistemology, and have questioned the nature of modernity presented and imposed by the West. It is important to note that these are not anti-modern fundamentalist arguments but rather what Grosfoguel (2002), making reference to Dussel's (2001) concept of 'transmodernity', argues is a "decolonial transmodern response of the subaltern to Eurocentric modernity" (p.26). This argument goes beyond the singularity that Western modernity presents. Similarly, in making a distinction between 'our modernity and their modernity', Chatterjee (1998) highlights the peculiarities that evidently exist in the conceptualisation of the concept of modernity, and calls for the re-contextualisation of this concept of modernity. In order to achieve this, it must be understood that "the modern crisis is a crisis of thought" (Escobar 2004, p.209), and therefore there is a limit to using the same knowledge epistemologies that created this crisis. Consequently, there is the need to move from a single Eurocentric 'global' conception of modern to a network of alternative local constructions of modernity, based on multiple contextualised knowledge forms that are reflective of the socio-cultural and economic orders of their respective contexts. It is this logic that this research attempts to apply to the current popular Western discourse on the concept of sustainability.

At the core of the modernism movement is the pursuit for universalism and therefore standardisation. Standardisation not only privileges those constructing 'the standard' but more significantly it involves the reductive abstraction of the diverse realities that characterise different contexts, resulting in concepts being far removed from contextual realities.

7.2.3. GLOBALISATION – THE UNIVERSALIST THINKING

Globalisation is the acme of the process that was initiated through the colonial/modernity Eurocentric (and more recently American) hegemonic and capitalistic system. Similar to colonial/modernity, the theory of globalisation is confined to Western construction driven fundamentally by capitalistic processes of exploitation (often of the global South) and accumulation (mainly by the global North). Capitalism therefore became a model of power and control, particularly for the exploitation of labour and resources from the global South, for the production of commodities for a global market. This system continues to flourish as a result of the already established Eurocentric hierarchical cultural and epistemological system. Thus, this discussion goes back to the question of Western intent. Why globalise? Answers to this question begin to illuminate the power and agency embedded in this global system.

To begin with, as Escobar (2007) submits, “globalisation entails the universalisation and radicalisation of modernity” (p.181). Cooper (2005) argues that globalisation presents two concerns, one, the “global” suggesting universality and two, “ization” suggesting an ongoing process (p.91). As a result, “the globalization of western knowledge and western culture constantly reaffirms the West’s view of itself as the centre of legitimate knowledge, the arbiter of what counts as knowledge and the source of ‘civilised’ knowledge” (Tuhiwai 2006, p.63). This, therefore, not only disadvantages local knowledge but advances control over knowledge production, dissemination, assimilation and application. From this research, colonial and neo-colonial imperialism remains evident not only in the politics and economy of Kenya (as in other former colonies) but also in the built landscapes, through concepts like modernism, globalisation, and more recently sustainability. Unfortunately, ‘developing’ countries like Kenya on the other hand continue to perpetuate this view by embracing these concepts developed in the West without critically questioning them.

Perhaps a good example of this with reference to sustainable design in Nairobi is the introduction and proliferation of assessment systems. More often than not, these systems are introduced to ‘developing’ countries with the intent to increase their global footprint and further the country of origin’s own agenda, overlooking local priorities and dynamics**.** These systems come with enabling technologies and products among other conditions. For example, in order to achieve LEED certification, prescribed technologies and products have to be employed. Therefore, manufacturer of ‘green materials’ for example will benefit from a global footprint through the validation and endorsement of their products by international governing institutions driving the agenda. Standardisation therefore becomes a strategy employed by large corporations - and governments - to ensure maximum profitability. This is exacerbated by the mental disposition of the ‘developing’ world discussed earlier, that glorifies international solutions and products.

Since the inception of the concept of sustainable design, the Western world has introduced numerous regulations in an attempt to guide sustainability. The view that introducing more stringent rules and regulations to the building industry in order to develop a sustainable built environment is widely held by the stakeholders interviewed in this study. However, this claim can be contested with regard the extent of the impact these rules and regulations would have. An increase in regulations may not necessarily translate to a sustainable built environment. This is evident in the Western countries where these guides, frameworks and assessment systems have been developed. Despite these tools having existed for decades now, there is little tangible evidence that suggests building environments have become more sustainable; on the contrary, evidence seem to point to a less sustainable built environment. However, the greater concern with the formation and adoption of sustainable design regulations in cities like Nairobi is the imposition and adoption of regulations that are termed as global standards, that have failed to bring about change even in the countries in which they were developed.

The absurdity of the concept of universal global knowledge is that, if the process of knowledge construction is bound by the context in which it is being produced, then this ‘global’ knowledge is in fact local knowledge (local to the West). Thus, the West relies on the failure of countries like Nairobi to distinguish their locality, thereby feeding its hegemony.

7.2.4. ECO – CENTRIC VS. ECON - CENTRIC

> *Wherever capital has its way, the ecological principles that underlie the emergence of flowering of life, beauty and consciousness are broken down through the intrusion of the commodity form. Kovel (1997, p.12)*

A capitalist market system was (is) a constitutive part of the narrative of modernity (Grosfoguel 2002). Stemming from the foregoing discussion, it is, therefore, worth discussing the influence of the capitalist market as an integral part of the ideals of modernity and globalisation, in relation to sustainability. Evidently, economically, the colonial situation in Africa continues to exist largely through massive international (Western) organisations such as International Monetary Fund (IMF), the World Bank (WB), the North Atlantic Treaty Organisation (NATO), and more recently China, not to mention smaller international organisations that fund ‘development’ projects across Africa. Therefore, capital remains a dominant axis that cements the imperialist hierarchical system. As they say, “he who pays the piper calls the tune.” Another example with regard to sustainability is the capitalistic market-based solution referred to as ‘carbon emission (credits) trading’ that privileges the Western world. The question once again is, who decides, and by what criteria are this emission allowances distributed? Who does it benefit? Certainly not the developing world. For transformative change to be achieved, countries like Kenya must de-link themselves from this systemic exploitative global system of domination and accumulation.

The economic aspect of sustainable design was of significant concern to the stakeholders in this study. One could argue that prior to the globalisation of the present capitalistic market, market dynamics in Nairobi were much weaker and less global, therefore, communities were in a position of greater power to make more ethically conscious decisions. This is reflected in vernacular and pre-80s architecture. With the growth of global economic market forces, architects have begun to turn to regulatory systems to mitigate market forces. However, without the understanding and appreciation of the ethical responsibility humans have to the planet and to themselves, evidently, more regulations may not be an effective solution.

As elaborated in Chapter 2, at its core, the call towards sustainability is fundamentally an ethical issue born out of a concern for the environment that supports human survival. However, unfortunately, on a global scale, there appears to be very little genuine concern for the environment or humanity for that matter, evidenced by the apparent reduction of this concept into a political issue, driven by a capitalistic global market. The profit-driven capitalist world continues to 'steal' from the natural world. Kovel (2007) in his book sub-title asks, "the end of capitalism or the end of the world?" He is concerned with the possibility of maintaining the expanding capitalistic economy while re-establishing ethical responsibility to the planet and its inhabitants. The question as to whether capitalism and sustainability can co-exist still remains unanswered.

The African indigenous perception and reverence for nature presupposes a lifestyle that recognises African's interconnectedness with nature and aims to live in harmony with the entire ecosystem. Gelfand (1981) in describing African indigenous cultural practices explains, "man (Africans) is more interested in pure living with people and his link with nature, with land, the water and his cattle" (p.76). This is in contrast with the Western capitalist lifestyle, on which urban cities in Africa have been modelled, that aims to exploit nature for the greatest benefit to a select few. The responses from the stakeholders in this research suggest a consensus on the importance of protecting and preserving the environment. However, there is reluctance in the adoption of practices that would ensure this is achieved. The construction industry in Nairobi is yet to integrate sustainability concerns to its processes in spite of the industry's link to immense negative environmental impact. In addition, there appears to be a consensus from the stakeholders, interviews (Chapter 4), that the construction industry in Nairobi is not driven by ethics, whether environmental, social or otherwise, but rather by external and internal economic market forces. From the stakeholders' perspectives, cost - profits or savings - seems to be the overriding consideration in the construction industry in Nairobi and therefore the main focus during decision making processes. As a consequence, the actual and perceived cost implications of sustainable design continue to impede the move towards a sustainable built environment. This is however not unique to Nairobi.

In addition, the increasing commodification of knowledge contrary to the ethical precepts of sustainability cannot be overlooked. Often those who determine what counts as knowledge, lay claim to its ownership and therefore attribute value – monetary or otherwise - to it, so that "the rest" must pay in order to access and utilise that knowledge. In relation to sustainable design, this is again best exemplified by the use of assessment systems and technological solutions mostly developed in the West that dictate what sustainable design should look like, while placing a premium price point to ascertain that buildings fit into that definition. From the study, the cost of certification based on these systems was considered unaffordable to the majority of developers in Nairobi. Furthermore, discussion with the stakeholders in this research suggest this model has been adopted by organisations in Nairobi who claim to offer training on these concepts at premium price points.

The data collected from the stakeholders in this research also suggested that only large corporations sought certification, and not necessarily out of ethical concern for the environment but more as a badge for global (Western) recognition and marketing (Capitalist) strategy. This too unfortunately is representative of the global scenario. The 'green' label has been deceptively attached to several buildings and other products to attract consumers. Hawken (1993) argues that green marketing by definition is a fraud. In his words;

> The leopard's new spots will wash off on the first acid rain, because green marketing is based on a view of the customer that's just as deeming as the one that got us into this situation in the first place (p.93).

It is simple for example for a building to gather enough points to earn the LEED certified badge without any real contribution to sustainability. Similarly, the technological solutions advanced are geared towards economic benefit and maintaining current lifestyles, while deceptively being distinguished as 'green' or 'sustainable'.

7.3. TOWARDS A SITUATED SUSTAINABLE DESIGN CONCEPT

Against the broad background of the perpetual epistemological impact of colonialism, Western modernity and globalisation, the foregoing discussion has challenged the hegemony embedded in the Western idea of universal knowledge and knowledge construction processes regarding the discourse of sustainability in Kenya. Abdulla *et al.* (2018) argue that knowledge should be "produced with and from rather than about" (p.89). Thus, epistemologically it goes beyond impositions and detached observational constructs about particular contexts, to understanding the experiences of these contexts, which therefore cannot be universal. Whereas the 'global' (Western) construction tends towards standardisation with generalised goals and measures, the concept of situatedness recognises contextual diversity and advances context specific goals and measures. This research found that the 'global' construction and understanding of sustainability is an impediment to achieving sustainability in Nairobi's built environment

From the research it is evident that knowledge construction in the discourse of sustainable design is inextricable from historical, social, cultural and political dispositions, and therefore cannot be understood without situating it. By this virtue knowledge is subjective to its context reference. The study also found that the concept of sustainable design is yet to be situated within the context of Nairobi. The concept of "situatedness" advanced by Haraway (1988), therefore, introduces a conceptual space that is aware and critical of epistemological, ontological, political and even ethical positions from which existing sustainable design knowledge claims are interrogated. Therefore, situated knowledge challenges the universalist construction of knowledge, in other words it challenges what counts as knowledge, arguing fundamentally that knowing is context specific. In this case the knowledge of sustainable design should be specific to the context of Nairobi. It goes beyond simply taking an anti-colonial or anti-west stance to deliberate attempts towards self-determination by developing local epistemologies, methodologies and approaches that consider local political, social, cultural and material circumstances in Nairobi and by extension Kenya, and which influence and transform knowledge construction on sustainable design. Furthermore, it asserts the importance of understanding the manner in which local communities understand and theorise their own realities.

Generally, it is improbable to encounter an expert on Western cultural, developmental or otherwise practices from Nairobi, for example. Conversely, it is acceptable, in fact expected, that the Western world should have 'experts' on Kenyan (African) matters. It is more than likely however, that Kenyans would know and understand their needs better than the so-called Western experts. As Irwin (cited in Tuhiwai, 1999 p.38) argues, "we don't need anyone else developing the tools which will help us come to terms with who we are. We can and will do this work. Real power lies with those who design the tools – it always has. This power is ours." In the same vein, this study argues that 'developing' countries do not need the Western world developing tools that would dictate how their sustainable built environment should look within their contexts. This principle of self-determination gives local people the power to define priorities, determine issues that need to be highlighted, and the opportunity to discuss these issues amongst themselves as well as measure their progress. This notion, though still in its infancy, is evident in the apparent differences between assessment systems developed locally in Nairobi when compared to systems developed in other contexts discussed in Chapter 4.

It is imperative to note that while the research is not opposed to Western knowledge and theory in its entirety, it is sensitive to its pertinence and the manner in which this knowledge and these theories are introduced, imposed and applied within the local context. Beyond this, the study is sceptical about the Western world's capacity, intentions and methodologies to advance sustainable design solutions that would benefit local communities in Nairobi. It is not enough just to acknowledge multiplicity or plurality, as colonial power structures were also predicated on acknowledging these differences and using them to subjugate others. Therefore, it is crucial to critically interrogate the ontological and epistemological lenses through which this multiplicity is acknowledged (Fry & Willis, 2017). This then calls to question the use of Western epistemologies that often refuse to acknowledge the heterogeneity of knowledge, in the understanding of the multiplicity as evident in several sustainable frameworks, best practices and or green building assessment systems that attempt to incorporate what is often termed as 'local components.' More importantly, it emphasises the demand to recognise indigenous epistemologies towards the development of situated knowledge by deconstructing Euro-centric, geopolitical knowledge paths and constructing pluriverse and interverse epistemologies (Mignolo &Walsh, 2018).

It is imperative, therefore that the move to develop situated knowledge that will undo and cease to contribute to the imperialist knowledge that privileges a select few at the expense of others. By way of example, through discussion with key stakeholders (Chapter 5), the research established a consensus that Kenya's vernacular architecture was and is still sustainable, notwithstanding the term not necessarily being used or understood according to Western theory. Based on indigenous knowledge of their environment and the innate cultural disposition of a sense of community and inter-dependence, indigenous communities lived in harmony with nature, were efficient, self-sufficient, and even resilient; terms that are often used in Western theory to define sustainability. With this in mind, perhaps the development of situated knowledge on sustainable environments should be inclined towards interrogating and understanding the theories that vernacular communities were based upon, as opposed to imposing Western theory on local contexts. In order to dismantle the Western imperialism embedded in the homogenisation and globalisation of concepts such as sustainability, there is a need to deconstruct, reconceive and reconstruct these concepts based on known contextual realities. With the realisation that Western epistemologies subjugated indigenous knowledge, perhaps vernacular design may provide a starting point for interrogation of the epistemologies and ethical ideologies embedded in indigenous practices. A number of studies have been carried out in Kenya investigating how vernacular architecture strategies can be applied to contemporary design strategies, particularly with regard to climatic considerations. However, this research proposes going deeper into vernacular design practices to understand the epistemological, ethical and cultural knowledge constructions that governed these decisions, climatic and otherwise.

Situating knowledge construction instigates a positionality shift from Western oriented thinking to an alternative way of thinking that is centred on and bound by locally relevant realities and interests. Developing situated knowledge is a complex process that as a basis will require stakeholders to be cognisant of their colonial history, as well as current international power and pressure that influence knowledge construction. Similarly, it requires a level of awareness and appreciation of complex power relationships and interests among different actors. Through the stakeholder interviews and case building analysis, this research presented preliminary efforts to create local spaces for dialogue with different stakeholders that would allow different actors to negotiate meanings and approaches. Perhaps the first step towards situating sustainable design in Nairobi is to construct situated problems that sustainable design would attempt to solve. From this research it is apparent that the Western agenda of sustainability is not cognisant of challenges faced in developing countries. The foregoing three chapters of this study begin to highlight locally distinctive challenges faced by Nairobi's built environment, such as rapid urbanisation, water scarcity, poverty, social inequalities, and the uncritical mimicry of 'Western style'. These contextual realities are often alienated by the Western concept of sustainable design.

The process of constructing local knowledge requires a reflexive methodology that deconstructs and reconstructs knowledge. The process of deconstruction begins with a critical epistemological reflection and the recognition of how popular discourse - including its rationale and biases - sits within local conditions, and how local historical, socio-cultural and political positionality shapes knowledge construction. This understanding sets the foundation for a continuous process of negotiation, reinterpretation and reconstruction of knowledge cognisant of the evolving local situations (Suresh, 2002). The research began by suggesting that perhaps the discourse of sustainability should be that of asking questions, the right questions. As part of the process of decolonising methodologies, Tuhiwai (1999) provides a set of questions that could be the point of departure for the process of local knowledge construction.

> Who defined the research problem? For whom is this study worthy and relevant? Who says so? What knowledge will the community gain from this study? What knowledge will the researcher gain from this study? What are some likely positive outcomes from the study, what are some possible negative outcomes? How can negative outcomes be eliminated? To whom is the research accountable? What processes are in place to support the research, the researched, and the researcher? (p.173)

Asking these questions not only challenges the power, interests and position of those who have placed (imposed) themselves as authorities in the construction and validation of knowledge, but more importantly, the idea of self-determination over local problems, priorities, procedures and solutions is affirmed. This study begins to answer some of these questions, arguing that sustainable design problems and solutions should be defined and advanced by those living in a particular context, in this case Nairobi, Kenya, ensuring they are relevant and beneficial to them.

Whereas all four case study buildings in this research when considered as artefacts could in one way or another be argued as sustainable (green) buildings depending on who is defining them, the Anwa Junior School is perhaps the best example where the focus was more on people and process than on product (building). There was an apparent attempt to root the product (building) into a process that was embedded in context. There have been several similar attempts in other cities that could be comparable with Nairobi. The sandbag houses by

MMA architects in Freedom Park, South Africa and Gando Primary School in Burkina Faso by Francis Kere are examples of dynamic flexible collaborative approaches entrenched in both the human and non-human context that not only provides an affordable, environmentally friendly solution but offer the local community a sense of dignity and ownership through process.

Overall, the construction of situated approaches to sustainable design in Nairobi and similar cities should involve a broader consideration of both historical and global positions and dynamics as well as a response to the complexity and diversity of problems encompassing climate, economics, technology, governance and socio-cultural issues.

7.4. CONCLUSION

This chapter attempted to theorise the findings of this study, and contributes to the ongoing discourse in countries like Kenya that challenges the hegemony embedded in Western Eurocentric knowledge forms and construction with reference to the concept of sustainable design. It establishes the correlation between knowledge, knowledge construction and the idea of power, identity and legitimacy. It also highlights Western imperialism, first as a consequence of its colonial past, closely followed by (and intertwined with) the Western construction of the concept of modernity, and finally, the culmination of hegemony as the concept of globalisation. In summation, modernity would be none-existent without coloniality. Whereas the main language of colonialism can be characterised as that of categorical subjugation, Western modernity on the other hand created a model and build narratives around that model as an aspiration through the imposition of Western norms, while that of globalisation was (is) the universalist language. The chapter submits that situating sustainability and by extension sustainable design would demand an awakening to the continued effects of coloniality, modernity and globalisation.

The chapter also contests the notion that Western modernity provides a pathway for 'the rest' of the world to follow, (especially with regard to creating a sustainable world), by questioning and rejecting the hierarchical hegemonic structures that characterised the colonial system, and which privileged Western epistemology over local epistemologies. It further recognises that Western knowledge forms are in fact local, local to the Western world, despite claims of its universality. Informed by Mignolo's notion of 'border thinking', Dussel's notion of 'transmodernity', and Escobar's notion of the 'pluriverse', it signals a departure from the singular Eurocentric forms of modernity and knowledge construction to the possibility of a network of alternative forms of local knowledge(s) that reconceptualise the power embedded in coloniality/modernity and knowledge construction. Decolonial thinking therefore provides a framework not only to decolonise knowledge, but more importantly to decolonise the process of knowledge construction. This involves an epistemological re-orientation from the Eurocentric imperial knowledge to knowledge construction that is centred on the African agenda as a deliberate attempt towards self-determination. This translates to the re-construction of concepts such as sustainability and sustainable design beyond the confines of Eurocentric epistemologies.

CHAPTER 8

CONCLUSION

...the way is simple. It does not mean exalting or restoring every bit of Africa's social heritage...nor does it mean rejecting everything history brought us from Europe and elsewhere. It means examining our real culture for the permanent values which created the unity, stability, solidarity and cohesion of ancient societies.

Iba Der Thiam, quoted in Falloux and Talbot, 1993, p.235

8.1. INTRODUCTION

This chapter presents a synopsis of the foregoing research chapters. It shall begin with an overview of the research, followed by a critical reflection of the research objectives and the methodological approach taken to meet these objectives. Subsequently, the key findings of the research and its contribution to the body of knowledge shall be discussed. The chapter will conclude by suggesting areas of future research.

8.2. RESEARCH OVERVIEW

Currently, countries such as Kenya bear an insignificant contribution to the global climate and ecological crisis when compared to Western countries. However, as previously highlighted, the UN estimates that currently, the built environment in East Africa is responsible for well over 60% of the energy consumption. The UN further estimates that the building stock in developing countries like Kenya will increase by 75% compared to European countries at 25-30% by 2050 (UN Habitat, 2014). This understanding necessitates a critical consideration of sustainability by developing countries, given their significant potential to influence the future global climate change scenario.

Consequently, this research suggests an increased concern for the current urban built environment in Nairobi. The strain of resources and infrastructure due to the rapid growth of the city, poor waste management, frequent floods and traffic congestion are among the challenges that suggest a disconnect between the socio-economic changes often considered as development, and the actual social, economic and environment challenges experienced in Nairobi. Broadly, African countries such as Kenya currently struggle with two seemingly divergent forces. On the one hand, the desire to develop as modelled by the Western (developed) world and on the other, the crucial demand for environmental and social consciousness and responsibility.

The literature review demonstrated that from a global perspectives the different meanings of the concept of sustainable design are based on selective interpretations, depending on who is defining it. It is evident that groups with special interests have exploited the ambiguity in this concept to push their own agendas. Similarly, the study highlighted conflicting views on the concept among stakeholders in Nairobi. It further suggests that this absence of clear contextualised meaning(s) or approach(es) to sustainable design in Nairobi renders current attempts knee jerk reactions, narrow or self-serving greenwash. The research appreciates the attempts made by architects and developers towards the development of a sustainable built environment. However, it is sceptical about the current motivations that influence design decisions towards sustainability. The research was inspired by questioning popular discourse on sustainable design. What really is sustainable design? What, who and why it (they) is being sustained, and finally how would this be achieved? In this regard, the main objective of this investigation was to assess and critique the discourse and practice of sustainable design within the context of Nairobi. Overall, this investigation is cognisant of the antagonistic relationship between the standardisation of the concept of sustainable design and the diversity that exists within different contexts.

Several studies in Nairobi have been undertaken surrounding the concept of sustainable design. However, none have critically interrogated the knowledge construction and understanding of the concept in an attempt to establish the situatedness of this concept based on its knowledge construction process.

On the basis of this background, the research developed the following objectives;

1. Investigate the local dynamics in Nairobi's built environment that would affect and influence the construction of the concept of sustainable design.
2. Investigate the concept of sustainable design in Nairobi from the perspective of different stakeholders.
3. Investigate the influence of stakeholder understanding of the concept and their power dynamics in existing approaches and processes in sustainable projects.
4. Establish a theoretical analysis of the construction of the concept of sustainable design.

8.3. RESEARCH APPROACH

As highlighted, the overarching objective of this investigation was to assess the discourse and practice of sustainable design within the context of Nairobi. In order to address objective one, the investigation attempted to build an understanding of the contextual dynamics embedded in Nairobi's built environment by reviewing existing research, policy and national strategies on sustainability, followed by an analysis of assessment systems adopted for 'green' buildings. Subsequently, after identifying key stakeholders, objective two was achieved as the research attempted to construct and understand the discourse of sustainable design in Nairobi, through interviews and focus groups with these stakeholders within Nairobi's built industry.

Subsequent to the context analysis and stakeholder interviews and focus group, the research investigated four case study buildings as artefacts that represent the interests and interpretations of the concepts of sustainable design of actors involved, together with the contextual socio-cultural, economic, environmental, technological and institutional dynamics that influence decision making during the design and construction process, in an attempt to answer objective three. In addition to interrogating the physical attributes of these buildings, while arguing that buildings cannot be understood exclusively as artefacts without questioning the means by which they were achieved, this investigation identified actors involved in each case study building, mapping their positions and powers throughout the design and construction process.

Finally, as means by which to respond to objective four, the research engaged with the wider discourse of the politics of knowledge construction with reference to sustainable design. In doing so, it further highlighted the Western hegemonic influence on knowledge construction, exploring how and why Western influence continues to repress countries in a similar position to Kenya. Consistent with this research's critical argument on contextualising the concept of sustainable design, it explored the concepts of decolonial thinking and Haraway's 'situatedness'.

8.4. KEY RESEARCH FINDINGS AND RECOMMENDATIONS

The discourse on what exactly sustainability and sustainable design means and how it can be achieved will continue to spur debate. From this investigation, it is apparent that there is no consensus in Nairobi regarding what a 'green' or 'sustainable' building should look like. Is it a certified building? Or one that passively or actively responds to climate? Or a building co-designed and built with the community? Overall, this investigation suggests that the answer to these questions depends on who decides and why.

One significant finding from the stakeholder perception analysis is the disconnect between their understanding of the challenges and priorities specific to the context of Nairobi and their understanding of the meaning of the concept of sustainable design. Evidence suggests that this can be attributed to the influence of the Western construction of the sustainability agenda. A number of locally distinctive challenges experienced in Nairobi’s building environment emerged from the findings of the context analysis, stakeholder perceptions, and case study analysis. Issues such as rapid urbanisation, water scarcity, poverty, social inequalities, and technological challenges, together with the mimicry of the ‘Western styles’, characterise Nairobi’s built environment.

Conspicuously, the Western sustainability agenda is oblivious to these challenges experienced by cities like Nairobi, and therefore the concept of sustainable design is disengaged from these realities. For instance, the research suggests that perhaps, as opposed to the Western focus on environmental issues, it is fundamental to prioritise and resolve socio-cultural and economic challenges facing developing countries like Kenya. These are challenges which current standards, guidelines, and assessment systems negate or have no capacity to measure. This is not to say that environmental issues are not important, but rather should be taken into consideration when solving the much greater socio-economic challenges.

Through the literature review, the research argued that perhaps at the core of sustainability, and by extension sustainable design, is an ethical consideration. However, this investigation found that the construction, understanding and articulation of sustainability and sustainable design in Nairobi is significantly driven by two dominant forces; international (Western) influence and economic market dynamics, as opposed to ethical considerations.

The results of this investigation suggest several ways in which international influence affected the knowledge construction of the concept of sustainable design as well as the decision making process during the design and construction of the built environment. It is evident that the international (Western) influence has significant impact on the local construction of the meaning of sustainable design, ultimately as a result of the position countries similar to Kenya find themselves, within the coloniality, modernity and globalisation matrix. Evidence further suggests that through this matrix Western narratives, images and knowledge forms created a mental disposition in cities like Nairobi that privilege Western thought and solutions, consequently impeding local thought and innovation.

The evolution of the built environment presented in this investigation points to the international (predominately Western) influence embedded in the growth of cities such as Nairobi in an attempt to gain global recognition and legitimacy. Similarly, analysis of the stakeholder perception suggest that not only is this influence present in the built environment but also in the Eurocentric academic, institutional and governance structures.

From the case study buildings analysis, the study suggests that in general, international influence is articulated in the design and construction process in three distinct ways. First, the use of international (Western) case study buildings both in the training of architects and during practice to inform design decisions. Second, the presence of international stakeholders in the design and construction process. Not only do international stakeholders involved in these projects carry their own biases and interests that dictate their approach to sustainable design, often these stakeholders do not adequately understand the dynamics that characterise contexts similar to Nairobi.

Third, and perhaps more significantly, the use of international assessment systems that dictate/determine the ‘greenness’ of buildings demonstrating the extent of the commodification of knowledge. This study indicates that assessment systems have become a major driver of sustainable design in Nairobi. Often however, this study found that, certification by way of these systems was sought more as a badge for global (Western) recognition and as a marketing (capitalist) strategy with no genuine environmental or social considerations. Notably, this study suggests that the lack of contextualisation of these systems could be counteractive to sustainable design. The disparity found in the comparison between the draft assessment systems developed in Kenya and the international systems begins to highlight the role of context in their development and application. This is evident for instance in the case of the energy mix in Kenya, which is significantly more sustainable when compared to Western countries which would translate to energy consideration being less of a priority. Conversely, Kenya as a water scarce country would prioritise water efficiency and management when compared to Western countries that do not have the challenge of water scarcity. These differences however are not reflected in these systems.

Furthermore, inadvertently, these assessment systems have become design tools that have biased the meaning of sustainable design to that of their countries of origin, arguably limiting design options and stifling innovation that would arise from contextually unique, emerging, unforeseen situations that require creativity, primarily for economic gain. By way of example, baseline assumptions of these systems, such as ASHREA, that have been used as universal standards, drive design towards technological solutions. The question is, who stands to gain? It can be argued that these systems primarily benefit those who develop them, manufacturers of the prescribed technology/ solutions and the so called ‘experts’. In addition to the difficulty in appreciating technology outside its social contexts, this study further demonstrates that the cost associated with these international systems often renders them economically unachievable in contexts such as Nairobi.

The different case studies investigated in this research not only illuminate the contrasting constructs of the concept of sustainable design but also the inadequacy of applying predefined ideological or technical solutions for sustainable design. Thus, sustainable design should go beyond prescriptive technical solutions to localised constructions of technology that are situated within local socio-cultural practices.

With regard to assessment systems and regulations in general, the fundamental question is, will more regulations conjure sustainable design? This research suggests that there is need for a more critical reflection on the role of regulatory systems (including assessment systems) in achieving sustainable design. The potential danger of regulations being counteractive to attaining sustainable design has been demonstrated by this study, which corroborates previous studies. Aside from the gaps that exist within these systems, there is a potential for them to be reduced to obsessive mechanical exercises of checking boxes at the expense of investment in tangible solutions. In addition, accreditation is based on predictive performance and often does not account for performance during occupancy.

Turning to the second driver, the market dynamics, from this study it is apparent that given the minimal regulation for sustainable design, developers, who often will not occupy the building or pay running costs, control the market. Consequently, initial investment cost considerations often supersede environmental or socio-cultural considerations. It is clear that with reference to market dynamics, there exists an antagonistic relationship between the prohibitive nature of initial cost investment and the potential long term cost benefit, coupled with the market value currently embedded in the concept of ‘green’.

The research shows that initial cost investment for buildings considered ‘green’ in Nairobi is higher than that of conventional construction, and therefore prohibitive. However, evidence suggests a consensus with regard to the potential reduction in energy running cost through the use of passive ventilation and lighting strategies, coupled with energy efficient fittings to reduce buildings’ energy demand. Overall, the scepticism around predicted cost benefit is due to the vagueness on how initial cost would be recuperated, due to the difficulty in quantifying long term cost benefits which can be argued significantly depend on what is being measured and by whom. In addition, evidence suggests that there is potential to reduce sustainable design practice to an abstract cost counting exercise.

Taken together, the analysis presented in this investigation attempted to demonstrate the heterogeneity of knowledge construction and understanding of the concept of sustainable design as a result of the interaction of different human and non-human dynamics. The strength of this argument is acknowledging that the concept of sustainable design does not and cannot bear a definitive, consistent, universal meaning or set of approaches, and therefore no single approach is, or should be, considered the 'correct' approach. Instead, the construction of this concept should be cognisant of the range of possible approaches. Only in acknowledging this heterogeneity and remaining open to not only the physical but more importantly the socio-political contextual differences, would context specific solutions that do not privilege some solutions over others be developed.

The analysis also indicates that the 'global' (Western) construction of the discourse of sustainable design is counterintuitive to the move towards sustainable design for cities like Nairobi. Not only does it seek to standardise solutions, Western theory on this discourse tends to construct sustainable design only as a science that prioritises technical approaches which this and previous studies have demonstrated to be flawed. This study suggests that perhaps the first stage towards breaking this Western monopoly over sustainable design knowledge is constructing and situating this concept and practice in Nairobi through participative processes of deeper engagement in debate and negotiation. These processes would engage with broader philosophical and sociological questions towards the construction of situated problems and priorities that sustainable design would be aimed at. The research further argues that if sustainable design is oriented towards developing solutions to the needs particular to people living within a specific context, then it only follows that those people are better placed to frame their own needs and possible solutions. Perhaps vernacular architectural practices could provide a point of departure in lieu of the current Western practices that are adopted.

Finally, this investigation is not against Western knowledge forms, but acknowledges its locality to the Western world, contrary to the assertions of its universality. It not only highlights the embedded hegemony but also the limits of Western knowledge when applied in other contexts. The core argument of this investigation is that contrary to the abstract universalist and reductionist Western Eurocentric epistemologies, which do not recognise other epistemologies, decolonial methodologies should be adopted in order to re-conceptualise, re-construct and re-articulate diverse contextualised alternative realities. This can be summarised in Escobar's notion of 'other worlds' and 'world otherwise'; "that is, worlds that are more just and sustainable and, at the same time, worlds that are defined through principles other than those of Eurocentric modernity" (Escobar, 2004, p.220). This speaks to the intention of this research to not only continue the dialogue of developing a sustainable built environment (world otherwise), but to develop contextualised (other worlds) versions of that sustainable world.

8.5. CONTRIBUTION TO KNOWLEDGE

The discourse of sustainable design in Nairobi has grown over the last decade, however there is no consensus with regards to what this means and how it should be articulated in the built environment. Having said that, it was not the intention of this research to provide a definition of what sustainable design is in the context of Nairobi, but to understand the process of knowledge construction of this discourse in Nairobi and to engage is how this discourse can be situated in the context of Nairobi. There being no previous studies that interrogate the process of knowledge construction on this discourse within this context this research attempted to fill this gap by mapping these processes through stakeholder interviews and case study analysis of selected buildings in Nairobi.

First, the study provides new insights into the process of knowledge construction in Nairobi shifting the focus from sustainable (green) buildings as artefacts (products) to complex processes that involve human and non-human interactions within a particular context. In doing so, the study proposes a methodology that involves interrogating both contextual human and non-human dynamics in order to establish self-determined situated sustainable design approaches.

Second, the study established an intersection between knowledge construction, power, legitimacy and the discourse of sustainability demonstrating the hegemonic nature of western knowledge when imposed and applied on other contexts, in this case Nairobi. Based on the research findings, the study proposes a theory that attempts to explains how international influence through the coloniality, modernity and globalisation matrix shapes the knowledge construction on the discourse of sustainable design in Nairobi.

Third, through Haraway's (1988) concept of situatedness, it provides evidence that knowledge construction is inextricable from historical, social, cultural and political dispositions and thus cannot be understood without situating it. Therefore, the research begins to develop a conceptual space for stakeholders in Nairobi's building industry, that is aware and critical of epistemological, ontological, political and ethical positions from which existing sustainable design claims can be interrogated. This conceptual space shifts the power to define problems, priorities, solutions and means of measuring progress to local communities and creates an opportunity for these issues to be discussed amongst themselves.

Overally, this study offers a critique of the universal perspective demonstrating the importance of context in the construction and understanding of the concept of sustainable design.

8.6. LIMITATIONS

Due to the time and resource constraints, despite the critical selection of the key stakeholders and case study buildings, a more expansive dialogue with key stakeholders could be undertaken. Therefore, it recommends further dialogue with more stakeholders in Nairobi's built environment, and further interrogation of buildings termed as 'green' in Nairobi. Second, due to the methodology used in this research, these findings cannot be completely generalised, however, the research provides a methodology than can be used in other contexts in an attempt to establish situated versions of sustainable design.

8.7. FURTHER RESEARCH

As this research provides a critique on the current discourse of sustainable design in Nairobi, it sets the foundation for further collaborative construction of local, context specific narratives, theories, materials, approaches and assessment systems with reference to sustainable design that would allow for a critical evaluation of the current training and practice on the discourse of sustainability and sustainable design. There is need for local research that would continuously identify changing local needs and develop context specific holistic approaches that would inform decision making, policy development and build on local knowledge capacity to meet locally established standards.

Secondly, given the time and resource constraints, this study analysed four case buildings. Therefore, in order to enhance the generalisability of results within Nairobi, while following the methodology used in this study, further research should be undertaken on the design and construction process on a larger number of buildings in Nairobi that are considered sustainable by the stakeholders within this context. A similar process should be undertaken for regions outside Nairobi to ensure context specific understanding and solutions are developed. Based on this study findings and the findings from the proposed subsequent studies a guiding framework and assessment criteria for green buildings in different regions of Kenya should be developed.

Thirdly, it was beyond the scope of this study to undertake a user oriented post occupancy analysis given that the focus of this research was to analyse the process of knowledge construction, whereas in this context it was apparent that the users of the building were not involved in the decision making process of design and construction. Therefore, the research proposes a further critical comparative analysis of the actual building performance based on the user perspectives against the anticipated performance based on the design decisions taken by different actors during then design and construction process.

8.8. CONCLUDING REMARK

In the introduction chapter, the research highlighted the positionality of the researcher with reference to one of this research's key argument, either as a victim of or a part of, the problem of Western influence in countries similar to Kenya. At the end of the research, the researcher believes that this research presented an opportunity for not only the researcher's voice to be heard, but more importantly, for the voices of the people of Nairobi's building industry to be heard. Their voice, like those in similar cities, are often muffled or disregarded in the 'global' knowledge construction, debates and decision making processes on the discourse of sustainability and by extension sustainable design. This speaks to the notion of self-determined problems, priorities and solutions.

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APPENDIX A: ETHICS APPROVAL LETTER

The University Of Sheffield.

Downloaded: 27/08/2017
Approved: 27/07/2017

Faith Ng'eno
Registration number: 160129553
School of Architecture
Programme: Ph.D Architecture

Dear Faith

PROJECT TITLE: TOWARDS SUSTAINABLE DESIGN IN NAIROBI: A CO-CONSTRUCTIONIST APPROACH
APPLICATION: Reference Number 015888

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 27/07/2017 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 015888 (dated 21/07/2017).
- Participant information sheet 1034187 version 1 (10/07/2017).
- Participant consent form 1034188 version 1 (10/07/2017).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Yours sincerely

Chengzhi Peng
Ethics Administrator
School of Architecture

APPENDIX B: PARTICIPANT INFORMATION SHEET

The University Of Sheffield.

PARTICIPANT INFORMATION SHEET

Research Project Title

Towards Sustainable Design in Nairobi: A Co-Constructivist Approach

Invitation

You have received this information sheet as an invitation to take part in my research project as part of fulfilment of my Ph.D. programme. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Feel free to ask if there is anything unclear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the project Purpose?

The discourse of sustainable design has propagated a profusion of constructs regarding its meaning through a diverse anthology of codes, guides, best-practice notes, standards and other documents. These construct however, must resonate with the meaning attributed to it by the people and their environment within a particular context. Therefore, any document that claims to prescribe solutions or assess a project against some specific criteria, must be cautiously interrogated to ensure the assumptions upon which they are based are applicable to the context they are being applied. The research argues that any building that boasts of being sustainable must essentially epitomise place. This research therefore primarily attempts to address the antagonistic and paradoxical relationship between contextual diversity and the standardisation of sustainable design as a discourse.

The main objective of the fieldwork research is to establish ideologies and methodologies of sustainable design among different stakeholders in Nairobi in an attempt to reach a theoretical consensus of the understanding of sustainable design in Nairobi. Consequently, after triangulation of the different constructs of the discourse, the research will test different building approaches in Nairobi against those findings, in an attempt to identify suitable approaches.

What sort of information will be sort from me and why is the collection of this information relevant for achieving the research projects objectives?

The research will seek to find out your understanding and interpretation of sustainable design, your approaches (or those of your organisation) to sustainable design and well as the ethical precepts that guide your understanding and approaches. The research will also seek to find out the challenges you (or your organisation) face in achieving sustainable design. Finally, which buildings in Nairobi you think are sustainably designed and constructed. As this research primarily seeks to understand and document the discourse of sustainable design from a contextual perspective, your responses as a key stakeholder in this context is imperative for the construction of contextually situated knowledge that will be applicable to Nairobi.

Why have I been chosen?

The research will collect data from two broad spectrums; key stakeholders of sustainable design in Nairobi through interviews and focus groups on one hand and from selected existing buildings in Nairobi through drawings analysis, observation, sketching, photography as well as scientific measurement of indoor climate. You have been chosen because the research recognises you as a Key stakeholder in the discourse of sustainable design in Nairobi.

What will happen to me if I take part?

Following your consent to take part in the research the researcher shall communicate an appropriate time, date and venue for the focus group discussion (FGD). No special preparation is required before on your end. The FGD will involve open ended questions, however the research approach acknowledges the participants as co-researchers and therefore you can also ask questions.

Do I have to take part?

Participation in the research is entirely voluntary, however if you choose to participate, we shall request that you sign a consent form. A copy of the information sheet and consent form will be given to you for your records. Even after signing the consent you can chose to withdraw from the research at any time without any negative effects to you. Upon withdrawal your initial responses will be discarded unless you give consent to their use.

What are the possible disadvantages and risks of taking part?

We do not foresee any discomforts, disadvantages or risks that may arise from participating in this research. In case of any complaints you can inform me or contact my principal supervisor.

What are the possible benefits to taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this study will bring necessary transformative influence and inform key decisions made by key stakeholders in Nairobi on matters regarding sustainable design.

Will my taking part in this research be kept confidential?

The identity of the participants shall not be disclosed. Participant's names shall not be linked to results from the data in the Ph.D. thesis or any other academic publications. However, given that the research takes a co-constructed approach, your responses shall be discussed by other participants though your identity will remain anonymous.

Will be FDG be recorded?

Following your consent, the FDG will be audio-recorded and notes will also be taken during the interview process. This recording shall only be accessible to the researcher.

What will happen to the results of the research?

Result of the research will be published in my thesis document as part of my fulfilment of my PH.D. programme and submitted to the department of Architecture at The University of Sheffield in September 2019. A copy of the thesis shall be available online through the university thesis repository upon request. The results may also be used by the researcher in subsequent publications in other academic platforms. Your response will however remain anonymous throughout the publications. It is also important to note that due to the nature of this research it is very likely that other researchers may find the data collected to be useful in answering future research questions. We shall ask for your explicit consent for your data to be shared in this way and if you agree, we shall ensure that the data collected about you is untraceable back to you before allowing others to use it.

Who is funding this research?

The research is funded by the Commonwealth Scholarship Commission under the United Kingdom Department for International Development (DFID).

Who has ethically reviewed the research?

This research has been ethically reviewed via the department of architecture ethics procedure at the University of Sheffield. The University's Research ethics committee monitors the application and delivery of the University's Ethics Review Procedures across the University.

Contact for further information

For further information, kindly do contact:

Faith Ng'eno (Doctoral Researcher)

fcngeno1@sheffield.ac.uk

+254720175468

+447459283297

Dr. Krzystof Nawratek (Research supervisor)

k.nawratek@sheffield.ac.uk

Dr. Ranald Lawrence. (Research supervisor)

ranald.lawrence@sheffield.ac.uk

Finally, a copy of this information sheet as well as the consent form will be given to you for your records.

APPENDIX C: CONSENT FORM

Title of Research Project: **TOWARDS SUSTAINABLE DESIGN IN NAIROBI: A CO-CONSTRUCTIVIST APPROACH**

Name of Researcher: **FAITH NG'ENO**

Participant Identification Number for this project: **Please initial box**

1. I confirm that I have read and understand the information sheet dated _____________ explaining the above research project and I have had the opportunity to ask questions about the project. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. ☐
3. I understand that my responses shall be shared with other participants but my identity shall be anonymised. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be ☐

   linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. ☐
4. I agree for the data collected from me to be used in future research
5. I agree to take part in the above research project. ☐

__________________________ __________________ ______________________

Name of Participant Date Signature
(*or legal representative*)

__________________________ __________________ ______________________

Name of person taking consent Date Signature
(*if different from lead researcher*)
To be signed and dated in presence of the participant

__________________________ __________________ ______________________

Lead Researcher Date Signature

To be signed and dated in presence of the participant

Copies:
Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

APPENDIX D: INTERVIEW GUIDE

This questions were used as a flexible guide and were adapted based on each participant.

The University Of Sheffield.

TOWARDS SUSTAINABLE DESIGN IN NAIROBI: A CO-CONTRUCTIVIST APPROACH

INTERVIEW GROUP GUIDE

1. What three words come to mind when you think of sustainable design?
    - Discuss what those words **mean**.
    - What is your (your organisation) **understanding** of sustainable?
2. Why should we design sustainably?
    - What **challenges** do you think sustainable architecture tries to solve in Nairobi?
    - What **ethical precepts** that should govern sustainable design in Nairobi.
3. How can we design sustainably?
    - Different **approaches**
    - What **buildings** would you term as sustainable buildings in Nairobi and **why**?
4. How would you characterise the nature of sustainable design in Kenya?
    - Major **successes**?
    - What do you think are the **challenges** sustainable design in Nairobi?
5. What do you think is your (your organisation) **role** in the move towards sustainable design?
6. Who else would you say has a role to play towards the move to sustainable design and what role would you say they have?
7. Is there anything you would like to add concerning the subject of sustainable design in Nairobi?

APPENDIX E: FOCUS GUIDE

This questions were used as a flexible guide and were adapted based on each participant.

The University Of Sheffield.

TOWARDS SUSTAINABLE DESIGN IN NAIROBI: A CO-CONTRUCTIVIST APPROACH

1. What three words come to mind when you think of sustainable design?
    - Discuss what those words **mean**.
    - What is your (your organisation) **understanding** of sustainable?
2. Why should we design sustainably?
    - What **challenges** do you think sustainable architecture tries to solve in Nairobi?
    - What **ethical precepts** that should govern sustainable design in Nairobi.
3. How can we design sustainably?
    - Different **approaches**
    - What **buildings** would you term as sustainable buildings in Nairobi and **why**?
4. How would you characterise the nature of sustainable design in Kenya?
    - Major **successes**?
    - What do you think are the **challenges** sustainable design in Nairobi?
5. What do you think is your (your organisation) **role** in the move towards sustainable design?
6. Who else would you say has a role to play towards the move to sustainable design and what role would you say they have?
7. Is there anything you would like to add concerning the subject of sustainable design in Nairobi?

APPENDIX F: FOCUS GROUP POSTER

APPENDIX G: INTERVIEW LIST

LIST OF STAKEHOLDER PARTICIPANTS

01. INTERVIEWS

No.	PARTICIPANT CODE	ORGANIZATION/RELEVANCE
01.	KJ	Vice Chairperson, Kenya Green Building Society (KGBS) USGBC LEED Green Associate Assessment tools: Green Star South Africa Kenya and EDGE
02.	MD	Architect C.E.O: National Construction Authority (NCA)
03.	OR NS	Research Officer: National Construction Authority (NCA) National Construction Authority (NCA)
04.	SI	Architect: TRIAD Architects One of the oldest architectural firms in Kenya. Architects: Coca-Cola Headquarters
05.	UN NJ	Chief, Urban Energy Unit: UN- Habitat Nairobi Researcher: UN- Habitat Nairobi
06.	LD	Architect & Environmental Design Consultant: Planning Systems Limited - One of the oldest architectural firms in Kenya Lead Architect: KCB Headquarters Upperhill LEED AP (BD+C)
07.	GM	Director Pharos Architects Architect: World Bank fit-out – LEED Gold Accredited Green Star AP
08.	MC	Chief Environmental Education and Information: National Environment Management Authority (NEMA)
09.	WW	Architect Director, Kenya Building Research Center - State Department of Housing and Urban Development. Government of Kenya
10.	OA	Architect Associate Professor: Technical University of Kenya Senior Lecturer: University of Nairobi (UoN)

		Principal Researcher: Eco- Build Africa
11.	ON	Graduate Architect Lecturer: Technical University of Kenya Director, Green Africa Standards and Certification: Green Africa Foundation. Assessment Tool Development Lead: The Green Mark Standard for Green Building President of the Executive Boards of World Student Community for Sustainable Development (WSCSD)
12.	OO	Lexicon + Ion Architect: Strathmore Business School
13.	KR	Kounkney Design Initiative: Design and Build International non-profit organisation Architect: Anwa Junior School
14.	DM	Architect: Architectural Association of Kenya (AAK) Environmental Design Chapter board member Advised on contextualisation of Green Star South Africa – Kenya Green star certified AP
15.	MM	Architect Lecturer: Technical University Kenya (TUK). Teaching Sustainable Design Module.
16.	KM	Lecturer – University of Nairobi (UoN) Architect: Learning Resource Centre (LRC) Catholic University Library complex Assessment Tool Development Lead: Safari Green Building Index
17.	GG	Kenya Property Development Association Board Member
18.	NW MN	Nairobi County Council Director, Urban Planning - Nairobi County Council
19.	MP	Standard Media Group journalist Specialises in Green Building Research
20.	MJ ND	Manager: Centre for Energy Efficiency and Conservation, Kenya Association of Manufacturers Energy Services Engineer: Kenya Association of Manufacturers

FOCUS GROUP DISCUSSION

No.	**PARTICIPANT CODE**	**ORGANIZATION/RELEVANCE**
STAKEHOLDERS IN PRACTICE **VENUE: THE FAIRVIEW HOTEL** **DATE/TIME: 22.09.2017. 10:30 AM – 13:00**		
01.	OA	Revive Consulting Solution (Water consultancy company)
02.	BD	HF Development and Investment Ltd. (Housing Finance)
03.	PD	Taka Taka Solution (Waste Collection and Recycling)
04.	GG	Mecoy Consultants (Mechanical and Electrical Engineers)
05.	KJ	Kenya Green Building Society
06.	MO	The Swedish Trade & Investment Council
07.	OO	Lexicon + Ion (Architects)
08.	KR	Gee Plan Management Ltd (Environmental Impact Assessment)
09.	OR	National Construction Authority
10.	MB	Celer Group (Real Estate Retail)
11.	NE	Centreline Projects Limited (Quantity Surveyors)
12.	WI	M&R Consult (Architects)
13.	NS	M&R Consult
14.	MS	Planning System Services Limited (Architects)
15.	KW	Property Industry Editor
STAKEHOLDERS IN ACADEMIA: 16.10.2017 **VENUE: JKUAT** **DATE/TIME: 16.10.2017. 10:00AM – 12:00**		
01.	ON2	Lecturer: Department of Architecture
02.	MM	Lecturer: Department of Architecture
03.	NO	Lecturer: Department of Architecture
04.	WN	Lecturer: Department of Architecture
05.	MJ	Lecturer: Department of Construction Management
06.	KK	Lecturer: Department of Construction Management
07.	DS	Dean School of Architecture and Building Science
08.	GD	Student: Department of Architecture

APPENDIX H: SAMPLE TRANSCIBED INTERVIEWS

Participant ON: Transcription

What is your understanding of sustainable design?

I think foremost the concept of sustainable design is universal, so we don't deviate from the definition of sustainable design as a philosophy. We basically aim to optimise the performance of buildings in terms of their impact on their environment, the society, places within which they are developed and contribution to the economic development of the specific country and in our case, we are talking of Kenya. So, the underlying principle is the same and we are looking at environmental impact, we are looking at key issues to deal with resource efficiency and so we are benchmarking with the rest of the world in terms of what the definition of a sustainable building is. But there are some slight areas of divergence in terms of what we lay our focus on looking at specifically the climatic context, looking at the social and regulatory context that we are in, bearing in mind that if you talk about climate essentially, we generally have a climate that is generally comfortable throughout the year. The comfort levels really don't vary significantly when you are talking about thermal comfort especially whether day time or night time so this means that our real construction of sustainable design extends towards more emphasis on passive natural designs, passive systems, really much as opposed to laying a lot of emphasis on the technologies, smart technology for instance. Much as we acknowledge the role of technology in the building industry, but as in our context really I think sustainability in the built environment has to be more about passive solutions, natural systems. For one reason that I mentioned the climate and for the second reason that the level of our development we still have a challenge with maintenance. Technology comes with cost, we are industrialising yes but a lot of those technologies, hi-tech solutions, smart systems are not necessarily developed in our context so we have to import this and that comes at a cost but also we need to maintain this systems. We are generally having a built environment that we could in building design the building itself and the building be maintained by users. Our really maintenance practices are not well advanced. We don't lay a lot of emphasis on maintenance, this is left to the users, and even as designers we rarely do people go back to check their buildings to check what we really projected or simulated in the design is actually performing in practice and what lessons we can learn from that. So, to me that is the understanding of sustainable design, simply we construct based on the universal principle that the building has to be comfortable for the users so its has to have very minimal to no negative impact on the environment and that it has to be socially relevant, contribute to empowering the community and fits well within its cultural context. That's its basic but how then we distribute the weight, where we lay emphasis on is more on our specific climatic and socio-economic context.

Where do you think we are in terms of building sustainably? Do you think we are and if not why?

I think having said that, I would like to bring to back to… this is my very personal position when you ask the question are we building sustainably. Yes. We do and No we don't. But again coming back to the question of construction of sustainable design. I know since you are still scholarly engaged, deeply in this subject if you follow the definition the emergence of sustainability as a concept and when you get to green buildings and you get to the levels of standardisation, you will begin stressing standardisation to the UK with the BREAM and then after BREAM quickly pick by the US LEED because of context and the non profit movement of the US green building council that transitioned into the World green building council then you have this emergence of many councils and now different tools all over the world. And this is not pretty long, this you are talking about a two decade or so movement that is growing so that more relates the concept to probably more western European and American construction. That does not necessarily mean that Africa and other regions of the world have not been designing and building sustainable buildings. If you then critically look at the components, what constitutes a sustainable building because some of the things we are looking at in sustainable buildings are a lot of our really traditional architecture meet them. The vernacular architecture that we have were simple grass thatch houses of the masaais if you were to run them through a rigorous check list, you would find that they would score pretty well, but in a strict sense they would hardly be classified of be rated as green buildings so the question, I'm answering both your first question and second question whether are we building sustainably an where we are in terms of building sustainably, you are specifically looking at Nairobi whether in your scope you are looking at Nairobi as the city or as the metropolitan.

Of course, where we are in terms of appreciating, people are generally now…the level of awareness of sustainable design is growing. There is a very strong drive from the private sector because a lot of corporates already appreciate, they see sustainable building as a key to there bottom line, they understand the business sense of sustainable buildings so we are seeing largely a number of corporate buildings, their new office blocks or commercial development that they are trying to really incorporate green building and so there is that growing trend and it is becoming more of something trendy that if my building is green…Yet, having said that, there are different levels of greenness, because some people lay claims to their buildings being green yet certification, rating of green buildings is just really picking in the country. Because our history if certifying buildings, we have a few buildings that have been US LEED certified and now we have, I don't know if you have had an engagement with people at the KGBS, they would give you the statistics of how many building they have rate Greenstar and so that would tell you what position we are. But, there are a number of buildings that have not been rated. Now, there is a growing interest in the buildings that are claiming to be green, within the confines of the standards, those who are formally either they set out to design and construct their buildings with the intent to have them rated or certified as green but having said that, there are a lot of buildings within Nairobi that have not claimed to be green that have not claimed that they were sustainably designed and will never apply to be certified as sustainable buildings, yet, if they were to be subjected to a test assessment as to what extent they meet the sustainable design principle I think they would score highly and especially looking at the buildings of the 80s and 70s and so I think Nairobi as a city was on a sustainable design pathway some decades back. If you look at some buildings like the ICEA within the CBD, if you were to rate such building a number of the buildings were designed with the principles of sustainable design because again in our teaching and training of architecture, you could recall in your training of sustainable design in JKUAT, there were units covering sustainable design so these are things that over years have been taught in our curriculum and so architects designers going out to practice have the principles and they apply them to a certain extent.

Do you think architects understand or a trained to design green?

To be very honest with you, from our training, I honestly believe that every architect that passes through our universities can design a sustainable building because the concepts they are not rocket science. They are very basic and we are trained through the simple modules, just from the bachelors course, we have the knowledge, proper understanding to be able to do sustainable design, and in fact, I would offer that if you look at the student project in the university a number of those students projects are sustainable projects. They are designed with high level of integration of sustainable principles. So, they understand. I can confidently say that the knowledge expertise and bringing you to the work that I am leading in developing a Kenya specific rating tool, we are doing this home grown. We are not calling the “godfather” or external experts of green buildings because we have experts in developing standards in this country. We have people who have been trained in architecture who have this knowledge. The only gap was that the will to do what we know, and, this doesn’t apply only on sustainable principles, if you look at our building code, the other planning regulations, really proper practice of architecture we have very good training in school but there is a training practise gap that once guys get out of school very few people have the courage to pursue what they know is right, they subject themselves to the market place, what the market pushes is, I want this building quick, people are often concerned about their little fee they can earn, the clients that are looking for shortcuts that would not even want to listen to necessarily those green building experts as it is deemed as demanding and cost prohibitive. Up to today, I don’t know of any single study rigorous academic empirical study that has been done in this country to demystify the cost of sustainable buildings. The perception is that sustainable buildings are expensive which is not necessarily the case. When you review the passive sustainable systems eventually they are not expensive, they should be cheaper, but that is a perception thing. So, what happens when guys get out there, they are subjected to the perceptions and trends in the industry. Shortcuts where regulations don't matter, even the basic statutory regulations like the EMCA the Environmental Coordination Act that already makes certain provisions of sustainable design mandatory are not followed. So, that's the gap. But, I was making a reference to the historical context we have, where, there was a discipline in the practice of architecture those decades that we refer to, you know the 80s the 90s, the 70s, when you single out those buildings that were done then, if you were to do an analysis, assess those buildings in terms of there energy performance, when you are looking at issues to deal with you know thermal provisions, when you look at the atrium, when you look at the façade, when you look at the overhangs, you will find out that they are properly sized, the lighting levels are ok. very basic things and they would score very highly. But, that again goes to the discipline of practice then and now we are in a generation that much as we are having this awareness of sustainable building design but we are seeing a number of buildings in Nairobi that are being done as if they are in Dubai. We are gotten into the age of glass. There is a tendency of too much glass all over the building is beauty and so people are running to that, and we have some cases you look at view park towers, those buildings that are really a disaster to the context and would hardly get 100% occupation but still again there are those who are going back to appreciate concrete large use of concrete, high thermal mass walls, and so it is a mix, as we are going towards modernisation and borrowing everything that is coming from outside, glass and the imported materials from China that are proliferating the market and when we talk of sustainable buildings with local materials and those recycled contents in the context of also globalisation where we have you know Chinese products filling every part of the society not only the building industry and guys thinking that the Saj ceramics are inferior to the Spanish or Italian tiles that are imported or you know the Chinese doors, we are now importing simple things like doors, that are not really high end so, there is a mix I think, we are at a level where there is increasing awareness and greening agenda becoming key in our country and Kenya being one of the countries that have a climate change act. We are generally becoming green conscious but this also comes with green washing where everybody wants to stand and say my building is green, but some of those buildings that are green I think some of them could be done better because I personally don't think that if things that we can do naturally we can do without using technology.

Would it then be right to say that currently the concept of sustainable design is market driven as opposed to driven by us practitioners?

I think it is mix, and when we say also market driven as I said the market force here, to bring the context clear, our market, they are not necessarily driven by just getting the certificate and you know get that label my building is green certified but it's out of as awareness of the business, the saving. So, I would give you a context that there has been a campaign going within the corporate world in this country for slightly over ten years driven by Kenya Association of Manufacturers and you know they have the Energy Efficiency and Conservation Centre which is hosted by Strathmore and KAM has been having energy management awards for a very long time. Now, this was not targeted at the building but it was initially targeted at the production processes, manufacturing processes there KAM, UNIDO and we had the formation of Kenya National Cleaner Production Centre which was supported by UNIDO the UN system and became a model of the other cleaner production centres in the world. This consciousness about the cost of energy, we really need to be profitable, there is benefit of saving energy and one way of saving energy is having efficient equipment, machinery and this when to our building could help us conserve more energy and so the corporate came to appreciate and get the link in term of more energy efficient buildings mean reduced cost of operations, means saving on there part and it means more profit so there is also that level of awareness with the market that the green buildings apart for the certificate it makes sense and then the energy I would say in the market place sustainable design has been driven by energy because you are moving from that transition that again you went further as a country to have the Energy regulation commission formed and now we have energy regulations that make it mandatory to do the energy audits and putting pressure on developers to meet certain requirements of energy performance in their buildings and now you have the solar, the renewable energy so that sector went, that is what is happening in the market place that became a driving force so its not necessarily just for the label but that's a narrow scope so having said that you get the understanding that where green building was more associated with you know the energy, with my bulbs, if I have the LED lighting and now you don't have the wholistic appreciation of what sustainable building would be. So that was a gap. But again from the practice, I can confidently say that though we don't have the numbers, but in this country we have had practitioners few professionals that have consistently pushed the agenda of sustainable building design and this ones are the people you would identify in out schools of learning. For example the current chairman of the architecture department in Nairobi university is very passionate about environmental design to the extent that everybody would call him the sustainable guy. This are people who have contributed significantly to also shaping the discourse in terms of sustainable design. From the point where this is something people don't understand, don't appreciate to begin influencing practice outside that people can begin to single out certain architects if they want sustainable design because they have curved a niche and our professional body which is now over 50 years old has an environmental design consultants chapter now which particularly is comprised of those people who specifically identify themselves and recognised as environmental design consultants. I know of practitioner who may not necessarily identify themselves as environmental design consultants or green architects, but they try based on their awareness at the early stages of conversation with their clients to infuse the principles of sustainable design. So it would not be proper to say that sustainable design in Nairobi is just being driven by the market place only, the market forces based on their understanding or the business benefit of resource efficiency but I put a rider there that in the market place it is a limited understanding, largely limited to energy and within energy it was focused more on the fittings, equipment, systems and renewable energy, which again when you are looking at design there is really no significance (or little significance) you see when I add on my solar panels on the roof there is nothing so much design about it, that a technology, I could use it as a roofing materials or a treatment of the design façade but that is a minimal design intervention but largely ignoring where design strategies come into play, you know passive solutions come into play. But, we have to acknowledge those few professionals who are now shaping the practice from teaching to industry and now we are at a level where not only the corporate we have moved to the level of the learning institutions now.

In your study maybe a justice would be when you are doing the cases, because this are some of the firms that have a foot print in terms of the Nairobi's architecture if you looked at TRIAD, you looked at the Planning systems with all this generations of buildings for the 60s to date and you followed their design thinking and philosophy where when the "TRIADs" they did those building where today in my humble opinion would score well in certain categories of sustainable design, the buildings that they did in 1970s and 1980s while you have now the buildings that they have done in the 20s where they are now fully talking a lot more of sustainable design, modern design, they are fully aware, even certification and standards are in place but some of them would still score poorly what happened in terms of philosophy of the design firm. What were the drivers then, what were the drivers now?

Having said that my look at the future would be a scenario where the design thinking, philosophy of practitioners has to guide the market as opposed to the market guiding the practice and this is not only about the sustainability this is also about the integrity of the practice because when we are talking we shouldn't talk of a green building where when I refer to the standard where if you were to ask me why you know why the process I am leading, why it was important for us to develop Kenyan standards – which was my next question – It makes no sense to me when you talk about sustainable buildings that have all those performance criteria that has been built on a riparian reserve, even if it would score 80 out of 100 in environmental performance or other criteria that you give but then it is sited on a grabbed piece of land, to me it makes no sense and so the future of sustainable design has to do with reclaiming the role of the designer in shaping the built environment, where the designer need not to be at the mercies of the developers, where we have the firms that have the philosophy that if it is not sustainable we would not design it and the same problem of bribing the council for building approval which means there is somethings that the designer know should be met based on the planning and building regulation. So, we have to reclaim ethics in the profession. Ethics in terms of having philosophy of sustainability but also having normative ethical practice within the industry. Then, lastly, my fear is that as we are growing with sustainability and sustainable design in Nairobi we are being pushed with the market forces with globalisation that the future it's a question of going back to the roots and we have to be bold enough to say that we don't need the west, we need to model. For example tell me about sustainability in agriculture, we are talking about organic agriculture that is what we left, tell me about sustainable architecture, we spent years teaching about the history of architecture of the Europeans and the books we are using in the school are all European and American books and the model architects we are talking about are all European and American system and we damped every things as if architecture, building… and if you looked at the history of building as a house it is as remote, you would like it to Africa, but the we abandoned this, then we told our wazees back at home that when we have a mud, grass thatched house that is uncivilised, barbaric and you need to abandon and get concrete and put it on the wall and then move now every body is striving to get the mabati on top of their roofs and the now in Nairobi we have all the mabati and everything we have put pavement on all the streets and when it rains it is a disaster. So, to me I look at the future of architecture and sustainable design for Kenya and Africa, if you are talking about principle if your paper or thesis can't really bring what construction of sustainable design ought to be and we have had academic scholarly discussion about is there African architecture, is there an African city, because again what we are looking at our city as Nairobi, if you look at it from the urban form, the discussion to grow is it really an African city, where we were having a conversation with a sociologist where would you go to the city as part of the city that has been planned to think about as a dweller to live as a true African, as a kikuyu as a luo as a masaai that I can be a masaai, that I can be a luo in the city of Nairobi. So to me sustainability is so inherent in the natural fabric of the society, basic systems we are looking at the ecological systems, we are looking at the social systems and now the economy is just playing within this two fundamental systems. So, the building needs to be anchored on those really natural systems that we had and that's why I am not a proponent of those buildings where you know we have to go for sustainable design where we are going to create jobs for the Chinese, for the Europeans and for the Americans and not for the Kenyans, not for the Africans? We are supporting the growth of their industries where much as in principle we are talking about natural materials, recyclable content and materials and all those things but then when we look at the tool they would give then certain rating because of certain reasons and there is big role, this drive cannot only be pushed by practitioners outside there, the bigger, bigger role has to be academia because we lack data.

What of government?

Government is a key player, I will come to that, government is pushed, government needs data, completing evidence to make certain policy decision critical for them to see. Because, for example, if you talk about standards now, KEBS is there, the role of KEBS in standards, talk about materials, somebody is today there has been a very interesting growth in making materials from waste. You have eco-poles and the likes making materials from waste, you know the challenge they have? Which architect would specify the poles, if you begin going by todays talk, what are the U-values, what are the co-efficients, what are the strength factors they are not there, they would be dismissed because of the KEBS and this are technical issues and that is why I say the role of academia is very important because some of those standards are not there, a lot of the things that we would dismiss our own things as inferior because there is no investment in proving that they are not inferior and if there is any fear in any element to develop them and improve them to meet the performance criteria that is necessary for them to be taken up so we need to strengthen that and that comes with also our academics we have to revolutionalise how we train to begin training and embed a thinking in our next generation of practitioners from training to get a certificate , degree, employment to training to create impact.

You asked me the role of the government is very key and what I am doing I have been pushing or working with the government. The government is not only relevant in setting policy, we have to move to a level where the government is leading sustainable design and construction in this country because the government is the largest single developer. So buildings will have to move to a stage where the next government construction project will be a green building that requires a policy, the government in the one regulating we have the BORAQS and so on we have to move to a point where in the BORAQS and this conversations we are having with architect musau through our AAK EDC chapter we are having this conversation where before you are registered as an architect and now we are proposing that sustainable design is part of the CPD they requirements that you would need to meet so that there are certain elements that you need to push. Government need to create incentives to promote local sustainable materials, to invest more in RnD but overally I must say the real transformative shift has to come from the academia. How can academia really generate empirical data that can shape policy? that can shape practice? How can academia training restore the sense of responsibility in the trainees to believe and see their role and contribution in the built environment.

My last comment, to you, your paper would be since it is philosophical, it's contribution the industry would be to push the debate as to where…to me the fundamental question is are our practices driven by sustainable design philosophy is there a sustainable design philosophy really in the practice of architecture in the practice of Nairobi? If eventually that is the discourse your research can push us to have more fundamentally and awaken the practitioner of architecture within Nairobi to restore design philosophy so I hope your paper would be making that contribution.

Rating tools… What is the value add of this rating tool and how contextualised is the rating tool being developed by the Green Africa Foundation?

I think the relevance of the tool is very clear, as normal with standards, theoretically you are trying to develop a framework for convergence of thoughts. The rating tools help to being a level of convergence at the level of practice not really at the scholarly and philosophical thinking level, because then we can be able to begin to agree that this is the framework against which we shall evaluate the greenness, the sustainability credentials of this building in our context. So then we can say, we can aspire to achieve this level of sustainability within our context and people can begin saying I have met that 100% or not and it can be a gradual improvement. Having said that, when we talk of the tool we are developing, our aspiration since 2010 was to develop a national tool and this is informed by the discussions we have had at length over the uniqueness of our context, that the principles of sustainable design are the same and the checklist, because at the end of the day, the rating tools are just checklists, that provide a framework upon which we can authenticate the greenness and also challenging us to have some ambitions.

Now why a national tool for us? And I must bring you to the context of yes, you have spoken to KGBS and they say they have the green start which sometimes they claim that they have contextualised, mine is not to criticise but to the best of my knowledge I can say that they have not contextualised the tool. I only know two effort to really domesticate rated tool is what I lead at

Green Africa Foundation, the Green Mark rating tool that we are developing to be a national building standard and what we are also working and we are working on at the AAK, Safari Green Building Index, which I guess architect Musau must have mentioned to you, I am part of the six member team that are working on this tool. These are efforts to develop Kenyan tools but we have a number of other tools that are being applied in Kenya and KGBS is at the forefront of this the Greenstar, the US LEED, you have even LEED experts that would certify buildings like UNEP and Strathmore, tomorrow they may be other people who may come to apply other tools or to start developing other tools. Our focus is, we are attempting to ask ourselves this question what is so important to us in defining what a green building in Kenya look like? Yes. We have these best practices, these principles that we don't contest against at the international level and we have looked at a number of tools. I can tell you we have bench marked with 11 tools we have looked at them, read them in detail and then we see each one of them have their strength we at our discussions have been largely focusing on what is Kenyan, what should be green building for Kenya, where should our emphasis be on. I agree with you when you say and I will say that though sustainable design is environmental in it's construction at the international level philosophically, but for us sustainable design is more social and economic because what drives our practice as we have delaboured on is more the economy and more the ethical issues that we have been dealing with, why we do what we are not supposed to do and why we cannot do what we need to do, so our discussion in developing a Kenyan tools has revolved around those issues, so how do we try to address those social and economic issues? Because it makes no sense if you were to apply LEED in Kenya, there are certain building that would be rated gold in Nairobi and we will be commending for performing very well in terms of sustainable design principles yet LEED will give the 30 points on energy focusing in very technical issues that as you have rightly put from the beginning were not a problem that we should have been struggling with in the first place and then you have applauded that building to have done well it's injustice, its disservice to the development of our build environment towards the aspiration of sustainability and so rather than put that 30 weight on this point we deliberately would say no for energy even if we were to give 30 point for energy we would not give 10 points on the systems, we would go back to the roots and let people not create problems for our buildings. So we weight, where do we weight in our scoring system, there are prerequisites when you bring US LEED and bring it here, there is no prerequisite you are referring to, if you go to sustainable sites talking about sustainable development, there is no brownfield site you are referring to here, brownfield is not an issue to us here. When we begin talking about parking and cycling and all those yes. When we talk about non-motorised transport is it an issue to us, yes it is an issue to us to appreciate than motorist transport, we have our guys doing with their bodaboda but at what point should we have this conversation? When we don't have the infrastructure yet to begin doing the non-motorised transport when you begin talking about circulation, the siting of you place what choice do you have in terms of your building, so we tweak those things, so within site for example we would lay emphasis on more important issues, to protect the integrity of our habitat, to take into consideration the users not only of the building the direct clients but how the building relates this other users around. How it deals with the salient issues of the landscape like how we manage our storm water. When you go to UK BREAM, largely focusing on retrofitting, the inherent language in the tool is how you deal with your built buildings but for us in fact if we are to begin focusing on retrofitting as we have said, we may not have a lot of problems with our retrofits because our old buildings were more consciously or unconsciously done with a lot of sustainable design consideration. Some of the things we would just be changing would be toilet fitting maybe just to produce low volume flashes but we shall not be altering facades, we will not be doing insulations and all those things so they are non-issues to us so the role of our local tool is at the core of deliberating on – and we have had these deliberations for six years- now we are coming to the point of freezing them but continuously we shall be having these discussions. We also need to have our own standards, I shall give you an example, when we talk about our indoor air quality, and as a country now I am in the technical team that is domesticating the WHO guidelines on indoor air quality and the conversation we are having there, if you were to just take that WHO guideline and apply it for Kenya you would have hardly any household that would meet those guidelines, because some of the parameters when you look at some of the particles the parameters that are given when you look at our cook stove none will score there, so, around the questions we are looking at is having now is for us, what is health. We need to develop our own parameters. Developing a local tool for us has been a very interesting process for us to begin looking at what should be our emphasis on what a sustainable building should be and what should not be. Green Africa foundation just provides the platform but the people involved are very many stakeholders. We hope that it begins to provide a basis for us to begin to define what can be a Kenyan green building but bigger role of a localised green building rating tool is more to provoke what needs to be done after we have developed the tool. It's giving us the basis and the framework for us to begin developing support, guidance notes, tools, incentives that can now help us make the shift. This is what has brought us to the level of talking to the government agencies that are involved within our team developing the tool. We need a green building policy because much as you say the role of government, the government is already doing certain things that support the sustainable design green building practices, there are scattered all over, if you look at a number of these regulations we have listed in our tool which are prerequisite, these are 25 regulations, each one of them have a piece they say about green building but there is no desk at the government level that you can go there and ask about green building at this point. You have some of the regulations that are countering the intent of other good regulations. So, what our working on this tool is helping us to do that we need to have is enabling policy. We also need academic problems that need to be solved where now the role of academia that are involved in the process of developing the tool would need to play part of the role of what are the research, applied research that need to be done to really make this standard make really big impact for us and I just hinted to you a few of them. There ought to be some R&D projects that are coming up, what are things that our companies need to produce, can we now have guidance to our manufacturers.

The rating tools we all have our strength for example KGBS they are a lot more in the market place, more conversation with the developers, AAK have influence with the professional bodies and GAF this is government and bringing the broader stakeholders and have a tool that is gazetted.

APPENDIX I: SAMPLE TRANSCIBED FOCUS GROUP

FOCUS GROUP ACADEMIA: Transcription

When we talk about sustainable design, what are key words that come to mind or what are the key issues that we are trying to solve?

JM: My understanding of sustainable design is you manage what we extract from our environment and whet we put in or dispose into our environment. My priority areas are, energy management, waste management and water and resource management of in supply and construction.

ST 01: Something that can maintain itself without out interference. Passive design, Urban greening and durability.

NO: For me what stands out is rainwater harvesting, because for the longest time Nairobi has never been self-sufficient in terms of water, there's a lot of rationing and even our politics is around resources such as water, so that is what jumped out for me. And then, self-sufficiency, and I am not just talking about buildings being self-reliant, you know power and water and other resources that are generated by the building itself but also in terms of maintenance of the systems, the systems need to be so simple and understandable so that the building occupants can be able to maintain those systems without using so much money. Then third was power saving. Power saving was rather obvious.

MM. My quick understanding is minimising the impact of the building on the environment by this a I mean, whenever a building is put up, it is calling for resources to sustain it and it is also producing waste into the environment so the idea of sustainability is to reduce the negative impact of the building onto the environment which it is put. In Nairobi the focus has been as others have said reducing the use of mechanical systems in buildings to provide lighting or ventilation, reuse of waste produced in the building, that water and also using the building to catch rainwater.

How does our context affect our understanding of sustainable design?

MM. One, I think Nairobi as a city has a fundamental problem in terms of the planning of the city and the problem is development has always preceded the planning, so that the planning is coming behind development and therefore the resources available are not planned for, therefore it becomes survival for the strongest. The approach of sustainability in terms of this resources that have not been planned for becomes key.

NO. A look at the infrastructure of the city shows that the infrastructure works intermittently, if you look at for instance, street lighting, drainage, power supply, they all work intermittently, thus sustainability is different in a way in Nairobi because people have learnt to leave with this systems that work intermittently, so the idea of self-sufficiency is stronger thus people will not wait for this to be delivered and also they are based on government cycles, what one government considers important may not be important to the next government, so, there is no relationship between planning, politics and the everyday life of people, so, in a way the approach to sustainability has to be different, there has to be more emphasis on people managing sustainability, if systems are simple enough and they can be understood by people, then they will be able to maintain them, use them widely and sort out problems more effectively, because there solution will be from the grassroot other that an overall idea of what sustainable design should be.

JM: Stemming from what you said the development outgrowing planning, which is a characteristic of urbanising cities and now we are a middle income economy and we are urbanising so fast that planning does not keep up. I think we don't demand this things in Nairobi as we don't see Nairobi as home. So we expect this to be somebody else's problem and we learnt to leave with this intermittently.

MM: There is also something about the institutional framework that will support sustainability. Sometimes are just knee jack reactions, there is no strong sustainable design framework to guide development. In other places there are strict requirements that you are to meet, what we have seen in Nairobi is sustainability is almost and individual initiative. That's why we are saying Strathmore can do one building that the say is the most sustainable and then the next time it doesn't follow up for that because it's just individual initiative. A corporate putting up a building in Nairobi has become a pride to say we have done a sustainable building which is not supported by any legal or institutional framework.

JM: I think the legal framework is there, it is the enforcement. For instance hot water heating, we had been given a deadline that passed, that all housing units more than three bedrooms bust have solar heating but we don't take into account. We don't have the value that go with it.

PROF D: My starting point would be the understanding of sustainability, we ought to ensure that when we are talking about sustainability we are talking about sustainability as defined in the Brundtland definition, that's the starting point. You see there the emphasis is more on the use of resources now with the future in mind. So when you look at it from that perspective, it encompasses extraction of resources, if it is natural stone that we are using, how effective are we extracting it, first of all it is not a renewable source, so is it something that is sustainable? And when we are doing that are we reclaiming the quarries we are extracting this materials from? Then comes the other aspect of design, there is where you begin to discuss things like high efficiency, in terms of resources, energy, from that perspective my argument usually is, Nairobi initially addressed that perspective of sustainability very efficiently because if you look at building that were done in the 60-70s you find those issues addressed, orientation, in fact even the planning of the CBD took that into account. You look at buildings like office of the president, jogoo house, treasury and the likes, those buildings in terms of lighting and ventilation, we don't need any artificial lighting, the comfort level is good, most of it also was almost maintenance free, then comes the new generation of glass cladding and AC and inefficient use of energy.

WN: On my side what I was looking at is in Nairobi we have a major issue with transportation, when we are looking at sustainable urban transport, we have seen the introduction of new road expansions because of the influx of cars and that why every administration is trying to deal with the issue of traffics jams and improve movement within the city. We also have a problem with waste disposal. A lot of developments are coming up as flats where there were planned as single dwelling and therefore, they put a lot of pressure on the system. We also have the issue of deforestation and lack of greenery, we are having a lot of subdivision and putting up concrete jungles in terms of housing estates and there is no part of that where greenery is being considered.

NO: Although when WN talks about planting trees, when you look at the old photos of Nairobi, it was just savannah land most trees have been planted after the city had been developed in a way, I see even in the metropolitan region, the planning of trees is accompanied by development.

JM: I think the more we develop, we actually need trees, because of the materials and hard surfaces we are using, we are actually making it harder in terms of water efficiency. So, the more we develop the more we need the trees.

The other question is whether the trees that are planted in the growth nodes for the city are the correct type because they require watering, maintenance and usually in areas that do not have sufficient water supply, you find that the water supply is through individual effort and it raises the question whether we are using the correct kind of soft landscape to deal with issues of water problems.

But it depends on why you are planting. Sometimes the landscape is a dream. I don't think there is conscious effort.

At times it's just to create a screen for the building, you find it is really standing out.

It's not just greenery, but greenery that works with regards to the context, with regards to the resources that are available.

If you look at the so called up market, all the greenery is being lost.

I think we have come back to what MM said, the development getting ahead of planning, there is the pressure to supply housing, densify, the thought of how sustainable it is comes after the resources start being strained.

But aren't those also political questions because it is not just developers being ahead of planning, it is also developer's kind of subverting the planning process through bribery, grabbing of land. So there's an aspect of politics that goes beyond the academic idea of politics. I think we need to acknowledge that sustainability is not a pure concept it also relates to what resources do we have and how do we divide this resources among people and that begins to generate ideas on how we can use resources and reserve resources for the future.

I believe that what you are taking about densification and the like is more of greed more than anything. Instead of open up green field properly and planning considering all the sustainability issues of design, we juxtapose, we just say we have money and there is demand we can put up whatever structure.

Do the practitioners understand what green design is, is it a new concept?

I think in that respect the practitioners sort of understand because they usually answer the brief they are given by the client, if the developer is driven by the capitalistic view and that is the brief they deliver, you either deliver that or you are out of the job, do despite your understanding of what is required, if you are not answering his greed. So, it's a balance between greed and knowledge of sustainability, it's not a new concept but the picture that is there is on the market value. When you go to the bank to apply for a loan they don't ask you how green it is, they ask you how many units to see of you will qualify for the loan.

Though again I think the answer is a bit more complex because of course practitioners will have their own world view, each practitioner has their own philosophy about what they would like architecture to be. But then again sustainability whether you call it a product of capitalism (our sustainability), it can be thought of as if you present it to the client as a way of saving money they will probably be for it. On the other hand if you present it as a way of increasing the project cost then they will reject it, But, again we must acknowledge that lots of building that are produced in Nairobi and around the country are not done by architects, they are done by communities and individuals who are outside the professional system so for them again it's an issues of how they utilise the resources available for them, if they see that rain water harvesting helps them to sort out an issue then they will apply because they see the benefit and it also applys to the idea of maintenance and self-sufficiency, client today are looking for buildings that are more self-sufficient. We have learnt to live with the idea that resources are constrained and therefore we must use them very efficiently of find other ways of coping with the deficiencies.

Maybe I could add that one need to look at is from city level and dwelling level, there are certain levels of it that is done at city level then the aspect of development control become the crucial thing and that's really our weak point. You can see the aspect of solar water heaters, that was the regulation that came from development control agencies and every building now how to comply to that. If they were able to effect regulations, we would have a much better management of resources in terms of sustainability. I have a good example, you know, of what happened in the 50s and 60s, a street like Moi avenue, development control established the massing up, you know plot ratio, plot coverage but on top of that introduced two levels of shopping so you had ground floor shopping and first floor shopping, in spite the fact that each of those blocks were designed and developed by individual developer, that concept was sustained. It is what you find in cities like Hong Kong, where you enter on one black but you can find yourself coming out after ten or so blocks, but that come with stringent development control, for us its really the weakest point.

Maybe I can add, he has brought it very well to dwelling and city level, because I think sustainability we all understand it, my grandmother understood it, and I keep saying in our rural homesteads we practice sustainability, waste is managed, water is harvested and recycled, we are using sustainable energy like biogas in the rural areas but as we said at a city level somewhere the professionals have lost the plot. As professionals we have made it seem very technical, people generally understand as individuals. But as a city level we have mystified it, so I actually think we need just to go back to our grass roots, because as a professional when I hear what people are claiming as sustainability I am like I know these things. I think at a dwelling level we understand it and a city level we don't.

But the city is much more complicated because having gotten used to intermittent systems that work don't work, then there's a lot of bureaucracy in water and power supply companies. That kind of management has made it difficult for people to collaborate effectively. Consider where you generate power and you to sell it back to the grid, that requires some level of sophistication, or water harvesting as a group, I think haven't got used to a very bureaucratic system it's hard to imagine the simplicity of a homestead in the village being extended to the town, because the town involves people coming to a consensus and being able to fulfil part of your agreement with the community and reaching this consensus is difficult in a city wide scale.

So, then what would the solution be for this complex system in the city, how would we solve the city challenges?

Maybe the starting point would be to realise that sustainability is not a shop thing, designers can contribute their expertise when it comes to buildings but when it comes to the issues of sustainability we must then identify who are the main stakeholders, especially in an urban context, since as we have discussed it is a very big problem and it covers economic, politics, social issues (the web of sustainability), to start addressing it first is to list who are the main stakeholder and try to address this issue per stakeholder, for example, they city government is a stakeholder so what roles would that stakeholder play, the urban dwellers, professionals, so we need to list this people so that you solve problems per sectors. Architects have a bigger responsibility, and as prof. has said basically if an architect exercises his training, he would address many issues of sustainability that falls within his sector, the same to all stakeholders.

For me I think, the way that would make sustainability a wide spread phenomenon would be to tie the idea of sustainability with the idea of individual benefit. If for instance, we could assure clients that so long as they have a certain system that is simple to maintain and durable that they will have water every single day and they will be able to generate power and save on building and maintenance cost, that way it appeals to individuals to start to begin thinking about integrating sustainability within the buildings, because the professionals are not the ones who drive the sustainability agenda, it is driven by people who want to build because ultimately they are the ones who choose whether they want to include this systems or not an they can simply refuse to spend more on sustainability if it is a burden so, it is up to the professionals to start thinking of a way of integrating sustainability systems into the design that creates value to the client that they can see and experience. Sometimes the agenda of the county government, and other agencies in charge of spearheading the sustainability movement is not driven by this pure need for sustainability. In a way I am sceptical about authorities and the powers that be in pushing the sustainability agenda that's why I am more for integrating sustainable systems into buildings in ways that appeal to the individual.

NO: I tend to believe that if we have proper political good will and proper legislation. Just like the issue of solar became legislation, because we tend to react to the things that's are forced to us that those we are willing to do. When there are repercussion people do it.

Are we trying to solve an environmental issue, what is the role of these environmental designers, do we need them, also the role of the rating tools, are we just mystifying sustainable design further?

KK: I think it is interesting how you have put it, what is the word that you have used, it is being hawked, because even as practitioners in this country that is how we feel, our involvement in it is very plastic or superficial, truth of the matter is the tools that they are trying to hawk as you have put it is what we do on our desk on a daily basis, we talk about cross ventilation, sun shading and all this. These tools are just being used for the bigger projects as marketing tools and it becomes almost unattainable, if you look at the cost of getting those start ratings, the client will ask if it is necessary.

I think I will agree with her, the mystification, we are making green buildings elitist, and to me sustainability is a simple thing that anyone should be able to do. The star rating tools are not even contextualised. You will find that even in this so called rated buildings the lights are on fulltime. They have used the north American rating without considering the contexts. The rating tools also come at a cost. Even for one to be trained they needed like 50K for a three-day training. We rate our building very well, we know when we are consuming too much power, too much water. I get frustrated with the waste management so, I think I have a problem with this environmental thing and rating tools, it makes things harder and unattainable.

I think you asked a question that was not answered, who responsibility is it, and in a way what JM says brings it back to the grass root, that you know people understand when you talk to them about their water bills, power bills, how much they spend per month on utilities, they will tell you and they feel either the joy or the pain, but when we begin to institutionalise the issue of sustainability and you begin to deal with politicians and their ideologies or lack of and the political cycles and how some rating is being applied form places you don't even know, then it become complicated. That is where we mystify a concept that is really so simple we should just be getting it. So for me again we should learn to contextualise the idea of sustainability find out what it means to people to make savings and get a sense of pride from self-sufficiency, especially in a continent where there is so much pressure of resources and public utilities. Because as prof said, a lot of our public utilities are from the 1960s and 70s and we have not pushed them further. The idea of sustainability as we already know as managing out environment and managing our resources.

Just to follow up on who's responsibility it is I agree with NO about political good will, the biggest gap I see is that we have not entrenched sustainability in our development agenda. We have a development blue print call Vision 2030, I think if we can have a clause in there so that we can hold somebody accountable. (example of how government criminalised community effort to collect garbage). At some level we need to involve the because the have to provide some infrastructure esp. at city level.

I think in a way, the sustainability question is one that demands a questioning of the city structure as we know it, because the problem with the city is that you get your resources from some other place, you get your water from some dam in some water catchment area and then you damp your waste into either into some sewage treatment facility in another county or into the river, in Nairobi actually we dump it into the river. So, the structure of the city as we know it form the colonial times fundamentally needs to be questioned. The city need to be restructured into self-sufficiency. Getting your resources in site and dealing with your waste on site. There is the idea of condemning the county for how the city has fallen from it's glory days in the 60s and 70s but technology ways of leaving in the city are changing, we cannot judge our city now based on the understanding of our city in the 70s. Yeah, there is a certain sense of nostalgia when the older generation remember how the city was and when they went through life when they were starting to get into employment. But, because technology is changing and ways of living in the city are changing, the we need to think how sustainability helps us to arrive at the idea of a city. I think sustainability today should be about manging resources and managing the waste on site. So that if it is like garbage why not manage it at household level. Then maybe the role of the county government would change. Maybe this debate is about questioning if our city today deserves to remain the way it is and if we should be looking at the past and saying we should go to a past that is only in our memories.

It has become like a fad and it not just in Nairobi but in many other cities and that fad like a fashion style normally is among the elitist group in order to get a certain rating, and you find that those "start" architects have themselves driven this agenda towards environmental issues around the building, so it pushes everybody forgetting that sustainability issues are really wider than that. The corporates are also driving this agenda but not for the sake of the sustainability agenda but for the sake of them getting recognition. Their interest is not at all about sustainability issues.

Again, about the rating tools, service or disservice?

I think it works both ways, I totally agree with you having attended half of a training, where you get points is, you have to have a sustainability expert and you get X no. of points, nothing to do with your building, then also having visited those buildings that are termed as green, I'm not sure whatever the rating is that they are designing building for out context but on the flip side it is starting a conversation at a higher level and putting pressure on us to discuss it. The rating index of the city will be brought down by the urban power so we need a tool that takes into consideration housing for the poor.

And one of the reasons is that is because who are the drivers, we are talking of social guys and some accounts who just want to make money and then the other question would be why would I pay 300K for my building to be rated, you will only pay this for a target market who are aware of this sustainability issues.

I think that when you are talking about the larger population especially the poor and then we are also talking about the elitist group, perhaps it should be more of a culture change (change, or backtrack?), so that it comes from us that we want a cleaner city a cleaner environment irrespective of where I live, otherwise whatever effort will be counteracted by the greater majority who not only are not aware, they just don't care, they have bigger problems. We need to mainstream it.

When we talk of context I agree with a lot of what you have said, a lot of the protagonists that I have met, it's I go study in the UK or North America then depending on the context you go to, you bring that back. As you were talking, two things came to my mind, when you say brainwashing, the brain washing did not happen now, when you go to the history of Nairobi, the way it was planned as a segregationist city, then it was racist now its economic, that has trickled down into sustainability, if you cross up to Upperhill, Kilimani, development and tree go together even when they are doing Ngong road they plant trees when they are doing outer ring road I don't know. The second thing that has come up is who do we go to, maybe we don't need to go far, look at our traditional ways, we have many climatic zones in Kenya, I think we have the whole spectrum, but every single community know how to design.

I think I like what you are saying, going backwards, and brainwashing, if you go to the Maasai area, the Maasai have stopped building the manyatta and now using mabati and they say during the say they cannot stay inside and at night its cool cold so the Maasai is wondering whether that is really progress.

Homelessness was invented by the building code.

In terms of context I think we also have to look at cooking fuel, how we cook impacts the environment gently, what is the majority using?

Rainwater harvesting?

We do! We do!

When it rains for 30 mins have you seen those flood waters? It is a lot of water, it all goes to South C. It is a lot, maybe because the surfaces are hard.

The rainwater is good. If we can find a way of storage, that can push for many months, so if everybody can do that collectively it will make a difference. It's the simplest approach.

I think maybe again that is an idea that needs to be put to test, that we don't have enough rainwater. (neighbour example).

(Check argument on rainwater on raw recording)

I think we need to get scientific justification for the volume and the use because we can say that it's a lot but in the real sense we don't have.

Perhaps the problem is not necessarily rainwater harvesting but the methods of collecting water. (example of farm in Athi river)

Because the problem with Nairobi is actually collecting run off.

(Check full argument on rainwater on raw recording)

What would we say are success in Nairobi, if we were to do an audit of Nairobi?

Maybe I can start, one thing that we are doing right is we don't throw garbage in the streets.

The issue of legislating the use of solar hot water heating.

I think even the plastic paper bags issue is a huge plus.

I look at the organisations or authorities like NCA and the fact that they are now more concerned with the construction process. Because now more professionals will be involved in the construction of buildings. The school training is also waking up to this school issue.

One of the things that they say is architects are not being trained well, what do you think given that you are academics, do you think training is an issue?

Yes!

Yes! It's the truth

Yes, it's the truth but there are two ways to look at it, one is even when we are trained its not a current issue, technology is changing so we need to find a way to keep up.

I look at training differently because we look at the units of sustainability, but unfortunately when you train you have to go and train under a registered architect, now when you move to the office to practice, that is when initiation happens and if nothing is done with regards to sustainable design, it's lost eventually. It's training but not necessarily at the university it's somewhere between the time they leave the university and they begin practise on their own.

In my opinion I think blaming the architect is a very simplistic approach to the issue of sustainability because its not just the architect that's concerned, there is politics, trends in building construction, materials and technology that affect the way sustainability is approached, if an architect messes up a job not all architect should be blamed. We are all trained in site analysis, of we are considering the training of architect with regards to certifications like LEED and so on, then maybe not, but if you are to talk about site analysis, the orientation of buildings and designing efficiently then I think architects are sufficiently trained for that.

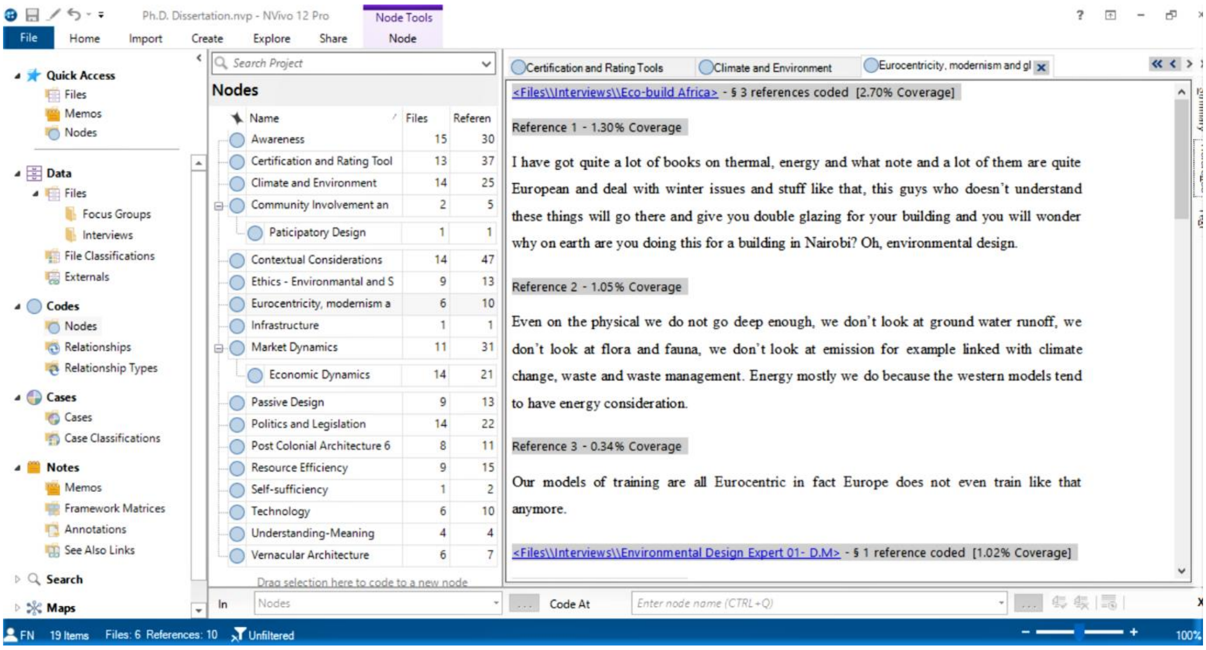
Coming from the point that in the industry they could be some shortcuts, I am thinking this student will run his own practice, so when we have the child, we try to hummer it as much as possible they may have some residue when they are independent.

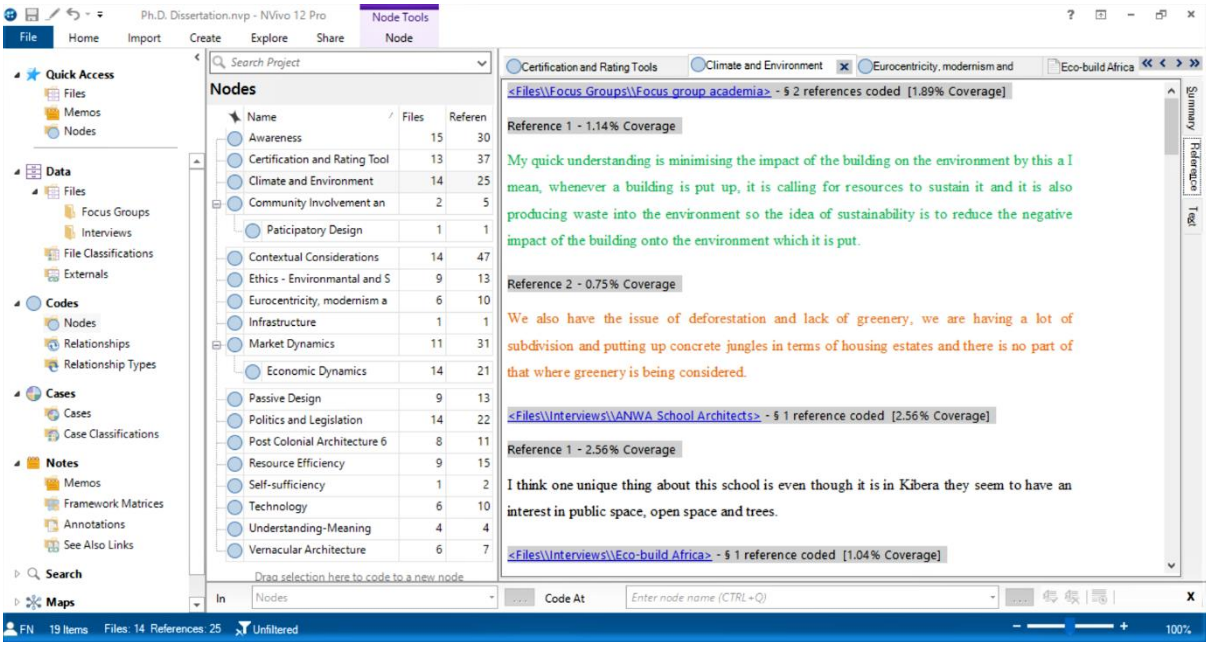
Are the architects losing control???

In our market cost is a huge factor. The initial cost of a project is what guys concentrate on; my thinking is the cost engineers have failed us in terms of doing life cycle costing of buildings. Maybe just to do a comparative analysis between a building that is more sustainable and a conventional building. So, that in another 10-15 years we can have a comparative analysis on this approaches.

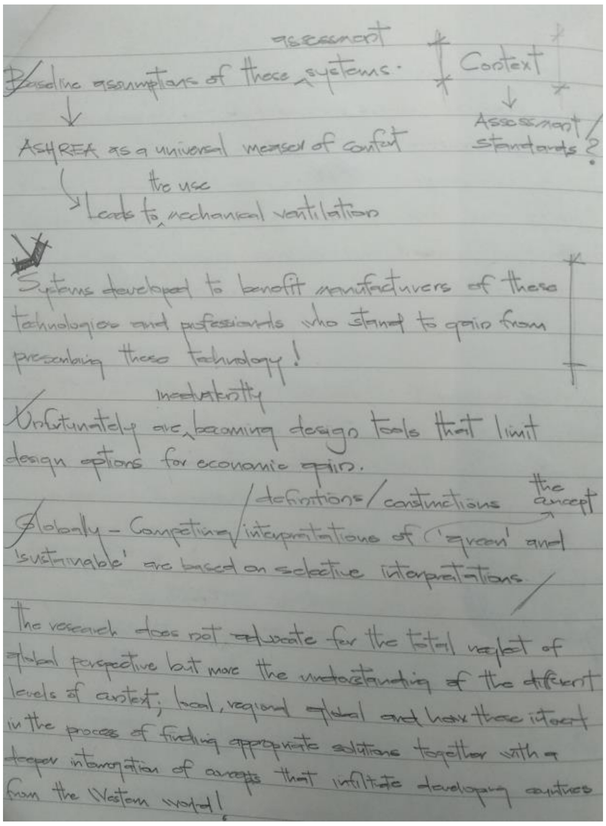
I think maybe, it bring us back to the point I had made that we look at the practice of architecture and design as a benign practice where things happen according to the rules and regulation, that if we have more rules and regulations that things will work, I don't think so, even us architects we hide our work for each other, so now we are going to ask the owner about cost yet half our buildings are on grabbed land, the other half are not approved. What are you talking about? We just need to make sure you appeal to peoples need to saving, if you make them simple enough, where people can understand them and maintain them even with what we refer to as jua kali tech. people will begin to use it but we need to put in mind that our country has a certain ideology behind it an there are certain inequalities that spill over to the sustainability debate so that if we are talking about governance, training

APPENDIX J: NVOVO CODING EXAMPLES





APPENDIX K: MEMO EXAMPLES



Baseline assumptions of these assessment systems. — Context → Assessment / standards?

ASHREA as a universal measure of comfort

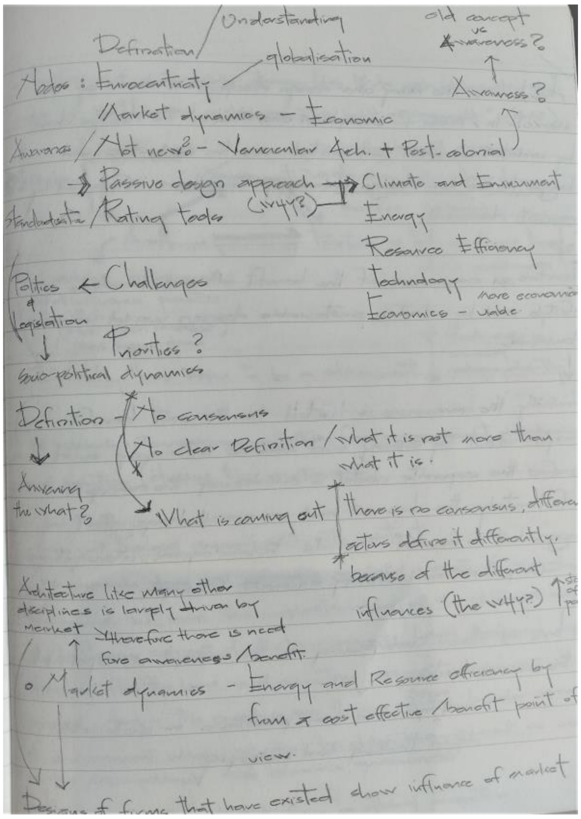
Leads to the use mechanical ventilation

Systems developed to benefit manufacturers of these technologies and professionals who stand to gain from promoting these technology!

Unfortunately are inadvertently becoming design tools that limit design options for economic gain.

Globally – Competing definitions / constructions / interpretations of the concept 'green' and 'sustainable' are based on selective interpretations

The research does not advocate for the total neglect of global perspective but more the understanding of the different levels of context; local, regional global and how these interact in the process of finding appropriate solutions together with a deeper interrogation of concepts that infiltrate developing countries from the Western world!



Definition / Understanding — old concept vs Awareness? — Awareness?

Nodes : Eurocentricity — globalisation

Market dynamics – Economic

Awareness / Not new? – Vernacular Arch. + Post-colonial

→ Passive design approach (WHY?) → Climate and Environment, Energy, Resource Efficiency, Technology, Economics – viable, more economical

Standardisation / Rating tools

Politics & legislation ← Challenges — Priorities?

↓ Socio-political dynamics

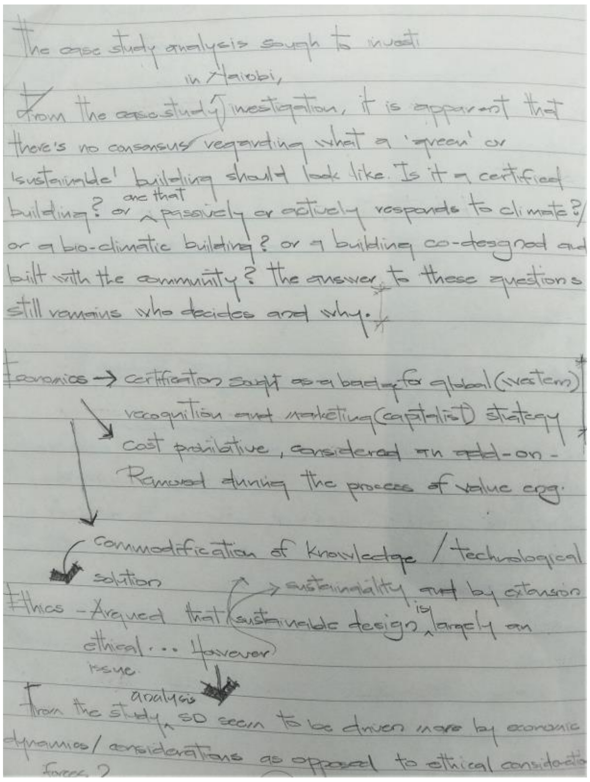
Definition – No consensus; No clear Definition / what it is not more than what it is.

↓ Answering the what? — What is coming out — there is no consensus, different actors define it differently, because of the different influences (the WHY?)

Architecture like many other disciplines is largely driven by market → therefore there is need for awareness / benefit.

∘ Market dynamics – Energy and Resource efficiency by from a cost effective / benefit point of view.

Designs of firms that have existed show influence of market



The case study analysis sough to investi

From the case study investigation in Nairobi, it is apparent that there's no consensus regarding what a 'green' or 'sustainable' building should look like. Is it a certified building? or one that passively or actively responds to climate? / or a bio-climatic building? or a building co-designed and built with the community? The answer to these questions still remains who decides and why.

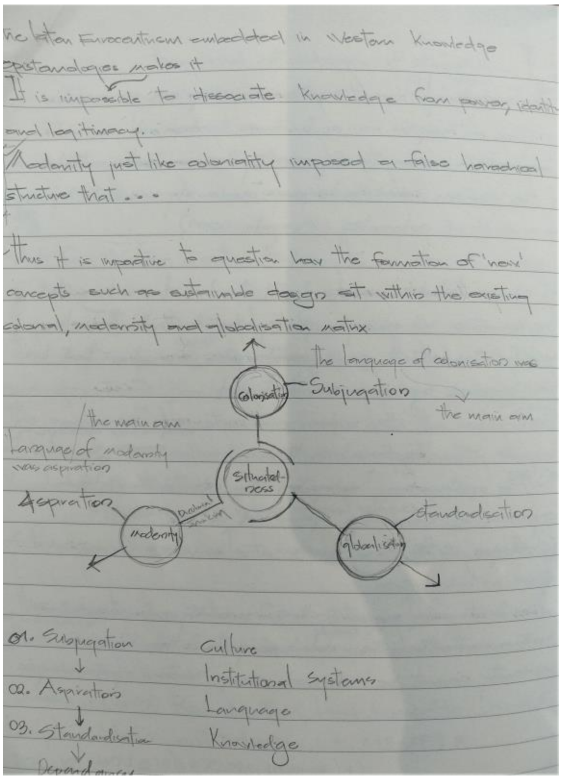
Economics → certification sought as a badge for global (western) recognition and marketing (capitalist) strategy

cost prohibitive, considered an add-on – Removed during the process of value eng.

Commodification of knowledge / technological solution

Ethics – Argued that sustainability and by extension sustainable design is largely an ethical ... However issue.

From the study analysis SD seem to be driven more by economic dynamics / considerations forces? as opposed to ethical considerations



The latent Eurocentrism embedded in Western Knowledge epistemologies makes it

It is impossible to dissociate knowledge from power, identity and legitimacy.

Modernity just like coloniality imposed a false hierarchical structure that . . .

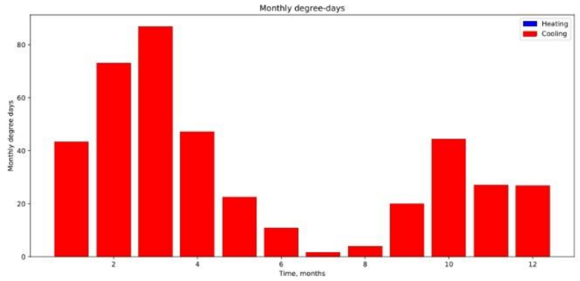
Thus it is imperative to question how the formation of 'new' concepts such as sustainable design sit within the existing colonial, modernity and globalisation matrix

01. Subjugation ↓ 02. Aspiration ↓ 03. Standardisation ↓ Dependency

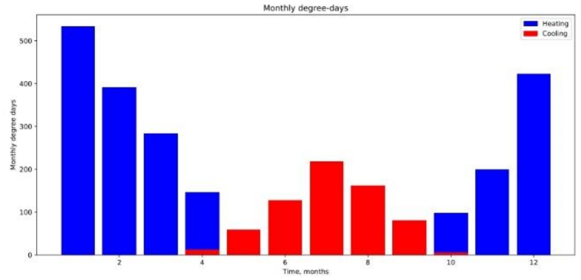
Culture
Institutional Systems
Language
Knowledge

APPENDIX L: CLIMATE COMPARISON (CHAPTER 04)

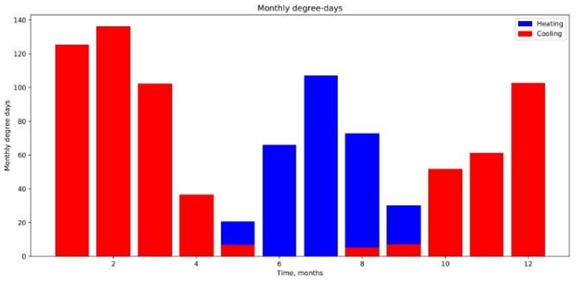
Monthy Degree Days



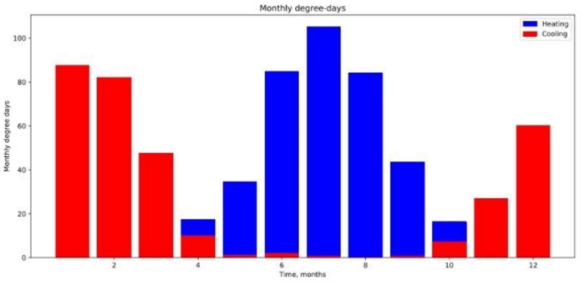
Nairobi - Kenya



New York- USA

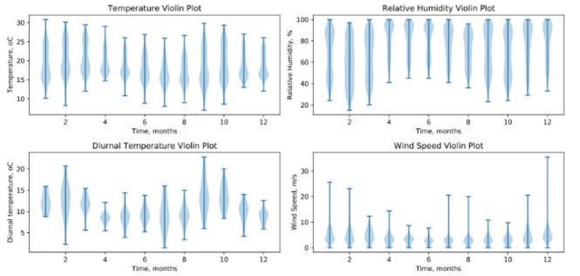


Sydney - Austrailia

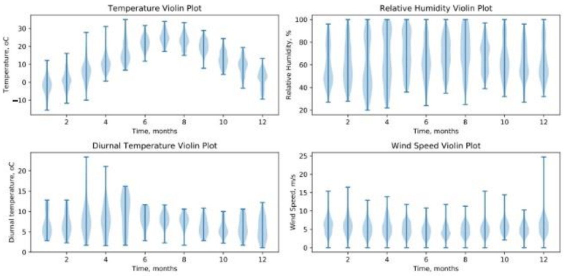


Cape Town - South Africa

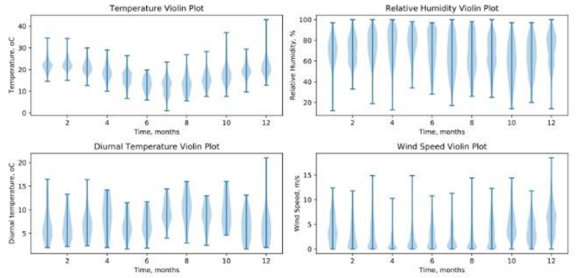
Temperature, Humidity and Wind



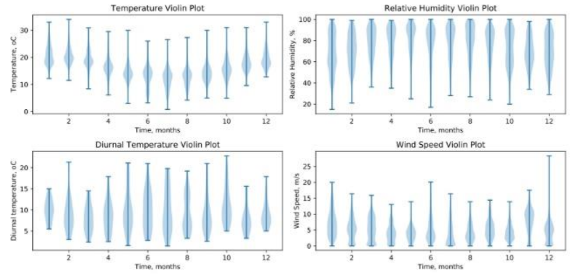
Nairobi - Kenya



New York - USA

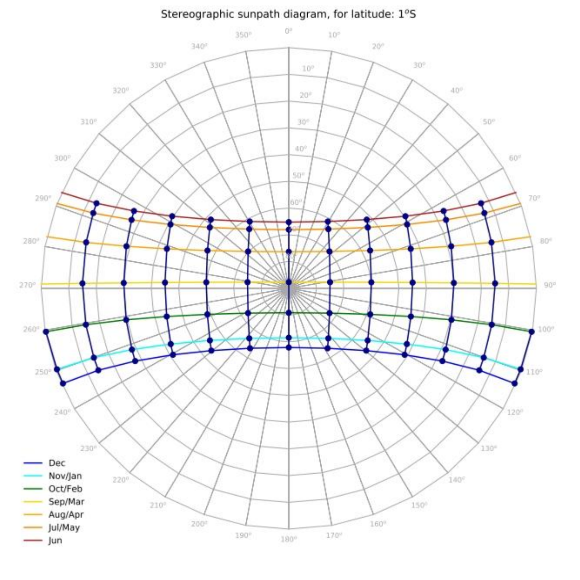


Sydney - Australia

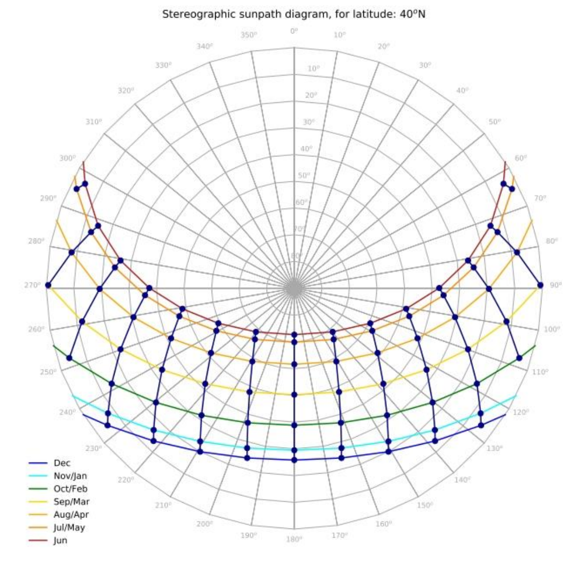


Cape Town - South Africa

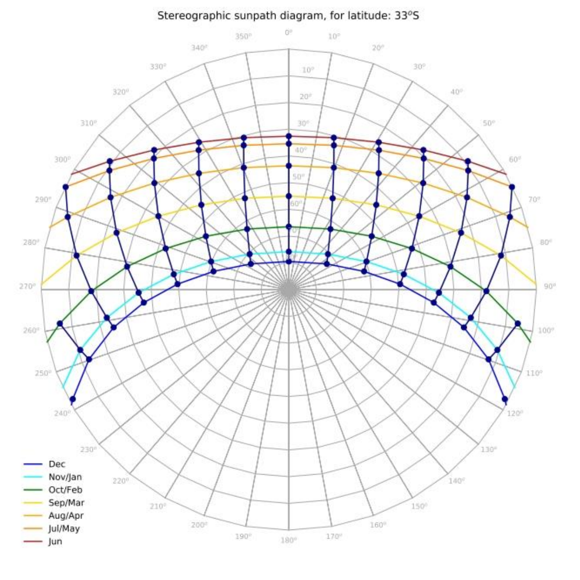
Sun Path



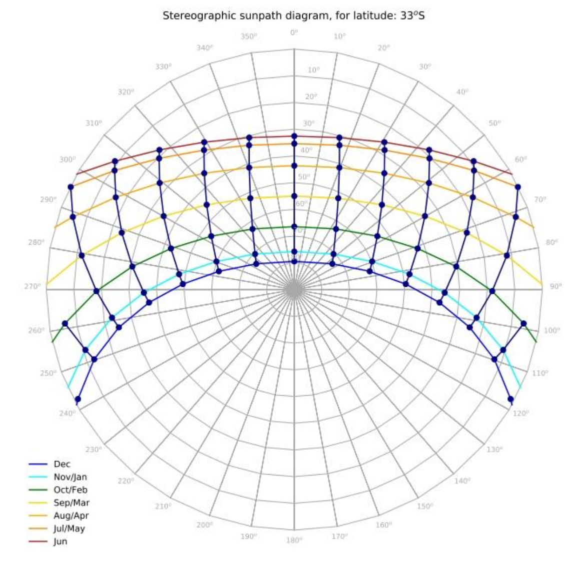
Nairobi - Kenya



New York - USA

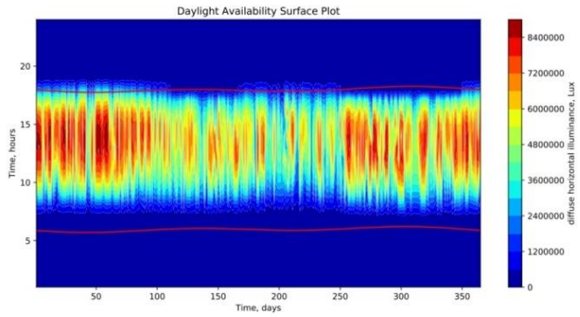


Sydney - Austrailia

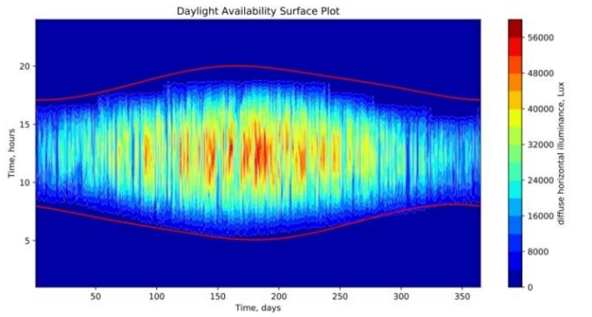


Cape Town - South Africa

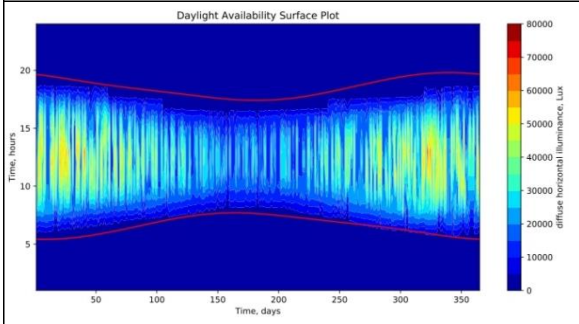
Day Lighting Availability



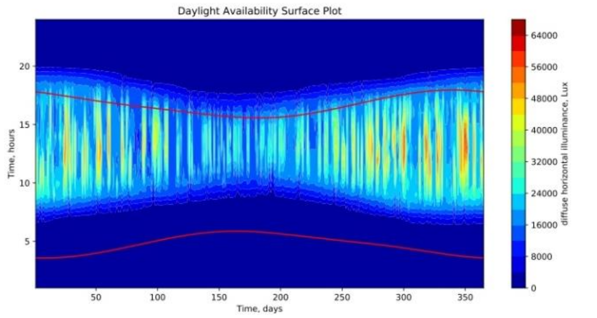
Nairobi - Kenya



New York - USA

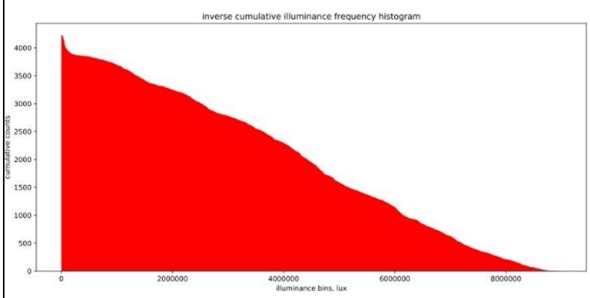


Sydney - Australia

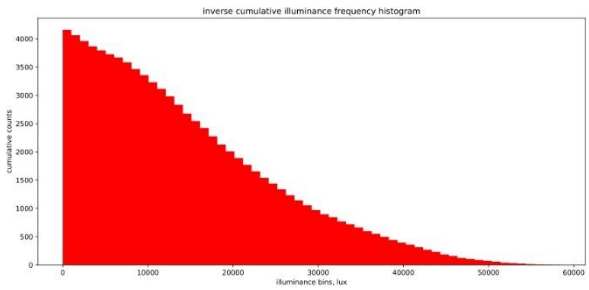


Cape Town - South Africa

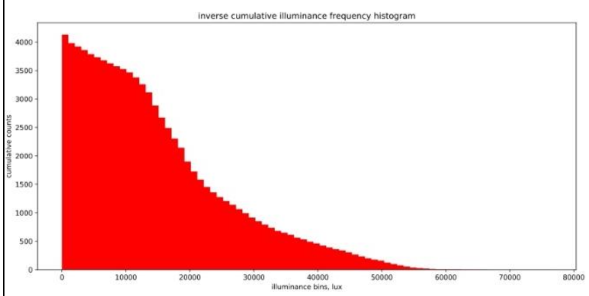
Cumulative Illuminance Frequency



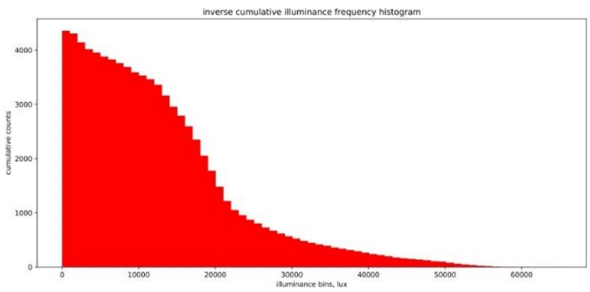
Nairobi - Kenya



New York - USA



Sydney - Australia

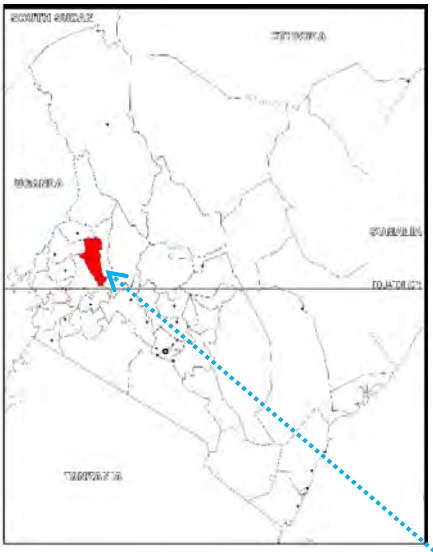


Cape Town - South Africa

ELDORET

Climatic Zone :	UPLAND
Latitude:	00° 31' N
Longitude:	35° 17' E
Altitude:	2,085 m

Figure 14: Location of Uasin Gishu county

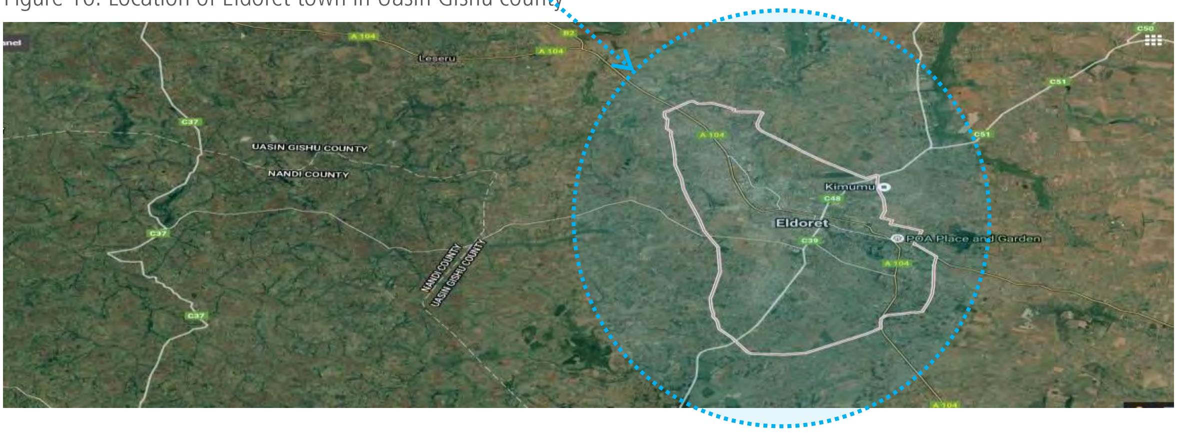


Source: http://www.d-maps.com/

Figure 15: Aerial view of Eldoret town

Source: Google map images © Sir Ray KILIMO

Figure 16: Location of Eldoret town in Uasin Gishu county



Source: https://maps.google.co.ke Map data © 2016 Google

GEOGRAPHY AND CLIMATE

Eldoret, the largest town in Uasin Gishu county, has grown to become the fifth largest town in Kenya - after Nairobi, Mombasa, Kisumu and Nakuru. It is located at geographic coordinates of 0° 31' N, 35° 17' E at an average altitude of 2,085 m above sea level. The town receives over 1, 082 mm of annual rainfall with the highest amount received in the months of August and the least amount in January. It also experiences relatively cool temperatures with mean air temperatures averaging 16.9 °C. The coolest month of the year is July while the highest average temperature is recorded in February. Relative humidity averages at 70% annually while the wind velocity ranges 2.1 – 4.6 m/s with the predominant wind direction being East North East (ENE). The annual average global solar radiation in Eldoret is 5.8 kWh/m^2. See Appendix 2 for hourly climatic data.

Bioclimatic Data

Table 4: Eldoret monthly mean climatic data

Month	Dry bulb temp [°C]	Relative humidity [%]	Wind velocity [m/s]	Global solar radiation [kWh/m^2 day]	Direct normal solar radiation [kWh/m^2 day]	Diffuse solar radiation [kWh/m^2 day]	Rainfall [mm][23]
JAN	17.8	58.0	3.3	6.2	6.1	2.1	30
FEB	18.5	53.0	4.6	6.4	5.9	2.3	50
MAR	18.2	62.0	3.4	6.2	5.2	2.3	70
APR	17.1	74.0	3.4	5.6	4.0	2.6	150
MAY	16.7	73.0	2.7	5.5	4.4	2.4	140
JUN	16.1	77.0	2.4	5.3	4.2	2.4	120
JUL	15.3	80.0	2.7	5.0	3.6	2.5	160
AUG	15.9	78.0	2.1	5.3	3.8	2.6	180
SEP	16.3	75.0	2.6	6.2	5.0	2.5	100
OCT	17.0	72.0	3.0	5.9	4.6	2.5	60
NOV	17.0	69.0	4.1	5.5	4.0	2.6	60
DEC	16.7	66.0	4.1	5.9	5.2	2.4	40

Figure 17: Monthly mean relative humidity for Eldoret

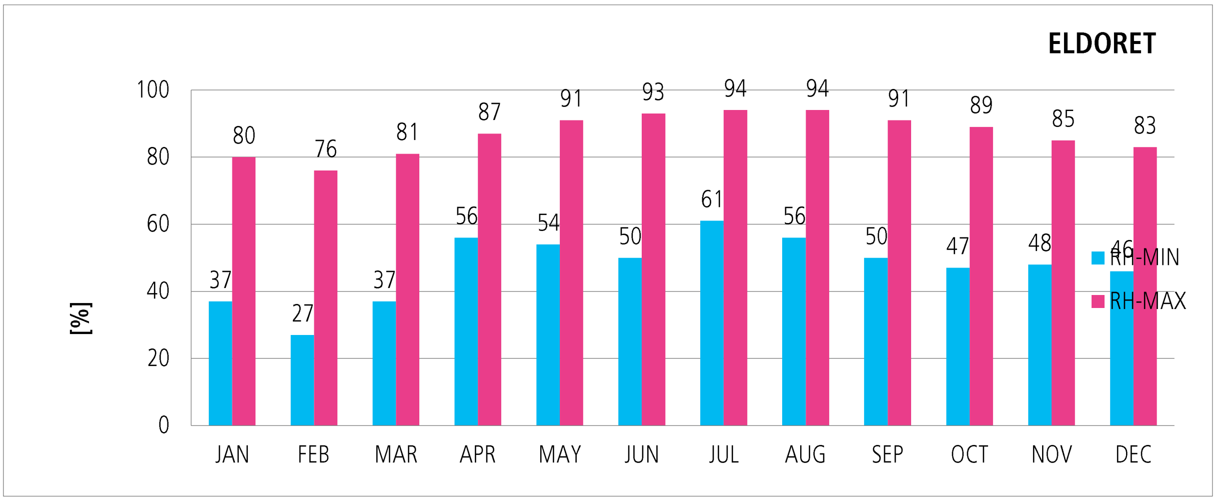
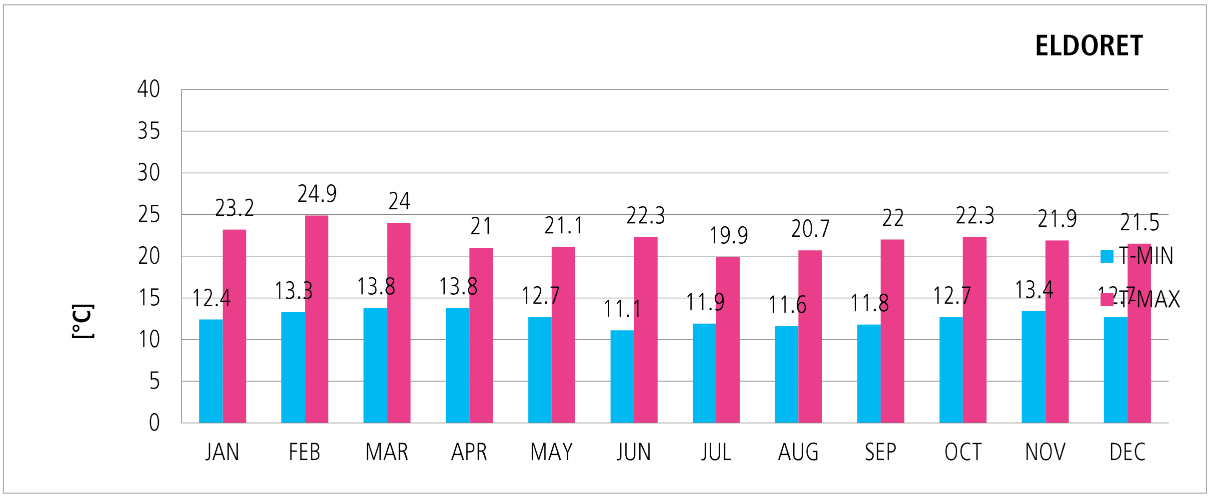


Figure 18: Monthly mean maximum and minimum temperature for Eldoret



23 http://www.weatherbase.com/

Figure 19: Monthly average rainfall for Eldoret

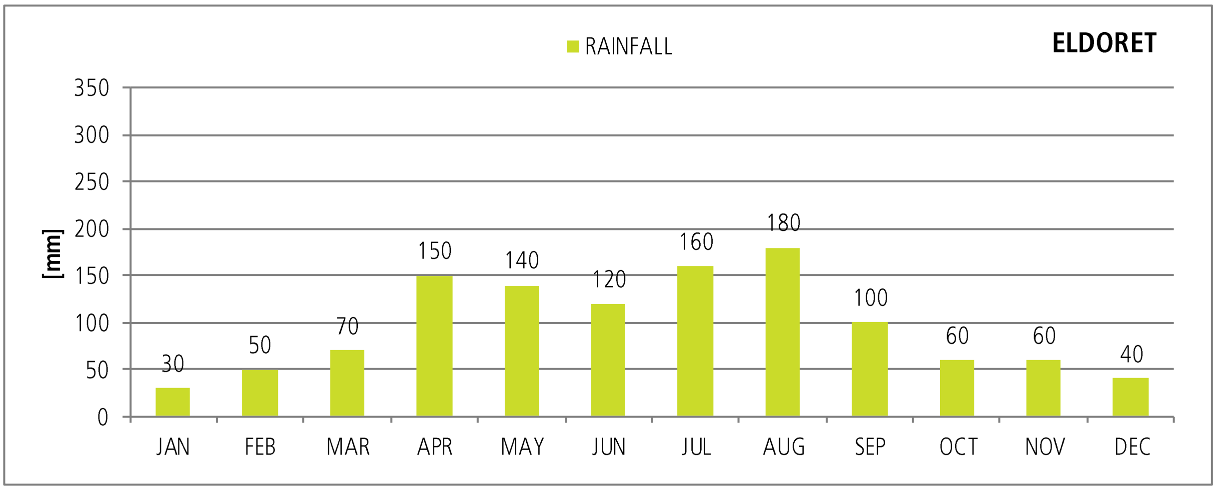


Figure 20: Polar sun path diagram for Latitude 0° (Equator)

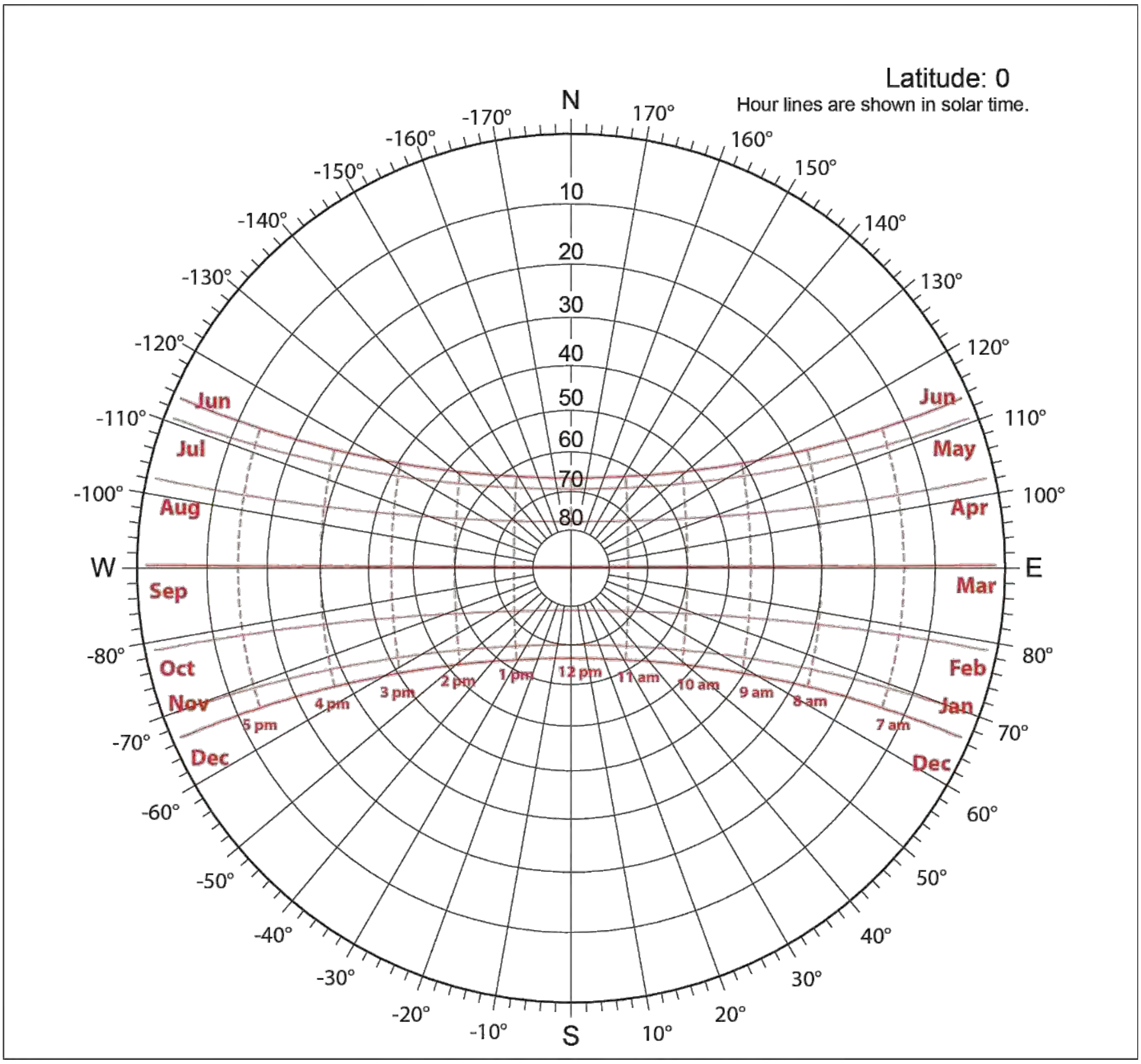
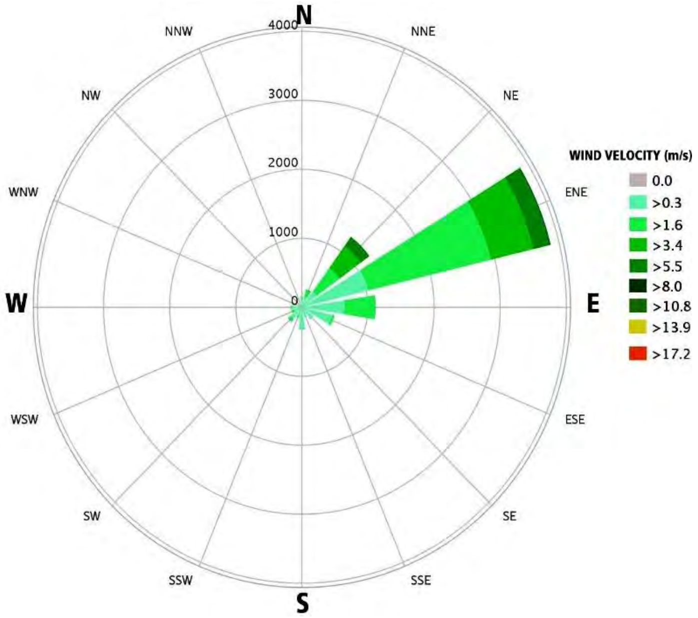
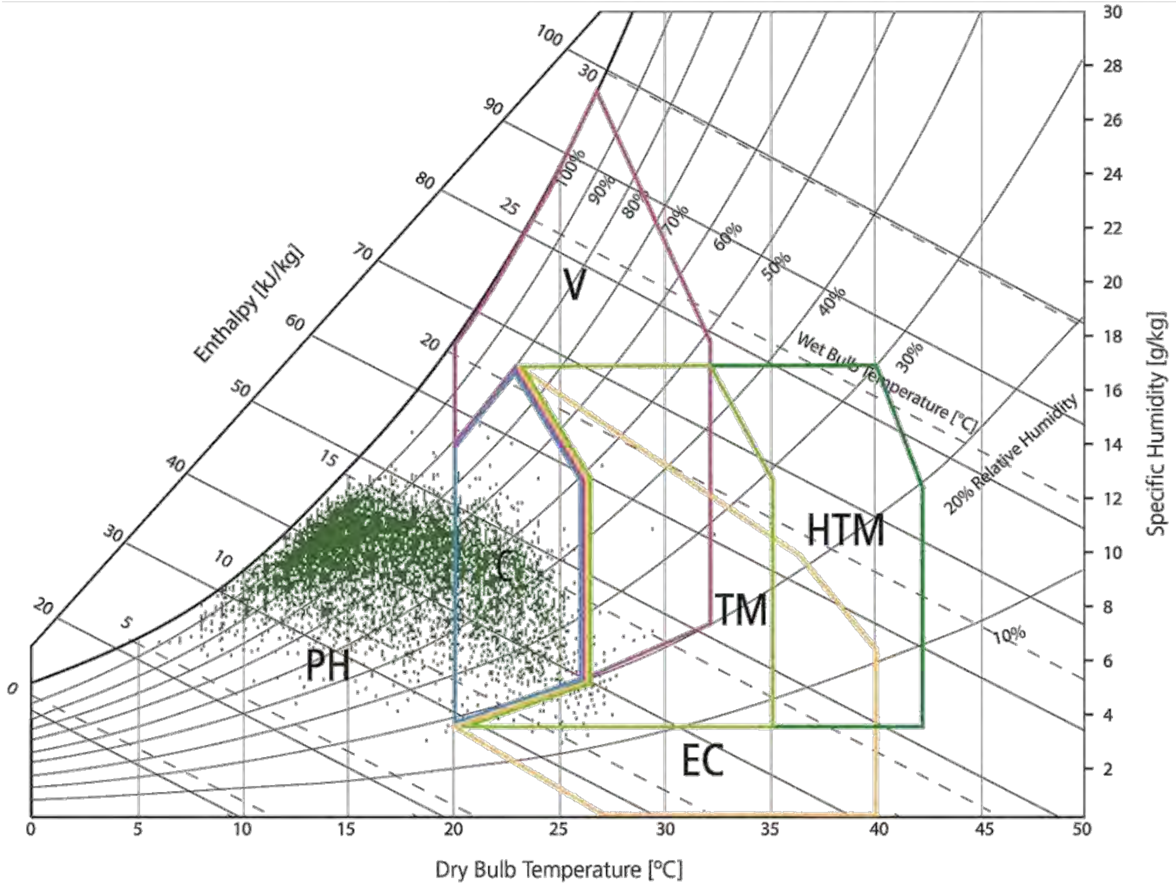


Figure 21: Wind rose diagram showing the prevailing wind direction in Eldoret



Source: https://www.windfinder.com/

Figure 22: Psychrometric chart with passive design strategies overlays for Eldoret



C	Comfort Zone	EC	Evaporative Cooling
V	Ventilation	PH	Passive Heating
TM	Thermal Mass	AC	Air Conditioning
HTM	High Thermal Mass		

Interpretation

The hourly outdoor dry bulb and relative humidity data points indicate that Eldoret falls within the comfort zone during certain periods of the year (see Figure 22). However, for a substantial period, the temperatures are clearly below comfort with temperatures getting to below 10 °C at certain times. This means that the main design objective should be to increase indoor temperatures to comfort levels. The chart therefore shows that passive heating through direct solar heat gain and thermal mass is therefore the most essential strategy for extending the thermal comfort zone during this under heated period. In addition, internal heat gain from equipment, lights and occupants provide a valuable source of heat contribution to space heating.

Bioclimatic recommendations

According to the climatic data for Eldoret, the following design strategies are recommended for:

a) Enabling passive heating

- Careful orientation of buildings with main rooms facing north east is appropriate to allow a certain amount of solar radiation to penetrate for passive heating during the cold periods.
- The floor plan should be organised such that it allows the sun to penetrate daytime spaces during the cold periods.
- Compact forms reduce heat gains during the hot periods and minimise heat losses during the cold periods.
- Medium weight walls, floors and ceilings are recommended to explore passive solar gains by storing heat accumulated during the day (avoiding overheating) to balance the night time low temperatures to keep them at comfort level.
- Excessive glazing should be avoided as it can lead to overheating during the hot period as well as lead to extensive heat loss at night or during the cold periods.
- All windows should be airtight to prevent heat losses when the outdoor temperatures are below the comfort zone and they should be located on opposite walls to allow for cross-ventilation.
- Additional heating systems such as fireplaces can be incorporated in the design.
- Internal heat gains from occupants, equipment and lights will greatly reduce heating needs.

b) Protection against heat gain in the hot period

- Buildings should be oriented with the main glazed windows facing north and south for easier sun control and to minimise overheating during the hot periods.
- Large windows should be avoided on the east and west facing façades.
- Appropriate sun shading devices should be incorporated to keep out the solar radiation and glare during certain hours of the day during the hot periods.

Figure 23: Large overhangs provide shading to the glazed north facing façade

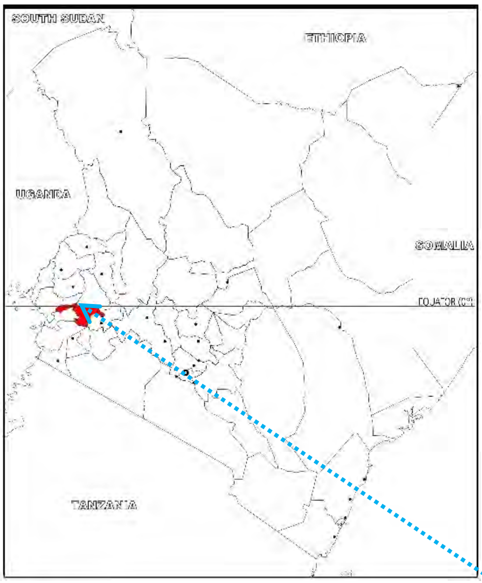
Eldoret international airport

Source: https://kaa.go.ke/airports/our-airports/eldoret-international-airport/ (Above)

http://www.jamiiforums.com/ (Below)

KISUMU

Figure 62: Location of Kisumu county



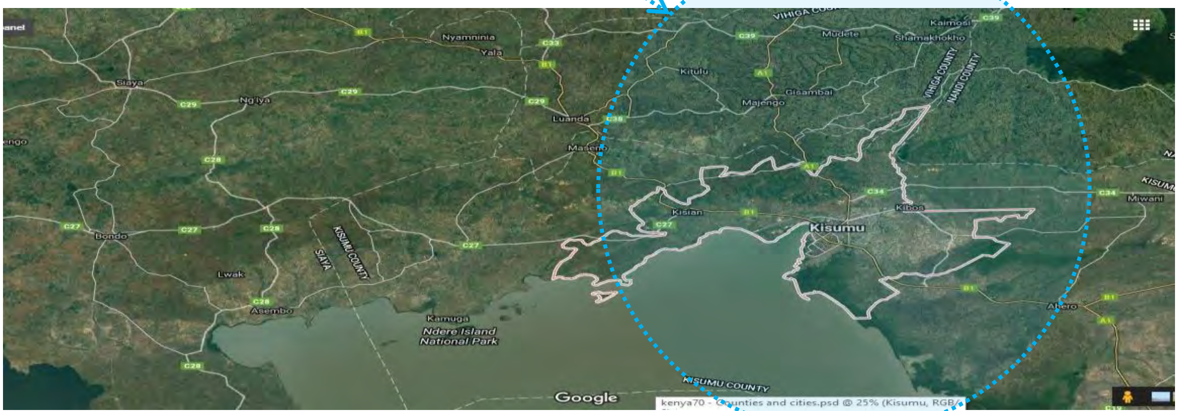
Source: http://www.d-maps.com/

Climatic Zone: GREAT LAKES
Latitude: 00° 06′ S
Longitude: 34° 45′
Altitude: 1,131 m

Figure 63: Aerial view of Kisumu city

Source: http://www.africatravelresource.com/kisumu-town-safari/

Figure 64: Location of Kisumu town in Kisumu county



Source: https://maps.google.co.ke Map data © 2016 Google

GEOGRAPHY AND CLIMATE

Kisumu city, the headquarters of Kisumu county, is the third largest city in Kenya. It is located at geographic coordinates 00° 06′ S, 34° 45′ E at an altitude of 1,131 m above sea level. Its climate is characterised by rainfall being recorded throughout the year with an average amount of 1,350 mm. The month with the most amount of rainfall is April while July and August are recorded as the months with the least amount. The average annual temperature is 22.9 °C with the warmest month on average being February while the coolest month on average is July. Relative humidity averages at 69.4% annually while the wind velocity ranges 2.2 – 3.7 m/s with the predominant wind direction being East North East (ENE). The annual average global solar radiation in Kisumu is 5.7 kWh/m^2. See Appendix 2 for hourly climatic data.

Bioclimatic Data

Table 9: Kisumu monthly mean climatic data table

Month	Dry bulb temp [°C]	Relative humidity [%]	Wind velocity [m/s]	Global solar radiation [kWh/m^2 day]	Direct normal solar radiation [kWh/m^2 day]	Diffuse solar radiation [kWh/m^2 day]	Rainfall [mm][29]
JAN	23.8	61.0	3.5	5.9	5.2	2.3	90
FEB	24.0	64.0	3.7	6.2	5.3	2.3	100
MAR	23.2	71.0	3.5	6.0	4.6	2.5	170
APR	23.4	73.0	3.0	5.4	3.7	2.6	180
MAY	22.3	79.0	2.2	5.2	3.8	2.5	170
JUN	22.0	74.0	2.3	5.3	4.1	2.3	90
JUL	21.6	71.0	3.1	5.3	4.0	2.5	70
AUG	22.1	69.0	2.6	5.7	4.2	2.5	70
SEP	22.9	65.0	2.8	6.0	4.5	2.6	90
OCT	23.0	69.0	2.9	5.8	4.1	2.7	100
NOV	23.2	69.0	3.1	5.4	3.7	2.7	130
DEC	23.4	68.0	2.8	5.7	4.6	2.4	90

Figure 65: Monthly mean relative humidity for Kisumu

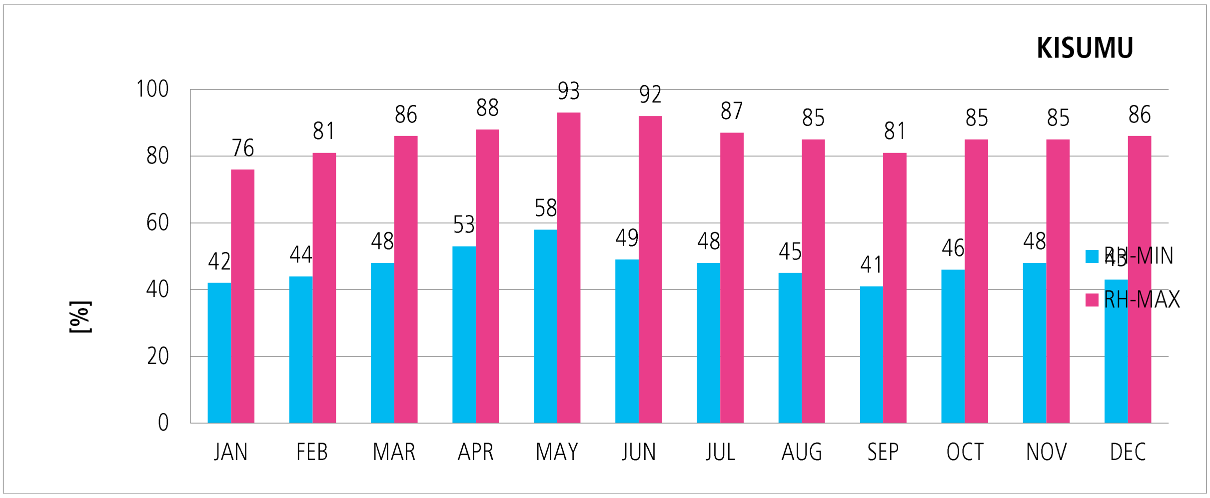
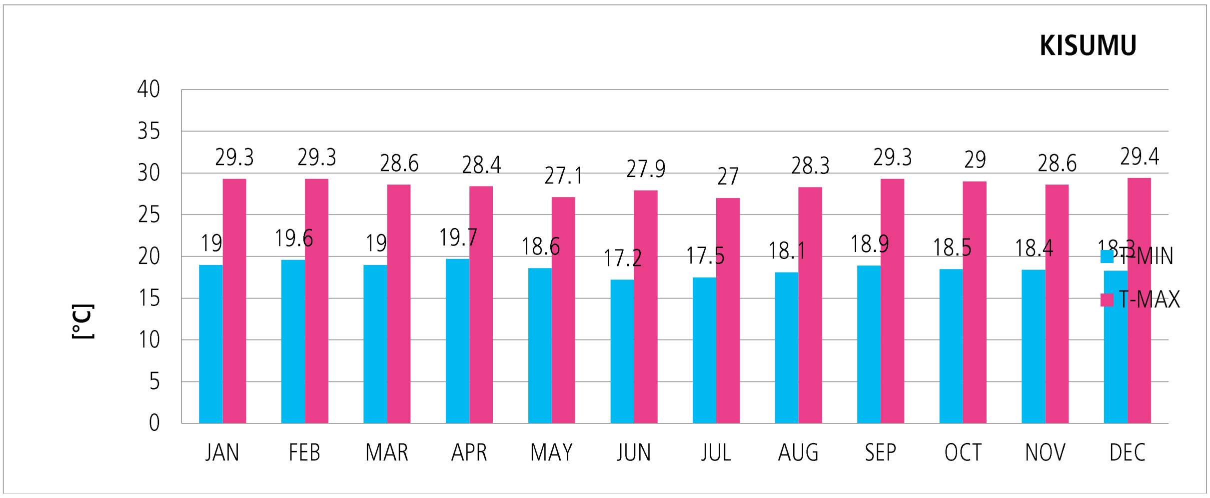


Figure 66: Monthly mean maximum and minimum temperature for Kisumu



[29] Ibid

Figure 67: Monthly average rainfall for Kisumu

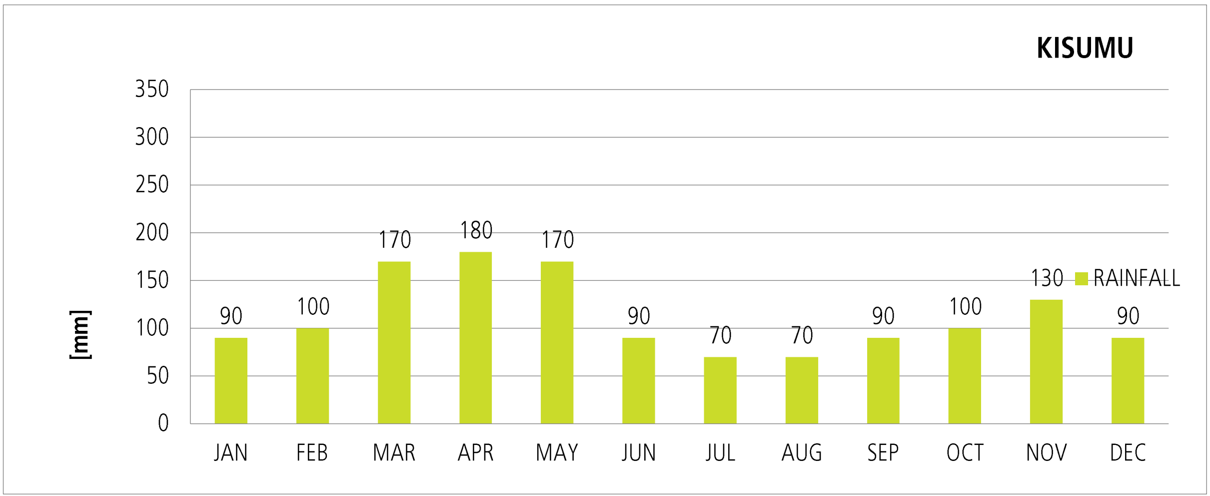


Figure 68: Polar sun path diagram for Latitude 0° (Equator)

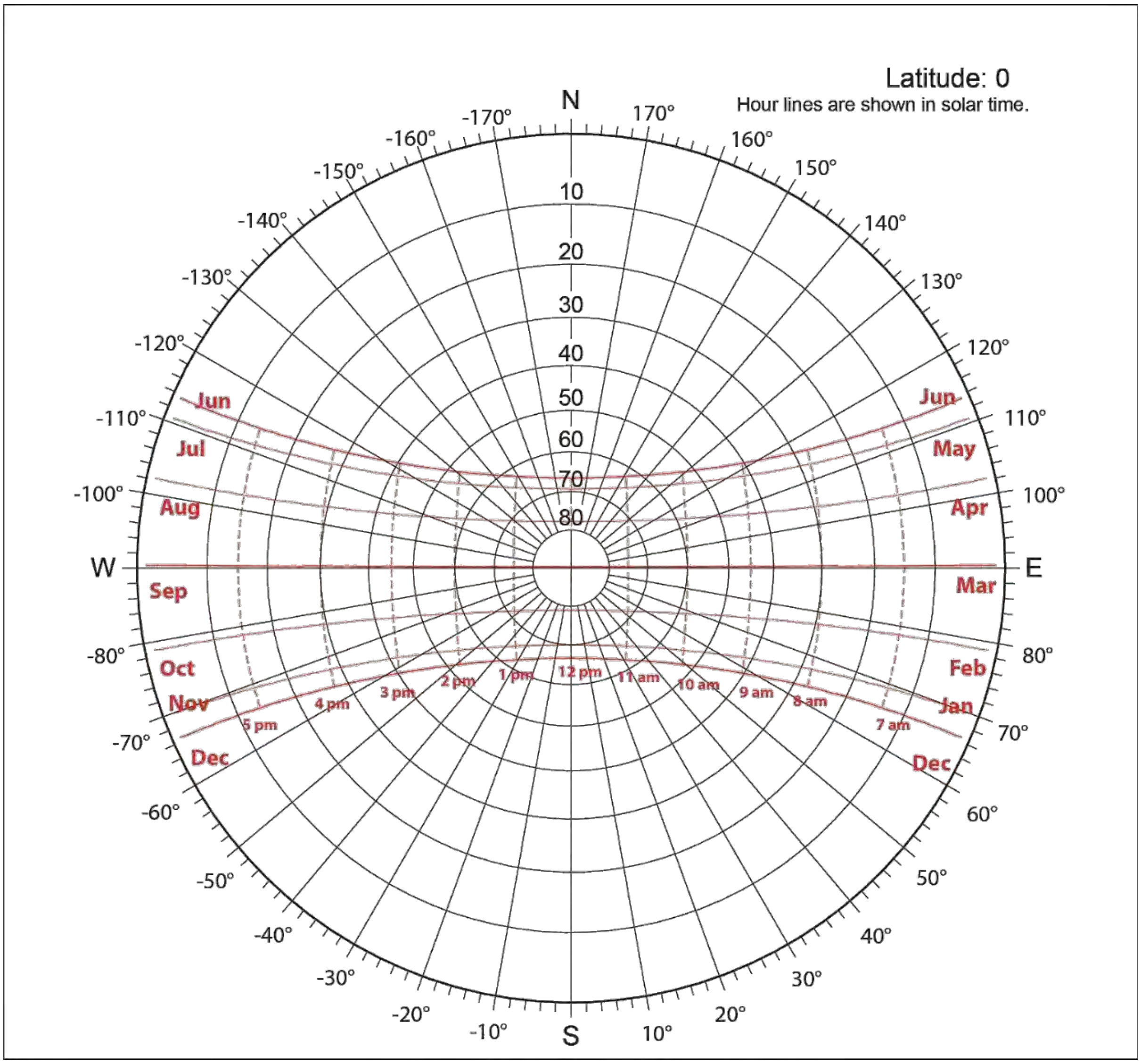
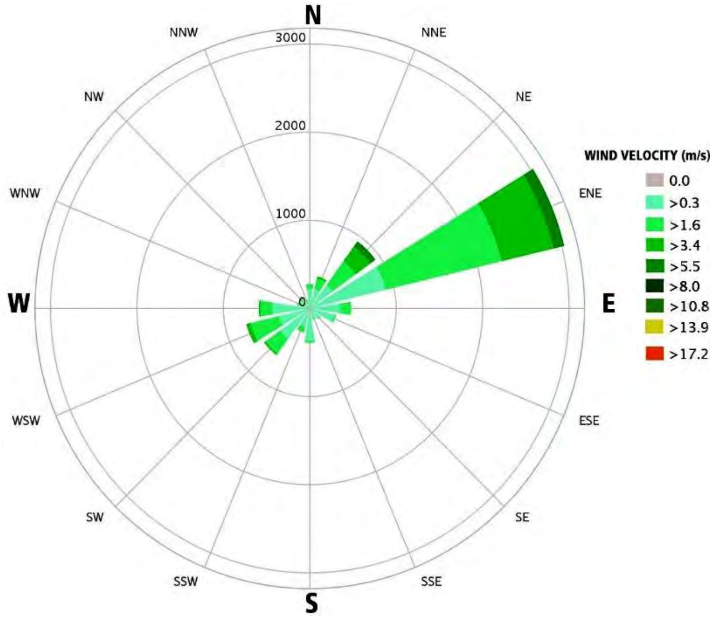
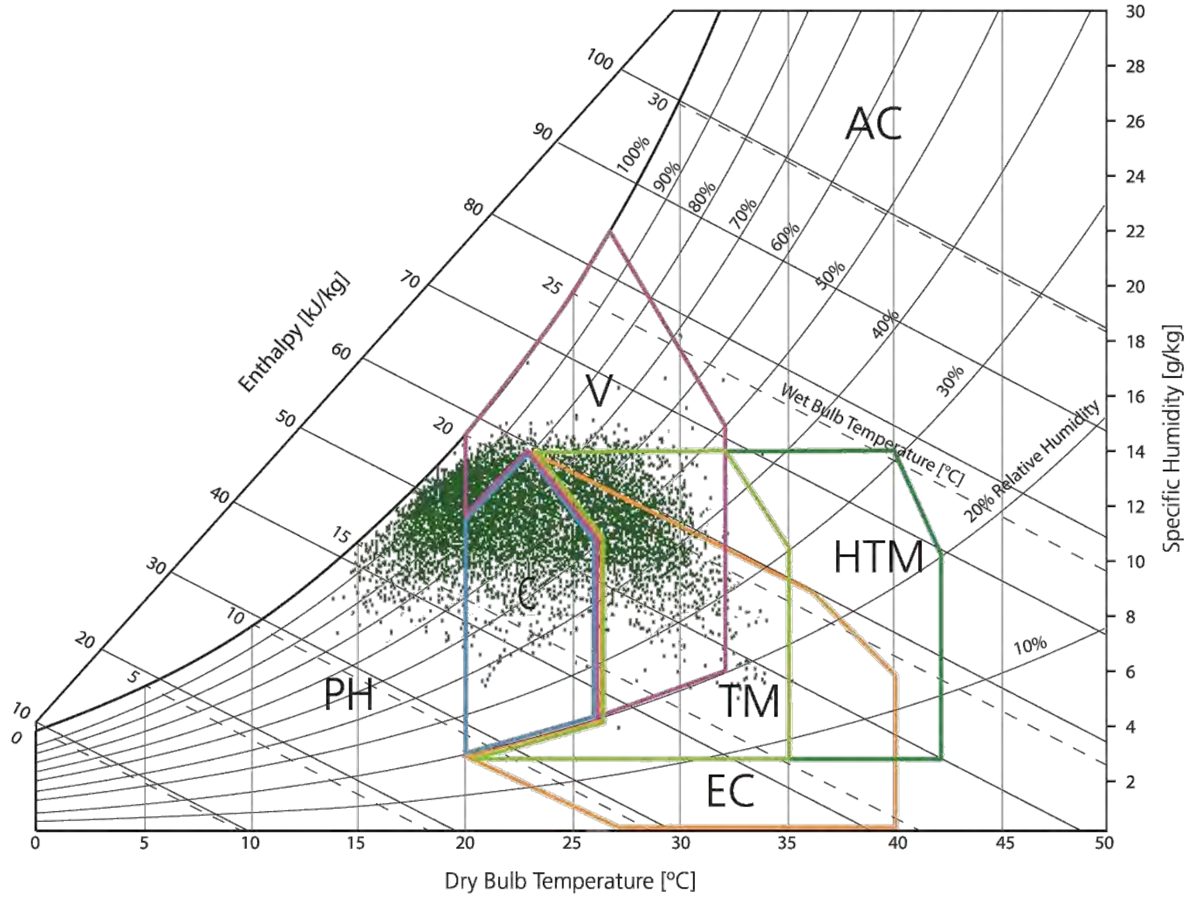


Figure 69: Wind rose diagram showing the prevailing wind direction in Kisumu



Source: https://www.windfinder.com/

Figure 70: Psychrometric chart with passive design strategies overlays for Kisumu



C	Comfort Zone	EC	Evaporative Cooling
V	Ventilation	PH	Passive Heating
TM	Thermal Mass	AC	Air Conditioning
HTM	High Thermal Mass		

Interpretation

The psychrometric chart (see Figure 70) shows that the Great Lake climate of Kisumu experiences some degree of thermal comfort. It also shows that most of the hourly data points of outdoor dry bulb temperature and relative humidity fall beyond the comfort zone thus experiencing high temperature and humidity. Certain periods of the year have the outside conditions falling below the comfort zone. The chart therefore suggests that natural ventilation, passive heating through direct solar heat gain and thermal mass are the most effective strategies for improving thermal comfort.

Bioclimatic recommendations

The design objectives and responses for Great Lakes climate like Kisumu's should be to address issues due to high daily temperatures variation, high relative humidity and high solar radiation levels. The following passive design strategies may be used to address the cooling and heating requirements that result from the above climatic characteristics:

a) To provide maximum protection against direct and indirect solar radiation

- Buildings should be oriented with their long axis running east – west to provide effective shading.
- Openings should be located on the north and south facing façades and avoided on the east and west facing façades to reduce heat gain from the low early morning and late afternoon sun.
- Appropriate shading devices should be located on all openings. These can be in form of extended roof eaves, vertical fins, covered verandas and porches etc.
- Additional solar radiation protection may be provided by shade-providing vegetation within the space surrounding the building.
- Reflective roof surfaces and light coloured external finishes are appropriate to reflect solar radiation and minimise heat gains.

Figure 71: Extensive use of horizontal and vertical shading devices

Vasity Plaza, Kisumu © UN-Habitat / Jerusha NGUNGUI

b) To promote maximum ventilation

- Building layout should be widely spaced to avoid obstruction of the wind and allow maximum ventilation around and inside buildings.
- Long and narrow buildings (shallow floor plans) are more suited to this climate as they provide maximum airflow through them.
- North and south facing walls should have large and fully openable openings. These openings should preferably be oriented to take advantage of the prevailing breezes to facilitate natural airflow. Openings at body level are more effective.
- Openings should be located on opposite sides of walls to allow for proper cross-ventilations. Internal walls should also have openings for airflow through the internal space.
- It is advisable to have permanent vents / openings close to the ceiling / roof to prevent the built up of hot air and encourage thermal air movement.
- Ventilated double roofs enhance ventilation of the roof minimising overheating.

Figure 72: Residential building showing horizontal shading devices protecting opening from the midday sun, high level ventilation blocks above windows to facilitate natural ventilation and light coloured external finishes to reflect solar radiation

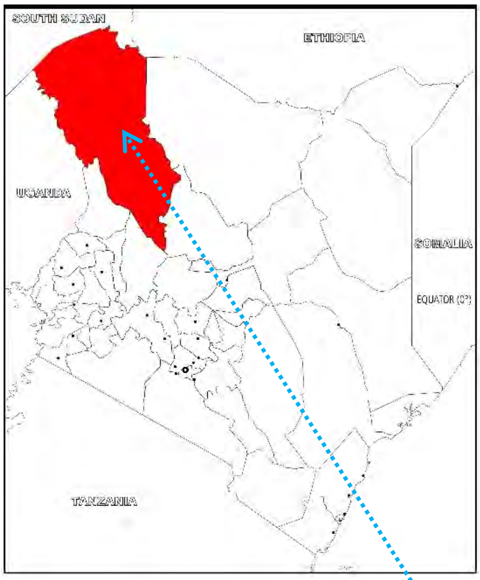
© UN-Habitat / Jerusha NGUNGUI

c) Enabling passive heating

- Medium weight walls, floors and ceilings are recommended to explore passive solar gains by storing heat accumulated during the day (avoiding overheating) to balance the night time low temperatures to keep them at comfort level.
- Excessive glazing should be avoided as it can lead to overheating during the hot period as well as lead to extensive heat loss at night or during the cold periods.
- All windows should be airtight to prevent heat losses when the outdoor temperatures are below the comfort zone.

LODWAR

Figure 93: Location of Turkana county



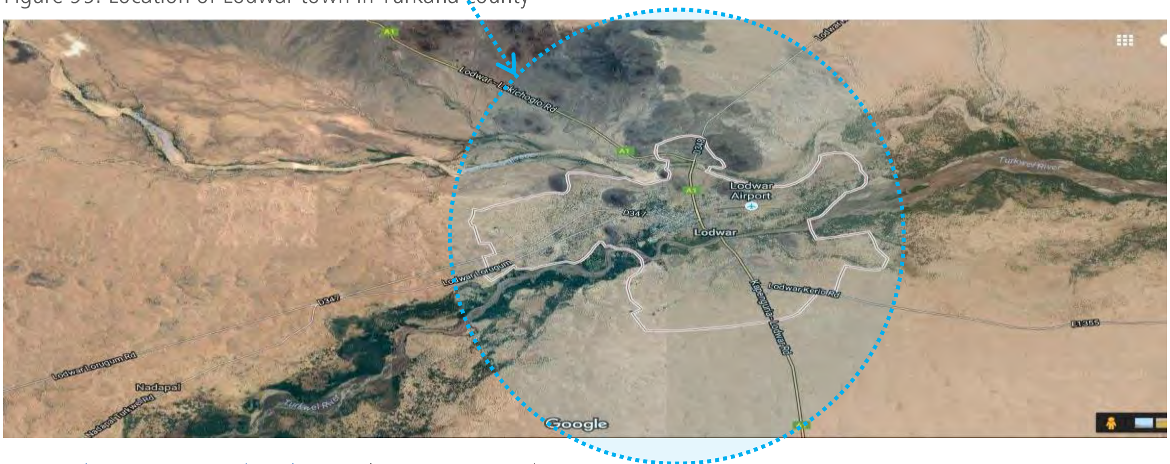
Source: http://www.d-maps.com/

Climatic Zone: HOT ARID
Latitude: 03° 07' N
Longitude: 35° 36' E
Altitude: 477 m

Figure 94: Aerial view of Lodwar town

Source: https://turkanamih.wordpress.com

Figure 95: Location of Lodwar town in Turkana county



Source: https://maps.google.co.ke Map data © 2016 Google

GEOGRAPHY AND CLIMATE

Lodwar town, located on the west of Lake Turkana, is the headquarters of Turkana county and is the largest town in the north-western Kenya. Its geographic location is 03° 07' N, 35° 36' E at an altitude of 477 m above sea level. Being in a hot arid climate, the town experiences high temperatures (annual mean of 29.7 °C) and little rainfall with an annual average of 231 mm. The hottest month recorded is March and the coolest month recorded is July. Relative humidity averages at 45% annually and can get to as low as 38% in February. Wind velocity ranges 3.1 – 4.9 m/s with the predominant wind direction being East and East North East (ENE). This town experiences intense solar radiation throughout the year with an annual average global solar radiation of 6.1 kWh/m^2. See Appendix 2 for hourly climatic data.

Bioclimatic Data

Table 12: Lodwar monthly mean climatic data table

Month	Dry bulb temp [°C]	Relative humidity [%]	Wind velocity [m/s]	Global solar radiation [kWh/m² day]	Direct normal solar radiation [kWh/m² day]	Diffuse solar radiation [kWh/m² day]	Rainfall [mm][32]
JAN	29.5	41.0	3.7	6.2	5.3	2.5	11.6
FEB	30.3	38.0	3.6	6.5	5.2	2.7	9.2
MAR	30.6	43.0	4.9	6.3	4.3	2.9	27.8
APR	30.1	53.0	4.6	5.9	4.0	2.8	57.1
MAY	30.1	50.0	3.3	5.8	4.3	2.7	29.8
JUN	29.4	48.0	3.9	5.9	5.0	2.3	9
JUL	28.5	45.0	4.6	6.0	5.3	2.3	21.3
AUG	29.1	46.0	3.5	6.3	5.7	2.2	10
SEP	29.9	43.0	4.2	6.7	6.4	2.0	6.2
OCT	29.8	47.0	4.0	6.2	5.1	2.5	10.6
NOV	29.9	46.0	4.3	5.8	4.6	2.6	24.4
DEC	29.6	44.0	3.1	5.9	5.1	2.4	14.6

Figure 96: Monthly mean relative humidity for Lodwar

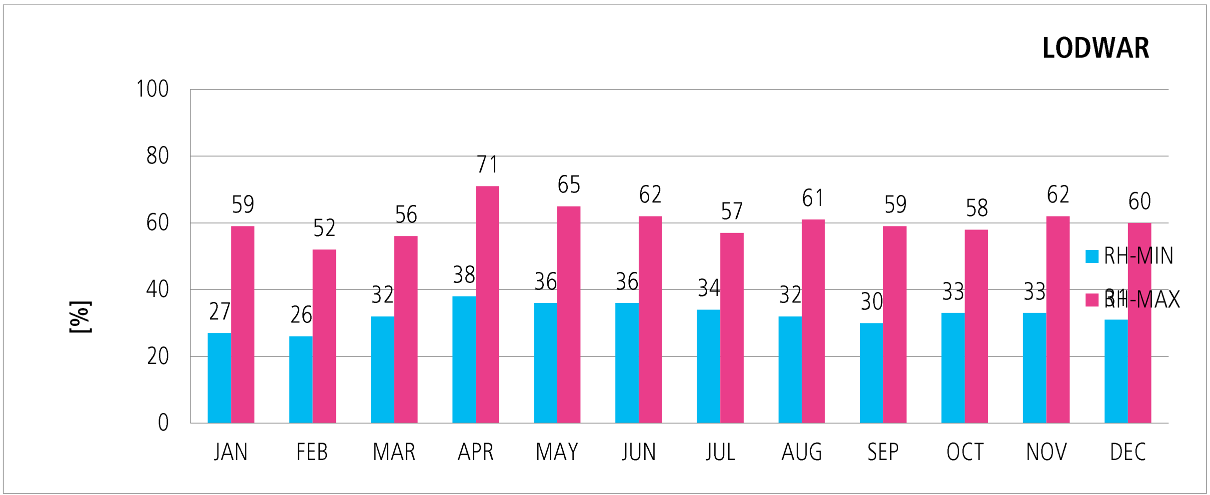
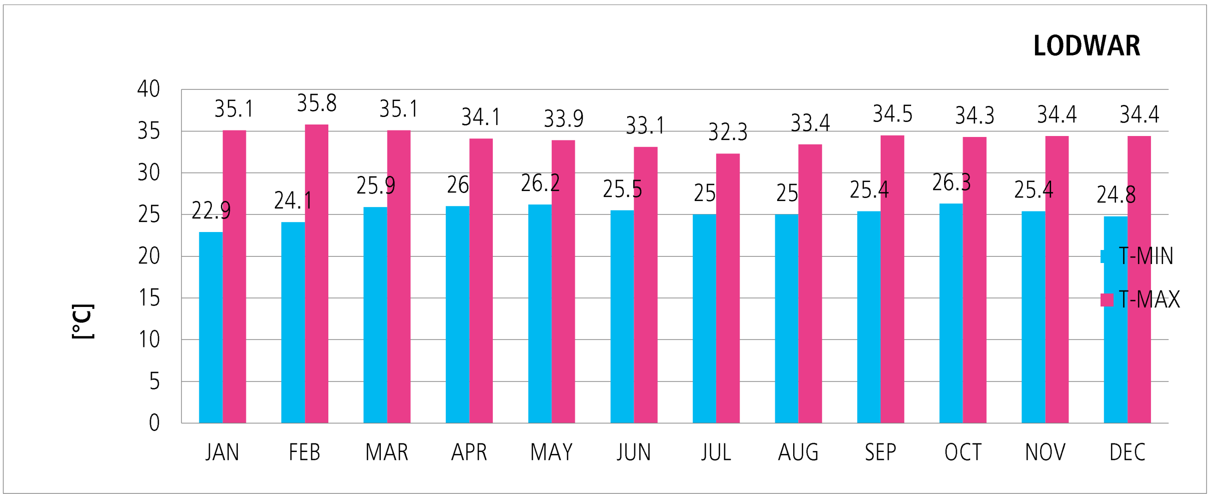


Figure 97: Monthly mean maximum and minimum temperature for Lodwar



[32] Ibid

Figure 98: Monthly average rainfall for Lodwar

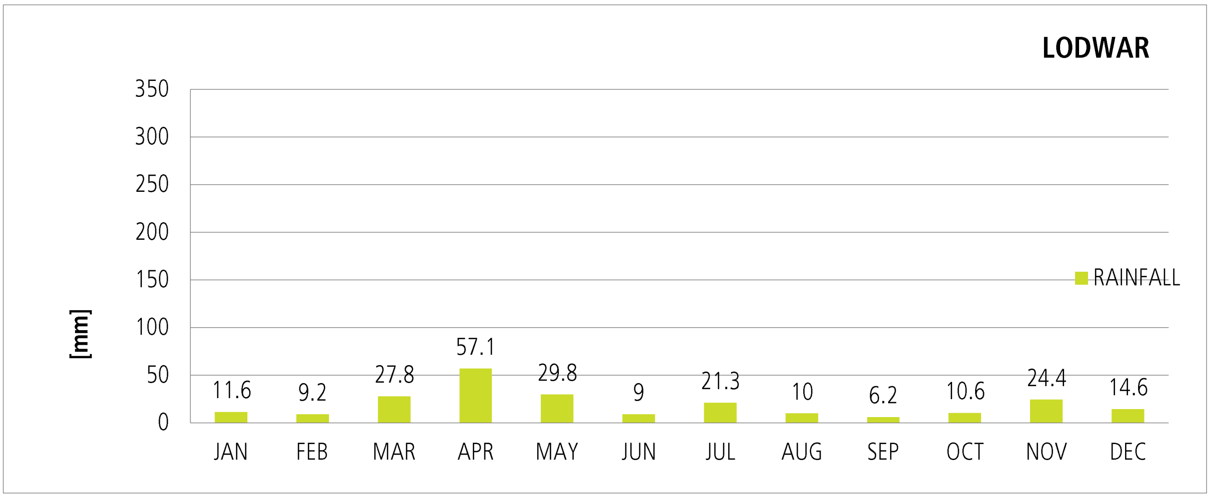


Figure 99: Polar sun path diagram for Latitude 3° North

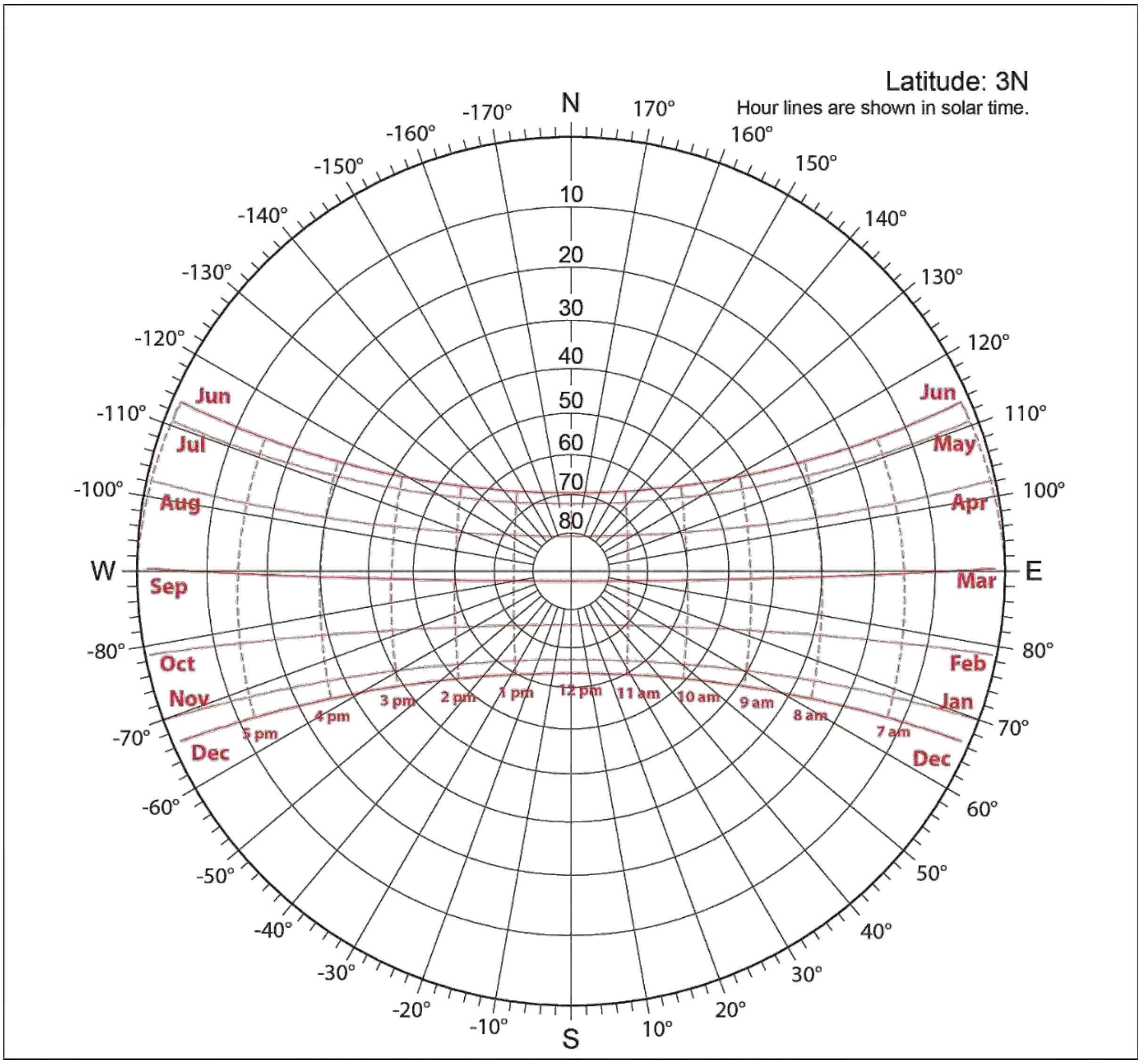
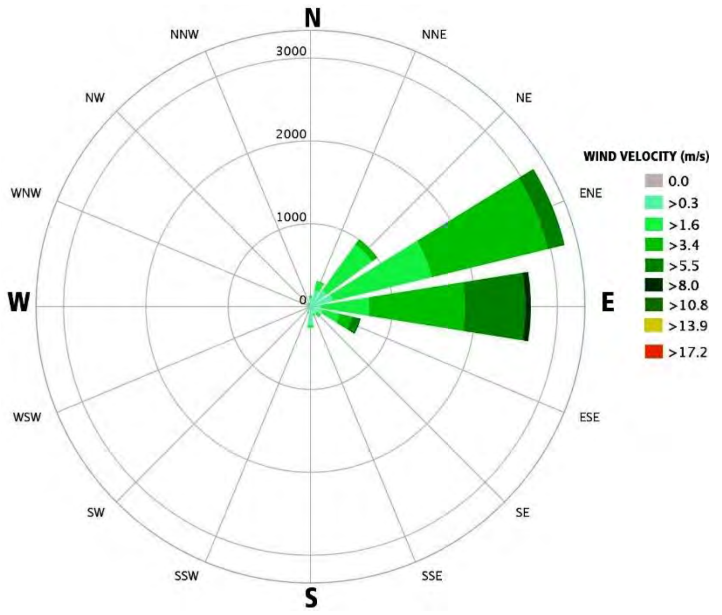
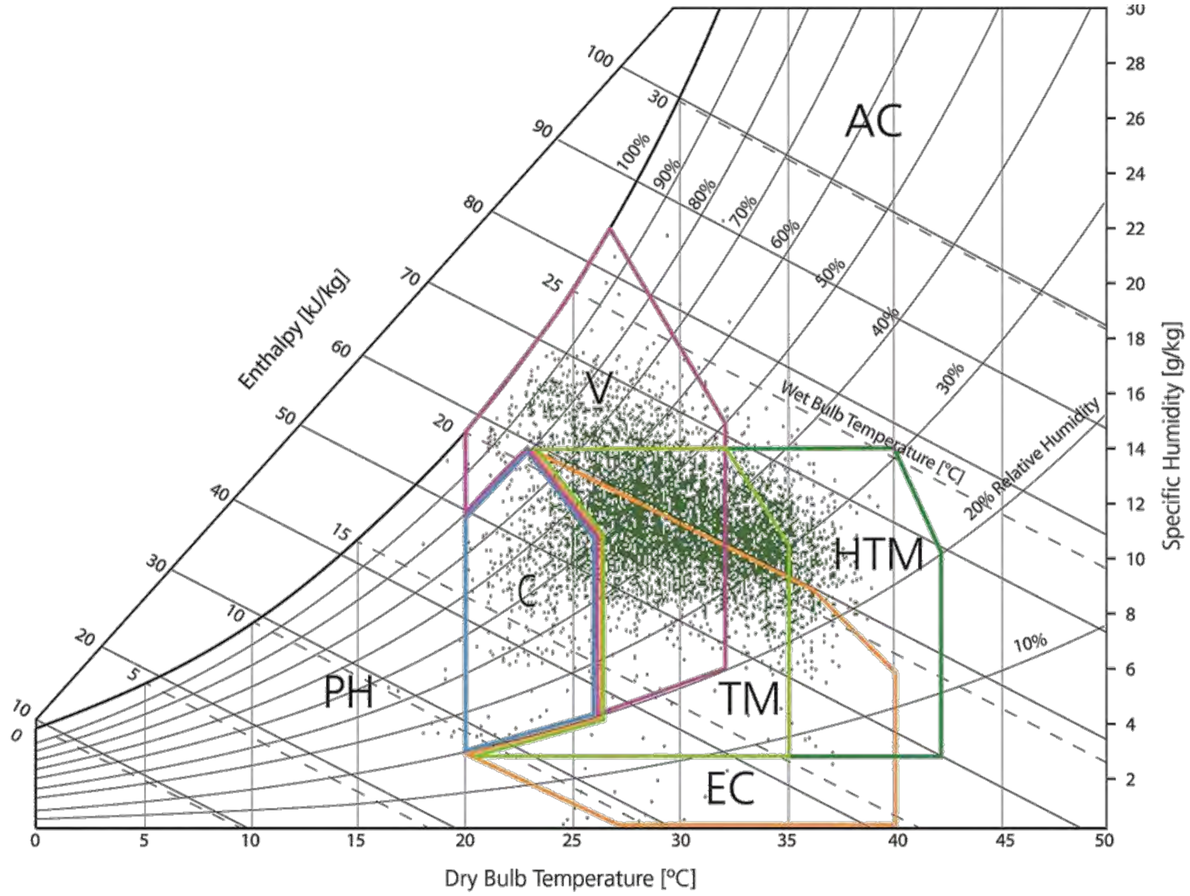


Figure 100: Wind rose diagram showing the prevailing wind direction in Lodwar



Source: https://www.windfinder.com/

Figure 101: Psychrometric chart with passive design strategies overlays for Lodwar



C	Comfort Zone	EC	Evaporative Cooling
V	Ventilation	PH	Passive Heating
TM	Thermal Mass	AC	Air Conditioning
HTM	High Thermal Mass		

Interpretation

Lodwar's climate is predominantly hot throughout the year with outside conditions (dry bulb temperature and relative humidity) beyond the comfort zone Therefore, cooling is very important and buildings need much more cooling and no heating at all. Based on the psychrometric chart (see Figure 101), the most appropriate cooling strategies to extend the limit of comfort include the following: shading, natural ventilation, high thermal mass with night ventilation (night flushing) and evaporative cooling.

Bioclimatic recommendations

The following passive design strategies may be used to address the cooling requirements of Lodwar's climate:

a) To reduce effects of intense solar radiation

- Compact layout of buildings is recommended to provide mutual shading and minimise exposure to solar radiation.
- Courtyard design of buildings minimises the impact of solar radiation on the outer walls as well as provide cool spaces within the buildings / building layout. This increases the daytime cooled spaces.
- Buildings should be oriented along the east – west axis with the longer sides facing north and south to prevent solar heat gains. The building's surface area exposed to the east and west should be minimised.
- Openings should be located on the north and south facing façades. Small openings that are located high on the walls are recommended to facilitate natural ventilation as well as reduce glare from light reflected from the ground or surrounding buildings.
- Appropriate shading devices are necessary on all openings to minimise heat gain from solar radiation. Use of vegetation, verandas, covered walkways, pergolas etc. is recommended to provide shade to walls, openings and outdoor spaces.

Figure 102: Traditional hut showcasing use of natural and local materials. Main opening to the hut is oriented away from the sun.

© UN-Habitat / Vincent KITIO

- Use of reflective surfaces (roof) and light-coloured walls are effective in reflecting solar radiation thus minimising solar heat gains and consequently minimising internal daytime temperatures.

b) To counter low relative humidity

- Evaporative cooling is recommended in this climate to improve the microclimate by elevating the humidity level while at the same time cooling the surrounding air. The following strategies are recommended: fountains, spray ponds, water surfaces, moistened fabrics, sprinklers or porous pots etc.

- Use of vegetation is effective in improving the air quality by reducing the air temperature as well as elevate the humidity level because of the evaporative cooling effect of plants.

c) To balance diurnal temperature range

- Heavy weight building materials with high thermal capacity are recommended to balance temperature variations between day and night. These heat storing materials keep daytime temperatures down.

- Due to the heat absorption qualities of the ground, earth-sheltered and underground housing are suited for this climate.

d) To ensure air circulation

- Openings should be located to take advantage of prevailing winds and allow for cross-ventilation.

- Ventilation through windows should be kept at a minimum during the daytime to keep hot and dusty air out. This also minimised heat gains. However, at night, windows may be opened to provide adequate ventilation for dissipation of heat accumulated during the day by walls and the roof to prevent overheating of the interior space.

- Other ventilation strategies include use of wind catchers, wind towers, solar chimneys, roof-mounted exhaust fans, high level vents etc.

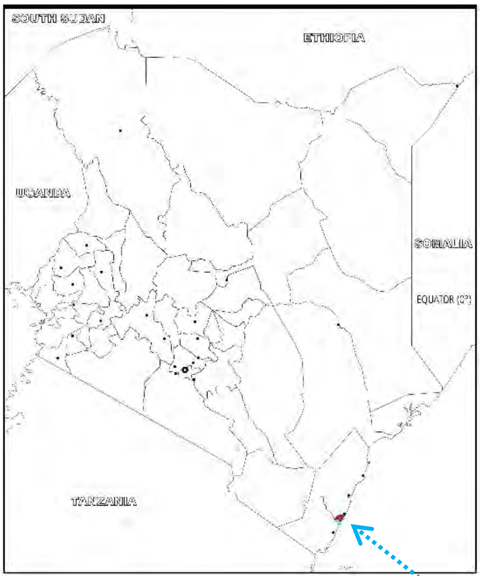
e) To minimise problems associated with dust

- Vegetation can be used to filter dust from the air before it gets into the building.

- Closing windows during daytime prevents dust from getting into the building on windy days. Windows should be tight-fitting as possible to prevent dust from infiltrating.

MOMBASA

Figure 145: Location of Mombasa county



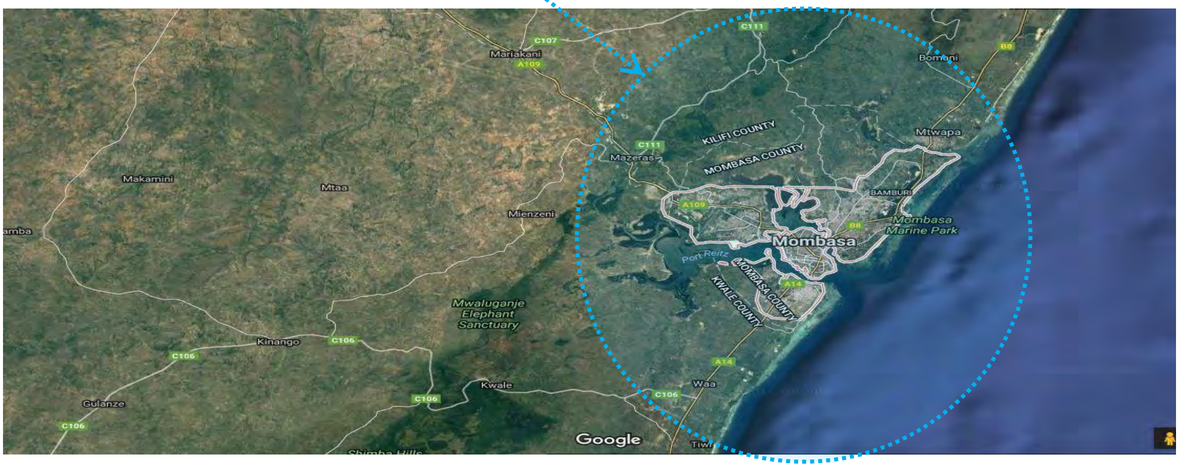
Source: http://www.d-maps.com/

Climatic Zone:	HOT AND HUMID
Latitude:	04° 03′ S
Longitude:	39° 40′ E
Altitude:	50 m

Figure 146: View of Mombasa tusks along Moi avenue

Source: http://nomad.sleepout.com/wp-content/uploads/2014/12/mombasa1.jpg

Figure 147: Location of Mombasa town in Mombasa county



Source: https://maps.google.co.ke Map data © 2016 Google

GEOGRAPHY AND CLIMATE

Mombasa, the headquarters of Mombasa county, is the second largest city in Kenya after Nairobi. At a geographic location of 04° 03′ S 39° 40′ E and an altitude of 50 m above sea level, the town's climates is characterised by permanent high humidity (annual average of 80%) and high temperatures (annual average of 25.9 °C) with minimum daily temperature swings. The hottest month is March while the coolest month is July. This city experiences intense solar radiation throughout the year with an annual average global solar radiation of 5.4 kWh/m^2. With an annual average speed of 3.5 m/s, the predominant wind direction is East (December to March) and South (April to November). See Appendix 2 for hourly climatic data.

Bioclimatic Data

Table 17: Mombasa monthly mean climatic data table

Month	Dry bulb temp [°C]	Relative humidity [%]	Wind velocity [m/s]	Global solar radiation [kWh/m^2 day]	Direct normal solar radiation [kWh/m^2 day]	Diffuse solar radiation [kWh/m^2 day]	Rainfall [mm][37]
JAN	26.8	78.0	3.6	5.8	3.8	3.0	20
FEB	27.0	75.0	3.9	6.0	4.1	2.9	10
MAR	28.1	77.0	3.0	6.0	4.1	2.8	60
APR	26.9	82.0	3.2	5.3	3.4	2.8	180
MAY	26.0	82.0	4.2	4.5	2.8	2.5	270
JUN	24.9	80.0	4.3	4.7	3.4	2.4	100
JUL	23.7	84.0	3.4	4.6	3.4	2.3	80
AUG	24.1	82.0	3.6	5.1	3.8	2.5	60
SEP	24.6	82.0	4.0	5.7	4.2	2.5	60
OCT	25.7	79.0	3.0	5.9	4.1	2.8	90
NOV	26.2	81.0	2.7	5.8	4.2	2.7	90
DEC	26.9	80.0	3.1	5.5	3.5	2.9	60

Figure 148: Monthly mean relative humidity for Mombasa

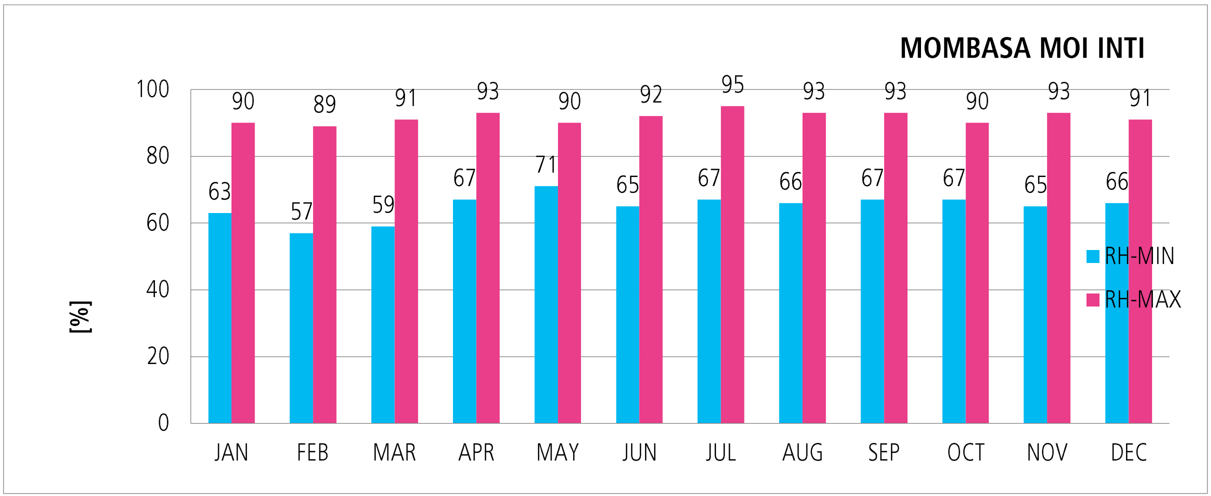
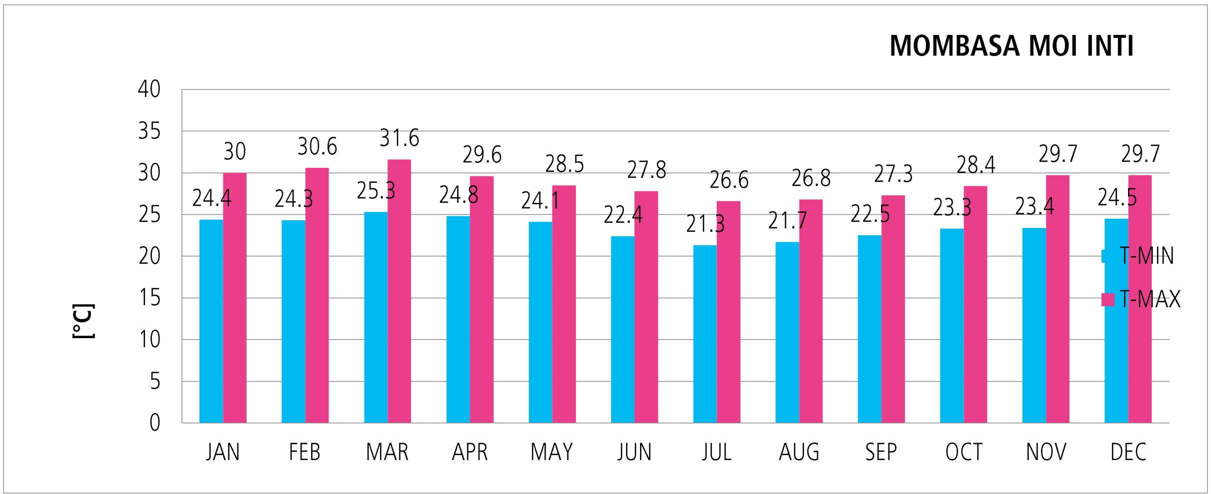


Figure 149: Monthly mean maximum and minimum temperature for Mombasa



[37] Ibid

Figure 150: Monthly average rainfall for Mombasa

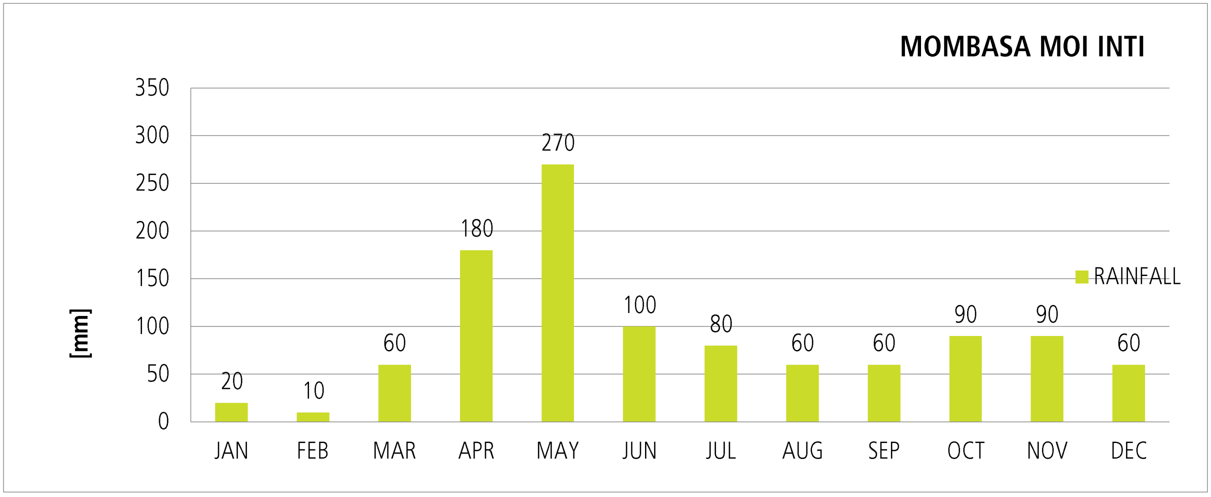


Figure 151: Polar sun path diagram for Latitude 4° South

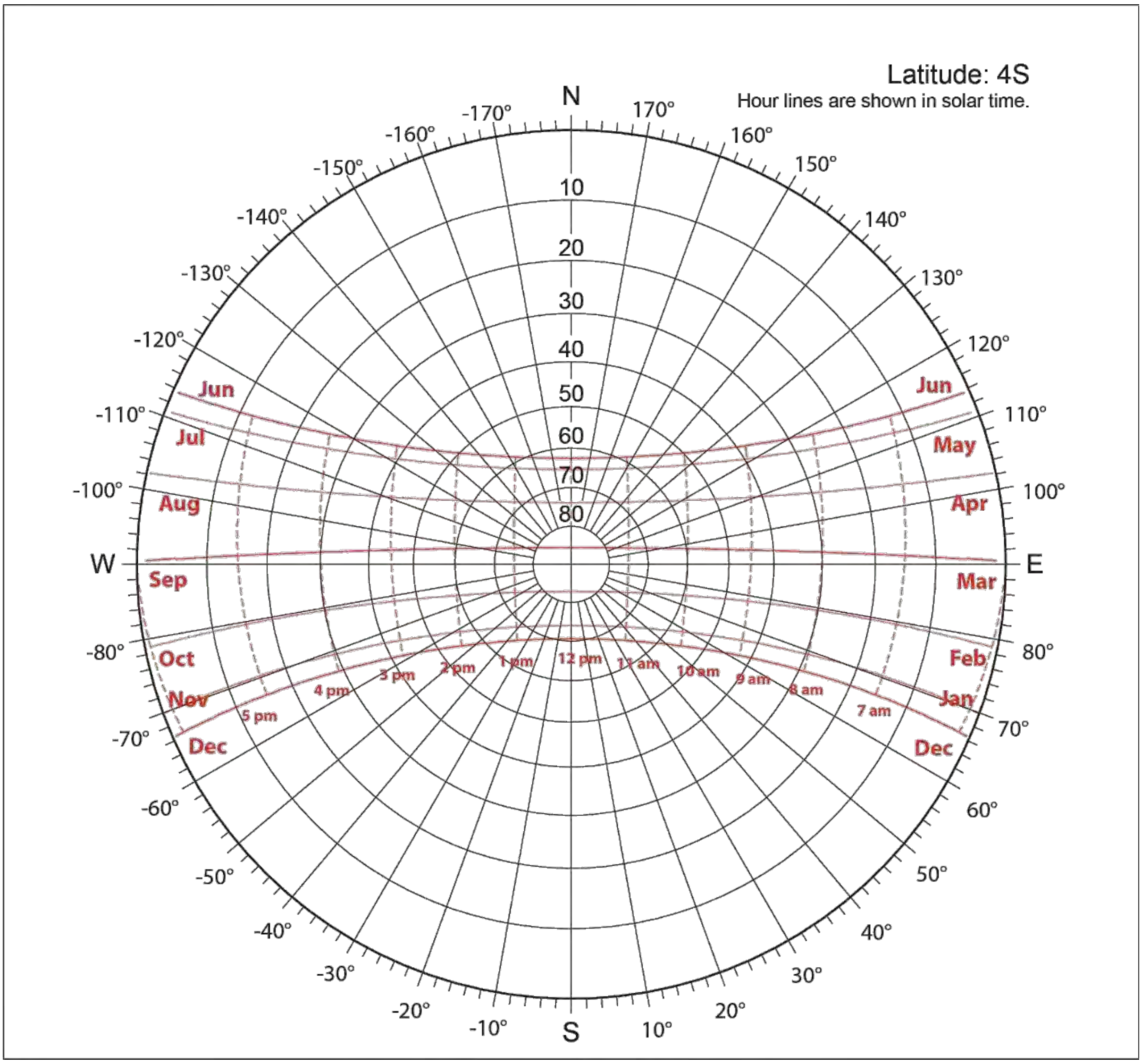
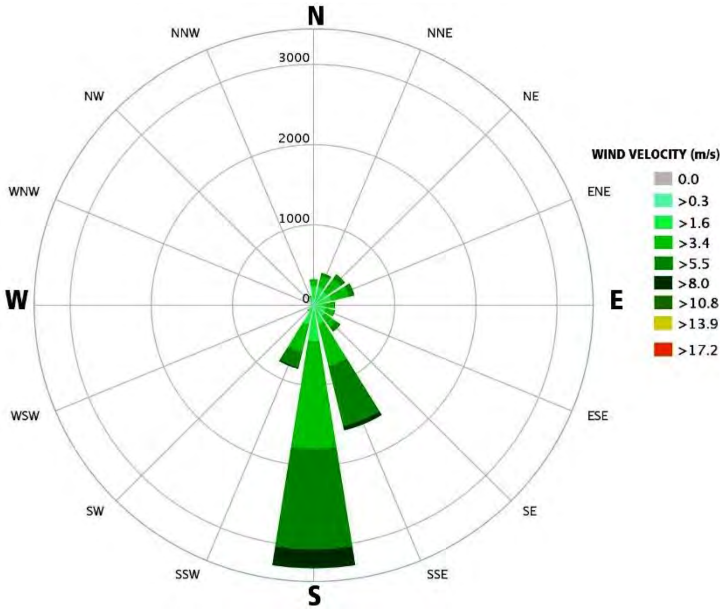
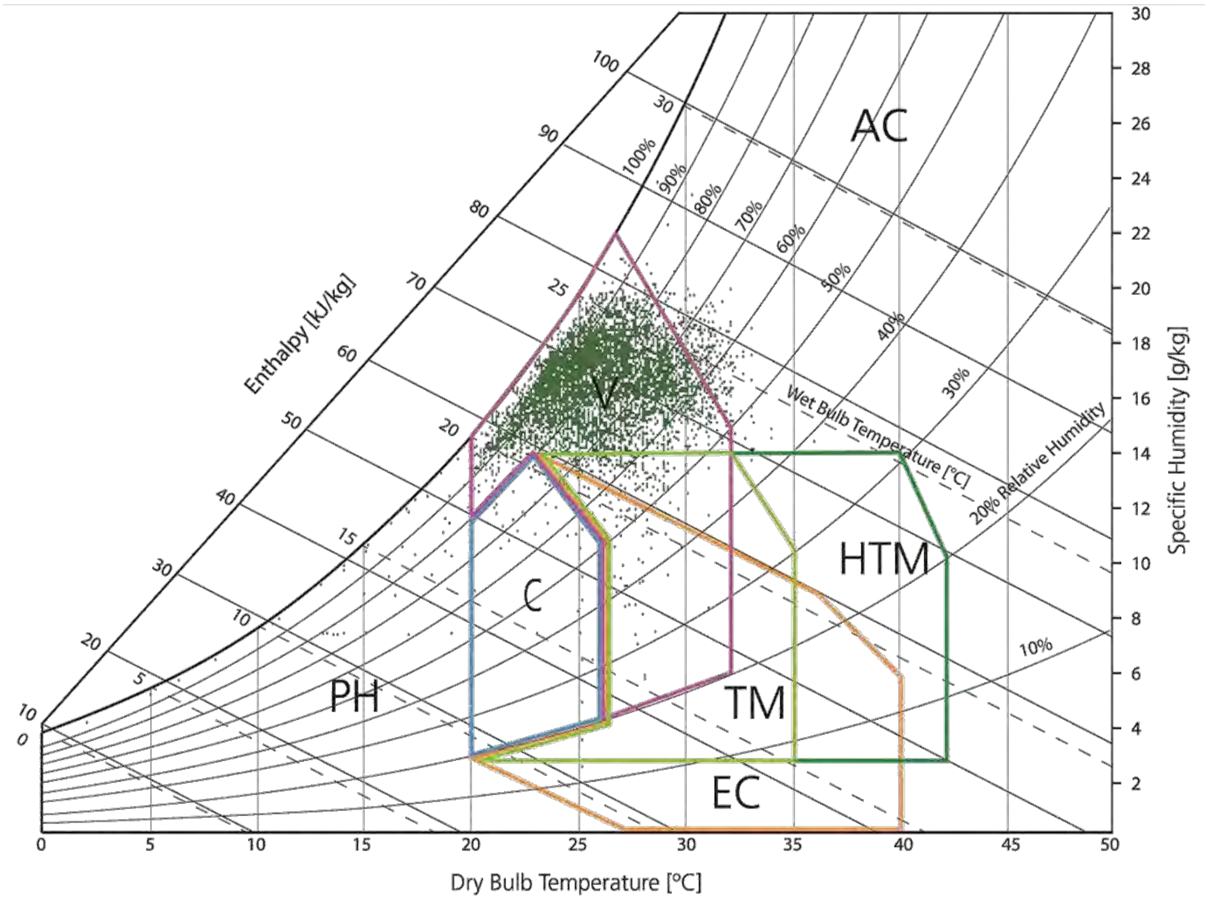


Figure 152: Wind rose diagram showing the prevailing wind direction in Mombasa



Source: https://www.meteoblue.com/

Figure 153: Psychrometric chart with passive design strategies overlays for Mombasa



C	Comfort Zone	EC	Evaporative Cooling
V	Ventilation	PH	Passive Heating
TM	Thermal Mass	AC	Air Conditioning
HTM	High Thermal Mass		

Interpretation

Figure 153 shows that Mombasa has its comfort region defined between 20 – 26 °C. The hourly outdoor dry bulb temperatures and relative humidity points indicate that the region is of the comfort zone. The resulting combination of high temperatures and high relative humidity caused discomfort. Thermal comfort can however be achieved passively through natural ventilation for temperatures below 33 °C but beyond the comfort zone. This makes it the most appropriate strategy to extend the comfort zone. However, at certain periods, outdoor dry bulb temperature and relative humidity fall outside the limits of natural ventilation, thereby necessitating the use of mechanical cooling and dehumidification to improve thermal comfort.

Bioclimatic recommendations

According to the cooling needs required by a hot and humid climate like Mombasa's, the following passive design strategies may be used:

a) To provide maximum protection against direct and indirect solar radiation

- Buildings should be oriented with their long axis running east – west to provide effective shading.
- Openings should be located on the north and south facing façades and avoided on the east and west facing façades to reduce heat gain from the low early morning and late afternoon sun.
- Appropriate shading devices should be located on all openings. These can be in form of extended roof eaves, covered verandas and porches etc.
- Additional solar radiation protection may be provided by shade-providing vegetation within the space surrounding the building.
- Reflective roof surfaces and light coloured external finishes are appropriate to reflect solar radiation and reduce heat gains.
- Lightweight building materials with low thermal capacity are recommended for walls, floors and roofs to allow rapid cooling at night.

Figure 154: Proper orientation of buildings along the east west axis and minimal openings on the west facing façade. Slanted glazed surfaces and provision of sun shading devices minimise heat gain.

Bank of India, Mombasa © UN-Habitat / Jerusha NGUNGUI

Figure 155: Example of a ventilated roof

© UN-Habitat / Jerusha NGUNGUI

Figure 156: Use of timber screens for shading the west facing openings against the later afternoon sun

A typical vernacular Swahili building (the Old Post office building) in Old Town, Mombasa © UN-Habitat / Jerusha NGUNGUI

b) To promote maximum ventilation

- Building layout should be widely spaced to avoid obstruction of the wind and allow maximum ventilation around and inside buildings.

- Long and narrow buildings (shallow floor plans) are more suited to this climate as they provide maximum ventilation.

- North and south facing walls should have large and fully openable openings. These openings should preferably be oriented to take advantage of the prevailing breezes to facilitate natural airflow. Openings at body level are more effective.

- Openings should be located on opposite sides of walls to allow for proper cross-ventilations. Internal walls should also have openings for airflow through the internal space.

- It is advisable to have permanent vents / openings close to the ceiling / roof to prevent the built up of hot air and encourage thermal air movement.

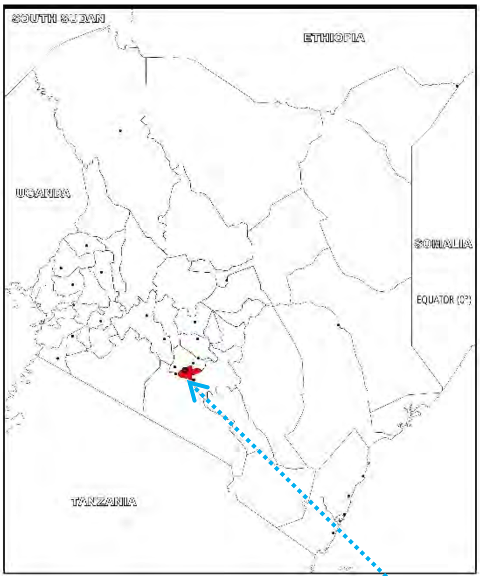
- Ventilated double roofs enhance ventilation of the roof minimising overheating.

Figure 157: Presence of permanent openings along walls enables airflow through the building. Vegetation provides shading. Lightly coloured external surface to reflect unwanted solar radiation.

Technical University of Mombasa © UN-Habitat / Jerusha NGUNGUI

NAIROBI

Figure 168: Location of Nairobi county



Source: http://www.d-maps.com/

Climatic Zone: UPLAND
Latitude: 01° 17′ S
Longitude: 36° 49′ E
Altitude: 1,661 m

Figure 169: Nairobi skyline

Source: http://www.panoramio.com/photo/31634398 © Klaus MERCKENS

Figure 170: Location of Nairobi city in Nairobi county

Source: https://maps.google.co.ke Map data © 2016 Google

GEOGRAPHY AND CLIMATE

Nairobi was founded in 1899 and is the political and capital city of Kenya. Located at geographic coordinates 01° 17′ S 36° 49′ E and at an altitude of 1,661 m above sea level, the city enjoys an upland climate with annual average temperature of 18.8 °C. The hottest and coolest months are March and July respectively. The average annual rainfall is recorded at 710 mm with the highest amount occurring in April / May and November / December. Relative humidity is above 60% throughout the year while the wind velocity ranges 0.9 – 2.9 m/s with the predominant wind direction being East North East (ENE) and East. The annual average global solar radiation in Nairobi is 5.1 kWh/m^2. See Appendix 2 for hourly climatic data.

Bioclimatic Data

Table 19: Nairobi (Dagoretti) monthly mean climatic data table

Month	Dry bulb temp [°C]	Relative humidity [%]	Wind velocity [m/s]	Global solar radiation [kWh/m² day]	Direct normal solar radiation [kWh/m² day]	Diffuse solar radiation [kWh/m² day]	Rainfall [mm][39]
JAN	18.8	71.0	2.4	6.0	4.9	2.5	40
FEB	19.5	62.0	2.4	6.6	5.7	2.4	40
MAR	20.0	68.0	2.8	5.8	3.9	2.8	70
APR	18.7	79.0	1.9	4.9	2.8	2.8	160
MAY	17.7	81.0	1.3	4.3	2.4	2.6	110
JUN	16.7	81.0	0.9	4.1	2.4	2.4	30
JUL	15.7	80.0	0.9	4.0	2.2	2.5	10
AUG	16.3	73.0	1.1	4.7	3.0	2.5	10
SEP	17.5	68.0	1.6	5.3	3.5	2.6	20
OCT	18.2	71.0	2.5	5.2	3.2	2.8	40
NOV	17.7	81.0	2.3	4.7	2.6	2.8	110
DEC	17.7	79.0	2.9	5.4	3.9	2.5	70

Figure 171: Monthly mean relative humidity for Nairobi - Dagoretti

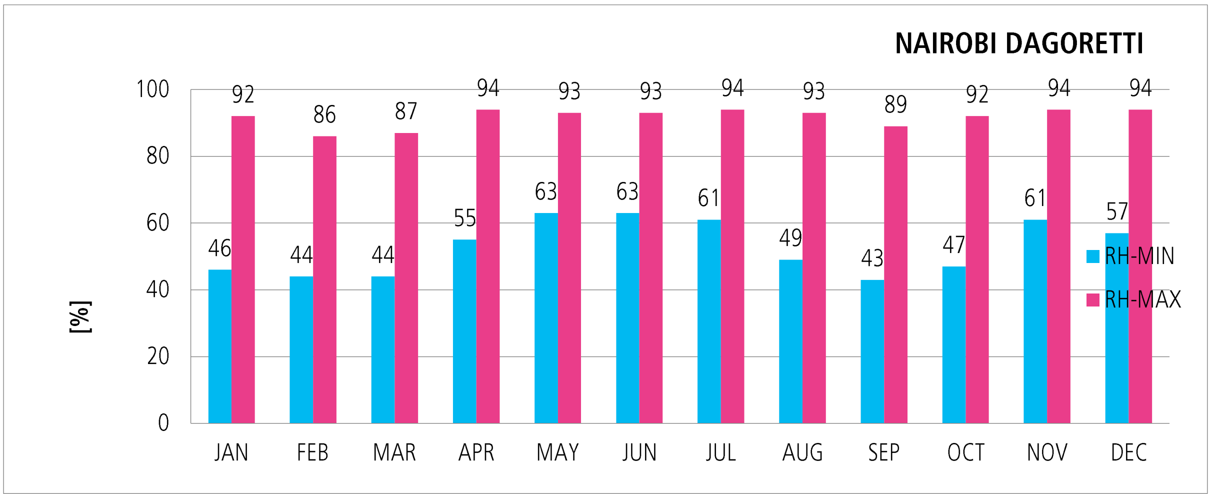
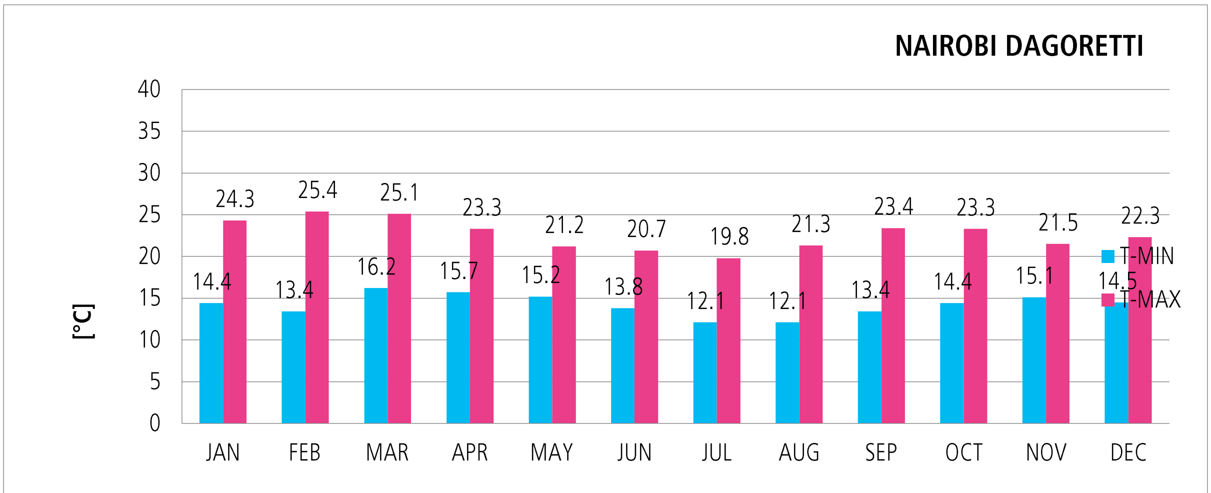


Figure 172: Monthly mean maximum and minimum temperature for Nairobi – Dagoretti



[39] Ibid

Figure 173: Monthly mean relative humidity for Nairobi – Jomo Kenyatta International Airport

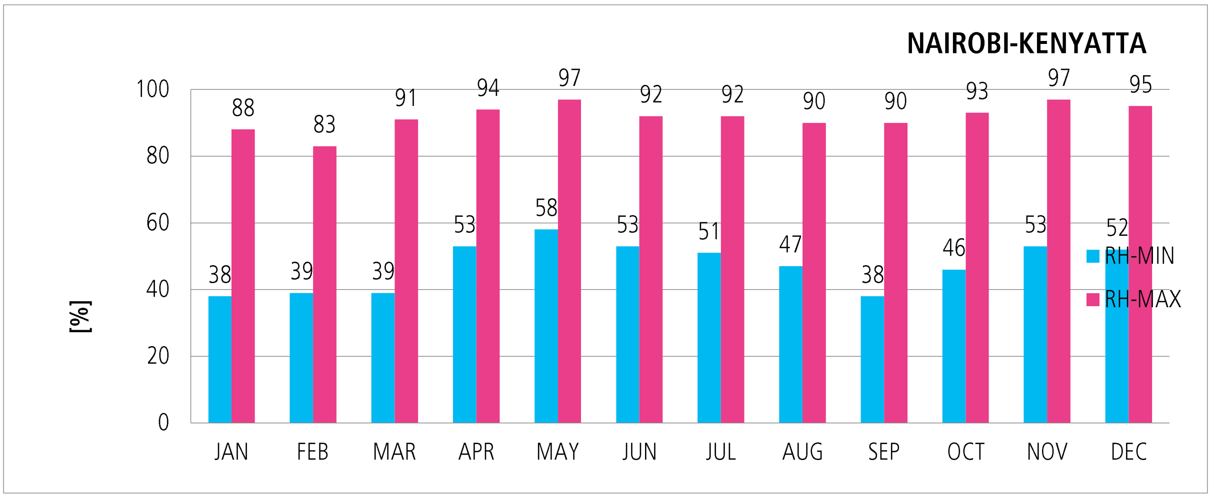


Figure 174: Monthly mean maximum and minimum temperature for Nairobi – Jomo Kenyatta International Airport

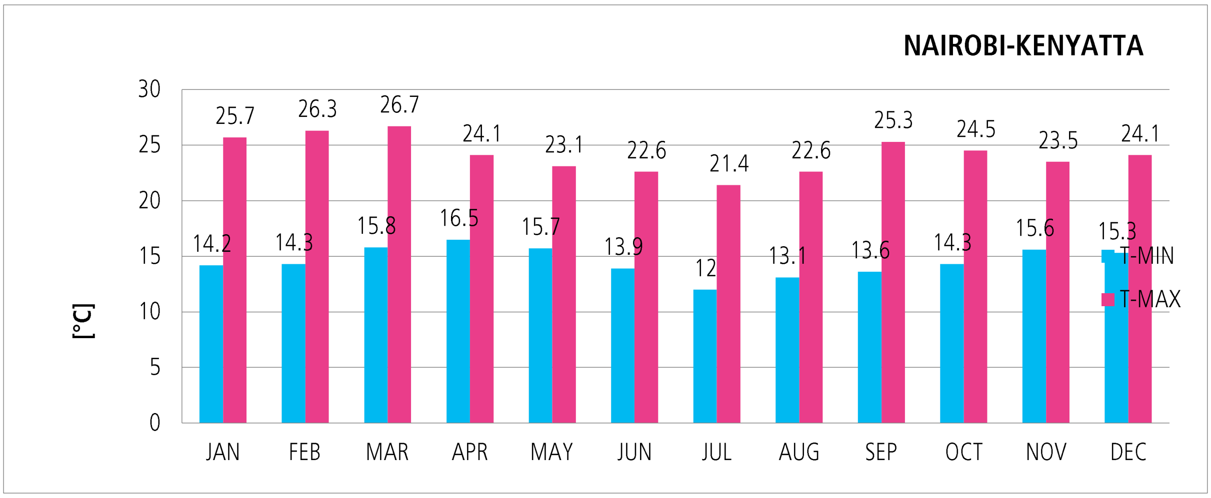


Figure 175: Monthly average rainfall for Nairobi

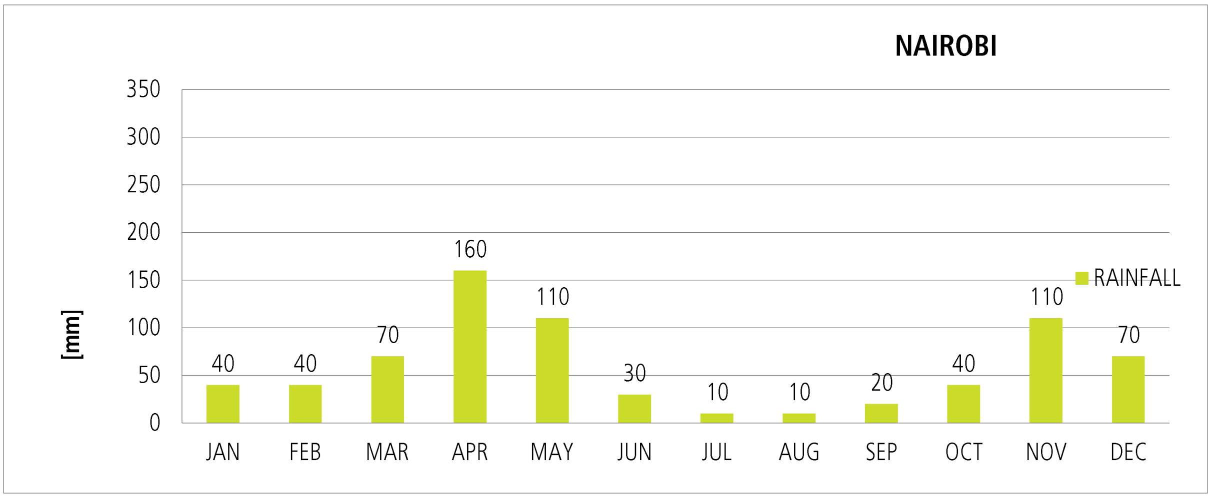


Figure 176: Polar sun path diagram for Latitude 1° South

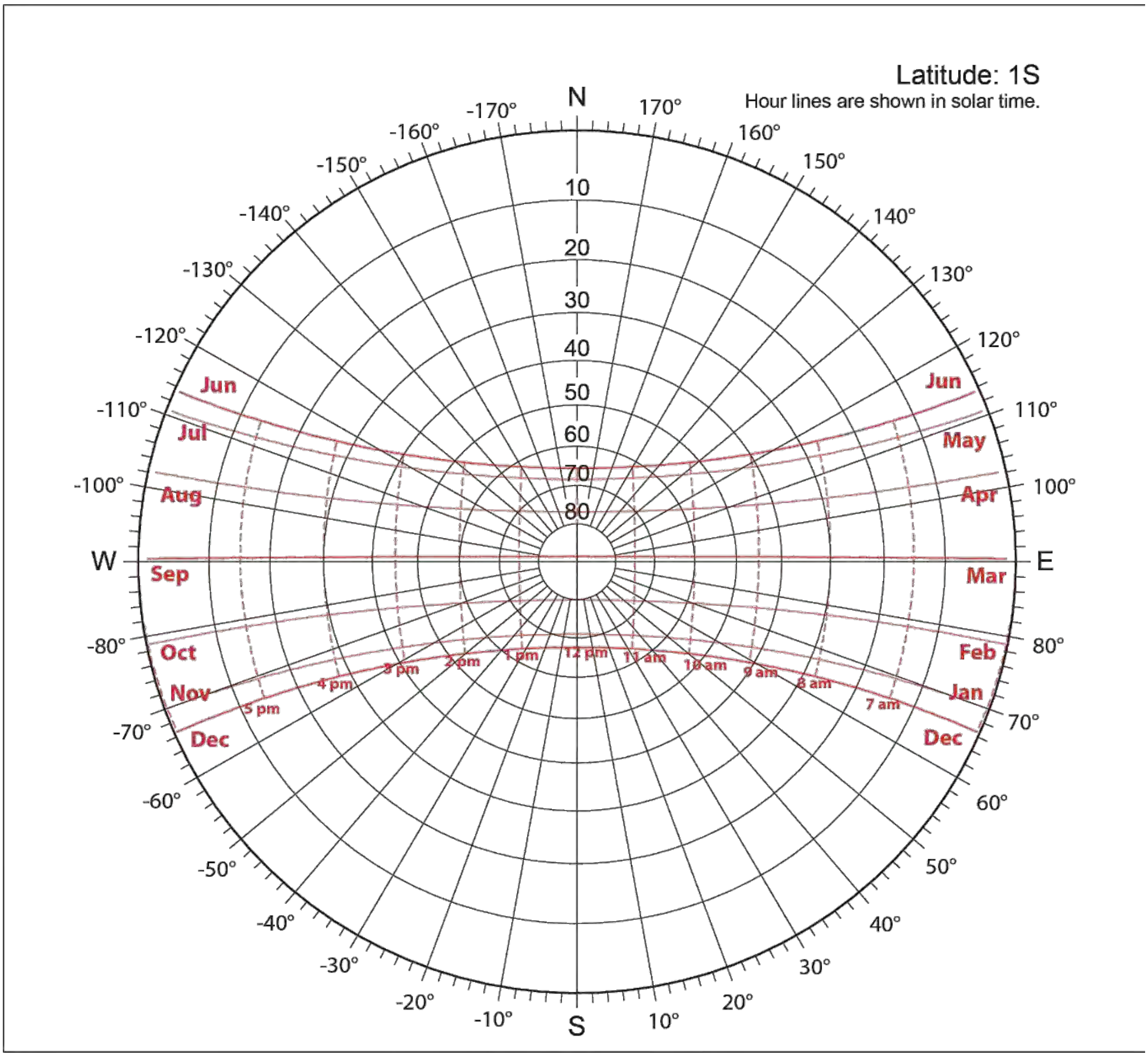
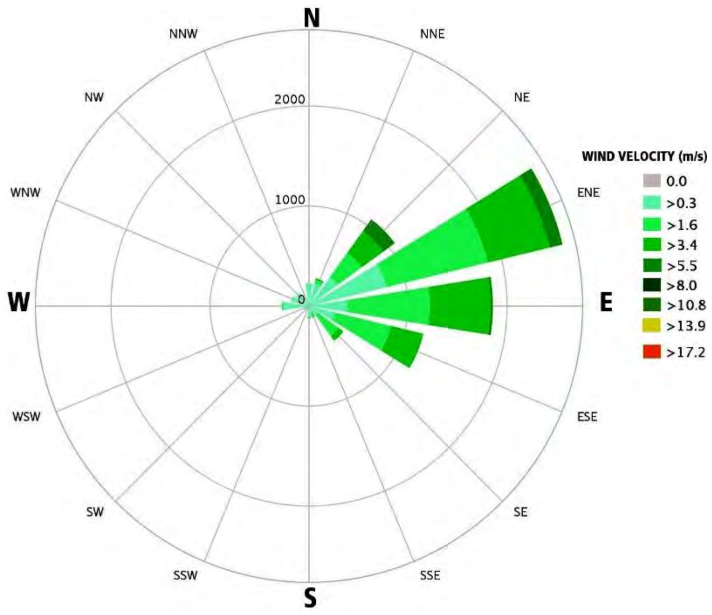
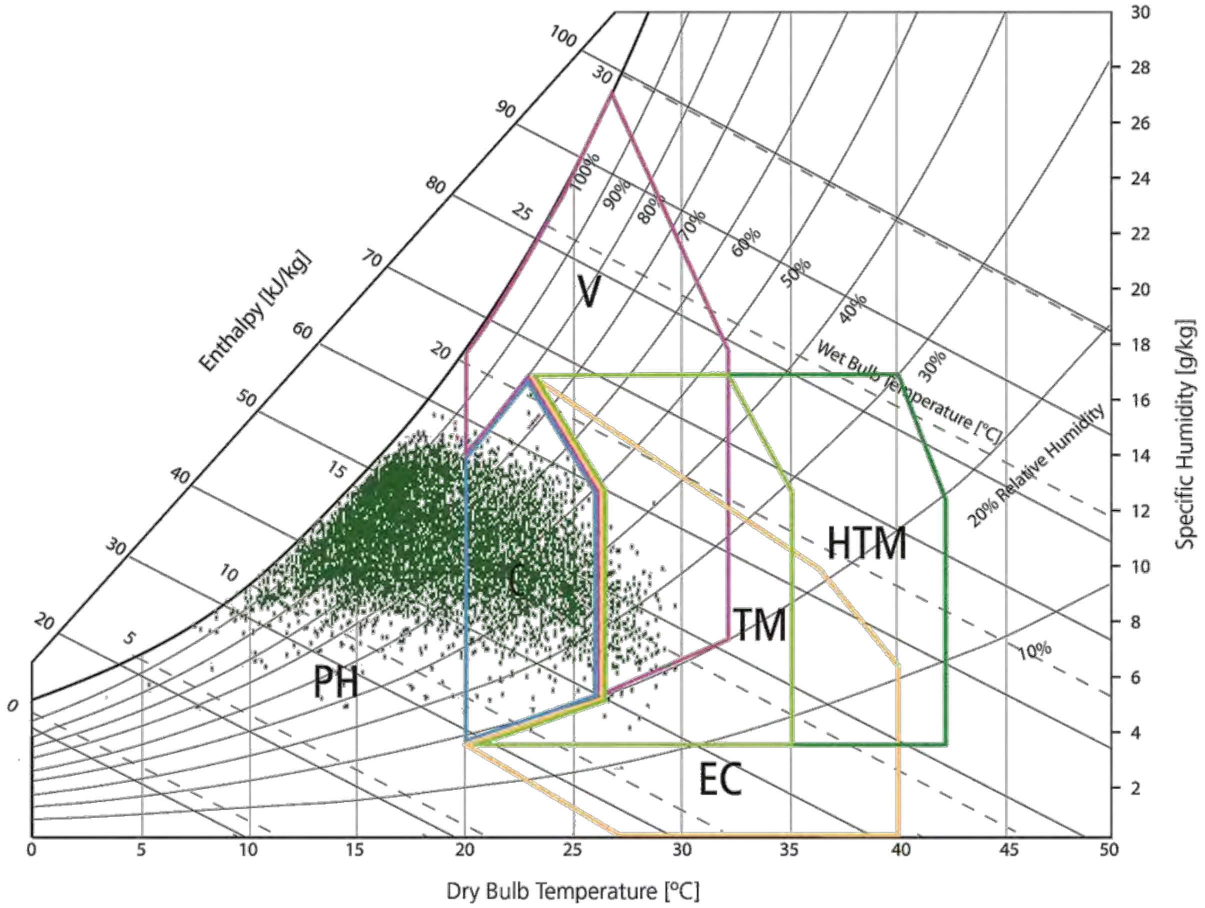


Figure 177: Wind rose diagram showing the prevailing wind direction in Nairobi



Source: https://www.meteoblue.com/

Figure 178: Psychrometric chart with passive design strategies overlays for Nairobi



C	Comfort Zone	EC	Evaporative Cooling
V	Ventilation	PH	Passive Heating
TM	Thermal Mass	AC	Air Conditioning
HTM	High Thermal Mass		

Interpretation

In Nairobi, most of the hourly points of outdoor dry bulb temperature and relative humidity fall within the comfort zone. However, a substantial portion falls below the comfort zone as seen in **Error! Reference source not found.**. This means that during that period, space heating is necessary to extend the limit of comfort zone. This can be done through passive heating through direct solar heat gain and thermal mass. Further, internal heat gain from equipment, lights and occupants are also helpful in extending the thermal comfort and reducing heading heating demand.

Bioclimatic recommendations

According to the climatic data for Nairobi, the following design strategies are recommended for:

a) Protection against heat gain in the hot period

- Buildings should be oriented with the main glazed windows facing north and south for easier sun control and to minimise overheating during the hot periods.
- Large windows should be avoided on the east and west facing façades.

Figure 179: The building is oriented with the long sides facing North – South and the short sides facing East-West. Openings are placed along the North – South facing façades.

ICEA Building, Nairobi

Source: http://www.jkuat.ac.ke/

Figure 180: Extensive use of horizontal and vertical shading devices all around the building protects windows from direct solar penetration

Kenindia House, Nairobi

Source:http://bauzeitgeist.blogspot.co.ke/2013/08/hauptstadt-von-ostafrika.html © MM Jones

- Appropriate sun shading devices should be incorporated to keep out the solar radiation and glare during certain hours of the day during the hot periods.

b) Enabling passive heating

- Careful orientation of buildings with main rooms facing north east is appropriate to allow a certain amount of solar radiation to penetrate for passive heating during the cold periods.
- The floor plan should be organised such that it allows the sun to penetrate daytime spaces during the cold periods.
- Compact forms reduce heat gains during the hot periods and minimise heat losses during the cold periods.
- Medium weight walls, floors and ceilings are recommended to explore passive heating by storing heat accumulated during the day (avoiding overheating) to balance the night

time low temperatures to keep them at comfort level.

- Excessive glazing should be avoided as it can lead to overheating during the hot period as well as lead to extensive heat loss at night or during the cold periods.
- All windows should be airtight to prevent heat losses when the outdoor temperatures are below the comfort zone and they should be located on opposite walls to allow for cross-ventilation.
- Additional heating systems such as fireplaces can be incorporated in the design.
- Internal heat gains from occupants, equipment and lights will greatly reduce heating needs.

Figure 181: All windows in the main façade are oriented facing North. They are deeply recessed to prevent direct solar radiation and glare. Horizontal aluminium light shelves reflect solar radiation while reflecting light into the interior spaces

Coca cola building, Nairobi © UN-Habitat / Jerusha NGUNGUI

Figure 182: The west facing façade is shaded using well designed sun shading elements that couple as aesthetic elements ensuring naturally lit spaces excluding solar heat gain

Administration Block, University of Nairobi

APPEDIX N: RESEARCH WORKS PROGRAM