UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

BIOPHILIC DESIGN IN ARCHITECTURE:

TOWARDS THE DESIGN OF A NATURAL SCIENCES MUSEUM IN DURBAN

Roshalin Padayachee

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Durban

DECLARATION

Submitted in partial fulfilment of the requirements for the degree of Masters of Architecture in the Graduate Programme in the School of Architecture, Planning and Housing, University of Kwazulu Natal, Durban,
South Africa.

I declare that this dissertation is my own unaided work. All citations, references and borrowed ideas have been duly acknowledged. It is being submitted for the degree of Masters of Housing in the Faculty of Humanities, Development and Social Science, University of Kwazulu Natal, Durban, South Africa. None of the present work has been submitted previously for any degree or examination in any other university.

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SIGNATURE

ROSHALIN PADAYACHEE

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STUDENT NAME

MAY 2014

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DATE

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DEDICATION

I dedicate this dissertation to Tooty, Tyson, Nige, Bob and Milkshake, all wonders of Nature.

ABSTRACT

Biophilia refers to the innate human tendency to affiliate with elements of the natural environment, and forms the basis of _biophilic' design. Man has historically shared a complex and interdependent relationship with nature, with much of human understanding stemming from thoughtful analysis of the natural world around. Contemporary lifestyle has led to man distanced from the natural environment, leading predominantly indoor lifestyles. Biophilic design provides the prospect for greater connectivity to the natural environment with the capacity to foster greater positive connections and stewardship of nature through more thoughtful, contextually sensitive approach to the creation of architectural built form. The research aims to establish how built form can be characterised through innate connections to the natural environment.

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Man & Nature

Imagine heat that, but for pressure, vaporizes all matter. Above it, a lifeless, lightless, solid crust. Not far above that, cold to solidify gas, were any there. Through this cold, a burning light of lethal intensity. Imagine – between the absolute cold and unimaginable heat, the murderous light and lifeless darkness, the solid and the nothing – a narrow zone where element interpenetrates element, where everything is in fluid interchange. Imagine this zone alive. Alive at every scale from sub-cellular to Gaian, from micro-organism to 100-metre trees, from individual to communal. Imagine a diversity beyond imagination, relationships beyond number. Imagine countless individual people, each different; countless individual places, each different. Imagine a world of indescribable beauty. But not a fixed world, not fixed beauty, for every elemental relationship, every living organism, every individual, every community of beings, constantly refines and re-shapes this world.

Only one species, however, does so with thought.

This is our world. This is our responsibility, our challenge.

Christopher Day (2002:1)

1.1 CHAPTER ONE | INTRODUCTION

1.1.1 Background

Fifteen generations ago, a period of little consequence in evolutionary terms, most of our ancestors would spend the majority of their waking hours outdoors, and buildings would primarily provide only shelter and security during the hours of darkness (Baker in Broadbent, G. & Brebbia, C.A., 2006:3). Survival required an intimate knowledge of Nature‘s systems, the weather and the landscape as illustrated by Baker (2006:3), *–Agriculture is an obvious example; rainfall, frosts, wind and their interaction with the landscape – shelter, drainage, pests etc, constantly reinforced man‘s link with nature.*”

Undoubtedly our drive to engineer the environment is broadly the same urge that made primitive hunter gatherer first improve his cave, stockpile food and fuel, then cultivate plants, domesticate animals, form cooperative groups, trade and so on (Baker, 2006:4). Howe (1993) succinctly expresses the consequence of man‘s quest to gain dominance over nature through the use of technology, and thereby regard the natural world as a commodity. This notion is further recognised by writers such as Chris Abel (2004:63) and Susannah Hagan (2001:16). The history of environmental philosophy testifies to two strands of thought that stand in stark contrast to one another: anthropocentrism and biocentrism (Howe, 1993:94). Howe‘s view on Heiddeger‘s later writings promotes the belief that all natural entities possess an inherent value by their interrelation to the surrounding world and thus ontology precedes ethics. *–By man's continual "forgetfulness" he tends to add characteristics to a thing and treat it as an object to be subdued by human control. This attitude is suggestive of the calculative thinking which artificially fabricates the thing with a view to quantifying it*.” (Howe, 1993:94)

The relationship between architecture and nature, for the last 500 years or so, has been one of juxtaposition (Gendall, 2009). The _built environment‘, a term referring to the human creation has often found itself distanced from nature – the other environment. The first (1750) and second (1850) Industrial Revolutions led to unprecedented advancements in building technologies and lit the path to modernity. Within the modernist framework the embeddedness of culture in nature can be, and often is, invasive rather than co-operative, a relentless endeavor to control how and what nature produces (Hagan, 2001:21). *–Many believe that the progress of civilization depends on subjugating and converting, if not conquering, the natural world. Indeed, many see this progression as the essence of civilization*” (Kellert, 2005:1). Mechanical process-orientated thinking and the deterministic

view of modern architecture as an instrument of ‗social engineering' addressed the commonalities of human nature. It was the specificity of different landscapes, different topographies, different climates, and high degree of differentiation in the biosphere, from weather to species, that modernism ignored (Hagan, 2001:22). *"Interaction with nature is critically important to human well-being and development, but sadly has become compromised and diminished in modern times"* (Kellert, 2005:1) The traditional role of architecture has been to imitate nature in various ways, with architects like Frank Lloyd Wright, Richard Neutra, and Alvar Aalto insisting that nature remain the model upon which architecture should be modelled (Hagan, 2001:22).

This dissertation shall explore the aforementioned issues and explore opportunities where Nature's systems can be integrated within architectural theory and practice to obtain a greater ecological connection within the eco-sphere of man (built environment) and Nature. The study shall progress toward the design of a Natural Sciences Museum for Durban.

1.1.2 **Motivation/Justification of the Study**

Baker (2006:13) states, ‗Although we spend 95% of our time indoors, we are really outdoor animals'. The current ecological crisis has forced professionals to re-evaluate the fundamental premises of how architecture is conceived and constructed (Metallinou in Broadbent, G. & Brebbia, C.A., 2006:15). Stephen Kellert (in Metallinou, 2006:27) establishes quite clearly that sustainable, green or, in general, ecological building processes, "will not achieve its full promise and potential until it more positively motivates individuals, developers and planners by capturing in the built environment the widest range of physical, emotional, and intellectual values of nature". Entomologist Edward Wilson, uses the term ‗biophilia' to describe people's inclination to affiliate with the natural world (Wilson, 1984 in Sanders, 2010:22). Studies have shown that life-sustaining environments are conducive to positive impacts on man's physical and mental wellbeing (Almusaed, 2011; Day, 2004). Through understanding Nature's interconnected systems and man's relative place within the biological world, a greater sense of awareness and ecological sensitivity can be fostered. The proposed Natural Sciences Museum shall serve as a vehicle for awareness and aim to intertwine the cultural concepts of man within the realm of biological and physical laws.

1.2 DEFINITION OF THE PROBLEM, AIMS AND OBJECTIVES

1.2.1 Definition of the Problem

Nature and its natural environments are an integral force of human existence but have been negated to the fringes through man‘s need for dominance over Nature through technological means (Metallinou, 2006:15). Ecological and human survival is now dependent on a new, deeper-ecological stance as ecological crisis moves ever closer to the centre of global focus. A fundamental aspect of the new ecological revolution is recognition of nature‘s diverse and complex life-promoting systems; and how they may be applied to architectural design through the principles of biophilia in architectural design.

1.2.2 Aims

The aim of this dissertation is to suggest guidelines towards architectural design that encompass the principles of biophilia. It intends to investigate the synthesis between natural and man-made environments and how architecture can facilitate positive impacts within the eco-sphere of natural and built environments through the application of biophilic design principles.

1.2.3 Objectives

The objectives of the study are:

- To investigate the influence of Nature within the design of man-made built environments
- To explore man‘s cultural conceptions of the natural environment(s)
- To investigate biophilic design as a tool for architectural design in responding to man‘s need for shelter, comfort and expression
- To investigate sustainable systems that promote diversity and minimize ecological impact

1.3 SETTING OUT THE SCOPE

1.3.1 Delimitation of Research Problem

This study seeks to explore the relationship between natural and man-made environments; and the capacity of biophilic design. Political and economic factors shall not be explored as

this is not the focus of the research. Where sustainable systems shall be explored, it will deal only with ecological impact sustainability.

1.3.2 **Definition of Terms**

Anthropocentrism: The belief that humans are the central most significant species on the plant, with an assessment of reality through an exclusively human perspective.

Architecture: Is both the process and the product of planning designing and constructing physical structures.

Biocentrism: A opposing stance to anthropocentrism that asserts the value of non-human life in Nature.

Biophilia: The suggestion that there is an instinctive bond between human beings and other living systems.

Built Environment: The term "built environment" may refer to man-made physical features such as streets, squares, parks, and buildings. This term may relate to internal and external spaces.

Culture: Is seen as the distinct ways in which different people organise their experiences and meanings in the world and how these experiences are symbolically represented. Culture is the framework in which a people or communities experience their reality.

Dialectical: Describing a method of discourse between two or more opposing views through rational discussion and a search for the truth.

Ecocentrism: The interactions and relationships between living organisms and their natural or developed environments.

Ecology: The interactions and relationships between living organisms and their natural or developed environments.

Flows: Movements as found in natural environments such as the flow of a river, the flows of energy.

International Style: An architectural style employed within the modernist movement that promoted the hegemony of machine expression through industrial process.

Man: Man shall be termed the collective of humankind.

Nature: Nature refers to the natural and physical phenomena of the world that include both living and dead. (Nature shall be used synonymously with the term ‚natural environment")

Ontology: The philosophical study of the nature of ‚being' or ‚reality' and how entities exist and can be grouped.

Perception: Perception is the process of representing and understanding the environment. Cultural framework provides the foundation for the individual's perception of the world around him or her, and therefore, the act of perception always involves an element of interpreting reality in terms of the specific individual.

Sustainability: a pattern of resource use that aims to achieve human needs whilst preserving the integrity of the natural environments from which the resources are claimed.

Tradition: a belief or behaviour of symbolic significance that has been passed down within a specific group or society.

1.3.3 Stating the Assumptions

This dissertation is based on the following assumptions:
Man has gained dominance over Nature through the use of technological innovation and built environments.
Ecological crisis is relevant and serious matter that requires architectural intervention to inform healthy human habitats.

1.3.4 **The Key Research Question:**

How can biophilic design facilitate a harmonious interaction between Nature and built environments to create meaningful architecture?

1.3.5 **The Secondary Questions Are:**

i) How can Nature influence architectural design and built form?

ii) How can aspects of Nature be integrated within the built environment?

1.3.6 **Hypothesis**

It is hypothesized that the application of biophilic design principles to architecture, produces integral connections with Nature which promotes the spirit and well-being of man.

1.4 **THEORIES AND CONCEPTS**

1.4.1 Postmodern Ecology

Place theory –*The ideas of postmodernity and ecology are complementary halves of a new environmental ethics and practice*" (White, 1998:32). The emergence of this philosophy can be traced back to the works of Frank Lloyd Wright, Richard Buckminster Fuller and Richard Neutra to name a few. Concepts that have emerged within the broad theory of postmodern ecology include biophilia and ecological theory. Ecology has provided increasing evidence of man's impact of the Earth's ecosystem as a result of increasing landscape heterogeneity and variations in energy and material cycles (Alberti, 2008:1). Biophilia, a concept introduced by Edward O Wilson (Wilson1984) proposes that humans subconsciously seek connections to Nature. Amjad Almusaed (2011:vii) describes Biophilic Architecture as –*part of an innovative view in architecture, where nature, life and architectural theory combine to create a lively habitable building competent to satisfy the demands, constraints and respect for both people and the environment*". Ecological Theory, as expressed in the writing Braungart (2002) and Girardet (1992), asserts that made-made systems should harmonise with natural environments as they are ultimately part of a larger ecosystem. Built entities should be conceived as part of the whole and not exist in isolation.

1.4.2 **Place Theory**

Place theory attempts to understand the phenomenon of "place" and "place-making". As influential landscape writer J.B. Jackson (Jackson, 1994:157-158 in Jiven & Larkham, 2003) describes, "*'Sense of place' of place is a much used expression, chiefly by architects but taken over by urban planner and interior decorators…it is the awkward and ambiguous translation of the Latin term genius loci translated as 'genius of a place' meaning its influence*'. Critical regionalism and phenomenology are concepts central to place theory.

Phenomenology of place is a theory proposed by Christian Norberg-Schulz (1980) where-by a place or environment has a distinct character that may not be quantifiable scientifically, Atmosphere is something we perceive through our spontaneous emotional sensibility which is a form of perception that works instantaneously and essentially gives meaning to places and buildings (Zumthor, 2006). Phenomenological geographer Edward Relph (2009:30) states "Place is central to future planning strategies: There has been a deep epistemological shift away from the rationalistic assumptions of modernism—assumptions that promoted universal, placeless solutions to environmental and social problems—— to an acknowledgement of the significance of diversity."

1.4.3 **Critical Regionalism**

According to Lefraivre (2003) and Frampton (1983, 1995 & 1996) Critical Regionalism is grounded to the dialectical relations and interconnectedness of a specific geographic location and the local community. Within the framework of this theory, the political and cultural circumstance of a region is critical in informing the development of the built environment.
"*Modern building is now so universally conditioned by optimized technology that the possibility of creating significant urban form has become extremely limited*" (Frampton, 1983:17).

Critical Regionalism seeks balance between the technology of the modernist, 'instrument reasoning' and the hapticity of the natural, organic expression. Frampton (1983:20) succinctly states, "*Critical regionalism necessarily involves a more directly dialectical relation with nature than the more abstract, formal traditions of modern avant garde architecture allow*". He goes on further to show that despite the flattening of a potential building site being the most 'economical' model upon which to build, it is a 'tabula rasa' tendency of modernism that cultivates absolute '*placelessness*' (Frampton, 1983:26).

Frampton argues that the specific culture of a region draws from its geographic history and thus this history is inscribed into the form and realization of the work (Frampton, 1983:26).

1.5 RESEARCH METHODS AND MATERIALS

A systematic, qualitative method is adopted for the collection and analysis of the data within the research. This is attained by means of historical research, philosophical research, precedent studies, interviews and case studies. The research seeks to understand the intangible character that nature may present within the built environment and architecture. Both primary and secondary data is employed as shown below:

Secondary data collection forms the basis of the research in the form of a literature review that investigates various sources of insight into the inferred topic. These include selected books, journal articles, websites, videos and precedent studies. Appropriate concepts and theories are explored and applied to the analysis of primary data and precedent studies.

Primary data is collected through case studies, interviews and architectural drawings. This data is tested against the theories and concepts explored in the secondary data; exploring the successes and failures. The case studies explore issues of space and ‗place' creation through site observations of selected architectural sites. Information obtained is documented through means of photographs, general architectural observations, and, where possible, interviews.

The proposed case studies are: Intuthukho Junction, Cator Manor Durban and The Durban City Hall with particular focus on the Durban Natural Sciences Museum housed within.

Research interviews were conducted with persons related to each of the aforementioned case studies including: Derek van Heerden, East Coast Architects; Nasreen Arabi of City Architects and Allison Ruiters of the Durban Natural Science Museum.

Occupants and visitors of the case studies were interviewed to investigate the influence of nature on the architectural design of the environments and its influence on the well-being and satisfaction of the persons interviewed.

Two methods of sampling are employed:

Maximum Variation Sampling: Individuals who cover the diverse spectrum of positions and perspectives in relation to the phenomenon of man-made built environments, natural environments and biophilia. This selection process is employed in choosing the participants of the general users survey/interview.

Expert Sampling: Professionals that possess a particular expertise in natural ecology and sustainable building practice form part of the expert sample to give greater insight into the role of biophilic design in the creation of man-made built form.

1.6 **CONCLUSION: CHAPTER ONE**

This chapter has identified the outlined problems, aims and objectives of the research, including the methodological approach. This research methodology is followed to conclude toward guidelines and recommendations for architecture with a greater affinity to Nature.

2 CHAPTER TWO | LITERATURE REVIEW

2.1 Introduction

The relationship between man, Nature and the built environment is that of complexity and inter-relatedness (Docrat, 2012:9). This chapter seeks to gain greater understanding of the role of man-made environments in relationship to the natural, and how architecture can foster connections to the biological world through the concept of biophilia or biophilic architecture. The concepts and theories shall be given due attention within this chapter to establish a theoretical framework within which the aforementioned connections may be established. The research falls into two parts, namely:

MAN, NATURE AND THE MAN-MADE ENVIRONMENTS: This section explores the interconnected relationship between the three entities to establish a perspective within which the research may build upon. This section explores the early origins of built form, how nature has influenced the creation of man-made environments and concepts such as phenomenology of place and genius loci.

BIOPHILIC DESIGN: This section explores the architectural integration of nature and its ‗*concrete*‘ elements into the creation of built environments that promote man‘s health and mental well-being. Concepts such as biophilia and bioclimatic responsiveness are explored to uncover ways in which architectural design may facilitate greater connectivity to the natural world and its processes.

of gods and goddesses; it is an inanimate source of raw materials" (Hagan, 2001:18).Weinstock (2010) expresses the perception of nature as undisturbed and pure sullied only by man's cultivations of technology. The opposing paradigm proposes that man was created for the purpose of perfecting nature and thus the natural world exists for the benefit of man (Weinstock, 2010). It is within the latter framework that domination of nature becomes sanctified.

2.2.2 Man's Conquest of Nature

"*There is no relationship with nature other than an implicit one: nature as a source of energy and raw materials*" (Hagan, 2001:55). Historically, nature in Western civilizations has been valued as feminine and inferior to culture which is considered masculine and superior (Hagan, 2001). "*Women are identified with nature and the realm of the physical...men are identified with the 'human' and the realm of the mental...Whatever is identified with nature and the realm of the physical is inferior to...whatever is identified with the 'human' and the realm of the mental, or conversely, the latter as superior to the former*" (Warren, 1990:129–30 cited in Hagan, 2001:19). Women are ultimately linked to nature in respect to their reproductive roles in way that men can avoid (Hagan, 2001). The age of enlightenment was somewhat of a 'men's club' with ladies only allowed to be passengers either as servants or ladylike guests as they were disempowered (White, 1998). "*Women are devalued because nature is devalued, and the identification of the former with the latter is no innocent analogy*" writes Susan Hagan (2001:19). As Francis Bacon vividly said "*I am come in very truth leading Nature to you, with all her children, to bind her to your service and to make her your slave...*" (cited in White, 1998:41). His statement articulates the domination of man upon the feminized nature, a phenomenon recognised by Susan Hagan (2001) and Daniel Ray White (1998).

Descartes is often considered the founder of modern science that laid down the theory of knowledge and method in terms of which science has progressed (White, 1998). His doctrine of 'primary' and 'secondary' qualities created the new posture of distinguishing between 'quantifiable' phenomena as primary, and intangible phenomena as secondary (White, 1998). Furthermore primary qualities were designated as 'objective' whilst secondary were tagged 'subjective' (White, 1998).. "*The result was a picture of 'objective' nature that was thoroughly mathematized. The 'subjective' nature of human beings, left to the impressionistic*

whims of consciousness, was in effect removed from the objective or primary-that is, the real world" (White, 1998:38). Christopher Alexander (2004) equally recognises that the foundations of modern science have led us to an unremarkable understanding of the world through modelled mechanics yet ignore the conscious experiences and the immediate awareness of self. It was through the intensification of science that nature was seen in the material domain, quantitatively defined, whose principal value was as a means to an end (White, 1998). The intensification of science largely contributed to the creation of the capitalist entrepreneur, who similarly followed in the primary-secondary and instrumental paradigms employed by scientists in the understanding of nature's machinery (White, 1998). *"In order to create this effective scientific world-picture we had to use a device: the intellectual device of treating entities in nature as if they were inert, as if they were lumps of geometric substance, without feeling, without life —in effect, merely mechanical elements in a larger machine*." (Alexander, 2004:13)

The architectural discourse of twentieth century modernism has been greatly influenced by the notion of monumental permanence (Hvattum, 2006) and has been preoccupied with _instrumental reason' (Frampton, 1983:17) since the dawn of the industrial revolution. *"Modern architecture had to go the hard way…it had to reconquer the most primitive thing as if nothing had ever been done before*" (Giedion, 1948 cited in Hvattum, 2006:36). For years agricultural and craftwork occupations had been the primary occupation in Europe, until industrialisation took shape and was spurred by a quick succession of new technologies (Mc Donough & Braungart, 2002: 19). Factories, with increasing capacity to manufacture larger volumes through standardized and centralised production, allowed industrialists to gain great affluence (Mc Donough & Braungart, 2002: 21). Industrialism began to inform the major creative directive and created some of the most tainted urban environments in human history. *_The factory became the nucleus of the new urban organism*' (Mumford, 1961: 458). *"Capitalism had begun to _turn every part of the city into a negotiable commodity*." (Mumford, 1961: 446). The factories occupied the most advantageous sites, sites near water edges where water could be fed to the large boiler machines to facilitate efficient industrial process. In return the factories would turn the rivers and canals into liquid dumps while the large mountains of ash, slag and rusty iron defined the horizons (Mumford, 1961: 446). Without much thought to zoning and functional planning, factories were established wherever an owner had purchased adequate land to establish their industry (Mumford, 1961: 446). The poor planning of industrial zones ultimately led to a massing of industries and an

nature and the world worked together (Hagan, 2001:33). Methods of brute force were employed in the attempt to overwhelm nature and impose universal design solutions to an infinite number or conditions and cultural contexts (Mc Donough & Braungart, 2002: 30-31) (Hagan, 2001:22). Christopher Day (2004:11) expresses how in the day of ~~h~~hand power" it would be easier to navigate around topographical challenges for pragmatic reasons in a ~~c~~*conversation*" with the landscape, as opposed to powerful machinery that is able to disregard the irregularities of the environment. A certain ~~s~~*sensitivity of placing*" is unlikely to occur through designing simply on paper without true cognisance of the environment and landscape. ~~P~~*aper design and mechanical construction have changed the relationship of buildings to surroundings much more dramatically than first appears"* (Day, 2004:11-12).

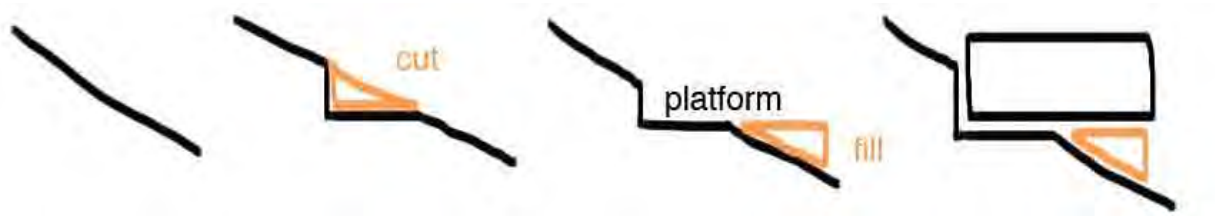

Figure 2.6: A cut and fill exercise shows the impact of modern machinery in subjugating nature as it does not directly respond to the particularities of place. (Finnie, C. : 2012)

Juhani Pallasmaa's *Eyes of the Skin* (2005:15-17) refers to a similar flattening that exists within the modernist paradigm through man's emphasis on the sense of sight. Plato regarded vision as humanity's greatest gift whilst Aristotle considered sight to the most noble of the senses (Pallasmaa, 2005:15). In the Renaissance, the five senses were perceived within a hierarchical system, with vision at the top. ~~T~~*The Renaissance system of the senses was related with the image of the cosmic body; vision was correlated to fire and light, hearing to air smell to vapour taste to water, and touch to earth*" (Pallasmaa, 2005:16). Pallasmaa (2005:17) identifies that man's ocularcentric relation of the world has its beginnings in ancient Greek and Western culture through the ~~v~~*vision-centred interpretation of knowledge truth and reality"* (Levin cited in Pallasmaa, 2005:17). David Michael Levin (in Pallasmaa 2005:17) recognises that there is a tendency, when utilising vision, to ~~g~~*grasp, fixate and totalise: a tendency to dominate, secure and control, which eventually, because it was so extensively promoted, assumed a certain uncontested hegemony over our culture*."

2.2.3 Importance of Nature in Urban Environments

By the end of this century, the world's population shall move from being a predominantly rural society to an urban civilisation (Girardet, 1992: 11 cited in Docrat 2012:27). Urbanization has historically relied on converting natural diversity into largely homogenous landscapes, consuming enormous amounts of resources and materials, and generating huge quantities of waste (Kellert, 2005:2). The modern urban environment now consumes approximately 40 percent of energy resources, 30 percent of natural resources, and 25 percent of freshwater resources while generating one-third of air and water pollutants and 25 percent of solid wastes (Kibert cited in Kellert:2005:2). The changes of lifestyles in contemporary society have subjugated nature in an attempt for 'progress' and disconnected man from the biological world (Kellert, 2005). *"The assumption that human progress and civilization is measured by our separation from if not transcendence of nature is an erroneous and dangerous illusion"* (Kellert 2008:4).

Authors such as Stephen Kellert (2005 & 2008), Timothy Beatley (2008 & 2011) and Judith Heerwagen (2008) have written extensively about the importance and benefits of greater awareness and care for the natural environments, and greater means through which nature can be incorporated into the built environment for the benefit of man. The need for daily contact with nature in order to achieve a healthy balanced, productive, and indeed our coevolution with nature has been the critical insights of E.O. Wilson (Beatley, 2011:3). Wilson popularized the term 'Biophilia' and described it as, *"the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature*." (Wilson cited in Beatley, 2011:3). Wilson asserts that the brain developed in a biocentric world, through an intimate knowledge of the natural environment, as opposed to the machine-regulated world today, a relatively short period of human existence (Beatley, 2011:3). Stephen Kellert (in Beatley, 2011:3) that our natural inclination to affiliate with nature and the biological world constitutes a *"...weak genetic tendency whose full and functional development depends on sufficient experience, learning, and cultural support*".

One of the earliest works to acknowledge the recuperative benefits of nature within built environment can be found in the work of Roger Ulrich of Texas A&M University (Beatley, 2011:4). Upon studying the postoperative recovery of gall bladder patients, he assessed that those with views of trees and nature recovered faster and more easily than compared with patients with views of walls (Beatley, 2011:4). Over the past several decades, research in a

The urban heat island effect is another phenomenon that biophilic design can assist in remediating (Almusaed, 2011:140-141). This phenomenon results in the heating up of the city environment several degrees warmer than the surrounding natural environments. This is as a result of three primary factors (Almusaed, 2011 in Docrat, 2012):

- heat storage from stone, asphalt, and concrete surfaces
- heating due to combustion and energy usage from cars, factories, heating and transport systems
- heating due to production of gases such as carbon dioxide and nitrogen oxide, which act as greenhouse gases which build up around the city (Almusaed, 2011: 140-141).

Vegetation and elements of water, according to studies conducted by NASA (in Almusaed, 2011:140), can effectively reduce heat gain in urban environments. Almusaed acknowledges that some of the impacts of the urban heat island effect (see Fig 2.8) include: increased energy consumption through the need for mechanical climate control, amplified pollutants in the air and an increase in health risks through impaired ecosystems (Almusaed, 2011:142-146). The heat island phenomenon illustrates the ability of man-made environments in dictating micro-climates and the role nature can play in rectifying man‘s erroneous constructs. It is however important to note the context within which the effect occurs as it may be beneficial in an alternative environment.

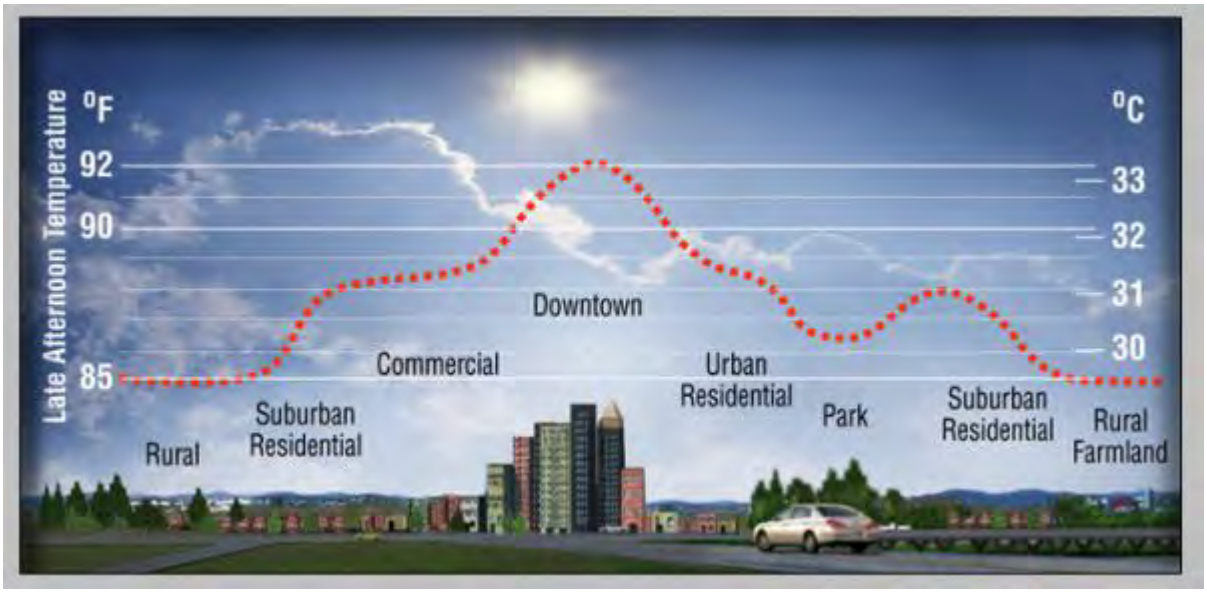

Figure 2.8: The variation of temperature shown as a result of the urban heat island effect (Lawrence Berkeley National Laboratory).

2.2.4 Man‘s Construct of ‗Place‘

A ‗place‘ can be considered to be a manifestation of material substance, having shape, texture and colour that, when put together, determine an ‗*environmental character*‘ (Norberg-Schulz, 1980:6). The Norwegian architect and phenomenologist Christian Norberg-Schulz is a key theorist in explicating the concept of genius loci & ‗sense of place‘. In Roman mythology the genius loci was a protective spirit of place often depicted as a snake however the contemporary usage usually refers to a location‘s distinctive atmosphere (Volger & Vittori, 2006). The phenomenology of place and genius loci are concepts within the broader place theory that seek to explore the intangible characteristics of space (Norberg-Schulz, 1980:5). Phenomenology is a ‗*return to things*‘ approach which deals implicitly or explicitly with the questions of space (Saferty-Gazon, 1985:4) and owes its roots in the works of Edmund Husserl and Matin Heidegger (Habib & Sahhaf 2011).

―*…to return to things themselves is to return to that world which precedes knowledge, of which knowledge always speaks and in relation to which any scientific schematization is an abstract and derivative sign language, as is geography in relation to the countryside in which we have learnt beforehand what a forest, a prairie, or a river is*.‖ (Merleau-Ponty, 1967, p.9 cited in Saferty-Gazon 1985:4).

These ideas are identified by Norberg-Schulz (1980:21) as a response to modernism‘s inability to consider the intangible, essential qualities of space. As Rene Dubos (cited in Kellert et al. 2008:6) argued:

―*People want to experience the sensory, emotional, and spiritual satisfactions that can be obtained only from an intimate interplay, indeed from an identification with the places in which they live. This interplay and identification generate the spirit of the place. The environment acquires the attributes of a place through the fusion of the natural and human order.*‖

The erosion of the connection to place within modern society has been referred to as ―*placelessness*‖ by Edward Ralph (cited in Kellert et al. 2008:6). He described the phenomena in the following manner, ―*If places are indeed a fundamental aspect of existence in the world, if they are sources of security and identity for individuals and for groups of people, then it is important that the means of experiencing, creating, and maintaining significant places are not lost. There are signs that these very means are disappearing and*

that "placelessness"—the weakening of distinct and diverse experiences and identities of places—is now a dominant force. Such a trend marks a major shift in the geographical bases of existence from a deep association with places to rootlessness." (Ralph cited in Kellert et al. 2008:6). Without a strong attachment to the culture and ecology of place people are rarely sufficiently motivated to act as responsible stewards of the environment (Kellert et al. 2008:6). As Wendell Berry (cited in Kellert et al. 2008:6) stated, "*Without a complex knowledge of one's place, and without the faithfulness to one's place on which such knowledge depends, it is inevitable that the place will be used carelessly and eventually destroyed*."

Gillian Rose (1995) expresses that 'a sense of place' implies that places are infused with meaning and feeling developed through individuals' life experience. Other writers such as Gorden Cullen of *Architectural Review* have also referred to 'spirit of place' or genius loci and describes the elements of the environments to exist within an "*art of relationship*" that create and give meaning to the character of the environment (Cullen, 1983:7-9).

Christian Norberg-Schulz (1980:5) identifies that the modernist scientific analysis of built form "*miss the concrete environmental character, that is, the very quality which is the object of man's identification, and which may give him a sense of existential foothold*". Furthermore, Norberg-Schulz (1980:8) states that a 'place' can be defined as the '*total qualitative phenomenon*' which cannot be reduced to any of its parts without losing the essence of the place. Jon Lang & Walter Moleski (2010) concur with Norberg-Schulz and identify the sense of place as the relationship between built environment and its immediate geographical locale. According to Lang & Moleski (2010:202), the sense of place emerges from the topographical and climate conditions and how the built environment responds to them. It is dependent on the qualities of the behavioural settings that exist in a locale and develops from the response to local conditions and traditions (Lang & Moleski, 2010:202).

Christian Norberg-Schulz's (1980: 25-32) description of genius loci recognises four thematic levels, two of which are natural environmental factors, these being;

1. The topography of the earth's surface
2. The cosmological light conditions and the sky as natural conditions
3. Buildings and
4. Cultural meanings

The natural conditions of a place are understood as being based on features in the landscape including the fluid changes of light and vegetation in the seasonal cycles (Norberg-Schulz, 1980: 25-32). This dynamic, rhythm of nature contrast with the stability of physical form and provide the varying atmosphere that brings life to the natural landscape. Norberg-Schulz (1980:23) describes the landscapes as embodying a certain structure and meaning that had given rise to the concept of dwelling. He expresses the idea that nature is the basis for people‘s interpretation and it is relative to nature that places and object take on meaning (cited in Jiven & Larkham, 2003). Jakle (1987 cited in Jiven & Larkham) emphasises the individual subjective nature of place in his writings on genius loci. Christopher Day (2004:23) recognises that environments consist of universal, cultural and personal effects, and that an individual‘s subjective impression of an environment can in fact be assessed objectively. For Jakle, the best person to experience and express the genius loci is the tourist rather than the resident since tourism *–involves the deliberate searching out of place experience*” (Jakle, 1987:8 cited in Jiven & Larkham, 2003:69).

Christian Norberg-Schulz (1980: 35) explains man‘s response to the natural environment, pointing out three basic reactions:

1. To structure nature to be more precise and ordered, taking cues from nature. In doing so man gains an existential foothold.
2. To complement the given condition, to add to it what it is lacking, making the environment more conducive for human habitation.
3. To symbolise his understanding of his environment, forming the bases of cultural development. (Norberg-Schulz, 1980: 35 cited in Docrat, 2012:16).

Norberg-Schulz distinguishes three basic landscape categories that are understandable as ideal archetypes:

Classical Landscape (Fig. 2.9)
These landscapes feature an intelligible composition of distinct elements: clearly defined landscape with imageable natural spaces such as valleys and basins (Norberg-Schulz, 1980). According to Norberg-Schulz (1980:45) it may be described as a *meaningful order of distinct individual places‘*.

qualities of movement, life, harmony, gesture and resolution of dynamic forces, they can bring a life-influence to the place a building bounds _.

Fundamental to all cultures are the contradictory yet simultaneous functions of walls, borders and boundaries – to divide and connect, to exclude and include, to shield and constrain (Silberman & Till & Ward, 2012:1). Modernism, post-modernism and contemporary architecture has been widely criticised for its inability to consider the climatic and experiential qualities of place with a result that environments alienate user and form strict separations between natural and man-made elements.

The boundaries of buildings can be defined within the following three categories (Docrat, 2012:42):

- Building-to-earth boundary
- Building-to-sky boundary
- Inside and outside (walling membrane)

The building to earth relationship is characterised by the manner in which the architecture relates itself to the natural topography. This relationship can be seen to be one of conversation with or domination of the natural topography as illustrated by the flattening of the site sketch (Fig.). Day (2002:33) and Frampton (1983:26) identify that buildings in conversation with the landscape create qualities of place as the boundaries converse with each other as the building rises from the ground.

The building to sky relationship is commonly identified as the connection between the sky and the roof of the building. Through appropriate consideration the roof can provide shelter from the climatic conditions whilst providing connections to the sky and celestial world, a strong link to man‘s spiritual and religious practice. Thus the roof can be seen to foster connections to the natural environment which have cultural and ecological significance.

Recent architectural works have placed an emphasis on seeing the walling membrane as akin to the skin of a human, able to set up a dialectical division between inside and outside (Flanagan, 2009). As the living skin varies to adapt to suit the exigencies of the body so too should the building skin afford the opportunity for adaptable flexibility. The building skin

also serves to give identity and portray the function thus due consideration must be given to the design of the skin when facilitating connections between the internal and external environments.

2.2.6 Critical Regionalism

The phenomenon of universalization, whilst greatly aiding the technological advancements of man, has also resulted in the subtle erosion of traditional culture (Ricoeur, 1961) and the commodification of culture and nature (Slessor, 2013). The homogenisation of landscape and culture is fairly well recognised phenomena by various authors such as Hagan, (2001), Mc Donough & Braungart (2002). As Paul Ricoeur (1961:276 cited in Frampton, 1983:148) succinctly stated,

"*Everywhere throughout the world, one finds the same bad movie, the same slot machines, the same plastic or aluminium atrocities, the same twisting of language by propaganda, etc. It seems as if mankind, by approaching en masse a basic consumer culture, were also stopped en masse at a subcultural level.*"

Critical regionalism champions the notion of place in shaping modern architecture and attempts to reconnect design with specific cultural and natural forces (Ratti et al. 2013). The approach of a critically regionalist architecture seeks to offset the phenomena of *'placelessness'* The concept of regionalism is not new; Vitruvius discussed regional variations in his ten books on architecture whilst the romantics advocated regionalism during the nineteenth and early twentieth centuries (Xianghua, 2006). The fundamental strategy of critical regionalism is to mediate the impact of universal civilization with regionalist cultural elements derived from the "*peculiarities of a particular place*" (Ratti et al. 2013). In Kenneth Frampton's (1983) *'Towards a Critical Regionalism: Six points for an architecture of resistance*' Frampton highlights the need for a *'direct dialectical relation with nature*' (1983:26). Frampton speaks of an architecture that embodies the articulation of structure through the changing impacts of climate, light and terrain (Xianghua, 2006*). Culture versus Nature: Topography, Context, Climate, Light and Tectonic form*, are one of Frampton's (1983:26) key points which is employed to resist the domination of universal design. This notion promotes a conversational relationship to the natural topography, allowing the 'peculiarities' of the site to find expression as noted by Christopher Day (2004:11-12). Local materials, craftsmanship, and responses to light and climate are significant factors within the critical regionalist movement, however does not advocate a return to a purely regionalist,

neo-vernacular architecture. As Lewis Mumford succinctly wrote, *"If one seeks to reproduce such a building in our own day, every mark on it will betray the fact that it is fake, and the harder the architect works to conceal that fact, the more patent the fact will be… the great lesson of history – and this applies to all arts- is that the past cannot be recaptured except in spirit. We cannot live another person's life; we cannot, except in the spirit of a costume ball…*" (Mumford, 1941, cited: Tzonis et al, 2001: 24)

Ratti et. al. suggest that whilst the popularity of critical regionalism has long passed the questions it raises are more pertinent than ever. They further investigate the possibilities of applying the peculiarities of a particular place to the peculiarities of a particular network so as to suggest a relative locational response. *"THE CAPACITY OF A NETWORK TO CONNECT AND BRING TOGETHER PEOPLE ACROSS A BREADTH OF SCALES SEEMS TO PROVIDE A NEW WAY OF MEDIATING BETWEEN THE GLOBAL AND THE LOCAL. IT IS THE FLUID INTERFACE BETWEEN THE INDIVIDUAL AND THE COLLECTIVE*' (Ratti et al. 2013)

2.3 **BIOPHILIC DESIGN**

Biophilic design can be described as *"the deliberate attempt to translate an understanding of the inherent human affinity to affiliate with natural systems and processes, known as 'biophilia', into the design of the built environment*" (Kellert, et al. 2008:3). As noted previously, biophilia is the inherent human inclination to affiliate with natural systems and processes (Kellert et al. 2008). The development of the human body and mind developed within the evolutionary context of a mainly sensory world, defined by critical environmental features such as light, sound, odour, wind, weather, water, vegetation, animals and landscapes (Kellert et al. 2008) (Beatley, 2011). Biophilic design encompasses more than just an integration of nature within the built environment; it equally questions how society relate to the natural environment and the way in which nature can facilitate various behaviour patterns (Kellert et al., 2008)(Alexander 1979, 2002). Stephen Kellert (2005:4) describes the new paradigm of design namely, *restorative environmental design*, which focuses on how to avoid excessively consuming energy, resources and materials; generating large amounts of waste and pollutants; and alienating people from natural environments. *Restorative environmental design* seeks harmonisation of built environments with the natural environment with an aim to foster positive environmental impacts or beneficial contact between man and nature

The second basic dimension of biophilic design is described as *place-based* or *vernacular* dimension, defined by buildings and landscapes that *"connect to the culture and ecology of a locality or geographic area"* (Kellert et al. 2008:6). This dimension encompasses the concept of genius loci discussed earlier, and underscores the idea that buildings and landscapes of meaning to people become integral to their collective and individual identities, *"metaphorically transforming inanimate matter into something that feels lifelike and often sustains life*" (Kellert et al. 2008:6).

The aforementioned dimensions of biophilic design can be related to six biophilic design elements and 70 attributes listed in the following table (Kellert et al., 2008:15):

Environmental features Colour Water Air Sunlight Plants Animals Natural materials Views and vistas Facade greening Geology and landscape Habitats and ecosystems Fire	**Natural shapes and forms** Botanical motifs Tree and columnar supports Animal (mainly vertebrate) motifs Shells and spirals Egg, oval and tubular forms Arches, vaults and domes Shapes resisting straight-lines and right angles Simulation of natural features Biomorphy Geomorphology Biomimicry	**Natural patterns and processes** Sensory variability Information richness Age, change and the patina of time Growth and efflorescence Central focal point Patterned wholes Bounded spaces Transitional spaces Linked series and chains Integration of parts of wholes Complementary contrasts Dynamic balance and tension Fractals Hierarchically organized ratios and scales
Light and space Natural light Filtered and diffused light Light and shadow Reflected light Light pools Warm light Light as shape and form Spaciousness Spatial variability Space as shape and form Spatial harmony Inside outside spaces	**Place-based relationships** Geographic connection to place Historic connection to place Ecological connection to place Cultural connection to place Indigenous materials Landscape orientation Landscape features that define building form Landscape ecology Integration of culture and ecology Spirit of place Avoiding placelessness	**Evolved human-nature relationships** Prospect and refuge Order and complexity Curiosity and enticement Change and metamorphosis Security and protection Mastery and control Affection and attachment Attraction and beauty Exploration and discovery Information and cognition Fear and awe Reverence and spirituality

Table 2: Elements and attributes of biophilic design (Kellert et al. 2008:15)

One of the first architects to utilize the term *organic design* was famed architect Frank Lloyd Wright (Kellert 2005:130). He asserted that the appeal of buildings and landscapes is frequently a function of their connection and relation to features on the natural environment. Further he suggested that the most successful architectural creations possesses a harmony and integrity that has its origins in nature, or as he suggested, "*being true to [their] nature*". (Wright cited in Kellert, 2005:130). Wright purposed that the most enduring designs possessed the organic qualities of harmony and symmetry often features found in nature. Wright explained his approach to organic design as follows:

"*Nature is a good teacher. I am a child of hers, and apart from her precepts, I cannot flourish. I cannot work as well as she, perhaps, but at least I can shape my work to sympathize with what seems beautiful to hers. . . . Any building . . . should be an elemental, sympathetic feature of the ground, complementary to its nature-environment, belonging by kinship to the terrain.*"

(Wright cited in Kellert, 2005:130). Wright's work incorporated natural shapes and forms as well as fitting his structures into the landscape to make them appear as if they had emerged out of the land (Kellert, 2005:130). He emphasised simulating the "*plasticity*" encountered in nature, and thus his designs can appear to transform and mature in response to seasonal variations (Kellert, 2005:131).

Writer David Pearson describes organic architecture as "*rooted in a passion for life, nature, and natural forms . . . full of the vitality of the natural world with its biological forms and processes*" (Pearson cited in Kellert, 2005:133). He identifies several features of organic design as being:

- *Inspired by nature*
- *Unfolding, like an organism, from the seed within*
- *Existing in the "continuous present"*
- *Following (natural) flows, flexible, and adaptable*
- *Satisfying social, physical, and spiritual needs*
- *Growing out of the site*
- *Celebrating a spirit of play and surprise*

(Pearson cited in Kellert, 2005:133)

experience of being, and wipes away the sense of place". Dim lighting allows the engagement of the peripheral vision and allows a user to feel a sense of inclusion within the space through tactile haptic exploration and imagination (Pallasmaa, 2005:46-49 in Docrat, 2012:54). When forms, shapes and object are brightly illuminated, the elements are brought into focus excluding the user from the space (Pallasmaa, 2005:46-49 in Docrat, 2012:54).

~~"~~The shadow gives shape and life to the object in light. It also provides the realm from which fantasies and dreams arise. The art of chiaroscuro is a skill of the master architect" (Pallasmaa, 2005:47). His critique of modernism lies in the quantitative manner in which light is defined and the diminishing significance of the window as mediation between the man-made and natural environment (Pallasmaa, 2005:47). Pallasmaa explains that the modernist free façade with its brazen use of glazing affords the user little room for retreat or privacy (2005:49).

Architects have often used dynamic natural daylight to create specific atmospheres (Phillips, 2004), with dimly lit spaces often used to exude a mystical character (Docrat, 2012:55). Pallasmaa (2005:47-48) refers to the council chamber of Alvar Aalto's Saynatsalo Town Hall (Figure 2.16) having a *~~"~~mystical and mythological sense of community"* through its application of lower and uneven distributed natural light. He suggests that the darkness of the space imbues a sense of solidarity and strengthens the power of the spoken word within the chamber (2005:47-48). The Pantheon (Fig 2.17) features its main hall with a single light source, the oculus that captures the zenith sunbeams to heat and illuminate the rotunda (Boubekri, 2008:23-24). Natural light sweeps across the hall, bringing variation to the patterns of light and colour (Docrat, 2012:55). Mohamed Boubekri (2008) identifies that the design of the Pantheon epitomizes the Roman's awareness of the importance of natural light in their architecture.

The plastic bottle is fitted to a roof tile and kept in place with polyester resin that serves as a waterproofing. With the bleach preventing the water from turning colour, each bottle is roughly equivalent to a conventional 55 watt light-bulb. As it relies on the sun it can only be used in daylight hours and in areas with adequate sunlight conditions. The innovation has spread throughout the world, with the lamps being able to provide adequate illumination for growing of food on small hydroponic farms (Zobel, 2013).

While sunlight has the capacity for many positive benefits it in important to consider the context within which it exists. In some instances sunlight may cause glare and distract users from certain tasks. There are methods to avoid discomfort glare such as: light shelves for reflected light, reflective walls, skylights, roof monitors and atriums for deep rooms and reflective blinds or shading (Sanders, 2012:47).

2.3.4 Bioclimatic Design, Thermal Comfort and Natural Ventilation

"*Bioclimatic architecture offers an exciting opportunity to achieve environmental, social, and economic benefits. Much remains to be understood about energy, environmental, and life-cycle processes…Passive bioclimatic architecture combines the interests of sustainability, environmental consciousness, green, natural, and organic approaches to evolve a design solution from these requirements and from the characteristics of the site, its neighborhood context, and the local microclimate and topography*" (Almusaed, 2012:219).

Baker (2006:4-7) identifies that the modern indoor lifestyle consumes large amounts of energy through the need to engineer the built environments against the same forces that shaped and moulded man. The primary goal of bioclimatic design is to minimise energy use and concerns itself with climate as the major contextual generator (Almusaed, 2012:219).

The following table illustrates climatic guidelines, as examples, for the application of bioclimatic design in various climatic regions (Van Wyk cited in Sanders, 2012:44):

	Cool regions	**Temperate regions**	**Hot humid regions**	**Hot arid regions**
Adaptations	Maximise warming effects of solar radiation, reduce impact of winter wind, avoid local climatic cold pockets	Maximise warming effect of sun in winter, maximize shade in summer, reduce impact of winter wind but allow air circulation in summer	Maximise shade, maximize wind	Maximise shade late morning and all afternoon, maximize humidity, maximize air movement in summer
Position on slope	Low for wind shelter	Middle-upper floor solar radiation exposure	High for wind	Low for cool air flow
Orientation on slope	North to Northeast	North to northeast	North	East to northeast for afternoon shade
Relation to water	Near large body of water	Close to water but avoid coastal fog	Near any water	On lee side of water
Clustering	Around sun pockets	Around a common sunny terrace	Open to wind	Along east-west axis, for shade and
Building orientation	Northeast	North to northeast	North towards prevailing wind	North
Tree forms	Deciduous trees near buildings,	Deciduous trees nearby on west, no	High canopy trees, deciduous trees near	Trees overhanging roof if possible
Road orientation	Perpendicular to winter wind	Perpendicular to winter wind	Broad channel, east-west axis	Narrow, east-west axis
Materials colouration	Medium to dark	Medium	Light, especially for roof	Light on exposed surfaces, dark to

Table 3: Table showing recommendations for design for buildings located in various climatic regions in the southern hemisphere (Sanders, 2012:45)

Health and Safety Exclusive guidance sited British Standard BS EN ISO 7730, defines thermal comfort as ~~"~~*a state of physical ease and the condition of mind which expresses satisfaction with the thermal environment*" (www.hse.gov.uk). The primary function of architecture is to provide adequate thermal comfort in order to regulate the heat balance within the human body (Docrat, 2012:50). Thermal discomfort is a result of heat loss or gain within a space.

The original work of Lisa Heschong entitled *"Thermal Delight*" denounces thermal uniformity and has led to the professional consensus that *"thermal variation is tolerated, and in many cases enjoyed*." (cited in Baker, 2006:5-6). Baker (2006), Day (2002) and Heerwagen (c2006) cite the need for *"adaptive opportunity"* which refers to a range of actions available to a subject that will allow the mitigation of the non-neutral thermal sensation (Baker, 2006:5-6). This can be achieved through the *real and perceived freedom* of users to make adjustments to the local environment (open windows, deploy shades, etc.) or to one's personal self (remove clothing, move to a cooler part of the building, etc.) (Baker, 2006:5). The design of buildings should be moulded to adapt to the local climatic conditions for the purposes of thermal comfort as it makes both design and energy saving sense to suit the architectural response to the natural environment (Day 2004:43-46 in Docrat 2012:51).

Christopher Day (2004:43) explains that very few environments are consistently comfortable for human habitation and thus heating and cooling of buildings must be done sustainably to ensure prolonged human survival. The sun provides the basis as *"Our world is solar powered. All life depends on the sun. It powers the water cycle and, together with the earth's rotation, drives the wind.*" (Day, 2004:43). Warm air rises therefore it can be seen that the sun is able to induce air movement (Day, 2004:51). Day (2002:51) states that air conditioned buildings usually recirculate pathogen rich air that is usually dry and devoid of ions. By contrast, natural air carries the scents and sounds of the season, time of day, and the activities going on (Day 2002:51).

Vernacular, regional buildings have historically evolved responding to the cultural and climatic considerations of place, and adapted to perfect the mechanisms that facilitate optimum human habitation (Fathy, 1986:19)(Day, 2004:40). *"Most traditional cities and building practices evolved out of necessity and not a supply-driven ideology. Their sense of sustainability emerged from having found resonance with nature, its pace and cyclical progression. This way nature is never so transformed to the point to treat it as a residual quality and more as a body whose presence already has a system of built-in efficiency…"* (Kazimee, B.A., 2010 in Hernandez, S. & Brebbia, C. & De Wilde, W.P., 2010:141).

One such example of vernacular architecture that responds with a deeper understanding of its climate is the traditional house of Middle Eastern Iran. (Khashei, 2010). The passive design systems employed filter nature's energy flows to enhance the conditions for human


Figure 2.21 (left): Direct experience of water through formal feature (www.freephotosbank.com)
Figure 2.22 (right): Direct experience of natural body of water at the Sydney Opera House (www.wikipedia.net)

Kellert (2005:138) identifies that water, when incorporated in building interiors and landscape, become more meaningful when well connected to other natural features (e.g. soils, geological forms, plants and animal life). Within the some *restorative environmental designs*, the experience of water has also been successfully connected to several building functions, such as irrigation, plumbing, wastewater treatment, storm water protection, and insulation (Kellert, 2005:140).

Charles Moore, in his classic study of water and architecture wrote of man‘s estrangement from nature and of how modern architecture often distorts the expression of water reflecting the growing detachment of man and nature. He suggests:
―Water is a natural material, and . . . although controlled by gravity and natural laws, it can be coaxed, shaped, and transformed. We can try to achieve harmony with nature, we can try to ignore it, or we can try to master it—or we can find ourselves, at the end of the twentieth century, in a confused, ecological attempt to do all three at once. As we in our century have steadily removed ourselves from the ideals of nature . . . we have risked losing intimate contact with water. . . .Water, in all its variations, interpretations, and presentations, shares a simple, common origin. It has inherent, immutable properties that time cannot alter” (Moore cited in Kellert, 2005:140).

Falling Water (Kaufmann House), one of Frank Lloyd Wright‘s most accomplished creations, sits dramatically astride a stream almost on top of a waterfall (Kellert, 2005:130). Wright evolved the house around the fireplace, the hearth of the home which he considered to be the

elements in relationship to each other, allowing the mediation of natural conditions. *"Architecture is always faced with the challenge of developing a whole out of innumerable details, out of various functions and form, materials and dimensions...the details establish the formal rhythm, the building's finely fractional scale*". (Zumthor, 1999:13-14)

"Materials create an ambience and provide texture or substance to architecture" (Farrelly, 2009:6). Pallasmaa (2005:31-32) suggests the *'flatness'* of modern construction has been strengthened by a weakened sense of materiality. Natural materials such as stone, brick and wood express their age and history, *"and enable us to become convinced of the veracity of matter*" (Pallasmaa, 2005:31). The wearing of materials allows architecture to be rooted to the inevitable sense of time and tells of the origin and history of human use. Modern machine-made materials tend to disguise the essence and age of the material, usually a deliberate aim at attaining *"ageless perfection*" (Pallasmaa, 2005:32). Commentators like Paul Virilio have expressed how the current world of instant replays and greater multimedia access has affected our conceptualising of time and space:

"What…becomes critical is not so much the three dimensions of space, but the fourth dimension of time – more precisely, the dimension of the present…[T]he new technologies are killing 'present' time by isolating it from its here and now, in favour of a commutative elsewhere, but the elsewhere of a 'discreet telepresence' that remains a complete mystery" (Virilio, 1997: 10–11 cited in Hagan, 2001:77).

Traditional architecture evolved the use of materials slowly over time, with subtle innovations that responded the needs and limits of the people and environment (Stevenson, 2006:258). Stevenson (2006:258) states that, *"Contemporary design is synonymous with relatively limitless innovation, often for its own sake, largely because capitalist economies need to both meet and create needs*". Baker identifies that *"vernacular buildings rarely show "references" to nature in form or element, since, like the primitive shelter, they by necessity incorporate nature"*. Construction methods and materials can be expressed in such a way that they immediately reveal the architectural idea behind a building. Baker (2006:10) further explains that natural elements such as thatch, wattle, daub, tiles and bricks are all from the locality and would be materials that the occupant understood *"trees are felled, reeds are cut, bricks are burnt. There was no need to fashion something to look like nature, it already was nature*." By contrast, in a modern downtown building, most people would be unable to

identify the materials, both inside and out, and would not know where from or how they had been produced (Baker, 2006:10). Christopher Day (2004:75) emphasises that materials which do not honestly convey the nature of the material are not ideal for the soul of man and provide an inadequate sensory experience. Baker (2006:10) describes the various ways in which modern architecture tricks the senses with *"slates produced from epoxy resin, autoclaved calcium silicate bricks, moulded doors, imitating wood grain, the rooms lined with laminate floor, synthetic carpet, reconstituted stone worktops and sink etc., etc.*"

Within the framework of environmental design there is a greater demand for a *'truth to materials'* and a contemporary understanding of a new *truth about materials* (Hagan, 2001:77). Norberg-Schulz (1988:16) writes of the need for a *"rediscovery of the world as a totality of interacting, concrete qualities*" through a phenomenological sense of *'environmental awareness'*. The concepts of *embodied energy* and *life-cycle analysis* have given material production a new dimension of social, environmental and ethical concerns (Hagan, 2001:77). On either side of the environmental design agenda, lay two divergent approaches, *'low-tech'* and *'eco-tech'* (Hagan, 2001:89-90). The *low-tech* visions seek to reduce damage to the environment to a minimum through the championing of natural local materials and social capital (Hagan, 2001:89). Hagan describes that within projects, *"At their 'grænest', the use of these materials is integrated with recycling schemes, organic cultivation of food, and the use of entirely passive heating and cooling techniques…all at a density low enough to allow each household to be autonomous in terms of energy generation and waste disposal*".

The *eco-tech* alternatives require more energy to produce the advanced technologies (greater *capital energy costs*), however have the ability to 'pay back' across its life (Hagan, 2001:89). Baker (2006:12) suggests that man's increasing cultural detachment from nature can become further enhanced through the application of *"ever more technological approach – controls with automation and IT feedback, simulation, virtual reality*" giving life to highly artificial, replicated forms of nature.

The work of Aalto and Renzo Piano can be seen to adopt a wide pallet of 'natural' and synthetic materials, that attempt to negotiate between culture and the natural environment, grounding the architecture in nature it cannot escape (Hagan, 2001:92). The Tijbaou Cultural

Centre for the native Kanak population of New Caledonia (Fig. 2.30) exhibits the synthesis of such integration.

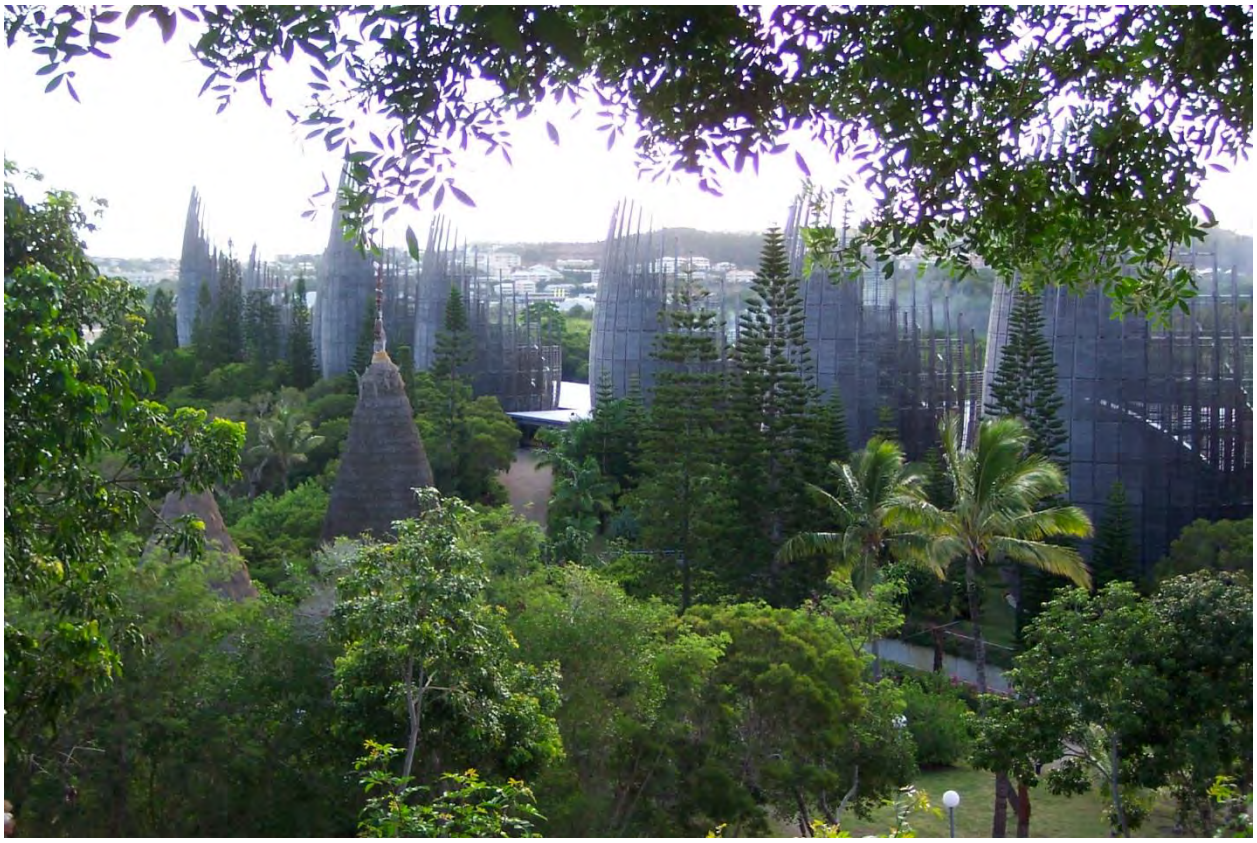

Figure 2.30: View of the complex of hut pavilions. (www.worldalldetails.com)

The wooden _cases‘ (Fig. 2.32) were conceived for cultural reasons, an abstraction of the Kanak‘s huts‘ conical roof forms (Fig. 2.31), one of the only forms available for a community of people who were not builders (Hagan, 2001:159). The _cases‘ face south-south-east and are made of laminated iroko wood elements up to twenty-eight metres high, supporting horizontal curved slats that allow free air circulation between themselves and a louvered internal skin (Hagan, 2001:160). The louvres (Fig. 2.32) are computer-operated, designed to open automatically to their full extent when there is a gentle breeze, and begin to close if wind speed increases. If the wind shifts direction, ventilation is through the much lower front of the building, evacuating through the top of the double skin (Hagan, 2001:160).

encountered in nature to the rigid, straight-line, abstract, and contrived geometries of artificially fabricated and designed forms and materials. *–Many of the world's most revered buildings contain biomimetic features. . . . They draw on design principles of natural forms. They have intricate fractal patterns in their spatial layouts and surface materials. They contain small, random variations in key elements rather than making exact replicates of forms, visual patterns, and spaces*." (Heerwagen cited in Kellert, 2005:163)

A detailed examination of grand central station (Fig 2.33) reveals extensive natural materials of stone and marble, organic shapes carved into the ornate metal-work, sunlight flooding through large rectangular windows, and other metaphorical interpretations of nature. (Kellert, 2005)

Figure 2.34: Use of metaphorical interpretations of nature in the Grand Central Station. (Kellert, 2005:163)

Symbolically incorporating the shapes and forms of nature into the design of the built environment has also been called –biomorphic" architecture." (Kellert, 2005:163). Biomorphic design has been linked to man's inherent affinity for natural forms that can enhance human physical and mental well-being (Kellert, 2005:163).

Baker (2006:10) suggests that due to man's distancing from „real' nature, contemporary architects and designers have become fascinated by mimicry. „*Unlike the classical column this mimicry becomes symbolic by form only, not by function*" (Baker, 2006:10). An example of such form symbolic architecture can be seen in the design of The Milwuakee Art Museum (Fig 2.34) by Santiago Calatrava. Moveable steel louvres are inspired by the wings of a bird (Fig 2.36), a cabled pedestrian bridge with a soaring mast inspired by the form of a sailboat and a curving single-storey galleria reminiscent of a wave (NSW Architects Registration Board Publication, c2011:20-22). Calatrava has drawn on Eero Saarinen's TWA Terminal (Fig. 2.35) for inspiration for the flowing contours that suggest a bird in flight (NSW, c2011:21).

Figure 2.35(left): Santiago Calatrava's Milwuakee Art Museum with moveable louvres. (www.inhabitat.com)


Figure 2.36 (left): Eero Saarinen's TWA Terminal, inspired by the wings of a bird in flight. (www.greatbuildings.com)
Figure 2.37 (right): A sketch by Calatrava inspired by a bird in flight and translated into architectural form. (www.archdaily.net)

2.3.9 Conclusion

The above review of literature highlights the inseparability of nature from the creation of _plæce'. The essence and character of place is rooted to time and space and revealed to man through the cycles of the natural world. Man can be seen to have gained an understanding within a multi-sensory environment through careful interaction with the natural elements. Culture is so deeply rooted in nature that the word itself originates from the latin _*cultivare*' which means, to bestow labour, or to train or grow; crops or oneself (Hagan, 2002).

Nature has been revealed to serve as a life replenishing force that is able to provide relief from mental and physical fatigue. Nature's concrete, material manifestations, when tempered by thoughtful appropriate boundaries, have the ability to create integral connections with nature for the benefit and well-being of man.

3 CHAPTER THREE | PRECEDENT STUDIES

3.1 Introduction

This chapter explores the key precedent study and a further secondary precedent study. The studies which illustrate theories and concepts discussed in the literature review. The key precedent study to be explored is the California Academy of Sciences, designed by Renzo Piano. The secondary precedent is the Visitors‘ Interpretive Centre for Prehistoric Art (also known as the Northwest Rock Art Visitors‘ Centre, National Monuments Council of Namibia designed by Nina Maritz & Dennis McDonald).

aluminium curtain-walling (99% Recycled content) concrete (15% Fly Ash And 35% Slag Recycled Content) and 50% FSC Certified Wood (Green, 2011).

Sense of Place

The California Academy of Sciences exhibits a complex but critical understanding of the local climate, topography, cultural meanings and building in forging a sense of place within the precinct, identifying with the four thematic levels illustrated by Norberg-Schulz‘s (1980: 25-32) description of genius loci.

The elevated swath of grass pays particular respect to the ecological and experiential qualities of the Golden Gate Park, creating meaningful connections with the sky and exterior landscaped areas. The formal composition and Neo-classical elements show a respect for the traditional, conservative undercurrents within the Academic institution and the reliable impression it holds over the users of the facility. The building design makes optimum use of the climatic conditions through its high-tech systems integration, creating a hybrid mechanical-natural ventilated environment.

The formal concept of the design was based on the three stages of trance, a physically enduring journey into supernatural undertaken by a healer or ‗shaman' embark: the first stage, retinal images called ‗phosphenes' ‗or entopics' appear to the shaman, who starts perspiring and shivering, the second stage is the ‗little death', a resemblance of the physical symptoms displayed by a wounded animal before dying (shivering, arched back, nosebleeds); and the third stage, that of full trance, the shaman leaves his or her body to merge with the visualised animal to enchant nature (Maritz, 2007:69).

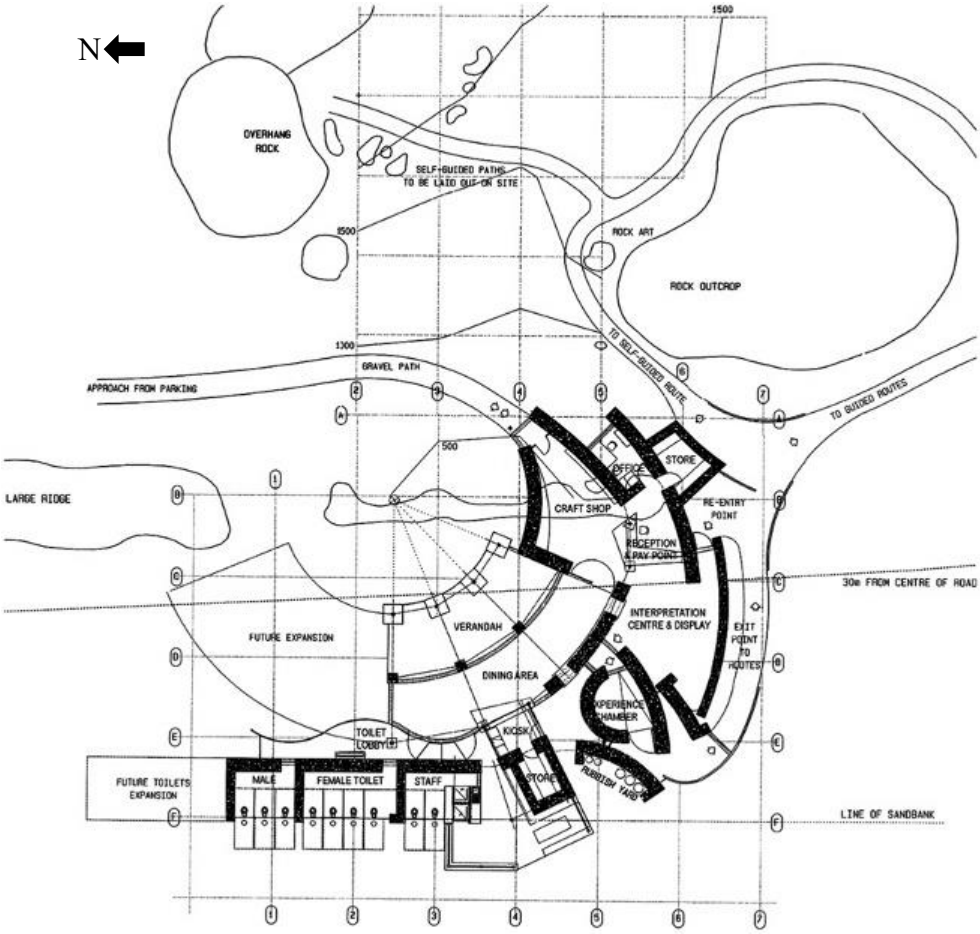

Figure 3.21: Plan of Visitors' Interpretive Centre. (Heath, 2011:136)

Visitors approach along a gravel path with loose stones (Fig. 3.20), entering through a narrow slit, much like a throat and proceeding through the interior as though they were the intestines of the creature (Fig. 3.21).

Sense of Place

The Interpretative Centre for Prehistoric Art evokes a strong character of place through its careful and considered approach to the local climate, topography, cultural meanings and building.

Through a thorough understanding of the climatic conditions and prerequisites for the proposal, a sensitive approach to the water stricken area was adopted. A survey of the community skills and the local availability of building materials resulted in the integrated sustainability of the project.

The building can be seen to be in conversation with the landscape as the natural topography defined its position while the solar climatic conditions aided in deciding the appropriate orientation.

The exhibition shows a deep and thoughtful understanding to the cultural meanings behind the ancient art, exposing the belief through its concept and execution. The use of local materials resonates with the informal nature of the local building practices.

4 CHAPTER FOUR – CASE STUDIES

4.1 Introduction

The case studies explore issues of space and ‗place' creation through site observations of selected architectural sites. Information obtained is documented through means of photographs, architectural drawings, general architectural observations, and, where possible, interviews.

The proposed case studies are: Intuthukho Junction, Cator Manor Durban and The Durban City Hall with particular focus on the Durban Natural Sciences Museum housed within.
The case studies were analysed according to the following criteria:

Background and Justification of Study
Historical and Social Context
Evaluations and Analysis of-
-Biophilic Elements (natural light, natural ventilation, vegetation, landscape, water)
-Materiality
-Sense of Place

Research interviews were conducted with persons related to each of the aforementioned case studies including: Derek van Heerden, East Coast Architects; Nasreen Arabi of City Architects and Allison Ruiters of the Durban Natural Science Museum.

Occupants and visitors of the case studies were interviewed to investigate the influence of nature on the architectural design of the environments and its influence on the well-being and satisfaction of the persons interviewed.

4.2 KEY CASE STUDY: INTUTHUKO JUNCTION

Architects	: East Coast Architects
Location	: Cato Manor, Durban, Kwazulu Natal, South Africa
Client	: Cato Manor Development Agency
Completion Date	: April 2006

Figure 4.01: Site Location Map (Source by Author, 2014).

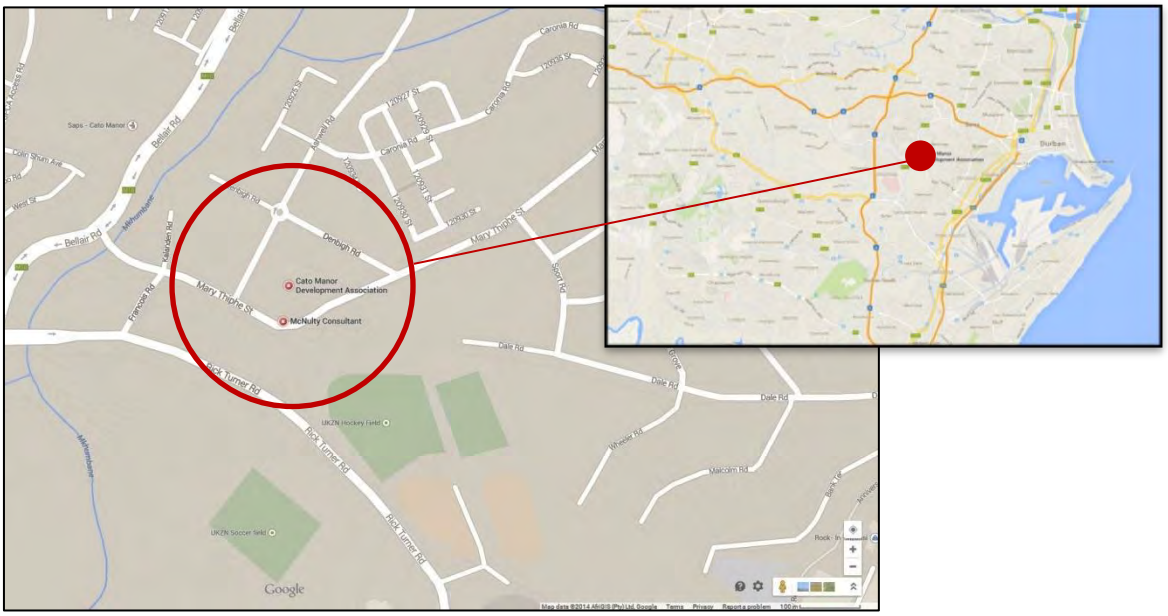

Figure 4.02: Site Location Map (Googlemaps.com).

4.2.1 Introduction

Intuthukho Junction was a project that resulted from a design competition called for by the Cato Manor Development Association in 1999, won by a local architectural practice, East Coast Architects. The complex accommodates an ‗Administrative Support Centre' for the CMDA and office space for other non-government organisations (KZ-NIA, 2002).

4.2.2 Justification of Case Study

Lipman (2002) titles his evaluation of Intuthukho Junction ‗*Focuses on local authenticity, not machismo*'. The headline aptly describes the vibrant architectural character of a building that exhibits sensitivity in the way in which it relates to the environment and its inhabitants. The Durban based practice of East Coast Architects is built on a deep commitment to responsible, sustainable architecture that responds creatively to the social needs of a community. Intuthukho Junction, one of the practices first major works, breaks from the traditional urban framework that defines its typology, and exists between the dimensions of formal and informal while attempting to sensitively filter nature's elements through a multitude of passive design techniques and concerned material choices. This belief in stewardship of nature comes from an environmental character that the designer's adhere to, within a belief that man's social and environmental ills stem from the unbridled sense of consumer culture experienced by contemporary culture.

4.2.3 Location

The Intuthukho Junction building is located in Cato Manor, Durban (Fig. 4.02), on the corner of Mary Thilphe Street and New High Street. The site sits within the outer limits of the Umbilo, Brickfield and Sherwood area and contains approximately 93 000 people (cmda.org.za).

4.2.4 Historical and Social Context of Case Study

The Cato Manor area is one that was greatly affected under the apartheid policy of forced removals. The land was granted to the first mayor of Durban, George Cato as compensation for his beach front property taken over by the military. In the early 1900's the land became divided into small farming lots that were sold or hired out to gardeners of the Indian Market. Informal dwellers began to move into the fringe areas of the farming lots, settling along the banks of the Umkhubane River. Due to laws prohibiting Africans from land ownership, they were considered temporary residents.

Cato manor then became designated as a temporary transit camp owing to the municipality‘s plans of relocating Africans to the Kwa-Mashu area. These attempts were met by heavy resistance from residents and later increased tension and violence. After the escalation of violence, the area was left vacant with some houses, shops and Hindu temples scattered about.

The early 90‘s saw a rapid wave of informal settlements in the area owing to mass urbanisation. The Cato Manor Development Association (CMDA) was formed in 1993 and tasked with the organisation and development of low-cost housing, schools, libraries, community halls, roads, clinics and other necessary infrastructure.

4.2.5 Evaluations and Analysis

Concept and Layout

The original proposal by the architectural team envisioned created a central defensible open community space (Fig. 4.04), however this space would later become a parking lot (Fig. 4.05), a testament to the extent which mans‘ technologies dictate the use and form of space despite the best intentions of a designer.

The complex consists of eight separate but linked structures which the architects refer to as ‗pods‘. These pods relate in an un-orthogonal manner to each other, a reference to the informal alignment of the local and traditional settlement patterns (Lipman, 2002). Each consists of a reinforced concrete frame, considered by the architects to be a ‗necessary Eurocentric evil‘ in the constructional aspect of the design (van Heerden, 2014). The structural frame is enclosed by panels of reinforced cement block-work that are plastered and painted to resonate with the colours of the surrounding landscape and according to the architects, represent the diverse ethnicity of the local inhabitants.

that despite the best attempts and best intents of the architect, the reception of the building‘s expression cannot be controlled. The centre proved popular during the early years of its life but due to fewer members of public participation the public component has been reduced to solely the Cato Manor Heritage Centre. Access is also limited to a single entry point forcing the centre to become internalised and segregated from the public. This can be seen as response to the surround which lack particular development as the centre is located on the fringes of two under-developed regions. There is a sense that in time, the centre could become more connected to its surrounding landscape as development of the surrounding region expands.

inception it was hailed as being too large and unnecessary but the city has ultimately grown into and outgrown the hall that houses the City Library, Durban Art Gallery and the Natural Sciences Museum.

4.3.3 Location

The City Hall is located in the Durban City Centre, Kwazulu-Natal, South Africa. The structure covers a large rectangular city block, bound by Anton Lembede Street, Doctor Pixley Kaseme Street and Church Street (Fig. 4.--). The central hall with main port cochere entrance faces Church Street and the formally structured Town Gardens (Francis Farewell Square). The Doctor Pixley Kaseme Street façade relates itself to the Meadwood Gardens and the Public Works Department offices. The City Hall precinct is a historically and culturally rich area in Durban that also serves as a ‗green lung' to the densely built urban environment.

Figure 4.20: Map showing City Hall within greater context of 'green lung' (Source by Author, 2014).

4.3.4 Historical and Social Context

Durban, South Africa‘s second largest city is among one of the most ethnically diverse cities in the country and founded its early success on the favourable position of its port. Its proximity to the inland, along with the discovery of gold in the Transvaal secured its position as the favoured access port for the transport of goods to the hinterland (Nair, 2010).

Figure 4.21: Doctor Pixley Kaseme Street (West Street), circa 1902 with old town hall tower visible and current city hall site undeveloped existing as a park (molegenealogy.blogspot.com)

The town was demarcated by George Cato between 1838 and 1842 with three main streets, namely Monty Naicker Road (Pine Street), Doctor Pixley Kaseme Street (West Street) and Anton Lembede Street (Smith Street). The Francis Farewell Square is located on the site of the original market square, and is the location where Francis Farewell first established a trading post in the city (Nair, 2010).

The site for the City Hall that was to replace the original Town Hall was identified in 1902. A competition was held with architects from Britain and South Africa called to submit proposals for the new building. The winning design was declared in 1904 to be from a Johannesburg architectural practice, Scott, Woolocott & Hudson.

Construction began soon thereafter but was delayed in 1905 as Durban experienced a turn in prosperity and debate arose around whether the building should see its completion. Mayor J Ellis Brown convinced the detractors that construction should proceed in order to become _…one of the most complete and architecturally one of the finest buildings in South Africa' (Rappoport, 2001:5). Construction was further interrupted due to a _native' rebellion in the Greytown district, affecting the availability of labour at the quarry that supplied the limestone. As part of the compromise to proceed with construction, the hall was to be constructed partly out of Natal stone and partly out of cement plaster (Rappoport, 2001:5).

Despite the debate and interruptions the new Durban City Hall forged ahead and was completed in early 1910. The massive imposing structure serves as a symbol of status for the city and its people with the social context of the area changing as the governments its constituencies have evolved. During apartheid legislation, indigenous people were unable to walk past or utilise the amenities provided, however in contemporary times the City Hall and its surrounding green spaces have become common meeting areas for all citizens to indulge in (Dlamini, n.d.).

4.3.5 Evaluations and Analysis

Concept and Layout

The building was conceived to serve as the new administrative seat to the growing town of Durban that would later receive the title of city. At the time of its creation the building was heavily criticised for its size and expense but would later form part of the rich cultural heritage of Durban and reach its maximum capacity, driving the need for new proposed development to house the Durban Central Library and Natural Sciences Museum.

The sandstone façade may be described as cladding as the architectural drawings show the brick masonry walls perform the load bearing function. It should be noted that the sandstone cladding is self-supporting and is only laterally affixed to the brickwork.

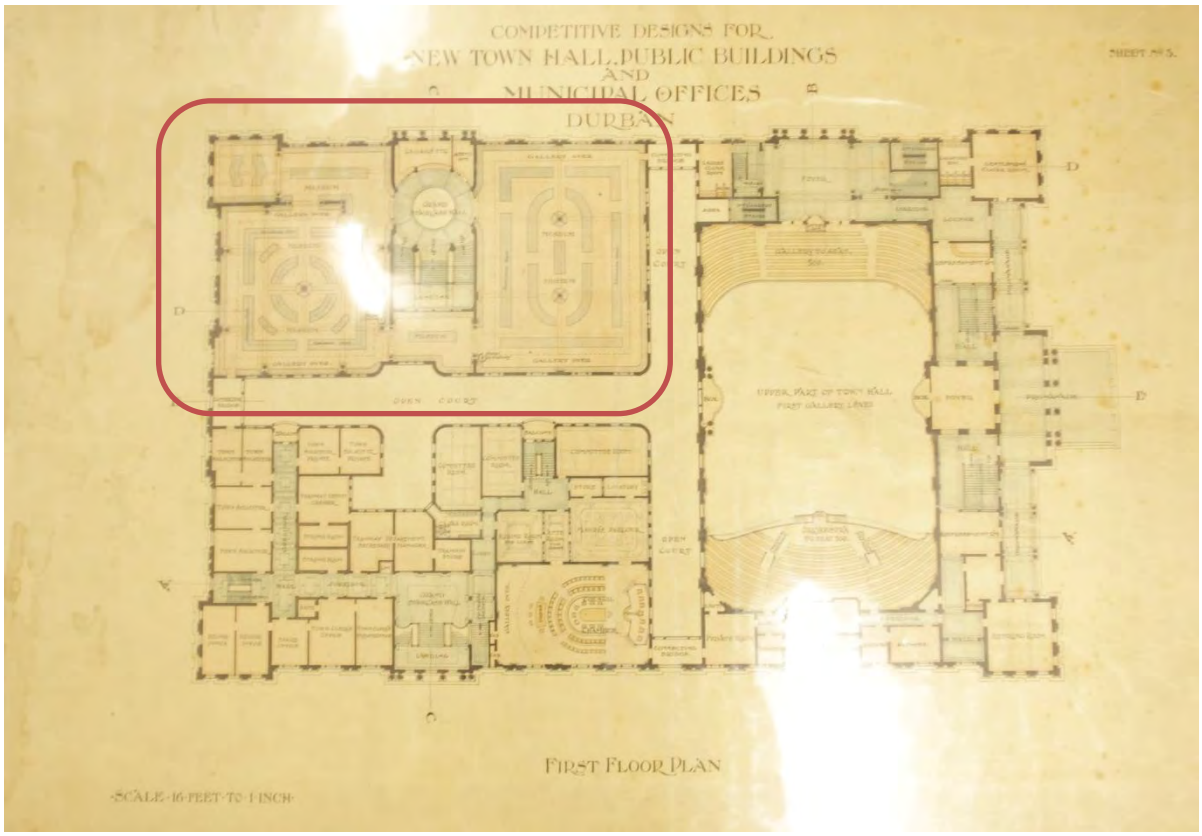

Figure 4.23: Original Competitive Design Plans for City Hall by Stanley Hudson. Red outline denotes the Natural Science Museum Component (Source by Author via UKZN Architecture Archive, 2014).

Biophilic Design Elements

The City Hall is located within an urban corridor of gardens and public green spaces that function at the level of *Community* and *Region* within the list identified by Girling in the literature review (Table 1). Its imposing structure articulates its expression through its monumental permanence that forms a firm barrier to the external forces and symbolises its strength, administrative power and dominance over nature. This phenomenon, recognised by Day (2004) identifies that civic buildings such as the City Hall, in commitment to scale and a single idea can often produce architecture that dominates the surrounding through its concerns with proportion, geometry and classically differentiated elements representing universal principles of relation to the earth.

views to the exterior. White walls assisted in reflecting natural light while the hardwood floors added warmth and tactility to the space.

Sense of Place

The City Hall displays a dominant, singular ideal to the way in which it relates itself to the conditions of local climate, topography, cultural meanings and building in forging a sense of place within the Durban City area.

The grand scale and heavy stone exterior serves as a distinct, impressionable boundary to the exterior, permitting few, inflexible connections to the exterior environment. The formal composition of the City Hall resonates through the formally structured outdoor landscaped areas of the nearby parks and is shown to provide a sense of comfort, security and harmony to the environment. The building shows little conversation with the landscape, firmly rooting itself to the flat topography.

Despite the historical symbolism of the City Hall, the transformation of the existing power structures within the seat of administration and the change of the public toward the symbolism of the building implies that cultural meanings are not static and, given the correct circumstance, can and do change. The recent upgrades to the building systems also prove that a building can adapt in its life changing its consumption patterns to achieve a greater biophilic connection.

5 ANALYSIS AND DISCUSSION

5.1 Introduction

In addition to the case studies conducted, interviews with key professionals related to the case study environment were undertaken. Research interviews were conducted with persons related to each of the aforementioned case studies including: Derek van Heerden, East Coast Architects; Nasreen Arabi of City Architects and Allison Ruiters of the Durban Natural Science Museum. Semi-structured interviews with occupants and visitors of the case study environments were conducted to gauge the influence of nature on the architectural design of the built environment and its influence on the well-being and satisfaction of the persons interviewed. The following chapter shall analyse the results of the findings and sets out to respond to the questions posed in the introductory chapter.

5.2 Investigative Approach

A qualitative method is adopted for the collection and analysis of the data within the research to understand the intangible character that nature may present within the built environment and architecture.

5.3 Summary of Analysis, Discussion and findings

5.3.1 Analysis of Interviews

Intuthuko Junction

Derek van Heerden, the architect responsible for Intuthukho Junction was a key respondent selected for his humanist approach to architecture. Van Heerden, an architect that practices primarily on the east coast of South Africa prescribes to a _bottom-up‘ approach to the conception of architecture with the belief that designs evolve and should never be imposed; they are products that should be strongly influenced by human, rather than glamour factors. Van Heerden believes all too often architecture focuses on the product and glossy images, _*Architectural pornography‘* negating the process and usually the community that exists with it. His belief is that architecture is a sustained relationship between architect, client and building through various stages of the lives of each.

Community workshops play a vital role in assessing the needs of the broader community prior to importing labour. Where possible, local materials are sourced to benefit the local economy, reduce the cost and carbon footprint. Working with the community enables the community to participate, become empowered and take ownership of the architecture, often

seeing a reduction in building vandalism. Van Heerden identifies that usually there is a strong link between environmental consciousness and community empowerment, with the idea that *if you're saving energy, you're saving a community's small resources…a building that is healthy for people should be healthy for the earth.*"

In light of rampant materialism and consumer culture van Heerden believes they are ultimately interrelated within the context of the greater social malaise. Van Heerden believes that local architecture has the greatest potential in making a difference in the lives of people and that if buildings can be more sustainable in the long term then funds be spent on the upliftment of people rather than maintenance and services.

In the response to questions posed on the influence of nature on the design of Intuthukho Junction, van Heerden replied that the primary driver was the need to gain adequate natural light and ventilation to each of the pods to facilitate healthy working environments. The variegated layout assisted in achieving adequate climatic conditions while relating to the informality of the nearby settlements. The many references to traditional building materials were a key concept in the conception of the architecture. Van Heerden notes that traditional cultures have a greater affinity to nature and is expressed in their architectural form making and materiality. While some architectural elements of the design refer to the informality of the Cato Manor settlements they can be equally seen to refer to indigenous building materials which exhibit a close link to the true nature of the material.

Van Heerden believes that technology is not the solution to man's ecological crisis but rather a means. He firmly subscribes to the notion that attitude and reduction in consumption is the key to a stable and healthy planetary future. He also views the continued relationship between client and architect key to the success of a project, something that is not the case with Intuthukho Junction, evident in the lack of general upkeep.

City Hall

Allison Ruiters and Nasreen Arabi were selected for their links to the Durban Natural Science Museum and City Hall respectively. Allison Ruiters, the director of the Natural Sciences Museum played in vital role in understanding the function and operation behind the museum which was the particular focus of the City Hall case study.

Ruiters believes that nature, both past and present form an integral part in understanding and respecting the natural world. Within this philosophy the museum educates the public through a series of exhibitions of recreated animals within a recreated natural setting.

An important consideration is the historical and legal protective status that the City Hall commands; with the result that very few internal alterations are permitted thus the Natural Science Museum is restricted when it comes to changing the layout of the exhibition spaces. Despite the restrictions the museum lauds a historical position within the landmark structure of the city hall. According to Ruiters, the centennial celebrations of the City Hall saw a revamp to the failing building exterior with the addition of water storing facilities to reduce maintenance water consumption. Ruiters claims the revamp has also seen an increase in visitor attendance and positive response.

Nasreen Arabi of City Architects believes that a major paradigm shift is required for the longevity of the world and the planet. At a minimum she believes there should be an understanding of the measures that will need to be present to deal with the current settlement patterns. Arabi believes that the need for „re-lifeing‘ and „re-vitalisation‘ of existing architectural environments is key to the success of the longevity and a movement away from the throw-away society that is evolving. As a key member of Durban City Architects, their aim is to develop buildings, landscapes and precincts where society is able to be „*productive, comfortable, happy and safe*‘.

Arabi states that, „*I firmly believe that simplicity and efficiency are the primary drivers of good architecture, and these should be present, not only in form and aesthetics, but also in function, construction and in the way a building consumes energy and resources*”. Within this framework the notion of passive, energy saving architecture is crucial to the development of healthy, comfortable human environments.

Arabi believes that City Architecture and architects‘ roles are to go beyond the expected and provide broader and more insightful responses than expected from their beneficiaries, working with people and nature to create architectural interventions that provide long term solutions and respond to the demand of all the city‘s residents. Initiatives that make best use of opportunities, aim for sustainability and promote positive change are supported, and

–As city architects our interventions must renew the human spirit with beauty, form and function, and delight. Architectural intervention can change lives and it requires being streetwise, knowledgeable and sometimes taking risks." (Arabi 2014)

In light of the City Hall, Arabi states that City Architects is committed to transforming the view of public spaces ensuring that historically significant buildings are protected, responsibly cared for and even improved within the right circumstance with the ultimate goal of achieving positive benefit.

5.3.2 Key Questionnaire Responses

Questionnaire surveys conducted with occupants and visitors of the case study visits revealed mixed results but provided some conclusive data in establishing nature‘s influence in architectural space and place creation.

Intuthukho Junction

Respondents at the Intuthukho Junction case study featured both tenants of the building and visitors to the centre. All respondents were in agreement that nature formed an important part of human life, with some commenting that it formed a key connection to cultural practices. There was a mixed response toward the outdoor spaces around the building. Some visitors enjoyed the outdoor spaces where shelter, light and abundant plantings were present. Many tenants and some visitors remarked that they appreciated the planting but only when it was adequately maintained and lively but did not favour the spaces in the immediate surrounding area. All respondents remarked that the building structure was safe and the environment was reasonably healthy with some expressing that the collapsed parking structure (Fig) did make them uneasy. Ms Tshabalala, a receptionist at the gallery confirmed that the building was a healthy environment and that the air conditioning systems need only be used during the most hot-humid periods of the year. The option of open-able windows was a preferred choice as it gave occupants the feeling

Figure 5.01: (Source by Author, 2014).

When asked if respondents believed that buildings had a relationship to nature, a majority answered yes immediately citing the building-ground relationship and the architecture functioning as a shelter from nature; only a small number were ‗unsure' and one replyed no. When asked why, the particular respondent remarked ‗*buildings are made by man and not nature*'. Upon further explanation of the cycle of materials the particular respondent changed his answer.

Respondents provided a variety of answers to the question of if and how nature should be incorporated into architecture; the identifiable pattern emerging a demand for lively plantings, light/sunshine, fresh air, with only two respondents identifying water and nature as a source of imaginative inspiration.

A small majority of respondents did believe the building was successful with an evident focus on the failing of the parking structure while general confidence in the integrity of the building. Those that believed the building was unsuccessful made mention that the style of the design or lack of visitor presence resulted in the answer.

City Hall

Respondents at the City Hall featured visitors to the Natural Science Museum and Art Gallery. All respondents believed nature is an important part of human life and responded equally well to the question of if they enjoy the outdoor spaces around the building with some expressing that the continued upkeep made it pleasant to utilise.

All but a few respondents believed that the City Hall provided a healthy environment with those exceptions citing their discomfort with some of the insect/animal exhibitions. Most respondents felt a sense of comfort and safety when in the City Hall precinct as the building's symbolic administrative power and function gave them the impression that the area was safer.

When asked if buildings have a relationship with nature most respondents cited yes with a few being unsure and none answering no. Most respondents that answered yes cited the building-ground relationship as a strong relationship between the two. Some respondents identified that buildings *shut out'* the elements of nature such as wind, water and sunlight.

Respondents identified that nature could be incorporated into buildings through potted plantings and more views to exterior planted spaces; a similar pattern emerging with a demand for sunshine, fresh air, and *water features*' and in the instance of visitors of the gallery, some mentioned incorporating animals into the building. Only a third immediately identified the symbolic decorative architectural patterns that made reference to nature. The Earth Sciences Hall with natural light and domed ceiling proved to be a popular space among respondents, with many using it as a point of reference or providing a space to seek warmth. The art gallery was also a favoured space for its wooden floors and generous lighting on white walls.

Nearly all but one respondent identified that the building was successful with many, especially older persons, expressing delight and respect for the City Hall. The individual, a young photographer, expressed that while the City Hall was a historically significant building, its Belfast inspired design has no tangible link to South African heritage and costs a vast amount to maintain from his understanding.

5.3.3 Discussions and Findings

It can be noted that nature forms an integral part in the creation of ‗place' and forms an important aspect of creating spaces with a sense of ‗life'. The literature explored revealed that man's construct of place is rooted to his knowledge gained from an understanding of the natural environment. The foundation of culture can be seen to be closely rooted in man's attempt at understanding and making sense of the natural phenomena of the environment. The sense of place manifests itself due to the conditions of the climate, conditions of light and natural topography of the locale.

The natural environments provide opportunities for mental and physical relief, with appropriate experiences of nature able to provide delight and comfort from stress. It is noted that clean, maintained, supervised, non-threatening natural environments are preferred by users.

Buildings can be seen as a series of boundaries, connections and separations from the natural environment. These boundaries provide opportunities for interactions with the natural environment thus the building envelope should be conceived to be adjustable to facilitate greater interaction and blur the boundary between inside and outside. Spaces that connect to nature by means of views, natural light, ventilation, features of water and interior landscaping enhance user satisfaction and promote positive engagement with elements of nature. These positive engagements encourage stewardship of nature and a consideration of place through linking cultural and ecological values.

Architects and architecture play a vital role in the creation of humane environments that possess a greater affinity to nature's systems and limits. Materials with a greater link to its natural state typically consume fewer resources to produce, emit fewer emissions and reduce the carbon footprint of the product. Local building technologies usually provide much needed employment and skills development through its labour intensive approach; while the materials are normally suited to work optimally within the local climatic conditions.

Designers must acknowledge that social and cultural conditions dictate the indoor modern lifestyles that the majority of the population lead, but that architecture can promote human refuge in nature through appropriate architectural connections to the natural environment.

6 CONCLUSION AND RECOMMENDATIONS

The study aimed to determine the impact of biophilia on architectural design through an investigation into the historical and contemporary relationship between man, nature and built form. A systematic literature review analysed the historical and architectural influence of nature within the creation of built form and the conceptualisation of ‗place'. This would test the hypothesis which states that the application of biophilic design elements produces integral connections with nature which promotes the spirit and well-being of man.

The problem outline found that man's technological progression has improved the quality of human life, but has slowly distanced man from the natural environment. The result has seen man assert dominance over nature with a view to quantify natural phenomenon into commodity, altering the flows and patterns of resource usage to the detriment of the Earth's longevity.

The primary question posed in the study asked how biophilic design can facilitate harmonious interaction between nature and built environment to create meaningful architecture. The research found that nature forms the basis of man's being, with connections to nature's elements such as dynamic natural light, water, greenery, ventilation (fresh air), materiality, visual and physical connectivity between the interior and exterior able to inform the sense of place and promote the spirit of man. These elements provide the life-enhancing qualities associated with diversity, variety and the ability to subtly change. The seasonal variation that comes with the changes in nature influence human behaviour and provide an escape from urban environment stress. Biophilic design in architecture, seeks to create a lively habitable building competent to satisfy the demands, constraints and respect for both people and the environment. Environments that are life-promoting and seek positive connections to nature are found to be in harmony thus other life forms and natural phenomenon flourishes. Architectural responses that form a dialectical relationship with the natural topography and respond to the natural climatic conditions can be seen to manifest a sense of place through belonging to the landscape rather than imposing on the landscape.

The secondary questions established how nature may influence architectural design and built form; and further, how nature can be incorporated within the architectural built environment. Built form can be seen as the human artefacts that exist between natural and man-made

phenomenon that both separate and connect man to nature, the source of life and nourishment; however built environments provide that which nature cannot. It is found that built form provides for the physical and psychological needs of man, and must also provide for the existential need of belonging. Contemporary architecture should infuse the life enhancing qualities of nature into the built environment, a practice not always well-considered through the pragmatic lenses of modernism and post-modernism. Engagement with nature is found to occur on three fundamental levels, namely direct, indirect and symbolic, and allow for varying intensities of connectivity to nature‘s systems.

Materiality can be considered arguably one of the most important aspects in determining the connectivity or separateness of man and the environments as the concrete quality of the material and its tectonics allow the character and quality of the environment to manifest. The articulation of the material elements is vital in creating harmony and a connection to the surrounding natural and built environments.

The aim of the research was to suggest guidelines towards architectural design that encompass the principles of biophilic design and facilitate positive impacts within the eco-sphere of natural and built environments. Biophilic design is found to be a key term in the creation of responsive design that stimulates the connections between man and the natural environment generating positive impacts. By exploring the various facets of biophilic and bioclimatic design, a series of guidelines have been formulated that are expanded upon within the recommendations. These guidelines are however contextually generic and it is crucial to note that any application of biophilic design should heed the local contextual factors.

The objective of the study further endeavoured to investigate the influence of nature within the design of man-made built environments, and to investigate biophilic design as a tool for architectural design in responding to man‘s need for shelter, comfort and expression. It can be seen that nature is interpreted within architectural design through mimicry of nature‘s systems and forms. Opportunities for interaction with nature‘s life promoting systems are generally favoured by occupants of buildings, although a perceived sense of control typically must accompany the freedom of choice. These brief interactions are found to bring mental and physical relief from the stress of the predominantly built environment the average urban dweller encounters. It is crucial to note that not all interactions with nature are inherently positive thus the forces of nature must be tempered appropriate to the context of the situation.

Nature is inherently able to soften the appearance of the solid built environments and bring about seasonal change and variation that connects man to nature‘s systems. It was found that concurrent to this notion, occupants required a sense of monumental permanence that brought the sensation of safety and comfort thus a meaningful architecture finds itself drawn between the parallels.

The objective to investigate sustainable systems that promote diversity and minimize ecological impact found that systems should intrinsically be designed into the architecture from its inception however older structures are able to alter their mechanical systems to achieve a greater harmony with energy and resource cycles. Material selection plays a large role in the ecological impact of built environment and should be thoroughly scrutinized considering its total environmental cost. Further research is required to explore man‘s cultural conceptions of the natural environments however it can be noted that greater awareness of the natural environment is required to foster care and appreciation and is crucial to the theory of ‗plæce‘. The increasing homogeneity of modern indoor lifestyle disconnects man from nature thus biophilic architecture can serve as an agonistic advocate for the preservation of diversity and acknowledge the vast interconnected relationship of life on Earth.

The research confirms the hypothesis that the application of biophilic design principles to architecture produces integral connections with nature which promotes the spirit and well-being of man. Nature is an invaluable source of resources and knowledge for man that has the capacity to positively influence human behaviour. Within the context of a vastly urban life, greater connections to nature are required to counter act the negative impacts of urban living. Biophilic design forms the basis of designing architecture that benefits both people and nature, and unites the two realms to foster a greater sense of co-existence.

6.1 Recommendations

Bioclimatic Responsive Design

- Climatic and topographical response is vital in conversing with the landscape and creating a true manifestation of ‗place‘.

- Orientation of the form should see the long façade north facing with appropriate solar control provided during summer months (this orientation is applicable to southern hemisphere – Durban).
- Diffused natural light affords the designer the prospect of chiaroscuro, the expression through a play on light and shadow on environment surfaces. Discomfort from glare can be mediated by means of light shelves, roof monitors, reflective blinds and other forms of brise solei or solar screening.
- Natural ventilation can be achieved through an understanding of cross-ventilation, stack ventilation and the ability to conceive contextually relevant solutions. Mechanical and natural ventilation systems can be utilised in a hybrid arrangement to induce air flow movements. Micro climates must also be considered within the specific context.
- The appropriate orientation and can generally maximise on north east and south-westerly winds reducing the reliance on mechanical active ventilation systems.
- Thermal uniformity is not ideal and the ability for *perceived thermal variability* is preferred by occupants of buildings. Such perception is achieved through the application of open able windows, manually controlled screens and blinds, and the provision for spaces of varying thermal capacities.

Indoor and Outdoor Landscaping

- Trees and plantings provide shade in warm climates and possess the ability to serve as a filter from the natural elements, mediating heat, light, water and particle matter.
- Trees and plantings soften the monumental permanence of architecture and add season rhythm to life. They also provide natural habitat for life forms to propagate and serve to provide mental and emotional relief from the stresses of modern life.
- Designers should aim to preserve natural elements of the architectural site which make the location unique and manifest the character or sense of place.
- Negative connections to nature should be avoided while positive connections to natural landmarks should be promoted.
- The evolution of human life toward a predominately indoor lifestyle translates to designs requiring greater positive connections to the outdoor natural landscape and the incorporation of indoor landscaped features.

- Landscapes should promote diversity of life including animal (eg. Butterflies) which may bring a therapeutic character to the environment. These environments typically require continued adequate human input to achieve positive benefits.

Building Technology and Materials

- Human resources should be promoted over mechanical resources as the human response tends to create humanistic environments that exhibit a greater dialectical relationship with nature.
- Materials concretise the character and sense of a place, revealing to the occupant, the manner in which the building is constructed. This plays an important role in the connection and exclusion of man from the environment.
- Material choices should be critically assessed given the context of the application and the energy costs across the life of the material. Due consideration should be applied to the selection of natural materials that have closer links to its natural state and typically exhibit lower embodied energy costs. Locally manufactured materials reduce the embodied energy costs of transportation and are characteristically suited as they have evolved to cope well under the contextual climatic conditions.
- Materials that are upcyclable are preferred over materials that are able to be recycled and down-cycled. Adaptively reused buildings should be first call before resorting to demolition and new construction.

Water

- Water is able to create therapeutic feelings by masking unwanted noises. Water interventions are able to captivate occupants and provide mental and emotional relief.
- It is important to note the context and thus apply the appropriate application with regard to the use and conservation of water.
- Storm water should be returned to the earth via site wetlands at a flow rate consistent to improving eco-system health. Runoff should be controlled and tempered to prevent the degradation of the natural habitat.
- Harvested rainwater should be stored for maintenance use while grey water storage and filtration shoulder also be considered.

Nature Experience and Health Benefits

- Experience of the natural environment can reduce stress and anxiety within occupants providing relief from dominant man-made environments.
- Extensions of space and views to the exterior reduce feelings of confinement and restriction and provide connectivity to the natural landscape.
- Areas of relief that provide fresh air and natural light are crucial to the creation of humane environments.
- Nature provides a multi-sensory experience that ought to be thoughtfully tempered to create meaningful connections to nature‘s elements.

Nature, Society and Stewardship

- Society and development must avoid viewing nature as a commodity with a view to quantifying and dominating it.
- Society and its developments must consider the flows of energy and resources, and nature‘s eco-cycles when conceiving human built environments. Human consumption patterns should show greater sensitivity toward that of nature‘s cycles.
- Cultural practice must link with ecological practice to establish a social value toward nature and thus alter the manner in which human built form is conceived.
- Nature has the capacity to regenerate depleted environments when employed in a thoughtful manner from an early stage of the project inception.
- Conservation of ‗plæce‘ functions through an emotional attachment to a place and a sense of community purpose that comes with natural conservation correlate to social development. Such conservation is critical to social unity and the preservation of the character or sense of place.

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APPENDICES

ANNEXURE A: IN DEPTH INTERVIEWS CONDUCTED WITH EXPERT SAMPLE GROUP (ARCHITECTS AND VARIOUS PROFESSIONALS ASSOCIATED WITH BIOPHILIC DESIGN)

What role does Nature play in the way in which people and architects conceptualize built form? Eg. Site conditions

How should built form be conceptualized given the nature of the relationship between man, culture and Nature?

What role does architecture/built form have in terms of Nature and ecology?

What natural elements informed the design of (Case study eg.) ?

What can contemporary architecture learn from the failures of modernism and post modernism in providing for man‘s need of shelter, comfort and expression?

How can dense urban environments provide more ecological diversity within the current conditions?

How can architects facilitate greater connectivity to Nature through their architecture given that humans have an affinity to nature?

ANNEXURE B: RESEARCH SURVEY QUESTIONAIRE CONDUCTED WITH MAXIMUM VARIATION SAMPLE GROUP (USERS OF CASE STUDY ENVIRONMENTS)

Name and Surname?

_____

Age and Gender?

_____

Do you believe nature is an important part of human life?

_____
_____
_____

Do you enjoy the outdoor spaces around the building?

_____
_____
_____

Does this building provide a healthy environment?

_____
_____
_____

Do you believe buildings have a relationship with nature?

_____
_____
_____

Do you think buildings should incorporate nature and in what way?

_____
_____
_____

Do you believe this building is successful?

_____
_____
_____

ANNEXURE C: INFORMED CONSENT FORM

(To be read out by researcher before the beginning of the interview. One copy of the form to be left with the respondent; one copy to be signed by the respondent and kept by the researcher.)

My name is Roshalin Padayachee (student number 206500161). I am doing research on a project entitled ‗The Influence of Biophilia in Architectural Built Form: Towards the Design of a Natural Sciences Museum for Durban'. This project is supervised by Mr Lawrence Ogunsanya at the School of Development Studies, University of KwaZulu-Natal. I am managing the project and should you have any questions my contact details are:

School of Development Studies, University of KwaZulu-Natal, Durban
Cell: 083 655 0749 **Tel:** 032 533 2312. **Email:** rosh_padayachee@hotmail.com

Thank you for agreeing to take part in the project. Before we start I would like to emphasize that:
-your participation is entirely voluntary;
-you are free to refuse to answer any question;
-you are free to withdraw at any time.

The interview will be kept strictly confidential and will be available only to members of the research team. Excerpts from the interview may be made part of the final research report. Do you give your consent for: *(please tick one of the options below)*

Your name, position and organisation, or	
Your position and organisation, or	
Your organisation or type of organisation *(please specify),* or	
None of the above	

to be used in the report?

Please sign this form to show that I have read the contents to you.

---------- (signed) ---------- (date)

---------- (print name)

Write your address below if you wish to receive a copy of the research report:

ANNEXURE D: DESIGN DEVELOPMENT

Biophilic Design in Architecture

A Living Natural Science Museum for Durban

roshalin padayachee - 206500161

Background

Problem Statement

Nature and its natural environments are an integral force of human existence but have been negated to the fringes through man's need for dominance over Nature through technological means (Metallinou, 2006:15). Ecological and human survival is now dependent on a new, deeper-ecological stance as ecological crisis moves ever closer to the centre of global focus. A fundamental aspect of the new ecological revolution is recognition of nature's diverse and complex life-promoting systems; and how they may be applied to architectural design through the principles of biophilia in architectural design.

Design Brief

Design Rationale

What? - Enabling the public to re-establish emotional and physical connections to the natural environment.

Why? - To educate and foster stewardship of the natural and built environments to reduce the degradation of both environments.

How? - Through a building that exposes the public to the working systems of nature and make available nature's resources through the thoughtful design of architectural environments that promote positive connections to nature.

The research hypothesised that the application of biophilic design principles to architecture produces integral connections with nature and promotes the spirit and well-being of man. The Living Natural Science Museum facility aims to facilitate positive impacts within the eco-sphere of natural and built environments through the thoughtful application of biophilic design principles. The museum facility consists of three key components:

- the exhibition spaces for the natural science museum and supporting staff functions
- an ecological treatment centre consisting of an anaerobic digester linked to an indoor grow house
- an aquaponic tilapia fish farm
- educational and instructional facilities

Project Clients

The clients involved will be a joint venture between the Durban eThekwini Municipality, The Department of Science and Technology and the Department of Trade and Industries. The Museum would act as a catalyst for the development of a selected precint and would link the static Museum element with a living farm, initiatives supported and a local and national level by each of the respective departments:

DURBAN NATURAL SCIENCE MUSEUM — A museum about ... said the earth, its history and life on earth; both past and present.

science & technology
Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

the dti
Department: Trade and Industry
REPUBLIC OF SOUTH AFRICA

Schedule of Accomodation

General Public Spaces

Entrance foyer/free exhibition	: 850 sqm
Restaurant	: 300 sqm
Fish Farm Cafe	: 200 sqm
Museum shop	: 100 sqm
Covered loading/weekend market	: 60 sqm
Ablutions	: 195 sqm
Reception & security	: 75 sqm
Subtotal	**: 1580 sqm**

Service Areas

Refuse and sorting	: 71 sqm
Hvac plantrooms	: 165 sqm
Water storage tanks	: 230 sqm
Service lobby	: 66 sqm
Cleaners	: 20 sqm
Staff basement parking	: 1440 sqm
Subtotal	**: 1991 sqm**

Tilapia Fish Farm

Fish farm & solar pond	: 760 sqm
Fish farm service & distribution	: 70 sqm
Offices & research	: 45 sqm
Staff change	: 35 sqm
Subtotal	**: 930 sqm**

Ecological Treatment Centre

Ecological treatment centre & exhibit	: 270 sqm
Laboratory & research	: 57 sqm
Eco treatment plantrooms	: 180 sqm
Offices	: 75 sqm
Subtotal	**: 582 sqm**

Museum Component

Public

Natural science exhibition	: 2400 sqm
Ablutions	: 150 sqm

Staff

Storage & technical area	: 445 sqm
Preparation laboratories	: 365 sqm
Boardrooms	: 113 sqm
Offices	: 120 sqm
Open plan offices	: 105 sqm
Ablutions	: 120 sqm
Waiting lounge & green roof	: 100 sqm
Staff recreation room	: 97 sqm
Staff lobby	: 150 sqm
Subtotal	**: 4165 sqm**

Education

Auditorium	: 360 sqm
Auditorium Foyer	: 150 sqm
Research Library	: 146 sqm
Subtotal	**: 656 sqm**

TOTAL : 9904 sqm

Theoretical Framework

1.0 Biophilia

Biophilia, a concept introduced by Edward O Wilson (1984) proposes that humans subconsciously seek connections to nature through the innate human tendency to affiliate with elements of the natural environment and forms the basis of **Biophilic Design**. Biophilic Architecture is part of an innovative view in architecture, where nature, life and architectural theory combine to create a lively habitable building competent to satisfy the demands, constraints and respect for both people and the environment. Biophilic design can be described as the deliberate attempt to translate an understanding of the inherent human affinity to affiliate with natural systems and processes, known as "biophilia" into the design of built environments. It is a **system of design** that **reconciles human communities** with the ecological imperatives of a **living planet**. Biophilic design attributes of **natural light, natural ventilation, water, planting, selection of natural materials, colours, frequent, spontaneous and repeated contact with nature** should be thoughtfully implemented throughout the architectural environment.


NATURAL VENTILATION


NATURAL LIGHT


CONNECTION TO WATER


FLORA & FAUNA


OUTDOOR & INDOOR LANDSCAPED SPACES

2.0 Place Theory

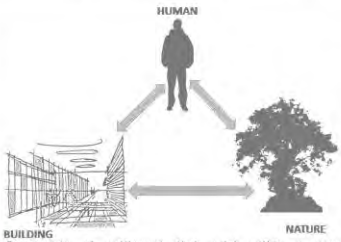
A 'place' can be considered to be a manifestation of material substance, having shape, texture and colour that, when put together, determine an **'environmental character'** (Norberg-Schulz, 1980:6). The phenomenology of place and genius loci are concepts within the broader place theory that seek to explore the intangible characteristics of space as a response to modernism's inability to consider the intangible, essential qualities of space.

"People want to experience the sensory, emotional, and spiritual satisfactions that can be obtained only from an intimate interplay, indeed from an identification with the places in which they live. This interplay and identification generate the spirit of the place. The environment acquires the attributes of a place through the fusion of the natural and human order."
Rene Dubos (cited in Kellert et al. 2008:6)

Gillian Rose (1995) expresses that 'a sense of place' implies that places are infused with meaning and feeling developed through individuals' life experience.Without a strong attachment to the culture and ecology of place people are rarely sufficiently motivated to act as responsible stewards of the environment.

3.0 Post Modern Ecology

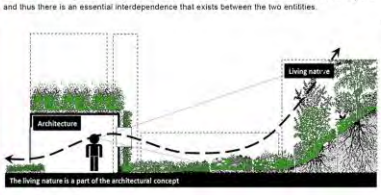
Postmodern Ecology is the broad theory under which the concepts of ecological theory and biophilia emerge. The theory acknowledges the complex interdependant relationship that exists between man and nature. Ecological theory asserts that man-made systems should harmonise with natural environments as they are ultimately a part of a larger interlinked ecosystem.



3 Components of settlement that exist within a complex interconnected relationship


Traditional systems base themselves on the edge-to-edge or face-to-face model with distinct separations between natural and built environments


The interconnecting model recognizes the idea that man is part of the functioning of the eco-system and thus there is an essential interdependence that exists between the two entities.



The living nature is a part of the architectural concept

Sustainable Systems

Water

Black water + grey water treatment via indoor anaerobic 'living machine' systems

Rainwater Harvesting

Low flow sanitary fittings

Energy

Solarvoltaic panels

Low energy LED lighting fixtures

Anaerobic biogas generation

Fittings manufactured from alien red gum trees

Food

Food security through production of Tilapia. Biomass to supply anaerobic biogas creation

Food grown via recycled and collected water

Precedent & Case Studies

Precedent Studies

California Academy of Sciences
Renzo Piano Building Workshop
Golden Gate Park, San Francisco, California
Client: California Academy of Sciences
Completion Date: Rebuilt 2008

The adaptive reuse was a rebuild of a precinct of 12 buildings destroyed in the 1989 Loma Prieta earthquake. The original buildings were compressed into a rectangular footprint around an external piazza and were consistent with the formal expression of the surrounding Golden Gate Park. The new building forms part of an adaptive re-use with half of a long façade of the original building being retained with a new structure built to 21st century standards for energy efficiency and intended to house an entirely new science museum, aquarium, planetarium and scientific labs.

The roof of the building was envisaged by the architect as a swath cut from the park and elevated 36 feet to the height of the old buildings, and is a 2.5 acre living roof dotted with portholelike skylights. The spherical Planetarium Dome and Rainforest Biosphere breach and distort the horizontal datum and form the grassy knolls that break from the otherwise formal expression.

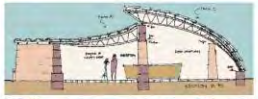
Piano adopted a phenomenological approach to conceiving his ideas for the Academy through spending time in the Academy and gardens where he could observe the nature of the place and his client. Whilst many other candidates presented models, plans, sections and movies Piano produced the definitive sketch that would result in the creation of the living roof planted with indigenous California plants. As a result the roof surface hosts about 1.7 million plants growing in 50 000, 6inch deep, biodegradable coconut husk trays. Through a 'measured playfulness' Piano has added theatricality and character to what is otherwise a very serious institution.

Visitors' Interpretive Centre for Prehistoric Art
Nina Maritz Architects with Dennis McDonald
Twyfelfontein, Namibia
Client: Namibian Tourism Development Programme
Completion Date: June 2005

The centre is situated in an arid and remote section of northwest Namibia, Located within the dry tropical region of southwest Africa, the Visitors' Interpretive Centre for Prehistoric Rock Art must negotiate the extreme climatic demands of severe radiation, heat and glare, while providing a non-intrusive interpretation of a twenty-thousand-year-old cultural site, with increasing number of visitors.

The conceptual and formal response was to tie the aspects of sustainability requirements together and promote the Rock Art Natural Monument so that visitors would treat its environment with respect. The design conducts users through organically inspired spaces that kindle awareness to the sensitive environment of Twyfontein, which translates in Afrikaans to 'doubtful fountain', an area where water is a precious resource. Thus the structure was to be constructed without cement and be completely removable and reusable. Rock outcrops and nearby ridges assisted in determining the specific location of the building aided by the advice of archaeologist, Dr John Kinahan.

Through the use of materials that were available on site, and the application of recycled materials, the embodied energy value of the building was greatly reduced. The labour intensive nature of the construction typology created much needed employment in the area as well as training worker in alternative building methods. The designer's aim was to ensure that sustainability was integrated to form part of an indivisible whole rather that to be viewed in isolation from the wider issues. Sustainability and a sense of contextual sensitivity were attained through the interaction of the design team and a multi-stakeholder client body. Nina Maritz utilises an 'eco-centric' approach to the design that pays particular attention to the geographical setting and the people.

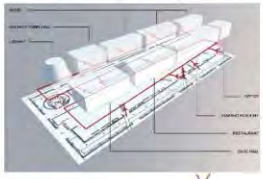


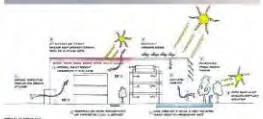
Academy Mont-Cenis Herne
HHS Planer + Architekten AG
Herne, Germany
Client: EMC GmbH
Completion Date: August 1999

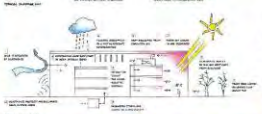
The academy was built as part of the International Building Exhibition Emscherpark at the site of a former coal mine in Sodigen.

Central to the scheme is the glass microclimatic envelope within which the academy and quarter centre are located. The envelope utilises a hybrid system of mechanical and manually operated openable window sections to reduce the need for mechanical ventilation, and was developed according to the meteorological conditions of sun, wind and outside and inside temperature.

The building also features an integrated photovoltaic power plant on the 10 000 square meter hall roof and walls. The PV panels are arranged in clouds of varying shading levels to serve as sun protection during the summer months. The building-integrated PV panels are produced as a standard building-product, fitting into the standard curtain wall facade and roof structures.







Case Studies

Intuthuko Junction
East Coast Architects
Cato Manor, Durban, KwaZulu Natal, South Africa
Client: Cato Manor Development Agency
Completion Date: April 2006

Intuthuko Junction was a project that resulted from a design competition called for by the Cato Manor Development Association in 1999, won by a local architectural practice, East Coast Architects. The complex accommodates an 'Administrative Support Centre' for the CMDA and office space for other non-government organisations.

The architectural character of the building is one that exhibits sensitivity to the way in which it relates to the environment and its inhabitants. The
Durban based practice of East Coast Architects is built on a deep commitment to responsible, sustainable architecture that responds creatively to the social needs of a community. Intuthuko Junction, one of the practices first major works, breaks from the traditional urban framework that defines its typology, and exists between the dimensions of formal and informal while attempting to sensitively filter nature's elements through a multitude of passive design techniques and concerned material choices. This belief in stewardship of nature comes from an environmental character that the designer's adhere to, within a belief that man's social and environmental ills stem from the untended sense of consumer culture experienced by contemporary culture.

The original proposal by the architectural team envisioned created a central defensible open community space, however this space would later become a parking lot, a testament to the extent which mans technologies dictate the use and form of space despite the best intentions of a designer. The complex consists of eight separate but linked structures which the architects refer to as 'pods'. These pods relate to an un-orthogonal manner to each other, a reference to the
informal alignment of the local and traditional settlement patterns.

Durban City Hall
Scott, Woolcott & Hudson Architects
Durban City Centre, KwaZulu Natal, South Africa
Client: California Academy of Sciences
Completion Date: April 1910

The Durban City Hall is one of the grandest Edwardian-Imperial-Baroque style civic buildings in South Africa and was inspired by the design of the Belfast City Hall in Northern Ireland. It is a highly decorative building abounding in motifs, columns, decorative cornices, sculptures and statues. The City Hall was intended to fulfil the needs of the prosperous port city of Durban by replacing the old town hall (current Durban Post Office), which was no longer adequate for the scale of the growing city.

The City Hall is located within an urban corridor of gardens and public green spaces that function at the level of Community and Region. Its imposing structure articulates its expression through its monumental permanence that forms a firm barrier to the external forces and symbolises its strength, administrative power and dominance over nature. This phenomenon, recognised by Day (2004) identifies that civic buildings such as the City Hall, in commitment to scale and a single idea can often produce architecture that dominates the surrounding through disconcerns with proportion, geometry and classically differentiated elements representing universal principles of relation to the earth.

The base of the building is articulated by means of the rusticated ground storey with the sandstone plinth affirming its rootedness to the earth (Fig). Plantings at the base along with palm trees along the façade can be seen as a means to achieve a softening of the imposing structural elements, and bring seasonal rhythm and life to the building.

Vodafone Innovation Centre
GLH Architects
Midrand, Johannesburg, South Africa
Client: Vodafone, Vodacom
Completion Date: October 2011

The Vodafone Site Solution Innovation Centre is the first building in South Africa to achieve a 6-Star Green Star SA certification and was designed as a concept building to showcase innovative techniques and design for construction, electrical, mechanical, and wet services.

The building features a simple square plan organised around an internalised courtyard that features an indoor wetland that replicates the natural process of water treatment.

The external glazing is not operatable but features mechanically controlled blinds for solar protection. The internal courtyard glazing is fully openable.

Basement gabion rock stores pre-temper air and reduce the requirement of water for evaporative cooling. Thermal solar panels generate hot water that feed absorption chillers that generate chilled water for the thermally activated slabs and space radiant panels.

Photovoltaic panels on the roof generate more electricity than required during the daylight hours, with the excess fed to the neighbouring building. In turn the neighbouring building supplies electricity at night to the centre for the running of essential systems. This arrangement results in a battery-less system that uses a two way metering system and is carbon neutral.

DURBAN (Zulu: eThekwini, from itheku meaning 'bay/lagoon')

Durban is the largest city in the province of KwaZulu-Natal, located on the east coast of South Africa and considered a tourism hotspot due to the warm subtropical climate and extensive beaches

SITE SELECTION CRITERIA

1. Pedestrian and vehicular accessibility
2. Access to public transit and supporting social services
3. Public exposure and site visibility
4. Ecological well being of site (brownfield, greenfield etc.)
5. Views, vistas and relationship to natural phenomena of context
6. Diversity of functions of surrounding context
7. Access to natural phenomena
8. Potential for urban rejuvenation and ecological preservation
9. Characteristics of site (sense of place)
10. Bioclimatic and biophilic characteristics of the site

PROPOSED SITE 1 - CENTRUM SITE, DURBAN CENTRAL

POSITIVE SITE TRAITS

Ease of vehicular and pedestrian access. Very close proximity to major public transport networks and essential services.

High number of pedestrian movement around site with prominent visibility of site area.

Located in the 'green lung' of the city in close proximity to the Gugu Dlamini park and part of the city's 'priority zone'. Is part of the public cultural precint of the city.

The opportunity to rejuvenate a brownfield site that currently serves as a large heat sink and assists in the urban heat island phenomenon.

NEGATIVE SITE TRAITS

High levels of vehicular traffic add to noise and air pollution.

1. Pedestrian and vehicular accessibility (9)
2. Access to public transit and supporting social services (9)
3. Public exposure and site visibility (9)
4. Ecological well being of site (brownfield, greenfield etc.) (3)
5. Views, vistas and relationship to natural phenomena of context (4)
6. Diversity of functions of surrounding context (8)
7. Access to natural phenomena (6)
8. Potential for urban rejuvenation and ecological preservation (7)
9. Characteristics of site (sense of place) (6)
10. Bioclimatic and biophilic characteristics of the site (7)

FINAL SCORE (OUT OF 100) = 68

PROPOSED SITE 2 - BLUE LAGOON, UMGENI RIVER MOUTH

POSITIVE SITE TRAITS

Ease of vehicular access via M12 and M4.

Area is located between the Durban Country Club golf course and the ecological hotspot of the uMgeni estuary with the nearby 'Greenhub' that serves as an eco-tourism information and education centre.

Near the uMgeni river and adjoining new beach promenade.

The disused recreational site provide an opportunity to rejuvenate a brownfield site and continue the ecological conservation efforts through a thoughtful urban rejuvenation.

NEGATIVE SITE TRAITS

Disconnected from the city centre.

Limited supporting services in the nearby vicinity.

Lack of diverse functions of surrounding context.

1. Pedestrian and vehicular accessibility (7)
2. Access to public transit and supporting social services (4)
3. Public exposure and site visibility (7)
4. Ecological well being of site (brownfield, greenfield etc.) (6)
5. Views, vistas and relationship to natural phenomena of context (8)
6. Diversity of functions of surrounding context (4)
7. Access to natural phenomena (9)
8. Potential for urban rejuvenation and ecological preservation (9)
9. Characteristics of site (sense of place) (8)
10. Bioclimatic and biophilic characteristics of the site (8)

FINAL SCORE (OUT OF 100) = 70

ROSHALIN PADAYACHEE
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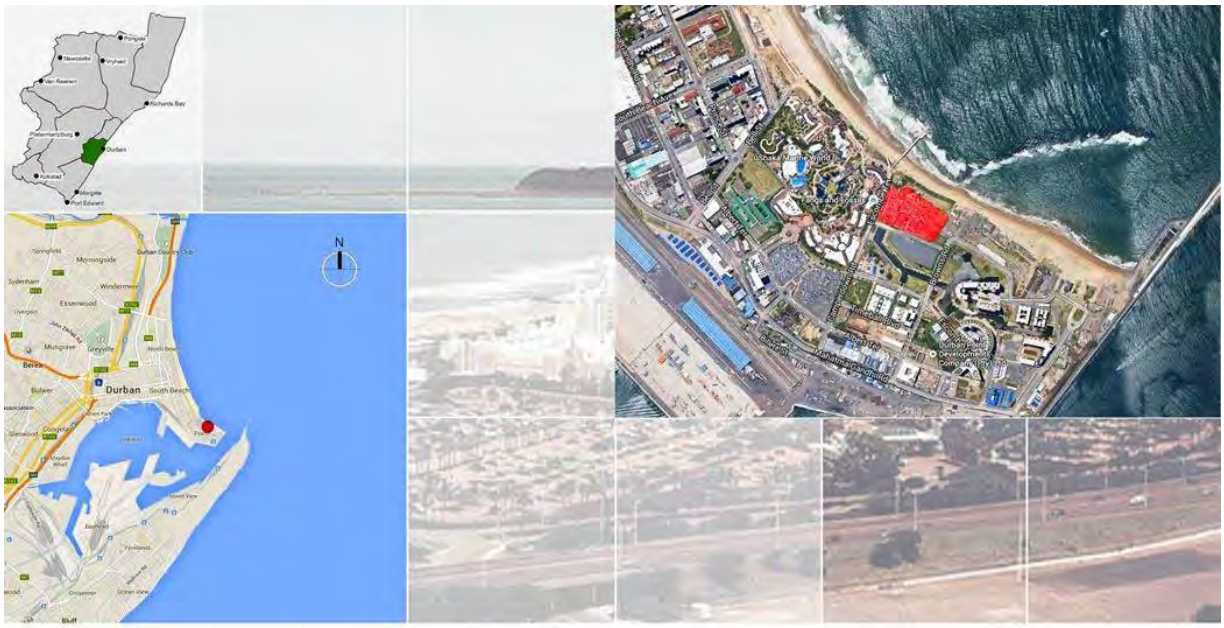


PROPOSED SITE 3 - POINT DEVELOPMENT, DURBAN

POSITIVE SITE TRAITS

Site is located adjacent the Ushaka Marine World recreational facility within the Point development.

Views to sea and close proximity to the beach and promenade.

Ease of vehicular and pedestrian access with public transit nearby.

The opportunity for urban rejuvenation of a brownfield site that currently serves as an informalised parking area.

1. Pedestrian and vehicular accessibility (8)
2. Access to public transit and supporting social services (5)
3. Public exposure and site visibility (6)
4. Ecological well being of site (brownfield, greenfield etc.) (6)
5. Views, vistas and relationship to natural phenomena of context (8)
6. Diversity of functions of surrounding context (5)
7. Access to natural phenomena (8)
8. Potential for urban rejuvenation and ecological preservation (7)
9. Characteristics of site (sense of place) (6)
10. Bioclimatic and biophilic characteristics of the site (7)

FINAL SCORE (OUT OF 100) = 66

NEGATIVE SITE TRAITS

Site is disconnected from the city and lacks immediate visibility.

Site lacks diversity of surrounding functions

Urban Framework Analysis

Macro Analysis

Project Location

Site Selection Criteria

1. Pedestrian and vehicular accessibility
2. Access to public transit and supporting social services
3. Public exposure and site visibility
4. Ecological well being of site (brownfield, greenfield etc.)
5. Views, vistas and relationship to natural phenomena of context
6. Diversity of functions of surrounding context
7. Access to natural phenomena
8. Potential for urban rejuvenation and ecological preservation
9. Characteristics of site (sense of place)
10. Bioclimatic and biophilic characteristics of the site

Urban Area Analysis

The urban intervention including the proposed building is to be in the Blue Lagoon Park, located on the south bank of the uMngeni River Estuary and was adopted as the precinct for focused investment in ecosystem enhancement due to its wealth of biodiversity. With nearly 10 000 picnickers enjoying the outdoors on the weekend, the highly utilised and pressured environment provides the opportunity to showcase Durban's natural attractions and provide education to a large audience.

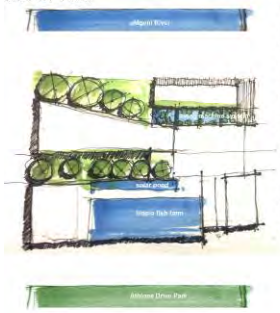
Recent upgrades to the Blue Lagoon precinct has seen major improvements in pedestrian connectivity and linkages. The proposed beachfront upgrade has the potential to further activate the precinct, however the lack of diversity of usage and the purely recreational nature results in users not participating in active stewardship of the area.

Proposed rezoning of Stiebel Place parking via new boulevard and onto Athlone Drive would allow an extension of the pedestrian promenade and link the proposed beachfront recreational facilities to the precinct. The under-utilised Windsor Municipal Golf Course would serve as a later phase of development to stitch the Blue Lagoon precinct with the rest of the developments along the uMngeni riverside. Possible linkages and connectivity were identified. Athlone drive park is proposed to be partially developed upon to scale the park to a more appropriate scale and provide added security and ownership of the precinct.

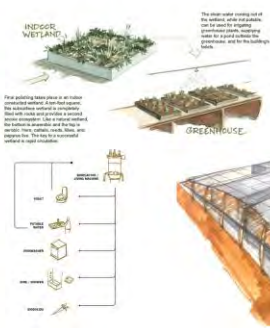
The identification of public spaces and opportunities for increased densities informed the position and allocation of various building proposals within the urban scheme, to add diversity and opportunity to the precinct. Connectivity links identified informed the reconfiguration of jetties and the proposal for more fishing/recreational piers along the southern edge of the uMngeni river. Desire paths and other urban site observations played a key role in dictating the structure of the urban redevelopment.

Design Development

Master Plan



The notion of layering elements of natural phenomena was adopted in the inception of the design with the key natural entities being the uMgeni River and the adjacent athlone drive park. These elements of water and plant entities were reversed and juxtaposed onto the site culminating in the creation of the proposed tilapia fish farm and anaerobic living machine, a system that utilises a series of indoor tanks to treat waste water, replicating the process that occurs in a natural wetland. The building form was dictated by large existing indigenious trees on site with the public entrance orientated toward the west, in conversation with the new proposed public library. The incorporation of the living machine system would link the cycles of nature with visitors to the museum with the proposed fish farm feeding the anaerobic process with its inherent biomass.



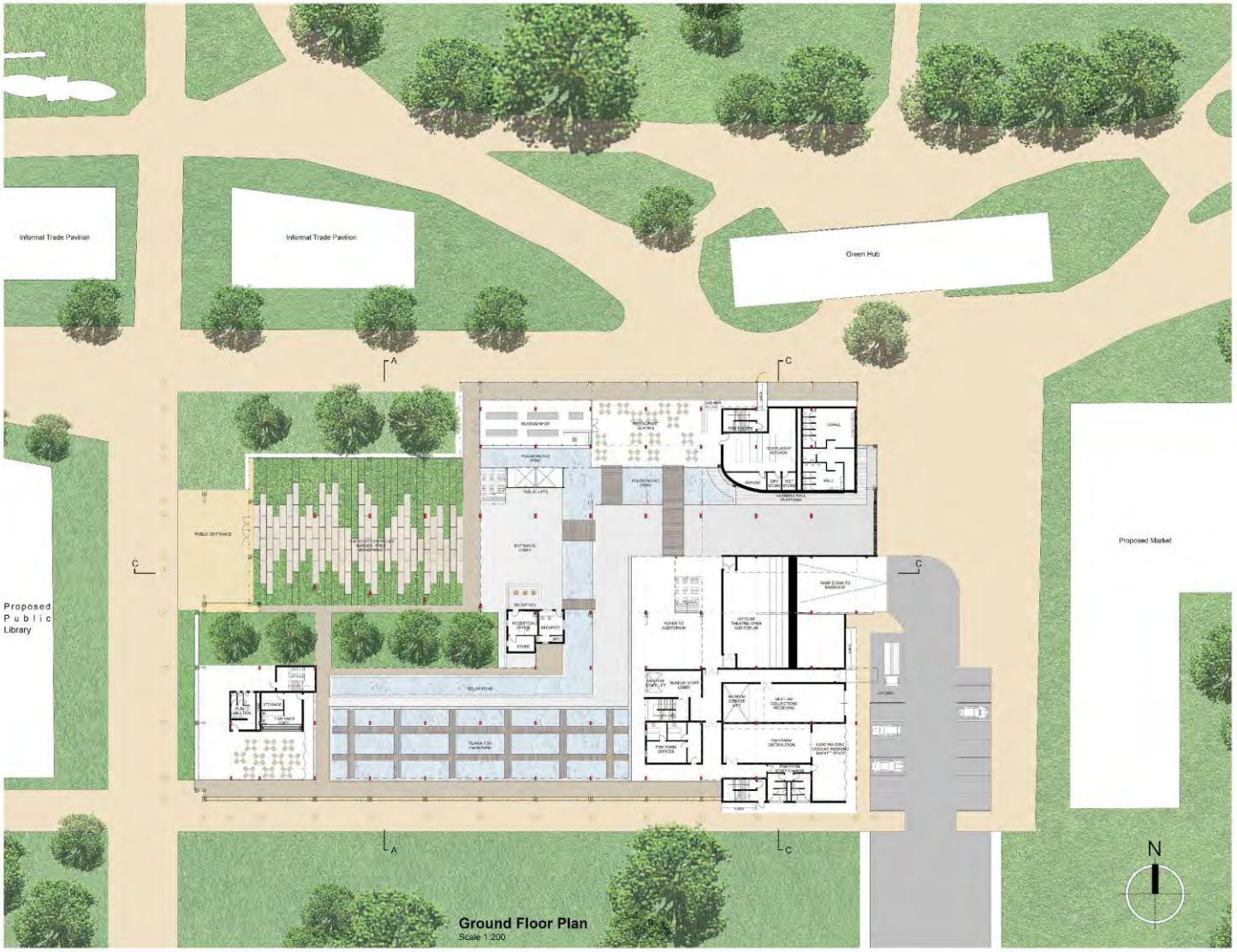
With the requirements for the provision of a greenhouse and solarium for the anaerobic living machine and fish farm, a climatic envelope was developed that would contain internally the various components of the museum. The 'static' formal museum component was proposed on the first floor with the greenhouse solarium positioned on the upper floor of the northern site edge and the fish farm on the southern Athlone Drive park edge.

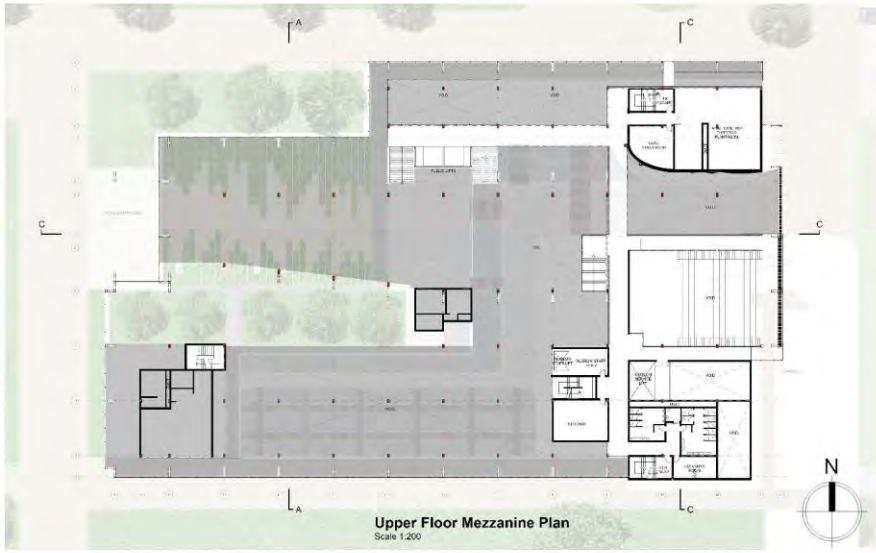
Biophilic Design in Architecture

A Living Natural Science Museum for Durban

roshalin padayachee - 206500161

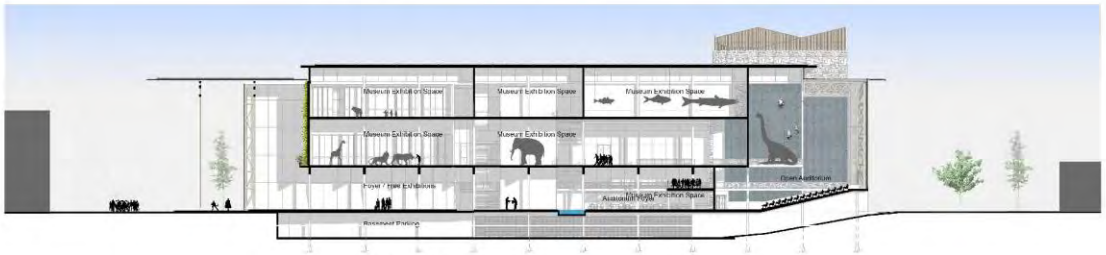
Design Drawings





Upper Floor Mezzanine Plan
Scale 1:200

First Floor Plan
Scale 1:200

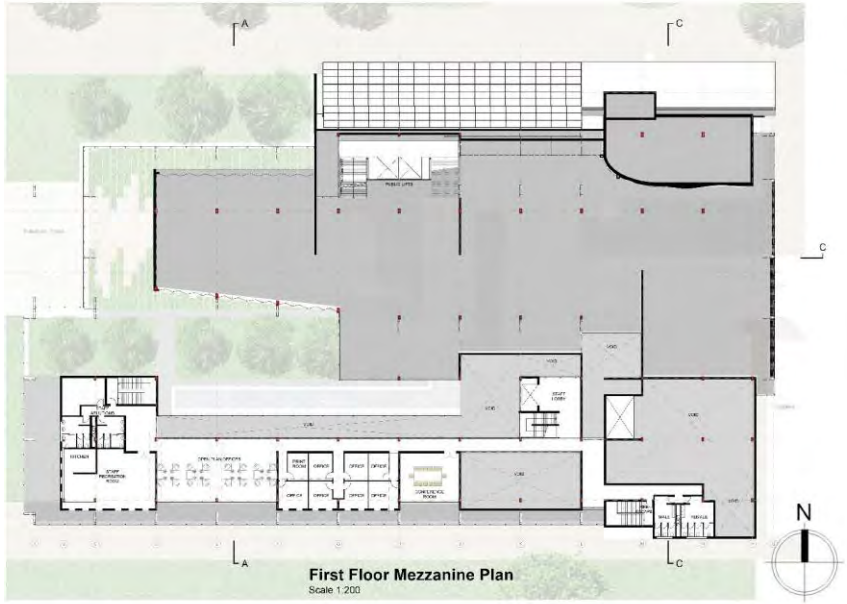


Section A-A
Scale 1:200

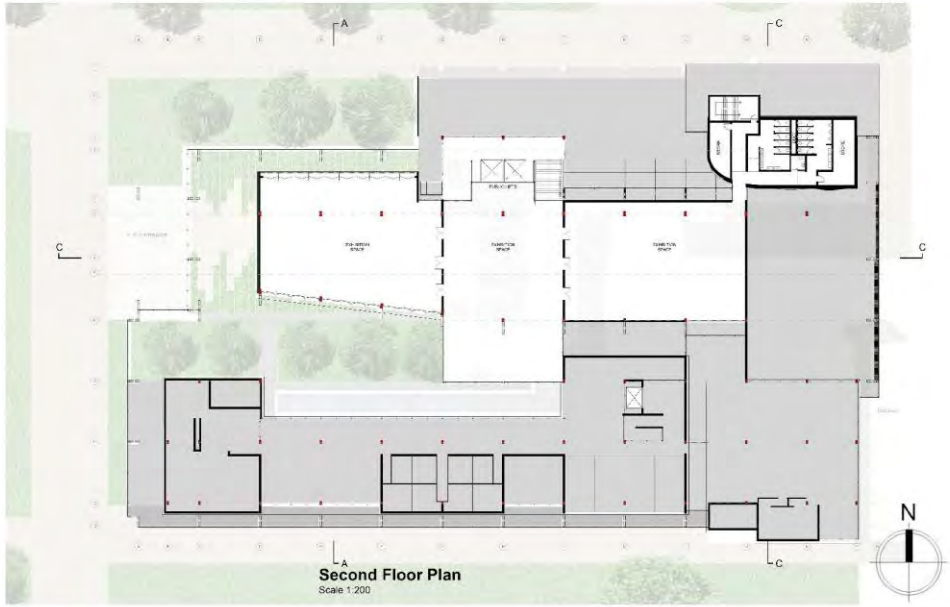
Section B-B
Scale 1:200

North Elevation
Scale 1:200

South Elevation
Scale 1:200



First Floor Mezzanine Plan
Scale 1:200



Second Floor Plan
Scale 1:200

Section C-C
Scale 1:200

West Elevation
Scale 1:200

Basement Plan
Scale 1:200

Biophilic Design in Architecture

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Architectural Impressions

Approach from North West

Approach from South West

Entrance Hall

Koi Pond and climbing wall

Tilapia fish farm