theory

Chapter 2

Fig 2.1:The Seven Sisters Oak Tree. [Kellert, 2008: 34]

"Humanity is exalted not because we are so far above other living creatures, but because knowing them well elevates the very concept of life."

(Wilson, 1989: 22)

2.1 Introduction

This dissertation investigates the potential of architecture to restore man's biophilic nature in a world where built environments are increasingly creating barriers between man and the natural world by proposing a return to man's ecological and nature-connected existence. The concept of biophilia and the primary attributes of biophilic design are two relevant concepts of regenerative theory and will be discussed as starting points, followed by a critique the three fundamental aspects that form part of biophilic design and later how and in what context these fundamental theories can be practically applied. These elements include natural ecologies or systems, and the river or element of water, and biophilic child development.

2.2 The History of Biophilic Design and Ecological Design Principles

Biophilic Design is not only an ethical, ecological stance towards conserving earth's resources but phenomenological in that it regards one of the fundamental dimensions of biophilic design as buildings and landscapes that connect to the culture and ecology of a locality (Kellert, 2008: 6).

Since the dawn of modernity at the beginning of the 20th Century, there have been a number of architectural movements, contributing to the principles of biophilic design, that have contested how Modernism has contributed to the over exploitation of natural resources and the decline of place and meaning in the design of the built environment. Ian McHarg was one of the pioneers of ecological design, who recognised and "defined the problems of modern development and presented a methodology or process prescribing compatible solutions" (Palmer, 2000: 228-241). In his book "Design with Nature", McHarg presented a system of guidelines where the layers of a site are analysed in order to generate a complete understanding of the qualitative attributes of a place. These layers include history, hydrology, topography, vegetation etc.

In 1974, Kenneth Frampton discusses a Martin Heidegger's paper, "Building, Dwelling, Thinking" where he emphasises how architects, at the time, were unable to create places connected to the identity of a locality. Two years later, Christian Norburg Schulz wrote the paper titles, "The Phenomenon of Place" where he also interprets Heidegger's essay. Edmund Husserl defines phenomenology as method that urges a return to things as opposed to abstractions and mental constructions (Nesbitt, 1996: 412). Schulz identifies phenomenology's potential in architecture as the ability to make the environment meaningful through the creation of specific places (Nesbitt, 1996: 412). This is where the ancient Roman idea of the *genius loci,* the spirit of a particular place is reintroduced. In 1983, Frampton offers an alternative, authentic architecture based on two essential aspects of architecture: an understanding of place, and tectonics. In the 1990's , Ken Yeang, one of the early pioneers of ecology-based green design and master planning wrote the book titled Designing with nature which proposes analysing a site in terms of an ecosystem. Other ethical standpoints in the 1990's include William McDonough's Hannover Principles which are a set of guidelines for sustainable design. Biophilic Design emerged as a result of all predeceasing theories and represents a combination of both ethical and phenomenological principles in an attempt to bring humanity back to nature through design.

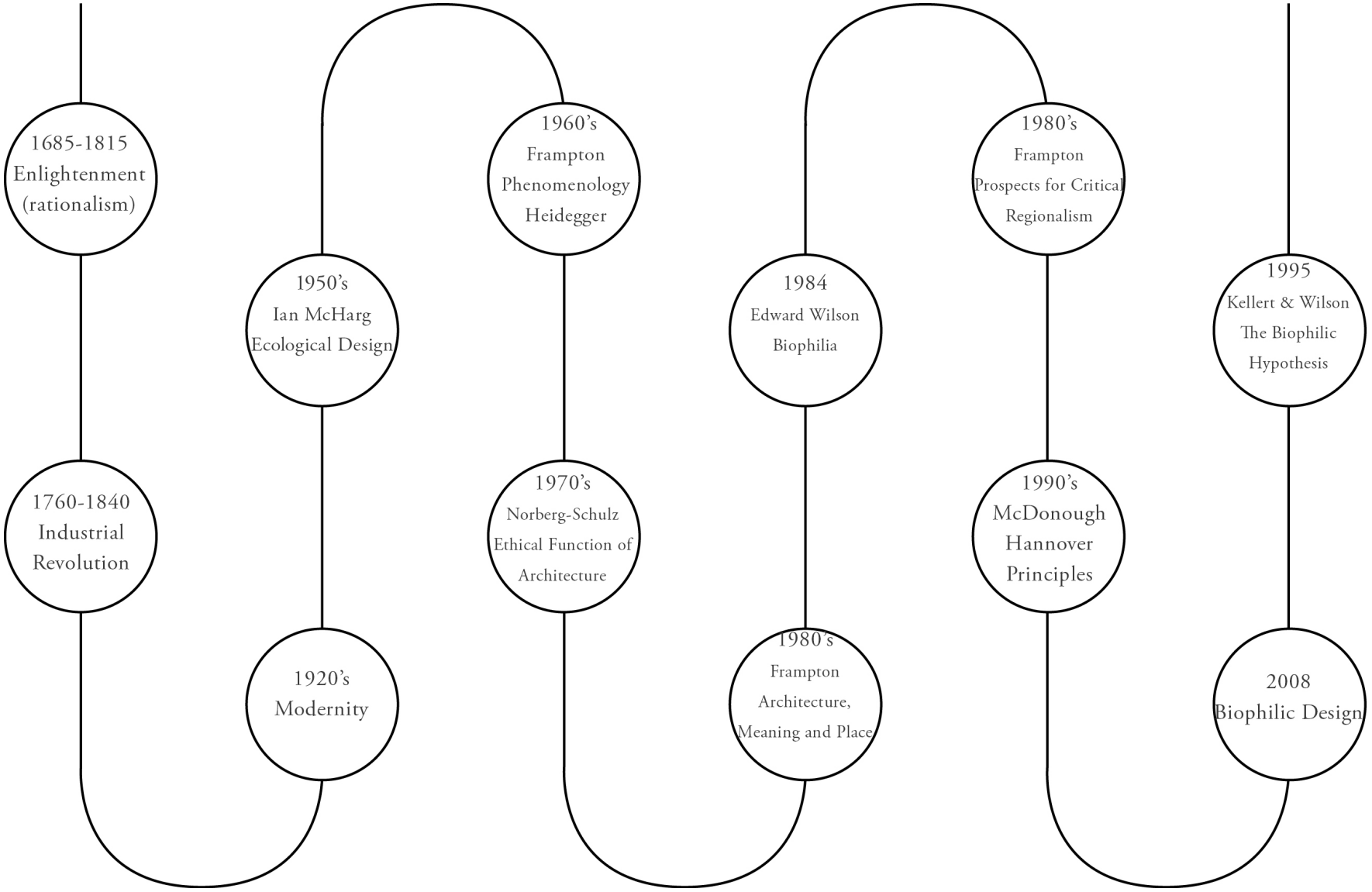

Fig 2.2: Author's interpretation of Archtecture's return to biophilia. (Author. 2016)

2.3 The dimensions, elements and attributes of biophilic design

"Biophilia is the inherent human affinity to affiliate with natural systems and processes" (Wilson 1984, Kellert and Wilson 1993). Biophilic Design is the deliberate attempt to translate an understanding of biophilia into the design of the built environment. This biophilic tendency became biologically encoded because it proved instrumental in enhancing human physical, emotional, and intellectual well-being during the course of human evolution. People's dependence on contact with nature reflects the reality of having evolved in a largely natural, not artificial or constructed, world. In other words the environment of human mind and body was a sensory world dominated by critical environmental features such as light, sound, odour, wind, weather, water, vegetation, animals, and landscapes.

Our biophilic needs is an adaptive product of human biology, and the satisfaction of our biophilic urges is related to human health, productivity and well-being. The findings by Stephen Kellert in 2005 are worth noting:
-Contact with nature has been linked to positive cognitive responses while completing tasks requiring concentration and memory.
-Healthy childhood development has been linked with contact with natural elements and landscapes
-Communities with higher-quality environments reveal more positive valuations of nature, superior quality of life, greater neighbourliness, and a stronger sense of place than communities of lower environment quality. These findings also occur in poor urban as well as more affluent and suburban neighbourhoods (Kellert 2008: 4).

According to Kellert (2008: 21-31) there are 70 physical attributes of biophilic design that can be applied to the built environment. These include two biophilic dimensions (Refer to Figure 2.3):

2.3.1 Organic or Naturalistic dimension:
Defined as "shapes and forms in the built environment that directly, indirectly or symbolically reflect the human affinity for nature" (Kellert 2008: 4). Direct experience refers to unstructured contact with the self-sustaining environment and indirect experience involves contact with nature that requires on-going human input to survive such as a potted plant. Symbolic contact requires no actual contact with real nature but rather the representation of the natural world through image.

2.3.2 Place-based or Vernacular dimension:
This dimension is defined as buildings and landscapes that connect to the culture and ecology of a locality or geographic area. This includes the *genius loci* or spirit of place emphasising how buildings and landscape of meaning to people become integral to their individual and collective identities.

Wendell Berry (1972: 68) remarked: "without a complex knowledge of one's place on which such knowledge depends, it is inevitable that the place will be used carelessly and eventually destroyed".

Today, despite the urge to travel around the globe, most people still retain a strong need for a place they can call "home". This attachment to place remains a major reason why people assume responsibility and long-term care for the upkeep and preservation of buildings and landscapes. However, the built environment consists of an ever increasing dismemberment of connection to place and has unfortunately become a common characteristic of modern society (Kellert 2008: 6).

2.3.3 Summary of attributes
These two dimensions of biophilic design can be related to six biophilic design elements (Kellert 2008: 6)

-Environmental features
-Natural shapes and forms
-Natural patterns and processes
-Light and space
-Place-based relationships
-Evolved human-nature relationships

These six elements are then further elaborated on with each having several attributes, indicated in Fig 2.2.

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

Fig 2.3 The table illustrates all 70 attributes of biophilic design in their various categories. (Kellert, Heerwagen & Mador, 2008: 15)

2.3.4 Choosing the appropriate attributes and elements

There are a wide range of dimensions, elements and attributes that make up biophilic design. The attributes have been explored in terms of what exists on site and the intentions of the dissertation. The four key informants on site have been identified as the element of **environmental features** such as water, light, and trees (Refer to page 17). What is intended are richer biophilic elements such as **human-nature evolved relationships** and **place-based relationships**.

Each environmental feature on site will therefore be explored in terms of how each feature can be re-appropriated biophilically through applied attributes, such as water and biophilia, the existing trees and interpreting them through biomimicry and lastly the child and how they are most cognitively stimulated through these biophilic applications.

Lastly, these attributes that can be applied according to each environmental feature will be related back to the intended elements such as place-based relationships and human-nature evolved relationships which are the intentions of the scheme. (Refer to Fig 2.4)

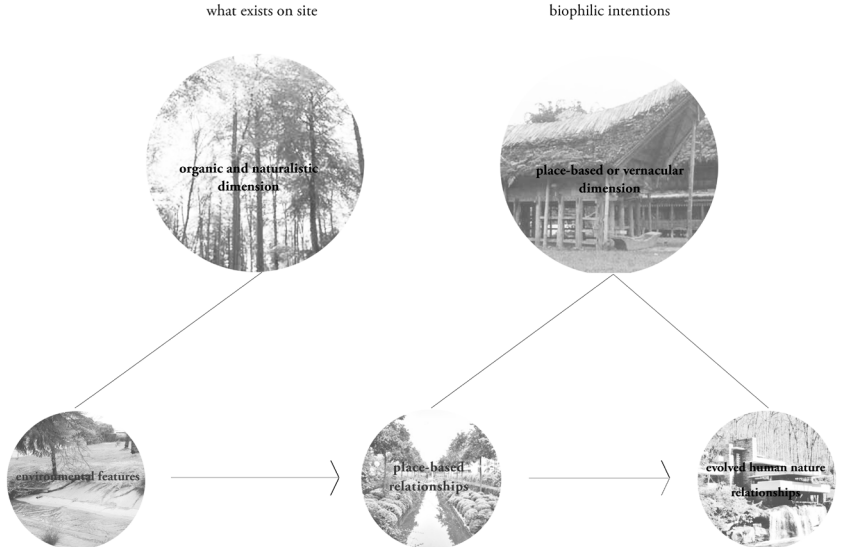

Fig 2.4 What exists and what is intended on the site according to the dimensions, elements and attributes of biophilic design (Author, 2016)

Fig 2.5: The channelised Walkerspruit.(Author, 2016)

2.4 The Biophilia of Water

"Water is the supreme sculptor of our environment" (Campbell, 1978: 9)

Water is in many ways the reticent component of our natural surroundings. Water covers 70 percent of the earth's surface. Water is undoubtedly necessary for life and accompanies every instance if human habitation. It forms a major component of the cellular structure of organisms. According to Martin Mador (2008 : 60), water is the unifying element of nature, connecting all aspects of the landscape.

Kellert (1997: 42) (2005: 51-57) developed a framework that provides a comprehensive structure for enumerating our many attachments to water. The relevant relationships with water to this dissertation are highlighted below:

Humanistic: the ability of man to form a bond with this natural element, to value its existence, its significance in his sense of place, and its value as a life-giving element

Aesthetic: This includes all the aspects of water that are found appealing to our five senses.

Moralistic: the sense of valuing the gift of this resource; the obligation to preserve it; equitable sharing among human and non-human users

Symbolic: a brook communicating to us through the gurgling of its tumbling waters; the strength and power of the flow of a mighty river

Scientific: lessons of aquatic chemistry, ecology and biology

In Figure 2.5, the current condition of the Walkerspruit is shown, with most of it being channelised and disconnected from the surrounding fabric.

We began to see engineering as the only body of knowledge necessary for problem solving. (Kellert, 2008: 47) In the built environment at both large and intimate scales, roadblocks presented by the natural world to human ambition could simply be engineered over around, or through.

Most of nature, and especially water, fell victim to this "advance" of civilization. Water in nature is never linear. Water bodies always have curvilinear boundaries. Rivers, left to themselves, will develop a meandering, hairpin-dominated course. The engineered world, however, thinks in straight lines. Water, whether as fresh supply or wastewater, is universally contained in straight pipes. Many, many river courses have been straightened for the convenience of abutting landowners. In sum, over the past century, we have exercised our engineering prowess to defeat and devalue nature, and we have degraded our water resources rather than celebrating them. The biophilic opportunity of water has been ignored with some exceptions. Over the last 40 years, however, sustainable and environmentally friendly interventions have created opportunities to restore man's biophilic connection to water. (Kellert, 2008: 48)

In Texas, the Paseo del Rio river-front into an attractive destination for tourists and residents. Shops and restaurants line the San Antonio River. In New York, an extensive and coordinated effort is being made to rehabilitate the entire area along the Hudson and East Rivers (Kellert, 2008: 48).

Water can be seen as an animate, dynamic object with different physical characteristics depending on its speed, and the amount and type of light of its environment. The movement of water has very strong biophilic attraction (Refer to Figure 2.6) As a primary life-sustaining force, water's significance is dramatized by the addition of flora. Facultative wetland vegetation, riparian plantings, and immersed water-based plants such as water lilies combine with water to express strongly biophilic elements of life (Kellert, 2008: 49).

Fig 2.6: Pa Daet, Thailand. unpalsh.com. Photo: Keenan, A.

Fig 2.7 (left): The Seven Sisters Oak on Lake Pontchartrain has survived 1200 years due to its ability to withstand hurricane forces. (Kellert, 2008: 34)

Fig 2.8 (right): Eco-machines from John Todd Ecological Design, Inc. mimic the patterns of nature's water-purifying ecosystems to clean sewage to pure water (Kellert, 2008: 161)

2.5 Biophilia of Trees

"In an unscripted moment that happens all over the world, a child tosses a maple seed into the air, clapping with delight as it helicopters to the ground on its perfectly shaped wing. The maple samara plays gravity against a cushion of air, allowing the seeds of the next generation to escape their parent's shade. Like all good design, it never fails to inspire wonder, and, eventually, imitation" (Kellert, 2008: 27).

Biomimicry is the act of learning from nature, borrowing designs and strategies that have worked in place for billions of years. This conscious emulation of life's genius is a natural part of biophilia.

Vernacular architects, struck by the practical beauty all around them, may have learned mud-daubing from swallows and termites, weaving from birds and spiders, and masonry from caddis flies. It's only recently that we've turned a blind eye to nature's guidance, focusing instead on each other's latest fashion.

Biomimicry is not a style of building, nor is it an identifiable design product. It is rather, a design process—a way of seeking solutions—in which the designer defines a challenge functionally (flexibility, strength under tension, wind resistance, sound protection, cooling, warming, etc.), seeks out a local organism or ecosystem that is the champion of that function, and then begins a conversation.

This focus on function points to a key difference between buildings that mimic nature to "look as nature looks" for decorative or symbolic purposes and those that mimic nature to 'do as nature does" in order to enhance functional performance.
"A building need not look exactly like a tree, but, as Frank Lloyd Wright reminded us, it should work like one" (Kellert, 2008: 29).

The two images above show how a tree, in nature, can be used as a model to create buildings that can withstand hurricane force while in Figure 2.9, eco-machines that mimic the water-purifying ecosystems found in nature are used to clean sewage. In terms of the trees that exist on site, biomimicry is seen as an appropriate element to mimic in terms of how trees bring the site back to human scale as well as the protective nature of trees and the mini-ecosystems they foster.

Fig 2.9 (left): The children of Ring Ting Pre-primary School in Sunnyside adjacent to the site. (Facebook/ Ring-Ting Pre Primary School & baby care. 2012)

Fig 2.10 (right): Children enjoying early morning exercise (Kellert, 2008: 159)

2.6 The Biophilia of Children

"Effective biophilic design must integrate two domains of health: children and planet" (Kellert, 2008: 155).

According to the latest research findings (Wells and Evans 2003; Wells 2000; Kua et al. 1998) children who are in direct exposure to nature experience a healthy, therapeutic effect on cognitive development and mental well-being. The research explores the physical design in improving the quality and quantity of contact with nature. It is evident that there is a paradigm shift in the way opportunities for children to explore nature are being created.

According to Chawla, children are born as "biophilic beings", which means that an curiosity to explore and learn about how the natural world and its processes work is inherent to children's biology. He states, 'Effective biophilic design must integrate two domains of health: children and planet." In order for effective biophilic design to occur, children need to be a intricate part of it and must spend enough time in natural environments in order for biophilia to be installed as a lifelong effect. This will create a large community of biophilic citizens who love the earth so strongly they will do anything in their power to conserve and protect it (Chawla, 2006:57-78).

2.7 The Barriers to Children's Biophilia

The modern age of urbanization has led the ever more increasing construction of barriers limiting man's access to natural spaces which prevents them from developing love and respect for the earth and its resources (Crain, 2003: 145). These barriers include the lack of direct experience and contact with natural materials and processes in early childhood when the sensory impact of these natural features is the fundamental mode of learning; the lack of use of living environments in schools where the young minds of children are most susceptible to the benefits of the natural world; and the lack of diverse and sustainable landscapes in residential suburbs where children live. To increase the "activity friendliness" of urban neighbourhoods for children (de Vries et al. 2007: 35), enough structural urban design issues must be addressed such as high traffic roads and better designed pedestrian routes and park planning. Location of shared spaces between neighbourhoods and designating recreational facilities close to high density areas in order to increase walking for young people should also be incorporated in urban design strategies. In the images above, the children that exist on site are compared to the intended condition of their environment with complete immersion in nature.

Fig 2.11 (left): A group of toddlers play with fallen leaves, experience their sensory properties and explore their behaviour on the curved surface of a hollow log.

Fig 2.12 (right): Traffic-free urban trails and green-ways expose children to nature and help them learn the joy of bicycle riding at an early age.

2.7.1 Impact on cognitive development

According to a survey carried out in the UK by psychologist Michael Shayer involving 10000 11 – 12 year old children, many of them are falling behind in their cognitive and conceptual development due to an increase in video game culture and a decrease of experiential play (Crace, 2006: [sp]) A longitudinal study carried out by Wells in 2000 revealed that a statistically significant correlation between experiential play with views to nature and cognitive functioning. No doubt, full immersion of experiential play within natural surroundings will have a greater effect (Wells, 2000: 775-795).

Other beneficial factors of nature on the well-being of children include improvement in conditions of attention deficit disorders, child obesity, and improvement in mental, social and physical health including natural green spaces serving as immune system boosters.

In summary children are drawn to nature because it is pleasurable and gives them a sense of well-being, expansive freedom and agency and control over events. For children to reap the full benefits of being outdoors, engagement with nature must be available as an everyday ritual of life. In the images above, children are seen enjoying the many benefits that nature has to offer such as the sensory properties of a hollow log and green urban trails to help them learn how to ride a bike in a natural environment.

2.8 South African Examples of Biophilic Design

Although there are not very many explicit examples of biophilic design in South Africa, the Afrisam annual Awards which is an award which recognises buildings where design and sustainability go hand in hand, gives subtle examples of the positive impact biophilic design has on its users and the environment. The winners of this award goes to buildings that contribute to their surrounding community as well as reducing the impact on their environment by incorporating passive systems and regenerative design strategies (Afrisam.co.za. 2016).

One of the winners of the award was given to the design team of the Alexander Forbes building, designed by Paragon Architects, in Sandton, Johannesburg. Rain water is harvested, passive ventilation systems implemented and high performance glazing with louvres to shade from the afternoon sun are implemented into the building's design. These are sustainable principles but what makes this building biophilic is essentially its integration with natural elements into the spaces of the building which have proven to increase productivity and limit stress levels amongst its users.

There are two large atria which aims maximise natural daylight penetration into the office spaces as well as to the ground below which was designed to become a natural park like environment with the inclusion of 6m high Ficus Benjamina trees sunken into the floor. The light sources are twelve giant 8.4m cones, which float above the atrium space like giant clouds. All of these principles incorporate biophilic principles such as biomimicry, the use of light and space, inside-outside spaces, the use of natural patterns and processes and many more.

In an interview with employees of Alexander Forbes conducted by the Afrisam awards, many expressed how they didn't even feel like they were at work because the building created such a beneficial and pleasant environment for them (Afrisam.co.za. 2016).

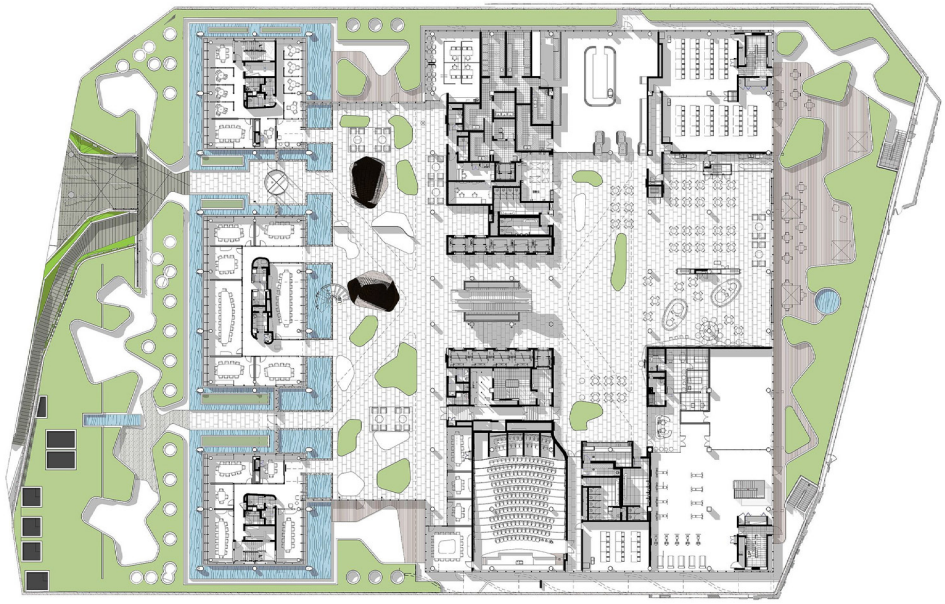

Fig 2.13 Ground floor plan (Arch Daily. 2012)

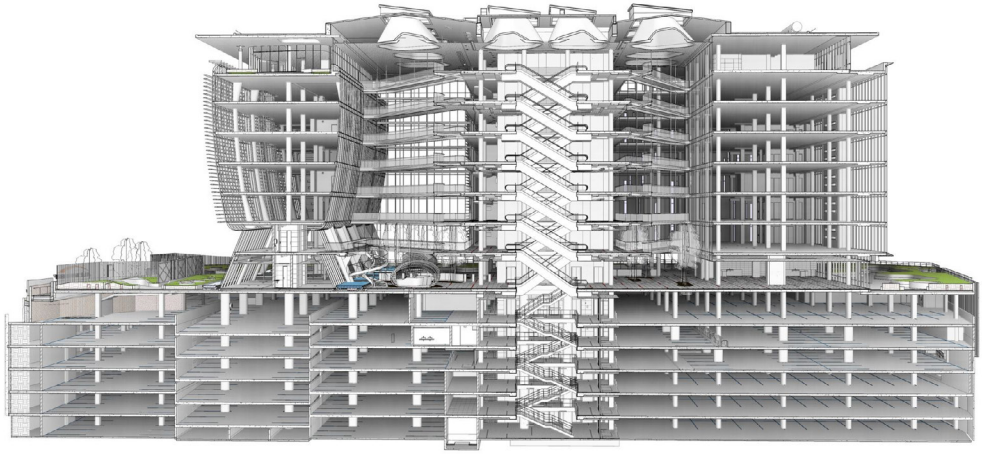

Fig 2.14 Section through atrium of building showing cloud like light sources (Arch Daily. 2012)

Fig 2.15 Image showing the trees in the designed park like ground floor. (Arch Daily. 2012)

2.9 Water, Nature, Children and Architecture

In the quest to answer the dissertation questions, of what relationship building should have with water, the child, and the natural systems that exist on site, and how biophilic experience can be enabled spatially, these different concepts of 'space' of firstly, water, the natural systems and the spatial perceptions of the child will be investigated in the architecture. For the water, space is seen as sculptor and unifier of all aspects of design (Kellert, 2008: 60). With regards to the biomimicry of natural systems, making of architecture is seen as a way to not only learn through the making of architecture what nature has to offer but also to pay homage and celebrate nature (Kellert, 2008: 164). The child, as biophilic beings, will learn through these principles, of the importance of natural systems, water and how they positively affect their environment.

Fig 2.16: A labyrinth at a primary school in the UK where children interact with nature and each other. (Kellert, 2008:170)

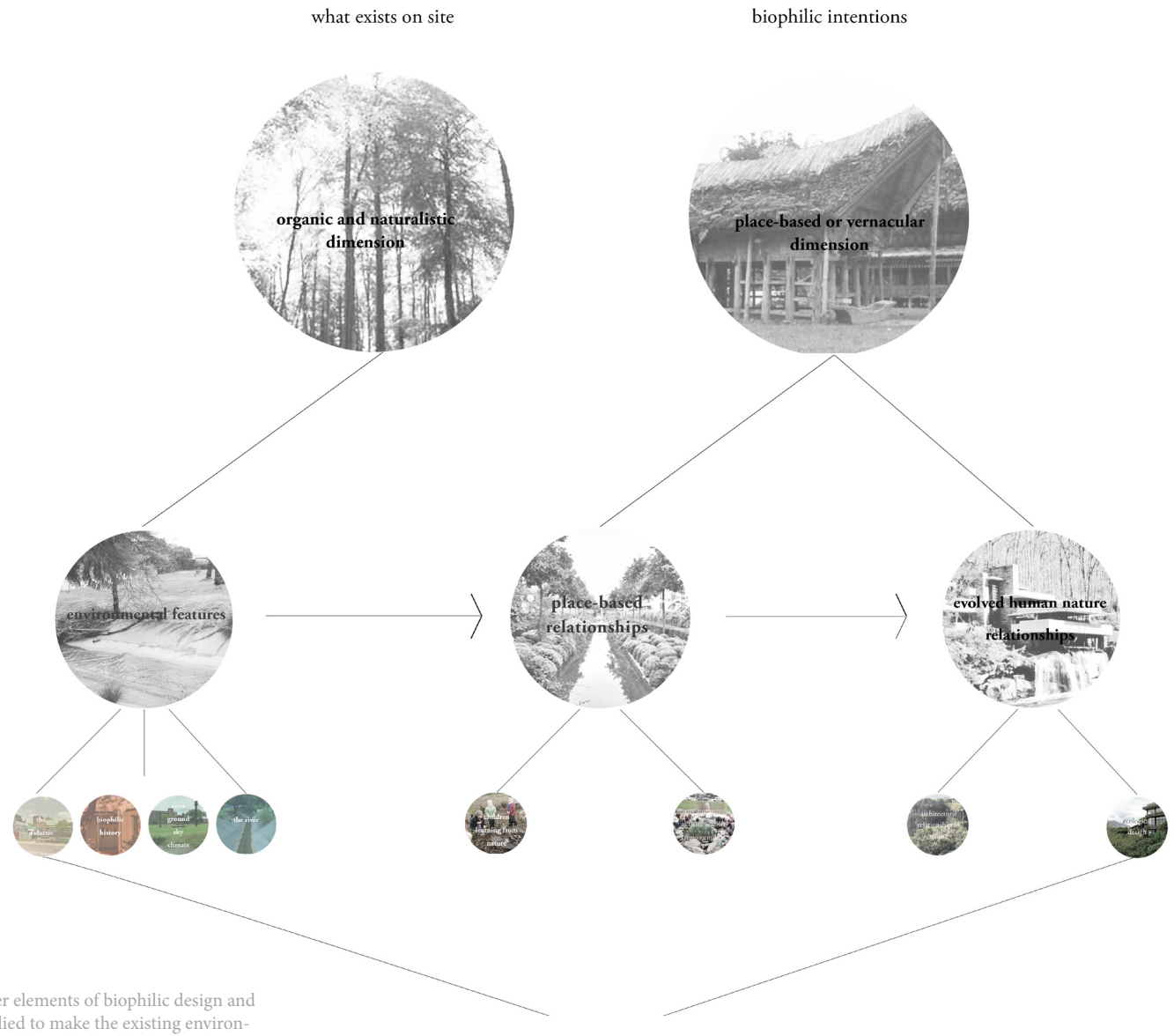

Fig 2.17 Diagram the richer elements of biophilic design and what attributes can be applied to make the existing environmental features richer (Author, 2016)