Biophilia in Architectural Design:
A Healthcare and Community Centre
for Mpumalanga, Durban

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ABSTRACT

Biophilia is the love of nature and all living things and is the theory that forms the basis of **'**biophilic**'** design. Biophilic design recognizes the positive experience of natural systems and processes in our buildings as critical to human health, performance, and well-being. Healthy living is a primary need for society and designing with nature could provide for these needs in architectural environments. Employing such techniques of design could improve the experiential quality of architectural space. The quality of healthcare environments and similar public places could become more accommodating for local communities. There would be a need for adapting these ideas to fit local conditions but through research initiatives, designers can understand what would be most suitable considering the circumstances of a region. If there is a marked effect of natural environments on the wellbeing of citizens, then biophilia can initiate a better approach in local architectural design for society.

DECLARATION

I hereby declare that this document is my own unaided work under the supervision of Mr Philippe Yavo. All citations, references and borrowed ideas have been duly acknowledged. It is for submission to the School of Architecture, Planning and Housing, University of KwaZulu-Natal, Durban, in partial fulfilment of the requirements for the degree of Master of Architecture. It has not been submitted before, for any degree or examination, at any other educational institution.

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………day of…………………………year………………

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PART ONE

BACKGROUND RESEARCH ON ISSUES

1.0 INTRODUCTION

1.1 Introduction

1.1.1 Background Statement

Building environments become subject to pollution, antisocial behaviour and poverty when neglected by citizens and authorities. The population in KwaZulu-Natal, as in other provinces of South Africa, live in the sprawl of under-developed settlements and do not have access to adequate services and as a result live in unhealthy environments. Quality of life for these people could improve by including healthier natural environments into architectural space, as supported by biophilic design, which proposes that the positive experience of natural systems and processes in our buildings is critical to human health, performance, and well-being. More than style and appearance, the harmony between man and the natural and built environments can potentially rejuvenate society both physically and mentally.

Fresh air, sunlight, water and greenery are desirable but built environments can deprive citizens of these when uncontrolled industrial and urban growth replaces natural biodiversity. Biophilic architectural design may revitalize the built environment, serving the needs of Durban and its surrounding population for a better living experience. More specifically, this approach can alter perceptions about the design of healthcare facilities and similar public buildings for quality service and experience. This renewed perspective can create awareness about the stewardship of nature and its beneficial role in architecture and the lives of the people that occupy it.

1.2 Definition of the Problem, Aims and Objectives

1.2.1 Definition of the Problem

Architects need to develop design recommendations that benefit people as well as the places in which they live by consulting and collaborating with other disciplines related to the environment and health. One must question whether natural environments are beneficial to human experience in comparison to building environments that are void of natural stimulus. Does biophilic design promote health and is there evidence that can support its effectiveness through the relation between built and natural environments? If proven that health and living conditions improve, then architects need to consider how nature and the built environment can work together. This method could provide healthy environments for citizens who use public buildings that provide essential services, namely healthcare, or live in otherwise unhealthy environments.

1.2.2 Aims of the Study

The aim of this study is to achieve the design of a healthcare and community centre with nature as a benefit to human experience. By conducting appropriate academic research on the principles of architecture in relation to biophilia, the recommendations and conclusions drawn can guide the designer to the eventual synthesis of a design prototype. If an effective design can be created with biophilia in mind then such an approach can be a socially and environmentally responsible method for developing built environments that are otherwise disadvantaged.

1.2.3 Objectives of the Study

The study's objectives will be to:

- Develop healthy built environments to improve living conditions
- Understand human health needs (physical, mental and social health)
- Study architectural examples manifesting biophilic characteristics
- Develop criteria and recommendations for future designs
- Demonstrate the concept through a proposed prototype for a healthcare and community centre

1.3 Setting out the Scope

1.3.1 Delimitation of Research Problem

The researcher will consider the human benefits (social, physical and mental health) associated with biophilic design and the positive experience of natural environments. The methods proposed cannot guarantee that nature will cure an individual from illness but rather that a prescribed healthy building can offer a positive contribution to healing. The eventual design for this dissertation will be limited to an environment with some form of natural value and in need of community revitalization.

1.3.2 Definition of Key Terms

- *Architectural phenomenology - a philosophical design current in contemporary architecture based on the conscious experience of buildings and their sensory properties*

- *Architectural regionalism - an approach to architecture that strives to counter lack of identity in modern architecture and built environments by utilizing the building's geographical context (economical, environmental and social) to create a sense of place and meaning*

- *Biophilia - the love of nature and all living things; the derivative of **biophilic design** which recognizes the positive experience of natural systems and processes in our buildings as critical to human health, performance, and well-being*

- *Environmental psychology - an interdisciplinary field focused on the interplay between humans and their surroundings*

1.3.3 Stating the Assumptions

The researcher assumes that designing buildings with the methods prescribed is economically viable for the developing peri-urban regions of Durban. The researcher also assumes that the theories explored in the study, namely architectural regionalism, biophilia and architectural phenomenology are the most appropriate for creating healthy places for communities and specifically towards the design of an effective healthcare and community centre.

1.3.4 Hypothesis

This research aims to accommodate society by promoting the primary needs of mental, physical and social health through buildings designed with nature. By investigating the claims of academics and the practicalities of such methods, researchers can develop conclusions for effective design principles in healthcare architecture and the built environment as a whole.

1.3.5 Key Questions

- How can developers balance economical development with natural and social conservation?
- How does one become a steward of the natural environment?
- Are there building methods which are a detriment to human health and environmental concerns?
- Is there a way of reversing negative effects by employing biophilia as a design method in our local context?
- Can the built environment foster health improvement and how would this be done?

1.4 Concepts and Theories

Biophilic design considers the harmonious relationship between humans and their natural and built environments. Such an approach in design can create built environments that restore and maintain human health and wellbeing. Considering the link between people and their buildings as 'bees to their hives' (Graham, 2003: 1), biophilic design encourages a symbiotic relationship between man and his natural environment. Buildings should place emphasis on issues such as 'increased sensitivity to chemicals and pollutants; acoustical design; and access to daylight, nature and the outdoors'

(Guenther & Vittori, 2008: xiv). These qualities can be physically and psychologically therapeutic as supported by **environmental psychology**. Architects need to consider the way in which buildings are designed, constructed and maintained to promote healthier built environments. The choice of building materials need to perform for human comfort and have low environmental impact. Such building methods can be adapted to a variety of building typologies but the effects of such approaches are more directly felt in healthcare related developments serving developing communities that do not have access to appropriate public services.

In today's fast paced world, buildings are often built with sole consideration towards finishing a project on time and within budget without considering the ecological and experiential qualities of the place. Buildings have many parts like the human body which need to function in harmony and together with their contextual setting (the spirit of place). 'Buildings define social, environmental, and economic realities, and they are places where people in many parts of the world spend most of their time' (Guenther & Vittori, 2008: xvii). **Phenomenology** aims to maintain the balance between architecture and the qualitative experience of place. Healthy natural environments must be identified within the modern context as it may be lost if designers continue planning ignorantly.

The three-fold approach of responding to the environment, society and economy is often employed in **architectural regionalism**. Essentially what architects should create are relationships between natural ecosystems and human systems for the social health benefits of a community. Regionalism is a response to the a-contextual attributes of modernist design in the global context. In South Africa as in many parts of the world, society is facing the problem of decreasing ecological health and increasing human needs from under-privileged citizens. Authorities must be less self-centred and more community centred. 'Like choosing medicine at a pharmacy, understanding what building decisions cause ecological ill-health is an essential prerequisite for being able to either choose the best building remedy or for developing even better ones' (Graham, 2003: 4). All designers should employ such methods with humility towards the service of man and the creation of **humanistic environments**. 'Ethical design must also be environmentally sound and ecologically benign. It needs to be human in scale, humane and embedded in social responsibility' (Papanek, 1995).

In the context of Durban, some hospitals and clinics fail to meet quality health requirements. Architect's need to be aware that the public facilities they design must amend such problems. The design of public buildings should be influenced by their environmental context. Seeing that health is a continually vital need for human existence, the decisions made at the beginning of a project need to be measured for their long-term effects on the local community and the natural environment; decisions need to be **sustainable**. Economic advancement is important but the new technologies employed in healthcare and building development need to be socially and environmentally responsible. Therefore

the materials used for construction need to have a low carbon footprint, low levels of toxicity and be easily replenished from local resources.

1.5 Research Methods and Materials

1.5.1 Primary Research

Primary research will be conducted in the form of case studies of existing facilities which are relevant to healthcare and community buildings. The methods used for retrieving data will include **oral surveys** (semi-structured interviews). This qualitative method can be used to clarify respondent's satisfaction with their working/ living environment and whether nature is a vital component to patient therapy. The important thing in an oral survey is to aim for clarity and not to pose ambiguous questions to respondents. Permission from the healthcare organization will be required for using data gathered for research purposes. The key is to ask relevant questions to meet the aims and objectives of the thesis (Neale, 2009: 121-136).

Another qualitative method is **in-depth interviewing**. Interviews can gain facts and opinions towards research from an experienced respondent in a particular field. The interview is generally unstructured or semi-structured. This kind of research is valuable in phenomenological research (subjective experiences, especially those within healthcare environments). The open-ended nature of unstructured interviews allows the researcher to probe for their answers and understand the facts within a broader context. The problem with in-depth interviewing however is the probability of bias. A good grounding in the existing literature on behalf of the researcher will allow an in-depth interview to take place without a tendency towards bias (Neale, 2009: 197-210).

The case studies will also be analyzed by **observation** and comparison with the conceptual framework established by background research in the literature review. Comprehension issues can arise due to language barriers and so observation becomes useful in this regard.

1.5.2 Secondary Research

Secondary research sources will be consulted to establish a conceptual framework to the eventual model building. The sources used will include books, journals, websites, dissertations and videos.

The quantitative method used will be the **randomized control trial** between community healthcare facilities that use nature conscious building design and facilities that use standard building design. The

goal is to compare the environments and the affects they have on patients. The groups of people in the trial need to be as similar as possible so that any affect is due to the intervention and not by any other factors (age, etc.) **Health status reports** can be used for comparison purposes to monitor the affects of healthier environments on people, if any (Neale, 2009: 152-165).The author will use existing health research documentation to validate the thesis statement, therefore being a secondary mode of research.

2.0 LITERATURE REVIEW

2.1 Introduction

A statement by Le Corbusier in the *Critique of Regionalism* (Colquhoun, 1996) cited by Canizaro (2007: 144) says: 'there will be no confusion of regions; for climatic, geographic, topographic conditions, the currents of race and thousands of things still today unknown, will always guide solutions toward forms conditioned by them.' Design solutions should be guided by the natural environment as well as social and economic factors for a more complete approach. 'An environmental improvement, if achieved at the cost of decreasing economic distribution, might be opposed by the poor' (Girard *et al,* 102) and similarly John Burchard and Albert Bush-Brown emphasize that, 'a design that fails to provide full emotional and physical performance is not economical, however cheap' (Roth, 1993:137). For the purpose of this research the aspects of natural environment and societal responsiveness in architecture will be addressed to revitalize disadvantaged places by improving living conditions.

Urbanization mostly replaces natural environments and society has become familiar with this mode of urbanity where nature takes second priority. 'Materialism and the emphasis on competition are eroding the more traditional emphasis on cooperation and collaboration' (Girard *et al,* 2003: 229), with nature and with each other. 'A host of contemporary environmental problems- climate change, ozone depletion, acid rain, toxic pollution, decreased biodiversity- can be linked to the production and maintenance of the built environment' (Guenther & Vittori, 2008: 26).

The goals of biophilic design are comparable to the 'organic architecture' advanced by Frank Lloyd Wright (Wright, 1954: 3) but with a greater emphasis on scientific evidence based design e.g. responding to medical research statistics to create healthier living environments. Sustaining natural environments can in turn sustain social environments; this symbiotic relationship is supported by biophilia. Biophilic design is not an innovation today, it was the way buildings were designed for much of human history (Kellert *et al,* 2008: vii), the issue is that modern society has neglected this way of building in the recent past (refer to Fig. 1). Many of the theorists, planners and architects referred to in this research were not necessarily aware of the biophilia theory during the course of their work but the ideas proposed by them bear relevance to biophilia.

(Fig. 1)(Source: img3.visualizeus.com) An artist's impression of the disparity between industry and nature; a balance needs to be formed. Accessed 25-11-10 (artist unknown)

The word *biophilia* originated with the entomologist EO Wilson (Wilson, 1984) meaning the love of nature and all living things. He used it to describe people's inclination to affiliate with the natural world. Biophilic design incorporates both organic/ naturalistic design and vernacular/ place-based design that can be conveyed symbolically as well as through direct relations with natural and social structures in architecture (Kellert *et al,* 2008: 5). The word organic in this sense is used to describe the integration of human architectural environments with natural ones. Such environments make people feel connected with their surroundings rather than feeling separated or boxed in by man-made containers. Climatic response through natural lighting and ventilation is also considered for the benefit of buildings occupants. Biophilic design aims to create psychological, physical and socially healthful environments for life and so place-based responses are part of this approach where social and cultural relevance remain important factors.

Immanuel Kant believed that humans are ends in themselves and separate beings from the rest of nature; an anthropocentric view. Consider a tree though: it still has interests even in the absence of consciousness (Girard *et al,* 2003: 114). Humanity must be in commune with nature and overcome the barriers which separate it from society. Without the resources of nature there would be no air, water, food, and shelter for people. Society must become a part of the eco-cycles of nature and not the conqueror of nature to prevent problems arising due to ignorant building methods. 'We human beings are members of a biotic community, no less than we are members of a nested hierarchy of human communities' (Girard *et al,* 116).

For this research attention must be focused on the South African context to develop a relevant response for the land and the community. With the 'healing' qualities associated with biophilic design the background research will eventually focus attention on community healthcare in the proposed prototype building. South Africa contributes about 40% of all expenditure on healthcare with the public sector being under resourced and over used. Most resources are concentrated in the private sector which sees to the health of only 20% of the population (southafrica.info, 2010). Healthcare and public service needs to find unity rather than difference in the service of citizens to avoid any forms of segregation. 'The challenge before us, and the healthcare industry, is how to support and advocate community growth that is healthy, socially just, and environmentally sustainable' (Guenther & Vittori, 2008: 48).

Health care varies from basic primary health care, offered free by the state, to highly specialised health services available in the private sector for those who can afford it. The public sector has shifted its emphasis from acute to primary health care while private hospitals have begun to take over many specialist health services in recent times (southafrica.info, 2010). The number of private hospitals and clinics continues to grow in centralized urban areas and the need of primary health care facilities especially in peri-urban communities has not received enough attention. Citizens rely on m obile medical care services to meet the ongoing need of the growing population but more permanent modes of healthcare are becoming vital to meet this need (refer to Fig. 2). For this reason, the eventual proposed prototype building will be a primary healthcare and community centre.

(Fig. 2)(Source: noozhawk.com & heinekeninternational.com) Mobile medical care services annually visit peri-urban and rural communities. The train above and van below are examples of mobile medical care units. There is a need for more permanent modes of healthcare to meet the needs of citizens. Accessed 25-11-10

Balance in the healthcare system needs to be restored by improving the performance of health care facilities in the health sector. Equal dispersion of funds accompanied by research in improving the quality of healthcare and community environments is needed. Architects need to generate new design strategies for regionally relevant buildings so that the performance of health facilities can improve from what is currently attained to in the health sector. The new design strategies need support and approval from the health sector (public and private) and there is need to educate architects and developers of the merits, viability and sustainability of biophilic design.

The literature review to follow will further clarify the qualities of biophilic design and relative theories and practicalities in the creation of architectural environments and how designers can create buildings that are in tune with nature and its life giving qualities. Once understood the theory can be considered for application in the local context and specifically its role in healthcare and community architecture.

2.2 Biophilic Design

2.2.1 Scales and Elements of Biophilic Design

Tried systems need to adapt just as the natural world adapts, 'as we grow in experience and knowledge, we change and adapt to our expanded condition' (Roth, 1993: 1). How do architect's design buildings for future change, how do they avoid compromising culture, the environment and human comfort; these are questions that need to be asked for a better building model for the future. Lewis Mumford said, 'the building must… fit its site, harmonize with or stand out from its neighbours, fulfill its own function as a shelter, a work-place, or a play-place, and give a special pleasure to everyone who passes it or enters it' (Roth, 135).

Before considering the biophilic approach, it is important to realise that biophilic design elements effect many scales of the built environment, from the macro of creating green networks within urban design schemes to the micro details of providing natural light to interior spaces for human comfort. One should experience nature at a variety of scales to ensure a continued sense of connection with nature in an urban environment. The following is a demonstrative list by Girling (2005) of the scales in biophilic design as cited in Kellert *et al.* (2008: 278):

SCALES AND ELEMENTS OF BIOPHILIC DESIGN

Scale	Biophilic design elements
Building	Green rooftops Sky gardens and green atria Rooftop garden Green walls Daylit interior spaces
Block	Green courtyards Clustered housing around green areas Native species yards and spaces
Street	Green streets Urban trees Low impact development (LID); vegetated swales and skinny streets Edible landscaping High degree of permeability
Neighborhood	Stream daylighting, stream restoration Urban forests Ecology parks Community gardens Neighborhood parks/pocket parks Greening grayfields and brownfields
Community	Urban creeks and riparian areas Urban ecological networks Green schools City tree canopy Community forest/community orchards Greening utility corridors
Region	River systems/floodplains Riparian systems Regional greenspace systems Greening major transport corridors

'At certain stages of life, the social and cultural richness of dense urban experience outweigh the disadvantages. For families, however, we need to find ways of combining this with the renewing qualities of light, air, greenery, quiet and space to feel free in' (Day, 2004: 271). The following table is a demonstrative list of the attributes of biophilic building design (Kellert *et al,* 2008: 15).

TABLE 2:

ATTRIBUTES OF BIOPHILIC DESIGN

Environmental features	Natural shapes and forms	Natural patterns and processes
Colour	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 and domes	Patterned wholes
Natural materials	Shapes resisting straight-lines and right angles	Bounded spaces
Views and vistas	Simulation of natural features	Transitional spaces
Facade greening	Biomorphy	Linked series and chains
Geology and landscape	Geomorphology	Integration of parts of 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

An interesting parallel is David Pearson's Gaia Charter (Pearson, 2001: 72) where it states:

"Let the design:

- be inspired by nature and be sustainable, healthy, conserving, and diverse.

- unfold, like an organism, from the seed within.

- exist in the "continuous present" and "begin again and again".

- follow the flows and be flexible and adaptable.

- satisfy social, physical, and spiritual needs.

- "grow out of the site" and be unique.

- celebrate the spirit of youth, play and surprise.

- express the rhythm of music and the power of dance."

The following chapter will begin with the macro scale of bioregional planning and each succeeding section will increase in focus thereafter.

2.2.2 Bioregional Planning

Buildings should be adapted to the climate, geography and topography of their place (Graham, 2003: 220). This mode of design is called 'bioregional planning'- it integrates urban and natural environments and promotes the design of communities to function in harmony with the ecosystems within which they are geographically located. In city environments it is referred to as 'green urbanism'. Bioregional planning emphasizes self-reliance, the use of indigenous landscapes, waste elimination through recycling and co-generation, and encouraging local economies and employment (Graham, 278). Consider also the human settlements in the past which almost always developed on high ground while agriculture thrived in the alluvial flat lands where water would retain; Lewis Mumford was an advocate for similar modes of regional planning where people lived off the land (Girard *et al,* 2003: 153).

'Ecological planning is the use of biophysical and socio-cultural information to suggest opportunities and constraints for consensual decision-making about the use of the landscape' (Stitt, 1999: 50). As a city expands, it displaces whatever came before it. Planners need to consider how nature can integrate into the urban environment. The 'fingers of the city' should develop on areas of least ecological impact to allow areas of rich ecological diversity to fill the spaces between (van Wyk, 2009: 35). Greenways and eco-networks, urban forestry and the naturalising of urban parks are all part of the regeneration ideas posed by ecological planning.

In a citing by Canizaro (2007: 249) from *A Pattern Language* by Christopher Alexander (1977) it says:

> *'As the big cities grow, the population movement overburdens these areas with air pollution, strangled transportation, water shortages, housing shortages, and living densities which go beyond the realm of human reasonableness. In some metropolitan centers, the ecology is perilously close to cracking. By contrast, a population that is spread more evenly over its region minimizes its impact on the ecology of the environment, and finds that it can take care of itself and the land more prudently, with less waste and more humanity.'*

If planners consider this in light of the compact city for socio-economical reasons they realize that a balance and order needs to be reached between density and adequate outdoor/ natural public space. Crowding may be highly stimulating in a market place for example but prolonged experiences of this sort can be unhealthy; the feeling of entrapment needs to be alleviated by natural outdoor public space. Planners must 'humanize' compact cities by balancing indoor private with outdoor public spaces.

Crain (2003) makes mention of nature deprived neighbourhoods saying:

> *'Many barriers presently limit children's access to nature, which may prevent them from growing up with love and respect for the planet and a passion to protect it. Experiences of natural processes and materials in early childhood, lack of use of living environments in schools, lack of rich, diverse, accessible sustainable landscapes in the residential districts where children live are all examples of this limited access.'*

Street sidewalk design can be more 'humanistic' such as in Seattle where an effort has been made to show the natural alternatives to conventional street-sidewalk-and-yard designs. 'Wide auto-dominated (suburban) streets have been converted into narrow, wavy, vegetation-filled green streets with sidewalks... the street has become a series of rain gardens collecting and treating stormwater' (Kellert *et al,* 2008: 282) (refer to Fig. 1). Likewise, such inviting, natural streets can be adapted to urban environments. As Christopher Day (2004: 238) says, 'human scale feeds street life... prestige scale doesn't. It makes gusty wind, permagloom shade and street boredom'. The scale of some modern buildings is impersonal and intimidating; designers must not create hard-edged environments but promote human scale, sociable and natural atmospheres at street level.

(Fig. 1) (Source: studioblog.com) A sidewalk in the residential area of Seattle uses landscaping to create a more human-nature friendly atmosphere for the pedestrian.
Accessed 25-11-10

In restorative environmental design the emphasis is not on leaving the built environment, but on 'reconciling it w ith the natural environment in a way that is psychologically, culturally, and ecologically sound' (Kellert *et al,* 2008: 141). The goal of Perth's 'Bush Forever' conservation program is 'keeping the bush in the city' and has designated a network of about 300 urban bush sites, together comprising more than 50 000 hectares of land (Kellert *et al,* 293). 'In Copenhagen, its famous regional 'fingers' plan, with large green wedges that extend to the centre, dates to 1947' (Kellert *et al,* 279). The greenway paths link to other natural areas, schools and shops in the region (refer to Fig. 2). 'Wooded lungs' incorporated into urban regional planning reduce the affect of 'smogs and high rates of respiratory illness' (Day, 2004: 77). 'The Trust for Public Land has determined that many of our best cities are comprised of 20 percent parks and open space' (Kellert *et al,* 301).

(Fig. 2) (Source: gardenvisit.com) The Copenhagen 'fingers' plan allows areas of natural diversity to penetrate city space, which improves the urban living environment. Accessed 17-05-11

'Cities are inherently embedded in complex ecosystems' (Kellert *et al,* 2008: 277) and so planners must provide for the continuation of green systems in urban environments for the benefit of natural, social and economic well-being. 'The usually excessive spaces allocated for facilities that do not materialize fragment the urban fabric and frequently become dangerous, environmentally negative, liabilities' (Dewar, 1995: 6); consider the 'lost' space of Durban's Centrum car park. Durban however has taken opportunities with the likes of Bulwer Park, the Botanical Gardens, Mitchell Park Zoo, the Beachfront and other reserved nature areas and the benefits that these afford for the citizen's (refer to Fig. 3).

(Fig. 3) (Source: roomsforafrica.com) Above is a map of Durban revealing the conserved green spaces of the city in relation to developed space. Accessed 17-05-11

By comparison one can consider an example of a city with a good open space network as Brisbane and a city with an inferior open space network being Mexico City (refer to Fig. 4). Citizens and tourists enjoy a variety of activities including shopping and dining in Brisbane's parklands, gardens and port. Cycling along one of the many bicycle paths through the city or climbing rocks at the nearby Kangaroo Point cliffs are amongst the many activities that make Brisbane an attractive place. Parts of Mexico City, however, have little open space between buildings and rely heavily on automobile transport, which has resulted in citizens suffering from various diseases due to urban congestion and air pollution (wikipedia.org, 2011).

(Fig. 4) (Source: exceptional.org.au & farm4.static.flickr.com) Compare the
examples of a city with a good open space network, Brisbane (above), and a city
with an inferior open space network, Mexico City (below). Accessed 17-05-11

Some good international examples of nature inclusive development are clustered housing and green space networks such as Trudesland in Denmark, Kronsberg in Hannover and Western Harbour redevelopment project in Malmo (refer to Fig. 5). 'If we green our streets, create urban parks, and create green pathways along rivers, waterfronts, and other parts of the natural connective tissue of our cities, then urban residents are likely to have more daily pedestrian contact with green space than suburban residents' (Kellert *et al*, 2008: 299). Similarly Ebenezer Howard proposed a network of dense garden towns and villages surrounded by greenbelts of preserved agricultural and natural lands as an alternative to the ills of the industrial city (Kellert *et al*, 2008: 298).
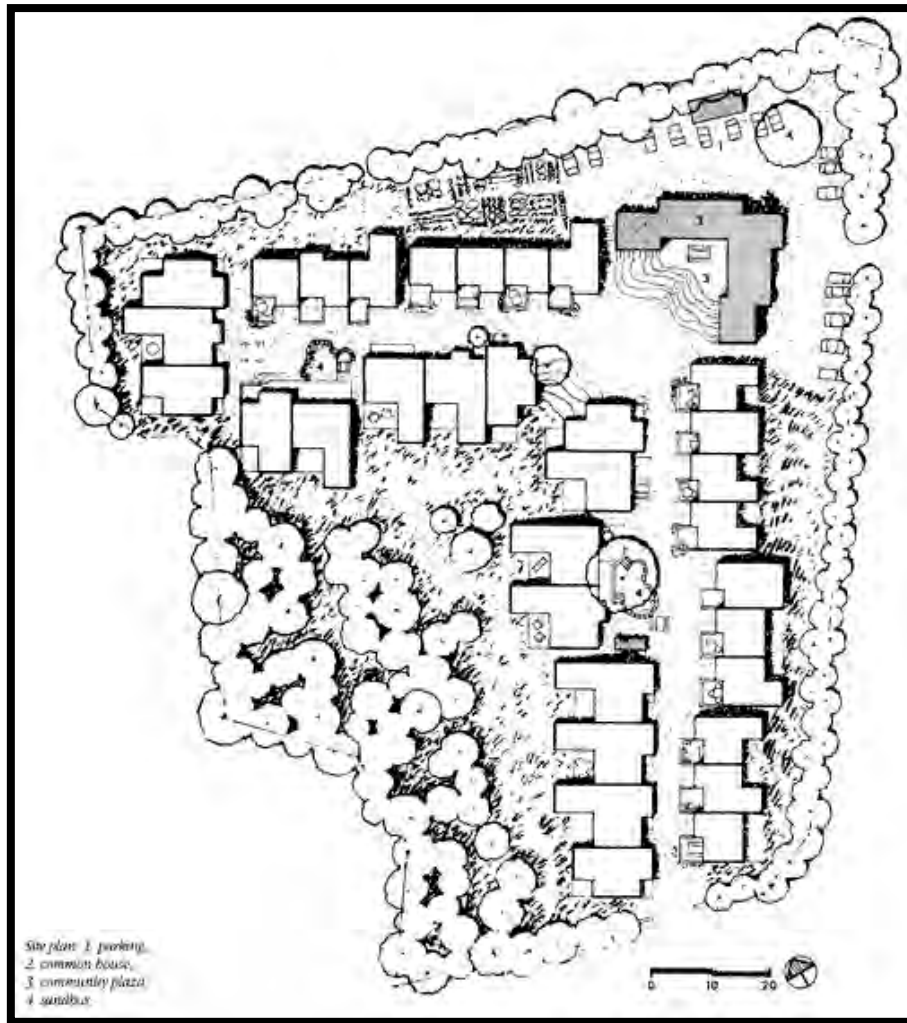
(Fig. 5) (Source: marshcousins.files.wordpress.com) The community housing at Trudesland in Denmark frames outdoor natural space for the benefit of the residents. Housing heights are no more than two stories high, ensuring a building scale that is humane and respectful to the natural landscape. Accessed 24-02-11

The content of this section has revealed that cities should develop on areas of least ecological impact to allow areas of rich ecological diversity to fill the spaces between and designers must not create hard-edged environments but promote the greening of streetscapes and urban public space for community benefit. The following section will consider some of the fundamentals of urban design including concepts such as public and private domains, urban imageability, figure-ground, linkage and place theories, compaction and mixed-use development.

2.2.3 Urban Design Fundamentals

As a su pplement to incorporating biophilia into urban environments, the following are some commonly accepted theories as a basis to urban design. Christopher Alexander (1987) divided the urban environment into six domains, namely:

Urban Public- highways, roads, civil parks

Urban semi-public- under institutional control

Group public- places of meeting

Group private- community garden, neighbourhood

Family private- house

Individual private- bedroom

Every opening in a building has the potential to connect people with the outside and vice versa. 'If we look at the world around us, the places most rich in life are meeting places – and not only cafés and city squares' (Day, 2004: 34). 'Some sorts of places, like widening in a corridor with a window seat, induce casual social meetings; others, like lifts, stifle such interplay. Similarly, some shapes, like round tables, bring people into community, and others, like uninterrupted corridors or long rooms, don't' (Day, 21). Architects need to create a diversity of spaces both outdoors and indoors where people have the opportunity to meet between the public and private realms; this will improve the connectedness of our built and social environments (Smithson, 1962: 44). Aldo van Eyck also said that the door should not just be a portal for coming and going but it should be 'made a place for an occasion' and integration between the inside and the outside (the threshold between private and public realms) (Luchinger, 1981: 32). This also improves defensibility by reducing crime through occupant surveillance.

Kevin Lynch (1960) went on further to identify five elements that compose the 'image of the city' (refer to Fig. 1) and in turn, shape public spaces, namely:

Path: a movement line that gives structure to a place e.g. active pedestrian street. All paths should lead to a 'destination'. One must also create visual paths to prominent parts of the urban environment (way finding)

Edge: a h ard edge is a b arrier between two places; a so ft edge is permeable such as a st orefront opening onto a sidewalk

District: a region with a common character, building heights, functions, colour, etc

Node: A convergence of important paths and activities in a particular place e.g. a transport node (bus, taxi, car)

Landmark: A point of reference, not necessarily monumental, can be an activity or natural feature or anything associated with a region
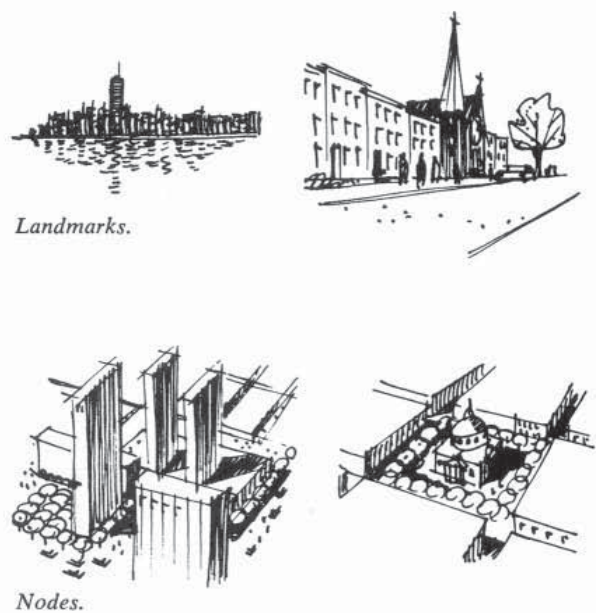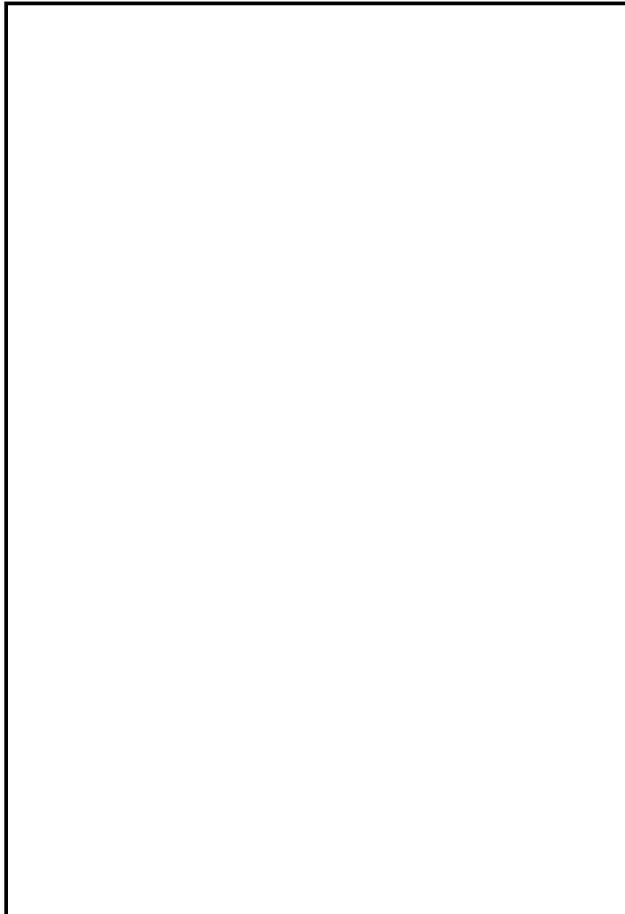
(Fig. 1)(Source: Time-Saver Standards for Urban Design, 2003) Kevin Lynch's elements that compose the 'Image of the City'. Published 2003

Roger Trancik conveyed the ideas of figure-ground, linkage and place theories in *Finding Lost Space: Theories of Urban Design* (Trancik, 1986). Figure-ground theory studies the relative land coverage of buildings as solid mass (figure) to open voids (ground). The figure and ground approach to spatial design is an attempt to manipulate space by adding to, subtracting from, or changing the physical geometry of the pattern to clarify the structure and hierarchy of urban space (the urban fabric) (Trancik, 1986: 97) (refer to Fig. 2). Linkage theory concerns "lines" connecting one element to another. These lines are formed by street, pedestrian ways, linear open spaces or other linking elements that physically connect the parts of the city, similar to Lynch's concept of the path. Cities
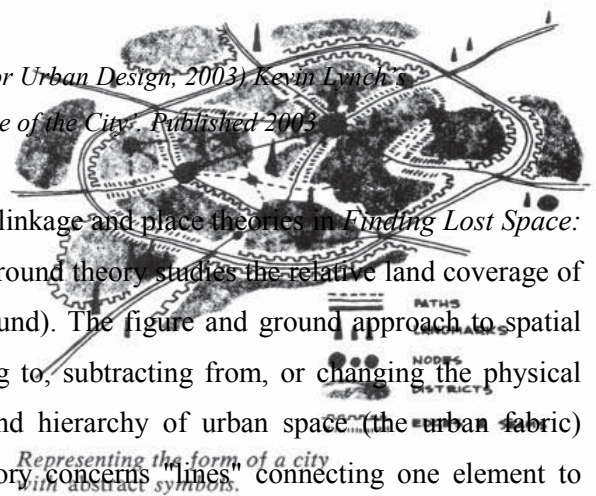
should not comprise of isolated blocks/ fragments, which is why cities need linkage. Place theory adds the components of human needs and cultural, historical and natural contexts to make spaces a vital part of community life within the urban context. In Aldo van Eyck's theories on structuralism, he also said, 'whatever space and time mean, place and occasion mean more' and that 'urbanism must create the interior both outside and inside' (Luchinger, 1981: 27); the homely street.

(Fig. 2)(Source: bricoleurbanism.org) The above figure-ground analysis is of a portion of Rome. It reveals the many 'linkages' in white as opposed to buildings in black and 'places' such as the central Piazza Navona which is framed by building figures. Accessed 17-05-11

'Different actions demand places with a different character. A dwelling has to be "protective", an office "practical", a b all-room "festive" and a church "solemn"' (Norberg-Schulz, 1979: 14). Architects must take note of the nature of the spaces they design. Such places as community markets provide opportunity for prospect, liveliness and social activity while the vicinity of healthcare environments needs to provide a sense of refuge and privacy for the ill. Designers must take cognizance of the activities taking place in urban space (complexity stimulates in the extraverted public space, simplicity calms in the introverted private space) (Augustin, 2009: 135- 137). Paul Rudolph's Lindemann Mental Health Centre is an example of where unnecessary complexity becomes disorienting and detrimental to the sanity of patients; simplicity will be adequate in a built environment of this nature (Nobel, 2011) (refer to Fig. 3).

The age of enlightenment brought with it many things… 'it gave rise to cities growth beyond their walls and to an intermediate zone between city and nature called the suburbs' (Kellert *et al,* 2008: 297). The sprawling townships of South Africa are not a result of this but rather forced removal during apartheid (eThekwini's 'periphery' townships include; Umlazi, Mpumalanga and kwaMashu amongst others). 'Environmental racism' links environmental issues to race and gender inequality and in turn to poverty (Girard *et al,* 2003: 100). Compact towns of diversity can be considered a better alternative with local mass transit meaning reduced travelling distances that improve air quality due to lower emission levels and reduced energy consumption. 'New Urbanism argues for a return to traditional neighborhood development- the compact, higher density, mixed-use, transit-oriented, walkable developments that were the norm [in the Western world] prior to the 1950s' (Guenther & Vittori, 2008: 35).

Mixed use was natural to pre-industrial cities; people made things and sold them from where they lived. Today, with mobility, specialization, industry and compartmentalized thinking, it is not. 'After decades of zoning, mixed use is now recognized as vital to social wholeness, security and urban colour, as well as traffic reduction' (Day, 2004: 267). Hertzberger believed that linked building structures created a 'lattice of social groups' (Luchinger, 1981: 43). 'Places can come into being where sociable commercial functions organically grow up – quays, streets and larger squares where it's natural for all sorts of commercial interchange to take place; off-street courts and upper-level arcades and passageways' (Day, 269). 'The smaller are streets, the more human their scale. Trees, awnings and curb-edge arcades narrow them. Bends, road-ends and out-jutting buildings 'deflect' or

'terminate' them, closing the space to a scale we can relate to and making inhumanely long strips into a series of smaller places' (Day, 271).

The favourite human pastime of watching people move through an outdoor urban space needs to be designed for. The new 'life style centers' feature 'water elements, village-type settings, pleasant landscaping with large trees, meandering pathways, multiple places to see and be seen, and a multiplicity of shops and restaurants' (Kellert *et al*, 2008: 232). Consider the Irene Mall in Gauteng Province, South Africa, being a more extroverted environment than the traditional introverted mall. It creates a greater sense of freedom and connection with the outdoors while people are shopping through the 'village' setting (refer to Fig.4).

(Fig. 4) (Source: static.panoramio.com) Statues and water features in the public spaces of Irene Mall offer a livelier alternative to the contained environment of the traditional shopping space. Accessed 25-11-10

Christopher Day argues that 'varied and visible human activity is central to urban vitality' (Day, 2004: 269); some refer to this as the hybridism of an architectural place. The more activities overlap in the public realm the greater the chance for social interaction; designers need to provide environments for these meetings. An international example of a building that incorporates mixed uses to encourage social wholeness is It Trochpaad in Wommels, Netherlands. The multi-use building successfully prevents the population in the small town from declining by offering a high level of municipal facilities that include two primary schools, a centre for baby and childcare, the community

health service, an office for home care, a sports club, a music school and the town library. The building has a central space with an entrance on all four sides (MIMOA.eu, 2011) (refer to Fig. 5).
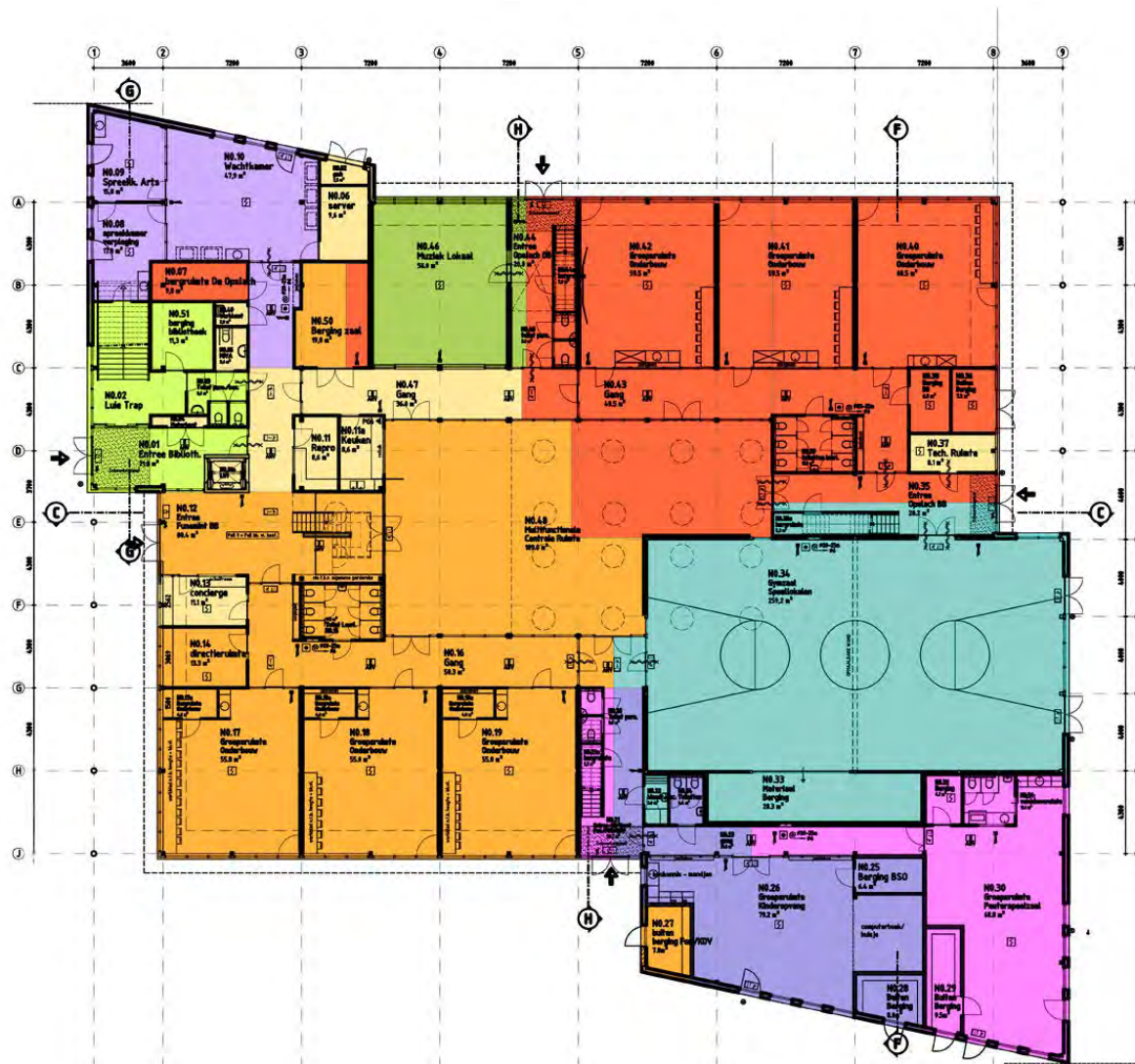
(Fig. 5) (Source: bureaubos.nl) The ground floor plan reveals the layout around the central common space with the mixed uses indicated by the various colours. It Trochpaad is a combination of educational, health and sporting facilities. Accessed 09-04-11

From the macro level of urban design and regional planning the research will now narrow down to the building and its respective issues. Some of the more critical elements will include climatic design, followed by indoor and outdoor landscaping, water in architectural environments, symbolism and nature as well as appropriate technologies and materials for construction.

2.2.4 Climate Responsive Design

Historically, environments of care were strategically located on hilltops or higher planes for reasons of 'solar orientation, prevailing winds and views' (Guenther & Vittori, 2008: 95). Commonly used spaces should have windows with nature views while avoiding possibilities of glare with shading devices for comfort. Waiting areas for stressed families in healthcare environments need natural light and ventilation to reduce the effects of stress. Bathrooms should be located on the hallway side to provide greater daylight exposure to wards and avoiding deep plan buildings can provide greater access to natural light within interior spaces. Consider meeting Scandinavian standards that ensure that 'every worker is within seven meters of a window wall, for views, light and air' (Kellert *et al,* 2008: 128).

Studies conducted by Beauchemin and Hays have shown that patients assigned to a sunny critical-care room had lower mortality rates than those in north-facing rooms lacking sunlight (the opposite would be true for the southern hemisphere) (Guenther & Vittori, 2008: 86). 'In healthcare environments, windows should occupy from 20 percent to 30 percent of the exterior wall' (Augustin, 2009: 234) for the above mentioned reasons. Paimio Sanatorium, designed by Alvar Aalto, supports outdoor sunshine therapy by permitting each tuberculosis patient's bed to be wheeled directly out onto adjacent southeastern terraces (refer to Fig. 1), this despite the twentieth-century trend of hospitals which pursued enclosed environments that kept the 'harms' of nature away from patients (Guenther & Vittori, 78). By encouraging sunlight and air to filtrate the many spaces of buildings, architect's can create healthier indoor environments.
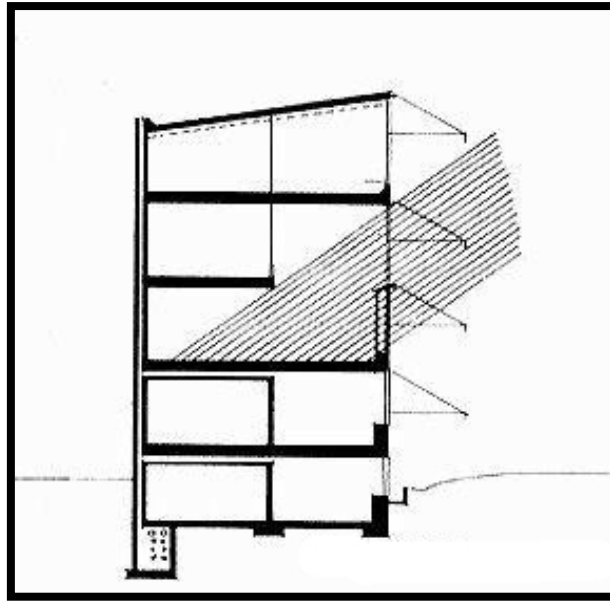
(Fig. 1)(Source: greatbuildings.com) Paimio Sanatorium, now a general hospital,
with its operable sun shields caters for the comfort levels of the buildings occupants
on the southeastern terraces. Accessed 24-02-11

Johan Bothma was cited by van Wyk (2010: 57) saying:

> *'Modern society has seen a move away from using nature in its elemental form to*
> *provide in its energy needs. Especially with the advent of the Industrial Revolution*
> *in the 19th century, energy consumption has increasingly grown as population*
> *growth started to soar, while at the same time, settlement densities in urban areas*
> *increased; and the trend has continued ever since. As a result, cities have grown in*
> *ways no longer dictated by the climates that they are found in; and the use of*
> *natural resources for the purposes of creating comfort is largely forgotten.'*

Here is an example of site selection criteria according to climate (van Wyk, 2010: 61):

Altitude: increase in altitude means decrease in temperature: consider for hot humid environs
Airflow: ventilation is essential in hot humid areas, off a body of water or at high altitudes. Hot arid winds are uncomfortable. Cold climate however should direct wind away to reduce wind chill factors
Evaporative cooling: bodies of water evaporate while prevailing wind cools
Urban ventilation: urban plans orientated to allow airflow for hot humid conditions; spaces between buildings need adequate natural light and ventilation and so we need to control the height of buildings and their proximity to each other. Designers must avoid building forms that accelerate wind at pedestrian level. They must also control building densities to reduce the chances of 'heat island' effect

Slope: temperature inversion provides airflow on top of hills, valleys are susceptible to cold air that sinks and air pollution that settles

Seashore breeze: applicable in hot humid and hot dry climates, orientation for ventilation; buildings that form barriers to on-shore and off-shore breezes aren't ideal

Orientation: orientation to sun and wind to reduce energy consumption

There are three general categories of South African climate, these include hot arid to semi arid, temperate/ mild and hot humid. Humidity discomfort is common in the KwaZulu-Natal coastal climate during the summer months. In summer, inner city air can be 10°C hotter than surrounding countryside. Topography and differential warming create diurnal air currents. Being delicate airflow, however, road embankments, forestry, tall or misplaced buildings can easily obstruct these (Day, 2004: 254). With clear air paths, these can cool and cleanse city air.

'Climate-responsive design is based on the way a building form and structure moderates the climate for human good and well-being' (van Wyk, 2009: 61). Refer to the climatic guidelines below for examples of climatic responsiveness (van Wyk, 64). Considering the guidelines given one can formulate a response for the predominantly hot-humid climate on the KwaZulu-Natal coast. For hot humid regions one should maximize shade and be open to wind flow, locate developments high on slopes for ventilation, orientate to north and prevailing wind, should be near water, have high canopy trees and deciduous trees near buildings, have broad channel, east-west axis roads and material coloration should be light, especially for the roof so as to reflect heat (van Wyk, 65) (refer to Fig. 2). When designing spaces one must also consider activity levels in different rooms and placement of spaces of activity in relation to solar and wind paths for human comfort.
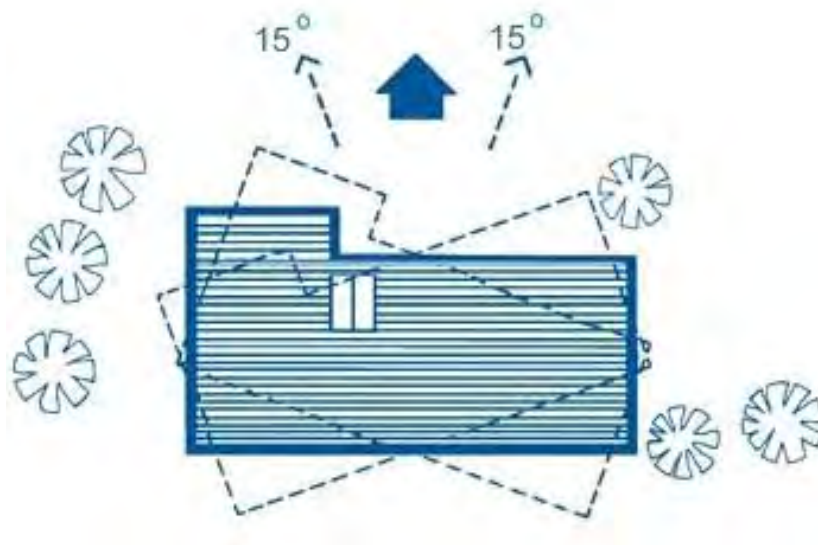
(Fig. 2) (Source: by author) The building should be orientated within 15 degrees to north, deciduous trees on the east and west faces provide shade from sunrise and sunset glare. For wind orientation along the east coast of South Africa it is best that the building deviates 15 degrees to the northeast to allow pleasant cross-ventilation. Created 02-03-11

TABLE 3:

RESPONSIBLE CLIMATIC DESIGN

|	**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 wind
Building orientation	Northeast	North to northeast	North towards prevailing wind	North
Tree forms	Deciduous trees near buildings, evergreens for windbreaks	Deciduous trees nearby on west, no evergreens near on north	High canopy trees, deciduous trees near buildings	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 avoid reflection

Note: These recommendations are for application in the southern hemisphere (switch north for south in the northern hemisphere)

Sunlight, natural ventilation, nature views and connection with outdoor spaces are all qualities to aim for when considering the benefit of buildings occupants (Kellert *et al,* 2008: 119). An interesting planning initiative in response to bio-climatic design is revealed in the pioneering late-1970s development of Village Homes in California (refer to Fig. 2 i n section 2.4.2 Sustaining the Connection between Nature and Society). 'The developer, Michael Corbett, narrowed the streets to discourage driving in favour of walking and biking, and ran them east-west so that he could orient houses toward the sun, which provides most of the space and water heating.

Lots are small, and homes cluster around common areas. In summer, trees shade the streets and houses. Village Homes gives its residents a sense of connection to nature and neighbours that has pushed home values up 12 percent compared to those in similar, nearby developments' (Roodman, 1995: 44). 'By decreasing the amounts of tar road surface in hot areas, the amount of heat absorbed by streets can also be significantly reduced. Thus planting enough trees in strategic places to shade reduced road surfaces during summer can significantly reduce cooling loads in hot regions' (van Wyk, 2009: 65)

Radiation and thermal mass of materials are also important. Thermal massive construction captures night radiant cooling that is stored and distributed into a building during the warmth of the day (likewise the heat of the day is stored in the mass of the walls and distributed at night for regulating temperatures). To contribute to thermal massing, designers must make sure that materials such as 'brick, stone and concrete are exposed internally' (van Wyk, 2009: 114). Consider also trombe wall construction (outside glazing which creates an air space in front of a massive wall for heat retention) (refer to Fig. 3). However, thermal massing may not suffice in climates that are constantly cold or hot. In the summer, shaded overhangs prevent the uncomfortable warm sunlight overhead from penetrating north glazing while low sunlight in the winter is allowed to penetrate the space providing warmth for the cold season. It is important that the north face be kept free from obstruction to allow effective warming during winter.
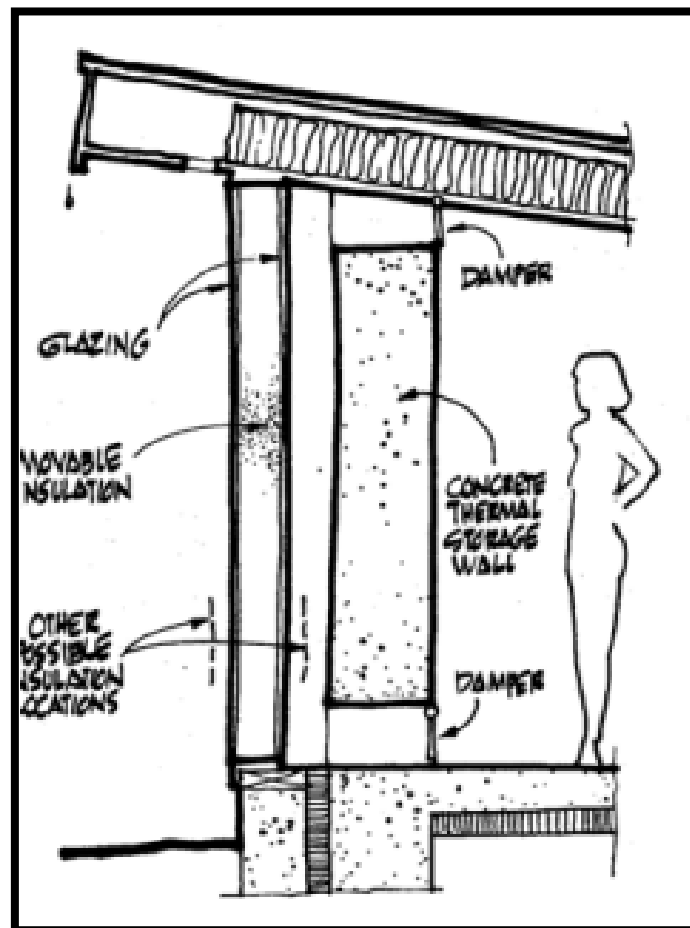
(Fig. 3) (Source: builditsolar.com) Trombe wall glazing and vents regulate indoor temperature. Accessed 17-05-11

While sunlight has its health benefits, its inclusion in the built environment needs to be controlled depending on the context. In a classroom for example, too much sunlight may cause glare and distract pupils from the work they are doing. 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. In child learning environments, outdoor classrooms which are essentially a roof without walls bring the children closer to nature. They can continue playing while the rain falls beyond the boundary of the roof or they can feel a cool breeze on a warm day.

Curved roofs allow even distribution of internal daylight if the ceiling has a reflective surface. Roof monitors and skylights can still pose a threat because of discomfort glare and sight lines of occupants need consideration to prevent this. Sunshades can also enhance the aesthetic appearance of a building. 'Equator facing glazing should have horizontal shading devices and east and west facing glazing should have vertical shading devices' (van Wyk, 2010: 158). Use solar charts as a guide for shade device angles. A pointer for light shelves as a form of solar shading is that they should be placed at 2/3 height of a window for effective distribution. External shading will reduce the need of blinds and reflective colours will aid distribution. Blinds and shutters can be used as alternatives to solar shading structures (refer to Fig. 4).
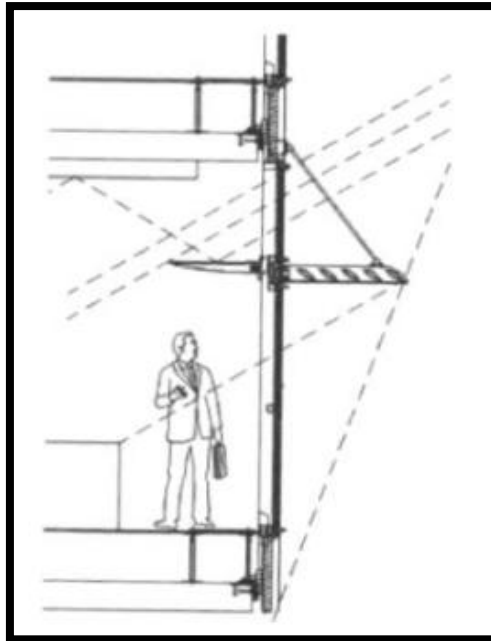
*(Fig. 4)(Sources: van Wyk, 2009; aboutblinds.org & home-dzine.co.za) Above, a
light shelf and shading louvers screen is used to prevent discomfort glare. Blinds
(left) and shutters (right) can be used as alternatives. Accessed 09-06-11*

Light and shade in spaces is not only relevant to comfort but also creativity as it emphasizes the shape and form of buildings. The diffusing of sunlight carries with it the potential for architectural expression through shadow and light; consider such architects as Tadao Ando and Eero Saarinen who use these contrasts creatively (refer to Fig. 5). Architects can also benefit from reflected light off walls and floors if direct light is undesired or too harsh for occupants. Light pools are an example of this which brings natural light into the lower parts of our buildings by reflection. Light can also change its hue by the screens it passes through and can have cool or warm light depending on the ambience we wish to create in our spaces (consider the warm light created beneath a white membrane structure).

(Fig. 5)(Source: archipreneur.blogspot.com & galinsky.com) Tadao Ando's Church
of the Light (left) uses natural lighting and architectural design together for creative
expression and symbolic meaning; likewise in Eero Saarinen's MIT Chapel (right).
Accessed 25-11-10

The misconception that indoor/ conditioned air is healthier than the air outdoors is a detriment to the occupants of buildings. This may be the case in urban spaces which are severely polluted (consider Beijing and other examples) but for the vast majority of suburban and rural environments the air outdoors is much healthier than recycled HVAC air. Buildings need to be situated and designed so as to take advantage of natural ventilation (wind orientation and shallow buildings). Avoiding deep building plans means that opportunities for natural rather than mechanical ventilation are more available. Natural ventilation has its limits in very high temperatures, humidity and pollution where mixed-mode cooling and ventilation HVAC systems can be utilized. Effective natural ventilation requires a good understanding of cross-ventilation, stack ventilation, and thermally induced ventilation and on the ability to define regionally relevant solutions (refer to Fig. 6). Thermally induced cooling is a passive method that is achieved by the simple indoor-outdoor air exchange of room air when temperatures outside are cooler.
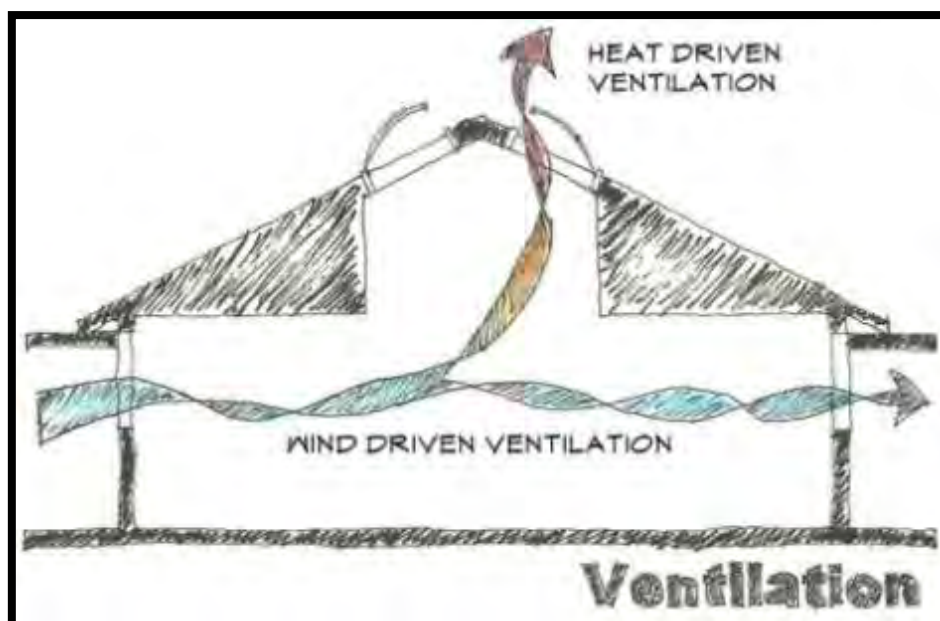
(Fig. 6) (Source: farm4.static.flickr.com) An illustration of the two common types of natural ventilation; heat driven and wind driven. Accessed 24-02-11

'The outer layer of the building envelope, like a raincoat and umbrella, provide protection against weather such as wind and rain. The middle layer, like shirts and jerseys, provide warmth and thermal insulation. The inner layer, like a vest, is comfortable to touch and works away excess moisture' (van Wyk, 2009: 109). Refer to the key performance table shown below for ideas on how to create effective building envelopes (van Wyk, 2009: 109- 110). Large 1:10 sections are vital for revealing envelope treatments such as window jambs, sills, thermal breaks and solar shading. It is important to address these early on so that they integrate into final designs.

TABLE 4:

GUIDELINES FOR EFFECTIVE BUILDING ENVELOPES

Aspect	Performance Objective
Daylight	The design of the building envelope ensures that an average daylight factor (DF) of 2.5% is achieved in all occupied (living and working) areas in the building
Ventilation	The design of the building ensures that spaces can be naturally ventilated. A minimum openable area within the external envelope of at least 5% of internal floor area is provided for natural ventilation
Sunlight	Direct sunlight is avoided in office working environments, particularly where VDUs are used. Sunlight access into the building is only allowed into the building as part of a direct gain passive solar strategy where this plays a useful role in warming the building in winter

Air tightness	The building envelope is airtight in order to avoid unwanted infiltration of cold or hot air through the building envelope. Air tightness standards exceed the minimum standards required by SANS 204
Noise	Obtrusive external noise from traffic etc is not experienced in the building and internal noise levels do not exceed good practice standards (i.e. ambient sound levels not exceed 45dBAeq in open plan offices)
Habitat and vegetation	At least 10% of the external building envelope has vegetation cover. This may be provided in the form of green roofs, window boxes, planted terraces and balconies and wall creepers. This is also used to support the creation of wildlife habitat
Thermal comfort	The envelope aims to achieve best practice internal thermal comfort levels as measured using the Predicated Mean Vote in ISO Standard 7730, Ergonomics of the Thermal Environment
Energy	The building envelope supports an overall integrated design strategy that achieves good practice energy consumption targets and significantly exceeds minimum energy efficiency standards listed in SANS 204
Car parking	All covered parking spaces are naturally ventilated
Renewable energy	The building envelope includes renewable energy generation such as photovoltaics, wind turbines and solar water heaters and 10% of the building's energy requirements are generate from these sources
Views	All working spaces are within 7m of a window and have a direct view of the outside
East and west elevations	Windows on east and west elevations are minimized and appropriate solar shading is provided where this exists to avoid unwanted solar gain
Openable windows	Openable windows are provided where they can easily be controlled by people near them. At least one openable window per 5 running metres of building envelope is provided in occupied areas
Internal blinds	All windows in working areas are provided with internal blinds
Rainwater harvesting	Roofs are used for harvesting rainwater and a target of 50% reduction in mains potable water consumption (relative to conventional buildings) is achieved
Cool roofs	Roofs and large external balconies and terraces are constructed of a material with an absorptance value of under 0.55 (are light coloured) to avoid unwanted heat gains
Insulation	Insulation values in the building exceed the minimum requirements outlined in SANS 204
Passive environmental control	The building envelopes support passive environmental control strategies as described in the passive environmental control chapter by providing correctly located and sized openings and thermal mass, etc

An interesting response to climate is Chandigarh's high court which uses deeply recessed windows and a parasol roof to keep subtropical sun away; while allowing wind to drive away heat buildup. Many consider the modern import of glass buildings as inappropriate for our local hot and humid climate. One might then consider that Philip Johnson's glass box house blatantly ignores sun exposure but in this instance it is a great example of designing with nature; in summer the glass house is shaded by the leaves of the surrounding oak trees and in winter the leaves fall off and provide warmth for the inhabitants. Occupants become more in tune with the seasonal changes of the region rather than relying on the falsities of air-conditioned environments which encourage a detachment from nature (refer to Fig. 7).

*(Fig. 7) (Sources: treehugger.com & flickr.com) The Glass House is in tune with
seasonal change and the provision of shade and sunlight. The use of double-glazing
can be an effective insulation method in such cases. Accessed 24-02-11*

World energy and water shortages have made the strategy of *passive survivability* more prevalent. It involves a combination of daylighting, natural ventilation, passive solar heating and cooling, as well as rainwater collection and gravity-fed water utilities which can support human activities independent of the power grid, heating fuel or water supply (Kellert *et al,* 2008: 127). In many respects, sustainable buildings that employ these strategies have healthier occupants as well, given the evidence base of nature and its benefit on people.

The above section has revealed that orientation is vital for the warming and cooling effects desired within a building microclimate. The north face must be free from obstruction to allow effective warming during winter. For the thermal massing affect desired, material choice (brick, stone, concrete) is important. Human activity levels in different spaces should also be considered and how these spaces relate to sun and wind exposure or alternatively to shelter for human comfort. In the following chapters, landscaping as an integral part of architectural design will be considered.

2.2.5 Indoor and Outdoor Landscaping

Architects need to realize that landscape and environmental features are to be considered equal with the building and are not an afterthought of design. The relation of the built environment and the natural environment can be a v ery direct one especially when nature is included in the internal experience of buildings. The potential of a garden, as with a building, is best realized when the patterns of nature are used to help organize the design. In building designs, architects must strive to retain the natural elements of the site which make the location unique and not destroy them with ignorant planning methods.

Christian Norberg-Schulz describes a variety of elements that compose our natural landscapes; plain, valley, basin, ravine, plateau, hill and mountain. These are further articulated by fields, forests and bodies of water (Norberg-Schulz, 1979: 37-40). The combinations of these can further determine the spirit of a landscape which is classified as ei ther: *romantic, cosmic, classical* or *complex.* The prominence of earth and sky in a landscape play a key role in determining these types. The *romantic* landscape is dominated by earth and the dynamics of water. The landscape is filled with the surprises of nature and man is consumed by the forest wilderness (Norberg-Schulz, 42). The *cosmic* landscape simplifies the absolutes of earth and sky. The sky is dominant along the horizon such as in the desert and a place of refuge is found in the oasis (Norberg-Schulz, 45). The *classical* landscape is evident in the agricultural lands of ancient Greece and Rome. Earth and sky are balanced where the topography is defined by human intervention (agriculture, towns, etc.) (Norberg-Schulz, 45). In reality,

landscapes are composed of a *complex* or synthesis of these types (Norberg-Schulz, 47) (refer to Fig. 1).
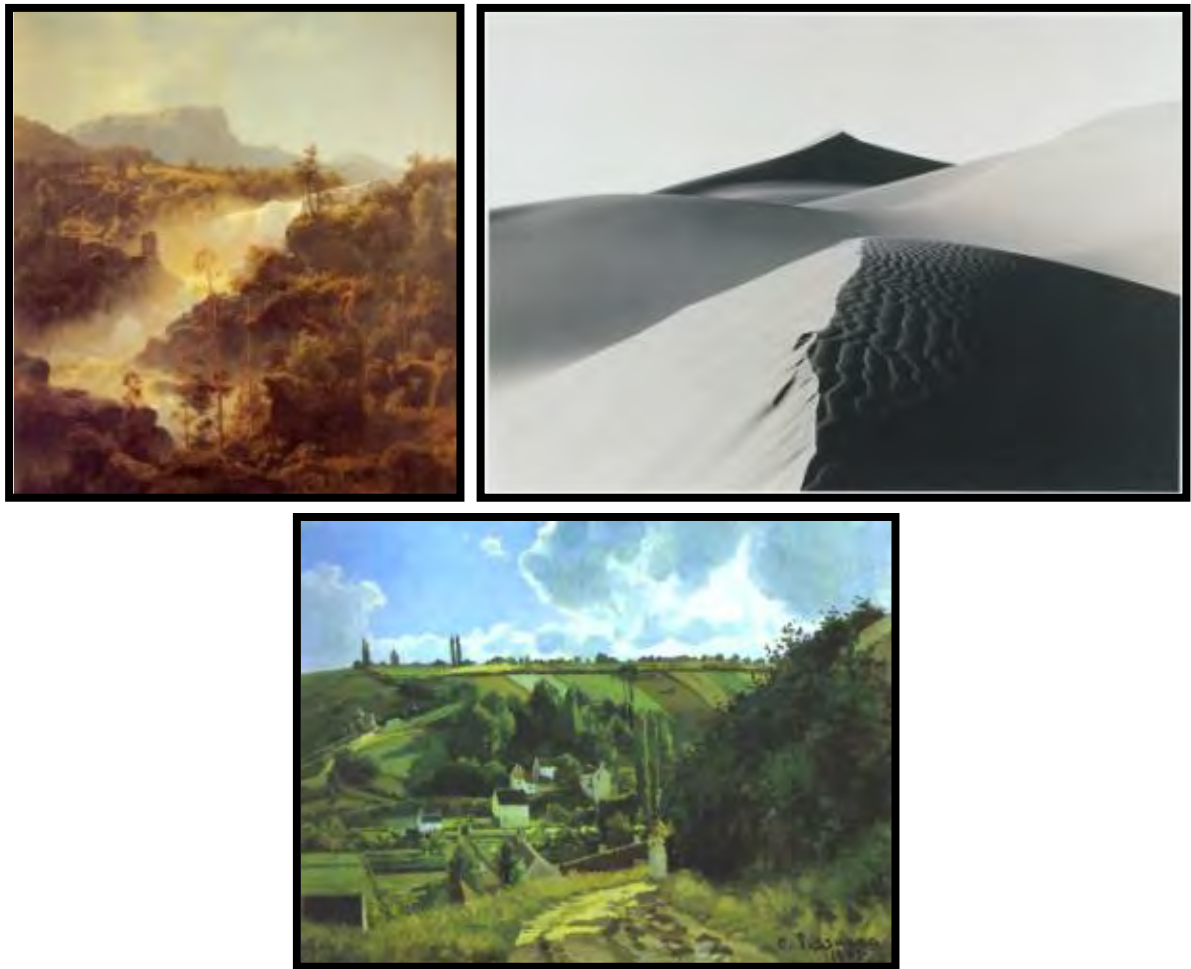
(Fig.1) (Source: freewebs.com) Figures depicting the romantic (left), cosmic (right) and classical (below) landscape types. These are respectively forest, desert and colonized landscapes. Complex landscapes are a combination of these types.
Accessed 13-05-11

Architects must design with topography and not attempt to conquer it (unnecessary cutting, filling and clearing). 'Stepped or steeply-sloping squares, unexpected vistas, short-cut steps up hillsides and streams cascading down them can recreate a coherent sense of the earth's shape beneath our feet' (Day, 2004: 255). Designers must orientate buildings to the contours of the landscape as far as is reasonable while considering solar and wind orientation (refer to Fig. 2). The use of shelterbelts can mitigate the pressure of wind flow in higher altitudes and the porosity of the vegetation prevents eddying. Filtering sunlight through foliage belts reduces glare and any discomfort it may cause for occupants. Water harvested in earthworks can be used to grow these plants that 'buffer noise, produce food, entice visitors, cool buildings, and deflect wind' (van Wyk, 2009: 72).
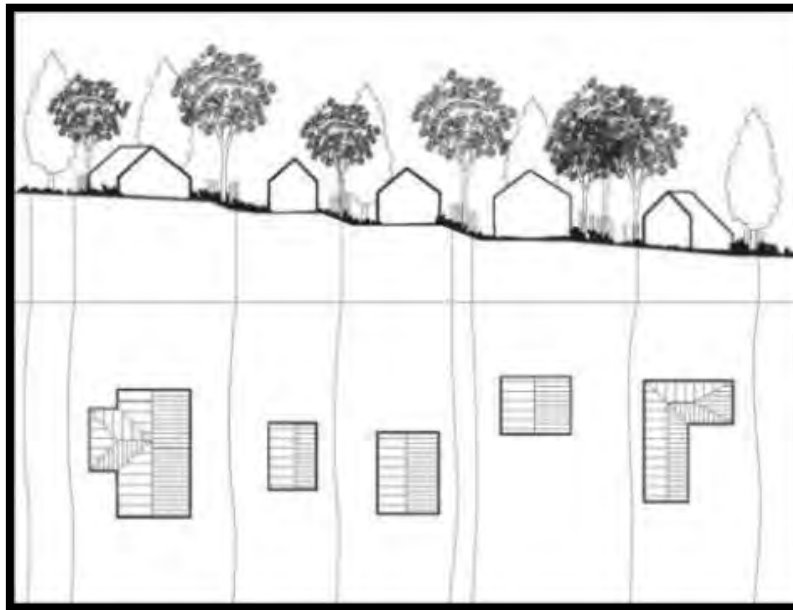
(Fig. 2) (Source: yourdevelopment.org) When terracing on sloping sites consider
solar access and natural breezes. Placing buildings in rows at different elevations
helps to retain views and prevent overshadowing. Preserving natural slopes will
also aid natural drainage for sensitive design. Accessed 24-02-11

Buildings in bio-diverse climates have great potential for associating closely with a natural environment but while it is beneficial for certain reasons, designers must consider that nature can be detrimental to people in disaster situations; an example being fires and floods. During dry seasons and wet seasons built environments can suffer from wild fire and floods depending on their proximity to commonly affected natural environments. The potential of this happening needs to be considered when locating the site of a development. Designers would not place their buildings within grasslands that are susceptible to fires during the dry season neither would they construct their buildings within a floodplain.

Landscaping needs to strike a balance between hard (construction materials) and soft (plant materials); a landscape that is entirely paved can hardly be called a landscape (even if some artful method is used in the laying of the pavers). Viewing natural elements such as trees, shrubs and grass creates a mental association with the sustaining of life. If environments cannot sustain vegetation, is that environment healthy for human life? It can also be considered bad practice to hide natural landmarks; these should form a part of the skyline. It shows an affinity towards the natural environment; concrete jungles are not the ideal. Landmarks are also an effective means of way finding; in conjunction with street names and directions. Consider some famous skylines in the world:

Sugar Loaf Hill in Rio de Janeiro, the Acropolis in Athens and Table Mountain in Cape Town, they all are celebrations of a natural landmark which have made their cities so identifiable (refer to Fig.3).

(Fig. 3)(Source: stickyinafrica.blogspot.com) The celebration of natural landmark is
a trait if biophilic design on a much larger scale in the icon of Table Mountain and
the city of Cape Town along its periphery. Accessed 25-11-10

Architects should provide equal access to garden spaces for all occupants of a building. Movable seating within these gardens can be adapted to differing social groups that may enter the space. Consider the design of gardens for active play and physical rehabilitation. 'The assumption that pleasant gardens help to motivate patients to engage in physical activity, as well as alleviate their emotional stress, has led some hospitals to design rehabilitation gardens that enable physiotherapists to treat specific categories of patients, such as those recovering from stroke, fractures, and burns' (Kellert *et al,* 2008: 97). Designers can create gardens for children and adults alike with 'calm refuges for adults and active play features for children' (Kellert *et al,* 98). Walking through a building should be made an enjoyable experience by introducing such features.

The reality of a room is found in negative space and not the positive space of walls and roofs (Roth, 1993: 45). The most notable part of the Roman Domus was the impluvium (open air court with roofs pitched inward over a pool). These provided fresh air and sunlight to the interior living spaces in an otherwise densely developed Roman residential settlement. What needs to be considered when designing a courtyard is that it can also create a feeling of confinement if it is too small for the amount of people it accommodates. Again if the surrounding buildings are out of proportion being too high,

the courtyard can be starved of natural light and the inhabitants may feel threatened by the inhumanity of the space. The space may start feeling like a jail courtyard and so at least one clear exit needs to be provided and building heights should be humane in scale to prevent such feelings of confinement.

'Every site must provide for potable water supply, wastewater conveyance, humidity regulation, landscaping, storm-water management, and site hydrology' (Kellert *et al,* 2008: 49). Stormwater sheds can lead to constructed on site wetlands or organic farms that improve eco-systemic health. An example of a building that does this is the Patrick H. Dollard Discovery Health Centre in Harris, New York which is a 2600 sq m ambulatory diagnostic and treatment facility that inhabits a rural residential landscape (Guenther & Vittori, 2008: 347) (refer to Fig.4). Constructed largely of wood, it transcends institutional definition and lives in a landscape of farm buildings, owing partly to its 'barn' aesthetic. The facility provides adult and pediatric medical, dental, physical and occupational therapy, and psychiatric and social services for approximately 200 developmentally disabled and medically fragile children and adults.

(Fig. 4) (Source: hpb.buildinggreen.com) The natural environment around the building is undisturbed providing a therapeutic environment for the patients at the centre. Accessed 24-02-11

The operations of the facility include community-supported agriculture manifested in its organic farm. The centre also has a therapeutic horseback riding facility and a historic dairy farm. Rainwater is harvested for fire suppression and farm irrigation. The construction of the building uses low-emitting materials such as formaldehyde-free insulation and agriboard cabinets. Operable windows are

installed throughout the exam rooms and offices with daylight and views accessible from more than 90 percent of occupied spaces. Brise-soleils provide shading from solar gain and activate the largely day lit space of the interior (refer to Fig. 5).
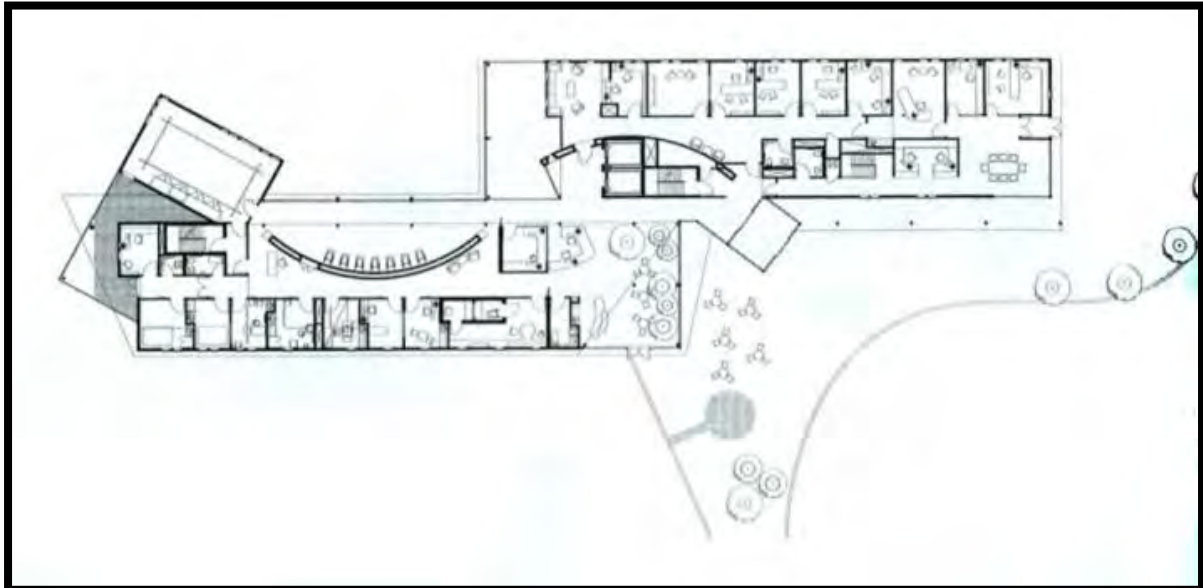
(Fig. 5) (Guenther & Vittori, 2008) The shallow floor plate of the building allows natural light to penetrate through the space. Published 2008

Architects must learn to mimic nature and avoid branding the landscape with ignorant geometries; they must be sensitive to the natural landscape of the region. Instead of using paved parking, consider using perforated concrete pavers so that stormwater runoff is prevented and heat islands are reduced. As Patrick Geddes says 'all to the soil, not all to the sewer' (Girard *et al,* 2003:93). Landscapes should improve ecosystemic health and the safety of inhabitants should always be considered in the incidence of natural disaster. Architects can also learn from the English gardens which augment the natural contours of the land such as the gardens at Stourhead (refer to Fig.6). Such gardens promoted 'the Picturesque that prized irregularity, roughness, asymmetry, and the surprise of unexpected vistas as one moved through the landscape' (Roth, 1993: 409). Another important element of landscaping besides the earth is water. Water in architectural environments will be addressed in the following chapter.

(Fig.6) (Source: Google earth & farm3.static.flickr.com) The gardens at Stourhead follow the contours of the land and mimic natural forest rather than imposing grids across the land (above); compare this approach to the South African landscape (below). Accessed 23-02-11

2.2.6 Water and Architecture

In today's urban society water is associated with utility (waste conveyance, industrial cooling and hydropower to name a few) and its connection to nature has somewhat been downplayed in societies daily lives. Being one of the dominant elements covering 70% of the earth's surface it should afford more attention in people's daily lives and architectural design. Water has for many generations been associated with life and so architects must consider integrating it into architectural environments for the benefit of society. Urbanization needs to be controlled to prevent stormwater run-off, increased volume of flood flows, morphological deterioration of water courses and water pollution to name a few. When designing, the natural down slope flow of shallow groundwater must continue to allow the soil recharging. Human activity and building development need to be kept away from water catchments to prevent disruption of ecosystems and natural cycles.

The mind associates flowing water with living things; a river filled with fish. A built environment that introduces the element of flowing water can arouse similar associations and thus one can say that the place is 'living'; Pallasmaa promotes the use of such metaphors in design (Pallasmaa, 2005: 71). Similarly, fish tanks visually stimulate for a lively interior. Durban being a coastal city also highlights the fact that water provides substantially for recreation purposes; swimming in the ocean, sailing boats in the harbor and water-themed entertainment parks such as uShaka Marine World. Durban's beach and waterfront become destinations for tourists and residents alike and many commercial developments take advantage of the natural appeal that water has becoming venues for community socialization. The revitalization of Durban beachfront has resulted in a more people friendly environment that naturally attracts the public and encourages recreational activities such as swimming, jogging and cycling. Cape Town's Victoria and Alfred Waterfront is also a popular attraction with its variety of shopping, entertainment, hotel and apartment options along the water's edge.

Water provides many venues for contemplation and spiritual restoration such as in the paths circumscribing the lake in New York's Central Park (Kellert *et al,* 2008: 46). Still water such as that found in a pond at the botanical garden provides a venue for contemplation and 'spiritual' restoration in contrast to the more dynamic qualities associated with water (Kellert *et al,* 46). Again the sound of flowing water can instill similar feelings of relaxation by masking unwanted noise; a fountain in an urban plaza for example can soften the harshness of the surrounding traffic noise and lower the perceived temperature of the space by evaporative cooling. Fountains can also entertain such as the fountains in Mariánské Lázně where the motion of the water is accompanied by classical music. From this one realizes the emotions that water instills and the physical effect it has on the experience of a space (refer to Fig.1).

*(Fig.1)(Source: author & discoverczech.com) The fountain court at Gateway
Shopping Centre (above) in Umhlanga Rocks uses rhythmic fountains and planting
to stimulate as well as provide relaxation for busy shoppers. A fountain court in
Mariánské Lázně (below) synchronizes motion of water with classical music.
Accessed 25-11-10*

Many of the urban environments of today are defined by canals of tarmac for the conveyance of vehicular traffic. In contrast we look at Venice that is defined by actual canals of water where boats are the prime mode of transport. When contemplating why Venice has such an appeal as a city, Maria Cerreta states that, 'the interaction between economy, society and environment… determine a unique combination of cultural heritage and environmental context' (Girard *et al,* 2003: 218). Rather than conquering its environment or perceiving nature and the built environment as separate entities, the city has integrated with it which is something that planners and architects need to consider if they wish to create spaces that are beneficial to people as well as the natural environments in which they place themselves.

The ancient Roman baths that were built next to the mineral hot springs along the Avon River in England recognized the healing benefits of water. Considered the 'health clubs' of their day the baths utilized their environment as in the mineral hot springs of Aquae Sulis (Roth, 1993: 235). The biggest baths (such as the Baths of Caracalla in Rome) contained 'shops, restaurants, exercise yards, libraries, and lecture halls and reading rooms, all arranged around spacious gardens filled with sculpture' (Roth, 233), an example of how social and natural environments can co-exist. A more modern example is Peter Zumthor's thermal bath in Switzerland which utilizes similar natural hot springs in the design and functioning of this building. While it is built in modern times, it retains the timelessness that is conveyed by the mountainous region that surrounds it (refer to Fig. 2).

(Fig. 2)(Source: greenroofs.com) Peter Zumthor's thermal baths are a very direct
example of a building connecting with its natural environment, covered in a green
roof it also utilizes natural hot springs to supply the baths in the facility. Accessed
25-11-10

Water can serve to connect the building to the immediately surrounding environment such as in the National Museum of the American Indian (Kellert *et al,* 2008: 49) (refer to Fig. 3). Hattersheim Town Hall in Germany reintroduces water into the urban environment as an aesthetic feature that is captivating for local children. The interesting response in the rhythm of undulating walls in Alvar Aalto's Baker House not only allowed it to fit the required functions on its site but provided oblique views of the river which stimulated the students who lived there.

(Fig. 3) (Source: Google Earth) An aerial view showing how the adjacent water feature expands the footprint of the museum; complemented by gardens to the north east in the busy urban environment of Washington DC. Accessed 23-02-11

Luis Barragan was a 20th century architect who adapted pueblo-building traditions into his modern architecture. He believed that nature was important in architectural designs and incorporated gardens and water into his works that added to the serene atmosphere he was trying to create. Barragan was aware of technological advancements but his fond memories of place and tradition ensured that his architecture was rooted to the region in which he was building (Zanco, 2001: 116). The ranch he lived on during his childhood was characterized by a water distribution system of gutted logs suspended on forked timber columns. This aqueduct supplied water throughout the pueblo town where water would flow into great stone fountains for the people to use (Zanco, 135). His works were subsequently inspired by his childhood village and can be seen in buildings such as the San Cristobal Stables where a water fountain becomes a prominent feature of a place where horses can come to drink (refer to Fig. 4). The colours and planar walls are also reminiscent of pueblo architecture.

(Fig. 4) (Source: vartcn.com) The San Cristobal Stables fountain is inspired by the childhood memories of Luis Barragan and pueblo tradition. Accessed 05-05-11

To be self-reliant people need to learn to work with nature. Rainwater collection systems are a step in the right direction but in terms of design they can be unsightly. Landscape architect Robert L Thayer Jr. believes one should make natural cycles visible in building design, he calls this 'aesthetic visual ecology'. Consider how the act of rainwater harvesting can potentially become a water feature for the immediate landscape e.g. a designed irrigation channel (Graham, 2003: 104) which in turn can supply a vegetable garden. Designers can consider the celebration of rain in the Late Renaissance Gardens which exploited changes in elevation to enhance water features with cascading streams, terraces and fountains (refer to Fig. 5).

Responsible use of water is vital for maintaining a respectful relationship with the natural environment. Greywater can be used to flush toilets and for irrigation purposes. Limit ground coverage to provide absorbent surfaces, reduce stormwater run-off, and provide soakaways for groundwater recharge. Rainwater harvesting requires a catchment area (roof or pavement, parks, ponds), screening to prevent ingress of detritus, a reservoir of appropriate size, and a withdrawal system mechanism e.g. tap.

The benefits of water in a built environment are numerous, from recreation and aesthetics, to the calming sounds that flowing water create, to providing thermal comfort and connecting a building with its surrounding landscape. Water needs to become integral in built environments for the benefit of the people that occupy spaces. From the 'negative' spaces of landscape and nature to the 'positive' space of the building it is now time to consider how natural form and function can influence the buildings created in architectural design.

2.2.7 Natural Symbolism in Architecture

'Humans have always tended to integrate formal representations of natural entities in artwork, architecture and design… perhaps the creation of such art by the brain is a way to stimulate itself' (Joye, 2007: 193). Some designers argue that 'it would make no difference in which type of environment an individual would spend his life because the brain would come to like the environments with which it became most familiar. Yet, the field of evolutionary psychology argues against this view' (Joye, 195). Evolutionary psychologists and researchers such as EO Wilson (1984) believe that people have an inherent affinity to the natural world because man has 'evolved' out of a predominantly natural past. Biomimicry and biomorphism in particular can be a means of acknowledging this affinity and a way to create more stimulating living environments for people.

'If lines, shapes, forms and spaces can be given qualities of movement, life, harmony, gesture and resolution of dynamic forces, they can bring a life-influence to the place a building bounds' (Day, 2004: 10). Simulations of nature in architecture can come in different forms, namely: ornament, material and biomorphism. Rudolf Steiner's Goetheanum buildings at Dornach reflect the spirit of nature in the way that the unusual concrete forms and expressive timber constructions mimic the organic growth of nature (Blaser, 2002) (refer to Fig.1). Many educational and health institutes are inspired by Steiner's philosophy of 'anthroposophy' which seeks to restore the spiritual and natural in people's lives; some of these include the Camphill Communities for the physically and mentally disabled and the Waldorf Schools which promote an alternative education that encourages imagination and self discovery.

(Fig.1) (Source: pixdaus.com) The Goetheanum's expressive concrete forms give the impression of organic growth out of its hilltop site. Accessed 03-03-11

In *Tradition and Modernity: The Feasibility of Regional Architecture in Post-Modern Society* (Pallasmaa, 1988) cited by Canizaro (2007: 133) Alvar Aalto's designs are referred to: 'biomorphisms give subconscious associations with the organic world, and his layered compositions give an impression of environments formed by tradition and history.' In reference to Ronchamp, Le Corbusier spent several days on the site sketching the profile of the surrounding forested hills in order to create a 'visual echo of the landscape' in the curving roof of the cathedral (Roth, 1993: 493) (refer to Fig. 2). In *Regionalism and Invention* (Speck, 1987) cited by Canizaro (2007: 75) it mentions Antonio Gaudi's work saying: 'it is deeply rooted in Catalonia… He acknowledges the building traditions of his region… But he also reaches deeper than building and craft precedents of Catalonia, drawing on the primal qualities of the region- its landscape, its vegetation, its connection to the sea.'
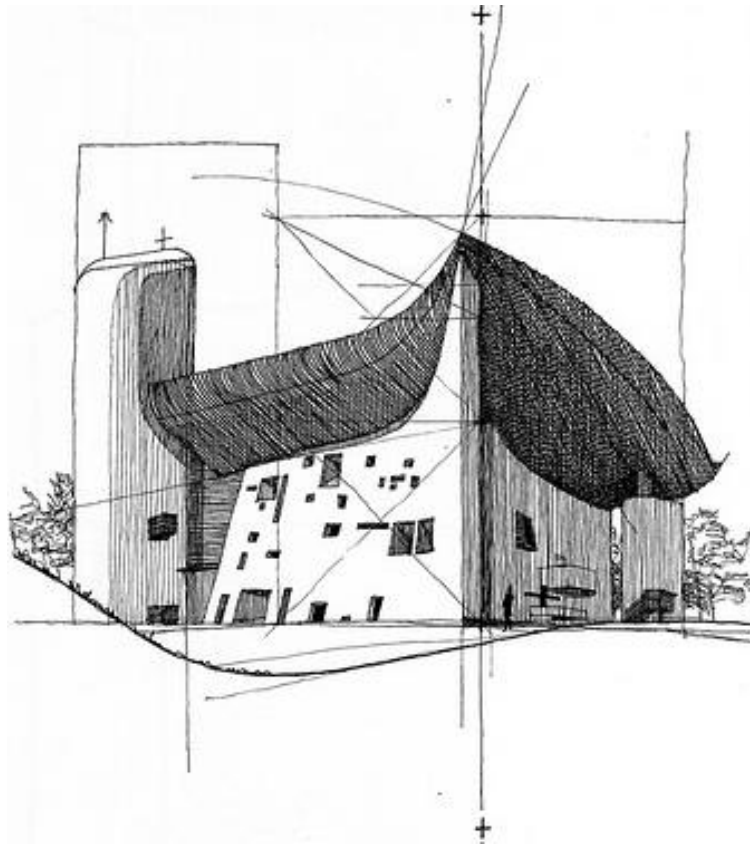
(Fig. 2) (Source: farm3.static.flickr.com) The forms of Le Corbusier's Notre Dame du Haut in Ronchamp are meant to evoke images of the hills in the surrounding landscape; it is also claimed to be mimicking a nun's habit. Accessed 13-05-11

The Prairie Style of Frank Lloyd Wright which was an extension of the topographical forms of the region is an example of the attention to the natural environment which should be echoed in the designs of today (refer to Fig. 3). Consider the metaphors of the Renaissance system of the senses and the cosmic body where 'vision was correlated to fire and light, hearing to air, smell to vapour, taste to water, and touch to earth' (Pallasmaa, 2005: 16). What people experienced in the past directly related to the variety of the natural world and they were more sympathetic towards nature; without it, our experiences in the modern world become one-dimensional. 'Architecture, besides providing shelter, is a symbolic representation, it proclaims the values and beliefs of its people' (Roth, 1993: 5). Another negative is the word 'style', architects should rather aim for regional relevance which brings life to a building for the people of a place.

(Fig.3) (Source: wideworldofgeometry.pbworks.com) Wright's Taliesin West winter home seems to grow out of the land being built with stone from the region and horizontally expressed in its elevation. Accessed 24-02-11

Biomorphism has a variety of precedents, from the botanical motifs of art nouveau to the animal motifs of Imre Makovecz' Lutheran Church (refer to Fig.4). The Golden Ratio (1:1.618) discovered by Greek architects was used in many of their classical buildings. What is interesting is that this ratio is found in many natural phenomena such as in the logarithmic spirals of seed patterns in a sunflower or the section of a nautilus shell. This relation has been mimicked in architecture such as in the spiral form of Wright's Guggenheim Museum. All these formal relations represent an affinity to nature in one way or another by using symbols to trigger memories in participants that relate to all that is living. Consider even the 'high-tech' buildings of Norman Foster such as the Greater London Authority building which is reminiscent of an egg-like shape and resists the tendency to create the right angled block of early twentieth century modernism.

(Fig.4)(Source: zenth.dk) The relation between bird's wings and an owl's face in Makovecz' Lutheran Church is an example of biomorphism. Depending on the individual such literal abstractions may illicit biophobic responses and designers need to be sensitive to this. Accessed 25-11-10

The arches, domes and vaults of classical architecture in Rome relate to the various curves seen in the natural world. These formal qualities create a much softer appearance that contrasts with some of the jarring, sharp edges of modern design. Like the colour arrangements of interiors, formal arrangements can also be subjective. The traditional Japanese man prefers the orthogonal plan based on the tatami square while the traditional Zulu man prefers his round wattle and thatch hut; designers have to take the people they are designing for into consideration. Biological symbols may seem direct but it is these relations that add dynamism to buildings. Consider the young child in the garden for the first time, the shapes and forms that the child sees spark the imagination. If designers could recreate similar feelings in the public built environment it would make for a pleasant experience as an alternative to the high-rise boxes of modern urbanism. There is an endless variety of natural forms that can become the precedent to expressive architectural forms. 'All-engrossing wonder, sensory delight, living forms and spaces – not only small children need these... all of us do' (Day, 2004: 227).

Louis Sullivan attempted to transcend an architecture that was only about function and structure by drawing inspiration from the natural world. The forms of nature inspired his facade compositions and ornament which he believed balanced out the orthogonal structure of his buildings. He also sought to find balance between the straight and curve, monolithic and tectonic. He believed this balance would create a complete building (Menocal, 1981). Ornament and façade composition can be limiting where today the actual structure of a building can evoke recollections of the natural world. Frei Otto's 'Institute of Lightweight Structures' have explored the economy of nature in their tensile membrane structures by spanning large areas with relatively simple modes of construction (Institut fur Leichte Flachentragwerke, 1983) and the concrete engineering wonders of Santiago Calatrava evoke the images of flying birds and twisting torsos (refer to Fig. 5).

(Fig. 5) (Sources: praemiumimperiale.org & cvent.com) The Pink Floyd stage roof
(above) by Frei Otto is reminiscent of a flower's geometry while the Milwaukee Art
Museum (below) by Santiago Calatrava incorporates adjustable brise-soleil
inspired by a bird's wings. Accessed 25-07-11

An interesting bio-metaphor which is combined with the ideas of prospect and refuge is found in the work of Cervera and Pioz Architects who are inspired by the flexibility, adaptability and energy-efficiency that are prevalent in natural species. They have adapted the ideas of biological structures into architectural structures as a 'bio-rhythmic' expression in the Santa Isabel Healthcare Centre located in Zaragoza, Spain. The structure of the building is like a vertebral spine that adapts its scale for differing environments; from the entrance hall (height and prospect) to the consultation rooms (low ceilings and refuge) (A+D Reporter, 2006: 58) (refer to Fig. 6).

GROUND FLOOR PLAN
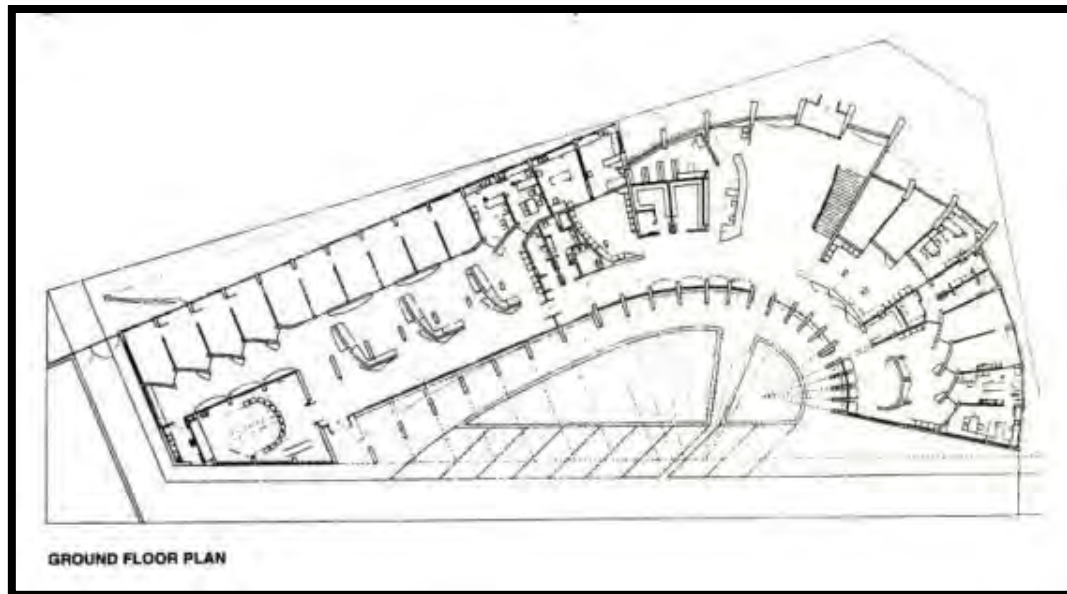
(Fig. 6) (Source: A+D Reporter, 2006) The structure inspired by a vertebral spine
changes in height to create greater volumes for those areas that are more public
such as the entrance hall and lesser volumes for more private areas. Published 2006

Like nature, buildings need to adapt with time by changing and growing; consider flexible spaces rather than static spaces. Walls should not be barriers but rather transitional spaces between the outside and the inside. Consider also adjustable internal walls which allow the personalization of space (refer to Fig. 7). Also Frank Lloyd Wright's Prairie style architecture exhibited in the Robie House displayed a quality of inter-connected spaces rather than an interior of fragmented rooms for a more flowing transition through the spaces of the house.
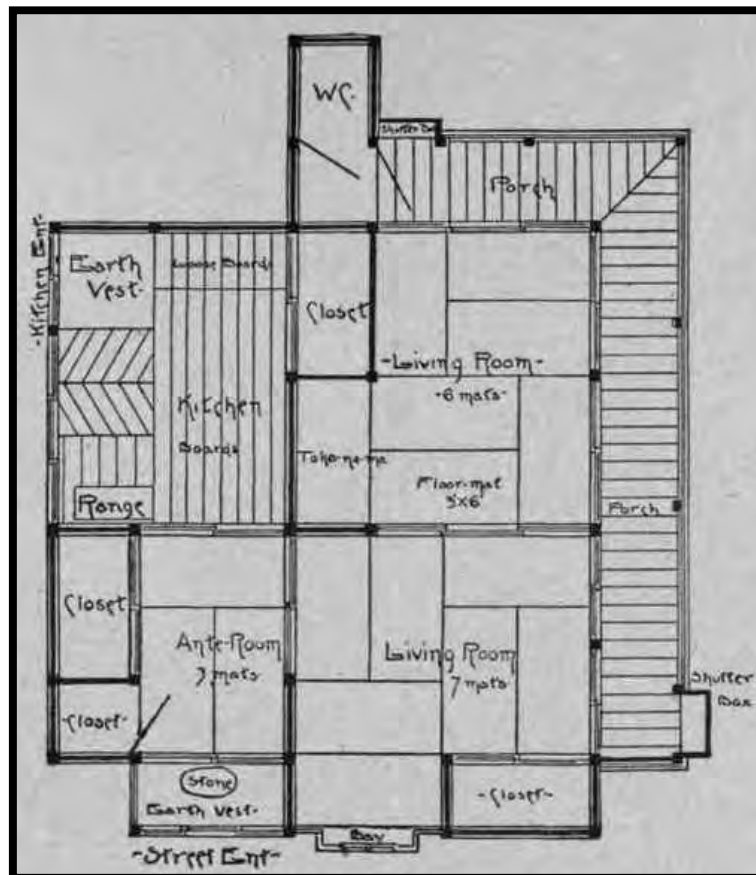
(Fig. 7) (Source: chestofbooks.com) The traditional Japanese house floor plan is a good example of flexible design; walls can roll back to expand space or close to create privacy. The rectangular tatami mats are used to sleep on during the night and during the day are rolled up and stored away giving a new function to a space.
Accessed 24-02-11

Design for contrast as nature has contrasts: the play of lightness and darkness, high and low. These rhythms of nature can be kept in balance or tension depending on the effect desired. An interesting example of contrast in architecture is that of stereotomic (heavy) and tectonic (light) structures as explained by Kenneth Frampton in his book *Studies in Tectonic Culture* (Frampton, 1995). One might compare these to the earth brick (heavy) structures of the Sotho and the beehive hut (light) structures of the Zulu (Jooste-Smit, 2009: 74).

Salangaros and Masden have discovered that 'human beings connect physiologically and psychologically to structures embodying organized complexity more strongly than to environments that are either too plain or which present disorganized complexity' (Kellert *et al*, 2008: 233). This compares to Aldo van Eyck's belief in the 'aesthetic of number' (Luchinger, 1981: 39). Organized complexity (fractal repetition) is embodied in such natural phenomena as clouds, waves and clusters of trees. The repetition in Fay Jones' Thorncrown chapel (refer to Fig. 8) and Louis Kahn's Salk Institute (refer to Fig. 1 i n section 2.3.3 Nature Experience and Mental Health) create abstracted impressions of forest canopies and ocean waves respectively. Fractal design has also been found in traditional African ornament and settlement planning (refer to Fig. 9). Designers need to consider how building functions can be articulated in such organized ways for a more coherent and stimulating built environment.

(Fig.8) (Source: info.aia.org) Thorncrown Chapel mimics the forest canopy through structural expression. Accessed 24-02-11
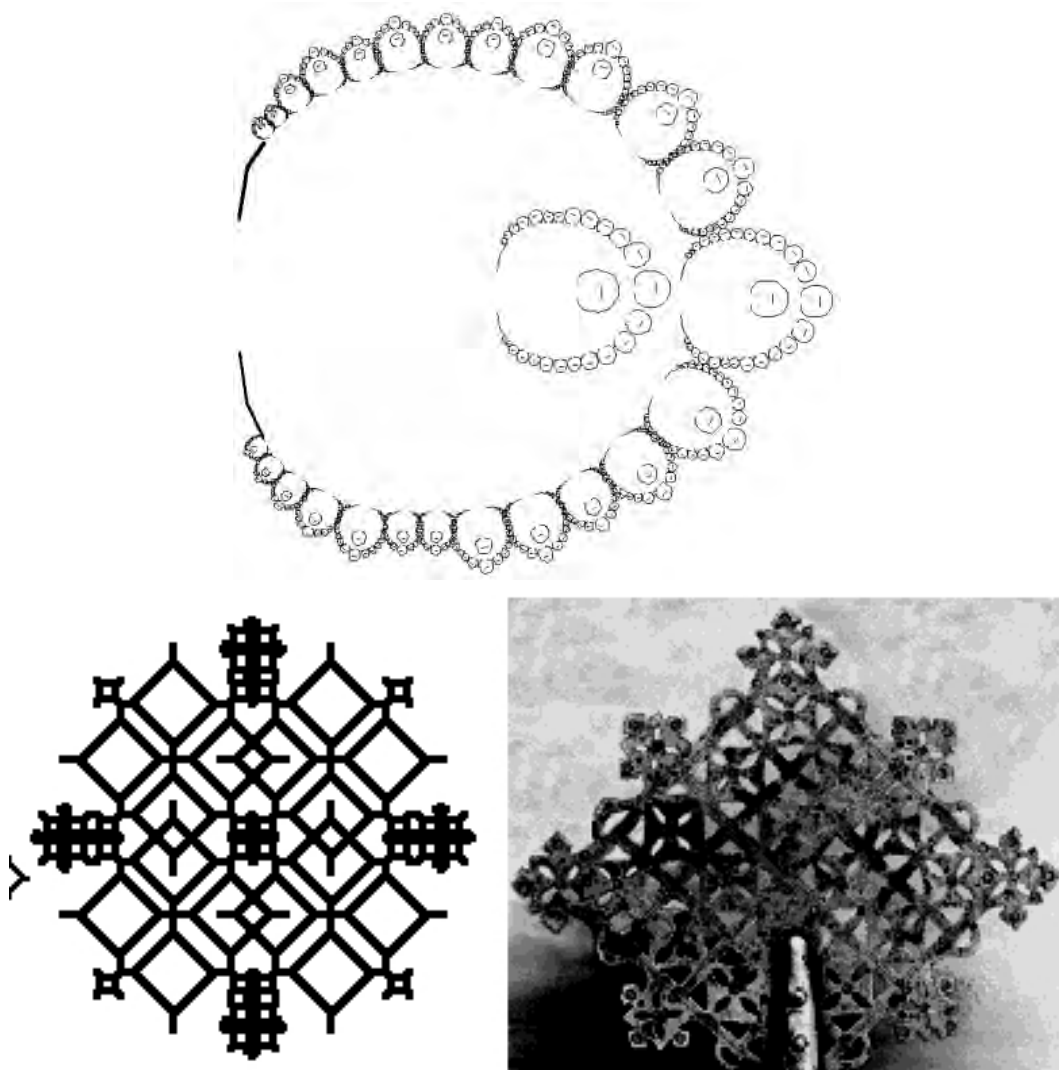
(Fig. 9)(Source: miqel.com) The Ba-Ila village from southern Zambia (above) and Ethiopian ornament (below) use fractal patterns in their design (the parts bear similarity to the whole). Accessed 14-05-11

Frank Lloyd Wright often used thirty or sixty-degree angles in patterns he designed which were inspired by the veins he found on the surface of a leaf (Kellert *et al,* 2008: 236). Another interesting example of biomorphism by Wright is in the Johnson Administration Centre that imitates a grove of trees to provide the occupants with shade from the glaring sun overhead. Christopher Day compares the rectangle to non-rectilinear enclosures saying that 'it's not the rectangle which is the problem, but its life-sapping characteristics... nonrectangular, or shape-moderated spaces are much easier to make humane' (Day, 2004: 112). Avoid also sharp protruding furniture in interior layouts for safety reasons, opt for rounded corners and curves for a more humane environment.

A study in a Scandinavian mental health facility by Roger Ulrich found that 'patients reported positive emotional responses to nature paintings and prints, but consistently evidenced negative, stressful reactions to abstract artworks in which the content was ambiguous and disordered' (Kellert *et al*, 2008: 96). Likewise in architecture as an art form designers need learn to imitate nature with such metaphors to make for more lively simulations of nature in the built environment that are ordered and unambiguous. Beyond the mere visual domain of architecture, biomimicry can serve much more functional ends such as in the Eastgate office complex in Harare, Zimbabwe. Architect Mick Pearce was inspired by local mound-building termites in the creation of the natural ventilation system utilized by this building (refer to Fig.10).
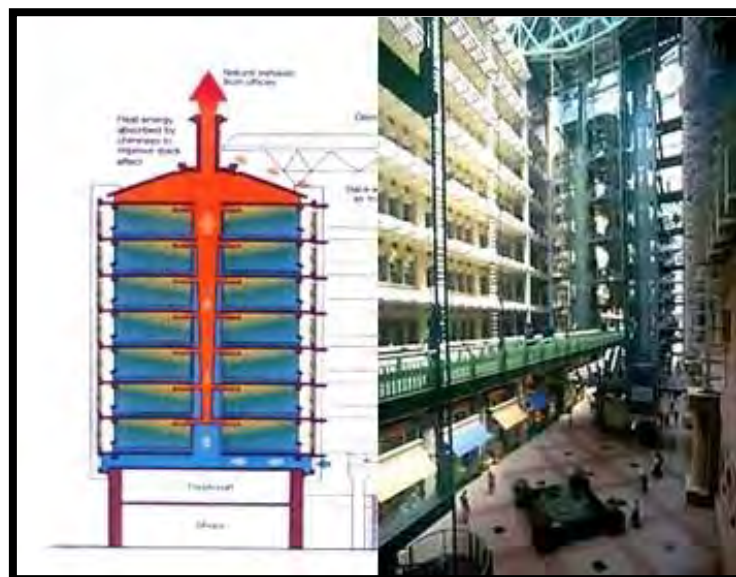
(Fig.10) (Source: myportfolio.usc.edu) Eastgate Centre in Harare mimics nature to serve the more functional aspect of heat driven ventilation; drawing cool air from the basement and offices while allowing hot air to escape at the top of the building. Accessed 24-02-11

The wide open spaces seen in nature are a great stress reliever from the congestion experienced in cities. Buildings need to imitate this spaciousness for psychological and physical comfort for building occupants. Positive and negative space need to work in harmony while integrating light, mass and scale just as nature has its elements which balance each other out (fire and water, summer and winter). The relation between the inside and outside can also be considered with transitional elements such as atria and colonnades or in the more regional approach of KwaZulu-Natal where the vernacular veranda home becomes an exterior extension of the interior space; providing shelter from sun and rain while allowing the possibility of cross-ventilation with sliding doors that open up to a veranda platform. People do not want to separate from nature but partake in it; architecture can help us accomplish this (refer to Fig.11).

(Fig.11)(Sources: syque.com & en.wikipedia.org) The distinction between outside and inside becomes less apparent and people are naturally drawn to the light and fresh air this quality of design promotes (above); consider also the cloisters of monasteries in historic architecture such as at Salisbury Cathedral (below).
Accessed 02-03-11

Although architects are not literally connecting with nature with biological symbols and mimicry it still has its merit as the aesthetics and processes seen in nature can help designers in forming and ordering complex spaces. Nature can inspire design and evoke memory of the forms, shapes and meaningful experiences of it and familiarity of these forms and experiences will spark fondness amongst citizens. Designers cannot consider these formal arrangements without the finer details that bring them together. These are the elements that are most closely associated with the experience of the person. The following chapter will deal with appropriate building technologies and materials.

2.2.8 Appropriate Building Technologies and Materials

'In the past, code compliance, performance, aesthetics, cost and availability were the key screening attributes for material selection' (Guenther & Vittori, 2008: 297). Today's product criteria include environmental sustainability and green materials as well. A green material requires no toxic chemicals for its production, use, and disposal; it is sustainably grown and harvested or includes postconsumer recycled content; and it is reusable, recyclable or compostable (Guenther &Vittori, 2008: 297). Considering material toxicity and its impact on air quality is important for creating healthier living spaces for people. Building owners may avoid sustainable building methods, fearing added costs, but health, reduced maintenance costs and occupant productivity are all valid reasons to include them into building specifications and design.

'New technologies in modern architecture produced new building forms- high rise, deep plan, sealed environments- that are inappropriately low in thermal mass and too heavily dependent on artificial systems' (Guenther & Vittori, 2008: 321). Architects need to use healthier technologies that are physically beneficial and economically viable (preferably locally sourced). Strategies must be appropriate to social, cultural and economic conditions. For example, ecologically sustainable strategies appropriate in a highly resource-consuming and waste-producing wealthy industrialized country will differ from appropriate responses required in poor countries where lack of infrastructure and poor access to resources in densely populated areas pose major health and ecological threats. These issues relate to the concept of 'appropriate technology' (Graham, 2003: 216). One aspect of traditional building materials is that they are all 'bound by the scale of the human body: bricks are sized to be laid by hand, prefabricated panels by crane' (Day, 2004: 172). Let developers promote human resources rather than mechanical resources as a step towards humanistic environments.

Materials are either natural (mud, clay, stone, thatch, and wood) or synthetic (brick, block, concrete, metal, glass, ceramics, plastic, foam, cement composite and natural fibre composites). 'Concrete is the predominant building material of our age due to its plasticity, longevity, formability, and ease of transport' (van Wyk, 2009: 195). Materials need life-cycle quality. Materials that are robust and require little maintenance are ideal for a lasting purpose in townships where lack of funding often renders citizens incapable of repairing deteriorating buildings. Those materials that eventually become inadequate need to have recyclable quality to avoid waste pollution and any negative effects on environmental health. Here are some suggestions of alternative/ sustainable materials to consider in construction: earth-filled tires and bags, gabion baskets, adobe bricks, rammed earth, reeds, straw bales and recycled materials (steel drums, etc.). Other alternatives that are more commercially accepted include cork, bamboo, linoleum, flyash concrete, formaldehyde-free insulation and cabinet substrate, and low-emitting paints and adhesives.

The potential of using natural materials from building sites is both economical and establishes a connection of buildings to their site be it by colour or texture (refer to Fig.1). Natural materials are inherently healthier than some recycled materials which have been known to give off harmful toxic gases. Another aspect to consider in technology is that of tectonic culture and the adaptation of regional construction methods and materials into modern architecture. Louis Kahn said, 'details should not be put in a mitten and hidden… space is architectural when the evidence of how it is made is seen and comprehended' (Jooste-Smit, 2009: 75). Tectonic cultures may also promote skeletal, transparent type buildings or monolithic, enclosed type buildings. 'By using local and regional materials and methods of construction, our buildings participate in defining a unique sense of place with both cultural and ecological relevance' (Guenther & Vittori, 2008: 341) (refer to Fig.2).

(Fig.1)(Source: jahsonic.com) Wright's Kaufmann House uses stone materials
claimed from the site in its construction to create a seamless relation between the
building and nature, inside and outside.
Accessed 25-11-10

(Fig. 2)(Source: dl4all.com) Traditional Japanese joinery techniques add a tectonic quality to Japanese regional architecture that is culturally significant; wood grain can also serve as a decorative simulation of nature. Accessed 27-02-11

'Natural materials express their age and history, as well as the story of their origins and their history of human use' (Pallasmaa, 2005: 31). An intriguing example that blends local material and modern technology is Herzog and de Meuron's Stone House which consists of 'an exposed concrete frame within which are set loose, mortarless stones quarried from the surrounding slopes. These stones, of the type used for centuries to build the region's barns and farmhouses, are so irregular in colour and shape as to teeter on the edge of rustic incoherence, to be saved from it only by the rational geometry of their concrete frame' (de Botton, 2006: 199).

The use of natural materials in architecture is also indirect as the parts still have to be assembled in a way that they naturally would not but the use of these materials carry with them health and economical benefits in the place of high tech materials and technologies which occasionally are unhealthy for human environments. 'Timber moderates humidity, temperature and airborne toxins with its extensive internal air spaces. If not sealed (by synthetic or oil-based paint or varnish) or wood-preservative poisoned, it is one of the healthiest materials to live within' (Day, 2004: 64).

Materials should have the following qualities: perform for human comfort, manufactured locally and have reduced environmental impact (have low embodied energy; from harvesting to manufacture, to delivery of goods to the site, to construction, to lifecycle energy usage, to preventive maintenance) (Heath, 2009:175). 'Grown materials such as thatch, timber and wool which are renewable should be used, where possible' (van Wyk, 2009: 111).

Green roofs and façade greening are other approaches in building technology which create a sort of natural sensitivity in our built environments. However this approach brings with it maintenance issues because the relationship between building and plants is somewhat forced and unnatural which can result in damp-proofing issues if not treated correctly. If achieved successfully it can lessen the impact of stark brick and concrete surfaces such as in the ivy covered walls of UCT campus; it also serves as an effective deterrent for graffiti. Green roofs are especially relevant in very dense urban environments with little outdoor natural space for the public. Such roofs also act as an alternative means of thermal insulation in warm regions.

When designers consider appropriate construction for walls, 'wall elements must be non-erodable and have low thermal conductivity' (Girard *et al,* 2003: 158). An example is engineered, non-erodable surfaces such as tile with a lean back up material like mud or flyash. An incorrect surface treatment would be cement plaster which blocks off the natural porosity of the brick. 'One is confronted with the additional problem of having created a heat trap, apart from having used an unnecessarily expensive material' (Girard *et al,* 156). Insulation blocks of pumice, blast-furnace slag or pulverized fuel ash can be up to '20 times as radioactive as bricks or limestone concrete blocks', and phosphogypsum plasterboard from desulphurization filters on factory chimneys, '100 times more than gypsum plasterboard' (Day, 2004: 62). Recycled furnace-product materials may be appealing but they are not the healthy option.

Another poor surface treatment in terms of climate would be the 'multi story offices with full glass facades, the new status symbol of modern architecture… a direct import from the sun starved, cold and artificial energy sufficient West, neglects the reality of the bright sun' (Girard *et al,* 2003: 294). The use of glass in modern building causes heat gain (all glass enclosed buildings experience a greenhouse effect). Architects can specify glass but then they must keep the sun off of it by means of brise-soleil or whatever prevention can be devised such as coated or insulated glass (refer to Fig.3).

(Fig.3) (Source: essential-architecture.com) This building in Bangkok, Thailand
uses a decorative brise-soleil that mimics the organic nature of tree branches.
Accessed 2-03-11

'By the time the Seagram Building was designed, mechanical systems for vertical transportation, lighting, heating and cooling were consuming more than half the budgets of new buildings. It was as if the building now was the mechanical system, wrapped in a membrane' (Roth, 1993: 128). Sustainable technology has become highly commercialized and people have found more complex ways of doing simple things. A simple environmental response in terms of keeping light out while letting air in during warm temperatures would be the perforated marble screens of the Isfahan mosques (refer to Fig.4). Designers should consider simple yet effective technology for local construction as p articipation is an existential act which can create a sen se of belonging which promotes social ties to the building and its place.

(Fig. 4) (Source: farm3.static.flickr.com) The perforated screens of the Isfahan
mosque provide ventilation while also having intrinsic value with the region and its
culture. Accessed 2-03-11

The Visitors' Interpretive Centre for Prehistoric Rock Art at Twyfelfontein designed by Nina Maritz is constructed of natural and recycled materials, and (as outlined in the Burra Charter of Conservation) is entirely reversible (Heath, 2009: 127). Only sand and masonry were available, but getting water to the site was difficult and would need to be transported to site. The alternative was low-maintenance (but sturdy) construction which included recycled metal framework and oil drum lids with sandstone infill gabion walls. Through Maritz's thoughtful approach to design, discarded elements are either given new life and utility in the manner in which they are reinterpreted, or conceived in such a way as to allow nature to redefine their character and meaning over time (Heath, 2009: 131) (refer to Fig. 5).
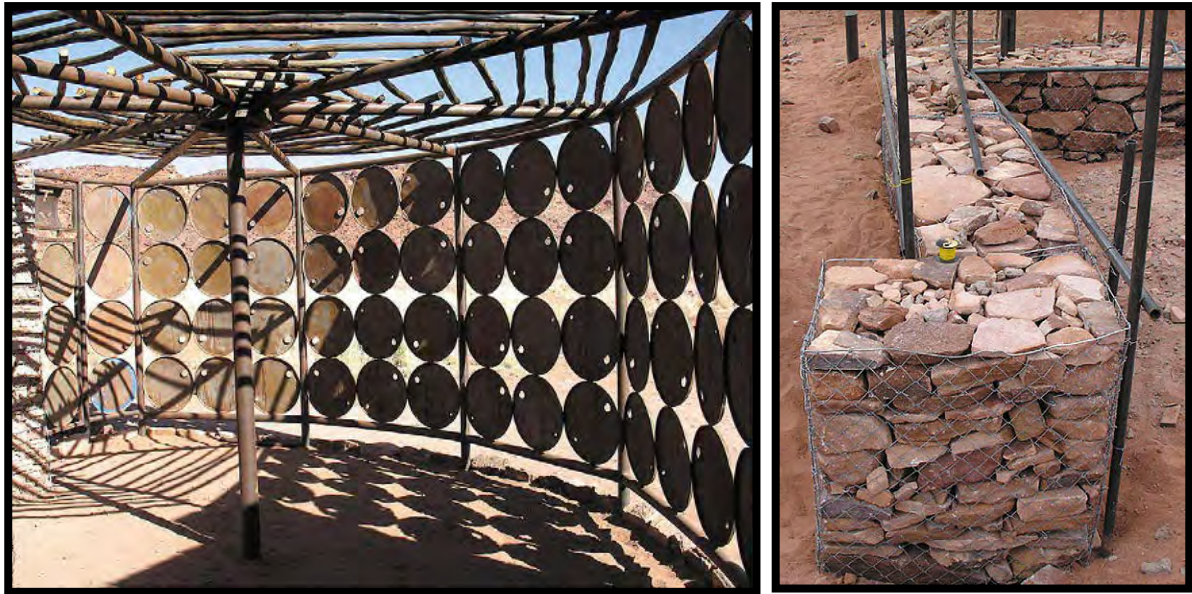
(Fig. 5) (Available from: Heath, 2009: 131, 142) Nina Maritz' design for a Rock Art Centre in Twyfelfontein uses recycled metal (left) and gabion construction (right) to adapt to the local conditions. Published 2009

Not only did Maritz take her cues from natural features, landscape patterns and their intrinsic coloration, but animal skeletons and San (Bushman) shelters were evoked in the concept drawings (Heath, 2009: 140). Addressing the extreme heat-gain factors and the strong glare component prominent in this region, the building turns its back to the sun, uses the gabion walls as heat sinks, has a softening effect on the strong glare and offers a physical effect on cooling the air by shading passageways and creating cross-ventilation (Heath, 2009: 143). The methods of assembly are so that the materials are easily retrieved and are able to be reused (bolt connections, screw fixings, etc.)

On May 13, 2011, Issy (Isaac) Benjamin delivered a lecture at the University of KwaZulu-Natal, South Africa entitled 'Intelligent Design'. In Issy's speech he made mention of numerous ideas relevant to ecological design such as drawing inspiration from context to create the spirit of a place, the benefits of natural views, designing with topography and natural materials. In response to the claims of biophilic design, he believed that mainstream science should not ignore 'correct analysis' and the worth of such methods in architecture (Benjamin, 2011). As a member of the ecological and architectural design team at Helionix Designs in the UK, he made mention of one of their projects, Pines Calyx.

'The Pines Calyx is a conference and events venue conceived of as a carbon neutral catalyst for rural and urban sustainable development… in the White Cliffs of Dover.' Notable characteristics include 'earth-sheltered and curved design with all the main walls being constructed in rammed chalk' and 'use of timbrel-vaulting' (shallow domes using no concrete or formwork) (greenspec.co.uk, 2011) (refer to Fig. 6). Other features include 'natural ventilation systems, 'virtual daylight' lighting, fully sustainable water management systems (including reedbeds naturally treating waste water), solar thermal hot water and energy management tailored to an ongoing programme for fully carbon neutral, renewable supply' (greenspec.co.uk, 2011).

(Fig. 6) (Source: pinescalyx.co.uk) The earth roof and curved chalk walls (above) relate to the natural surroundings by incorporating local natural materials in construction. The upper roundel (below) is used for a variety of purposes from seminars to wedding receptions. Accessed 14-05-11

2.2.9 Conclusion

A city should be built on areas of least ecological impact to allow areas of rich ecological diversity to fill the spaces between for community satisfaction. When designing, one should consider maintaining existing trees and native landscapes. Bioregional planning emphasizes self-reliance, the use of indigenous landscapes, waste elimination through recycling and co-generation, and encourages local economies and employment. Planners should then strive to maintain balance and order between urban density and adequate outdoor/ natural public space considering that both are beneficial in a city environment.

Bearing bioregional planning and climatic design in mind, designers must also consider the fundamentals of urban design. Designers should not create hard-edged environments but promote a more human scale and sociable atmosphere between the public and private realms. Mixed-use development provides opportunity for prospect, liveliness and social activity and is vital for citizen well-being. Environments need to provide a sense of prospect as well as refuge and privacy for the different community activities of a place. Along with biophilic design theory the fundamentals of public and private domains, urban imageability, figure-ground, linkage and place theories, compaction and mixed-use development should be understood and applied through the course of design.

Climate and topography are important considerations when designing a comfortable and nature sensitive design. When designing spaces one must consider activity levels in different rooms and placement of spaces of activity in relation to solar and wind paths for human comfort. To contribute to thermal comfort, designers must make sure that materials such as brick, stone and concrete are exposed internally for thermal massing and transfer. Designers should also orient houses towards the sun with the north face kept free from obstruction to allow effective warming during winter while sufficient shading is provided for summer months.

Diffusing of sunlight carries with it the potential for architectural expression through shadow and light. Designers should also make sure every occupant is within seven meters of a window wall, for views, light and air. In healthcare environments, windows should occupy from 20 percent to 30 percent of the exterior wall and discomfort glare should be avoided by using light shelves, reflective walls, skylights, roof monitors, atriums, reflective blinds or other forms of shading and indirect lighting. Natural ventilation requires a good understanding of cross-ventilation, stack ventilation, and thermally induced ventilation and the ability to define regionally relevant solutions.

Trees are a natural source of shade in warm climates and also provide a filter for particulate matter. Architects must strive to retain the natural elements of the site which make the location unique and add aesthetic quality to a region. Potential disasters such as floods and fires should be considered during site selection and the development of prevention measures. It is bad practice to hide natural landmarks; these should form a part of the skyline. The presence of domesticated animals can also provide a therapeutic quality to any living environment. Therapeutic hospital gardens invigorate patients after spending long hours in a contained environment.

Stormwater can be led to constructed on site wetlands or organic farms that improve eco-systemic health. Designers should consider the provision of recycled greywater or reed bed filters for eco-systemic health. Rainwater can be harvested for fire suppression and farm irrigation. The use of perforated concrete pavers prevents stormwater runoff and the heat island effect. The sound of flowing water creates 'white noise' and can instill feelings of relaxation by masking unwanted noise. Designers should reintroduce water into the urban environment as an aesthetic feature that is captivating for local citizens.

Natural metaphors in buildings trigger associations with living things that stimulate the on-looker. Designers should also consider walls not being barriers but rather transitional spaces between the outside and the inside and internal flexibility of space should also be provided. Human beings connect physiologically and psychologically to structures embodying organized complexity and designers should endeavor to create buildings that exhibit such qualities. Developers should promote human resources rather than mechanical resources as a step towards humanistic environments. Robust materials are ideal for a lasting purpose in regions where lack of funding often renders citizens incapable of repairing deteriorating buildings. Materials that eventually become inadequate need to have recyclable quality to avoid waste pollution.

Natural materials are inherently healthier than some recycled materials which have been known to give off harmful toxic gases. Materials should have the following qualities: they should perform for human comfort, be locally manufactured and have reduced environmental impact (low embodied energy). Participation in building environments creates a sense of belonging, which promotes social ties to the building and its place. Conversion of buildings is better than demolition for a more economically and environmentally responsible approach and designers should experiment with sustainable and natural materials and technologies to encourage better building practices and acceptance by society. Having considered the implementation of environmentally and socially responsive buildings through the biophilic design approach; the research will now consider its use in architectural environments for the benefit of human health specifically.

2.3 Natural Environments and Health Benefits

2.3.1 Introduction

To explain physical and mental health the perspective of occupational therapy will be employed to understand the value of human well-being. Occupational Therapists consider occupations to be everything that people do to occupy themselves, including looking after themselves (self-care), enjoying life (leisure), and contributing to the social and economic fabric of their communities (work/ productivity). Occupational therapy (OT) is concerned with promoting health and well being through occupation which correlates with a philosophy of OT called existentialism. Soren Kierkegaard, the founding father of existential theory, believed that instilling a sense of purpose in life amongst people is highly beneficial in defeating the adverse affects that mental, physical or social disease have on self esteem (Marino, 2004). OT helps people to develop adaptive/ physical skills that will aid in daily living and improve interactions with a person's physical and social world. These physical and social aspects are relative to the built environment which is why existentialism is also applicable in architectural theory.

Occupational Therapists have a broad education that equips them with skills and knowledge to assist people to overcome limitations caused by injury or illness, psychological or emotional difficulties, developmental delay or the effects of aging. OT examines not only the physical effects of an injury or disease but also addresses the psycho-social, community and environmental factors that impact on functional independence. Their goal is to assist individuals to move from dependence to independence, maximizing personal productivity, well-being and quality of life through the use of specific, purposeful and meaningful activity. There are a v ariety of treatments that occupational therapists use, namely: group therapy, life skills and social skills training, splinting, pressure garments, neuro-developmental techniques, sensory motor integration and assistive devices (refer to Fig. 1). Occupational therapists often work in collaboration with physiotherapists, audiologists, speech therapists as well as medical doctors to improve motor and communication skills of patients so that they can enjoy a higher quality of life once again.

(Fig. 1) (Source: trustpointhospital.com) Occupational rehabilitation requires an exercise room to foster independence amongst disabled patients. Accessed 23-02-11

Humanism is the service of sustainable healing which aims to heal the 'body, mind and also the spirit' (Guenther & Vittori, 2008: 341). The existential experience of nature and the sense of community purpose that natural conservation brings correlates with the social development aspects of existentialism which are relative to our built environments. These ideas are advocated by environmental / architectural psychology that has drawn inspiration from existentialism to create more stimulating and empowering environments for people to live in. With existentialism man rises above the 'structures' constraining him in a movement of permanent 'transcendence' (Luchinger, 1981: 15-16) and 'man's most fundamental need is to experience his existence as meaningful' (Norberg-Schulz, 1979: 166). The previous chapters considered how designers can sustain the connection between nature and society for the benefit of communities. The following sub-sections will now specifically look at the physical and mental effects that nature experience has towards improved health and functional development.

The information in the above section has been provided by Mrs. N Pillay from the Pietermaritzburg Assessment and Therapy Centre which serves people living in the locality of Northdale, Pietermaritzburg (28/02/2011).

2.3.2 Nature Experience and Physical Health

'Some people prefer to think of health as the absence of disease, while others insist that health is a state of physical, mental, and social well-being' (Guenther & Vittori, 2008: 68). One association that people need to amend is that 'diminished human and ecosystem health is 'the price we pay' for technological or economic progress' (Guenther & Vittori, 55). The public health challenges of today- 'asthma, developmental disabilities, diabetes, obesity, reduced fertility, cancer- have significant linkages to the technological and environmental changes of the twentieth century' (Guenther &Vittori, 26). N.E. Adler stated that 'people with few economic resources generally have poorer health outcomes than people who have more economic means' (Kellert *et al,* 2008: 147) and so government must prevent economic progress from creating social and environmental segregation and eventual health degradation of the poor.

If architect's want to improve the state of living spaces, 'the built environment… must be conducive to clean, healthy, comfortable, pleasant and aesthetic living. Green trees, clean air and water, birds and animals, gardens and open spaces are as m uch an integral part of the built environment as skyscrapers, bridges and roads. It is important that they co-exist in a harmonious manner' (Girard *et al,* 2003: 294). 'Biodiversity is important for life on Earth because it contributes to the resilience of ecosystems and to human inspiration and peace' (Graham, 2003: 109).

In a study conducted by the late G. Scott Williamson 'he believed that, physical, mental and social health were unified attributes and there were aspects of the physical and social environment that were their corollaries'. He died before he could attain any conclusive evidence to his hypothesis but a study was conducted for the city of Philadelphia with respect to his belief (McHarg, 1992: 187). A summary of physical disease was developed for the region and the results were overlaid to create a v isual indication of the city areas that were most affected by disease (McHarg, 189). It was interesting to note that the city centre experienced the most physical disease and social disease while mental disease was more diffused but the northeastern and southern reaches of the city remained free which also correlated with the open, natural spaces of these peri-urban environments (refer to Fig. 1).

(Fig. 1) (McHarg, 1992) A study on Philadelphia indicates that the city centre corresponds with higher levels of unhealthy citizens. The darker the shade the higher the incidence of illness. Published 1992

In *Regional Planning* (Mumford, 1931) cited by Canizaro (2007: 241) it says:

> *'We created the coal-agglomeration and the financial metropolis, seeking quickly to extract coal and iron from the soil, and to organize industry so as to produce a maximum profit to the investors; in the act of paying attention only to these limited ends, we forgot to create orderly, healthy, hygienic, and esthetically decent environments.'*

Air pollution from industry; water pollution from improper waste management and soil pollution from improper landfill management are all side effects from man's negligence which in turn has an effect on the environment and man's health. Lower income communities cannot avoid some of these consequences; consider the air pollution experienced in the residential area of Wentworth due to the Engen refinery in the industrial zone south of Durban. Residents are faced with health hazards linked to petrochemical industrial production. South African refineries produce approximately 82 tons of sulphur dioxide gas daily (umich.edu, 2011) (refer to Fig. 2). Consider also the pollution resulting from the oil refineries in Cape Town, the Caltex Refinery specifically. It is notorious for its contribution to hazy winter mornings, foul smelling air, respiratory illnesses and accumulated black

soot on the side of homes (saepej.igc.org, 2011). Reduction in pollution or considerate planning in the future would have a positive impact by improving health and living conditions for affected citizens (consider the Sambhavna clinic and the Bhopal tragedy in India, pg. 120-121).
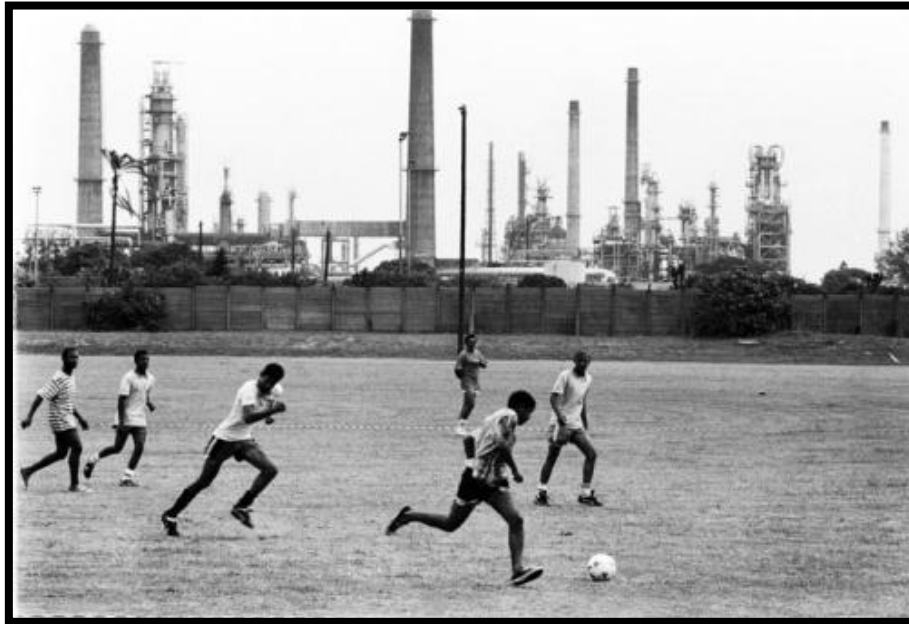
(Fig. 2) (Source: baileyseippel.co.za) A game of soccer at a park in Wentworth is tainted by pollution and industrial factories in the background. Accessed 24-02-11

'Normal clean air is negatively ionized; normal urban air is usually positively charged… the United States Navy confirmed that positive ionization induces anxiety, tension, eroticism and low morale while negative ionization contributes to a feeling of well-being' (McHarg, 1992: 195). 'Less negative ions mean more micro-dust in the air, so it's less fresh' (Day, 2004: 57). Much of the fresh air that the rural communities breathe is critical to their health and the negative ions needed are produced in nature. 'Negative ionization is produced by lightning and thunderstorms, water falling in rain, waterfalls and fountains… and it is believed that the oxygen expelled in plant photosynthesis is negatively charged' (McHarg, 195). This is good evidence to include nature into architectural environments as a health benefit for occupants. Trees offer indirect health benefits by reducing air pollutants, especially ozone, nitrogen dioxide, and to a lesser extent particulate matter (Kellert *et al*, 2008: 115).

Another type of pollution to consider is the noise pollution experienced in cities. This can come from a variety of sources: people, machinery, traffic, etc. If this exceeds the threshold of 70 dB it can have 'adverse effects on physical and mental health' (Girard *et al*, 44). It is advisable to provide break areas in work environments that are effectively sound proofed from city noise to provide rest (insulated

walls and acoustic ceiling tiles). 'Burbling brooks, rustling leaves, and similar sounds calm us quickly' (Augustin, 2009: 46). These sounds relate to an atmospheric tool called white noise. Sound engineers can create recordings of similar sounds, if there is no possibility of physically creating them, to be played in spaces which may improve productivity by eliminating the effects of disruptive noise (Augustin, 2009).

An extract from Graham (2003: 85) makes mention of indoor air quality saying:

> *'Building in recent times has had almost as equally damaging effects on people as on ecosystems. The increased use of synthetic materials, mechanical control of ventilation, coupled with poor consideration of the relationships between material choice, climate, site and their combined effect on people, has led to the creation of unhealthy indoor environments… many common materials contain substances that are toxic and which can lead to serious health impacts… leading to a decrease in productivity… off-gassing materials, bacteria or viruses, lack of fresh air… formaldehyde and xylene are commonly susceptible to off-gassing… a significant influence on asthma sufferers.'*

The Ecolonia housing project in the Netherlands pays particular attention to 'the choice of paints and materials to avoid indoor pollution' (Roodman, 1995: 46). Some of the common pollutants of interior spaces that were considered included radon, moulds, carbon monoxide, VOCs, legionella, asbestos fibres, carbon dioxide and ozone. These exist in the following forms: radon (rock base for foundations; some materials), moulds (excessive moisture), carbon monoxide (tobacco smoke and automobile exhaust fumes), VOC's (a variety of sources from paints to furnishing), legionella (evaporative cooling towers), carbon dioxide (human activity) and ozone (electrical devices) (van Wyk, 2009: 179). Indoor air quality is particularly relevant to people within healthcare settings where sick building syndrome should be avoided at all costs. High performance ventilation and filtration media can be considered for filtering out pollutants.

'Features like natural light, fresh air, and user-adjustable task lights make offices more pleasant and give employees more control over their environment. Happier with the workplace, they show up for work more often, and are more productive' (Roodman, 1995: 47). 'In early 1995, Sweden's largest housing bank, Hypoteksbanken, announced that, having sustained massive losses from sick building syndrome, it planned to lend money *only* for 'green' buildings. For the same reason, insurance companies could also begin to reward healthier buildings with lower liability coverage premiums' (Roodman, 52). From this example we can clearly see how physical well-being results in productivity which can help towards building costs and economical development.

Type 2 di abetes and obesity can be prevented by simple exercises such as walking. The best non-medicated ways to treat depression are also exercise and social activity. Exercise that takes place in natural settings combines the benefits of physical activity with the benefits of nature contact (Kellert *et al*, 2008: 111). Travelling by foot and bike are also the most fuel-efficient and non-pollutant methods of transport and designers must create places for such activities (Guenther & Vittori, 2008: 32). 'But as unrelieved stimulation can cross the border to stress, we need places to rest, to 'take a break' from pressure – from people-watching seats to havens for soul recuperation' (Day, 269).

With people realizing the importance of physical health, they should avoid pollution and promote biodiversity. Buildings need to use more people friendly technologies and materials in building construction and architect's must design for social health as w ell and realize that the inclusion of nature into the spaces they create can potentially reduce viral infection and physical pain. What needs consideration is the mental relief that nature can provide from the busy modern lifestyle and how designers can foster positive associations with nature in the experience of architecture.

2.3.3 Nature Experience and Mental Health

Place science or environmental/ architectural psychology 'establishes how the place you're in physically influences the state you are in mentally and then determines what changes (if any) need to be made in a space to achieve personal and professional objectives' (Augustin, 2009: 9). Experience of natural environments is important for human well-being. 'The mind craves information, constantly varying information, and when that input is cut off- when sight, hearing, smell and touch are completely un-stimulated, as in a flotation tank- the mind will eventually invent its own stimuli and hallucination will result' (Roth, 1993: 59). Beyond the sense of sight, architecture has other senses that it can appeal to and in turn add value to the psychological experience of the architectural space.

> *'The perception of architecture, then, is an activity in which the whole body is*
> *involved- basking in the warmth of a sun-filled court or feeling the cool shadows of*
> *its encircling arcade, scanning the rhythm and scale of a façade, listening to the*
> *volume of a room, feeling the roughness of stone, the smoothness of tile, smelling*
> *the bite of a boxwood hedge along a garden's edge, tasting the cool water of a*
> *fountain' (Roth 1993: 103).*

In modern society people are being seduced by technological progress and buildings are losing their humanistic quality (Kellert *et al*, 2008: 76). Nature relates more to the human as a living being than concrete and glass does. The way architects design their buildings can become therapeutic depending

on how they address the inclusion of nature. Christopher Alexander's *A Pattern Language* (1977) has many patterns which stress the need for people to connect with nature, from greening streets, to the preservation of natural pools and streams and using trees to shape social spaces. The many patterns referred to in his text can be combined to create a complex relation of buildings to their environment which in turn creates more livable spaces. The relation and balance between the built environment and natural environment becomes more coherent in the inhabitants mind.

'It follows that the balance we approve of in architecture, and which we anoint with the word 'beautiful', alludes to a state that, on a psychological level, we can describe as mental health or happiness' (de Botton, 2006: 199). Salk Institute is an example of architecture that serves a psychological function for a research environment by balancing work and reflection. The facility has large spaces for work and small private spaces for reflection that offer views of nature; specifically those of the Pacific Ocean beyond the cliff edge. These perceptual extensions of the space reduce feelings of confinement and claustrophobia. The internal study spaces add a humanistic dimension to the facility and display the fact that the researchers aren't machines but souls that require mediation between hard hours of working and time for recess and contemplation (refer to Fig. 1).
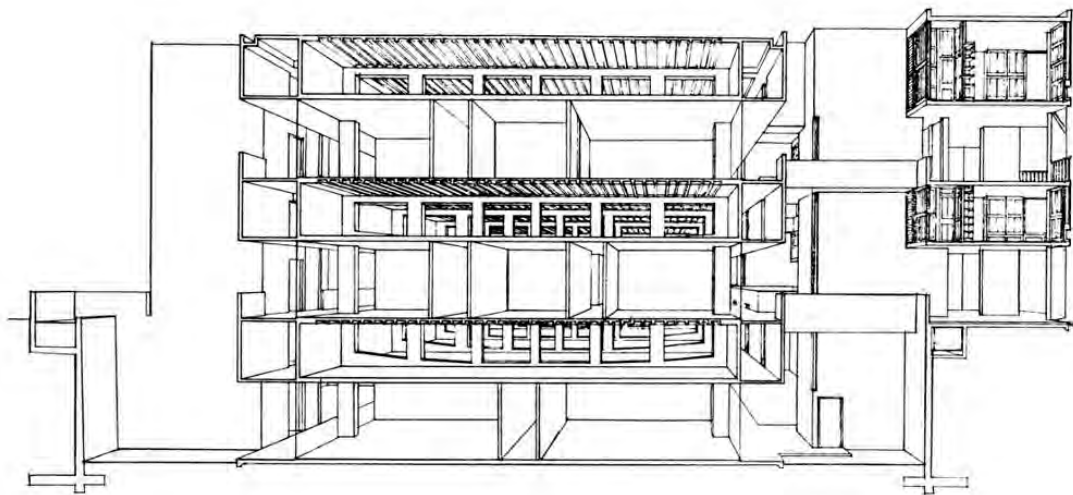
(Fig. 1) (Sources: mimoa.org & acsa-arch.org) The study rooms of the Salk Institute provide contemplative views over the Pacific Ocean (above) and a more humanistic environment for the researchers (right of section) away from the institute laboratories (left of section). Accessed 25-11-10

Christopher Day says, 'even for occupations which theoretically do not need natural light, windows connect the artificially- controlled indoor world to the life of activity, weather and season outside – the lifeless, unvarying with the life-renewing, ever-changing' (Day, 2004: 75). In *Regionalism in Architecture* (Neutra, 1939) cited by Canizaro (2007: 276) Richard Neutra said that his sensitivity to climate and region was not for emotive and creative power, but because it yielded a 'psychological and physically healthier environment'. Likewise we can compare this to Peter Stutchbury's Bangalay House in New South Wales which responds to climate and land and allows the living spaces to open up to nature with sliding glass doors (refer to Fig. 2). Stutchbury believes this connection 'sustains the mind and spirit' bringing peace and comfort with one's natural surroundings (Power, 2009).

(Fig. 2) (Source: takesunset.com & farm2.static.flickr.com) Richard Neutra's
Kaufmann House (above) displays sensitivity to its region for health reasons and
Peter Stutchbury's Bangalay House (below) provides sliding doors as a connection
between the interior and outdoor nature for human comfort. Accessed 25-11-10

Consider the captivation of the senses and the spirit of place portrayed by the Villa d' Este in Tivoli near Rome; objects of contemplation in the gardens and sensual stimulation create a spirit of place which make it memorable and enjoyable to be in (refer to Fig. 3). In *The Meaning of Regionalism in Architecture* (Belluschi, 1955) cited by Canizaro (2007: 323) it says: 'our emotions have become second hand, they come through books, movies, radios, television, in world-wide uniformity. We have gotten more and more away from nature and from the discipline which nature requires.' 'The Ancient Greeks, who had spent most of their time outdoors, whose cities were small and ringed by forests and seas, had only rarely felt the need to celebrate the natural world in their art' (de Botton, 2006: 160). Modern society is different and our developed cities have created a longing for natural experiences and designers need to provide experiences that will give relief once again for the modern world.

(Fig. 3) (Sources: lifeinitaly.com) The smell and colours of flowers, the sounds of
flowing water and the coolness of the air at the fountains of the Villa d Este provide
a sensual experience for the public. Accessed 25-11-10

Urban parks, wilderness areas, gardens and seashores satisfy the interest and need to connect with nature. Architectural design can evoke nature's qualities, relationships, and structures without direct replication (Kellert *et al*, 2008: 228). Too often architecture is solely based around the visual sense while the remaining four senses are ignored. Pallasmaa believes that architecture should captivate all senses to encourage positive emotional experience amongst people (Pallasmaa, 2005). In an excerpt from Kellert (2008: 230) it says:

'Architecture provides the opportunity for celebration of the cycles of day and season, not only visually but with the seasons of autumn and spring come different odours and colours as well. Other examples such as the motion of people through open outdoor space, hearing birds in a pleasant landscape, feeling different textures under foot as one meanders through a park and the provision of gardens with fruit bearing vegetation for people to enjoy all provide positive sensory stimulation for the community.'

Different textures underfoot have been used effectively to orientate blind people; giving them a sense of assurance when in outdoor public spaces. Synthetic scents of nature can also be used in architectural environments to create feelings of relaxation (lavender) or excitement (cinnamon) (Augustin, 2009: 44). It is also important to remember that texture can be tactile as well as visual.

The colour of paint can also be beneficial to building occupants. British nurse Florence Nightingale wrote in *Notes on Nursing* that 'variety of form and brilliancy of colour in the objects presented to patients are an actual means of recovery' (Kellert *et al,* 2008, 326). Exposed to green or blue; the body experiences a release of muscular tension, slowing of the heartbeat and a slight lowering of the body temperature (Roth, 1993: 76) (refer to Fig. 4). 'Red helps activate autistic children, encouraging them out of themselves into activity; blue calms down hyperactive ones, bringing them more into themselves' (Day, 2004: 72). Our use of colour must not under-stimulate or over-stimulate our senses as these can potentially result in depression or on the other hand increase blood pressure (Meerwein, 2007: 22). We might use warmer colours for depressed patients in a psychiatric ward to reinvigorate them mentally rather than using cold or sterile colours (Meerwein, 133).

*(Fig. 4) (Meerwein et al, 2007) The patient visitor's room in a hospital uses
'calming' hues of green and blue to put visitors at ease. Published 2007*

'The boundaries of a built space are known as *floor, wall* and *ceiling*. The boundaries of a landscape are structurally similar, and consist of ground, horizon, and sky. This simple structural similarity is of basic importance for the relationship between natural and man-made places' (Norberg-Schulz, 1979: 13). Relatively, waking up in a sp ace with a d arker floor, a lighter ceiling, and walls painted an intermediate colour 'helps patients properly orientate themselves on Earth… we are used to a darker ground, lighter sky, and vegetation of intermediate darkness' (Augustin, 2009: 237).

Logical way finding in healthcare facilities reduces visitor stress therefore 'colour-coding sections of buildings or paths through buildings can prevent people from getting lost' (Augustin, 2009: 242). The use of colour must also be proportionate to the spaces they are in; extremely bright colours in a small space is too shocking but in a much larger space their effect would be less direct and intruding (Meerwein, 2007: 72). Allowingoccupants to decorate their environments the way they want to i.e. murals, furniture, pot plants, etc. would be a good alternative for interiors where a sense of ownership is created; this idea relates to Hertzberger's concept of freedom within a 'structure' (Luchinger, 1981: 52).

An extract from Roth (1993: 16) also mentions stress and anxiety saying:

> *'A waiting room at a doctor's office or emergency room in a he althcare environment would be a place where most people experience heightened anxiety. The architect might determine that creating a domestic atmosphere like that of a home living room, with a view out to an enclosed garden, rather than an antiseptic clinical atmosphere, would help to reduce those anxieties.'*

(Refer to Fig. 5)

*(Fig. 5) (Source: 1.bp.blogspot.com) The waiting room at Santa Fe Cancer Centre
at St. Vincent Hospital looks out onto a healing garden*

An interesting example of a 'home-like' healthcare environment is Friedensreich Hundertwasser's design for the oncology ward at the medical university of Graz, Austria. In order to make the patient's visit pleasant, Hundertwasser designed colourful and comfortable patient rooms, a garden lounge and roof terrace to create a cheerful spirit of place (Graz Medical University, 2011) (refer to Fig. 6). One can also consider sound-absorbing surfaces which instill a spirit of acceptance; reflective surfaces are harsh as if they throw the sounds of sociable people back at the public. For this reason, rubber floors or carpeting in visitor spaces is a better alternative to tiles. Curtains, upholstery, pillows and rough surfaces also help dampen sound and fewer right angles in furniture and space help reduce echo.

(Fig. 6) (Source: onkologie-graz.at) Irregular lines, colourful shapes and the visual texture of plantings create a pleasant home-like experience for the healthcare patient at Hundertwasser's oncology ward. Accessed 12-04-11

It is thought provoking that the estrangement and detachment from nature is often evoked by the technologically most advanced settings, such as hospitals (Pallasmaa, 2005: 19). Architects need to remedy this association for a revitalizing experience. A walk through a hospital garden is much more invigorating than one along a double-loaded hospital corridor for example. The natural environment can stimulate our senses; and 'the natural and traditional built environments rich in informational content make a place more intrinsically human' (Kellert *et al*, 2008: 77). 'In the twenty-first century, our neocortex's stimulation hunger is satiated at least partially by participation in the world of

electronic information technology, which takes us into make-believe realms unconnected to much of the actual physical world around us' (Kellert *et al,* 308). The danger of this is that people and architecture may evolve away from synchronization with nature and the experience of it. Architects must revitalize the quality of spaces for positive experiences of nature once again.

In the past century society has become separated from nature, economies are centred on major cities and people have 'mastered' nature and become mostly 'an indoor species' (Kellert *et al,* 2008: 214). Children in cities have become separated from the experiences that previous generations had. There is no more wild play and children are becoming absorbed into the electronic realm of computers and television (Louv, 2005). Richard Louv suggests that lack of contact with nature may be one of the contributors to the dramatic rise in ADHD (attention deficit hyperactivity disorder) among children in recent years (Kellert *et al,* 2008: 328).

Kevin Moore says that 'in the richer suburbs of Gauteng, children seem to be more enticed by the fast track gratification offered by computer simulated games than to want to venture into the garden' (Moore, 2007). 'Architectural determinism is the belief that you can change people's behavior by modifying the places in which they behave, without changing anything else in their lives' (Augustin, 2009: 181). Applying this theory, architects need to counterbalance 'nature deficit disorder' in cities by reintroducing nature into deprived regions that children and communities can enjoy (refer to Fig. 7).

(Fig. 7)(Source: albertmohler.com) The experience of nature during childhood is
vital, without it, future generations living in dense urban environments may become
alienated and have no inclination to ever be out in the wilderness.
Accessed 25-11-10

'Pollution and strictly utilitarian values have crippled our emotional attachment to water' (Kellert *et al,* 2008: 48) as well as many of the other elements. These have become mere resources and people don't connect with them on emotional levels as often as they used to. It is good that designers foster positive emotional experiences of nature but they need to be aware that the threats and dangers of nature can also develop a phobia towards our environment. Many aspects of nature, such as violent storms, fire, floods, earthquakes, wild animals, disease, and dark places elicit dislike, anxiety, fear, and avoidance and fall into the category of 'biophobia' (Kellert *et al,* 228). Architects need to maintain our environments and design so that occupants do not develop negative associations with their natural environment e.g. design for shelter against natural disaster. We can direct our attention to some of today's architecture that establishes positive sensory connections with nature such as in the work of Glenn Murcutt (refer to Fig. 8).

(Fig. 8)(Source: residentialarchitect.com) The Ball Eastway House by Glenn Murcutt in Sydney, Australia provides a balanced experience with the surrounding forest. A curved roof prevents leaves from collecting, water is reserved for protection against bush fire, and raising the structure above ground preserves the forest floor while providing a place of respite for the occupants. Accessed 24-02-11

From the above we realize that the design of architecture can affect the anxiety and stress that occupant's experience. Perceptual extensions of space to the outdoors reduce feelings of confinement and claustrophobia. Designers need to create less imposing buildings that incorporate natural experience for human comfort and a more homely atmosphere to provide relief from urban stressors. Exposure to sunlight helps reduce stress therefore 'break' areas are vital for allowing access to natural light and fresh air for building occupants. The following chapter will provide medical research evidence with regards to the affects of natural experience on human health.

**2.3.4 Evidence from Healthcare Environments**

Clinical epidemiology in the form of randomized controlled trials can provide evidence of nature's health benefits for people. In Stephen Kellert's publication of *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life,* there are numerous examples where the physical and psychological benefit of nature is manifested in the recovery of ill patients and those who have recently undergone medical operations. From these examples people can realize that nature is essential if we wish to create a healthy and satisfied modern society in our architectural environments. To follow are some examples that provide evidence of nature's health benefits in healthcare environments.

In viral prevention a 1996 field study of 690 residents at a four-building nursing home facility in Wisconsin revealed that there was an '87.3 percent reduction in the incidence of influenza in a building with 100 percent outside air ventilation and local filtration for each room, as compared to three buildings with 30-70 percent re-circulated air and central filtration only' (Kellert *et al,* 2008: 123). Also, O. Seppanen and W.J. Fisk have identified over a dozen studies revealing the benefits of natural ventilation in reducing 'headaches, mucosal symptoms, colds, coughs, circulatory problems, and sick building syndrome' (Kellert *et al,* 2008: 123).

Roger Ulrich has undergone research which explores the effects of nature on patients that have undergone surgery. In a study of patients recovering from abdominal surgery 'those assigned to rooms with a bedside view of nature (trees) had better postoperative recovery courses than matched patients assigned to identical rooms with windows overlooking a brick wall' (Kellert *et al,* 2008: 94). Ulrich also discovered that patients who had undergone gall bladder surgery 'with a view of nature... received fewer negative evaluations from nurses and took fewer strong analgesics' (Kellert *et al,* 120). When designing medical wards one must consider sill heights and sight lines of nature for the benefit of such individuals.

In Roger Ulrich's research on reducing pain experienced by patients, experiencing natural environments during recovery resulted in 'shorter average recovery periods, fewer pain-killers, and fewer nursing calls'. This research has led to the use of 'healing gardens' as elements in many new hospitals (Cooper Marcus and Barnes, 1999). The reason for this reduction in pain is attributed to higher sunlight exposure which 'influences levels of serotonin, a neurotransmitter known to inhibit pain pathways' (Kellert *et al*, 2008: 100). Knowing this, designers should avoid site plans where some buildings block natural light from others, especially morning sunlight which helps maintain circadian rhythms (synchronizing asleep and awake cycles). Daylight also stimulates the metabolism of Vitamin D which is vital for human health.

With the production of serotonin aside, some researchers have also associated nature with 'gate control theory' as the cause to this reduction in pain. Gate control theory proposes that distraction can prevent our nervous system from readily responding to physical pain experienced. 'Gate control theory suggests that a nature view can close the gate and alleviate pain by distracting the patient, reducing stress, and increasing positive emotions' (Kellert *et al*, 2008: 93). The more engrossing and sensually stimulating a nature experience; the more distracting it will be. In severe health cases however, audio-visual simulation can be used as an alternative. Consider the luminous sky ceilings manufactured by the Sky Factory in Fairfield, Iowa (Kellert *et al*, 2008: 327) (refer to Fig. 1).
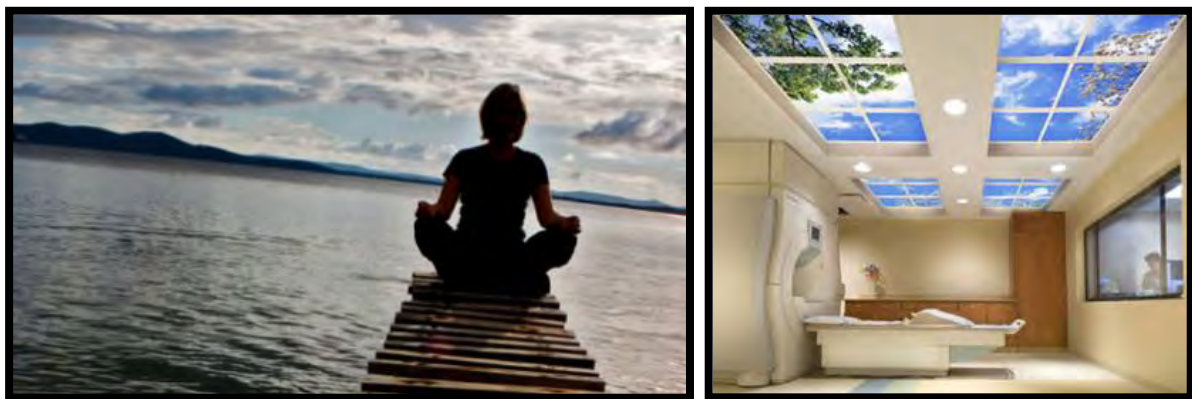
(Fig. 1) (Source: anxiety.net; elitechoice.org) Providing places for respite where one can experience nature has potential to reduce stress as supported by gate control theory. Luminous 'sky ceilings' also create a pleasant distraction in medical environments. Accessed 24-02-11

Roger Ulrich has found that 'reductions in stress should directly and indirectly promote improved health outcomes, such as lessened pain and faster wound healing in connection with enhanced immune function' (Kellert *et al*, 2008: 90). He has found that nature experiences can reduce stress and that 'well-lighted or sunny nature settings… elicit responses, improve emotional well-being, foster

restoration, and promote health' (Kellert *et al,* 91). Time outdoors in direct sun, especially early in the day ensures 'UV-induced melatonin production' which is successful in reducing depression and improving mood (Kellert *et al,* 122). Urban settings on t he other hand are lacking nature (streets, parking lots, building exteriors without nature, windowless rooms) and are 'unsuccessful in producing restoration, and in some instances worsen stress' (Kellert *et al,* 91).

Researcher E.J.W. van Someren has revealed that 'exposure to higher levels of daylight or white artificial light may improve sleep in community-dwelling older adults and persons in dementia facilities' (Kellert *et al,* 2008: 99). These higher levels of light reduce the stress experienced by patients and so designers must consider providing 'break' areas where natural light and fresh air is present. The least effective physical settings would be 'built or artefact-dominated spaces that lack nature and have overcast or dim light conditions' (Kellert *et al,* 101). 'Daylightless living (like night-shift work) is also linked to increased cancer risk' (Day, 2004: 180).

2.3.5 Conclusion

Physical and psycho-social responsiveness in built and natural environments help create healthy spaces for people to live in; young and old. Factors in the improvement of physical health are the prevention of air pollution, water pollution and soil pollution which have negative effects on the environment and man's health. Compact cities are more socially and economically sustainable than sprawling cities and they prevent air pollution caused by long distance commuting (buses, taxis, etc.) Off-gassing materials, bacteria and viruses pose a threat when there is a l ack of fresh air and so natural light, fresh air, user-adjustable task lights and operable windows are vital to making interiors more pleasant to be in. Exercise that takes place in natural settings also combines the benefits of physical activity with the benefits of nature experience and the provision of this kind of exercise should be considered.

Paint colours can be mentally therapeutic depending on the context in which they are used. Creating a domestic atmosphere like that of a home living room in a public place reduces anxiety and the use of scents that mimic those in nature can also be therapeutic in an interior environment. Perceptual extension of space reduces feelings of confinement and so designers should provide views to nature from interiors. Designers also need to provide experiences of nature and the outdoors that will give relief from a dominantly man-made environment and should consider exterior as well as interior landscaping. Avoid site plans where some buildings block natural light from others and consider sill heights and sight lines of nature for the benefit of building occupants. Consider providing 'break' areas where natural light and fresh air are present and provide effective sound proofing from work

noise to allow rest. Occupants should always maintain a clean environment to retain the appeal of a place.

From the theories and evidence provided it can be concluded that environments can indirectly promote physical, psychological and social health through human experience. Researchers such as Esther Sternberg have likened this phenomenon to the placebo effect where people are healed without actual medical treatment (Sternberg, 2009). The research will now consider how designers can apply biophilia in building design which is in tune with the communities and cultures of a region.

2.4 Designing with Nature in Developing Communities

2.4.1 Introduction

People need to belong to their place and architects must strive to create place based relationships in their buildings for this reason. Many citizens of the country live in poverty and the inability of cities to absorb the entry of people from rural areas in search of work forces them to live in squalor due to lack of appropriate housing facilities and public services. These people succumb to disease which needs to be met with an appropriate service from local healthcare facilities. These services can be inappropriate, providing poor accommodation, technical capacity, and few medical staff (refer to Fig. 1). Biophilic design is not only the incorporation of nature into the built environment for human health but social and economic factors have to be considered as well to create humanistic environments for developing regions.

(Fig. 1) (Source: i.ytimg.com) Mothers and their children in a crowded and
discomforting healthcare waiting room is a result of inadequate funding. Accessed
23-02-11

The problem is the rate of population expansion and the need of development to provide for this expansion. 'Millions of additional people are forced, alongside those already in cities, to live in slum-like conditions... the consequence of a prolonged pattern of this lifestyle will be ecological and infrastructural collapse, followed by social collapse' (van Wyk, 2009: 49). The provision of environmentally, socially and economically sustainable built environments is a source of hope in preventing the ill effects of inequality and social unrest in the country.

Since the Industrial Revolution and the effects of the later trend of modern globalization, the built environment has been dictated by concepts that hardly respect the value of nature. Pre-industrial cultures exhibited a g reater sensitivity towards nature than the modern generation. Nature was especially relevant to agricultural or hunter-gatherer cultures. Nature was their sustainer and such cultures can inspire architects to re-establish a connection between culture and ecology for community benefit. Settlements were built spontaneously to meet human needs and with the absence of modern transport they grew organically instead of orthogonally for a more humanistic experience. Architecture can promote this connection again and evoke a past and more naturally and socially connected way of living. Learning from cultures such as the Zulu may inspire modern designers to promote ecology (refer to Fig. 2). This is not to say that society must turn away from industry and progress but rather that people find a balance between the two seemingly opposed modes of ecology/ natural environment and industrial/ urban environment.

(Fig. 2)(Source: art.com) The Zulu 'kraal' within its natural setting can inspire
modern design to recover its connection and balance with nature.
Accessed 25-11-10

Linking culture with ecology helps establish the 'spirit' of a place which is more desirable than the standardized and repetitive boxes of modernism. Aldo van Eyck believed 'we must attempt to solve the aesthetic problems of standardization of constructional elements, dwellings, housing units and groups' (Luchinger, 1981: 35) and that 'the built form needs to fit the people' not the other way round. Social class, gender, intelligence, education, conformity and race are all factors important in relating built environments to diverse cultures. The motive of biophilic design is one that needs to be considered critically for every region that is inhabited. 'Despite the modern inclinations for mobility, most people retain a strong physical and psychological need for calling some place 'home' (Kellert *et al,* 2008: 6). Architects must avoid losing the spirit of a place by instilling this sense of 'home' even in places of work. They must create places of 'enjoyment, pleasure, interest, fascination, and wonder'; these are 'the precursors of human attachment to and caring for place' (Kellert *et al,* 228).

'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 environmental quality' (Kellert *et al,* 2008: 4). People have learned 'positive and restorative associations with nature through personal experiences such as vacations in rural environments, but acquire negative associations with cities because of work pressure, noise, crime, and other urban stressors' (Kellert *et al,* 89). This is not a question of nature 'or' city but rather nature 'and' city. Planners must develop complete approaches in design that harmonize natural, social and economic well-being (refer to pg. 33-34 on open space networks and citizen satisfaction). The following is a list that proposes some of the elements that are vital to sustainable community development, the environment and society being an important part of this matrix (Girard *et al,* 2003: 184):

CONSTRUCTION PRAXIS:

Compact Layout

Resource-efficient Construction

Mixed-use: Residential and Commercial

Consultative Planning Procedures

Traffic Minimalization Concept	tram route
	All amenities within easy walking distance
	Cycle priority route
	Parking space restrictions
Open Space Quality	courtyards
	Avenues
	Neighbourhood parks
	Green corridors
	District Park

SOCIO-CULTURAL CONSIDERATIONS:

Social Mix of Future Residents

Central Facilities	arts, community and advice centre
	Church and neighbourhood centre
	Health centre
Social Infrastructure	'kinder house' with community bakery
	Kindergartens
	Primary school and middle/ secondary school
	'FOKUS' housing project
	'Habitat' international housing project
	Decentralized support for senior citizens
	Space allocation for community use
Nutrition	market
	Kronsberg Farm- 'Herrmannsdorfer Landwerkstatten am Kronsberg'

ENVIRONMENT:

Ecological Standards

Energy	Energy use optimization	district heating systems
		Low energy buildings
		Electricity saving measures

'Solar City'	solar district heating system
	Passive solar houses
	Fuel-cell co-generation plant
	Wind turbines
	Photovoltaic cell technology
Water	rainwater management concept
	Drinking water economy measures
Waste	ecologically compatible building materials
	Building waste concept
	Domestic and commercial waste concept
Soil	soil management
	Inherited pollution- removal or containment
Landscape	ecological landscaping
	Ecological farming
Environmental communications	KUKA- Kronsberg Environmental Liaison Agency

Developing with nature and society in mind can revitalize disadvantaged areas but how planners and designers sustain the connection between a multi-faceted society and nature is an issue that will be the discourse of the following chapter.

2.4.2 Connecting Nature and Society

Balance needs to be maintained between nature and urban life but solutions from hundreds of years ago will not work today and designers need to adapt past ways of thinking for the present. In *Cultural Continuum and Regional Identity in Architecture* (Doshi, 1985) cited by Canizaro (2007: 112) it said:

> *'Pre-industrial architecture of any given region had the strength to serve the physical and spiritual needs of people, from a single family to the entire community... to achieve this unity and to integrate physical and spiritual needs, due importance was given to nature and its basic laws... life-style and activity followed in consonance with nature and architecture with nature.'*

Industrialization has caused a decline in the service of people's physical and spiritual needs and academics have attributed this to the absence of nature in everyday life. Indeed, 'the most primitive of the 'scared places' we know of constituted a microcosm: a landscape of stones, water and trees' (Norberg-Schulz, 1979: 27). A renewed balance will counter the degradation of society and the natural environment.

'Environmental protection must go hand-in-hand with human development' (van Wyk, 2009: 16), otherwise ignorant development will have negative impacts on the health of the environment and the health of communities. Social sustainability requires the unity of people and the ability to work towards common goals. Individual needs, such as those for 'health and well-being, nutrition, shelter, education and cultural expression should be met' (van Wyk, 23). Natural environments are healthy, they yield food for people, people use nature's resources to shelter themselves and it is an intrinsic part of society, people should protect nature for their sake.

The environment is very much a part of a nation's heritage. The environment is a relief for the urban population in the form of recreational destinations (mountainous regions, coastal wetlands, etc) therefore proper facilities and protection of the region needs to be provided for. Nature is a part of many people's identities throughout the world but on the other hand the city and technology have become the identity of many 'modern' generations. One must mediate between the natural and the engineered to cater for all members of society and retain the identity which makes a region unique. Canizaro quoted Lewis Mumford (2007: 26) saying: 'in accepting the universal order of the machine… we still have the duty to make it human and see that it incorporates more, not less, of those social and esthetic elements that bind people sentimentally to their homes and regions.'

Idealism is dangerous because combined with identity it can exclude the diversity of regional heritage. Multiculturalism becomes 'captive to the forces of capital accumulation and the market… love of nature is made to equal ecotourism and ethnicity is reduced to a matter of restaurants or authentic commodities for market' (Girard *et al,* 2003: 247). The built environment needs to cater for diverse people and not only capitalism and the interests of the land developer. The provision of housing, education, job creation and healthcare facilities are the realities of the local region of KwaZulu-Natal. Consider the subsistence farm in comparison to the cash-crop farm (refer to Fig. 1); the latter has much less cultural value than its counterpart. Society must avoid reducing everything to commodity and must not forget to promote the identity of diverse people.

(Fig. 1) (Sources: theepochtimes.com & maxwellbeeffarms.com) Comparing the
image of subsistence and culture (above) with cash crops and industry (below).
Accessed 23-02-11

'All elements of Earth, whether living or non-living, are interdependent. In this context biodiversity perhaps presents the richness of the experience of life because, when immersed in a bio-diverse landscape, we are surrounded by many reminders of our part in the whole, of how we are connected' (Graham, 2003: 112). Architects must establish a relation between ecosystems and human systems, realizing that if taken care of, the environment will in turn take care of the people. This sense of purpose can inspire people because the less society participates in nature and conservation the more detached they become from the cause. In the words of Juhani Pallasmaa, 'the ultimate meaning of any building is beyond architecture; it directs our consciousness back to the world and towards our own sense of self and being' (2005: 11).

To balance the effects of rural migration to the big cities planners can develop peri-urban communities such as Mpumalanga to provide economic growth and encourage a redistribution of the migrants to their hometowns. A great sensitivity to life currents is needed in this approach as impromptu traders can't afford high rent locations (Day, 2004: 267). It is also not enough 'to fix up a community building like a school, clinic, or church... you also have to consider how communities might earn money from them' (Heath, 2009: 135). In a citing from *A Pattern Language* by Christopher Alexander (1977) it says: 'unless the present-day great nations have their power greatly decentralized, the beautiful and differentiated languages, cultures, customs, and ways of life of the earth's people, vital to the health of the planet, will vanish' (Canizaro, 2007: 247).

In urban environments that lack connection with nature, children develop a greater interest with what they see on TV or the computer. Village Homes in California is an example of design which fosters a sense of eco-community which negates the effects that media has on children's interaction with nature and other children. At Village Homes, children are involved in agriculture programs which encourage them to form a more respectful generation for the future because they realize that taking care of nature will provide them with food (refer to Fig. 2). Providing public parkland for people to ride their bikes is also recommended rather than subjecting citizens to a contained life. Planners need to encourage outdoor activities because youth contained in an urban environment without any outdoor public space for positive recreation will seek other forms of recreation which can be detrimental, such as drugs and vandalism (graffiti). Socializing is a natural trait of humans which ensures human and community health.
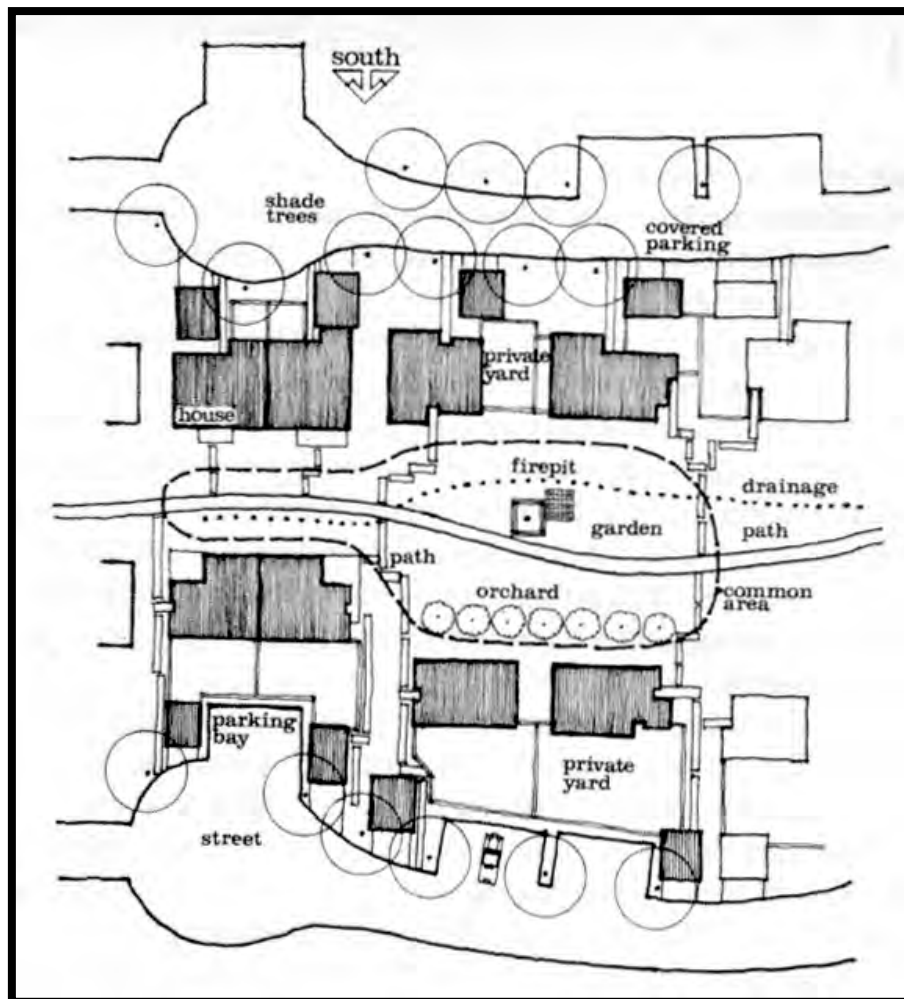
(Fig. 2) (Source: eslarp.illinois.edu) A plan of the Village Homes development reveals how the houses, roads and common green areas are planned to ensure ecological and social well-being. Accessed 23-02-11

Other than neighbourhood agriculture, designers can also consider urban gardens that bring a sense of 'peaceful productivity, of connection to the larger whole. Whether walking, sitting, thinking, reading, or listening to a concert, gardens are a gateway to feeling the interdependence of humans and nature' (Kellert *et al,* 2008: 304). Recreational activities in such open spaces can foster a sense of belonging to a community that can motivate people to live healthier lives. An interesting example of nature and societies triumph over dehumanizing industrial landscapes is 'Landscape Park' in Duisberg-Nord, Germany (refer to Fig. 3). This is an example of industrial lands that have undergone extensive ecological restoration and now serve the purpose of providing the community with recreational activities instead of environmental pollution.

(Fig. 3) (Source: landline.hippoville.biz) The triumph of people and nature over the ills of industrial pollution. Accessed 23-02-11

All relations that society has with nature are their responsibility and linking culture with ecology can help re-establish the spirit of our places. Planners must consider creative ways in which stewardship of nature can be encouraged amongst people to develop this culture of ecology.

2.4.3 Stewardship of Nature

In *The Regional Motive* (Berry, 1972) cited by Canizaro (2007: 39) it says: 'without a complex knowledge of one's place, and without the faithfulness to one's place on w hich such knowledge depends, it is inevitable that the place will be used carelessly, and eventually destroyed.' This is why architects need to know the people and the place for which they are building to avoid an ignorant response to social and natural needs. Stewardship of the natural environment in turn will have social and economical consequences. In Kenneth Frampton's *Ten Points on an Architecture of Regionalism: A Provisional Polemic* (1987) as cited by Canizaro (2007: 383) it says: 'more than any other art form, building and architecture have an interactive relationship with nature. Nature is not only topography and site, but also climate and light to which architecture is ultimately responsive to a far greater degree than any other art.'

'Communalism inspired by religious or ecological beliefs… has become foundational rather than instrumental in the quest for alternative forms of social change' (Girard *et al,* 2003: 238). People are not the conquerors of the Earth but its citizens. Authorities need to instill a sense of responsibility towards the environment amongst communities. Natural environment aside, 'people have been found to be healthier in societies where there is greater equity and inclusiveness' (Girard *et al,* 334). 'Trustworthy friends, shared experiences... and heightened self-esteem resulting from territorial control is more likely to maintain good health' (Kellert *et al,* 2008: 158).

An important element in the design of a building is to relate the wants and needs of the people with the needs of the environment; 'by incorporating feedback mechanisms a building can not only help occupants make it work best for the environment, it can teach them about the environment, their relationship with it, and the impacts their decisions have on it' (Graham, 2003: 222). For instance, an environment that is subject to sprawling communities leaves little space for the natural environment if not controlled; in turn this environment becomes unhealthy and the citizens may complain about higher levels of stress. It has been concluded that 'as density increases, so do social pressures, which manifest themselves in stress diseases' (McHarg, 1992: 194). Green, open spaces are therefore effectual 'breathing' spaces that may counter the ill effects of overly dense social environments.

In *Regional Development: The Architect's Role* (Mayer, 1971) cited by Canizaro (2007: 257) it says: 'one must think of a region as a tapestry of many figures… the danger is of each running over and spilling into the other in a blurred non-crystalline mass, with no open water or green land between the entities.' For these reasons authorities need to create awareness amongst the communities. If economic growth is not controlled, environments will be stripped purely for monetary gain and industry could cause unhealthy environmental pollution. Planning authorities need to understand their duties towards societal health and the environment to prevent uncontrolled growth from depleting natural environment and causing adverse effects on the community.

Designers need to consider how they can make natural environments a part of the public domain, the most obvious of these being the community park. The inclusion of such spaces into disadvantaged areas is a form of environmental rehabilitation. Such a space 'has a positive impact on their health, access to services, productivity of labour and other activities, and employment opportunities' (Girard *et al,* 2003: 23). It is an example of how natural space can become a social, economic and healthy asset to a community. Such features remind one of Central Park in New York (refer to Fig. 1) which provides a variety of activities and employment opportunities ranging from birding and horse riding to sports and playgrounds. Concerts are often held at the park and people see a variety of fauna and flora at the Central Park Zoo (wikipedia.org/wiki/Central_Park, 2011).

*(Fig. 1) (Source: wikipedia.org) Central Park in New York is an example of how
nature can become a social and economic asset to a city. Accessed 16-05-11*

Under-developed environments such as the Cape Flats have little in the way of natural reserved parklands or socially friendly roadways. This is a prime example of where management of natural and social space would benefit the deprived citizens (refer to Fig. 2). A community more involved in their environment will also lessen the chance of negligence; they take ownership of their place. In *Four Approaches to Regionalism in Architecture* (Pavlides, 1991) cited by Canizaro (2007: 164) it says:

> *'A dwelling that satisfies physical comforts may also create social discomfort. If architecture- particularly the mass architecture of the future- is to serve the former and avoid the latter, it must take cognizance of the significant social relationships in the lives of those who inhabit the spaces it provides.'*
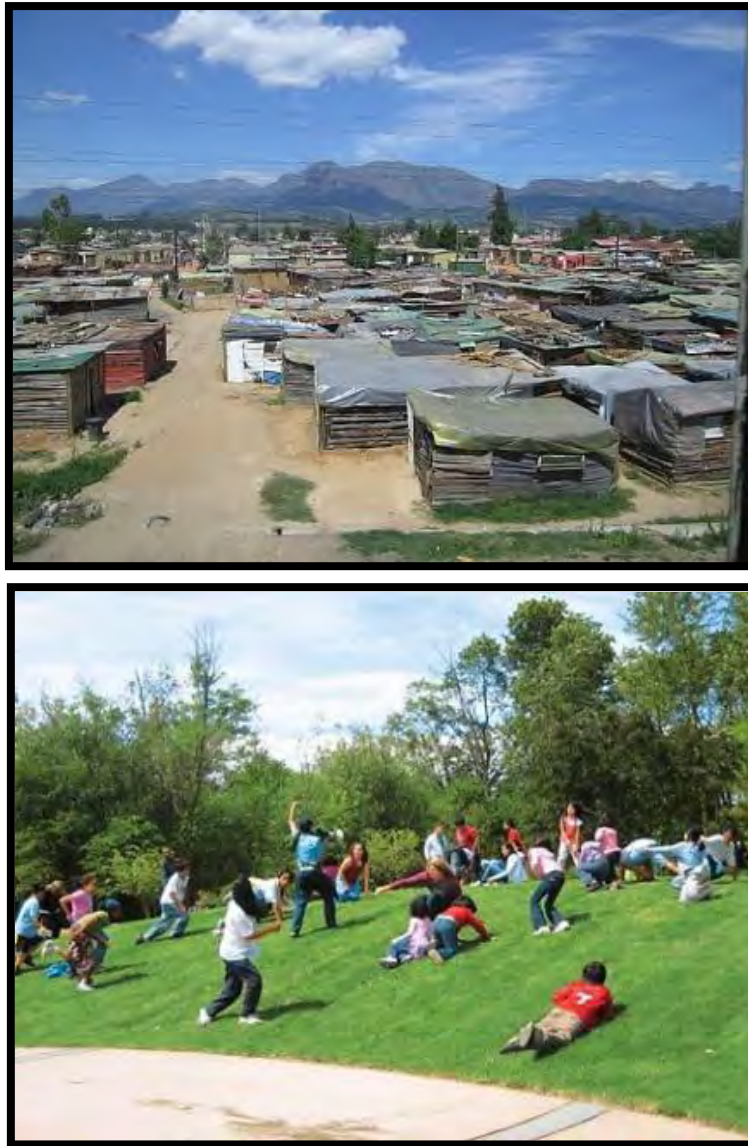
(Fig. 2)(Sources: images.travelpod.com & seattletimes.nwsource.com) A visual comparison between unplanned and planned environments and how green space can foster a place for social activity. Accessed 23-02-11

An example of encouraging stewardship amongst citizens is when planners 'involve clients in propagation and planting and solid waste recycling' (Graham, 2003: 163). Community green open spaces can be used for community gardens. Solid food wastes can be used in a composting heap and the citizens can form a closer relation with the land they live on by propagating it to grow vegetables and fruits; a type of subsistence farming. This agricultural way of living is reminiscent of the connection people had with the land before the industrial age. This connection is healthier, encourages authentic ties with the land and is an economical way of providing food for the family if people are willing to invest their time in farming the land.

'Positive feedback' loops allow 'waste' to become 'food' (an ecosystem) (Graham, 2003: 144). The on-site treatment of grey and black water for re-use in irrigation for local food production is an example. Another thought is the incorporation of medicinal gardens within this cycle as a form of horticultural therapy specifically for a healthcare environment. An example would be the Saint Gall Monastery which grew gardens that supplied the kitchen with vegetables and the infirmary with herbs and medicinal plants during the medieval ages (Roth, 1993: 274). Maintenance and cleanup programs are also examples of promoting stewardship amongst citizens. Societies living systems should be part of the natural environments systems for a more eco-conscious approach.

The Sambhavna Trust Clinic in Bhopal, India is a 2044 sq m ambulatory care building catering to the victims of the 1984 Union Carbide chemical leak. It includes a medicinal garden and an associated ayurvedic medicine (traditional Indian medicine) manufacturing facility while also using Western allopathic (conventional) techniques to cure patients (refer to Fig. 3). The clinic maintains that 120 000 to 150 000 of the area's people are chronically ill, many from allegedly contaminated water. The clinic's design works within the local vernacular to provide a tranquil, verdant, non-threatening place for treatment of a sometimes medicine wary clientele (Guenther & Vittori, 2008: 57).

Survivors from surrounding communities are welcomed by a space of tranquility and natural vegetation. The community partakes in the cultivating of the medicinal plants and they are educated on health issues. Daily-use handcrafted construction, waste-disposal, sustainable energy use, rainwater harvesting and grey water irrigation are other notable features of the building. Passive ventilation, shading, roof insulation and correct solar orientation provide physical comfort for the occupants.

(Fig. 3) (Sources: ultimatemagda.com; Google Earth) The provision of landscaping features at the clinic provide a welcome relief from the hot and sandy environment of the slums. Accessed 23-02-11

The Japanese have long been stewards of nature and thus the integration of their traditional architecture with nature is noteworthy. 'Perhaps the most sensitive interplay of textures is to be found in the traditional Japanese house and its surrounding gardens. In this fusion of building and landscape, plant materials, rocks, gravel, water, and architecture employ a full range of textures from rough to smooth… this is summarized in the pavilions and gardens of the imperial villa of Katsura' (Roth, 1993: 74). Despite its aesthetic qualities the constant presence and experience of nature makes the environment a valued and everyday part of Japanese life; the spirit of place (refer to Fig. 4). Ian McHarg has said that, 'clearly the problem of man and nature is not one of providing a decorative background for human play, or even ameliorating the grim city: it is the necessity of sustaining nature as source of life, milieu, teacher, sanctum, challenge and, most of all, of rediscovering nature's corollary of the unknown in the self, the source of meaning' (McHarg, 1992: 19).

(Fig. 4) (Source: admodelmaking.co.uk) This model of the imperial villa of Katsura reveals how nature has become an integral part in the quality of the place and the value of the people. Accessed 23-02-11

An interesting summary was devised by Yannick Joye (2007) on biophilic value and how this is adapted to the human condition:

TABLE 6:
BIOPHILIC AND ADAPTIVE VALUE OF NATURE

	Biophilic value	Adaptive value
Utilitarian	The material value of nature	This value helps to get physical sustenance, security and protection. Think for example of plants as a source of food and medicine
Naturalistic	Fascination, awe and wonder about nature, which triggers curiosity and exploration	This value leads to increased knowledge and understanding of nature, and is beneficial for physical fitness and outdoor skills
Ecologistic-scientific	The systematic study of structure, function and relationships in nature	Those who could precisely observe, analyze and study in detail the richness of life-forms had a clear survival advantage
Aesthetic	The aesthetic impact of nature on individuals	This value provides a guide for finding food and safety

Symbolic	The symbolic value of nature is perhaps most prominent in language, where metaphors and symbols referring to the natural world are omnipresent	Symbolizations and metaphors facilitate communication, thinking and mental development
Humanistic	The deep emotional bonds that an individual can develop with (elements of) the natural world. Perhaps this 'love for nature' is most pronounced in the human relationship with domesticated animals	Human-animal relations can function as a template for bonding, altruism and sharing – values important for social beings like humans. Bonding with companion animals is also important because these can help in finding food and can offer protection. Furthermore by mimicking the behavior of (semi) domesticated animals, one can get more adapted and attuned with the environmental context
Moralistic	The '… strong feelings of affinity, ethical responsibility, and even reverence for the natural world' (Kellert, 1993, 53). Often, this goes hand in hand with attributing nature a spiritual meaning	This value can contribute to feelings of kinship, affiliation and loyalty, which in turn can promote cooperative and altruistic behavior. Furthermore, projecting intrinsic meaning and ordering onto the cosmos can lead to more conservationist attitudes towards the natural environments and might also enhance feelings of wellbeing
Dominionistic	The wish to master, to physically control, and to dominate the natural world	Such stances can lead to increased knowledge and understanding of the natural world, and might improve mechanical skills and physical prowess
Negativistic	Contact with nature is not always a pleasant experience, but can also be associated with fearful and even phobic responses	Such behavior motivates the individual to search for security, protection and safety

The above has considered how designers can sustain connections with nature and society during development to encourage a stewardship of it for the benefit of future generations. Understanding that stewardship of nature and outdoor recreation is good for environmental and social health helps establish an identity of people to their place.

2.4.4 Conclusion

Natural environments and social responsiveness in architecture can revitalize disadvantaged places and this should be addressed early in the design process. Biophilia linked with landscape/ urban renewal and economic development will encourage a redistribution of migrants to their revitalized hometowns. Society must become a part of the eco-cycles of nature and not the 'conqueror' of nature to prevent future ills and through biophilic design and associated health benefits, an appropriate provision for local healthcare facilities can be provided. Linking culture with ecology helps establish the value of nature in a place. Society must avoid reducing nature to commodity and must not forget to promote identity and by encouraging outdoor activities in urban public space, positive recreation amongst citizens can be achieved.

Sustainable built environments are a source of hope in preventing the ill effects of environmental and economic inequality as well as social unrest. Developments can involve clients in propagation and planting and solid waste recycling for a more ecological built environment. The neighbourhood children can become involved in agriculture programs encouraging them to form a more respectful generation for the future. Nature experiences are vital for healthy child development. The sense of community purpose that natural conservation brings correlates with social development that is vital for promoting unity amongst citizens and by adapting the motives of biophilic design to regional contexts, society can become tuned with the needs of its local natural environment and people. The research will now consider relevant precedents and case studies that have biophilic qualities and specifically provide healthcare and community services for their local communities.

3.0 PRECEDENT STUDY

3.1 Natural Synthesis: Duke Integrative Medicine, Durham, North Carolina

3.1.1 Justification

Winner of AIA's National Healthcare Design Award for 2010, the healthcare centre's program is an example of how nature and technology can coexist (Duda/Paine Architects, 2011). Health of body, mind and spirit are considered in their entirety through the programs offered at the centre. Health is promoted through the integration of the building with the surrounding nature, creating a relaxing experience for patients. The centre also strives to educate people on the fundamentals of healthy living. Ergonomics and natural/ non-toxic materials were important issues to consider during the design phase. The sense of community is also emphasised at the centre to provide a support base for the visiting patients (Dukes Integrative Medicine, 2011).

3.1.2 Historical and Social Context

'In the early 1990s, a group of visionary medical doctors gathered together to discuss the vast possibilities for healing that exist in all of the scientific, cultural, and spiritual traditions. ... under the direction of Drs. Marty Sullivan, Larry Burk, and Jeffrey Brantley, they led discussions across all the academic disciplines at the university, and explored avenues for extending the boundaries of practice, research, and teaching at Duke. Health System Chancellor Dr. Ralph Snyderman embraced the work of Drs. Sullivan, Burk, and Brantley with enthusiasm and brought a vision that extended beyond the walls of the University, imagining a living laboratory that could hold answers to many of the most systemic challenges to the American health care system. ... with the support of a grant from the Duke Endowment, and with the leadership of Drs. Snyderman and Sullivan, The Duke Center for Integrative Medicine was founded in 1998' (Dukes Integrative Medicine, 2011).

'In 2000, Dr. Snyderman's vision was catapulted forward when he hired Dr. Tracy Gaudet to lead the Center into a new century and when Christy Mack of the C.J. Mack Foundation stepped forward in partnership with a generous gift of support. Along with an endorsement across the faculty of the health system, they began to plan to build the state-of-the-art healing environment executed by the masterful architecture firm Duda/Paine. The doors of Duke Integrative Medicine opened in November 2006. The building was the very first medical facility in North Carolina to receive LEED (Leadership in Energy and Environmental Design) certification for its stewardship of the environment' (Dukes Integrative Medicine, 2011).

The philosophy behind integrative medicine is to prevent disease through lifestyle change rather than to treat symptoms of a harmful lifestyle. The healthcare centre is considered the first designed solely for the combined practice of alternative and conventional medicine. The scenic campus in Durham and serene environment are a valued asset to the treatment of patients at the centre being an effective stress reliever (Duda/Paine Architects, 2011) (refer to Fig. 1). The medical staff includes; physicians, nurses, nutritionists, health coaches, acupuncturists, massage therapists, psychologists, mind-body therapists and a wide range of other healthcare providers including life and career goal counsellors (Dukes Integrative Medicine, 2011).


(Fig. 1) (Source: dudapaine.com) An artist's impression of the Duke Integrative
Medicine centre in its serene natural environment. Accessed 04-08-11

The climate of North Carolina is humid sub-tropical, which is comparable to the climate experienced in KwaZulu-Natal. 'Durham attracts over 5 million people each year who partake in the vast array of activities the area has to offer. With entertainment including art, nature, science, sports, history and special events, Durham has activities that appeal to all ages and tastes. Nationally acclaimed chefs and splendid shopping differentiate Durham from the rest of the surrounding cities' (Dukes Integrative Medicine, 2011).

3.1.3 Empirical Data

The centre portrays a non-clinical environment and has a floor area of about 2430 sq m. The facility accommodates a sitting room/ library and indoor and outdoor meditation spaces, evaluation rooms, treatment rooms, conference and workshop spaces, fitness facilities, showers and changing rooms, and a full kitchen/ dining room for healthy cooking demonstrations and guest meals (refer to Fig. 2). The pines forest setting and nearby streams are integral to the program and include a meditation pavilion, ornamental and functional herb gardens, walking paths and seating areas. A gently curved entrance facade building radiates outwards in branches with corridors that culminate in meeting spaces that range from multipurpose spaces and the nutrition centre to meditation rooms (refer to Fig. 3). In plan, the concave entrance way implies a welcoming notion. Outdoor spaces between the branches are cultivated with gardens and water features. Glass walls along the garden edges create a visual extension from the interior space (Duda/Paine Architects, 2011).
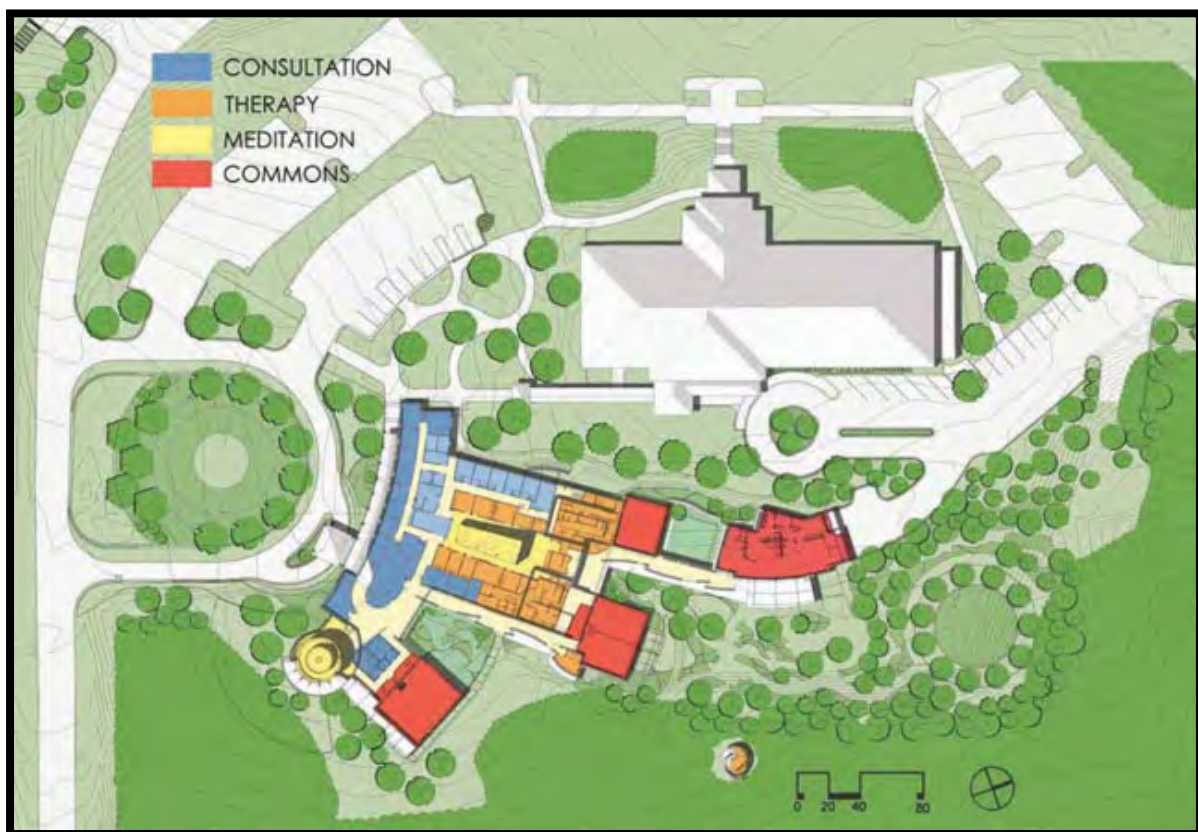
(Fig. 2)(Source: archinnovations.com) The plan of the Integrative Medicine Centre indicates the colour coding of the zones: consultation, therapy, meditation and commons. The 'branches' of the facility stretch into the domain of the pine forest to the east. Accessed 04-08-11

(Fig. 3) (Source: dudapaine.com) The nutrition centre is a communal space that
*caters for events as well as educates visitors on the fundamentals of healthy cooking.*
Accessed 04-08-11

A bench-lined front hall that faces a water wall has floor to ceiling paintings of the four seasons that improve the mood within the waiting area (Dukes Integrative Medicine, 2011). The circular library/ sitting room where arched wooden trusses suggest a canopy of tree branches is a place to learn about health conditions and therapies (refer to Fig. 4). It is the most public space in the facility and is articulated with a rotunda. Computer stations are also provided for further research. Near the library is a retail store that sells vitamins, supplements, books, CDs and exercise supplies amongst others (Dukes Integrative Medicine, 2011). The 'anteroom' at the centre of the facility is a naturally lit covered garden and is the most private space within the facility (refer to Fig. 5). Patients emerge from treatment rooms each side into this space with comfortable lounging furniture. Flanked by the water wall at one end and planted with bamboo, the garden also features arched wooden truss work similar to that seen along the entrance loggia and sitting room (overlapping circles create segmented arcs and a golden ratio) (refer to Fig. 6).

(Fig. 4) (above)(Source: archinnovations.com) The library/ sitting room is articulated with a rotunda supported by tree-like columns; the glowing rotunda is a distinguishing feature of the centre. Accessed 04-08-11
(Fig. 5) (below)(Source: archinnovations.com) The anteroom provides space for patients to lounge and relax in a planted and naturally lit space, shaded by a forest-like canopy. Accessed 04-08-11
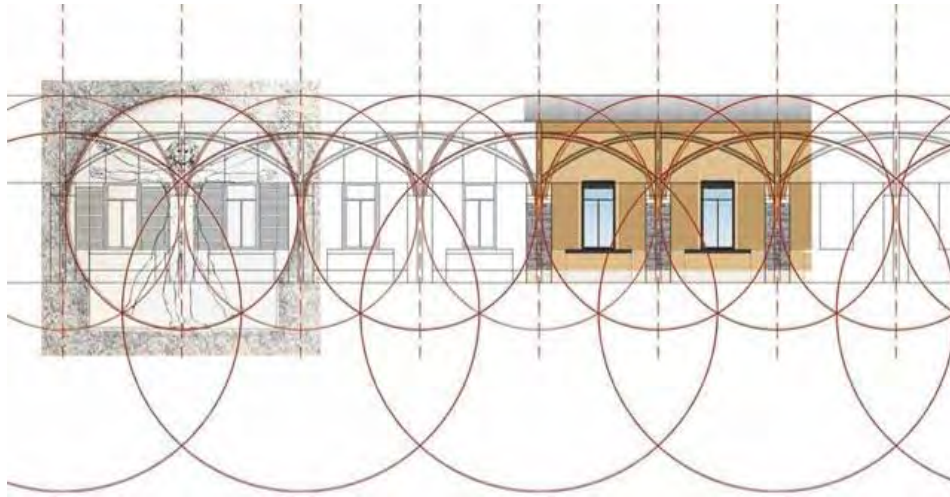
*(Fig. 6) (Source: archinnovations.com) Circular intersections that are proportioned
by the golden ratio inspire the truss work along the entrance loggia.
Accessed 04-08-11*

Consultation and treatment rooms are designed to create a calm environment with diffused lighting and Japanese inspired screening for privacy. The workshop rooms are outfitted with a wide variety of audio-visual equipment to aid in educational presentations (Dukes Integrative Medicine, 2011). Wood, stone and neutral colours are used throughout the centre to impart the perception of warmth and comfort (refer to Fig. 7). Patients can partake in a variety of programs that include day visits, individual services and multiple day experiences (Duda/Paine Architects, 2011).

*(Fig. 7) ((Source: archinnovations.com) Wood and stone construction materials
against a backdrop of trees and shrubs provide a calming and comforting
environment for the visitor. Accessed 04-08-11*

3.1.4 Conclusion

Dukes Integrative Medicine is a good example of a building that incorporates ideas that match the goals of biophilia in architectural design. The design of the centre synthesises the building with nature to promote health. The facility is designed with nature in mind and thereby promotes the conservation of the surrounding landscape. The naturally lit facility incorporates indoor landscaping which includes the benefits of water as a means of creating relaxing environments for visiting patients. Tree canopies and natural geometry inspire the structural forms within the centre, which are relative to biomorphic design in architecture. Appropriate, natural/ non-toxic materials in the construction of the centre and similar sustainable strategies have made the centre an exemplar of environmental stewardship.
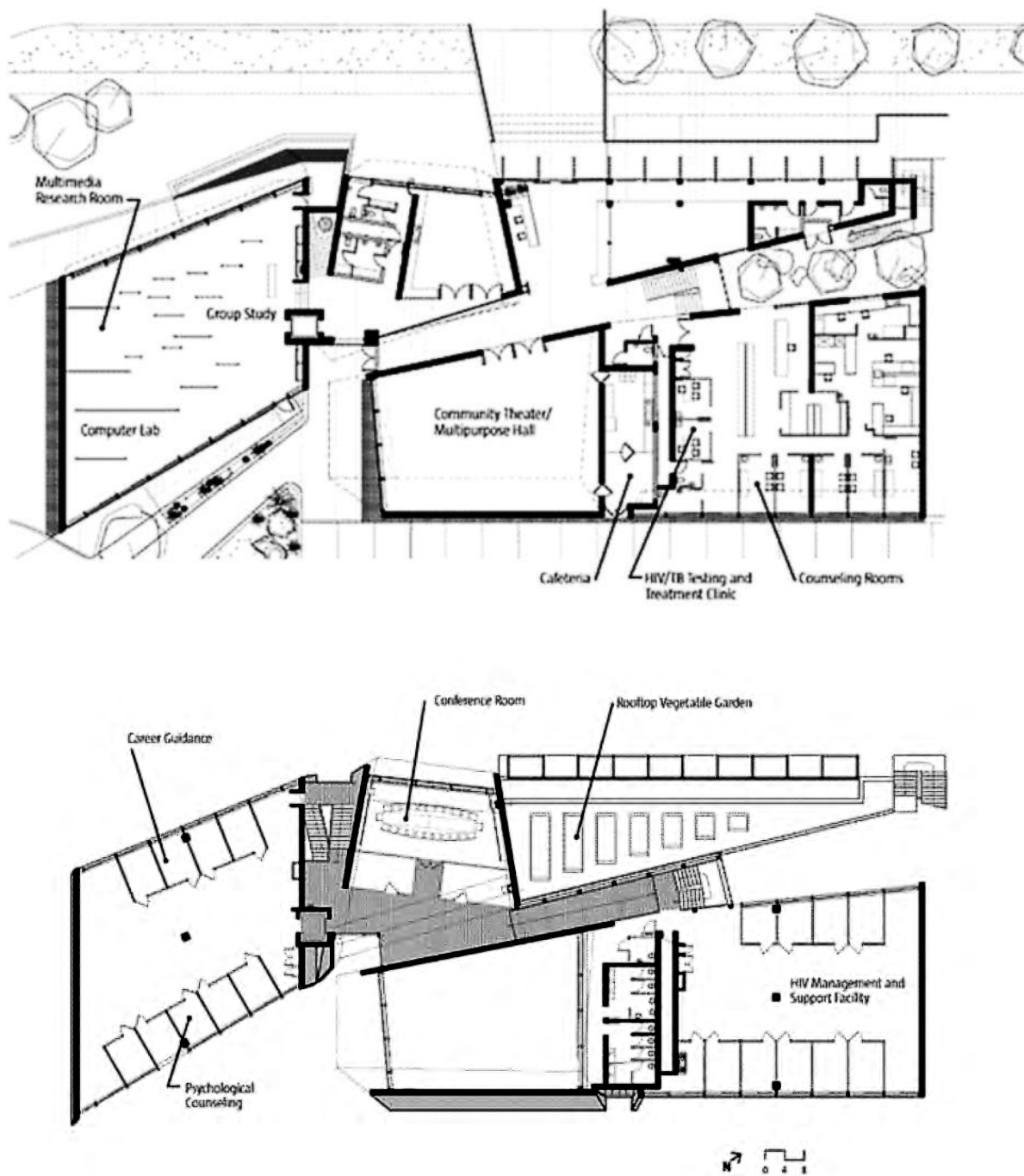
3.2 Progressive Healthcare: The Ubuntu Centre, Zwide, Port Elizabeth

3.2.1 Justification

The Ubuntu Centre in Zwide, Port Elizabeth is surrounded by succulent plant landscaping but the township generally does not have ample amounts of natural landscape (refer to Fig. 1). The facility does however renew the provision of healthcare services in the locality and promotes community participation through its various complimentary services. The Centre features an HIV clinic (counselling, support and prevention services), community theatre for after-school programmes, and an educational centre (group study, computer centre and career guidance). Support facilities include office, conference room and workshops (refer to Fig. 2). The urban agriculture programme run by the centre is a valuable initiative and an example of architecture working with the patterns of nature to sustain human life. The centre also makes provision for natural lighting and ventilation, which is vital for indoor environmental quality and human health (90 percent of the facility is naturally lit) (refer to Fig. 3). By providing free world class services in a single facility, the centre uplifts the township experience (Gerfen, 2011).

(Fig. 1) (Source: archdaily.com) The external succulent plant landscaping provides
a softer edge to the hardness of the concrete shell forms. Accessed 09-06-11

Multimedia
Research Room

Group Study

Computer Lab

Community Theater/
Multipurpose Hall

Cafeteria

HIV/TB Testing and
Treatment Clinic

Counseling Rooms

Conference Room

Rooftop Vegetable Garden

Career Guidance

HIV Management and
Support Facility

Psychological
Counseling

N

*(Fig. 2) (Source: architectmagazine.com) The ground (above) and first floor plan
(below) reveal the range of complimentary services provided at the Ubuntu Centre.
Accessed 09-06-11*

(Fig. 3) (Source: archdaily.com) Sections reveal large curtain walls with external gum pole shading devices; these large glazing envelopes allow 90 percent of the facility to be day lit. Accessed 9-06-11

3.2.2 Historical and Social Context

The Port Elizabeth township communities population equals 400 000. This 12-kilometre area has limited public and private infrastructure and a lack of essential services. Access to adequate nutrition, sanitation, health care, housing and educational facilities remain a ch allenge for most children growing up in the community. The residents in the townships are Black South Africans belonging to the Xhosa ethnic group. Port Elizabeth township communities are renowned for their deep engagement in the struggle against apartheid, organising through strong grassroots community structures. The region has a proud history as home to many of South Africa's most famous anti-apartheid leaders (ubuntufund.org, 2011).

The Eastern Cape is one of South Africa's poorest provinces, with the highest infant mortality rate in the country. Approximately 80 percent of the population is unemployed. Household income is derived through the informal sector and social grants. The local economy is based primarily on the automotive industry with multinational companies historically establishing factories within the townships to exploit cheap, unskilled labour. Women find employment as domestic workers in Port Elizabeth and its suburbs, 10 k ilometres from the townships. While progress continues in housing development, more than one-third of the population lives in informal settlements, made up of tightly clustered shacks, with the remaining living in overcrowded brick homes (ubuntufund.org, 2011).

On September 16, 2010, Ubuntu Education Fund officially opened 'The Ubuntu Centre' in Zwide Township, South Africa, representing a $6 million investment. The centre's floor area is 1932 sq m and provides access to a state-of-the-art facility in a neglected post-apartheid township community.

The townships of Port Elizabeth have an HIV prevalence of 32 percent (ubuntufund.org, 2011). Funded globally and operated locally, the centre reflects the resurgence of local, community based organizations which provide support to local clinics to improve the health of the community at large. The centre is designed by Port Elizabeth born Stan Field of California based Field Architecture, the centre provides necessary services in an inspiring environment (ubuntufund.org, 2011).The architects hired a top Black Economic Empowerment (BEE) construction firm, Ngonyama Okpanum Hewitt-Coleman Architects to serve as project managers and oversee all elements of construction.

Located along one of the main roads in Zwide, the centre is easily accessible by public transport. The centre serves 3500 clients with holistic support services for themselves and their families, 250 students with a groundbreaking after-school programme, 2000 children with daily meals from the organic gardens and 6000 community members with HIV counselling and testing. Children who are sexually abused, orphaned or HIV-positive have a place that meets their needs and provides education initiatives and hope for the future goals of the affected children in the greater Mandela Metro area (ubuntufund.org, 2011).

3.2.3 Empirical Data

Working within a two-story height limit the centre retains its human scale towards passing pedestrians and no perimeter walls surround the building, indicating it belongs to the community. The series of trapezoidal forms stand like concrete boulders in the township landscape and house education, health, and social services for the 400,000 local residents. Pedestrian walkways continue uninterrupted between the masses which encourages community ownership (refer to Fig. 4). The clinic is placed en route to the other wings to help de-stigmatize HIV patients in the community through anonymity. The building uses natural and local materials (gum pole sunscreen), solar and wind energy and recycled grey water for the rooftop vegetable garden which provides daily meals at the centre (refer to Fig. 5). The buildings massive concrete walls and roof allow for passive heating and cooling strategies. The concrete shell of the building is also robust and ideal for a lasting purpose in a region where lack of funding often renders citizens incapable of repairing deteriorating buildings (Gerfen, 2011).

(Fig. 4)(Source: architectmagazine.com) The pedestrian paths weave between the trapezoidal shapes of the facility, encouraging community ownership of the space.
Accessed 09-06-11

(Fig. 5) (Source: fieldarchitecture.com) The hydroponic roof gardens at the Ubuntu Centre in Zwide feed many local school children on a daily basis.
Accessed 09-06-11

Convection cooling through the placement of low and high ventilating windows creates cross circulation of cooler air entering at lower levels and hotter air exhausting at higher levels through the stacking effect. This mode of natural ventilation eliminates the need for using active mechanical ventilation systems. The timber veneered and stone tile clad interior surfaces provide a contrast to the starkness of the township environment. Such natural materials are also healthier than some recycled materials which have been known to give off harmful toxic gases (refer to Fig. 6). Discomfort glare is prevented through the use of the external gum pole shading devices in front of large glazing panels in the community theatre space for example (ubuntufund.org, 2011) (refer to Fig. 7).

(Fig. 6)(Source: ubuntufund.org) The timber and stone surfaces are healthy material
choices that are locally sourced and aesthetically pleasing.
Accessed 09-06-11

(Fig. 7) (Source: ubuntufund.org) The external louvered shading devices prevent discomfort glare in the community theatre space. Accessed 09-06-11

3.2.4 Conclusion

The natural environment throughout the township should be rehabilitated in general, which will bring a greater sense of pride amongst the citizens of the locality and provide an enjoyable environment for the people to be in. The Ubuntu Centre could also benefit from environmental rehabilitation as therapeutic gardens can benefit patients who require spaces of solitude and relaxation. Trees also provide shade during the summer months and serve as a filter for particulate matter. The provision of some sort of water feature can also provide relief from the heat experienced by citizens in the area.

Aside from these criticisms, the centre is an example of world class health and education which every person has the right to receive. The Ubuntu Centre provides a practical example for sustainability on a societal as well as environmental level through its incorporation of sustainable technologies and strategies such as the agricultural program run by the facility. Indigenous materials also provide an economic and healthy option for building construction. The research will now consider case studies of other relevant healthcare and community facilities in the eThekwini Metro area and Pietermaritzburg.

4.0 CASE STUDIES

4.1 Humanising Healthcare: Umkhumbane Community Health Centre, Cato Manor, Durban

4.1.1 Justification

The Community Health Centre design meets the needs of an increasing local population. Apart from providing community services such as health, youth programs, religious worship and community gardening the design of the building also allows for natural ventilation and lighting as well as internal planting courts. These qualities together with its pedestrian friendly circulation spine maintain to a certain extent the healthful experience of nature and human activity in the healthcare environment. The facility as a ca se study also caters for a variety of health services that would stand as a good precedent to the design of a community healthcare facility. The construction methods used were economical and gave many local labourers the opportunity to partake in erecting the structure (refer to Fig. 1).
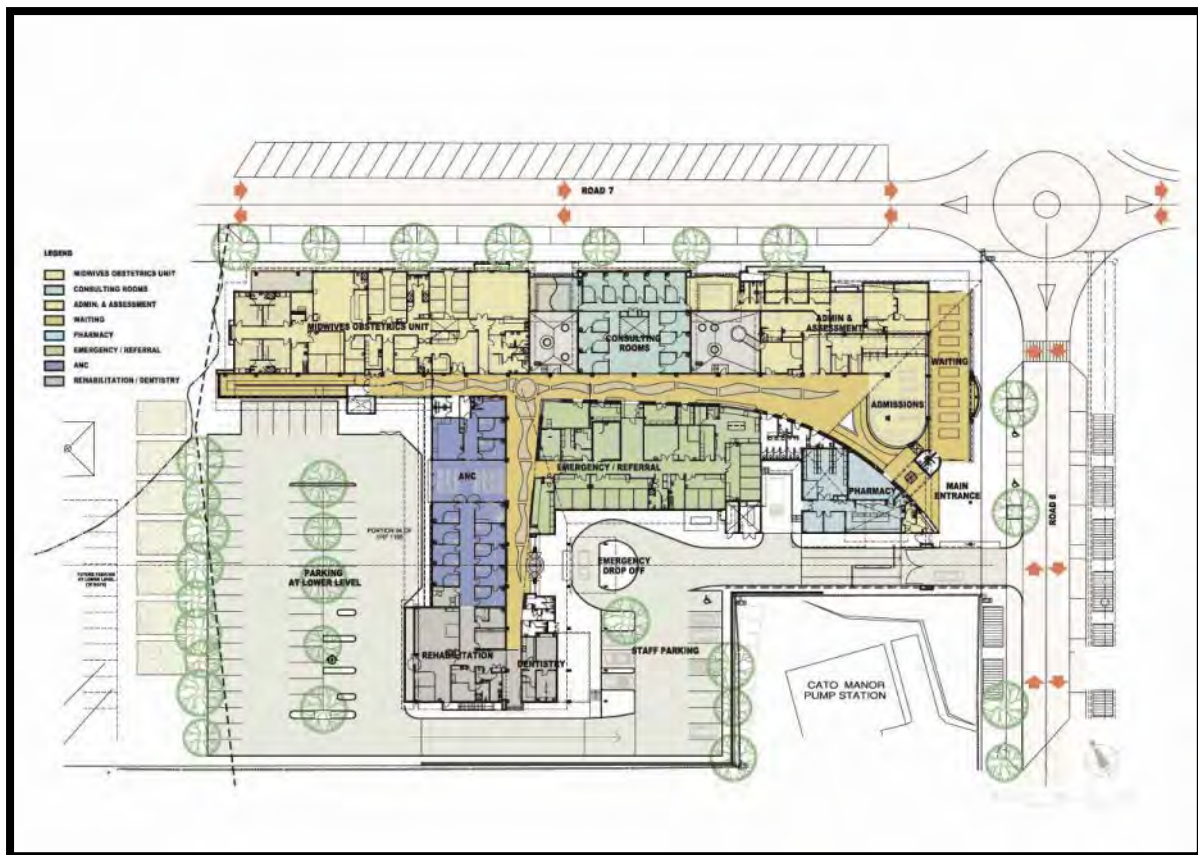
(Fig. 1) (Robert Johnson Architects, 2011) The admin, pharmacy and waiting areas are located towards the east entrance. The obstetrics, antenatal care, rehabilitation and dentistry departments are located to the west and south. The planting courtyards, consulting and emergency rooms are located either side of the circulation spine. Accessed 02-03-11

4.1.2 Historical and Social Context

Cato Manor is a large area not far from the Durban City centre within the boundaries of the Durban Metro that suffered greatly under the Apartheid government's policy of forced removal. It is characterised by rapid urban growth, essentially comprised of low-income communities moving into informal settlements and is home to about 93 000 people with a future population estimated at 170 000 (robertjohnsonarchitects.co.za, 2011).

Part of the Greater Cato Manor Urban Renewal project, initiated in 1993, this community health centre was developed in consultation with the Durban City Health Department as the need for such a facility in the area was called for by the Cato Manor Development Association. The development incorporates the need to redress the injustices of the past, and promote black empowerment, focusing

on the stimulation of economic development and community empowerment through interventions such as training schemes and small, micro and medium enterprise development.

Robert Johnson Architect & Associates were appointed as lead Architect in an association with ZAI Consultants, by the Architectural Department of the City Engineer's Unit acting as implementing agents for the CMDA. The tender documentation required that 50% of the skilled labour and 100% of the unskilled labour be from the local community. Construction monitoring throughout the process ensured meeting goals (Digest of South African Architecture Reporter, 2005: 38).

4.1.3 Empirical Data

The basis for the schedule of accommodation was the set of services listed in the Cato Manor Health Plan. What emerged was the idea of a "Place of Wellness" where health care could include services centred on lifestyle, nutrition and diet, exercise, urban agriculture, various forms of therapy and counselling in an atmosphere of learning, teaching, and exchange of ideas. Academic post-graduate programmes include practical experience at the centre as part of the syllabus.

Based on the health requirements, the estimated area (and consequently the cost) exceeded that originally contemplated by about 45% and vigorous debate with the service providers followed, exploring the possibilities of sharing space, and the use of the same space at different times. The proposal was that non-specific, generic spaces, which could accommodate a range of activities, would be appropriate. Once the schedule and estimate had been fine-tuned, a motivation for additional funding by the City Council was accepted.

The schedule included seminar, research, community group activity, outdoor "break-out" (compare to balconies outside the physiotherapy ward) and creative 'activities' spaces (refer to Fig. 2). Included are an exercise lawn, a maintenance workshop that can double as an occupational therapy facility and a garden store doubling as the urban agriculture programme headquarters (refer to Fig. 3). The main patient waiting area with attached community project rooms functions independently as a community activity space for use after hours. Space was provided which could become a commercial gym with access to the public but linked to the Rehabilitation Department. This however did not see fruition as the building is now mainly a medical facility. If provided it could become a potential draw card for the people of the location and could improve the defensible quality of the space in the evening.

(Fig. 2) (Source: author) An example of one of the break balconies which provide fresh air for the recovering patients; some planters may soften the hard edges of the balcony. Captured 02-03-11

(Fig. 3)(Source: author) An example of one of the urban agriculture gardens; harvested rainwater is used to irrigate the plants. Captured 02-03-11

The architect says that the regulations for health planning were very prescriptive and each consultation space had to meet specific regulations. Every department also has its own reception/ admin section. A notable element of the facility is its hybrid quality; youth programs and church services are conducted here as well as accommodation for traditional healers and food vendors to sell fruits and vegetables in the waiting area (refer to Fig. 4). Cross programming should be encouraged to appeal to the wider community; multiplicity of spaces appeals to the many types of patients and professionals in the holistic health centre. The health spaces in the facility are closed off by security gates in the evenings (refer to Fig. 5).

(Fig. 4) (Source: author) Vendors sell fruits and vegetables in the waiting area.
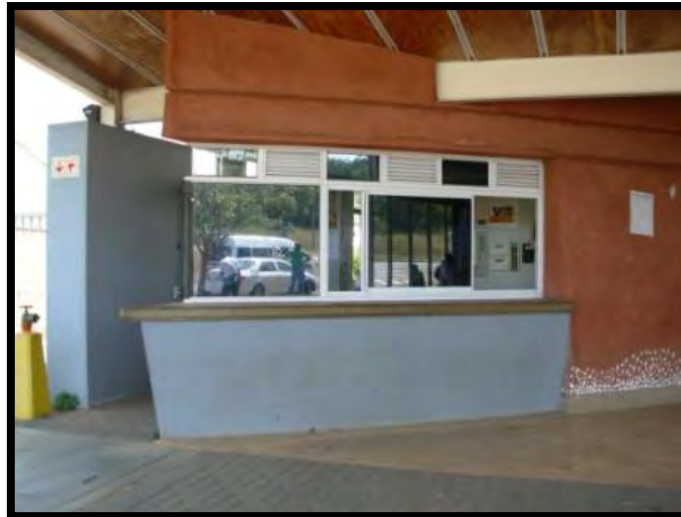*Captured 02-03-11*

(Fig. 5) (Source: author) High levels of security provide protection of patients and
rights to privacy after hours. Captured 02-03-11

The building is pedestrian responsive and the density of the development is two to three storeys. The new road on the Eastern boundary was identified as the intended "high street"; the main pedestrian entrance, and components which could serve the public on a semi-independent basis would be off the high street, with pedestrian oriented activities taking precedence over vehicular functions and providing an active edge to the facility (refer to Fig. 6). The cage-like appearance of the waiting area is a result of the security needs of the facility; the designers could have chosen a more attractive means but perhaps it was a result of budget constraint. The curving red wall with facility name provides a street side landmark for the passing pedestrian.

(Fig. 6) (Source: Robert Johnson Architects, 2011) The pedestrian waiting area on the east side of the facility near the entrance. Accessed 02-03-11

The Health Department required that health service provision be at one level, a clear separation between client, staff and service access, exclusion of visitor parking from the site, and a high degree of security, especially for the 24 hour (MOU) facility (refer to Fig. 7). Of primary concern to the Department was the very real threat of baby theft – babies are frequently stolen & registered as the thief's own child so that the state subsidy can be claimed. The circulation spine is a 'shopping mall' for health services with a roof monitor that admits fresh air and sunlight. The circulation spine serves as a unifying element for the facility and provides a coherent route between the health facilities (refer to Fig. 8). The orientation of the building allows northeasterly winds to pass through the entrance and ventilate the internal space along the circulation route. The external masonry walls and concrete flooring provide thermal massing which cools the interior during the warmth of the day.

(Fig. 7) (Source: author) The guardhouse provides 24-hour surveillance of the entrance to the facility. Captured 02-03-11

(Fig. 8) (Robert Johnson Architects, 2011) The sections show how the healthcare departments have been organised adjacently to the central circulation spine. The centre exhibits an internalized atmosphere (does not open to outdoor open space) but the circulation spine provides relief by admitting fresh air and sunlight.

Accessed 02-03-11

Compaction of the facilities around the spine also contributes to efficiency by reducing walking distances that the staff and patients have to take. When considering prospect and refuge, the spine is a place of prospect and meeting while the consultation rooms provide refuge for the patients at the facility. Private rooms allow patients to feel comfortable and divulge more information about their ill state. Industrial building technology, assessed to be the most economical with which to form the external envelope, forms large span monopitch roofs meeting at a centre monitor, where a pair of curved columns supports all of the members meeting at the mid-point. Under a large span roof supported independently a variety of room sizes are possible. This allows for flexibility of space as non-loadbearing internal partitions adjust for change in program.

The roof monitor, while providing natural light and ventilation to the circulation spine and to the rooms facing and backing onto it, was thought of as a shaded avenue, with places for rest and recreation, filled with fresh air and sunshine (refer to Fig. 9). Looking at the column supports of the roof structure and the repetitive rhythm of them it reminds the viewer of a ribcage (an architectural metaphor). The monitor admits south ambient light for if it was orientated to the north it would introduce the problems of heat and glare discomfort. The facility exhibits an internalized mode of design. The sliding folding doors to the internal courtyard spaces remain closed most of the time and with a bit of maintenance these spaces could become a welcome relief and place of respite for the patients inside (also promoting natural ventilation and avoiding stagnating air). Mandla Ngidi, the grounds man at the facility, commented on how he enjoyed the quality of the interior space; mosaic pathways with built in seating and natural light along the pedestrian circulation path encourage conversation between visiting patients (refer to Fig. 10).

(Fig. 9) (Robert Johnson Architects, 2011) The photos reveal the long span roof that shelters the healthcare departments. The roof monitor admits fresh air and daylight into the pedestrian circulation spine. Accessed 02-03-11

(Fig. 10) (Source: author) The overgrown planters need attention to create a more welcoming courtyard (left). The mosaic pathways create interesting patterns that stimulate the visitor rather than having bland corridors (right). Accessed 02-03-11

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The inclined interior walls create a welcome relief from the right angle and create a sense of movement and dynamism in the space (inclined surfaces are also effective at reducing slap echo). These create a break from the clinical atmosphere that many health centres exhibit and improve the spirit of the place with the variety of forms, vibrant colours and visual texture that it exhibits. These attributes can be compared to Herman Hertzberger's 'De Drie Hoven' elderly complex where the humanistic qualities of the environment encourage a sense of community; each unit has its own 'porch' which connects to an 'internal street' (Suckle, 1980; 58).

The slope of the site from the entrance road on the East towards the West end of the site, and the need to keep health service accommodation on one level resulted in the void below the building, increasing in height from East to West forming an accessible service zone for piped gases, water, and sewers. At the point at the lower level where the height becomes sufficient for accommodation, the service rooms are located, with access off the lower level parking and loading area. The monotony of the grid is balanced by using a variety of facade treatments along the north edge (refer to Fig. 11). The north edge also provides views for the patients of the nearby natural bush, providing some relief from the internalized atmosphere. Some of the internal laboratories however provide no external views and use mechanical ventilation; if occupants work in these conditions for extended periods it could be detrimental to their health.

(Fig. 11) (Source: author) A variety of facades stimulate the onlooker rather than boring repetition. Captured 02-03-11

The community tends a vegetable garden on the premises. Such a program encourages stewardship of the environment amongst the people. An ARV department addition, after the completion of the facility, is in park homes on the western side surface parking (robertjohnsonarchitects.co.za, 2011). The addition of these homes have somewhat dampened the spirit of the place by taking over much of the urban agriculture ground. The homes also heighten the concept of discriminating HIV patients through space design. One must consider how architecture can integrate people into society. Planting at the emergency entrance make for an aesthetic arrival and softens the hard edge appearance of the building (refer to Fig. 12). Some of the street side planters are now barren and need replanting and maintenance.

(Fig. 12) (Source: author) Planting improves the aesthetic appeal of the emergency entranceway. Captured 02-03-11

4.1.4 Conclusion

Health and community programs ensure that the design is relevant to the local population while natural ventilation and lighting provide a level of comfort to the interior. The hybrid quality of the building ensures a place filled with varied activity. The construction methods used were economical and provided construction jobs for many local workers. Compaction of the facility contributes to worker efficiency. A criticism is that the cage-like appearance of the waiting area could have been treated in a more attractive and welcoming way. The variety of colours, textures and forms of the interior are visually stimulating and the inclined walls and curving structures in the circulation spine suggest natural forms. A criticism is that the sliding folding doors to the internal courtyard spaces remain closed most of the time and plantings need maintenance. If maintained properly the sliding folding doors can open onto courtyards, improving ventilation along the circulation spine. Some of the internal laboratories are not ideal and might have needed some form of 'breathing' space.

The addition of the ARV park homes have somewhat dampened the spirit of the place by taking over the urban agriculture ground. The homes also heighten discrimination and a more accommodating facility is needed that will be socially as well as environmentally sensitive. The inactive northern street edge could attract anti-social behaviour. Complementary facilities together with urban and landscape renewal could negate such affects. Apart from these observations, the friendly staff is providing a vital health service to the local community and the facility creates a welcoming atmosphere for the visitor.

4.2 Nature Therapy: Pietermaritzburg Assessment and Therapy Centre, Northdale, PMB

4.2.1 Justification

The centre is a place for occupational therapy that considers the psychological, physical and social improvement of patients. How these goals manifest in the design of the facility would be interesting to analyse. The ample amounts of green space and disabled friendly circulation provide a healthy and comfortable environment. The treatment encourages outdoor activity to stimulate the patients such as gardening, ball games and playtime for children. Natural ventilation, lighting and a connection with the natural environment make for a more welcoming atmosphere than an enclosed, sealed and clinical hospital environment.

4.2.2 Historical and Social Context

The centre is located in the predominantly Indian community of Northdale in Pietermaritzburg. Kiran Lalloo who is now a principal architect at Lalloo Weeks Architecture, Engineering and Planning in the USA designed the facility. The centre deals predominantly with occupational, physical, speech and hearing therapy. Mr B Dookie, then the Minister of Health opened the facility on the 29 August 1990. The House of Delegates funded the project at that time. Under apartheid, the Delegates were the House for the country's Indian population in the tricameral Parliament between 1984 and 1994. The surrounding community live in tightly clustered brick homes and there is a school ground located directly adjacent to the site to the southeast. An aerial photo of the site is provided below (refer to Fig. 1).

(Fig. 1) (Source: Google Earth) In comparison to the surrounding plots, the therapy centre surrounds itself with a buffer of greenery. These spaces are for the rehabilitation of the patients and promote a healthy experience for visitors and staff.
Accessed 23-02-11

4.2.3 Empirical Data

The free flowing circulatory system promotes easy movement of the patients who may have walking disabilities. Ramp ways prevent tedious climbing of stairs (refer to Fig. 2). The facility accommodates consultation rooms, therapy classrooms, medicine dispensary and outdoor activity areas for the stimulation of the patients. There is no accommodation provided as in the Fort Napier facility but rather provision of outpatient therapy to patients from the surrounding community.

(Fig. 2) (Source: author) Ramped pathways adorned with landscaping balance the
hard edges of the building. Seating along the path provides place for respite.
Captured 23-02-11

Tammy Rascher, an audiologist at the facility, claims that the outdoor activity for the children she treats is very beneficial, especially those children affected with autism and ADD. Stimulation of the senses from the outdoor natural spaces and playground makes them more responsive to their environment and subsequently to therapy. This is a better alternative to a clinical hospital interior (refer to Fig. 3). The green buffer around the facility provides an effective barrier from noise pollution for sensitive patients.

(Fig. 3) (Source: kznhealth.gov.za) The play space provides a place for children to develop their gross motor skills and enjoy being in the outdoors; it is the central feature of the facility and is a welcome site to visiting children. Accessed 23-02-11

The occupational therapists at the facility, Melissa Brink and Nazmeera Mohomed, say that encouraging their patients to take part in activities in the playground or sports on the field outside is vital in the development of their gross motor skills. The patients that Nazmeera was treating ranged in ages from 1.5 to 19 years of age and so the types of activities (playground and sports) cater to the interests of different age groups (refer to Fig. 4).

(Fig. 4) (Source: author) The ample amount of outdoor green space provides place for the older patients to take part in ball sports that stimulate physical rehabilitation. Captured 23-02-11

Sister E. Rathanan and Sister A. Thaver in the psychology department encourage patients to take part in vegetable and herbal gardening projects that improve the mood of the patients as they form social connections and people skills with those involved. The patients benefit from the fruits of their labour, feeling empowered by the cultivating skills taught and they can earn an income by selling produce. This sort of interaction encourages re-integration with society. All the programs provided at the centre promote a sense of 'home' rather than 'institution' to make patients feel at ease in the environment and social therapy as opposed to isolation prevents their psychological condition from worsening.

Some of the notable architectural features are the circulation spines in the wings of the facility. Clerestory lighting allows south ambient light to reflect off the white ceiling finish and filter into the internal spaces (refer to Fig. 5). The volume of the clerestory space creates a sense of relief in comparison to what would have been an otherwise confined corridor. Kiran Lalloo says that the facility design allows 75 % natural ventilation while the physiotherapy and swimming pool facilities use mechanical ventilation for thermal comfort when exercising. The exterior cavity brick walls insulate rooms to regulate internal temperature.

(Fig. 5) (Source: author) Clerestory lighting, operable windows, curtain walls and light scoops allow natural light and ventilation to pass through the rooms and stairwells of the building. Captured 23-02-11

Consultation rooms are located on either side of the passage and doors are open for the most part except during examination sessions. The floor plate of the wing ensures that occupants are never more than 7m from an operable window to allow for effective cross ventilation and views of the natural surrounds (refer to Fig. 6). Designed brise-soleil provided along the east face prevents discomfort glare from morning sunrise (refer to Fig. 7). The entrance hall is orientated to allow north-easterly breezes to pass into the internal courtyard and aerate the space. The courtyard allows patients to interact outside, while remaining under observation. Large windows on the lower floor allow north light to filter into the circulation passage on the south wing ground level. The natural light filtering into these spaces provide the indoor pot plants with the necessary sunlight needed for growth. The buttress-like roof supports to the south of the building create a visual rhythm.
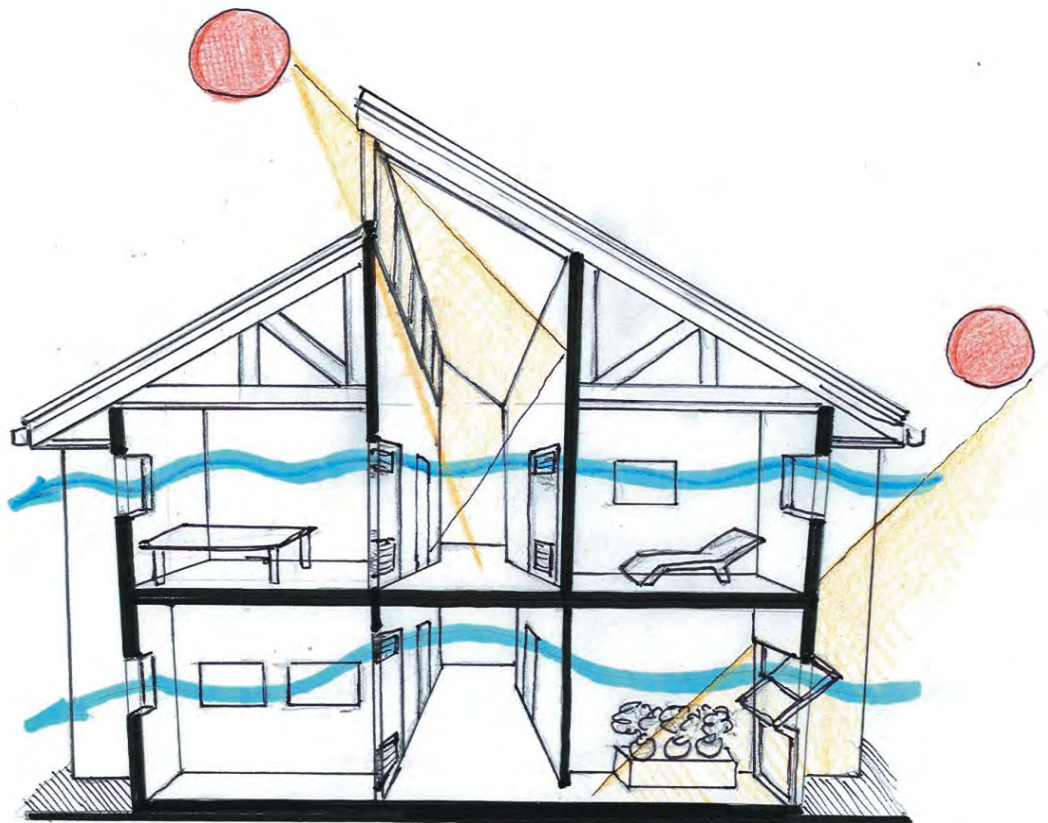
(Fig. 6) (Source: author) A sectional perspective revealing the methods of natural lighting and ventilation in the psychiatric wing. Drawn 01-03-11

(Fig. 7)(Source: author) Designed brise-soleil becomes a decorative as well as functional element for the building. Captured 23-02-11

The northern wing deals with audiology and speech therapy and is located on one floor. The occupational and physical therapy department is located in the west wing and is on one floor. The psychiatric wing is to the south and is located over two floors while the administration rooms are to the east and located on one floor. This arrangement allows north light to penetrate the courtyard play space in the centre and the two storey south wing to shield the space from unwanted south-westerly storm winds. It expresses the idea of refuge and privacy needed for some of the patients, while the outdoor playing fields create an element of prospect where pedestrians can pass by and witness the activities of the patients. The length of the building follows the contours of the slope making the building more topographically sensitive and preventing wheelchair bound visitors from travelling longer distances up slope to the entrance of the facility (refer to Fig. 8).
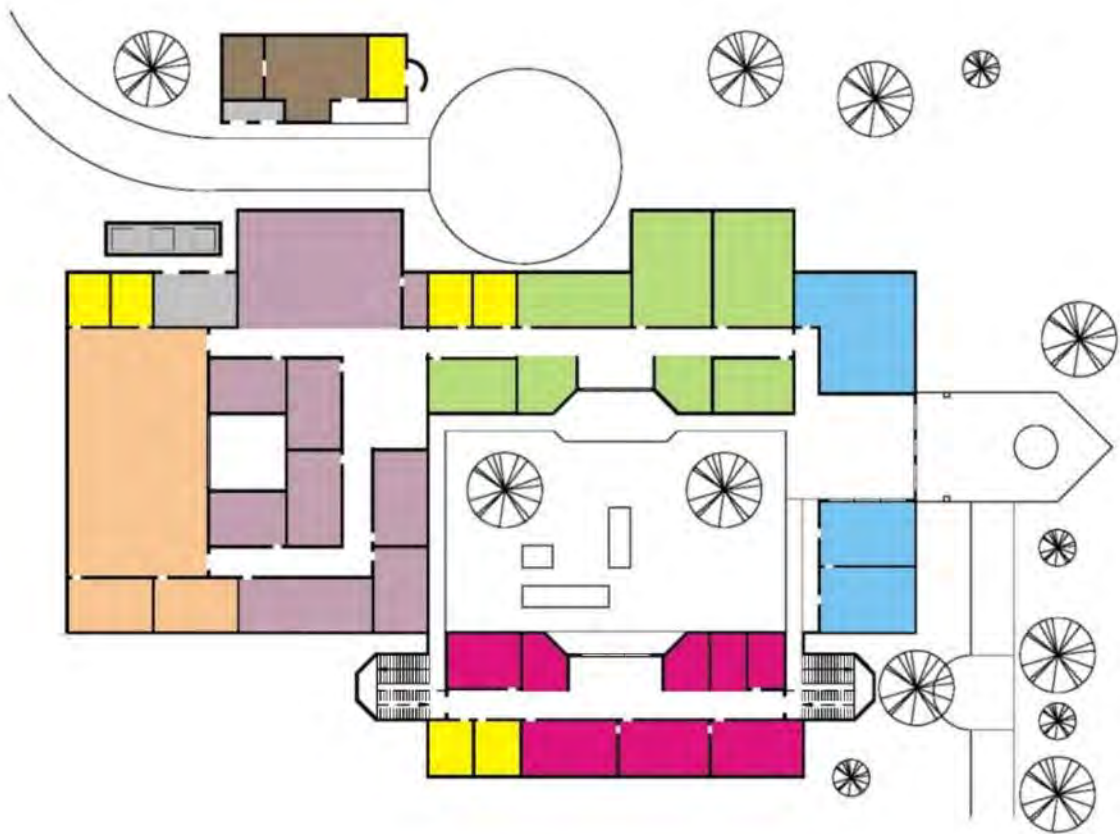
(Fig. 8)(Source: author) Zoning of ground floor plan: Blue (Reception and Storage),
Magenta (Psychiatric and Consulting), Yellow (Ablutions), Purple (Offices,
Woodwork and Occupational Therapy), Orange (Physiotherapy Gym and
Treatment), Green (Audiology and Speech Therapy Offices), Brown (Cleaning Staff
Quarters) and Grey (Mechanical and Electrical). Floor above Psychiatric and
Consulting accommodates Conference Room and Staff Offices. Drawn 31-07-11

The therapists say that hospital environments, namely the nearby Northdale hospital, do not provide such outdoor activities as the ones provided at the facility. The hospital is very much detached from the surrounding environment and promotes an internal and clinical atmosphere, rather than an outdoor and natural one. If deemed necessary, the hospital refers patients to the Therapy Centre who are in need of rehabilitation (one may say that it is a specialised, satellite facility to the hospital). The hospital sees to the needs of the majority of the population so people have to question that the hospital also needs healthy outdoor environments such as mentioned above to create a balance in the experience of the internal healthcare environment for the local community; a balance between clinical and natural therapy for the benefit of human health.

4.2.4 Conclusion

Ample amounts of green space have been preserved and disabled friendly circulation provide a healthy and comfortable environment where gardening, ball games and playtime for children in the outdoors has a therapeutic value for the patients. Natural ventilation, lighting and a connection with the natural environment make for a welcoming atmosphere. Stimulation of the senses from the outdoor natural spaces and playground makes patients more responsive to their environment and subsequently to therapy, which reinforces the biophilic value of nature. Outdoor activities improve the mood of the patients and they form social connections and people skills with those involved. This sort of interaction encourages re-integration with society and so bears relevance to social health as well. Views of the natural surrounds benefit patients as well as therapists creating a m ore productive atmosphere. The length of the building follows the contours of the slope being topographically sensitive.

The psychological, physical and social needs of the patients meet with a welcoming, natural and friendly environment of the facility. The encouragement of outdoor activity to stimulate the young patients is a most admirable quality of the facility program seeing that many youth today have lost touch with nature in the modern world. The Pietermaritzburg Assessment and Therapy Centre is a good example of a building that is in tune with the natural environment and meets the health needs of its occupants. Similar qualities need introduction into the wider healthcare environment for the benefit of the greater population.

## 4.3 Community Value: Chatsworth Youth Centre, Chatsworth, Durban

4.3.1 Justification

While providing a clinic for the counselling and life orientation needs of the youth in the area, the Chatsworth Youth Centre incorporates other complementary activities such as sport and youth clubs to develop local appeal. The issue to consider is how responsive the local community are to the centre; do they benefit from it and if the centre is lacking how to improve it. The building provides adjacent outdoor activity spaces and an internal green courtyard. If the centre were to promote more community-based initiatives, it would develop a greater sense of ownership of the building and it would naturally become an attractive place of social gathering and development. Natural ventilation and lighting are notable features that improve the indoor quality.

4.3.2 Historical and Social Context

Situated 20 km from Durban, Chatsworth came into being in the mid-1960s by the Group Areas Act. Populated largely by the Indian community, much of the suburb consisted of small, council built, semi-detached homes. Over the years, however, there have been substantial improvements to many of the houses, roads, communication systems and general services. Schools are well organised and the formal and informal business sectors have thrived with the development of the Chatsworth Centre shopping complex.

The economic challenges of the area compel most parents to work, breaking down the family-centred social structure. Children become vulnerable through exposure to drug abuse, gambling and prostitution. Sports clubs are adult-orientated, with no provision for keeping children occupied on club premises. Thirteen young people died in the Throb Nightclub disaster, highlighting the social need for a facility such as the Chatsworth Youth Centre. Nelson Mandela initiated the project and a trust comprising representatives of the funders and the local community formed. The land was donated by the eThekwini municipality' (Digest of South African Architecture Reporter, 2004/2005: 78) (refer to Fig. 1 & 2).
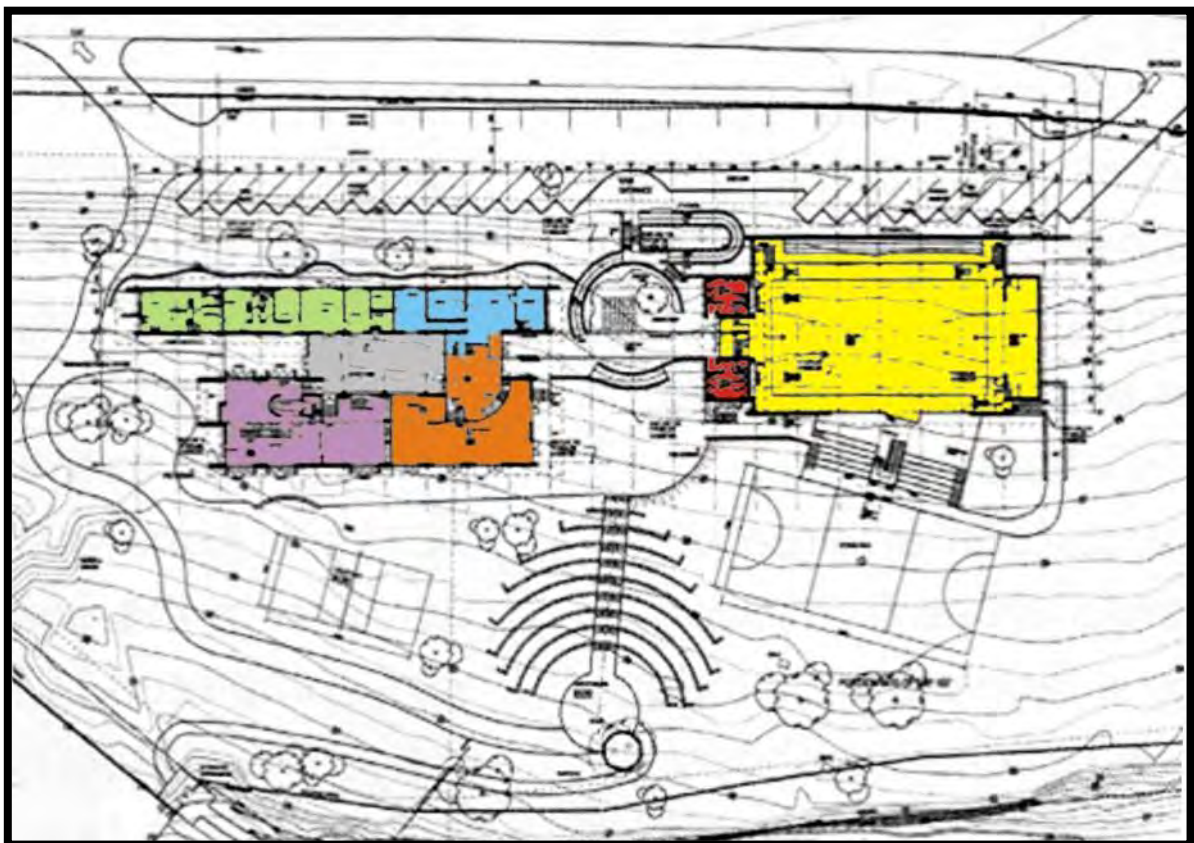
(Fig. 1)(Sources: Google Earth) The Chatsworth Shopping Centre is located to the
northeast of the Youth Centre (above). Accessed 04-04-11
(Fig. 2)(Digest of South African Architecture Vol. 9: 78-79) In the ground floor plan
(below) the major spaces of the facility are the indoor sport hall and ablutions
(yellow and red), the admin and entertainment rooms (blue and orange), the
counselling clinic and IT/ AV room (green and purple) with the garden courtyard
(grey) between. Published 2005

4.3.3 Empirical Data

The brief entailed juggling the wishes of the youth and those of parents and teachers. Adults preferred a formal emphasis on education, while the youth wanted a free-feeling environment and a 'cool' place to 'hang out'. Not being a compulsory institution like a school, it would have to attract the youth through its atmosphere and the activities offered.

Due to financial constraints, the centre requires minimal maintenance and there is no air-conditioning. The architects, therefore, opted for a light, open design, with generous ventilation. A galvanised steel structure was chosen with steel and glass being a feature from the base wall upwards (refer to Fig.2). The steel shop fronts bolt to the steel portal frame structure like a kit of parts. The effect is one of transparency, openness and lightness, maximising the views through the glass panels over Chatsworth and Amanzimtoti in the distance.

(Fig. 3) (Digest of South African Architecture, 2004/2005: 79) The steel- framed and
glass infill building creates a transparent appearance to the building; overhangs
provide shading and brick walls provide thermal massing. Terraced amphitheatre
seating is seen in the foreground. Published 2005

Infill panels for the shop fronts vary from fixed glass and opening sections, to the solid sheet or expanded metal, depending on the adjacent space requirements. Fibre-cement and glass panels mounted with black silicone eliminating any need to paint. Expanded metal mesh permits cool-air circulation within the hall. Large roof overhangs restrict heat from direct sunlight entering the interior spaces. Students from the Durban Institute of Technology painted murals throughout the centre. These murals, in addition to the brightly painted walls and doors, fulfilled the requests for colour from the children in the community (refer to Fig. 3). The brickwork is finished with a tinted cementitious wall coating.

(Fig. 4) (Source: author) The mosaic memorial wall and brightly coloured infill panels are a visually stimulating feature of the youth centre environment. Captured 04-04-11

The oblong shape of the facility follows the site contours and a natural amphitheatre is available for outdoor activities. Stepped levels and ramps create interesting perspectives, giving visibility to all levels of the structure. The parking area at the top level leads to the main entrance, with the lowest level terminating in a pedestrian entrance that allows children access from the shopping centre and surrounding amenities below. The focus of the centre is an open plaza, with a memorial wall, and the centre's facilities radiate outward from there (refer to Fig. 4). Covered walkways link the buildings.

(Fig. 5)(Digest of South African Architecture, 2004/2005: 79) The central plaza is a pivotal space that links the activities of the adjacent buildings with a covered walkway. Published 2005

The children wished for a facility that would accommodate a variety of sports and so designers decided that sport would be a main component for the centre's schedule of accommodation. The main hall is utilised for basketball and volleyball. The steep slope of the site precluded accommodation of large facilities such as soccer fields, but a basketball court and beach volleyball court have been provided towards the lower end of the site. Change room facilities are located beneath the basketball pavilion (refer to Fig. 5).

(Fig. 6) (Source: author) An indoor multi-sport court and performance stage along with outdoor basketball court are attractive activities for local youth.
Captured 04-04-11

The ground level accommodates an entertainment area with canteen, IT centre, audio-visual area and counselling rooms, while a mezzanine level houses a lounge and planted balcony. A ground floor courtyard, with planting, is a co ol shady place to congregate between the entertainment and counselling areas. Madiba insisted for the provision of a garden for children. The garden flows between the structures and has been planted with a wide variety of indigenous flora (Digest of South African Architecture Reporter 2004/2005: 78) (refer to Fig. 6). The IT centre and AV facility where designed to meet the education needs for local youth while the counselling facility is a place to seek advice on issues relating to career guidance, addiction and general health related issues. A commendable initiative by the facility is the recycling of plastic. The holding facility however needs to be secured as much of the recycling material is stolen (refer to Fig. 7).

(Fig. 7; left) (Source: author) The clinic and entertainment building provides an
internal green courtyard for shade and socialising. Captured 04-04-11
(Fig. 8; right) (Source: author) Recycling is an important initiative to promote
amongst the community. Captured 04-04-11

4.3.4 Conclusion

Counselling, life orientation, sport and youth clubs have local relevance amongst the youth and this needs constant encouragement and supervision by management to be affective. Outdoor activity spaces and an internal green courtyard are commendable but these spaces are in need of maintenance to retain appeal. The promotion of more community-based initiatives that engage the citizens might

revitalize the facility and restore it to original value. Natural ventilation and lighting are notable features that improve the indoor quality. Expanded metal mesh permits cool-air circulation within the hall while large roof overhangs restrict heat from direct sunlight entering the interior spaces for human comfort. Murals, in addition to the brightly painted walls and doors, fulfilled the requests for colour from the children in the community and make for a welcoming environment. The placement of the facility follows site contours and provides for an outdoor amphitheatre but this facility is in need of maintenance. A commendable initiative by the facility is the recycling of plastic and the storage of donated merchandise for distribution to the needy.

The centre needs to attract youth through more activities like the ones they currently host: karate, boxing, basketball, indoor soccer, netball and badminton. Although the materials used for construction are 'low-maintenance', the building still needs care. The problem with the facility being 'transparent' is that windows have been broken and equipment has been stolen (refer to Fig. 8). The facility has to compete with the shopping centre that is also a popular destination for the youth. The facility fence all the way around the property is perhaps giving the impression of a private facility rather than a community centre. The facility grounds have enough space to host a small agricultural program, which could supplement the centres existing program. Cross programming, that includes other activities like a crèche, tuck shop, wholesale market or bakery/ home industry and various evening activities may create a more utilized and relevant facility that becomes a defensible space throughout the week.
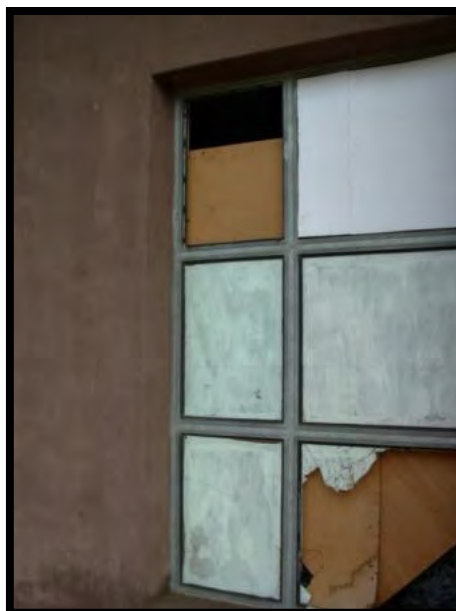
(Fig. 9) (Source: author) A broken window outside one of the counseling rooms; the defensibility of the facility against theft can be improved upon by encouraging constant community activity on site

5.0 Analysis and Discussions

Nature in its elemental form is inseparable from place; without it, there is no life. Development should occur on the least ecologically sensitive parts of a region for healthier urban environments where public space is naturally humanistic while private spaces are climatically responsive and provide a place of refuge for occupants. Natural light can be expressive as well as functional but the affects of glare needs consideration at all times. Allow storm water to return to the soil and rainwater harvesting for daily use. The relaxation and aesthetic appeal of water is a healthful inclusion into building environments and metaphors of organic form in buildings are visually stimulating. Adjustable envelopes also allow the outdoors to become an extension of the interior. Living space that opens up to nature with adjustable envelopes improves connection with nature and enhances occupant satisfaction; internal landscaping is an alternative. Natural materials are a healthy and recyclable alternative and technologies should encourage local participation in construction.

Natural and homely environments provide physical and mental relief from the threats of pollution and stress while proximity to windows for natural light and ventilation is also important for providing views and experiences of nature as an effective method for reducing stress. Inclusion of natural environments into built environments is therapeutic and creates a non-threatening place for human interaction. This relationship may be beneficial but building management should always maintain a clean environment to retain appeal amongst visitors.

The separation between ecology and industry is narrowing in today's world with the rise of environmentally sustainable technology. The relationship between ecological and industrial/ urban environments is the next step in narrowing the gap and planners need to explore new methods of design for healthier cities. Biophilic design is an appropriate provision for local healthcare facilities considering health benefits associated with it but designers must take note of biophobic elements such as natural disaster, the fear of certain animals or allergy and attempt to negate these potential affects. Designing in locations less prone to these factors would be the easiest approach or using technologies that minimize the effects.

Nature sensitive design encourages symbiotic relationships between society and the environment and by linking culture with ecology a balance between nature and development is encouraged. Recreational outdoor public spaces are vital for sustaining the connection between society and nature. Compact towns that make provision for outdoor public space are more successful in achieving environmental, social and economical sustainability than sprawling suburbs. Society must encourage each other to propagate plant and recycle waste to promote stewardship of the environment for a

better future. The sense of community purpose that natural conservation brings correlates with social development that is vital for promoting unity amongst citizens. Similar initiatives should be encouraged to bring people together for a good cause.

By incorporating the above approaches to architecture, designers can evolve and restore the connection with nature as a primary need for healthy living. Designers must encourage society to take refuge in nature while still partaking in a modern lifestyle (not one or the other but both). Designers and developers need to consider establishing connections with nature through biophilic design because without exploring the possibilities, its potential benefits for human and communal wellness will remain a mystery. These methods would be beneficial as a social service to those people in need of renewed health and such techniques could become a standard through many types of buildings.

Designers and clients need to be informed of these benefits and through the promotion of these ideas citizens can find security in a m ore humane and eco-conscious method. Architects would have reestablished the primordial relation and respect of nature and encouraged an ecological movement to partake in the ecological spirit of the time. Society's otherwise unhealthy environments would become more accommodating especially in healthcare and community environments. Architecture is the process of responding to human needs through the design of the built environment. Buildings themselves do not cure illnesses, but they do have the potential to either improve living conditions or hinder them. Designers must understand the needs of nature and social needs of the people who will use the environment. Successful healthcare and community buildings can then interpret these needs for occupant satisfaction.

6.0 Recommendations and Conclusions

The contributions noted above are all valuable, but their worth will only be realised if translated into architectural design recommendations. Based on the outcomes of the research, literature review and case studies, the following recommendations are made to architects faced with the task of designing a nature and human sensitive healthcare and community centre in South Africa, and will be implemented in Part Two of this study, in which a model facility will be designed. In summary, the research has shown that the built and natural environment can affect the provision of healthy and sociable spaces in the following ways:

Bioregional Planning

- a city should be built on areas of least ecological impact to allow areas of rich ecological diversity to fill the spaces between for community satisfaction; maintain existing trees and native landscapes
- bioregional planning emphasizes self-reliance, the use of indigenous landscapes, waste elimination through recycling and co-generation, and encouraging local economies and employment
- balance and order between urban density and adequate outdoor/ natural public space is vital considering that both are beneficial in a city environment

Urban Design Fundamentals

- designers must not create hard-edged environments but promote a more human scale and sociable atmosphere between the public and private realms
- mixed use development provides opportunity for prospect, liveliness and social activity
- environments need to provide a s ense of prospect as well as refuge and privacy for the different community activities of a place
- along with biophilic design elements the fundamentals of public and private domains, urban imageability, figure-ground, linkage and place theories, compaction and mixed-use development should be understood and applied

Climate Responsive Design

- climatic and topographical response is vital for creating a comfortable and nature sensitive design
- when designing spaces one must consider activity levels in different rooms and placement of spaces of activity in relation to solar and wind paths for human comfort
- to contribute to thermal massing, designers must make sure that materials such as brick, stone and concrete are exposed internally
- orient houses towards the sun with the north face kept free from obstruction to allow effective warming during winter; sufficient shading needs to be provided for summer
- diffusing of sunlight carries with it the potential for architectural expression through shadow and light
- make sure every occupant is within seven meters of a window wall, for views, light and air
- in healthcare environments, windows should occupy from 20 percent to 30 percent of the exterior wall
- avoid discomfort glare with light shelves, reflective walls, skylights, roof monitors, atriums, reflective blinds or other forms of shading or indirect lighting
- natural ventilation requires a good understanding of cross-ventilation, stack ventilation, and thermally induced ventilation and the ability to define regionally relevant solutions

Indoor and Outdoor Landscaping

- trees are a natural source of shade in warm climates; also a filter for particulate matter
- architects must strive to retain the natural elements of the site which make the location unique and add aesthetic quality to a region
- potential disasters such as floods and fires should be considered during site selection and the development of prevention measures
- it is bad practice to hide natural landmarks; these should form a part of the skyline
- the presence of animals can provide a therapeutic quality to any living environment
- therapeutic hospital gardens invigorate patients after spending long hours in a contained environment

Water and Architecture

- stormwater can be led to constructed on site wetlands or organic farms which improve eco-systemic health; consider also recycled greywater and reed bed filters
- harvest rainwater for fire suppression and farm irrigation
- use perforated concrete pavers so that stormwater runoff is prevented and heat islands are reduced
- the sound of flowing water creates 'white noise' can instill feelings of relaxation by masking unwanted noise
- reintroduce water into the urban environment as an aesthetic feature that is captivating for local citizens

Natural Symbolism in Architecture

- natural metaphors in buildings trigger associations with living things that stimulate the on-looker
- walls should not be barriers but rather transitional spaces between the outside and the inside or provide internal flexibility
- human beings connect physiologically and psychologically to structures embodying organized complexity

Appropriate Building Technologies and Materials

- let developers promote human resources rather than mechanical resources as a step towards humanistic environments
- materials that are robust are ideal for a lasting purpose in regions where lack of funding often renders citizens incapable of repairing deteriorating buildings
- materials that eventually become inadequate need to have recyclable quality to avoid waste pollution
- natural materials are inherently healthier than some recycled materials which have been known to give off harmful toxic gases
- materials should have the following qualities: they should perform for human comfort, be locally manufactured and have reduced environmental impact (low embodied energy)
- participation creates a sense of belonging which promotes social ties to the building and its place

- conversion of buildings is better than demolition for a more economically and environmentally responsible approach
- experimentation with sustainable and natural materials and technologies by designers encourages better building practices and acceptance by society

Nature Experience and Physical Health

- physical and psycho-social responsiveness in built and natural environments help create healthy spaces for people to live in; young and old
- prevent air pollution, water pollution and soil pollution which have negative effects on the environment and man's health
- compact cities are more socially and economically sustainable than sprawling cities and they prevent air pollution caused by long distance commuting (buses, taxis, etc.)
- off-gassing materials, bacteria and viruses pose a threat when there is a lack of fresh air
- features like natural light, fresh air, user-adjustable task lights and operable windows make interiors more pleasant
- exercise that takes place in natural settings combines the benefits of physical activity with the benefits of nature experience; consider the provision of this relationship

Nature Experience and Mental Health

- paint colours can have therapeutic qualities depending on the context in which they are used
- creating a domestic atmosphere like that of a home living room in a public place reduces anxiety
- using scents that mimic those in nature can be therapeutic in an interior environment
- perceptual extension of space reduces feelings of confinement; provide views to nature

- designers need to provide experiences of nature and the outdoors that will give relief from a dominantly man-made environment; consider exterior as well as interior landscaping
- avoid site plans where some buildings block natural light from others
- consider sill heights and sight lines of nature for the benefit of occupants
- consider providing 'break' areas where natural light and fresh air is present; break areas need to be effectively sound proofed from work noise to provide rest
- always maintain a clean environment to retain appeal amongst visitors

Connecting Nature and Society

- natural environments and social responsiveness in architecture can revitalize disadvantaged places and this should be addressed early in the design process
- biophilia linked with landscape/ urban renewal and economic development will encourage a redistribution of migrants to their hometowns
- society must become a part of the eco-cycles of nature and not the 'conqueror' of nature to prevent future ills
- biophilic design is an appropriate provision for local healthcare facilities considering health benefits associated with it
- linking culture with ecology helps establish the value of nature in a place
- society must avoid reducing nature to commodity and must not forget to promote identity
- encourage outdoor activities because youth contained in an urban environment without any outdoor public space for positive recreation will suffer
- sustainable built environments are a source of hope in preventing the ill effects of environmental and economic inequality as well as social unrest in the country

Stewardship of Nature

- involve clients in propagation and planting and solid waste recycling
- children involved in agriculture programs encourages them to form a more respectful generation for the future; nature experiences are vital for healthy child development
- the sense of community purpose that natural conservation brings correlates with social development that is vital for promoting unity amongst citizens

In light of the health needs of people and the need for responsible community architecture, this research shows that society can benefit mentally, physically and socially from buildings designed with nature. The design method of biophilia is a plausible approach in healthcare, community architecture and the built environment as a whole. If developers realise the benefits of natural conservation during the planning process and if citizens play a more active role in stewardship of the environment then the prevention of negative urban effects can provide healthier built environments.

It is possible that during the complex process of designing a community-based healthcare centre, which forms Part Two of this study, other mechanisms by which to maximise the positive effect that the building can have on healthcare provision will be explored, particularly with regard to a specific physical context. As long as t he focus remains on responding to human and environmental needs throughout the design process, the result will be a built environment that makes a significant, positive contribution to effective treatment and recovery in a healthcare centre and provides naturally and socially relevant environments for the community.

Areas of rich ecological diversity are vital to environmental and human health. Durban City is interspersed with pockets of ecological diversity (parks, gardens, reserves) but the peri-urban regions of eThekwini Metro such as Mp umalanga are interspersed with much larger areas of ecological diversity (alluvial valleys and natural bush). There are parts of Durban City that are too 'developed' for the purposes of this research. The aim of this research is to encourage local economies and employment in developing regions and to revitalize disadvantaged places. Biophilic design and sustainable built environments are a source of hope in preventing the ill effects of environmental, economic and social inequality and therefore the area of focus for site selection will be located in the peri-urban region of Mpumalanga rather than the developed urban region of Durban City.

A survey of healthcare service networks is needed for the local region of the eThekwini Municipality. In order to be of any importance for the local population and biophilic research a survey of hundreds of people in a variety of healthcare clinics, centres and hospitals in the greater Durban area will be relevant, avoiding any possibility of bias. The questionnaire will consider things such as patient satisfaction and nature experience. Such a survey would also need translation into relevant languages to improve comprehension amongst respondents. What may also be relevant amongst the general population (not only medical patients) is to discover what societies perceptions are on nature and its inclusion in the architectural environment. Due to time and fiscal constraints on be half of the researcher, model survey questionnaires are provided in the Appendix of this research document.

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Appendix A

Survey and Semi-structured Interview Questions

The questions below are split into two parts. The first set of questions is intended for a survey of healthcare service user networks in the local region of the eThekwini Municipality which considers patient satisfaction and nature experience. The second set of questions is intended for members of the public which considers societies perceptions and experiences of nature and its inclusion in the architectural environment. Due to time and fiscal constraints on behalf of the researcher, these are model questionnaires which can still be implemented by other researchers with like-minded goals.

Set One:

- Did you find that your stay in the healthcare ward was a pleasant experience?
- Would you say that enough outdoor natural light filled the ward during the day?
- Would you say that the ward was in a state of good repair and clean?
- Did you have easy access to an outdoor garden from the ward that you stayed in?
- Did you feel safe during your stay at the healthcare facility?

Set Two:

- What is the fondest memory you have of being in nature? Tell me about it?
- What effect if any did this encounter have on you?
- What other similar experiences can you remember?
- Do you feel experiences such as these are beneficial for human health; mentally and physically? In what way and why?
- Have you had any bad experiences of nature (violent storms, floods, fires, dangerous animals)?
- Do you think your feelings about nature will differ from other South African's?
- Do you think nature experiences are in any way beneficial for people that live in city environments? In what way and why?

Appendix B

Green Guide for Health Care

The Green Guide for Health Care (gghc.org, 2011) was initially released in 2003 by the Center for Maximum Potential Building Systems; an organization in the USA. It is the centre's first sustainable design toolkit, integrating environmental and health principles into the design, construction and operations of healthcare buildings. It involves rigorous materials evaluation requirements and principles of evidence-based design through an emphasis on daylighting, acoustics, and places of respite. The guide continues to evolve to provide healthier environments for healthcare facilities.

Version 2.2's construction checklist contains twelve prerequisites and ninety-seven optional points in seven categories that are modeled after America's LEED system for sustainable construction. South Africa has its own green building rating system, the Green Star SA, and it would be beneficial if the Green Star were informed by the Green Guide for Health Care to propose a regionally relevant response in the South African context. Currently, Green Star SA has rating tools for office, retail and multiunit residential development yet no tool for healthcare analysis (gbcsa.org.za, 2011). The GGHC construction project checklist is included below for possible further research and contribution to the South African Green Star rating system.

Construction

Y - (yes) you are moderately confident that you can attain the credit.
? - (maybe) it will be challending for this project andyou are uncertain of your ability to attain i t but you wil try.
N - (no) while technically possible, you currently don't expect to try to achieve this credit in thi s project due to cost or other tradeoffs with project goals.
NA - (not applicable) it is inherently physically unattainable for this particular project regardless   of effort due to physical conditions or project scope.

Note: an Excel spreadsheet of this checklist is available for download at www.gghc.org

Integrated Design

Y				Prereq 1	Integrated Design Process	Required
Y				Prereq 2	Health Mission Statement & Program	Required

Sustainable Sites | 21 Points

Y				Prereq 1	Construction Activity Pollution Prevention	Required
Y	?	N	NA	Credit 1	Site Selection	1
Y	?	N	NA	Credit 2	Development Density & Community Connectivity	1
Y	?	N	NA	Credit 3.1	Brownfield Redevelopment: Basic Remediation Level	1
Y	?	N	NA	Credit 3.2	Brownfield Redevelopment: Residential Remediation Level	1
Y	?	N	NA	Credit 3.3	Brownfield Redevelopment: Minimizing Future Hazards	1
Y	?	N	NA	Credit 4.1	Alternative Transportation: Public Transportation Access	1
Y	?	N	NA	Credit 4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	1
Y	?	N	NA	Credit 4.3	Alternative Transportation: Low-Emitting & Fuel Efficient Vehicles	1
Y	?	N	NA	Credit 4.4	Alternative Transportation: Parking Capacity	1
Y	?	N	NA	Credit 5.1	Site Development: Protect or Restore Open Space or Habitat	1
Y	?	N	NA	Credit 5.2	Site Development: Reduce Development Footprint	1
Y	?	N	NA	Credit 5.3	Site Development: Structured Parking	1
Y	?	N	NA	Credit 6.1	Stormwater Design: Quantity Control	1
Y	?	N	NA	Credit 6.2	Stormwater Design: Quality Control	1
Y	?	N	NA	Credit 7.1	Heat Island Effect: Non-Roof	1
Y	?	N	NA	Credit 7.2	Heat Island Effect: Roof	1
Y	?	N	NA	Credit 8	Light Pollution Reduction	1
Y	?	N	NA	Credit 9.1	Connection to the Natural World: Outdoor Places of Respite	1
Y	?	N	NA	Credit 9.2	Connection to the Natural World: Exterior Access for Patients	1
Y	?	N	NA	Credit 10.1	Community Contaminant Prevention: Airborne Releases	1
Y	?	N	NA	Credit 10.2	Community Contaminant Prevention: Leaks & Spills	1

Water Efficiency | 6 Points

Y				Prereq 1	Potable Water Use for Medical Equipment Cooling	Required
Y	?	N	NA	Credit 1	Water Efficient Landscaping: No Potable Water Use or No Irrigation	1
Y	?	N	NA	Credit 2.1	Potable Water Use Reduction: Measurement & Verification	1
Y	?	N	NA	Credit 2.2	Potable Water Use Reduction: Domestic Water	1
Y	?	N	NA	Credit 2.3	Potable Water Use Reduction: Domestic Water	1
Y	?	N	NA	Credit 2.4	Potable Water Use Reduction: Process Water & Building System Equipment	1
Y	?	N	NA	Credit 2.5	Potable Water Use Reduction: Process Water & Building System Equipment	1

Energy & Atmosphere   21 Points

Y				Prereq 1	Fundamental Commissioning of the Building Energy Systems		Required
Y				Prereq 2	Minimum Energy Performance		Required
Y				Prereq 3	Fundamental Refrigerant Management		Required

Y	?	N	NA	Credit 1.1	Optimize Energy Performance: 3.5%/10.5%	1
Y	?	N	NA	Credit 1.2	Optimize Energy Performance: 7%/14%	1
Y	?	N	NA	Credit 1.3	Optimize Energy Performance: 10.5%/17.5%	1
Y	?	N	NA	Credit 1.4	Optimize Energy Performance: 14%/21%	1
Y	?	N	NA	Credit 1.5	Optimize Energy Performance: 17.5%/24.5%	1
Y	?	N	NA	Credit 1.6	Optimize Energy Performance: 21%/28%	1
Y	?	N	NA	Credit 1.7	Optimize Energy Performance: 24.5%/31.5%	1
Y	?	N	NA	Credit 1.8	Optimize Energy Performance: 28%/35%	1
Y	?	N	NA	Credit 1.9	Optimize Energy Performance: 31.5%/38.5%	1
Y	?	N	NA	Credit 1.10	Optimize Energy Performance: 35%/42%	1
Y	?	N	NA	Credit 2.1	On-Site Renewable Energy: 0.05 watts of renewable generating capacity / sf of building area	1
Y	?	N	NA	Credit 2.2	On-Site Renewable Energy: 0.10 watts of renewable generating capacity / sf of building area	1
Y	?	N	NA	Credit 2.3	On-Site Renewable Energy: 0.15 watts of renewable generating capacity / sf of building area	1
Y	?	N	NA	Credit 3	Enhanced Commissioning	1
Y	?	N	NA	Credit 4	Enhanced Refrigerant Management	1
Y	?	N	NA	Credit 5	Measurement & Verification	1
Y	?	N	NA	Credit 6.1	Green Power: 20%	1
Y	?	N	NA	Credit 6.2	Green Power: 50%	1
Y	?	N	NA	Credit 6.3	Green Power: 80%	1
Y	?	N	NA	Credit 6.4	Green Power: 100%	1
Y	?	N	NA	Credit 7	Equipment Efficiency	1

Materials & Resources   21 Points

Y				Prereq 1	Storage & Collection of Recyclables		Required
Y				Prereq 2	Mercury Elimination		Required

Y	?	N	NA	Credit 1.1	Building Reuse: Maintain 40% of Existing Walls, Floors & Roof	1
Y	?	N	NA	Credit 1.2	Building Reuse: Maintain 80% of Existing Walls, Floors & Roof	1
Y	?	N	NA	Credit 1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements	1
Y	?	N	NA	Credit 2.1	Construction Waste Management: Divert 50% from Disposal	1
Y	?	N	NA	Credit 2.2	Construction Waste Management: Divert 75% from Disposal	1
Y	?	N	NA	Credit 2.3	Construction Practices: Site & Materials Management	1
Y	?	N	NA	Credit 2.4	Construction Practices: Utility & Emissions Control	1
Y	?	N	NA	Credit 3.1	Sustainably Sourced Materials: 10%	1
Y	?	N	NA	Credit 3.2	Sustainably Sourced Materials: 20%	1
Y	?	N	NA	Credit 3.3	Sustainably Sourced Materials: 30%	1
Y	?	N	NA	Credit 3.4	Sustainably Sourced Materials: 40%	1
Y	?	N	NA	Credit 3.5	Sustainably Sourced Materials: 50%	1
Y	?	N	NA	Credit 4.1	PBT Elimination: Dioxins	1
Y	?	N	NA	Credit 4.2	PBT Elimination: Mercury	1
Y	?	N	NA	Credit 4.3	PBT Elimination: Lead & Cadmium	1
Y	?	N	NA	Credit 5.1	Furniture & Medical Furnishings: Resource Reuse	1
Y	?	N	NA	Credit 5.2	Furniture & Medical Furnishings: Materials	1
Y	?	N	NA	Credit 5.3	Furniture & Medical Furnishings: Manufacturing, Transportation & Recycling	1
Y	?	N	NA	Credit 6	Copper Reduction	1
Y	?	N	NA	Credit 7.1	Resource Use: Design for Flexibility	1
Y	?	N	NA	Credit 7.2	Resource Use: Design for Durability	1

				Environmental Quality		**24**	**Points**
Y				Prereq 1	Minimum IAQ Performance		Required
Y				Prereq 2	Environmental Tobacco Smoke Control (ETS)		Required
Y				Prereq 3	Hazardous Material Removal or Encapsulation		Required
Y	?	N	NA	Credit 1	Outdoor Air Delivery Monitoring		1
Y	?	N	NA	Credit 2	Natural Ventilation		1
Y	?	N	NA	Credit 3.1	Construction EQ Management Plan: During Construction		1
Y	?	N	NA	Credit 3.2	Construction EQ Management Plan: Before Occupancy		1
Y	?	N	NA	Credit 4.1	Low-Emitting Materials: Interior Adhesives & Sealants		1
Y	?	N	NA	Credit 4.2	Low-Emitting Materials: Wall & Ceiling Finishes		1
Y	?	N	NA	Credit 4.3	Low-Emitting Materials: Flooring Systems		1
Y	?	N	NA	Credit 4.4	Low-Emitting Materials: Composite Wood & Insulation		1
Y	?	N	NA	Credit 4.5	Low-Emitting Materials: Furniture & Medical Furnishings		1
Y	?	N	NA	Credit 4.6	Low-Emitting Materials: Exterior Applied Products		1
Y	?	N	NA	Credit 5.1	Chemical & Pollutant Source Control: Outdoor		1
Y	?	N	NA	Credit 5.2	Chemical & Pollutant Source Control: Indoor		1
Y	?	N	NA	Credit 6.1	Controllability of Systems: Lighting		1
Y	?	N	NA	Credit 6.2	Controllability of Systems: Thermal Comfort		1
Y	?	N	NA	Credit 7	Thermal Comfort		1
Y	?	N	NA	Credit 8.1a	Daylight & Views: Daylight for Occupied Spaces: 6% above 'square-root base' daylit area		1
Y	?	N	NA	Credit 8.1b	Daylight & Views: Daylight for Occupied Spaces: 12% above 'square-root base' daylit area		1
Y	?	N	NA	Credit 8.1c	Daylight & Views: Daylight for Occupied Spaces: 18% above 'square-root base' daylit area		1
Y	?	N	NA	Credit 8.1d	Daylight & Views: Daylight for Occupied Spaces: 75% of regularly occupied spaces		1
Y	?	N	NA	Credit 8.1e	Daylight & Views: Daylight for Occupied Spaces: 90% of regularly occupied spaces		1
Y	?	N	NA	Credit 8.2	Daylight & Views: Connection to the Natural World: Indoor Places of Respite		1
Y	?	N	NA	Credit 8.3	Daylight & Views: Lighting & Circadian Rhythm		1
Y	?	N	NA	Credit 9.1	Acoustic Environment: Exterior Noise, Acoustical Finishes, & Room Noise Levels		1
Y	?	N	NA	Credit 9.2	Acoustic Environment: Sound Isolation, Paging & Call System, & Building Vibration		1

			Innovation & Design Process		**4**	**Points**
Y	?	N	Credit 1.1	Innovation in Design:		1
Y	?	N	Credit 1.2	Innovation in Design		1
Y	?	N	Credit 1.3	Innovation in Design		1
Y	?	N	Credit 2	Documenting Health, Quality of Care & Productivity Performance Impacts: Research Initiatives		1

Construction Project Total	**97**	**Points**

DESIGN REPORT

CONTENTS

PART TWO

DESIGN REPORT

1.0 INTRODUCTION

1.1 INTRODUCTION

This report documents Part Two of the study - the process of designing 'A Healthcare and Community Centre for Mpumalanga, Durban'. It follows on from Part One, which provides the background research on the topic 'Biophilia in Architectural Design'. The fundamental purpose of this report is to demonstrate the application of the research findings to architectural design. One can pay particular attention to the 'Analysis and Discussions' as well as 'Recommendations and Conclusions' in Part One as a summary of the theoretical background and point of departure in establishing the concept behind the Healthcare and Community Centre for Mpumalanga, Durban.

1.2 CONCEPT DESCRIPTION

The concept for the centre needs to be influenced by its context as in any building design. Mpumalanga's Hlengisizwe Health Centre caters for residents in Ntshongweni and Hammarsdale as well and is located in the east of the township. The centre has 31 beds and serves a population of 115 000 and indirectly serves as a referral for 5 affiliation clinics, this amounts to a total population of 140 000 (kznhealth.gov.za, 2011). The services offered at the centre include; ARV therapy, curative & chronic services, maternity services, dentistry, dietician, eye clinic, emergency, labs, mental health, mobile services, occupational therapy, paediatrics, pharmacy, physiotherapy, family planning, school health services, social work and tuberculosis therapy (kznhealth.gov.za/Hlengisizwe, 2011). There are clinics in the western wards of Mpumalanga but their health services are limited. The suggestion is that a healthcare centre in the western locality will alleviate pressures placed on Hlengisizwe Centre and provide a readily accessible healthcare centre for western Mpumalanga and Georgedale.

In addition to providing a comprehensive primary-care service with a small in-patient component, the facility will also cater for community-based activities that engage the local people and form a heart of the neighbourhood. Medical practitioners combine their efforts with social workers and community oriented programs. The community centre is a means of improving the image of healthcare facilities as a place where people feel welcomed and secure because their cultures are valued through this provision. While providing these functions the concept of biophilia in architectural design and its health benefits will guide the design process.

Some of the key 'biophilic' elements that will form part of the design at the centre are listed below:

Bioregional Planning

- revitalizing of outdoor public spaces (particularly the chosen site) by way of recreational and natural landscaping to complement existing facilities
- greening of pedestrian paths to create an 'eco-network' between the outdoor public spaces of the region

Urban Design Fundamentals

- establish an active edge to the chosen site for community benefit
- preserve existing pedestrian paths through site to maintain public accessibility
- establishing appropriate linkages with facilities adjacent to chosen site
- creating a distinction between private outdoor spaces for patients and public spaces for the community
- provide adequate amounts of parking space without negatively affecting the provision of outdoor public space

Climate Responsive Design

- a northeasterly orientated building to allow ventilation of courtyard spaces during summer months
- trees and shading structures on the east and west faces provide a shield from unwanted morning and afternoon glare
- consider how natural lighting can be utilised in an aesthetic manner (skylights, picture windows with nature views and sunlit courtyards that become an extension of interior space)
- width of buildings should be shallow enough to allow cross-ventilation (consider possibility of heat driven ventilation)

Water and Architecture

- rainwater harvesting off roofs provides for a range of uses (e.g. agriculture irrigation, washing, etc.)
- greywater recycling and waste composting can propagate agriculture for the marketplace; consider providing agricultural gardens as part of the adjacent school's activities

- provide water features for the benefit of citizens (pool courtyards and fountains)

Natural Symbolism in Architecture

- curvilinear design as opposed to grid-like construction provides a humanistic environment for visitors to enjoy

Appropriate Building Technologies and Materials

- flexible interiors and envelopes provide a level of adaptability
- utilize thermally massive materials for exterior walls
- consider engineered timber and tensile membrane structures as a sustainable and economic form of spanning wide spaces
- stained and polished concrete slabs provide a floor finish that is economic and attractive
- private spaces can use carpeting composed of natural fibres; consider utilising other 'green' materials in interior design (bamboo, cork, reeds, thatch)
- wall finishes have a tactile quality
- the landscape includes fixed seating areas with porous paving to prevent stormwater runoff

1.3 THE NOTIONAL CLIENT

1.3.1 Introduction

Healthcare facilities include clinics (mobile and fixed), community health centres, community hospitals, regional hospitals and academic hospitals. In terms of management, healthcare facilities are divided into three groups:

- **Private** – privately funded patients; these facilities are often very expensive and inaccessible to most people
- **Semi-private** – 'non-profit' organisations that are often subsidised by the government and are therefore able to accept non-paying patients
- **Public** – state funded and run

As discussed in Part One, South Africa has a poor record of service with respect to public healthcare facilities. The poor quality of facilities in the densely populated, peri-urban areas of Durban contrasts with the higher quality of care available in the private sector. This inadequacy immediately suggests that the client for this project should be the KwaZulu-Natal Department of Health (KZN-DoH). Given the status of public healthcare in South Africa, the government aims to address these issues through economic development. Through adequate subsidising of healthcare facilities and considerate design, construction and maintenance, facilities can experience a vast improvement providing a quality service to people in need.

1.3.2 The Client's Organisation

The motto of the Department of Health is 'Fighting Disease, Fighting Poverty, Giving Hope'. The mission of the department is to provide a caring and humane society in which all South Africans have access to affordable, good quality health care. The department also focus on working in partnership with other stakeholders to improve the quality of care of all levels of the health system, especially preventive and promotive health. Some of the pressing health issues in the country include AIDS, cholera and TB and the DoH programmes are committed to challenging prejudice and discrimination wherever it occurs while fighting to prevent these diseases. The department develops policies and monitors medical conditions and the provision of services throughout the country. It also conducts various department programmes and campaigns that aid in improving societal health by promoting ideas such as proper nutrition and exercise (doh.gov.za, 2011).

1.3.3 The Client's Requirements

The client's requirements from the architect are as follows:

- **Brief and Schedule of Accommodation** – To supplement the clients established requirements with the research findings in order to generate an appropriate design brief and schedule of accommodation for the proposal

- **Urban Analysis and Site Selection** – To assist with the selection of an appropriate site for a new healthcare and community centre, by conducting an investigation and analysis of care availability in the Mpumalanga Township

- **Conceptual Design** – To provide the client with a detailed design of the proposed building

1.3.4 The Client's Brief

The brief was formed by referring to the ideas put forward in 'Designed with Care: Design and Neighbourhood Healthcare Buildings', a CABE publication (Mason, 2006).

Project Overview:

- The KZN-DoH requires a new facility for the treatment of the local community
- The new building will need to facilitate care provision and must therefore cater for inpatient, outpatient and preventative (educational) treatment
- It is imperative that the new clinic be designed with the latest treatment models in mind, and that the building embodies the beliefs and attitudes of the KZN-DoH, conveying a message of dignity and respect to patients and the public alike
- The architect is to design a therapeutic, non-institutional treatment environment that contributes positively to the treatment and recovery of the patients, avoiding a typical clinical hospital atmosphere as much as possible while providing a welcoming space for the local community

Inpatient Accommodation:

- The facility is to accommodate +/- 25 inpatients at a time
- The accepted gender breakdown is 50/50 - Males are to be accommodated separately to females
- Each inpatient should have his or her own window and section of wall to personalise. Ideally, each bed should be located in its own corner of the bedroom
- The bed configuration should be arranged for social interaction rather than detachment from the others in the room (although drawing curtains should be provided when privacy is needed)

Therapy Spaces:

- A variety of therapy spaces are to be provided, as p er the attached schedule of accommodation
- These therapy spaces should be separate from both the public components and in-patient zones of the built environment

Public Spaces:

- In order to facilitate holistic addressing of healthcare provision, the building must serve as an interface between the public and the healthcare professionals who work at the centre
- This public facility should project an open, welcoming attitude, encouraging members of the community to seek information and help as well as interact with others in the community. A disabled friendly ground floor is obligatory for universal access

Outdoor Spaces:

- In addition to the enclosed areas stipulated in the schedule of accommodation below, the built environment should incorporate substantial open landscaped areas for recreation and outdoor therapy
- Such areas should ideally be contained by the building itself, and be easily supervised by staff

Adapting to Needs:

- Consider the possibility of expansion to accommodate future additions (horizontal or vertical)

Safety and Security:

- Access to the facility should be easily controlled by staff through one clear entrance/ reception area
- Publicly accessible areas should be clearly distinct from private therapy and in-patient zones
- The nurse's station ('duty room') should be strategically positioned so as to enable the sister on duty to visually survey circulation routes and entrances to spaces
- The building must not allow for unsupervised contact between patients and members of the community
- The facility design must prevent patients from harming themselves e.g. robust materials, finishes and furnishings prevent damage of property and potential injury
- The facility should provide secure storage of records, publications and leaflets, equipment and supplies

1.3.5 Schedule of Accommodation

The Healthcare and Community Centre needs to cater for a variety of functions. These can be broken down into five main groups:

Administration and Maintenance – As in any health-care facility, a v ariety of support spaces accommodate the staff members who work at the clinic, from the administration crew and kitchen staff to facility security personnel

Emergency and In-patient Facility – this department provides x-ray facilities for diagnostics, operations theatre for minor surgery and in-patient accommodation for the time required until normal health is restored amongst patients or it is decided to refer them to a ce ntre of higher care. This component of the facility would serve to accommodate these in-patients in wards with three to four beds each, and one bathroom

Out-patient Clinic & Therapy spaces – These spaces are the core of the clinic, and facilitate the various treatment activities such as rehabilitation, dentistry, eye clinic, audiology, dietician, etc.

Education & Fitness – These spaces are accessible to the public, and serve as the first point of contact between the community and education/ fitness professionals. A library and a gym form the main facilities of this group. An outdoor theatre serves as a venue to inform students, practitioners and the public on a variety of subjects pertaining to health and community

Communal – Spaces such as the taxi/ market facilities and agriculture spaces are required to serve patients, staff and the public alike

A maternity department has been excluded from the schedule. Hlengisizwe Centre caters for this service currently and if the need arises, provision for additions will be provided for the site in western Mpumalanga. The schedule of accommodation has been established after considering the various precedents and case studies considered in Part One, including Duke Integrative Medicine, the Ubuntu Centre, the Umkhumbane Health Centre, Pietermaritzburg Assessment and Therapy Centre and Chatsworth Youth Centre. After consulting healthcare designer, Trevor Blanchard (2011) and various literature resources on the design of primary healthcare facilities the results were further moderated and improved upon to create an appropriate Healthcare and Community Centre for Mpumalanga. Refer to the table below for the schedule of accommodation. The spatial diagram to follow demonstrates the relationship between the public, patients and staff with the various departments within the facility (refer to Fig. 1).

TABLE 1:
PROPOSED SCHEDULE OF ACCOMMODATION

Space	Area (m²)	No.	Total Area (m²)
Administration:			
Information Desk	30	1	30
Waiting \Room	45	1	45
Offices (Healthcare Practitioners)	20	4	80
General Storage & DB Room	10	1	10
Security Control	15	1	15
Medical Records	50	1	50
Data Capturing	30	1	30
Board-room	50	1	50
Staff Lounge	25	1	25

Staff Ablutions	i.t.o. NBR	N/A	25
Total -			**360**
Maintenance Staff:			
Gate House	10	2	20
Contaminated Waste	30	1	30
General Waste	30	1	30
Workshop	35	1	35
Staff Ablutions	25	2	50
Staff Loubge	60	1	60
Staff Courtyard	N/A	1	N/A
Dirty Linen Washing & Airing Room	35	1	35
Sterile Store	25	1	25
Decontamination Room	30	1	30
Linen Packing Room	40	1	40
Bulk Storage	25	3	75
Storage Office	20	1	20
Total -			**450**
Emergency & In- Patient Facility			
Incoming Patients			
Emergency Entrance/ Waiting	60	1	60
Information Desk	15	1	15
Security Control	15	1	15
Medical Records	40	1	40
Data Capturing	30	1	30
Wheel Chair Store	10	1	10
General Store	25	1	25
Kitchen	60	1	60
Staff Ablutions	i.t.o NBR	N/A	25
Staff Lounge	30	1	30
Surgical Sundries Store	25	1	25
Triage	30	1	30
Nurse's Station	40	1	40
Minor Operations Theatre	40	1	40

Patient's Ablutions	25	2	50
Staff Ablutions	25	1	25
Sluice	25	1	25
Plant Room	45	1	45
Post Trauma			
Dressing Room	80	1	80
Male Recovery	80	2	160
Female Recovery	80	2	160
Children's Recovery	80	1	80
Laboratory	70	1	70
Body Room	35	1	35
Diagnostic X-Ray Theatre:			
X-Ray Room	35	1	35
X-Ray Records	15	1	15
Dark Room	10	1	10
Ultrasound Room	25	1	25
In-patient Accommodation:			
Inpatients Recreation Room	100	1	100
Inpatients Quiet courtyard	N/A	1	N/A
Nurse's Office	25	1	25
General Storage	25	2	50
Total -			**1435**
Semi-Public: Out-Patient Clinic And Therapy Spaces			
Waiting Area	80	1	80
Traditional Healers Room	30	1	30
Patient Ablutions	i.t.o. NBR	N/A	50
Children's Ablutions	i.t.o. NBR	N/A	25
Group Therapy Courtyard	250	1	250
Therapy Storage	80	1	80
Dispensary	60	1	60

Pharmacy Store	80	1	80
Pharmacy Office	20	1	20
Pump Rooms	20	2	40
Hydrotherapy Facility	120	1	120
Audiology and Speech therapy	40	1	40
Dentistry	60	1	60
Dentist's Lab	25	1	25
Eye Testing	15	1	15
Eye Specialist's Office	25	1	25
School Health Services	30	1	30
Blood Testing	25	1	25
Assessment Room	25	1	25
Dietician	25	1	25
Cleaning Room	10	1	10
General Store	25	3	75
Splinting Room	30	1	30
Activities Room	40	1	40
Occupational Therapist's Office	20	1	20
Physio Treatment	50	2	100
Sluice	20	1	20
Laundry	20	1	20
Physio Gym	120	1	120
Physiotherapist's Office	30	1	30
Total -			**1570**
Public: Counselling, Education & Fitness			
Waiting	30	1	30
Counselling Information Desk	30	1	30
Social Workers' Offices	30	1	30
Business Consultant	30	1	30
Lecture Room	40	1	40
General Storage	20	2	40
Public Library	280	1	280
Issuing Desk	30	1	30

Reserved Books	60	1	60
IT Facility	80	1	80
Créche/ Games Room	60	1	60
Gym Information Desk	30	1	30
Records	30	1	30
Public Gym	260	1	260
Gym Changerooms	60	2	120
Total -			**1150**
Taxi, Market & Agriculture :			
Reservoir Pump House	15	1	15
Mini Substation	40	1	40
Garden Facility	100	1	100
General Storage	25	4	100
Public Ablutions	30	4	120
Bicycle shed	N/A	1	N/A
Taxi Shelter Bays	i.t.o. NBR	24	N/A
Food Market	1000	1	1000
Chicken Coop	30	1	30
Performance Stage	80	2	160
Craft Market	600	1	600
Games Room	100	1	100
Taxi Market Administration	60	1	60
Security Control	30	1	30
Lettable Space	60	1	60
Outdoor Seating Area	N/A	1	N/A
Agricultural Gardens	N/A	1	N/A
Total -			**2415**
Other:			
Outdoor Theatre	350	1	**350**
Therapy Gardens	-	-	-
Water Features	-	-	-
Playground	-	-	-

Parking:			
Staff Parking	-	-	-
Visitors Parking	-	-	-
Service entry and Delivery	-	-	-
Refuse collection	-	-	-
Total Specified Floor Area -			**7730**
Add 8% for building structure	618.4		**8348.4**
Add 15% for circulation	1159.5		**9507.9**

TABLE 2:

SPATIAL DIAGRAM

This spatial diagram reveals the relationships between the people that use the facility and the departments within the healthcare and community centre

2.0 SITE SELECTION, SURVEY AND ANALYSIS

2.1 INTRODUCTION

The eThekwini Economic Development Unit has targeted peri-urban communities for future development with aims to alleviate these areas of poverty by providing more jobs, adequate public facilities and living environments. Umlazi, kwaMashu, Inanda and Mpumalanga are among the numerous areas that have been identified for development in the eThekwini Municipal region. For the realization of a Healthcare and Community Centre, Mpumalanga Township has been chosen for further investigation (refer to Fig 1). The town is located roughly midway between Durban and Pietermaritzburg and has commercial, residential and industrial components with great economic potential if developed. Mpumalanga is one of the most densely populated peripheral communities in the eThekwini Municipal region, justifying the motion to develop civic services for this expanding community (refer to Fig. 2).

(Fig. 1) (EDU, 2011) A locality map of Mpumalanga in relation to the rest of the eThekwini Municipal region (proposed Mpumalanga New Town Centre indicated in red)
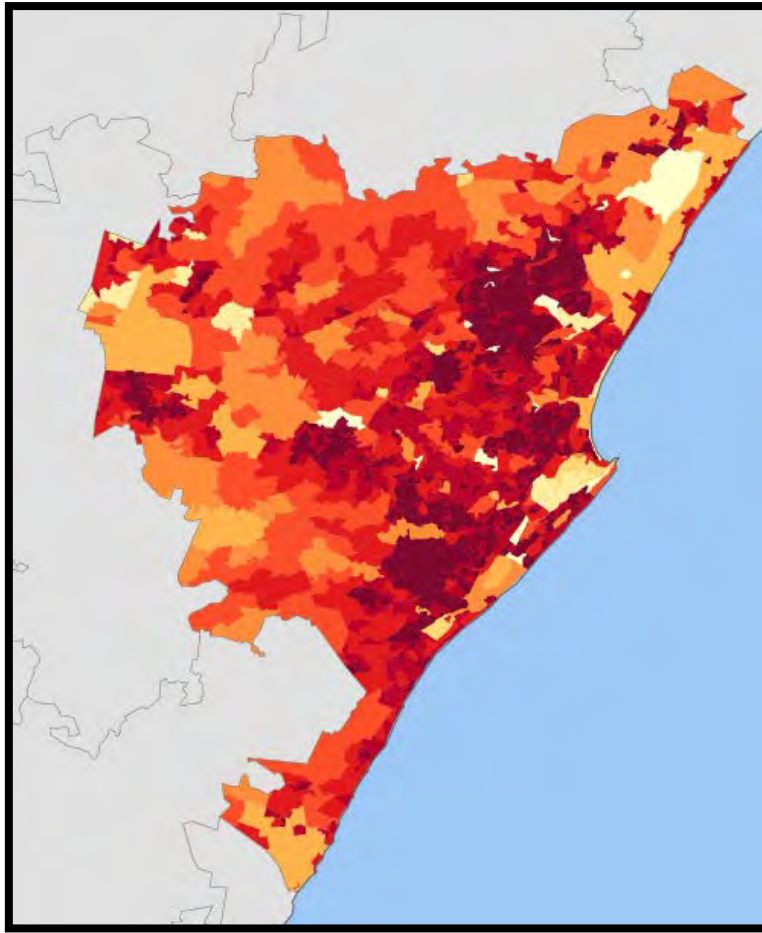
(Fig. 2) (Source: en.wikipedia.org/) A 2001 population density map of the eThekwini Municipal region (Mpumalanga near western boundary in dark red indicates a population exceeding 3000 people/ sq km)

'The formal township was originally built by the authorities as a residential location for Africans in terms of the State's industrial decentralization policy in the 1960s. It was proclaimed a township within the boundaries of KwaZulu on 29 D ecember 1972, a master plan being put into action involving the expropriation of land and accommodation of a new town layout' (Hattingh, 1987: 5). The people of Mpumalanga Township are located on eThekwini's western border, 38 km west of Durban and 33 km southeast of Pietermaritzburg. The region experienced bitter political feuding in the 1980s and early 1990s that claimed the lives of many citizens. The IFP and ANC eventually put aside their differences for peace, reconciliation and stability but crime, unemployment and the abuse of alcohol and drugs remain major challenges. With sufficient funding and quality service, Mpumalanga has the potential to overcome these weaknesses and create a place of economic opportunity for the local people (Durban.gov.za, 2011).

The town plan is organic (designed with the topography of the land). The road network forms spinal access ways to the various wards of the township. Development occurs on the relatively flat part of the hilltops with forest growth occurring in the valleys. The northeastern 'gateway' to the township is near the KwaZulu-Natal Department of works and Mpumalanga police station and library but most of the commercial activity occurs in the northwestern part of the township near the taxi rank and shopping centre.


(Fig. 3) (Source: Google Earth, 2011) An aerial view of western Mpumalanga showing how development occurs on the hilled areas of the town while alluvial valleys are preserved in their natural state between these developed areas

The taxi rank provides transport to majority of the population, as most citizens do not have privately owned vehicles. The location needs a variety of public services closer to home to save on taxi fares and time. 'After the recent reconstruction of the Mpumalanga Stadium it became clear that locals had long been hungry for quality, live sporting events (refer to Fig. 4). They buy tickets and come out in large numbers to watch soccer games, particularly when big name clubs visit but a tour of the area revealed that there are still some challenges' (Durban.gov.za 2011). As an example, there is no swimming pool. Such a facility is needed especially during summer months for the enjoyment of the local population.

(Fig. 4) The Mpumalanga Stadium draws large crowds especially when big name clubs play locally

Facilities such as sport or youth centres would provide venues for the youth to be active and healthy. Economic development projects are planned for the future of Mpumalanga Township and these are currently underway. One of the major additions to the peri-urban environment will be the new 18000 sq m retail centre to the north of the region. This will be accompanied by mixed use, civic, residential (RDP and social housing) and road upgrades that will provide greater opportunity for employment of the local people (Peter Gilmore, 2011) (refer to Fig. 5 & 6).
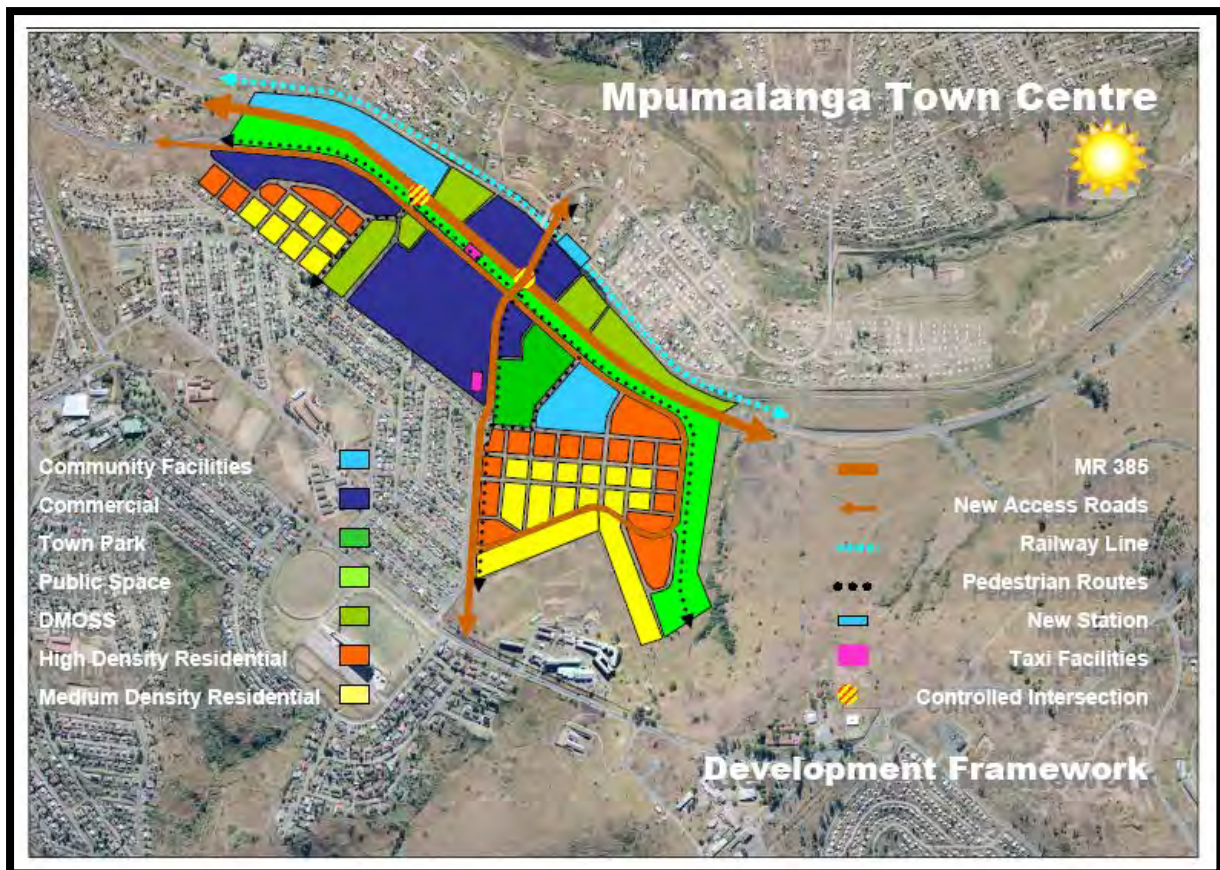
(Fig. 5) (Source: EDU, 2011) The zoning of the first phase of Mpumalanga's new town centre above. Succeeding phases will develop the land in the eastern regions into medium density residences and eventually provide a regional hospital in the southeastern portion of the above map

(Fig. 6) Improving road infrastructure and providing housing for the increasing population is part of eThekwini Municipalities program to develop peri-urban communities such as Mpumalanga

Mobile clinics have served as a short-term relief to the lack of health services in peri-urban communities such as Mpumalanga but with the economic development and population increase projected for the near future, a more permanent form of health service is required by creating a network of co-operative healthcare buildings for the region. The nearest provincial hospitals are located in Durban and Pietermaritzburg and the intentions of the eThekwini Economic Development Unit is to eventually establish a provincial hospital in the north eastern corner of Mpumalanga to serve the local community. This would be a more financially feasible alternative for local people who have to travel long distances by taxi or train to receive treatment. Until adequate funding is provided, this phase will remain pending.

The focus of this design however is not the regional hospital but rather a complimentary healthcare and community centre in the western ward of Mpumalanga. The eventual establishment of a regional hospital would make referrals for more intensive forms of healthcare readily available for the local population while the community healthcare centres will attend to the primary healthcare needs of the local people. The selection of a site for a healthcare and community centre is needed as a complimentary healthcare post for the already existing Hlengisizwe Community Health Centre and affiliated clinics. In response to the healthcare needs of the region, an analysis of Mpumalanga's distribution of healthcare facilities and other public buildings and infrastructure has been captured in the figure presented below (Fig. 7 & 8). Following this figure is a list of site selection criteria that will aid in the selection of the proposed site.
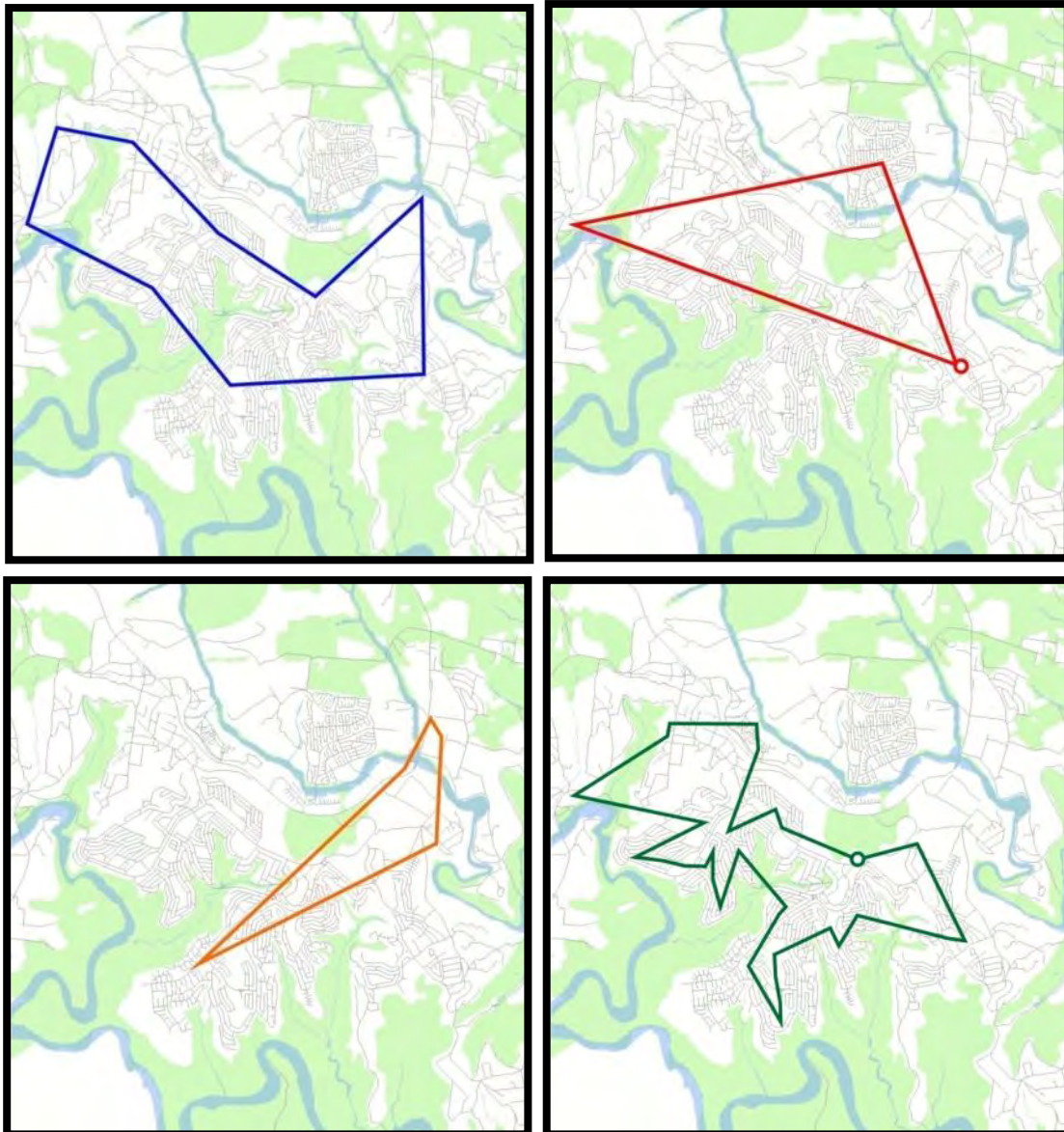
(Fig. 7) (Source: citymaps.durban.gov.za, 2011 - edited by author) Locality maps of the Mpumalanga township indicating civic building networks. Top left – town halls; Top right – healthcare posts (circle indicates main health centre; Hlengisizwe); Bottom left – mobile clinic stations; Bottom right – education facilities (circle indicates library)
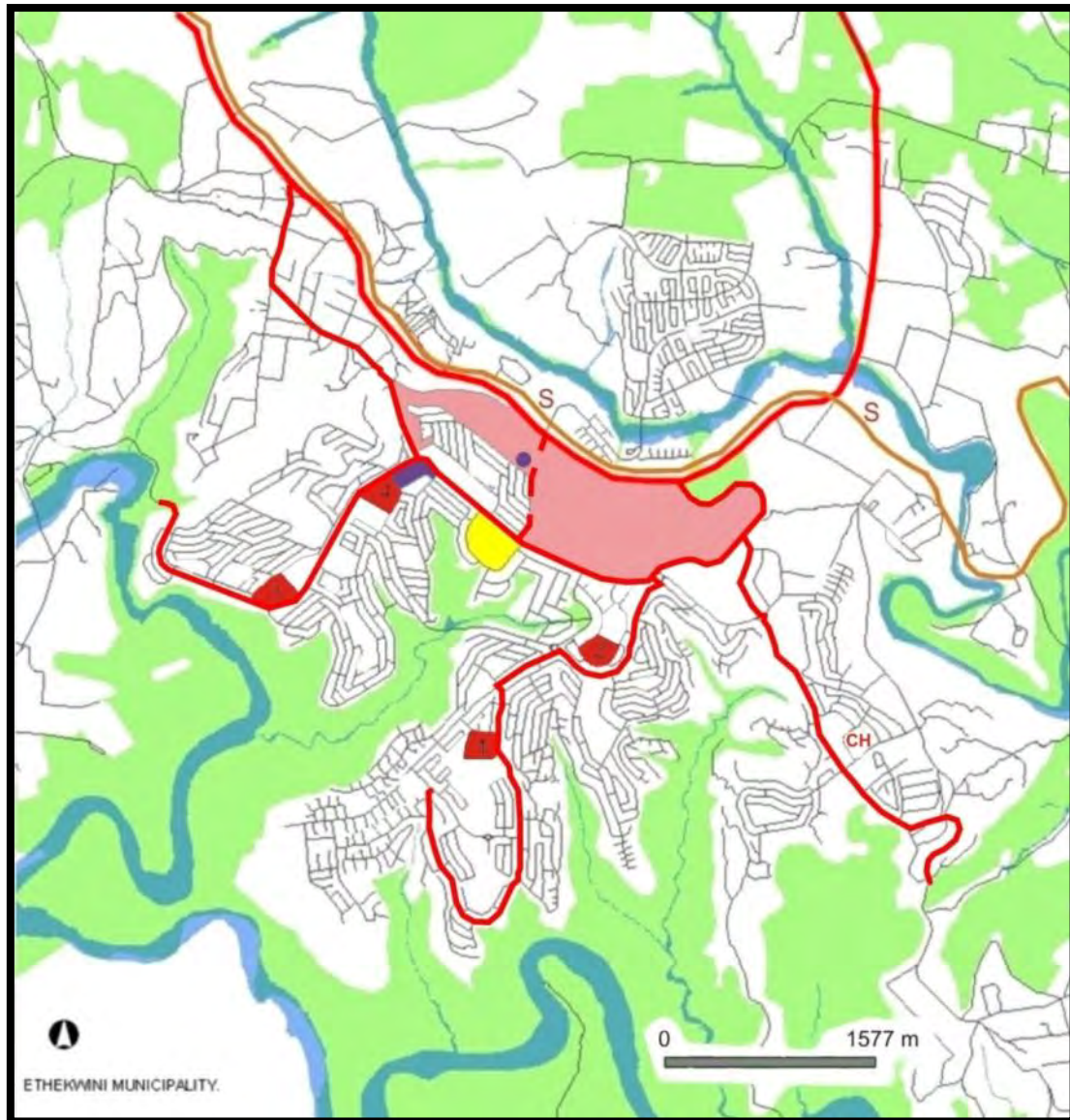
(Fig. 8) (citymaps.durban.gov.za, 2011 – edited by author) A locality map of the Mpumalanga Township

LEGEND

PROPOSED SITE SELECTIONS   *numbers 1-4*
RAILWAY   *ORANGE LINE*
TRAIN STATION   *S*
ARTERIAL ROADS   *RED LINE*
HEALTH CENTRE   *CH*
SOCCER STADIUM   *YELLOW SHADE*
TAXI/ MARKET   *PURPLE SHADE*
NEW TOWN CENTRE   *PINK SHADE*
NEW TAXI FACILITY   *PURPLE DOT*
NEW ARTERIAL LINK   *RED DASHES*

2.2 SITE SELECTION CRITERIA

The facility needs to improve the healthcare service of the needy community in the peri-urban region by complimenting already existing clinics and health centres. Proximity to transport services will also improve accessibility for the surrounding population. The four proposed sites in Mpumalanga indicated on the previous page will be analyzed in terms of the criteria to follow. Each variable will be given a weighted score and the site that attains the highest overall score will undergo further analysis to inform the design.

POPULATION
- Public facilities need to be near public activity to make them feasible

ACCESSIBILITY
- Proximity to transport infrastructure improves accessibility (taxi, train, etc.). A centralized location for easy pedestrian access is also important and a site with a shallow slope makes access easier for disabled citizens

COMMUNITY VALUE
- Adjacent community spaces add social value to a place (sport, marketplace, public library, etc.)

HEALTHCARE PROXIMITY
- The facility location should complement the local network of health services (facilities need to be distributed and not concentrated)

NATURAL VALUE
- Sites with landscaped or natural green space can be therapeutic for building occupants

ORIENTATION AND VIEWS
- Solar and wind orientation provide natural lighting and ventilation for human comfort while views of the natural environment improve aesthetic appeal of the place

REVITALIZATION
- Build in areas that have the greatest need of renewal

2.3 SITE SELECTION OPTIONS

2.3.1 Site Option 1 - 54 Saganga Highway

(Fig. 1)

The site is framed by housing to the north and west with a primary school to the south and open field to the east (Fig. 1). There is also a tuck shop nearby to the northwest. The land is zoned for education purposes but it could be possible to rezone it for civic and social purposes, seeing that there are already +/- 10 primary and secondary schools for Mpumalanga E section. Although it is the furthest removed from the main road, it is still easily accessible by motor vehicle. The greenfield site is barren with patches of sand that need to be rehabilitated. There is a nearby mobile clinic station and the nearest health centre is 3 km away. The site is an open space that offers no activity for local citizens. The site is neglected and could potentially attract anti-social behavior. The plot however offers good views over the valley and hills to the southeast and may be a good site to develop on and create a more sociable place for the area.

2.3.2 Site Option 2 - 41 76740 Street

(Fig. 2)

Future development projects will eventually surround this site with housing and civic/ social facilities (Fig. 2). The site is zoned as a public open space and would need a good reason to be developed on (green space is vital for preventing development congestion). The site is near the main road that also serves the adjacent SAP station and nearby civic centre and library. There is a crèche adjacent to the site that is busy throughout the week and used as a church hall on Sundays. The SAP station has also allocated a portion of the site for helipads to the northeast. The nearest health centre is 2 km away. The site is overgrown with natural bush and shaded with tall trees to the northeast. The hilltop site offers views over the south of Mpumalanga and the hills and valleys to the southeast. The nearby crèche and SAP station is adequately secured by perimeter fencing and reception houses.

2.3.3 Site Option 3- 114 Meyiwa Main Road

(Fig. 3)

This site is zoned for civic and social development that would serve the residents of Mpumalanga West (Fig. 3). The site is just over a kilometer away from the nearest taxi stop. There are adjacent schools and a community hall near the piece of land with housing located along the east and west perimeters. The site has a soccer field that is used by the youth of the area after school and over weekends. The nearest health clinic is 1 km away with the nearest health centre being 4 km away. The site is overgrown with grassland apart from the soccer field, which is dusty and barren. The hilltop site offers views over the hills and valleys to the south of Mpumalanga. The land has no secure perimeter fencing and lack of onsite activities may attract anti-social behaviour. By revitalizing the site, a range of activities would add community value to the neighbourhood.

2.3.4 Site Option 4- 97 Meyiwa Main Road and 19 Bakhaliphi Road

(Fig. 4)

The site is framed by housing to the east and west with an adjacent primary school to the south and shopping district to the north (Fig. 4). The two portions of the site are zoned for transport facilities and public open space. Despite the east portion of the site being zoned for transport, a home for the disabled has been built in its place and the north portion has become the transport facility. The minibus taxi rank to the north makes the region easily accessible for commuters. Nearby soccer fields and food stands to the south create a social environment which adds community value. The nearest clinic is next to the grocery store and the nearest health centre is 3 km away. The site is overgrown with natural bush with a few dispersed trees along its periphery. The adjacent school and disabled home are in need of revitalization. The site offers views of the distant hills to the north. A facility to complement the existing environment will bring value to the site that the whole community can enjoy.

TABLE 3:

SITE SELECTION

CRITERIA	MAXIMUM POINTS	SCORE
SITE OPTION 1 - 54 SAGANGA HIGHWAY		
POPULATION	20	16
ACCESSIBILITY	15	10
COMMUNITY VALUE	15	8
HEALTHCARE PROXIMITY	15	10
NATURAL VALUE	15	10
ORIENTATION & VIEWS	10	8
REVITALIZATION	10	8
TOTAL	100	70
SITE OPTION 2 - 41 76740 STREET		
POPULATION	20	16
ACCESSIBILITY	15	12
COMMUNITY VALUE	15	10
HEALTHCARE PROXIMITY	15	10
NATURAL VALUE	15	12
ORIENTATION & VIEWS	10	8
REVITALIZATION	10	6
TOTAL	100	74
SITE OPTION 3- 114 MEYIWA MAIN ROAD		
POPULATION	20	16
ACCESSIBILITY	15	12
COMMUNITY VALUE	15	10
HEALTHCARE PROXIMITY	15	10
NATURAL VALUE	15	12
ORIENTATION & VIEWS	10	8

REVITALIZATION	10	8
TOTAL	100	76

SITE OPTION 4- 97 MEYIWA MAIN ROAD AND 19 BAKHALIPHI ROAD

POPULATION	20	18
ACCESSIBILITY	15	12
COMMUNITY VALUE	15	12
HEALTHCARE PROXIMITY	15	12
NATURAL VALUE	15	12
ORIENTATION & VIEWS	10	6
REVITALIZATION	10	8
TOTAL	100	80

The above table has revealed site option 4 – 97 Meyiwa Main Road and 19 Bakhaliphi Road as the proposed site for the healthcare and community centre.

2.4 DESCRIPTION OF EXISTING SITE CONDITIONS

The chosen site (option 4) is directly adjacent to the Okhozini Primary School to the south and the Boxer Grocery Store to the North in the township of Mpumalanga with housing and roadways framing the east and west perimeters. The site is occupied by ERF 1930 (zoned for public open space) and 1931 (zoned for transport facilities) of Mpumalanga B. A disabled home and taxi yard currently occupy 1931 and a portion of 1930. The plans below show the site in its immediate context, giving an idea of the facilities and zoning surrounding the site (Fig. 1 & 2). It is close to various public amenities such as the shopping district and marketplace, providing an environment of community value for visitors to the area (Fig. 3). There is a possibility that a portion of site 1930 could be zoned for civic and social purposes to enhance the accommodation facilities for disabled citizens. The remaining portion can provide a public open space for communal purposes at the eventual healthcare and community centre. The land to the southwest of the primary school has a soccer field on it. The sporting facilities can be improved and adding a swimming pool for public use after hours could add communal value to the vicinity (Fig. 4). The most significant aspects of the site's context are discussed in the nest subsection.
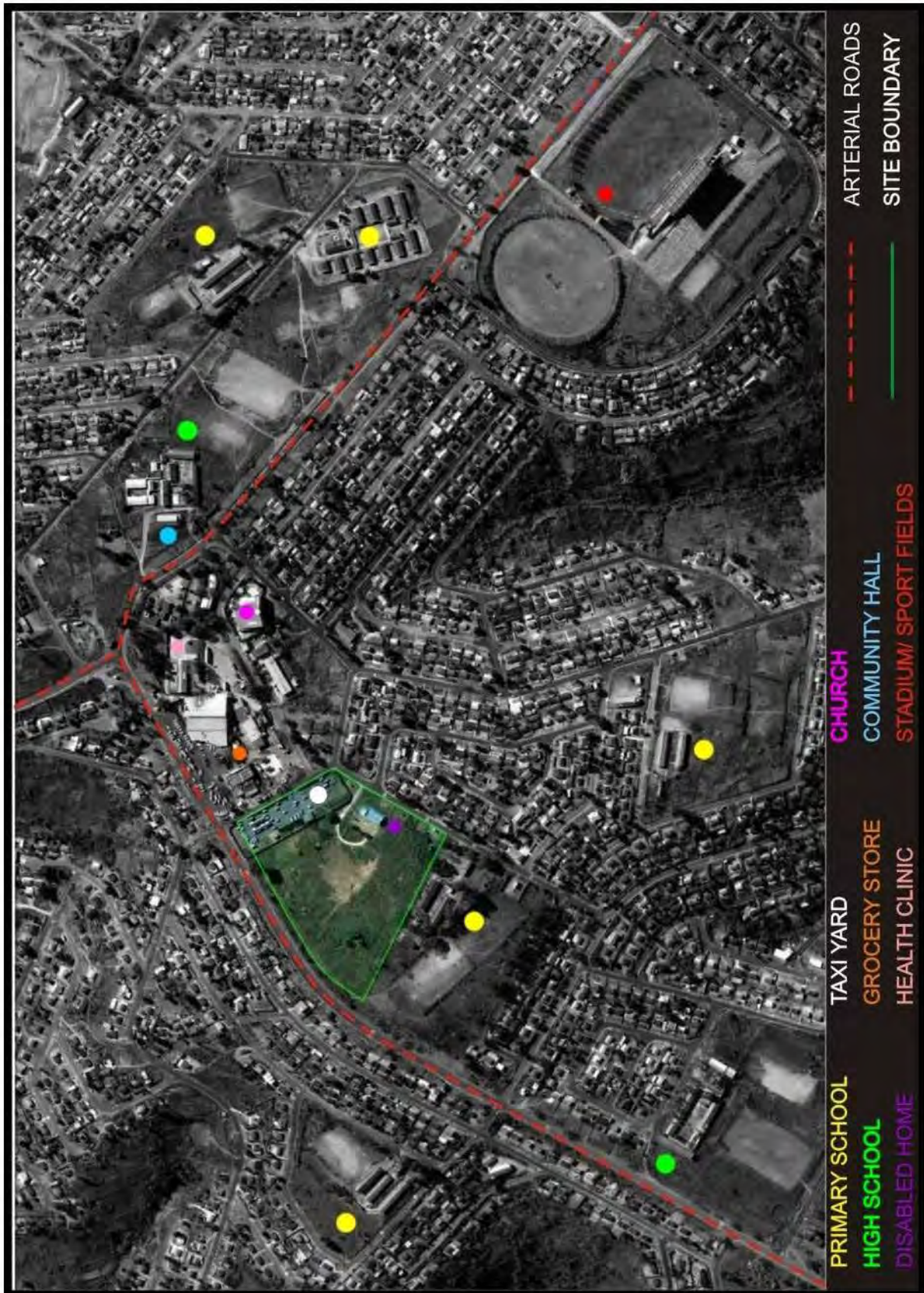
(Fig. 1) (Source: Google Earth; edit) The above plan gives one an idea of the facilities surrounding the site

(Fig. 2) (Source: Google Earth; edit) The above figure is a zoning plan for the area surrounding the chosen site. Every ward within Mpumalanga township has a mixed use/ civic & social district to improve accessibility to such services for the local population. This is done to prevent creating a centralized district which may exclude citizens for reasons of travelling cost and increased walking distances for pedestrians

LEGEND

Civic & Social	*Red*
Mixed Use	*Blue*
Residential	*Yellow*
Educational	*Green*
Worship	*Pink*
Public Open Space	*Light Green*

(Fig. 3) (Source: Author, 2011) An impression of the marketplace adjacent to the proposed site

(Fig. 4) (Source: Author, 2011) The sport fields adjacent to the primary school need to be revitalized and maintained for the benefit of local youth

2.5 SITE ANALYSIS

SITE DATA

AREA & SITE BOUNDARY

ERF 1930 -   25 356 sq m
ERF 1931 -   11 743 sq m
TOTAL -   37 099 sq m

Refer to Fig. 1 below for a detailed drawing of the site boundaries.

(Fig. 1) (Source: Durban Municipal Offices, 2011) A surveyors drawing of the proposed site

ORIENTATION AND VIEWS

The site is on a northeasterly – southwesterly axis. The elevated position of the site in relation to the surrounding area and steep slope of the land provides views of the hills in Cato Ridge towards the northwest (*refer to Fig. 2*).

(Fig. 2) (Source: Author, 2011) The views to the northwest provide a pleasant vista for anyone who occupies the site

ACCESS

Access to the taxi rank is off 2301 Street to the northeast. Access to the disabled home parking is off Bakhaliphi Road. The Okhozini Primary School to the south has perimeter fencing as well as the taxi rank to the northeast, forming a barrier between the site and marketplace. The site however has no fencing along the eastern and western perimeters, allowing pedestrians to walk freely across the open public space.

EXISTING USE

Local builders have not kept to zoning regulations but have located the taxi rank in a more suitable position along the northeast edge so that it can directly serve the public occupying the shopping district. A disabled home is built in the place zoned for transport facilities and it is suggested that the healthcare facilities will complement this existing facility, which is meeting a vital need. Food stands are located towards the southern corner of the site.

TOPOGRAPHY

The land is covered in wild grass, some of which has been cleared for parking. Most of the trees are located near the primary school, providing shaded areas for school children. Other trees are sparsely located on the northeastern perimeter with a grouping located in the southwest and a few shrubs near the disabled home parking area. The species of tree approach a height of 6 - 8 m; especially those near the school building while others do not exceed a height of 4 m. The eastern perimeter has small-scale agricultural gardens growing along its edge. Crops such as maize are grown on these patches of land.

CLIMATE & SITE DRAINAGE

The region experiences humid-subtropical weather with hot, wet summers and cool, dry winters. The SSW wind generally brings wet weather to the region while the SW bears winter rain. The NE wind is favorable for pleasant winds during warm weather. Average rainfall is 1310mm per year with 40-50% falling during summer months. The land slopes towards the eastern, northeastern and western perimeters. Roadside catchments along Meyiwa Main Road and Bhakaliphi Road lead to the underground stormwater pipe system that slopes southwards. For appropriate climatic design, refer to the section 'Climate Responsive Design' in Part One.

Refer to Fig. 3 Locality Plan below:

(Fig. 3) (Source: Author, 2011) Areas of interest are labeled 1-5 and a brief description of these adjacent facilities is to follow

LEGEND: *Site Boundary -* green *line*

Primary roads - red dashes

Secondary roads – orange dashes

Pedestrian paths - blue line

Contours - grey line

Taxi yard fence - black dots

Views of distant landscape – grey shade

Proposed swimming pool facility – light blue & light brown

SURROUNDING FACILITIES:

OKHOZINI PRIMARY SCHOOL (1)

The Okhozini Primary School (Fig. 4) provides an adequate amount of trees for shading the children during recess times. The figure ground of the school creates a u-shape that encloses a central garden with newly planted trees that the children tend to in their gardening program. The building however is in a bad state of repair, with many windows broken. Principal of the school, Mr. FAM Ngcobo, says that the school remains in the state it is in because of lack of funding. An example of cross programming which is exhibited in other facilities of the region is the fact that the school is also used for religious worship on Sundays. The primary school perimeter fence forms a hard edge to the proposed site to provide security for the children. School gates are opened however at the beginning of the day and at the closing of school where children cross the adjacent field to and from their homes or towards the taxi rank if they rely on public transport. The children also play soccer on the south field but it is very dusty and needs some form of rehabilitation.

(Fig. 4) (Source: Author, 2011) Saplings have been planted in the Okhozini Primary School Courtyard to provide shade for children in the future. Classrooms are in a bad state of repair and need to be rennovated

HOME FOR THE DISABLED (2)

The disabled home and field can only be accessed by vehicle off Bakhaliphi road to the east (Fig. 5). There is no vehicular access off Meyiwa Main to the west as there is a steep bank creating an obstruction. The grounds are easily accessible by the public as the perimeter fence that does exist is collapsing. There is no reception house as such to the disabled home. With adequate funding, an adjacent 'Healthcare and Community Centre' would vastly improve the accommodation of such individuals in the region. The figure ground of the home dose not form a place of privacy for the residents; their only refuge is the interior. There are stands to the south of the disabled home were the public can buy food at all hours of the day from the side of the road. The building has a distinctive quality about it, with its yellow walls, blue shed-like roof and maize crops along its east front.

(Fig. 5) (Source: Author, 2011) A healthcare and community centre in place of the disabled home occupying the chosen site will meet a vital need for the local community and complement the existing civic and social nature of the area

SINGLE STAND HOUSES (3)

The east and west side of the site is comprised of dense individual family dwellings (Fig. 6). This renders the site appropriate in terms of community integration. When designing the eventual facility, one would need to consider creating a place of refuge to balance these public areas for the benefit of the patients. A notable quality about township life is that there is no hard edge between neighbouring houses and the street front. This allows a level of community interaction not experienced in other suburban areas of the eThekwini Municipality. On the other hand, properties are less secure from criminals. The roads forming the edges to the residential component are Meyiwa Main Road to the west and Bakhaliphi Road to the east. Both Meyiwa Main and Bakhaliphi Road link directly to Shezi Main Road to the northeast, which is the spinal road linking east and west Mpumalanga.

(Fig. 6) (Source: Author, 2011) Local housing is built out of concrete slabs, blocks and corrugated iron roofing. Some structures are in a bad state of repair and it is notable that hardly any properties have perimeter fencing

TAXI RANK & MARKET (4)

The taxi yard to the northeast forms a hard edge to the disabled home and adjacent field (Fig. 7). If an eventual 'Healthcare and Community Centre' is to be established, this wall would need to be removed, creating a welcoming point of arrival for those visiting the centre. Planting could be used as an alternative to allow visual privacy and a shield from noise pollution.

(Fig. 7) (Source: Author, 2011) The taxi rank can be improved upon; the boundary fence and expanse of tarmac create an unwelcoming and unpleasant space

BOXER GROCERY STORE (5)

The Boxer Grocery Store (Fig. 8) along with the adjacent clinic, church, taxi rank and street side vendors make the immediate surrounds a nodal point of activity and landmark in the network of Mpumalanga Township. Being located on a main road makes these facilities easily accessible by the rest of the community and creates a socially active edge that is inviting to the passer by.
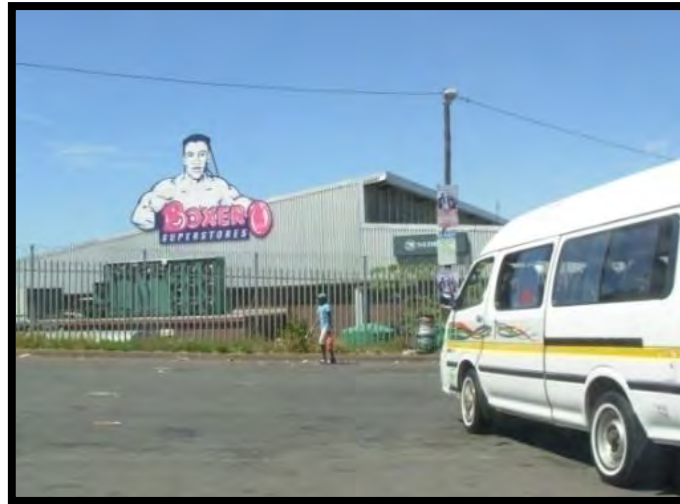
(Fig. 8) (Source: Author, 2011) The Boxer Grocery Store and surrounding facilities see many people from the surrounding community passing through on a daily basis
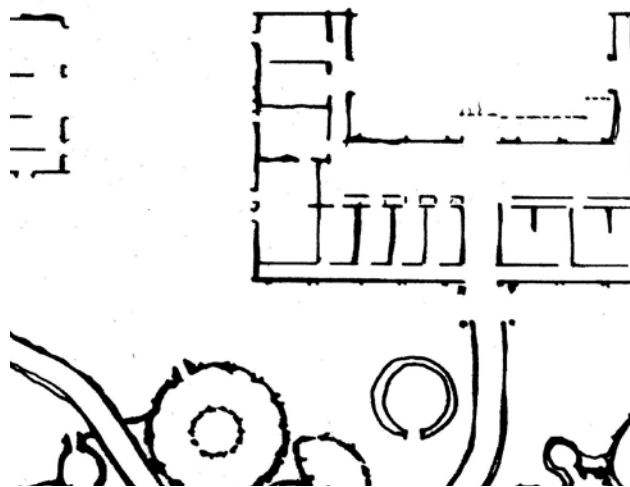
3.0 DESIGN RESOLUTION

The design resolution has considered the theories connected to biophilia and its aims at accommodating a healthy society through quality natural and built environments. This in conjunction with the site analysis and accommodation requirements has formed a framework for design. The author has used his own judgment to draw from these sources as well as general knowledge on architectural design to inform the resolution.

The design resolution and spatial arrangement developed from an African village plan *(refer to Fig. 1)*. The intention was for the arrangement to allow a transition between a series of enclosed courtyard spaces that would provide a place of refuge for visitors to the centre. The periphery of the centre creates a distinction between what is public space on the outside and what is private space on the inside. Other influences from the African village were the idea of fractal planning (parts relate to the whole) and the idea of incorporating communal activities in the centre. This eventually saw the realization of the community centre component to the facility. An interesting precedent to the idea of fractal planning was found in the Kaedi Hospital by Fabrizio Carola *(refer to Fig. 2)*. The centre is built sustainably from stone and earth bricks, while its fractal plan is composed of curving circulation routes for staff and clusters of circular rooms enclosing communal courtyards providing space for families to meet.
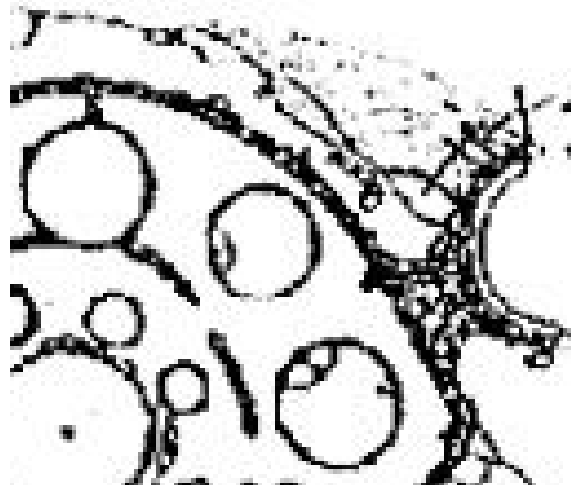
(Fig. 1) (Source: abovetopsecret.com) The African village plan inspires various concepts such as the ideas of bounded and transitional space, fractal planning, culture and refuge


(Fig. 2) (Source: bhutandiploma.files.wordpress.com) The Kaedi Hospital is an example of a contemporary healthcare facility in Mauritania that incorporates most of the ideas of the African village in its design resolution

With the idea of creating a place of refuge and the theory of biophilia, which resists straight lines and right angles in the design of spaces; a semi-concentric plan formed the basis of the design for the Healthcare and Community Centre in Mpumalanga. The intention was to maintain the existing transport facilities to the north of the sight, understanding that it was vital for the mobility of citizens to and from the heart of western Mpumalanga. Another important issue was the design of the amenities accompanying the transport component, which included an active market edge that would

complement the already existing market component to the north. The passage of people through the site was also important; it needed to engage the public (agriculture and market area). Also important was the relation of the facility to the school, which provides accessibility for school agricultural programs.

The complex was fragmented, so the idea was to start consolidating spaces to create definite public and private spaces with controlled access points. Urban agriculture would constitute majority of the public landscape while therapeutic gardens would constitute private landscape. Other important issues were harvesting rainwater on site, which would contribute to the facility (washing, irrigation, water features, ablutions) and so a plan needed to be devised for this function. Staff and visitor parking were located nearer to the taxi drop off zone to avoid dispersing transport facilities across site and to allow these facilities to relate to the market area. The relocation of the emergency entrance in close proximity to the main entrance was important to avoid confusion in emergency situations. This resulted in the relocation of the cleaning staff quarters and related spaces to the south of the site and relieving landscape space for the benefit of patients to the south.

The water canal system was formalized and the outdoor theatre located at the main entrance to the centre. The southern wing of the emergency department became curvilinear instead of angular and the fragmented departments to the south were joined to enhance the continuity of the centre's spatial arrangement and circulation. The circular nodes, which articulate various communal spaces at the facility were further emphasized at other nodal points in the facility to enhance the idea of fractal planning in the design resolution. Various departments in the facility were rearranged to relieve the courtyard of congested space, allowing a water feature to form a central element to the centre *(refer to Fig. 3)*.
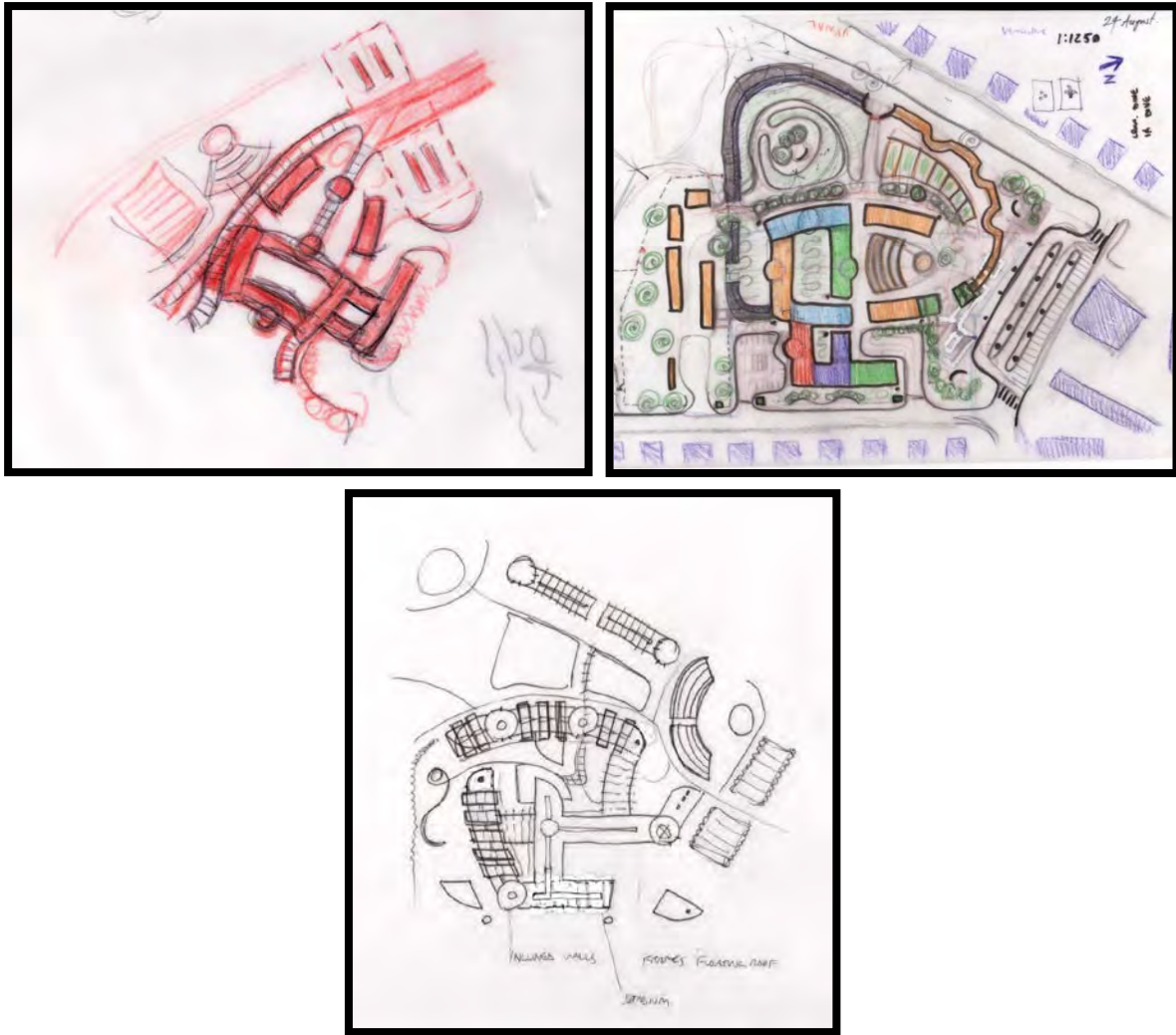
(Fig. 3) (Source: Author) The above are drawings from the initial design development stages, which eventually led to the current design revealed in the next chapter

Public transport shelters and off street parking for staff and visitors need to be provided but the main emphasis should be pedestrian access. Considering their needs, street sidewalks will provide seating as well as pleasant landscaping for those waiting for transport. The entrance to the Healthcare and Community Centre needs some form of gateway as an orientation device for the passing pedestrian. This will be on the north side of the site closest to the market place (the most active area). Coloured pillars, patterned walls, trees and the dome structure over the theatre stage, mark the entrance. The plan of circulation through the internal medicinal gardens is comparable to that of a spiral. Along this path one experiences a v ariety of spaces which are supervised by adjacent departments. Ramps throughout the site make the various departments more accessible by the public.

The entrance constricts and then releases the visitor into the outdoor exhibition theatre where various activities take place, relating to health and community. Taking inspiration from pre-industrial, organic planning, the centre avoids the use of grid-like arrangements to create a more humanistic atmosphere for the visitor. The centre takes note of the axial path, which connects the market place and taxi rank with the school and its sporting grounds by not encroaching onto it. Site contours have been followed where possible to avoid unnecessary cutting and filling of the land.

The building explores the contrast between monolith & tectonic structure, straight & curved lines to form a balanced composition. The monolithic structures express the permanence of the healthcare facility as a vital need of the local community. The monolithic forms have drawn inspiration from architects such as Louis Kahn and Tadao Ando whose buildings have explored the connection with nature through the elements of earth, water and light *(refer to Fig. 4)*. The colourful feature walls have drawn inspiration from Luis Barragan to express the vibrancy of the community as opposed to creating a clinical atmosphere that appears monotonous *(refer to Fig. 5)*. Biomimicry is evident in the many roof structures throughout the facility, which serve as 'tree canopies' that harvest water for irrigating the gardens at the centre as well as washing vehicles and flushing toilets. The roofs come in various forms ranging from inverted cones, butterfly roofs, domes and barrels. Variation in sizes develop a hierarchy of spaces at the centre. Peripheral windows allow occupants to survey the area to ensure the safety of others.

(Fig. 4) (Source: jvtc.blogspot.com; thecityreview.com/newarch.html) Designing with water and light are important in many of Louis Kahn and Tadao Ando's buildings. This establishes a connection between the building and its environment as in The Indian Institute of Management by Louis Kahn (left) and Fort Worth Museum of Modern Art by Tadao Ando (right)

(Fig. 5) (Source: 30.media.tumblr.com) The play of light on the colours and textures of Luis Barragan's Gilardi House create bright compositions that stimulate and intrigue the visitor

Many citizens within the township use tent structures for public meetings because they are affordable and functional. This has inspired parts of the healthcare and community centre, which has drawn inspiration from architects such as F rei Otto. Ottos's Institute of Lightweight Structures drew inspiration from the organic forms of nature in many of their designs *(refer to Fig. 6)*. While being affordable and functional, membrane structures are also attractive. It is an expression of a community living lightly (sustainably). Besides membrane structures, consider architect's such as Glenn Murcutt who express the lightness of a tree canopy with metal clad roofs in many of his house designs *(refer to Fig. 7)*.

(Fig. 6) (Source: structuremag.org) One of the many lightweight pavilion structures designed by German architect and structural engineer, Frei Otto
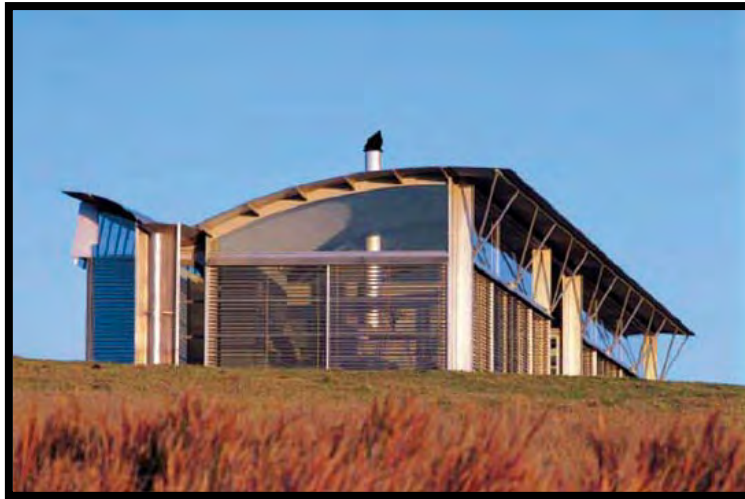
(Fig. 7) (Source: domtak.ru) The Magney House by Glenn Murcutt capitalizes on natural light, which is controlled by louvre blinds. The v-shaped metal roof harvests rainwater for drinking and heating

The membrane roof over the marketplace and exhibition theatre seating is supported compartmentally. The repetition of portals becomes a rhythmic expression. This arrangement articulates the roof structures over these spaces. The lightness of the covering structure means fewer vertical supports, which allows minimal interference with ground floor space. Sun visors on the east and west faces prevent direct light from early morning and late afternoon sun. External doors open mostly onto the interior garden to allow easy access from internal spaces. Not many doors open onto the exterior for reasons of security. Homely interiors make visitors feel welcomed and the variety of programs offered at the centre aim to revitalize the neighbourhood.

Monotony is avoided in elevation by articulating with setbacks and protrusions of walls as well as the rise and fall of spatial volumes. The building has interval communal spaces along its length that provide various activities for visitors at the centre. These are also control points leading into the other departments within the building. Some of the communal spaces include the physio gym, library and group therapy spaces. The elevation of the building is limited to one floor with the possibilty of building a first floor in strategic places for future growth. Limiting the elevation of the building ensured that the scale and proportion of the building is respectful to human dimensions and is therefore less imposing in the township environment. All spaces are easily accessible by the disabled as well. The elevation should allow the centre to be distinguishable within the neighbourhood context as a landmark for the area by using interesting forms, colours and textures.

The trees on site should be preserved for shade and windbreaks and others planted where needed. Many places for sitting should be provided (for groups as well as individuals). Outdoor features such as ledges, steps, double sided seats, grass patches, tables and chairs can provide for this need, giving the centre a more people friendly environment. Active street edges (food and craft market) provide an environment that promotes a sense of security. Shaded verandah circulation can provide comfort for visitors during the warm summer months. The cental water feature has drawn inspiration from Japanese garden design as an expression of nature in architectural environments. This feature also improves environmental cooling within the facility.

4.0 TECHNICAL RESOLUTION

The following technical resolutions were submitted in the final thesis design presentation:

5.0 DESIGN RESOLUTION

The following design drawings were submitted in the final thesis design presentation:

biophilia
in architectural
design

THEORETICAL ABSTRACT

Nature is inseparable from place: without it, there is no life. The word biophilia originated with the entomologist E O Wilson (1984) meaning the love of nature and all living things. Biophilia forms the basis of 'biophilic' design in architecture and considers how designers can create buildings that are in tune with nature and its life giving qualities. This is not an innovation today; it was the way buildings were designed for much of human history. The issue is that modern society has neglected this way of building in recent times. Positive experiences of natural systems and processes in buildings become critical to human health, performance; and well-being.

Biophilic design incorporates organic and vernacular/ place-based design. These are conveyed symbolically or by direct relation to natural and social systems (Kellert et al. 2008: 5). The objective is a symbiosis that conserves society, economy and environment. More specifically, this approach can alter perceptions about the design of healthcare facilities and other public buildings. A renewed perspective can create awareness on the stewardship of nature and its beneficial role in architecture and the lives of citizens. Similar initiatives should be encouraged to bring people together for a good cause and partake in the ecological spirit of the time. Consider some of the attributes of biophilic design below:

Environmental features	Natural shapes and forms	Natural patterns and processes
Colour	Botanical motifs	Sensory variability
Water	Tree and columnar supports	Information richness
Air	Animal (livery w/zooarid) motifs	Age, change and the patina of
Sunlight	Shells and spirals	time
Plants	Egg, oval and tubular forms	Growth and efflorescence
Animals	Arches, vaults and domes	Central focal point
Natural materials	Shapes resisting straight-lines and	Patterned wholes
Views and vistas	right angles	Bounded spaces
Facade greening	Simulation of natural features	Transitional spaces
Geology and landscape	Biomorphy	Linked series and chains
Habitats and ecosystems	Geomorphology	Integration of parts of wholes
Fire	Biomimicry	Complementary contrasts
		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	Affection and attachment
Spaciousness	building form	Attraction and beauty
Spatial variability	Landscape ecology	Exploration and discovery
Space as shape and form	Integration of culture and	Information and cognition
Spatial harmony	ecology	Fear and awe
Inside outside spaces	Spirit of place	Reverence and spirituality
	Avoiding placelessness	

Selected **theories** were considered as **supplementary**
to the idea of **biophilia**, these included:

- **Architectural regionalism** - an approach to architecture that strives to counter lack of identity in modern architecture and built environments by utilizing the building's geographical context (economical, environmental and social) to create a sense of place and meaning
- **Architectural phenomenology** - a philosophical design current in contemporary architecture based on the conscious experience of buildings and their sensory properties
- **Environmental psychology** - an interdisciplinary field focused on the interplay between humans and their surroundings in order to create environments that are appropriate for human needs (physical, mental, social, etc.)
- **Sustainable development** - a pattern of resource use, that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come

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The Ba-Ila village from southern Zambia uses fractal patterns in its design. Consider also the Zulu 'kraal' and Great Zimbabwe ruins.
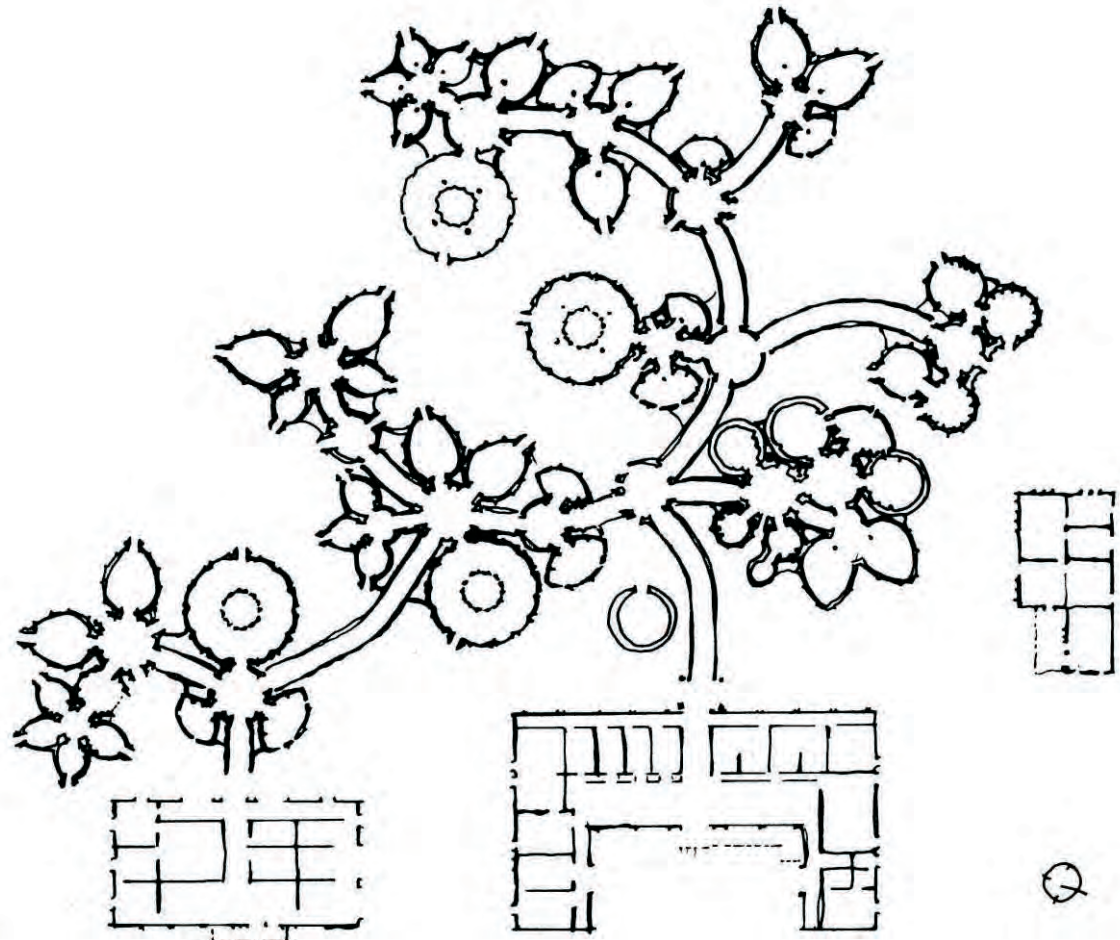
The Kaedi Hospital by Fabrizio Carola is constructed from stone and earth bricks while its plan is inspired by fractal patterns found in nature and encloses communal courtyards

The structure of a healthcare centre designed by Cevera and Piaz Architects is inspired by a vertebral spine

Thorncrown Chapel by Euine Fay Jones mimics the forest canopy through structural expression

Michael Sorkin abstracts animal forms into many of his designs like his Ray House above

The Uluru Kata Tjuta Cultural Centre by Gregory Burgess is organic in form and local materials used in its construction are respectful of its natural surrounding

Mosaic pathways at the Umkhumbane Healthcare Centre create stimulating fractal patterns

precedent and case studies

Following a review of the precedent and case studies, some key 'biophilic' guidelines were identified which would inform the design of a 'Healthcare and Community Centre' in Mpumalanga:

Bioregional Planning

- revitalising of outdoor public spaces (particularly the chosen site) by way of recreational and natural landscaping to complement existing facilities
- greening of pedestrian paths to create an 'eco-network' between the outdoor public spaces of the region

Urban Design Fundamentals

- establish an active edge to the chosen site for community benefit
- preserve existing pedestrian paths through site to maintain public accessibility
- establishing appropriate linkages with facilities adjacent to chosen site
- creating a distinction between private outdoor spaces for patients and public spaces for the community
- provide adequate amounts of parking space without negatively affecting the provision of outdoor public space

Climate Responsive Design

- a northeasterly orientated building to allow ventilation of courtyard spaces during summer months
- trees and shading structures on the east and west faces provide a shield from unwanted morning and afternoon glare
- consider how natural lighting can be utilised in an aesthetic manner (skylights, picture windows with nature views and sunlit courtyards that become an extension of interior space)
- width of buildings should be shallow enough to allow cross-ventilation (consider possibility of heat driven ventilation)

Water and Architecture

- rainwater harvesting off roofs provides for a range of uses such as agriculture irrigation and washing
- food waste composting can be used to grow food crops for the marketplace; the agricultural gardens can also form part of the adjacent school's gardening programme
- provide water features to improve environmental appeal for citizens (pool courtyards and fountains)

Natural Symbolism in Architecture

- curvilinear design and fractal patterns as opposed to grid-like planning creates spaces that are potentially more stimulating for visitors

Appropriate Building Technologies and Materials

- flexible interiors and building envelopes provide spatial adaptability
- utilize thermally massive materials for exterior walls
- consider engineered timber and membrane structures as a sustainable and economic form of construction
- stained and polished concrete slabs provide a floor finish that is economic and attractive
- private spaces can use carpeting composed of natural fibres; consider utilising other 'green' materials in interior design (thatch, reed, cork, bamboo)
- the landscape includes fixed seating areas with porous paving to prevent stormwater runoff
- consider the provision of photovoltaic power as a sustainable resource to the centres energy requirements

The imperial villa of Katsura reveals how nature was as integral part of the quality of place and the value of the people in historic Japan

Stage roofing designed by Frei Otto is reminiscent of a flower's geometry

Wright's Kaufmann House uses stone materials claimed from the site in its construction to create a seamless relation between the building and nature

The smell and colours of flowers, the sounds of flowing water and the coolness of the air at the fountains of the Villa d'Este provide a sensual and memorable experience for visitors

An artist's impression of the Duke Integrative Medicine centre in its serene natural environment

The play space at Pietermaritzburg Assessment and Therapy Centre provides a place for children to develop their gross motor skills and enjoy being in the outdoors; it is the central feature of the facility and is a welcome site to visiting children
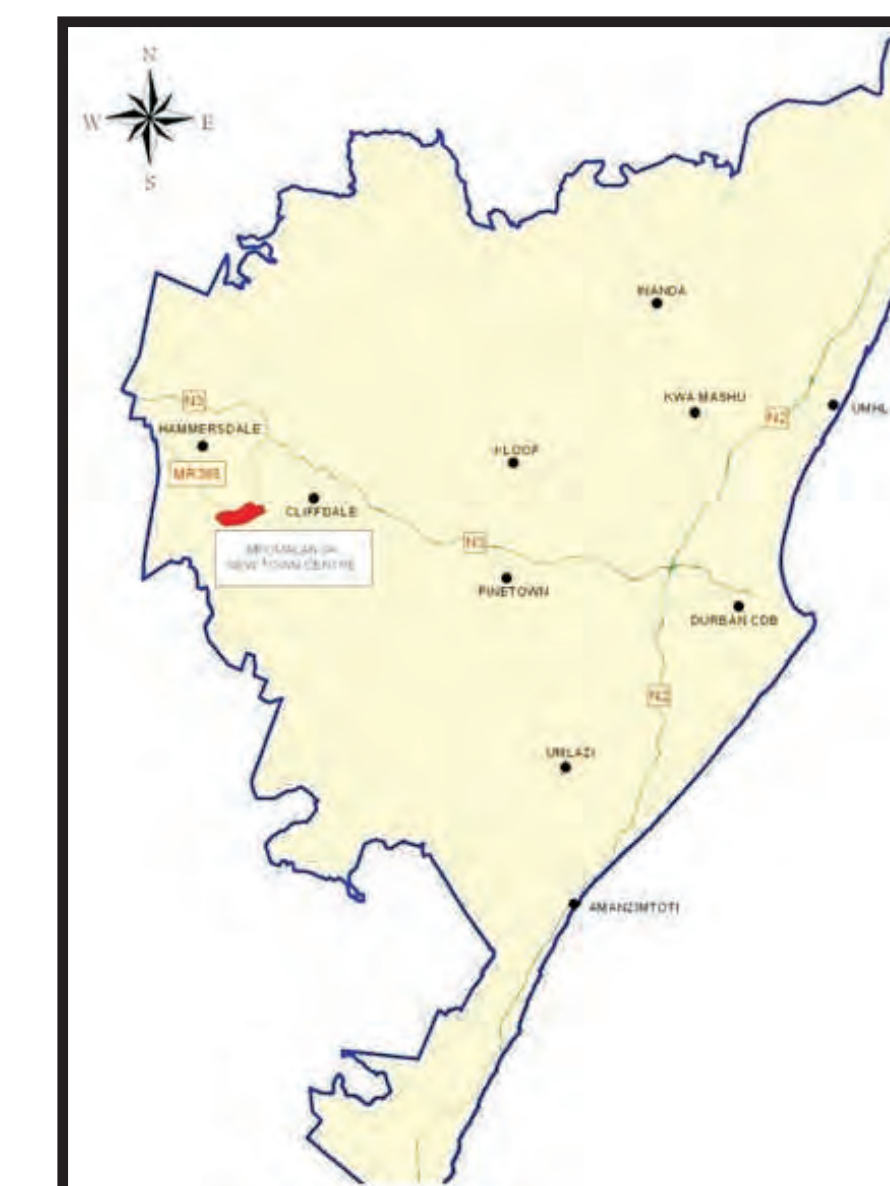

A range of complimentary services provided at the Ubuntu Centre includes a rooftop hydroponic garden which feeds many local school children on a daily basis
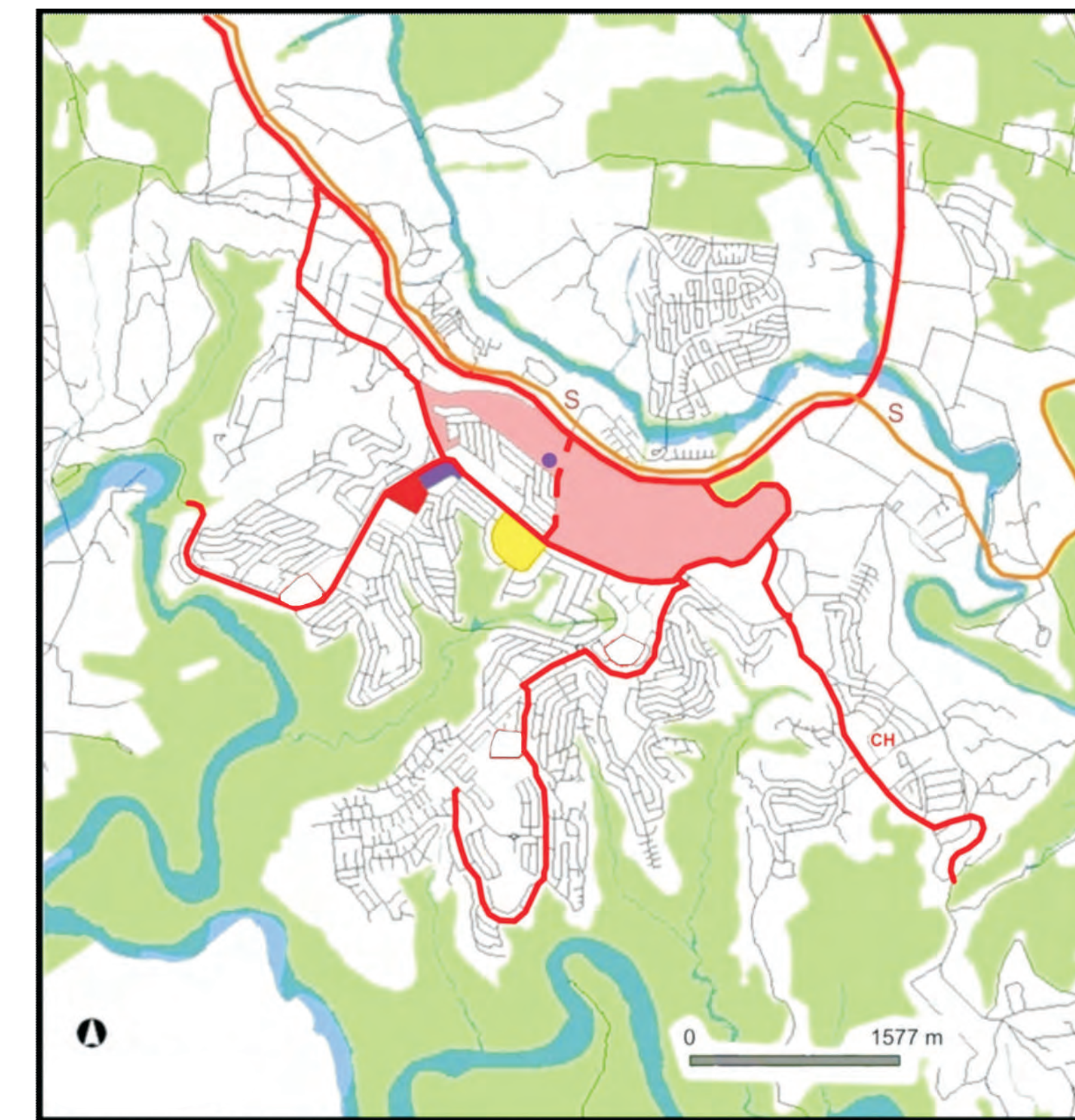

The anteroom at Dukes provides space for patients to lounge and relax in a planted and naturally lit space, shaded by a forest-like canopy structure

mpumalanga, durban context

A locality map of Mpumalanga in relation to the rest of the eThekwini Municipal region (proposed Mpumalanga New Town Centre indicated in red). The township is one of the larger peri-urban populations in the region

locality plan legend

alluvial valleys	green
rivers	blue
proposed site selection	red shade
new town centre	pink shade
railway	orange line
train station	S
arterial roads	red line
health centre	CH
soccer stadium	yellow shade
taxi market	purple shade
new taxi facility	purple dot
new arterial link	red dashes

zoning legend

civic & social	red
mixed use	blue
residential	yellow
educational	green
worship	pink
public open space	light green

site description

The chosen site is directly adjacent to the **Okhozini Primary School** to the south and the **Boxer Grocery Store** to the North in the township of Mpumalanga with **housing** and roadways framing the east and west perimeters. A **disabled home** and **taxi rank** currently occupy Erf 1931 and a portion of 1930. The adjacent taxi rank makes the site a highly accessible location. It is close to various public amenities such as the shopping district and **marketplace**, providing an environment of communal activity in the area. There is a possibility that a portion of site 1930 could be zoned for civic and social purposes to enhance the accommodation facilities for disabled citizens. The remaining portion can provide a public open space for therapeutic and communal purposes at the eventual **healthcare and community centre**. The land to the southwest of the primary school has a soccer field on it. The **sporting facilities** can be improved and adding a swimming pool for public use after hours will add communal value to the vicinity.

scale 1:2000

site plan legend

site boundary	green line
primary roads	red dashes
secondary roads	orange dashes
pedestrian paths	blue line
contours	grey line
taxi yard fence	black dots
landscape views	grey shade
proposed pool	light blue

the marketplace

upper umlaas river valley

okhozini primary

street side tuck shop

boxer grocery store

soccer field

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western mpumalanga urban eco-network

bioregional planning

revitalizing of outdoor spaces by way of recreational and natural landscaping (includes parks, outdoor sporting facilities, nature trails, urban agriculture, community gardens and complimentary facilities)

greening of pedestrian paths and arterial roads to create an 'eco-network' between the outdoor public spaces mentioned above. Facilities are not isolated but linked to form a 'symbiotic' relationship

site concept

There are clinics in the western wards of Mpumalanga but their health services are limited. The suggestion is that a healthcare centre in the western locality will alleviate pressures placed on Hlengisizwe Centre in the east and provide a readily accessible healthcare centre for western Mpumalanga and Georgedale. In addition to providing a comprehensive primary-care service with a small in-patient component, the facility will also cater for community-based activities that engage the local people and form a heart of the neighbourhood. The community centre is a means of improving the image of healthcare facilities as a place where people feel welcomed and secure. While providing these functions the concept of biophilia in architectural design and its health benefits will guide the design process.

design development

Labels on aerial image:
- public parks & community gardens
- urban agriculture healthcare & community centre
- nature trail & conservation centre
- outdoor & indoor sporting facilities
- mpumalanga new town centre
- SITE

LEGEND

- COMMUNITY FACILITIES
- COMMERCIAL
- TOWN PARK
- DMOSS
- HIGH DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- TREES
- MR 385
- ARTERIAL ROADS
- PEDESTRIAN ROUTES
- RAILWAY LINE
- NEW STATION
- TAXI FACILITIES
- CONTROLLED INTERSECTIONS

scale 1: 10 000

N

health & community centre landscaping

The revitalizing of the health and community centre site includes recreational and natural landscaping:

- a **micro-agricultural** component that benefits school programs, the marketplace and provides meals at the centre

- **harvested rainwater** is used to irrigate the land, excess water flows to a reservoir pond, pump systems recirculate the water for **landscape features** and **irrigation**

- **food waste is decomposed** in a worm farm to **fertilize the crops** which include grains such as maize, vegetables, fruit trees (mango) and culinary herbs

- **existing trees are preserved** where possible

- internal **sunlit courtyards with water features**, decorative paving and **therapeutic/ medicinal gardens** benefit the patients and working staff at the centre

- **northeasterly orientation** allows **cool breezes** to filter through courtyard spaces during the warm summer months

- **sliding folding doors** allow the courtyard spaces to become an extension of interior space (width of buildings are shallow enough to allow **cross-ventilation**)

① ② *spatial diagram*
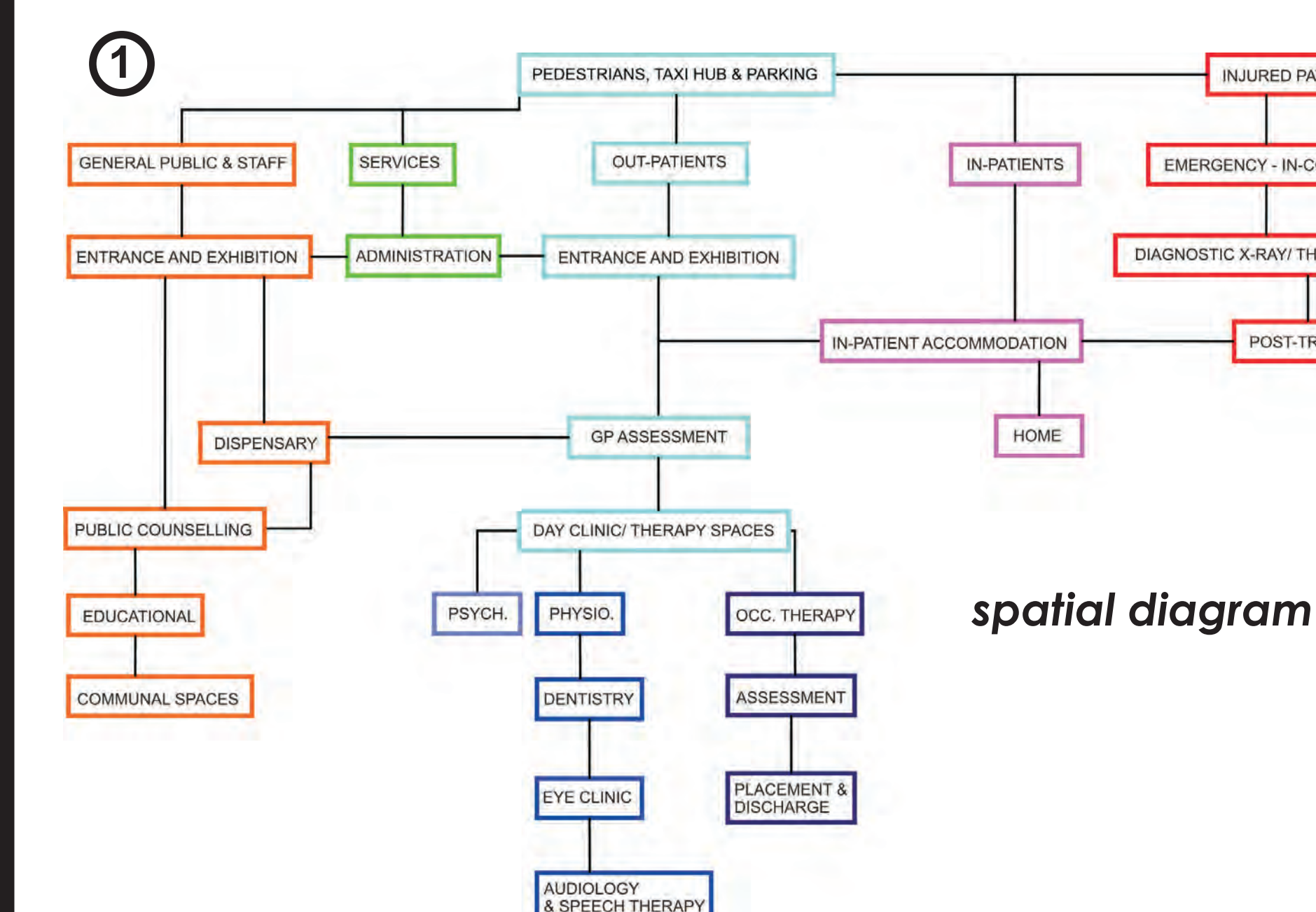
african village plan

(bounded spaces, transitional space fractal planning, cultural connection place of refuge)

These ideas inspired the eventual arrangement of spaces in plan. They were to allow a transition between a series of enclosed courtyard spaces that would provide a place of refuge for visitors to the centre

③ Using estimated floor areas, the original layout was orthogonal in nature. Considering the theory of biophilia which resists straight lines and right angles in the forming of space, curving walls were used to frame the courtyard spaces at the centre.

Another important issue was the design of the taxi spaces and amenities and creating an active market edge to the facility which would complement the already existing market component to the north. The intention was to maintain the existing transport facilities on site, understanding that it was vital for the mobility of citizens to and from the heart of western Mpumalanga.

④ The passage of people through the site became a point of consideration. The path would transition between the school, healthcare and community centre and taxi rank while providing activities in the form of an agricultural market to the west which the school children and public could benefit from.

The complex was initially fragmented, the idea was to then consolidate spaces to create definite public and private areas with controlled access points. Urban agriculture would constitute majority of the public landscape while therapeutic gardens would constitute private landscape within the healthcare centre

⑤ Water features were added to contribute to the experience of space. Water would also be harvested on site to provide a sustainable mode of irrigation for agriculture. Staff and visitor parking was located nearer to the taxi drop off zone to avoid dispersing transport facilities across site. The relocation of the emergency entrance in close proximity to the main entrance was important to avoid confusion in emergency situations. This resulted in the relocation of the maintenance staff quarters and related spaces to the south of the site and relieving landscape space for the benefit of patients and public.

⑥ Transport amenities have been moved to associate with the market space, relieving the eastern corner to provide outdoor recreational space. The water canal system was formalised and the outdoor theatre located at the main entrance to the centre. The southern wing of the emergency department became curvilinear instead of angular and rotundas were added along the periphery of the centre to enhance the continuity of the fractal spatial arrangement (circles along a curvilinear path)

N

Site plan labels:
- HOUSING
- MEYIWA MAIN ROAD
- TAXI RANK
- RESERVOIR
- STOREHOUSE
- 23RD STREET
- MARKETPLACE PLAZA
- FOOD & CRAFT MARKET
- PARKING
- WATER WELL
- COMMUNITY CENTRE
- MAIN ENTRANCE
- COMMUNITY GARDEN
- AGRI - GARDENS
- ADMIN
- EMERGENCY ENTRANCE
- RESERVOIR
- FRUIT ORCHARD
- MEDI - GARDENS
- ADMIN
- BAKHALIPHI ROAD
- GATEWAY
- HOUSING
- PLAYGROUND
- SPORT FIELDS
- MAINTENANCE & DELIVERY
- OKHOZINI PRIMARY SCHOOL
- PRIMARY SCHOOL SOCCER FIELD

HEALTH CENTRE/ OUT-PATIENT FACILITIES

EMERGENCY/ IN-PATIENT FACILITIES

site plan 1: 500

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healthcare and **community centre**
for **Mpumalanga, Durban**

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GATEWAY

MEDI-GARDENS

POND

OUTDOOR THEATRE

PLAYGROUND

OKHOZINI PRIMARY SCHOOL

DRYING YARD

NO ENTRY

MAIN ENTRANCE

EMERGENCY ENTRANCE

COMMUNITY GARDEN

PARKING

TAXI MARKET ADMINISTRATION

TAXI RANK
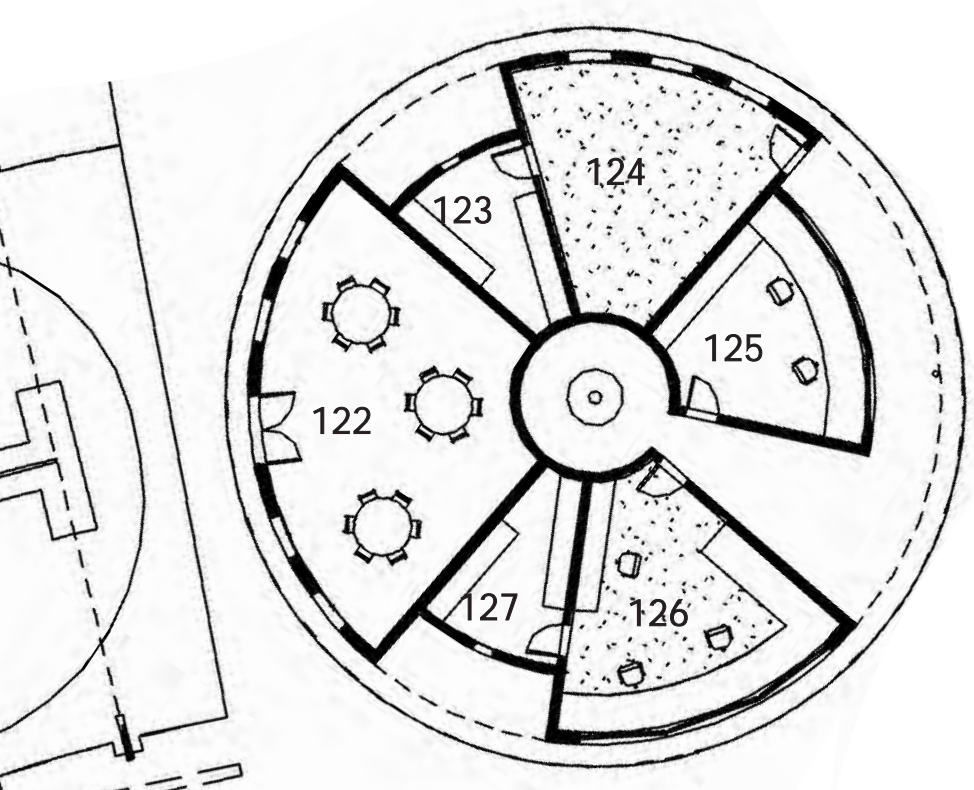
healthcare & community centre

schedule of accommodation

emergency & in-patient

13	waiting/ emergency entrance
14	information desk
15	records
16	ablutions
17	office
18	office
19	kitchen
20	CCTV control room
21	wheelchair storage
22	staff lounge
23	bedroom
24	head sister's office
25	dressing room
26	ablutions
27	sluice room
28	recovery room
29	body room
30	children's recovery
31	recovery
32	laboratory
33	ultrasound room
34	female ward
35	storage
36	male ward
37	nurse's office
38	recreation room
39	plant room
40	ablutions
41	male ward
42	ablutions
43	female ward
44	x-ray records/ dark room
45	x-ray room
46	minor operations theater
47	triage
48	surgical sundries store
49	foyer

administration

1	main entrance
2	information desk
3	security control
4	records
5	data capturing
6	mobile clinic office
7	office
8	staff lounge
9	ablutions
10	storage
11	board room
12	waiting room

maintenance staff

50	maintenance gate house
51	contaminated waste
52	general waste
53	workshop
54	dirty linen washing
55	bulk storage
56	linen packing room
57	ablutions
58	bulk store 1
59	bulk store 2
60	storage office
61	staff lounge
62	sterile store
63	decontamination room

therapy & out-patient clinic

64	waiting area
65	dentistry
66	dentist's laboratory
67	blood testing
68	ablutions
69	cleaning room
70	assessment room
71	optometrist's office
72	storage
73	eye testing
74	sound booth
75	audiology and speech therapy
76	school health services
77	children's activity room
78	ablutions
79	storage
80	ablutions
81	activity room
82	hydro/ physiotherapy gym
83	office
84	splinting room
85	physio. treatment 1
86	physio. treatment 2
87	traditional healer
88	storage
89	lecture room
90	medical superintendent
91	psychologist's office
92	therapy courtyard (art & music)
93	pharmacy storage
94	dispensary
95	storage
96	activity storage
97	group therapy

public library & gym

98	computer facility
99	computer administrator
100	reserved books
101	issuing desk
102	library
103	storage
104	female change rooms
105	storage
106	male change rooms
107	gym
108	foyer
109	reception
110	storage

taxi, market & agriculture

111	mini substation
112	ablutions
113	garden store
114	chicken coop
115	food market
116	performance stage
117	ablutions
118	storage
119	storage
120	performance stage
121	craft market
122	activity room
123	storage
124	rentable space
125	security control
126	taxi market offices
127	storage

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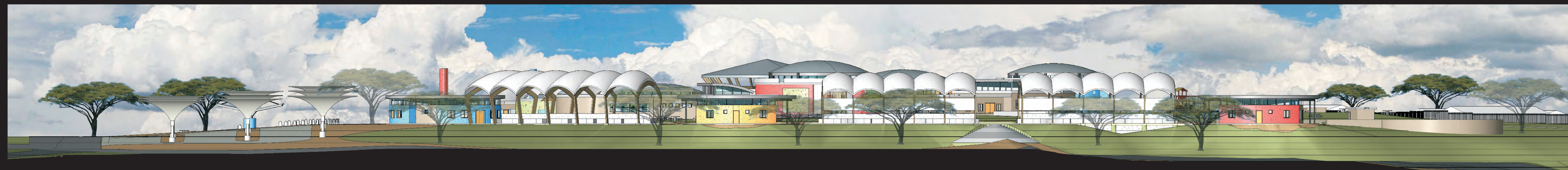205500202
december 2011
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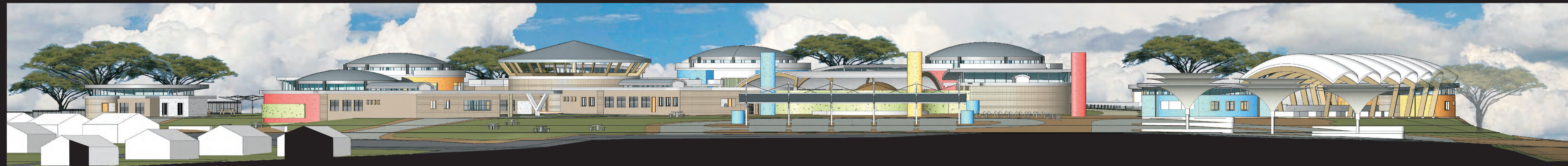
elevation from marketplace (north)   scale 1:200
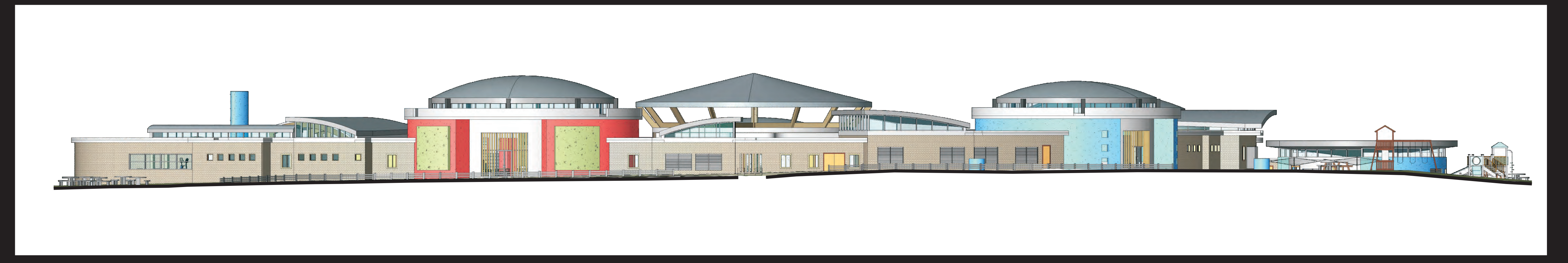
elevation from agricultural gardens (west)   scale 1:200

elevation from bakhaliphi road (east)   scale 1:200

southern aerial perspective

elevation from meyiwa main road (west)   scale 1:200

elevation from okhozini primary school (south)   scale 1:200

section a-a   scale 1:200

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interior courtyard perspective

in-patient courtyard

library entrance

food and craft market

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POND FEATURE

GROUP/ CREATIVE THERAPY

section aa   scale 1:50

LIBRARY

PUBLIC GYM

section bb   scale 1:50
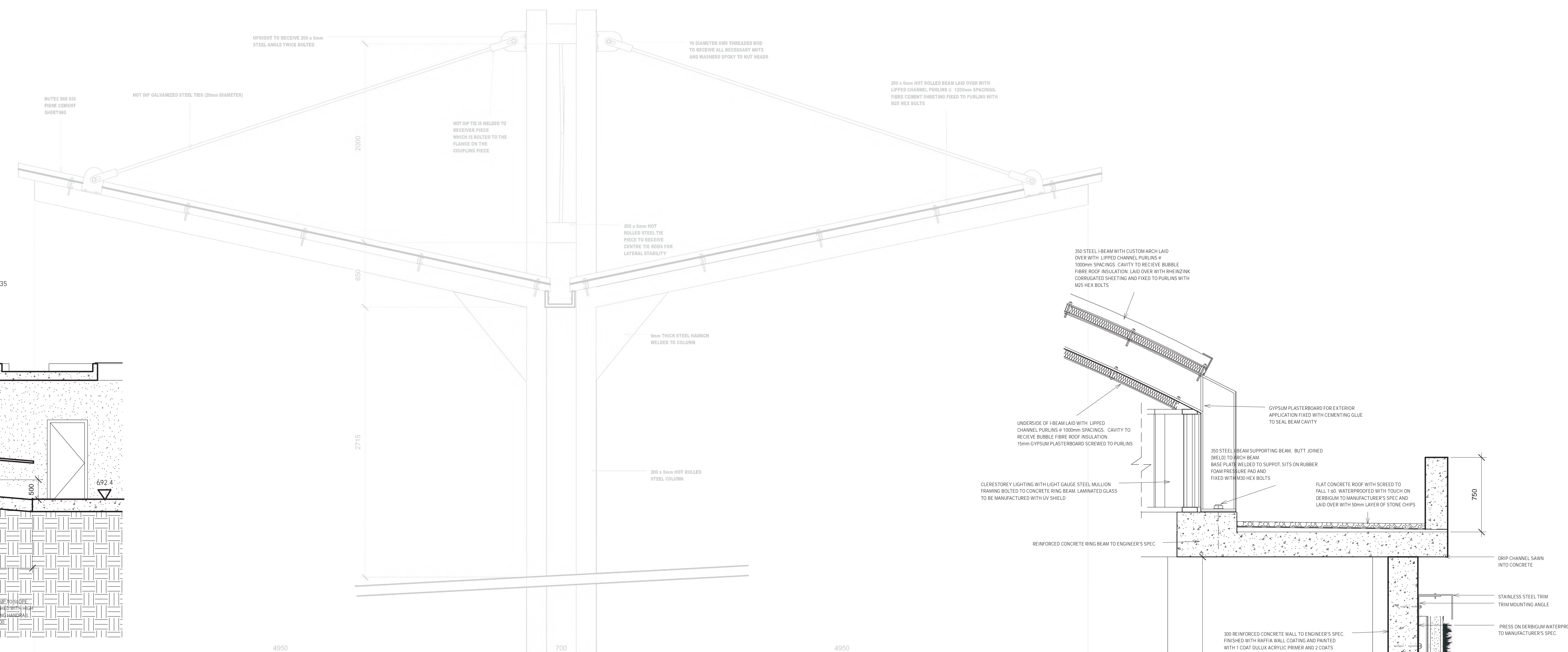
parking shelter detail   scale 1:20

library wall strip section   scale 1:20

healthcare and **community centre**
for **Mpumalanga, Durban**
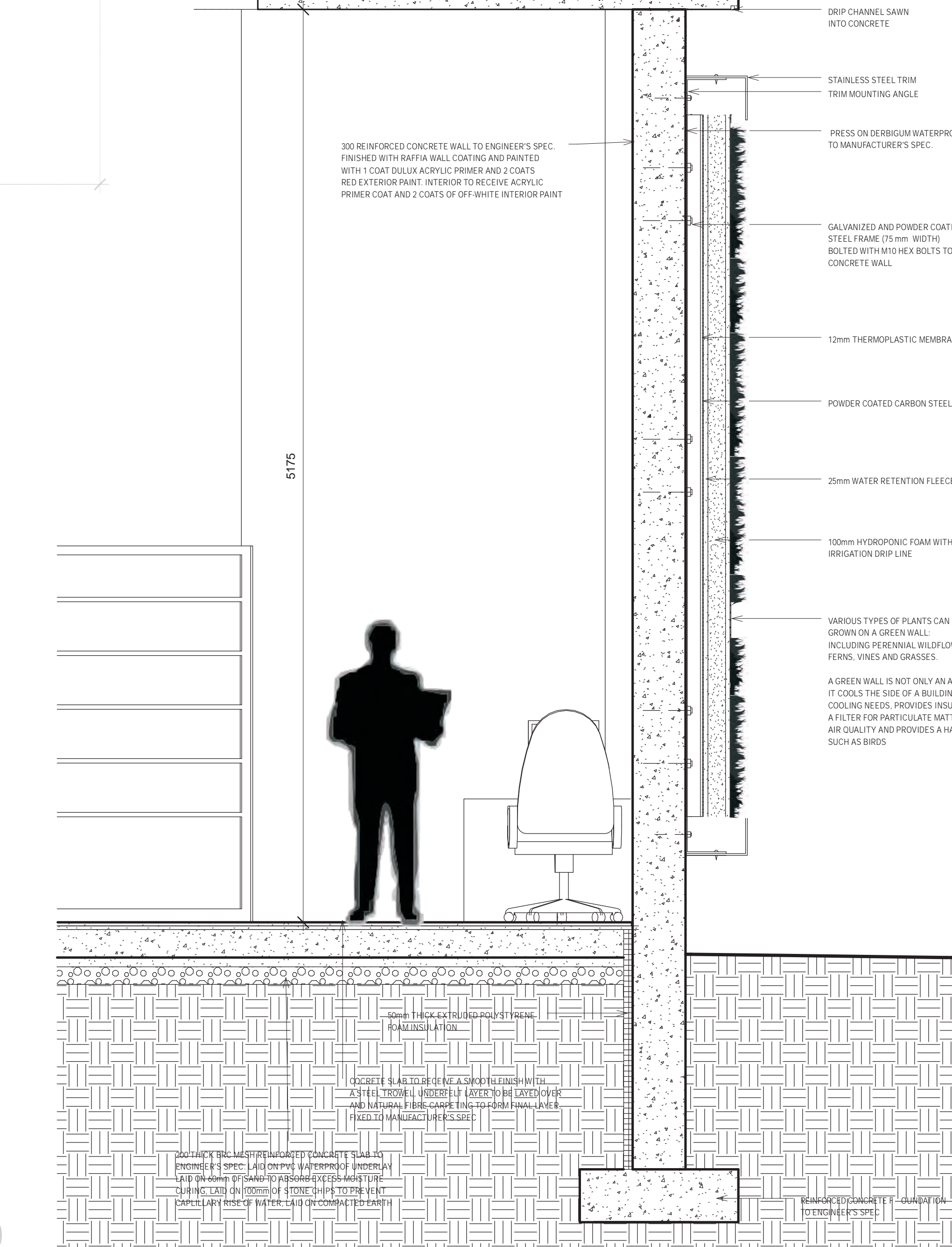
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- BLANCHARD, T. (2011) Personal interview with health planner at Ruben Reddy Architects [23/03/11]
- GILMORE, P. (2011) Personal Interview with chairperson of eThekwini Economic Development Unit [28/02/11]

- MCHUNU, P (2011) Personal interview with a resident of Mpumalanga; also Registry Secretary at Outer-West City Council [24/03/11]

LIST OF FIGURES

2.0 SITE SELECTION, SURVEY & ANALYSIS

2.1 Introduction

Fig. 1: Available from; eThekwini Economic Development Unit. JPEG format [28 February 2011]

Fig. 2: Available from; <http://en.wikipedia.org/wiki/File:Ethekwini_population_density_map.svg> [accessed 9 August 2011]

Fig. 3: Available from; <Google Earth v 5.2.1.1588> [accessed 28 February 2011]

Fig. 4: Available from Author. JPEG format [taken 20 March 2011]

Fig. 5: Available from; eThekwini Economic Development Unit. JPEG format [28 February 2011]

Fig. 6: Available from Author. JPEG format [taken 20 March 2011]

Fig. 7 & 8: Available from; <http://citymaps.durban.gov.za/website/master/viewer.htm> (edited by author) [accessed 28 February 2011]

2.3 Site Selection Options

Fig. 1: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 23 February 2011]

Fig. 2: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 23 February 2011]

Fig. 3: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 23 February 2011]

Fig. 4: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 23 February 2011]

2.4 Description of Existing Site Conditions

Fig. 1: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 3 March 2011]

Fig. 2: Available from*;* <Google Earth v 5.2.1.1588> (edited by author) [accessed 3 March 2011]

Fig. 3: Available from Author. JPEG format [drawn 4 July 2011]

Fig. 4: Available from Author. JPEG format [drawn 4 July 2011]

2.5 Site Analysis

Fig. 1: Available from Durban Municipal Offices. JPEG format [scanned 23 March 2011]

Fig. 2: Available from Author. JPEG format [taken 20 March 2011]

Fig. 3: Available from Author. JPEG format [created 23 March 2011]

Fig. 4: Available from Author. JPEG format [taken 20 March 2011]

Fig. 5: Available from Author. JPEG format [taken 20 March 2011]

Fig. 6: Available from Author. JPEG format [taken 20 March 2011]

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Fig. 1: Available from; <http://www.abovetopsecret.com/forum/thread542140/pg6> [accessed 23 March 2011]

Fig. 2: Available from*;* <http://bhutandiploma.files.wordpress.com/2011/04/plan-av-kaedi-maur1.jpeg> [accessed 20 July 2011]

Fig. 3: Available from Author. JPEG format [created 23 July 2011]

Fig. 4: Available from; <http://jvtc.blogspot.com/2009/11/louis-kahn.html> and

<http://www.thecityreview.com/newarch.html> [accessed 22 October 2011]

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4.0 TECHNICAL RESOLUTION &
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All figures in these chapters were produced by the author in the year 2011 for the partial fulfillment of the degree, Master of Architecture. Figures are available from the author in JPEG format.

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