THE INCORPORATION OF NATURE INTO ARCHITECTURE AS A HEALING AID:

A Hydrotherapy Health Centre

By

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DECLARATION

I declare that this dissertation is my own, unaided work and carried out exclusively by me under the supervision of Professor Ayse Gulcin Kucukkaya and of Mr Dumisani Mhlaba. This document is to be submitted for the Master of Architecture degree from the University of Kwa-Zulu Natal, Durban. It has not been submitted before for any degree or examination in any other university.

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ABSTRACT

The intension of this dissertation was to investigate why architectural environments were not healing, but harming people, and what factors could be looked at in order to provide healing environments for mankind. The human living and working environments are contributing more to illness and the aesthetic, than to creating environments that comfort, engage and heal the human beings. Buildings needed to become more attuned to people's physical and mental well-being and by providing an architecture that incorporates water and finds ways to heal while being functional. Nature's principles incorporate networks of complexity while remaining harmonious and by looking towards, and using nature in architecture is where inspiration can be found for a solution. The aim of this dissertation was to create an appropriate architecture that respects nature, while providing the essential resourceful, sensitive, delightful and therapeutic environments for the betterment of those who suffer from illnesses. The challenge was that creating balance between architecture and nature is difficult but necessary for producing healing environments for human well-being.

A research investigation was carried out in the form of a literature review that covered nature, water and architecture and the factors and elements that these categories contribute to healing. Precedents and case studies where investigated and analyzed to prove these theories of healing of a successful collaboration between nature and architecture. Questionnaires and interviews were conducted with medical professionals to establish the relevance of water in healing for humans through hydrotherapy.

The research concluded that healing environments were possible and greatly enhanced when nature, water and architecture were combined. What can be contributed on a large scale is that healing environments is achievable and should be implanted in every society and city for the overall well-being of mankind, and specifically, can contribute medically to healing certain diseases and conditions.

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DEDICATION

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"We shape our surrounding and our surrounding shapes us"

Winston Churchill

"We enjoy the fruits of the plains and of the mountains,
The rivers and the lakes are ours, we sow corn, we plant trees,
We fertilize the soil by irrigation, we confine the rivers and straighten or divert their courses. In fine, by means of our hands we essay to create as it were a second world within the world of nature."

Cicero, De natura decorum (1st century BC)

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

Nature is a pure, complete and continuous element. It is made up of a multitude of ecosystems in which animate and inanimate organisms coexist together forming a symbiotic system. This system is linked to other ecosystems ultimately forming the interwoven network of what is called nature – made up of the natural world such as plants; animals; seasonal and weather elements; land and water. Nature provides a vital element to human health and development both physiologically and psychologically because it encompasses all elements of harmony, synchronization, peace, vitality, and rejuvenation. These very same elements that make nature a unique and working system is highly lacking in human environments, which is statistically proved, with increasing levels of disease, stress and illness. Nature provides a model of life and cycle which is perfect, non-wasteful and complex, not only of the aesthetic surface but also within the invisible inner workings. By looking towards nature as inspiration to building design principles and qualities can be established in order to create healing environments.

Nature consists of many components but its greatest natural element in the world is water which is a fundamental aspect of life. It is the most abundant substance on the planet. Water encompasses many different qualities that can be utilized for healing, from its sound to perception. The element of water is full of energy and meaning throughout the ages and has been a part of human culture. Water symbolizes life and growth and sustenance. Many societies of the world are completely cut off from nature and water and a connection must be re-established. By incorporating water into the built environment, nature can facilitate in creating with the designer, more healing and harmonious human environments that can be adapted to treat many forms of illnesses and diseases in the built environment.

All forms of environments have an influence on human beings, both positively and negatively. The concept of healing environments is not a common first impression of architecture, but it is the most important function for it, other than sheltering from the elements. All structures of life need to contribute to the bigger order and system of the planet and within the current environmental context, the natural resources of the planet is at a dangerous low due to human globalization. It is imperative that healing takes place within the human societies, not only to heal damage done to people through the built environment, but also damage done to the natural ecosystem in which all humans are dependent on. There is a different energy to nature than there is to man-made environments. Man-made environments have energy that is rushed, demanding, and harsh; whereas Nature's energy is harmonious, peaceful, and serene, all symbolic of healing. When these environments are experienced the difference in energy is obvious and extreme, this highlights inequalities of the current human living realm.

Architecture is the practice of growth and creativity that creates a physical form of humans' existence on earth. Architecture is an organization system that brings people together whether by means of habitation or recreation. Architecture becomes an expression of individuality and culture, of societies, ideals and essential works for humans comfort. With the acceleration of technology and urbanization, Architecture has taken the world by storm, but has left many inconsistencies in its wake. These inconsistencies are the majority of buildings that do not harmonize with the environment and human health and it is therefore necessary then to steer the realm of architecture back to this path.

The purpose of this dissertation is to establish suitable ways to complement and merge the built environment with the natural environment, to create ideal healing spaces for humans. By incorporating nature, specifically the natural element of water, into architecture with design principles inspired from nature, human environments can become the best experience for people with or without ailments.

Figure 1.1 Diatoms (Campylodisus Hibernicus) which are plankton, photographed at magnification of 250 times life size with double curved form. (Pearson, 2001: 50)

Figure 1.2 Fractal forms in nature (http://www.myspace.com/brendablueowl)

Figure 1.3 A section through a sea shell and its geometric curved form. (http://nickgogerty.typepad.com/designing_better_futures/2009/12/thinking-in-prime-numbers.html)

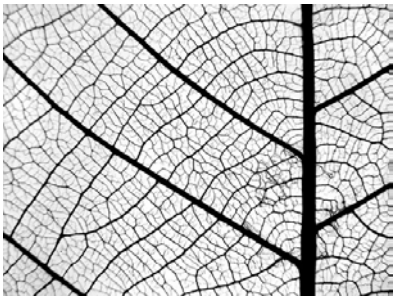


Figure 1.4 The intricate web design of the veins on a leaf. (http://www.flicker.com/photos/mark_boucher/111855002/)

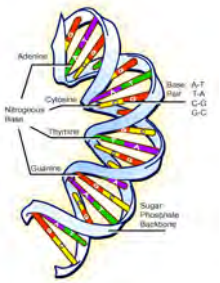


Figure 1.5 The human DNA double helix twisted form. (http://www.squ.ubc.ca/a-monks-flourishing-gard-en-the-basics-of-molecular-biology-explained/)

Figure 1.6 Sea-Anemones, water dwelling sea animal. (http://www.redmap.org.au)

With globalization, urbanization and general growth the human environments have begun dominating the natural landscape and recourses. Environmentally if there is no adequate action

taking place, the natural world in which humans so completely depend upon will be desolate leaving a huge mark on human society and its future. The built environment needs to be symbiotically incorporated with the natural environment to restore balance again. On a humane level, the statistics of building related illnesses and general stress levels for the average person is increasing every year. This is because most of people's time is spent in the built environments that are causing these symptoms. This design process must be reassessed to provide a catalyst for re-intervention and to produce healing environments that brings health physical, social and emotional balance back to people. When addressing healing architecture most books have not addressed targeting any particular illness in the human body to heal, but instead, have only looked at people's general well-being. It is therefore a step forward to take these new theories to address more specific issues within the human body and mind which will provide environments that achieve better healing properties.

1.2 DEFINITION OF THE RESEARCH PROBLEM

Architecture and the built environment have become a hard, harsh and dominating feature in our landscape and most importantly towards the people. The human living and working environments are contributing more to illness and the aesthetic than to creating environments that comfort, engage and heal the human being. Buildings are the most important physical mass of the human life because it surrounds people on a daily basis but the basic functions are not being met due to our focus on mass reproduction and personal gain. Water is the most natural fundamental living element for humans because it provides sustenance to the human body. Buildings need to become more attuned to people's physical and mental well-being and by providing an architecture that incorporates water. Nature's principles incorporate networks of complexity while remaining harmonious. By using nature as an inspiration for architecture, balance in human lives can be achieved.

1.3 AIMS AND OBJECTIVES

The aim of this dissertation is to try and create a sensitive, gentle and appropriate architecture that respects nature, while providing the essential environments that make liveable, comfortable and healing environments for people. By learning from Nature and water, its patterns and principals, as well as that of organic forms, an architectural language can be designed to create resourceful, sensitive, delightful and therapeutic environments for the betterment of those who suffer from illness.

- The primary objective of this dissertation is in creating healing environments for humans' well-being through the incorporation of the natural element of hot and cold

water, by looking at its history in relation to healing and architecture. This should establish a method in which environments can help not only the sick who require it but the 'unaware' everyday person. On a broader note, there a possibility that healing architectural environments could not only heal or aid the sickly and suffering of medical patients in a medical environment but also other general types of non-medical buildings such as offices, residences, industry, and commercial centres.

- The study will investigate the treatment of water for medical illnesses and conditions in the human body and how hydrotherapy can assist in the symptoms and suffering of individuals with various diseases. Hydrotherapy would be targeted to relieve pain and improve body movement through bathing, immersion and exercise.

- This study is aimed at identifying how nature has influenced architecture through the ages whether consciously or subconsciously and how by incorporating natures design principles into human environments can create the same harmony and symbiosis that is experienced by nature.

- Nature is the stabilizing element of the Earth, constantly providing natural resources which humans utilize for the creation of their own environments and lifestyles. Humans do not work with these systems but instead try to control and make these systems work for their betterment. They have taken advantage of theses natural systems to an extent that nature cannot keep up with the reproduction of the natural resources. Buildings have become large, heavy, solid structures that do not respect the natural surrounding environments. They use as much of the land as lawfully possible but do not give back to Nature. It is therefore essential that an architectural means be investigated to improve these conditions by looking towards and working with Nature is where an understanding and result can be achieved.

- By dealing with nature and architecture as a healing aid, can this sensitivity to the surrounding environment also contribute to preventing the extinction of natural resources and ecosystems that is currently drastically diminishing and being taken advantage off?

- By incorporating the element of water as a natural component in architecture, the effects of healing that water contributes will be established and how water and architecture can provide environments to help the healing process. The technical

issues of hot water need to be addressed with possible design solutions by the process of technology.

1.4 SETTING OUT THE SCOPE

1.4.1 Delimitation of Research Problem

The study aims to identify a link between nature and architecture and how the harmonious qualities of nature and its inspiration and integration into architecture, specifically the relationship of water and architecture, can create healing environments for people. On a practical level this will be in terms of a hydrotherapy water practice and illnesses relating to this treatment such as rheumatism, musculoskeletal disorders and sports injuries. It mainly treats pain ,swelling and aids in improvement of body movement; so any diseases or conditions beyond this will not be considered. Only the element of water will be looked at from nature and not any others.

1.4.2 Definition of Terms

- ***Nature*** – the material world and the forces and processes that produce and control all the phenomena of the material world – A primitive state of existence, untouched and uninfluenced by civilisation or artificiality (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000*); the whole system of the existence, arrangement, forces, and events of all physical life that are not controlled by man – all natural phenomena and plant and animal life, as distinct from man and his creations (*Collins English Dictionary, 2003*)
- ***Natural Resources*** – are all the land, forests, energy sources and minerals existing naturally in a place that can be used by people (*Collins English Dictionary, 2003)*; a material source of wealth, such as timber, fresh water, or a mineral deposit, that occurs in a natural state and has economic value (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000)*
- ***Symbiosis*** – A close, prolonged association between two or more different organisms of different species that may, but does not necessarily, benefit each member (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000);* a close and usually obligatory association of two organisms of different species that live together, often to their mutual benefit (*Collins English Dictionary, 2003)*
- ***Biomimicry*** – the mimicking of life using imitation biological systems (*Collins English Dictionary, 2003);* the mimicking of life using imitation of biological systems (the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems sustainably (www.wikipedia.org)

- ***Organic Architecture*** - philosophy of architecture which promotes harmony between human habitation and the natural world through design approaches so sympathetic and well integrated with its site that buildings, furnishings, and surroundings become part of a unified, interrelated composition (www.wikipedia.org)
- ***Biophilia*** – An appreciation of life and the living world (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000);* An innate love for the natural world, supposed to be felt universally by humankind (*Collins English Dictionary, 2003)*
- ***Hydrotherapy*** – External use of water in the medical treatment of certain diseases (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000);*Medically the treatment of certain diseases by the external use of water, especially by exercising in water in order to mobilize stiff joints or strengthen weakened muscles (*Collins English Dictionary, 2003);* the treatment of diseases through the use of water, whether internal or external, as whirlpool baths, compresses, or drinking mineral waters (*Ologies & Isms, The Gale Group, 2008*); the treatment of physical disability, injury, or illness by immersion of all or part of the body in water to facilitate movement, promote wound healing, relieve pain, etc., usually under the supervision of a trained therapist (www.wikipedia.org)
- ***Immersion*** – the act of sinking until covered completely with water, a descent through liquid especially through water – the act of making something wet (*WordNet 3.0, 2003-2008, Princeton University*)
- ***Placelessness*** – places that lack "sense of place" are sometimes referred to as "placeless" or "inauthentic". Placeless landscapes are those that have no special relationship to the places in which they are located – they could be anywhere (www.wikipedia.org); indistinguishable from other such places in appearance or character (*The Merriam-Webster Unabriged Dictionary, 2011*)
- ***Urbanism*** – the culture or way of life of city dwellers – urbanisation – to nake urban in nature or character (*The American Heritage Dictionary of the English Language, 4TH Ed, 2000)*

1.4.3 Stating the Assumptions

The assumption can be made that by looking to and using nature, a better understanding can be achieved in drawing out the healing component within architecture for healing living. It is also an assumption that water is the most substantial natural element for the context of this study; more than fire, earth, and air. Dealing with a medical component and hydrotherapy to treat human illnesses, it can be assumed that a variety of conditions can be treated and thereby healed from water therapy.

1.4.4 Key Questions

- What is Nature and how does it affect or influence humans and their built environment?
- What are the appropriate elements of Nature that can be contributed to healing?
- What is the current relationship between architecture and nature?
- How can nature act or influence design as a healing element, for healing to be gained through architecture?
- What can be done in terms of building design and form to create a symbiosis with the natural environment?
- What design strategies and concepts have been used in architecture to be incorporated and achieve harmony with the natural environment?
- Being one of the most important natural elements, what are the potential healing qualities to water and can it influence or affect interior inside and outside architectural environments into being healing?
- Does water and architecture create any unhealthy environments?
- Has water had any healing precedents around the world?
- How can hydrotherapy aid in the rehabilitation and treatment of certain diseases and what are the other benefits of water treatment?
- Is it possible to create a healing centre that is not a hospital?
- Can healing architecture and its design principles be directed towards creating environments for people suffering from any disease?

1.4.5 Hypothesis

Nature consists of the most basic and complex forms, the most intriguing relationships and interdependencies between species, and is the most inspiring expression of symbiotic compositions. The natural element of water contributes to environmental healing on a social, psychological and physical level. This dissertation states that to learn and integrate nature, its principals and forms into architecture will thereby inject these same symbiotic, safe and calming environments into architecture and thereby create healing environments for all humans.

1.5 RESEARCH METHODS AND MATERIALS

The research methodology will be qualitative and quantitative.

Qualitative methods will be carried out in the forms of case studies and interviews at healing environments with the incorporation of water. The analysis of these studies will provide information of how appropriate healing environments should be considered and designed and

what elements of human environments lack these fundamental principles. Recorded information will be put through qualitative analysis to determine appropriate materials, sizes, water temperatures, and supporting functions necessary to create healing environments with water for hydrotherapy. This information will be in forms of drawings and photographs. The interviews that will be carried out will be structured and consisting of open-ended and closed-ended questions to the operating managers of these establishments as well as physiotherapists and Rheumatologists in the medical field. Observational studies will be carried out in order to catalogue people's movement and behavior within these spaces and if any discomfort or unease is experienced. An analysis of this information would then aid in the design process of creating suitable spaces for water healing and the suffering patients.

The questions will be based on the following themes:

- Personal details including their culture and medical status.
- General questions based on certain diseases, its affects, and patients living / working environments.
- The value and advantage of hydrotherapy for rehabilitation and treatment.
- The current and past status of hydrotherapy in the country of study and future schemes.
- The idea of a comfortable, pain-free and healing environment.

The Quantitative method will be large-scale surveys with the general public, on how many of the general public suffers from rheumatic disorders to muscles injuries or knowledge of people who do and how do they deal with these symptoms or seek help. A determination of the general understanding and knowledge of hydrotherapy and water therapy should be achieved as well. A rough statistic would be gathered for the study region in order to justify the need for an architectural intervention.

Research Methods

The primary research methods would be involved with documentation of background and history of the people that the project will be designed for. Photographic data will be gathered to document current spaces that prove negative to patients.

Secondary research will be determined from the literature review of concepts, theories and how nature, water and architecture all contribute to healing environments and thereby answer the key questions in 1.4.4. This research will be carried out through the research of books,

journals, and the world wide web and an analysis will be undertaken to determine how they can be relevant to the case and precedent studies.

1.6 CONCLUSION

Nature incorporates all types of forms and functions, while its entire system is enormously complex it still manages to create complete harmony within itself and towards external factors. When experiencing nature, it consists of wonder, admiration and peace. This mood is an ideal environment that could be beneficial to humans' health in the built environment. Looking deeper into the value of water symbolically and physically in treatment, rehabilitation and therapy within architecture, can greatly benefit human well-being and certain diseases. Nature can therefore provide the inspiration in architecture to create an environment which minimised people's stress and sicknesses. By incorporating nature as a means to creating a solution, specific architectural human problems can be achieved such as targeted in this study with water and hydrotherapy practice.

CHAPTER 2
THEORTICAL FRAMEWORK

2.1 USING ARCHITECTURE TO PROVIDE HEALING ENVIRONMENTS

Architecture, as a general perception, is "the profession of designing buildings and environments with consideration for their aesthetic effect" (*wordnetweb.princeton.edu*). But architecture has functions greater than that of looking pleasing and providing shelter. Architecture also has the responsibility of maintaining the well-being of mankind, considering the amount of time humans spend in these environments. What has recently been established as a theory is that healing can be triggered and supported by things outside of the body, such as architectural environments that have healing qualities; this is according to architects Christopher Day and Carol Venolia. By analyzing the specific qualities of human environments and how the built environments affect humans, solutions and recommendations can be ascertained. What can be established is that contemporary architecture is currently too demanding; it is power and advertising specific and the human relationship to the built environment is being compromised for growth and expansion. The built environment has become harsh in the modern world for the human temperament and leaves lasting negative consequences to human health. By manipulating design elements such as the control of light, noise, colour, texture and temperature; an environment can be create to balance an individual's mental and physical state. This will initiate a healing process that will infiltrate all types and functions of buildings and ultimately create better living, working conditions and stronger societies. Achieving a balance within the human body and the physical habitable environments will facilitate people to attain complete peace, harmony and good health.

> *"When you are in a healing environment, you know it; no analysis is required. You somehow feel welcome, balance, and at one with yourself and the world. You are relaxed and stimulated, reassured… you feel at home" (Venolia, 1988; 7).*

2.2 THE INFLUENCE OF NATURE IN THE BUILT ENVIRONMENT

Nature is the epitome of harmony and a totality. It does not waste, overuse, or abuse the planet. Nature is filled with complex forms, fundamental functions, and beautiful aesthetics. Nature is the very reason why humans can survive, and without it, humans would not be able to survive. As humans develop their habitats and lifestyles, a precedent is needed to create a system, and materials are needed to create this habitat of which nature provides both of these essentials. Humans have investigated and worked continuously to understand nature's laws and principles, and to understand how the system in the world maintains its balance. Through examples from history and today, nature is providing inspiration to architecture to achieve symbiotic and self sustaining environments. This establishes a collaboration with nature that can aid in the emotional, psychological, physical and spiritual health of humans. Eugene Tsui

and Paolo Portoghesi have looked to finding the relationship between architecture and nature, to how nature has influenced the built environment, and how it still has much inspiration to provide for the ideal architectural environments.

> *"To create and architecture of meaning and beauty we need to return to the source – nature. By applying underlying natural principles as a basis for design in our human-made living and working environments we can experience for ourselves the power and beauty of nature's comprehensive design wisdom." (Eugene Tsui from Pearson, 2001: 184)*

2.3 ORGANIC ARCHITECTURE

The phrase of Organic Architecture was first termed by architect Frank Lloyd Wright when he was describing his approach to design. Wright believed that "form and function are the same thing" whereas architects before claimed that "form follows function". He also believed that every building should grow naturally from its environment and not be concerned with architectural style (Zevi, 1950). Organic architecture's philosophy strives to integrate human habitation and the natural world into a unified whole, by incorporating design with the surrounding environment and buildings, from the geographical composition of the site to the detail of the buildings furnishings. Effectively, organic architecture is also the exact design of every element of a building; from the windows, to the floors, to the individual chairs planned to fill the space. Everything relates to one another, reflecting the symbiotic ordering systems of nature. All characteristics of Organic architecture follow flowing forms, curves, flexibility, adaptability and rhythm. Organic architecture is inspired by nature and its systems and strives to attain a harmonious unified whole within each building and the universal natural world.

> *"For some, organic is curved, organic is asymmetrical, organic is natural materials, organic is individualistic, organic is holistic." Sidney K. Robinson from Pearson, 2001: 28)*

2.4 CRITICAL REGIONALISM

Critical Regionalism uses design as an element when addressing the site and its context in enhancing community, especially when within a full historical and cultural setting. The concept of Regionalism is to focus more on the identity of a particular place or setting, making it a priority, rather than incorporating a design with universal principles. The concept of Critical Regionalism impacts on all fields, but specifically for architecture, it is a conflict between international intervention or globalization and local identity with the desire to appreciate technological advancement, but at the same time protect local cultural ethnicity, their heritage and building construction. Critical Regionalism recognizes that in design the

value of the identity of a physical, social, and cultural situation should have precedence on the design process and overall architectural product (Lefairve, 2003: 10).

> *"The fundamental strategy of Critical Regionalism is to mediate the impact of universal civilization with elements derived indirectly from the peculiarities of a given place. Critical Regionalism depends upon maintaining a high level of critical self-consciousness. It may find its governing inspiration in such things as the range and quality of the local light, or in the tectonic derived from a peculiar structural mode, or in the topography of a given site." (Frampton, 2002: 82)*

2.5 WATER AND ARCHITECTURE

Water has been integrated into architecture and landscape from ancient times. It is seen as a foundation of life and a great symbol for living. Water that is refreshing, clear and reflective suggests beauty and health. From ancient eras people have believed certain waters to have healing qualities and so have flocked to spas to bathe in therapeutic pools. Water has been seen featured and complimenting architecture through the ages. Water on practical level reduces harsh noise and instead provides peaceful sounds (Moore, 1994: 17). Water can be incorporated into design of buildings to maximize its qualities to enhance healing and therapeutic environments.

> *"Water is a natural material with an unchanging identity, wherever it appears in architecture or nature. If we can effectively incorporate water's symbolism, history, and physical nature, then our water and architecture can have a potential for wonder unmatched by any other material that we can include in our environments." (Moore, 1994: 199)*

2.6 WATER HEALING THROUGH HYDROTHERAPY

Water has the ability to captivate engage, entertain and heal humans. Hydrotherapy is a water therapy that utilizes water and its unique properties in the treatment and rehabilitation of certain disease and illnesses. Water not only can captivate aesthetically but a physical engagement with the substance can result in healing both the body and mind of individuals.

> *"There is a place for therapy and recreation for all who suffer a disability, providing physical, psychological and social benefits. Hydrotherapy is a modality for rehabilitation and a wonderful medium for exercise." (Campion, 1997: xi)*

CHAPTER 3
FROM NATURE TO ARCHITECTURE

3.1 UNDERSTANDING NATURE

3.1.1 NATURE AS AN INSPIRATIONAL SOURCE OF DESIGN

What is nature? One of the many definitions is that created by forces beyond the human. The natural world comprises four broad categories, although with indistinct boundaries: the (lifeless) mineral, (living) vegetative, (responsive) animal and (conscious) human kingdoms (Day, 2002: 15). Nature is made up of ecosystems that are dependant and interdependent from each other, and these ecosystems work together to form the functional aspects of the natural world. But as the years go by there is much damage to the natural world and its resources as mankind utilise these at a rapid and irresponsible rate. There is currently no part of the world uninfluenced by human activity, not even the most remote areas of the world such as Antarctica and Mount Everest. (Day, 2002: 16). Although nature is being used by man it is essential that mankind has an understanding of how truly powerful nature is as shown in (*fig 3.1*) where nature has the power to manipulate the universe and change its pattern and forms, by the harsh wind actually transforming these trees that should be standing straight and tall into an unusual and rare horizontality. Nature is always capable of revealing its intrinsic and bountiful forces in the harshest of ways.

Figure 3.1 A tree shaped by the wind in Sardinia, Italy. (Portoghesi, 2000: 163)

A view of Nature from Christopher Day, a healing architect, states that the four levels that create 'spirit of place' are elemental levels; physical substance, time continuum, mood and essence which can also be described as matter, flow, emotion and inspiration – or earth, water, air and fire. But what is so important about these elements with regard to nature? What do they have to do with nature? Well these elements are the vital forces that keep the natural environments and ecosystems moving, functioning and evolving as the world is made up of

solid, fluid and vaporous substances, powered by heat. Life is contingent on the constant cycling through matter, vapour, water and warmth processes and is most energetic where all four elements are active. Our world is not just made up of material; it is also alive, inhabited by animals and humans (Day, 2002: 29). But for the sake of this research a deeper look into the element of water and its soothing and healing qualities will be focused on.

A concept of man and nature from Blaser's perspective explains that 'Man is a part of nature within nature'. The idea of drawing inspiration from nature is not about imitating it but rather interpreting and transforming it into our built environment. And by following nature mankind will be plugging into the self-efficient system of the universe and thereby connecting life forces with one another. It is also significant to note that objects that are naturally evolved function and are recycled better than any creations of man. The procedure in which nature develops is something similar to a soft technology: achieving as much as possible with as little as possible. "Copying nature does not suffice, what is necessary is a knowledge about nature and learning from nature" (Blaser, 2002: 11). Nature's construction principles can be modeled in the built environment based on the movement and force of a construction with the lowest amount payable in materials and energy; such as natural materials. The idea of creation also makes man creative and the model of ideal creation is the "natural engineer" or Nature. Sometimes is can be seen that good building solutions often follow the "building principles" of nature, as Nature has shown us how technical problems can be mastered and solutions can be found (Blaser, 2002: 15).

Another concerned view of the interaction between man and nature comes from J. Mateo as he shows in a series of essays that a philosophy of nature in its primordial state and belief in these places is lost. As mankind has been trying to restore the natural environment to some degree based on the idea of 'idyllic' settings stated quite frequently in our history, such as the Greeks, the suburban cultures of today has all but eliminated these virginal, untouched, and simple places. What comes through is a comparison between today's culture and the culture of the previous eras is a lack of reverence and respect for nature and how sacred it is to humans. These idyllic natural settings of untouched splendor and beauty will not be found in our present society of massive environmental upheaval and what is left should be treasured (Mateo, 2007: 29).

In Paolo Portoghesi's insight of *Nature and Architecture*, he has broken up the elements in nature and its observed nature-artificial parallel relationship with other physical elements in the built environment and animal species. Portoghesi argues that architecture itself is the product of the transformation of the earth's crust and therefore becomes a part of nature, just

like the coral reefs in the sea, the gardens built by the bower-birds for their mating rituals and like the dams built with endless patience by the beavers seeking domestic space from the gushing water currents of the rivers. This gives architecture a concept of simplicity as it should coexist with nature in harmony like all the other natural systems of the planet (Portoghesi, 2000: 9). He states that the symbol is an effective example in concept to understand the relationship between nature and architecture. The type of symbolism that captures architecture's character in terms of nature is "symbolic imitation". This is due to the idea that a symbol captures the idea of an element but can also explain or express this idea when words are inadequate. Symbolic imitation then leads to that large never-ending field of analogy and mimicry. Analogy and mimicry creates many various repetitions in the universe which recalls specific traits of elements in family members and interlinked between the systems of the universe and natural world. (Portoghesi, 2000: 14).

John Ruskin studied the analogy between natural forms and architecture. Portoghesi states that Ruskin "believed that no form or set of forms be conceivable without there being an example somewhere in the universe and that the origin of natural morphology be both a homage to, and a continuation of, creation" (Portoghesi, 2000: 46). What had fascinated Ruskin was that artificial objects and nature shared a similar beauty which he believed were portrayed more effectively when these objects were consumed and changed over time and were than not seen as individual elements but as part of the given environment they changed in. In his book *Seven Lamps* he wrote: "*I do not mean to assert that every arrangement of line is directly suggested by a natural object; but that all beautiful lines are adaptations of those which are the commonest in external creation; that as a type and help, must be more closely attempted, and more clearly seen, and that beyond a certain point, and that a very low one, man cannot advance in the invention of beauty, without directly imitating natural form.*" (Portoghesi, 2000: 47)

Rarely is the harmonization process between architecture and nature truly imitative, especially when it involves decoration. Portoghesi explains that with Frank Lloyd Wright's famous basis for organic architecture and its harmony with the natural landscape of the Prairie houses that these did not imitate the landscape but rather the houses interpreted the "horizontality" of the Pennsylvania landscape and contextualized and manifested this concept into a building aesthetic of parallel lines hugging the ground (Portoghesi, 2000: 50).

Portoghesi explains that in L.B. Alberti's book *On the Art of Building*, Alberi defines the relationship of architecture to nature as a cosmic balance. He writes: *"Beauty is a form of sympathy and consonance of the parts within a body, according to a definite number, outline*

and position, as dictated by the 'agreement of sounds,' the concinnitas (arrangement or attunement), the absolute and fundamental rule in nature. This is the main object of the art of building, and the source of her dignity, charm, authority and worth. Everything that we as a society know today our ancestors learned through observation of Nature herself; so they had no doubt that if they neglected natures virtues, they would be unable to attain all that contributes to the praise and honour of the work: nor without reason they declared that Nature, as the perfect generator of forms, should be their model. And so, with utmost industry, they searched out the rules that she employed in producing things, and translated them into methods of building. By studying in Nature the patterns both for whole bodies and for their individual parts, they understood that at their very origins bodies do not consist of equal portions; with the result that some are slender, some aft, and others in-between. And observing the great difference in purpose and intention between one building and another, as we have already observed in earlier books, they concluded that, by the same token, each should be treated differently" (Portoghesi, 2000: 34). Portoghesi therefore believes that nature is a balance of systems, a balance of parts and something that should be valued by humans. Some natural elements that created parallel or was drawn inspiration from are shown the following categories:

- **The Human Body**

By looking at the shape and form of a human body, by its uniqueness, its identity made up of separate parts, it informs man of the first rule of composition: unity in multiplicity (*fig 3.2 + 3.3*). There may or may not be a specific reference to the human body but it is an essential element of all architectural civilizations in all periods and eras (Portoghesi, 2000: 12).

Figure 3.2 Imre Makovecz, the Catholic Church in Siofok, Hungary, inspired by anthropomorphic traditions of houses in the past linking heaven and earth. (Portoghesi, 2000: 13)

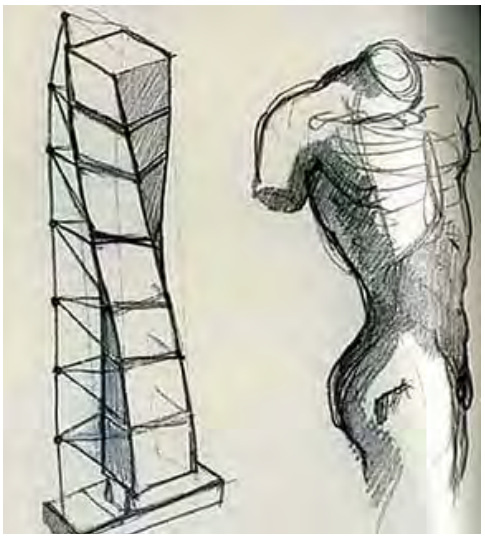


Figure 3.3 A sketch of the twisting human torso being translated into a twisting vertical skyscraper. (http://styleenvelope.blogspot.com/2010/03/body-beauty-design.html)

- **The Skeleton**

In the design of the skeleton as a load bearing structure of the human body can be reflected in man-made structures such as the primitive huts which were made of branches and then covered with vegetation and animal skins. This partnership between structure and skin (*Fig 3.4 – 3.7)* has moved from wooden structures to ones made from iron and reinforced concrete as a building material which has taken the skeleton structure to an entirely new meaning. In disagreement of the divisibility of the architectural mass, Alberti's idea of organism is very similar to the fixed behaviour of an organism in which the skeleton, muscles and nerves co-operate with the shell. (Portoghesi, 2000: 16).

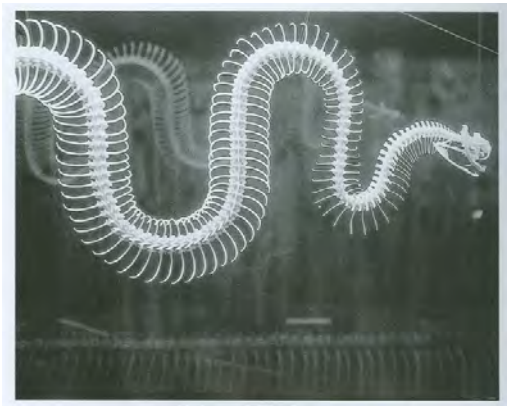


Figure 3.4 The skelton of a snake photographed inside the Museum of Natural History in Sao Paulo, Brazil. (Portoghesi, 2000: 16)

Figure 3.5 The image of a hut in Ethiopia under construction clearly showing the skeleton frame made of timer braches and the skin layer covering of thatch and straw. (http://www.dreamstime.com/african-hut-in-ethiopia-image3688534)

Figure 3.6 The photograph of the inside of an elephant's skeleton as a frame protecting the organ insides. (Portoghesi, 2000: 16)

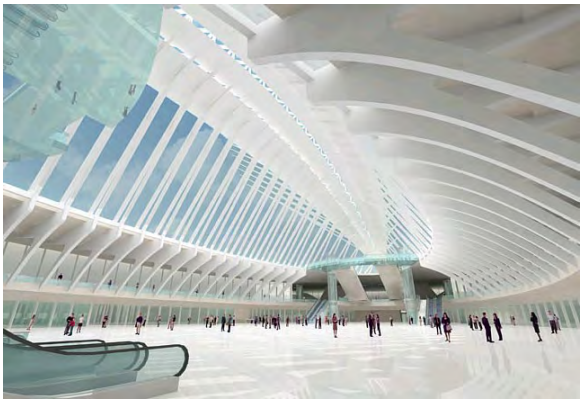


Figure 3.7 A render portraying the interior of a building with the main structure very similar to the skeleton of an animal or human with the spine element at the roof connecting the supporting ribs at the sides. (http://integrallife.com/member/linda-hollier/blog/integral-architecture)

- **The Verticality**

Phallic symbolism – the symbol of power and dominance – as man exists, is generally expressed by the tower archetype (*fig 3.8+3.9*). This can also be seen in the obelisk, the menhir, and the tombs. Verticality celebrates virility and supremacy and the elimination of empty spaces o land. That is why the cities are a competition of tall skyscrapers with the most wealthy, powerful and popular cities having the highest towering structures (Portoghesi, 2000: 24).

Figure 3.8 Adobe Mosque wit vertical spires and towers built in Mali. (Portoghesi, 2000: 24)

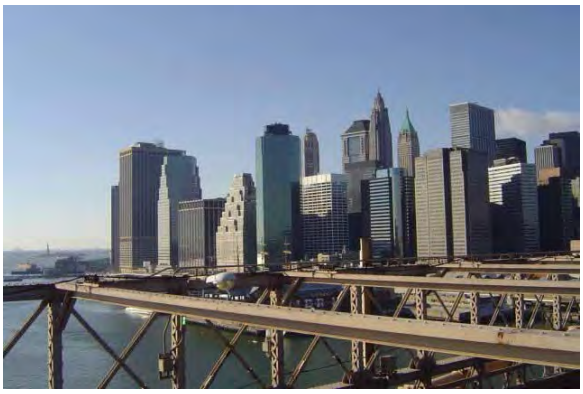


Figure 3.9 Verticality is a representation of power in New York City's skyline. (http://www.e-architect.co.uk/new_york_architecture.html)

- **Animals**

"Every archetypology," wrote Gilbert Durand, "must lead to a Bestiary and begin by reflecting on the universality and banality of the Bestiary."

The symbolism placed on animal bodies by many civilizations and cultures make it possible for the architect to communicate ideas and values through symbolic imitation of these animals. The individuality of character of each animal and every part of their bodies (*Fig 3.10-3.13*) has been reflected in buildings to create magical structures. An example of the individual quality of reference is the defensive action of the turtle, the liberating flight of the bird and the enveloping shape of a snail.

Figure 3.10 The Condor bird gracefully taking flight as it spreads its wings. (Portoghesi, 2000: 28)

Figure 3.11 A project for the Teatro Puccini at Torre del Lago near Pisa, in which the curve and shape of birds wings can be seen. (Portoghesi, 2000: 28)

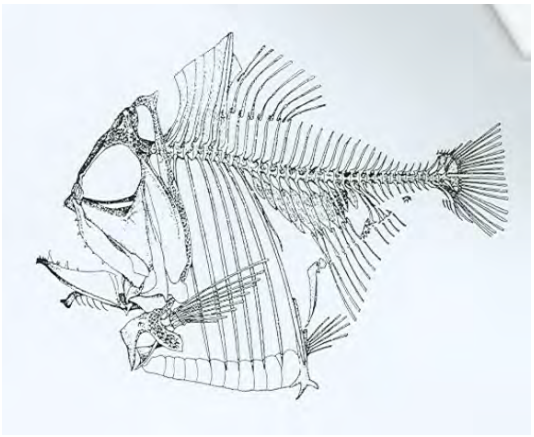


Figure 3.12 A piranha fish skeleton. (Portoghesi, 2000: 29)

Figure 3.13 this is the plan of the church of Kaleva in Tampere, Finland, which from its layout can be seen inspired by the Christian symbol of the fish as a hidden image of Christ. (Portoghesi, 2000: 29)

- **The Mountain**

Gaston Bachelard wrote, "For those whose dreams come from nature, even the smallest hill is an inspiration." There is a belief that the mountain is considered as a cosmic reference point (the sacred mountain in Asia called Mount Kailas) and this inspires a desire of man to erect artificial mountains which can be seen from the Ka'ba, the ziggurat, the pyramids, the immense temple of Borobudur, as well as the skyscrapers and residential structures that imitate the landscape (*fig 3.14-3.17*) (Portoghesi, 2000: 32).

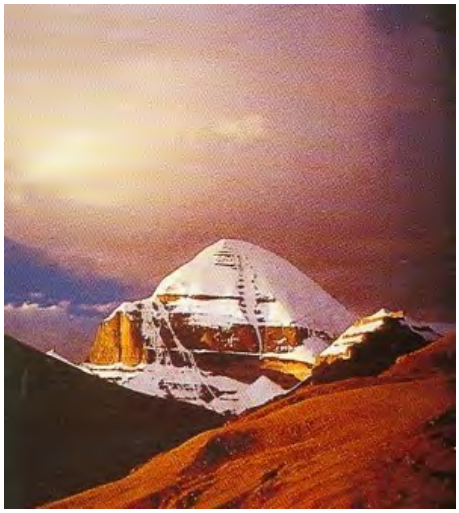


Figure 3.14 The most sacred mountain in Asia, Mount Kalias, identified as the centre of the world. (Portoghesi, 2000: 32)

Figure 3.15 The panorama of Rome with her characteristic cupolas that is reminiscent of the tops of mountains. (Portoghesi, 2000: 32)

Figure 3.16 A view of Union Beach State Park and its rock outcroppings.

Figure 3.17 A group of Trulli in Martina Franca, Italy.

(Portoghesi, 2000: 33)

- **The Rock**

Rocks were used by the primitive man as tools and stones for building. Through cutting and shaping these stones and trial and error they recognized which stones were hardest or fragile and how as association with the earth's surface could be made through building with it (*fig 3.19+3.20*) (Portoghesi, 2000: 36).

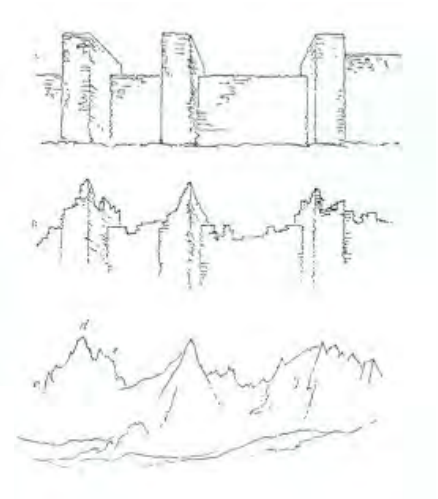


Figure 3. 18 John Ruskin sketch showing an analogy between alpine peaks above Chamonix and a turreted urban wall. (Portoghesi, 2000: 37)

Figure 3.19 An image of a rocky spur at the entrance to the Talampaya canyon in Argentina, showing erosions or composition of tall vertical segments appearing solid and dominating. (Portoghesi, 2000: 36)

Figure 3.20 The large dimensions of sturdy columns that form part of the temple base in Segesta, Italy, with strong similarity to the vertical segment of the rocky spur. (Portoghesi, 2000: 36)

- **Geomorphism**

Geomorphism is a theory or movement that is highly conscious of the impact and responsibilities in the methodical and negative alteration to the natural landscape that has been consequent to the Industrial Revolution. Man has taken Geomorphism as a defense mechanism in respect for nature which should be preserved and valued. It also shows that earth is a building material (*fig 3.21+3.22*) as well that can create curvilinear forms which can be moulded to reflect flowing water and appear far from man-made productions (Portoghesi, 2000: 40).

Figure 3.21 this is an image of a 700 year old rock home in Iran reminiscent of cave dwellings of our ancestors. (http://www.architecture-view.com/2010/08/25/extraordinary-700-year-old-rock-homes-in-iran/rock-homes-modern-structure-8/)

Figure 3.22 A group of caves dug out of the rock face and later whitewashed like an artificial facade on the Island of Santorini. (Portoghesi, 2000: 40)

- **The Shaft**

The tree inspires an image that man derives as a weave concept based on flexibility and braiding which can also be reminiscent from the animal and plant world. The younger trees and flower shafts as well as bamboo have these qualities and in architecture the vertical linear emphasis of forests and outcroppings can be seen by colonnades in buildings as well as weave patterns on facades (*fig 3.23 + 3.24*) (Portoghesi, 2000: 48).

Figure 3.23 A bamboo thicket in the garden of the Buddhist temple Saiho-ji, Kyoto. A representation of thin, vertical lines. (Portoghesi, 2000: 48)

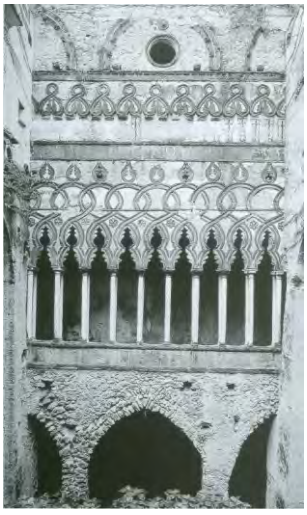


Figure 3.24 A colonnaded walkway of Palazzo Rufolo in Ravello, portraying the thin vertical columns o a stalk, reed or bamboo. (Portoghesi, 2000: 49)

- **The Branch**

The tree has taught man the concept of growth and multiplication since ramification lies at the center of its nature. Ramification represents the metamorphosis of an object that at a certain point of its growth it doubles in nature – the exact opposite to water as water collects eventually to form a reservoir. Ramification (*fig 3.25-3.27*) has taught man the power of repetition as in the sequence of a trunk, branches and leaves, seen in architectural orders (Portoghesi, 2000: 50).

Figure 3.25 A drawing done by John Ruskin that examines the law of Ramification and illustrates the curve between borders of the foliage and the rhythmic qualities of the development process. (Portghesi, 2000: 50)

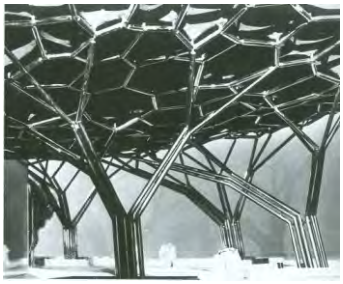


Figure 3.26 An image showing the tree-like supports of a hexagonal frame. (Portoghesi, 2000: 50)

Figure 3.27 The forked ramification of a lightning bolt as it descends to the earths surface. (Portoghesi, 2000: 51)

- **The Tree**

Gilbert Durand wrote that within most traditions of many cultures the tree is always the representation of the centre of the universe, its genesis and evolution. Its vertical growth draws a parallel to mans vertical growth as a symbolism of growth and health and time passing. The concept of a tree offers architecture an example of strength in structure as the tree starts with a trunk like a column and with its upward growth and ramification into branches that span in wide 360 degree directions and continues standing permanently (*fig 3.28 + 3.29)* (Portoghesi, 2000: 50).

Figure 3.28 A tree lined street in Acireale, Sicily, showing the tree canopies intertwining. (Portoghesi, 2000: 52)

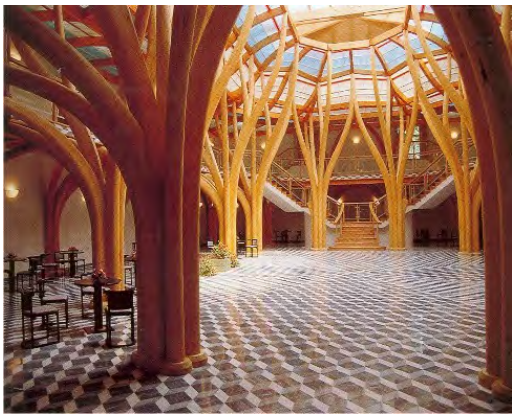


Figure 3.29 The main lounge of the Tettuccio Baths in Montecatini with its tree-like columns branching out to support the skylight above. (Portoghesi, 2000: 53)

- **The Flower**

The flower is an absolute example of centrality and frontality as it has inspired architects with distributive principles and architectural organisms (*fig 3.30 + 3.31*) based on vertical reference axis allowing appropriate forms with overlapping layers from a vertical radiating point. It has also greatly inspired endless decorative elements and forms (Portoghesi, 2000: 56).

Figure 3.30 A flower of the species Strelitzia reginae, with its layers of petals. (Portoghesi, 200: 56)

Figure 3.31 An aerial view of the Sydney Opera House in Australia, the form reminiscent of the layering and opening forms of flowers. (Portoghesi, 2000: 56)

- **Radii**

The idea of the radius is a basic concept of geometry which comes from the observation of light as the suns rays spread around the earth. Outward radiation from a central nucleus is one of the most common structures of the plant world and the architect has been expressing this concept from the times of primitive huts to the urban design of cities (*fig 3.32-34*) (Portoghesi, 2000: 64).

Figure 3.32 A detail photograph of the Hibiscus flower and the petals and veins in them radiating from a central point. (Portoghesi, 2000: 64)

Figure 3.33 A detail of the roof of the Seagram building in New York and how the cladding pattern or design is a radiating one. (Portoghesi, 2000: 65)

Figure 3.34 Canberra city plan in Australia designed as a radial pattern focused on city hall. (http://conferences.alia.org.au/alia2000/images/canmapsm.gif)

There are parallels in nature which includes the animal, plant and human aspects of nature. There are similarities in nature's elements that can be seen crossing between these aspects and indicate how nature may have an extremely large amount of facets but ultimately they all form a whole which is the universe. Examples of these parallels can be the coral, seen under the ocean, mimics parts of the human body, such as the brain and bone matter (*fig 3.35-38*).

Figure 3.35 The fragile pattern and structure of coral reef in the ocean. (http://www.ianskipworth.com/sui g/fiordland04-3.html)

Figure 3.36 The extremely similar construction from the internal view of a dissected human bone showing its trabecular structure. (Portoghesi, 2000: 17)

Figure 3.37 A certain type of coral called Diploria labyrinthiformis found in the Caribean. (http://www.flickr.com/photos/maytevid ri/2506388569/)

Figure 3.38 The human brain. (http://www.marcgunther.com/2010/0 8/25/sustainability-and-your-brain/)

Some general parallels or similarities between architecture can be seen below:

In the first pair the solidity and enormity of the vertical support of massive tree trucks of the Sequoia National Park in California (*fig 3.39*), can be seen in the columns of the "Paestum basilica" (*fig 3.40*). In the second pair the radiation and pattern of the spider's web (*fig 3.41*) can be seen in the layout of a Chinese tropical island city in an aerial photograph along the River of Pearls (*fig 3.42*). In the third pair it can be observed a free-well staircase in the Palazzo Ducale in Urbino (*fig 3.43*) and it's curved, rotating parallel in the axial view of the shell of the Galeodea echinophora species (*fig 3.44*). From the fourth pair what can be seen is the rhythm and pattern of the rings of ripples created on a pond by throwing a stone in (*fig 3.45*). This is the simplest example of a wave expanding in concentric circles and is a pattern used in cosmetology to represent the heavens. This pattern of ripples can be seen in the next figure in the ceiling in the church of Sacra Famigila in Salerno (*fig 3.46*), Italy. In the fifth pair is photographed an orchid (*fig 3.47*) of the Gymnadenia Cnopesea family in the Italian countryside with its bright red layered towered composition and similarly the same principles of the temple pagoda in Ysakushi-ji in Nara, Japan (*fig 3.48*) (Portoghesi, 2000).

Figure 3.39 Massive tree trunks of the Sequoia National Park. (Portoghesi, 2000: 129)

Figure 3.40 Incredible girth and height of the columns of a Basilica. (Portoghesi, 2000: 129)

Figure 3.41 The pattern of a spiders web works with a central circle an then radiating circles with paths to support the structure. (Portoghesi, 2000: 492)

Figure 3.42 From an aerial image of a Chinese city these same radiating lines and circles can be seen as the spider's web. (Portoghesi, 2000: 492)

Figure 3.43 The conical shape of a sea shell as a central point that radiates outward in a spiral. (Portoghesi, 2000: 311)

Figure 3.44 The same spiralling form can be seen from an aerial view of a spiral or circular staircase as the perspective view winds to a focal point. (Portoghesi, 2000: 311)

Figure 3.45 The concentric rings forms on the surface of a body of water called ripples and forming a rhythmic moving pattern. (Portoghesi, 2000: 348)

Figure 3.46 The concentric waves on the Church ceiling also creates movement. (Portoghesi, 2000: 348)

Figure 3.47 An orchid flower seen with its layered layout of petals from the widest at the bottom to the narrowest point at the top. (Portoghesi, 200: 249)

Figure 3.48 A temple roof in Japan with similar layered composition to the orchid as well as colour tone. (Portoghesi, 2000: 249)

In the following pairs there is a direct similarity in certain characteristics that link the architecture with a vegetative object. In this sixth pair what is shown is a convex wall following the shape of the rock (an Inca building near Cuzo) (*fig 3.49*) and its parallel which a corn-cob grown in the Sacred Valley of the Incas (*fig 3.50*). The plasticity and irregular layout of these Inca walls seems to have been inspired by the corn grown and aggregation of seeds by these people in the area. The ashlar patterns of the walls create patterns that resemble the corn flower. And the last comparative parallel pair is of the Astrophytum ornatum cactus (*fig*

3.51) with its radial, spiked segments and then the interior view of the cupola of the Ambassador's Hall in the Alhambra in Granada (*fig 3.52*), interpreted as a counter-form to a fully flowered cactus (Portoghesi, 2000).

Figure 3.49 The patterns and irregular layout of the corn-cob. (Portoghesi, 2000: 75)

Figure 3.50 A walls built by the Incas as they drew inspiration of form from the shape and pattern of corn grown in the settlements, following the curve of the natural rock. (Portoghesi, 2000: 75)

Figure 3.51 The intricate segments of the desert cactus. (Portoghesi, 2000: 266)

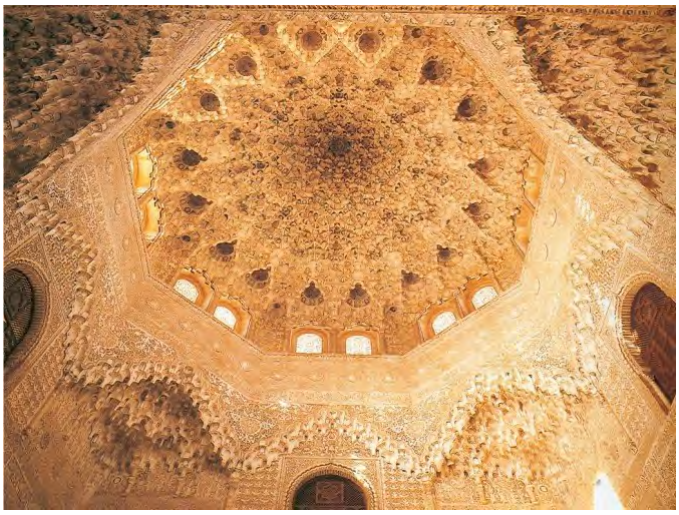


Figure 3.52 An interior view of the Ambassador's Hall cupola which resembles an inverted cactus with its segments and indentations and intricate detail symbolising spikes and ribs. (Portoghesi, 2000: 266)

Portoghesi believes that theorists of organic architecture understand nature's complexity and appropriateness, but he seems to go further into another understanding, that for nature appearances and their functions are of equal importance and that in as much as they are independent organisms. They are made to interact with organic and inorganic elements and these interactions are what determine their forms.

Portoghesi has hypothesized 'Listening architecture' that involves man and objects which stems from the observation of nature and "spirit" of place. This is based on a theory that defines morphic fields (these permit the site not to be considered as an island but as an entity that interacts with its surroundings and is influenced by past events of the site) in which they can influence the harmony between the site and its architecture, an element vital for successful acclimatization. Listening architecture tends to connect the building to the site so that it grows upwards from the site like a plant. This concept is just like how through their roots plants draw water from underground sources, taking nourishment from what is actually there and from what passes through or has passed through, leaving just faint traces. But to be in harmony does not mean that a site is an island of area on the earth's surface, because earth is a system within systems, and therefore the site is connected to and a part of these systems. Therefore when designing a site, it should be understood as a base for receiving flows and messages from all other surrounding sites, and also giving messages back, while having its own individual identity (Portoghesi, 2000: 63).

These parallels between nature and architecture must mean that even on a subconscious level man must be seeking for inspiration in design and finds the ideal model in nature due to its enormously varied functions, forms and aesthetics where the materials to observe the integration is vast and complex, yet common and simple at the same time.

3.1.2 NATURE AND THE BUILT ENVIRONMENT

Can we compare architecture to nature, one being a part of the whole of another. The answer should then be 'yes' because as history is made man leaves his defiant mark on the earth, which is a mixture of objects and signs that give evidence to his time there. This 'mark' or most significant part of it is mans' architecture which can be found above and below the earth's surface. Some architecture is based on a structural and symbolic interpretation of nature to which certain methods and principles are established, and experienced through man by his five senses as well as through language and thought. Portoghesi believed that the 'symbolic imitation' was a good way to understand the specific relationship between architecture and nature. Architecture allows man to give rise to forms and objects that render natural experiences ambiguously and imitate structures that when experiencing the object seem both near and far or traceable and lost. According to researcher Fischer-Barnicol, the symbol is the simplest and most reflective device to express a certain reality in a different medium. And so by using a symbol, the object of imitation or experience captures an intangible or invisible force in which can be revealed for a person to experience. A symbol therefore helps to express the inexpressible (Portoghesi, 2000: 9).

An architect who shares a similar outlook is Crowe, who states that mankind reveals their presence in the world by creating places – buildings, towns, villages, farms, and cities – which are directly or indirectly set into the world of nature. The first environment of humans is the natural environment, in which humans learned the most amount of knowledge of the world they come from, and the only lifestyle and system in which to compare or speculate against. Humans have created our ideologies of how life must work, and how the world exists within a greater universe from what they have observed firsthand in nature: life and death, the passing of days and the seasons, the geometry of ecosystems and life forms, the seasons of the years and the stars, moon and sun of the sky (Crowe, 1995).

When looking at any other living species, such as animals and insects, one can notice a distinct difference between humans and the rest of the world in terms of their habitat. Providing shelter is a part of survival in which all living species do, but humans are the only species that take that function and advance it to a level of forming art, as humans have become obsessed with advertising their homes with architecture. From settling down in a fertile place protected from the elements they have instead erected buildings and cities that contest with nature for grandeur; by making an artificial world within a natural one. An ideal balance between the human world and nature is an individual choice, and not the same for everyone everywhere. But this cohesive balance is not just a scientific definition but a critical humanistic necessity that needs to be addressed (Crowe, 1995). A perspective of architecture and the built environment dealing with nature in some way should be expressed.

A history in the relationship between architecture and nature can be seen since the 19th century, explains Mateo, as it can be represented as the history of forms in architecture; framing, imitating or transforming the specific forms of nature and its forces. Historically Joseph Paxton's Crystal Palace at the Great Exhibition of 1851 in London plays a central role (*fig 3.53*). As is generally known, the transept of the building had to be designed in a manner as to spare three old elms in Hyde Park. These remained unspoiled within the glass architecture as an idealistic aura of nature, as an image of an entity that in fact had actually been eliminated and destroyed by the architecture. The most influential architecture in the imitation of nature was in the 20th century by Alvar Alto and Eero Saarinen. They followed organic shapes in the broadest sense. Their method of applying the materials – whether it was wood or concrete – reflects the forces of nature, which become visible through the materials, i.e. the force of gravity, tectonics, erosion and growth. Using Nature as a metaphor the message was in inserting something that in principle is unplaceable into a larger context. Another reason was that their projects always communicated that the forces of nature fundamentally could be captured and made accessible to humans, and that they were not

threatening but available. An example was Saarinen's TWA Flight Centre (*fig 3.54*) in the John F. Kennedy Airport which is reminiscent of a bird spreading out its wings (Mateo, 1997: 11-13).

Figure 3.53 Joseph Paxton's Crystal Palace in England built on temporary glass and steel frame and accommodating the existing trees in Hyde Park. Mateo, 2007: 10)

Figure 3.54 TWA terminal by Eero Saarinen with its curvaceous and flowing interior forms synonymous with Organic Architecture and the natural flowing movements of Nature. Mateo, 2007: 12)

> *"Man has always been intervening in nature. With the emergence of things like bioengineering and nanotechnologies you could really say that culture is more driven by nature than nature is being driven by culture at this point. There is a kind of awareness that we have a lot to learn from nature: not in an idealised way by looking at it as a sort of wild thing out there, but by regarding it as a kind of system that calculates and regulates. If we can understand those mechanisms, we can also produce an architecture that is more responsive."*
>
> Conversation between Stan Allen and Florian Sauter (Mateo, 2007: 139).

There are working examples of the merging of nature and architecture, forming harmony and respect while existing together.

3.1.3 EXPRESSION OF A MODEL RELATIONSHIP WITH NATURE:

Frank Lloyd Wright's Fallingwater, Pennsylvania

An articulation of an absolute balance between architecture and nature can be found in Fallingwater (*fig 3.55*). Fallingwater over the many buildings produced in the modern age is the building generally viewed as the ideal response to nature. It became the advert for Organic Architecture and initiated a huge interest in this genre of building typologies that was brushed aside before. In 1936 Frank Lloyd Wright was commissioned to design a summer or weekend house for the affluent Kaufmann family (Crowe, 1995: 10). This home was intended to be an escape from the city in which this close family could relax and bond. Mr. Kaufmann provided the site and Wright was allowed to design without any limitations. What resulted from this was a building that completely exploited the site, a site which was the most difficult and unusual seen to date, a building built on top of a waterfall (Hoffmann, 1978: 3).

Figure 3.55 A perspective view showing Fallingwater set on top of a waterfall and stream. (Waggoner, 1996: 28)

According to Hitchcock the Kaufmann House encapsulates two ideals of Romanticism. The first ideal was the site and designs romanticism with nature and the second was the romanticism of impossible scientific constructions. This building and its design represented material for any creative person to draw from as it became an inspiration and a different way forward for architecture (Hitchcock, 1942: 90).

The site was located in an area of the Pennsylvania woods in which a stream with waterfall ran through (*fig 3.56*). This location was termed Bear Run. The access route to get to Fallingwater was quite complex having to first move through thick vegetation, then enter the gorge, move across bridges to get to the building. This evoked a sense of anticipation as the sounds of water from the stream could be heard quite early. Once the building is seen the viewer is met with a composition of verticals and horizontals all elevated or hovering above a waterfall dropping down below. The building appears to be in flight waiting for the right forces to push it along the stream. The general architectural aesthetics of the design entirely incorporate all of Wright's famous characteristics such as cavernous overhanging eaves, windows, alcoves, terraces and prominent balconies (*fig 3.57*). The main entrance of the building has not been made a prominent aspect and is quite low-key. The entrance is situated in between two rock masses with the floors also made of rock. The feeling which is evoked at entry is similar to entering a cave; this is emphasized by the amount of rock finishes and protrusions in the interior spaces (Hildebramd, 1991: 96).

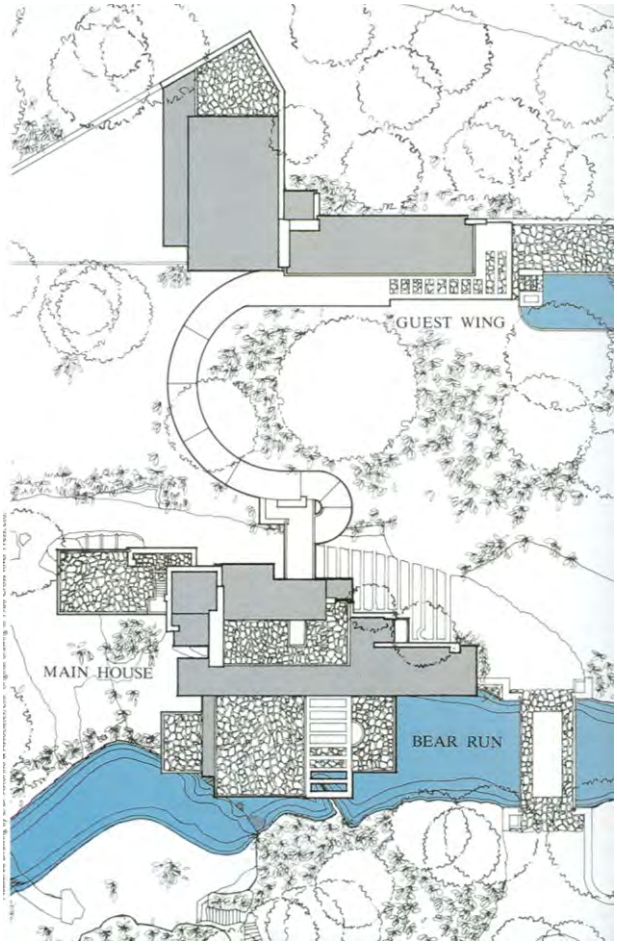


Figure 3.56 A roof view showing the location of the main house and guest wing in relation to Bear Run. (Waggoner, 1996: 80)

Figure 3.57 An image of Fallingwater portraying Wright's design characteristics - balconies, overhanging eaves and hidden window supports. (Hoffmann, 1978: 51)

The interior space is open and unobstructed and there is an immediate presentation of the nature outside by the wide panoramic glass walls which seem to break the house into just anchored floor and floating ceiling (*fig 3.58*). These glass windows are actually supported by steel mullions but these are mostly hidden from view by the large cantilevers. One enters into the main living space and two things are immediately apparent, the first being the unique fireplace also made out of roughly coursed rock, and the second is the built in furniture kept mainly towards the edges of the space. The private spaces, master and secondary bedrooms and bathrooms, are located at the upper level with each having its own private terrace which juts out into the woods and nature (Hildebrand, 1991: 100).

Figure 3.58 The spacious living area with built in furniture at the edges. The gleaming stone flooring is a reminder to the wet rocks of the stream. (Waggoner, 1996: 52)

Fallingwater presents the viewer with a complete sensory experience filled with drama. This structure induces the human sense of sight with its complexity of planes, sound with the soothing and violent sounds of the waterfall, smell as the fragrant scents of the forest permeate the air, and touch as the textures of rock, stone and plaster all contrast to one another. At a visual level Fallingwater is a series of balances; balances between elongated cantilevers with vertical stone towers, smooth plastered horizontals to textured vertical stonework, transparent openings to solid walls, and ultimately flowing water to still architecture. The main theme of the house was to merge with nature and this was done with a more open indoor outdoor relationship and a complimentary palette of natural building materials. The large window planes easily connected visually the nature outside to the living human space inside, and open up at most edges to create a barrier free zone and complete flow of space, an expressive communication to the outside realm. The natural materials like mentioned before gave a part of the building a cave-like appearance such as the rocks but there were also other elements such as where the natural boulders of the site protrude into the

living and circulation space (*fig 3.59+3.60*) and the moss gardens are situated under windows, and where the concrete beams defer to the exposing trees and are constructed around them (*fig 3.61*). The vertical stone towers where constructed from indigenous rock that was made to look like the texture of rough bark like the surrounding wooded trees (Moore, 1994: 197). No action has been taken to interfere with the lush natural growth of fauna of the woods or even the flow of water of the stream; the woods continue on as of the building was not even there. The woods even take over to an extent where smaller plants have grown over the pergola projections (Hitchcock, 1942: 90). Even small details have been considered in keeping the relation to nature such as the floor finishes. The fieldstone paving in the living room space have been coated with wax so that they relate to the water glazed stones at the stream. Every aspect of the building was designed to be second to the natural environment and not alter its natural harmony (Moore, 1994: 197).

Fallingwater is basically anchored to the rock cliff over the waterfall. The main strength of the building is obvious, as it comes from the rigid, massive concrete slabs and who it is anchored to the Cliffside. The enormous mass of rock is integrated into the building design almost holding the building down, or counter balancing the weight ratio of the terraces over the water (*fig 3.63,66,69*). The hovering of the terraces does create a feeling that they might tip over into the stream but the solidity of the stone vertical pulls the structure upright balancing the entire structural composition (*fig 3.68*) (Hildebrand, 1991: 96). Sound is also an important factor to consider with this unique location as the sounds of the stream can be heard in almost every area of the house. These sounds vary according to the season where in summer the water is gushing and loud and in winter where there is the dripping of water drops or even silence from the water turning to ice from snow cold conditions.

Figure 3.59 The existing boulders have been left untouched and incorporated into the building disturbing the natural features as least as possible. (Hoffmann, 1978: 87)

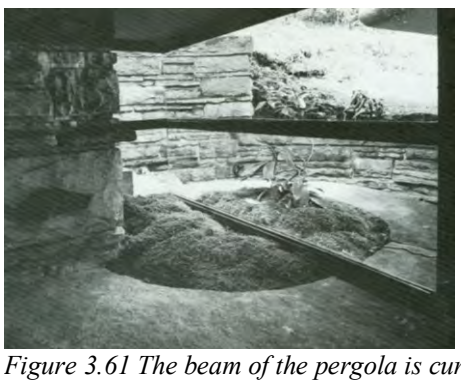


Figure 3.60 A visual and physical connection of indoor-outdoor with the moss garden simultaneously being on the inside and outside of the building.. (Hoffmann, 1978: 87)

Figure 3.61 The beam of the pergola is curved to accommodate the location of the tree trunk, complete respect for nature. (Hoffmann, 1978: 43)

It was advantageous that concrete was used in building construction as the mass of the material provided a sound filter reducing the harsh stream sounds especially when for example the family was trying to sleep (*fig 3.65*) (Moore, 1994: 198).

Wright incorporates unusual design elements linking to nature like the exterior staircase (*fig 3.62*). This staircase is accessed from a glass canopy in the living room which opens out to show steps that are suspended by metal strips. These steps lead to a lit platform which hovers just above the stream allowing the residents to splash their legs into it. This feature provides a constant link with the water to the architecture. Even the forethought to the types of experiences that would be created is impressive as the terraces allow the residents to feel the mist on their faces as the turbulent water spray up from the stream (Moore, 1994: 198).

Figure 3.62 The unique suspended stairs that access the stream from the living space and maintains a constant connection to the water. (Waggoner, 1996: 66)

Figure 3.63 The house is anchored to the rock cliff at the rear allowing the terraces to reach out far over the stream. (Waggoner, 1996: 24)

The building orientation and location became quite beneficial to creating better livable spaces. The current position allowed direct sunlight to penetrate the main rooms, while the original location would have not provided this. The original suggested location was actually downstream from the waterfall and would have worked terribly for the residents. This is because the house would have been more dominated by the waterfall and the sounds from it would have been thunderous. This location would have also resulted in a free-standing house rather than the organic morphing image the building is today (Hildebrand, 1991: 104).

Fallingwater speaks to the individual, natural sense of place of this site with the cantilevered terraces echoing the aesthetics of the overhanging rock strata of the waterfall, in dimension, colour tones and geometry. This links the parallel representation of danger from the over hangings of both the natural rock and unnatural terraces and this links the building more psychologically to the site (Hildebrand, 1991: 104). These parallels in form, colour, composition, and character evokes a sense of rightness that is perhaps due to the fact that each

element of the building was designed to evoke a similarity and contrast to its surroundings, the highest qualities of natural landscape (Aguar, 2002: 230).

Fallingwater is an ideal expression of an architectural structure creating a dialogue with its site, not just as a house overlooking nature but one that participate in it. It is perfectly balanced and contrasted to the natural setting. This building design provides connection with architecture to nature, water to architecture and humans to nature, creating a natural, organic, modern sense of place.

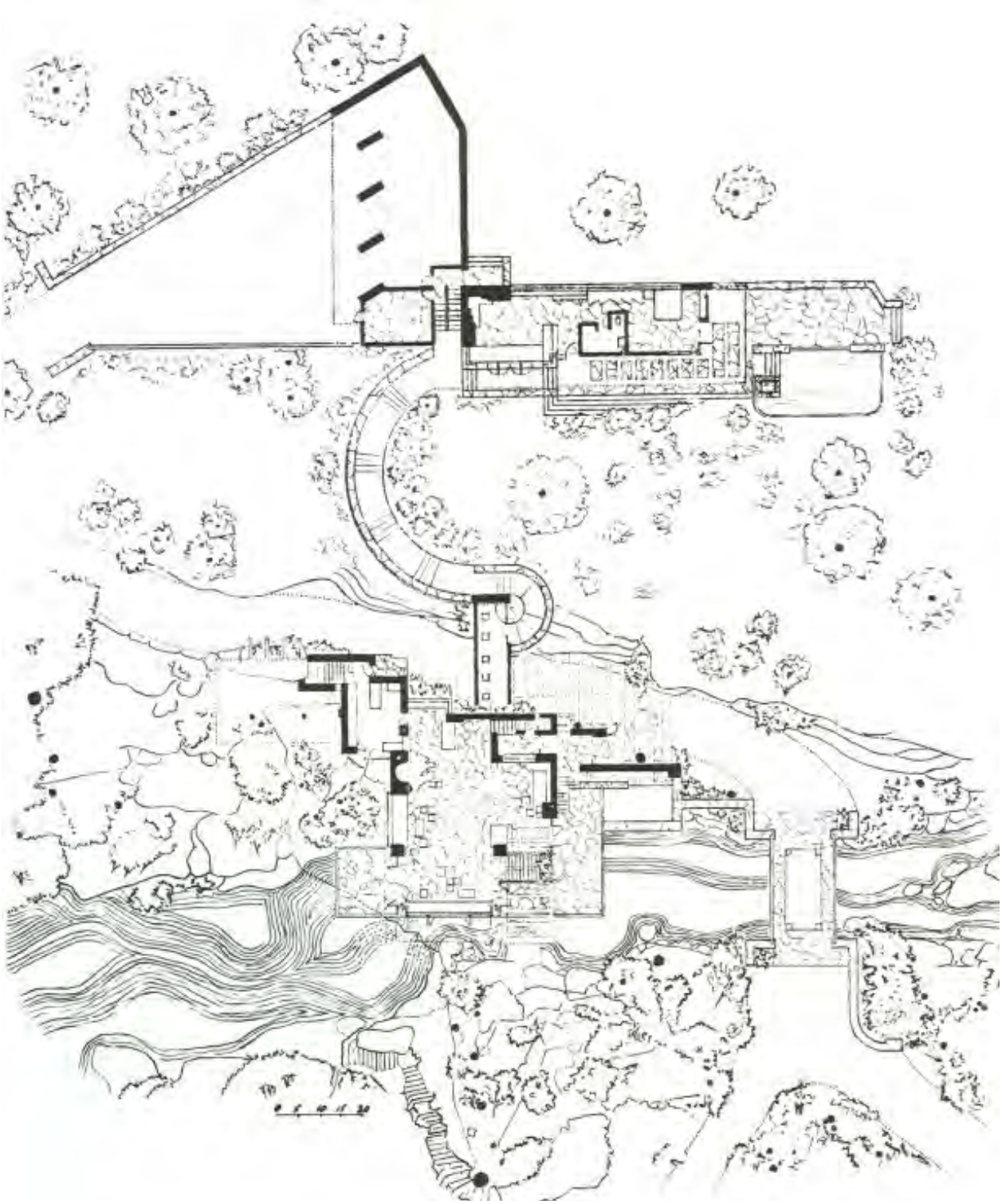


Figure 3.64 A site plan showing the connection between the guest house and main house separated by the driveway. (Hoffmann, 1978: 79)

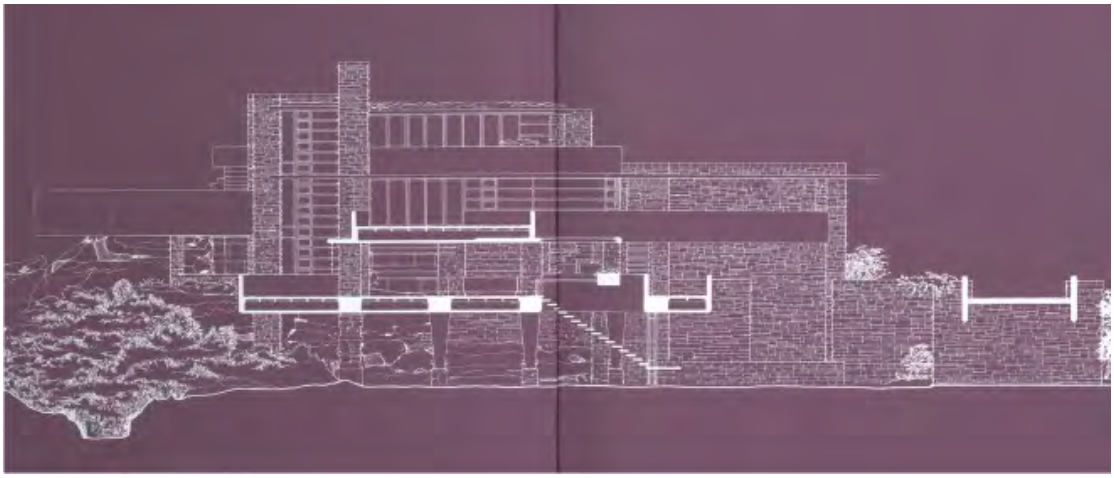


Figure 3.65 A drawing indicating the strong, smooth, plastered horizontals of the terraces against the tall, textured verticals of the stone towers. Heavy concrete slabs were used for these terraced planes because it was the only material that could accomplish these spans. (Waggoner, 1996: 1)

Figure 3.66 This side view shows the main component of Fallingwater and guest house arranged against the hillside, looking like it grew from the site, un-dominating. (Waggoner, 1996: 40)

Figure 3.67 Intricate detail of design can be seen with this corner window meeting a desk and the cut out in wood allowing a window opening to be placed. (Waggoner: 1996: 61)

Figure 3.68 Wright's elimination of mullions at window corners allow the corners to open up, a special feature of the house and typical Wright characteristic. (Hoffmann, 1978: 54)

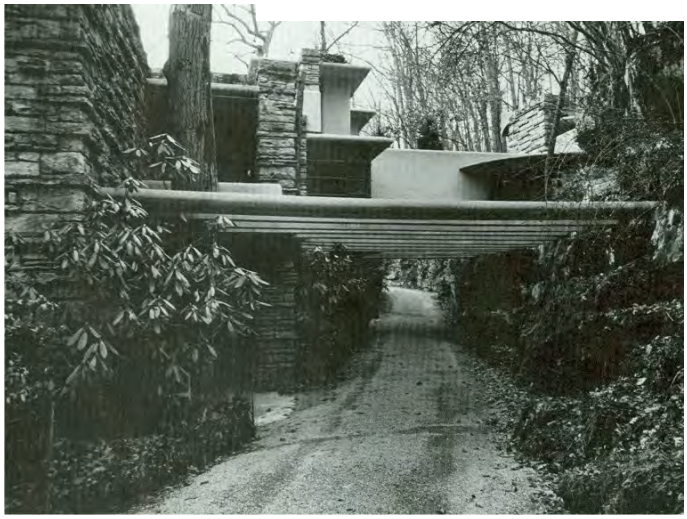


Figure 3.69 The second floor trellis or concrete pergola tying or anchoring the building to the hillside. (Hoffmann, 1978: 42)

3.2 CRITICAL REGIONALISM

Critical regionalism is an approach to architecture that attempts to counter 'placelessness' and lack of identity in Modern Architecture by making use of the building's geographical context. This theory was first implemented with Alexander Tzonis and Liane Lefaivre. Tzonis and Lefaivre states that Critical Regionalism came about as a movement or idea in undertaking a different view to Postmodernism. It became the theoretical framework for the architects who looked at a concept where design was based according to individual identities and not a universal ideal or formula. Critical Regionalism also became known as Realism which all was concerned with the conflict between globalization and international intervention, and local identity and ethnic seclusion. Regionalism's approach to design was to express the value of physical, social and cultural identities of a particular region all within the context of its current political, ecological and intellectual position; and to investigate the potentials of this initiative in creating the most appropriate and suitable architecture (Lefaivre, 2003: 10). Critical Regionalism recognizes that in design the value of the identity of a physical, social, and cultural situation should have precedence on the design process and overall architectural product. Regional architecture confines itself to dealing with a specific identity which can be traced back to an identifiable group – it therefore becomes not only site specific but people specific (Lefairve, 2003: 12).

Climatic and physical elements are a great influence to buildings in this style, and so these elements therefore influence human beings. Colder regions have their own style of architecture being more enclosed to retain warmth whereas the warmer regions tend to be open to access better cooling ventilation. These two types of regions then influence the human habitation and therefore the human movement and patterns. Since critical regionalism refers to many different ecosystems, environments and regions; it consequently covers many various cultural identities and diversity of architectural styles and expressions (Lefaivre, 2003: 11).

The awareness of regional architecture as an expression of a groups' identity being recognized and understood dates back as far as the ancient Greek period. In ancient Greece each region, while all being building temples dedicated to different Gods, would do so ornamenting these buildings using architectural elements with individual motifs that would be characterised in each region. So where the design of buildings was generally the same the decoration of columns and such each had a different identity and thereby allowed each region to be identifiable. One of the earliest references to regional concept of building design came from *Vitruvius's De Re Architectura*, where he suggests that natural events or incidences and human ideology are the factors that established architectural form. Vitruvius states that architecture is influenced by specific and restricting external and internal elements and that

one can actually see the differences between the kinds of buildings when moving from one region to another. And that these buildings where resulted from each regions differing physical environments and differing characteristics of a house as established by Nature (Lefaivre, 2003: 11).

Tzonis and Lefaivre bring to the table that Mumford who was a regionalist thinker believed that critical regionalism could be summed up in a few points and these were (Lefaivre, 2003: 13),

- A search for authenticity and return to one's roots. He argued that although natural processes, the use of natural materials, and the methods of natural construction was a valuable knowledge and resource but that this could not be applied to every region and culture. Limiting societies to these traditional forms of thinking was hindering them in the advancement of architectural expressions. So the use of traditional architectural systems should be used specifically and effectively and not everywhere at once.
- A step in returning to nature. He believed that in making a successful human environment, it was not just about placing a building on a piece of land but the interaction of that building to its surrounding context and site topography. To fully utilize and capture the natural processes and forms of nature would result in a better architecture and completed living space. Ecologically the importance of a balance between man and nature was important and through this sustainability was the way forward was his assumption.
- Mumford approved of the use of advanced technology, feeling that this tool was highly relevant and important in the use of furthering architecture and the human society, but not at the price of losing the cultural beliefs and practices that people have tried to maintain. There would be a need to create a balance between these two of technology and history.
- He viewed communities and culture as an important aspect of building as these people used buildings to express and enhance their stations and view of themselves. Buildings were important aspect to communities and determined many elements of their societies such as maintaining a degree of order, establishing cooperation and intelligence and sensitiveness, all factors which make a multicultural community.
- And lastly he believed that regionalism should strike a balance between the opposing forces of local and regional versus universal and global. That while maintaining cultural roots the use of technology to advance humans was essential.

Mumford's vision was for multicultural and traditional communities to architecturally adapt to the new technological changes in the world as elegantly and gracefully as possible while preserving identity, sustainability, memory, community, and traditions. He believed that breaking away from stagnant older practices while keeping the diversity and essential belief system and furthering the built environment universally was the way forward (Lefaivre, 2003: 20).

Critical Regionalism was later analyzed by Kenneth Frampton who had a rather different view to Alexander Tzonis and Liane Lefaivre. He states that,

> *"The fundamental strategy of Critical Regionalism is to mediate the impact of universal civilization with elements derived indirectly from the pecularities of a particular place"* (Frampton, 2002: 82).

Kenneth Frampton views the world today as a competition between globalization and culture, where with changes to the world from technology and appearance cannot form a coherence or partnership with traditional and ancient cultures, and where the former dominates and obliviates the latter. It is the shifting of locally inflected culture to universal civilization (Frampton, 2002: 78). As a social people, humans need advancement and creation in order to thrive and exist but without the basis or foundation of values, principles and cultural tradition the meaning to living is lost. When seen in the urban fabric the meaning and significance to homes and buildings that were created directly from nature, created before most of the development of technological advancement, is being forgotten and overtaken to make way for the newer and hi-tech developments. But the difference in these urban fabrics is great as the traditional symbolizes where mankind has come from, and where within the bigger scheme of the world humans have a part. But the newer and dominating fabric while providing many luxuries and comforts, does not explain our part in the world sense, only considering humans lifestyle, 'utopia', and selfish goals. By having grown from living with the earth and using its resources to provide places to live and work and play, man has been made aware of the role nature plays within the function of the universe.

But Frampton believes that while modern architecture is not the most successful, or highly ecologically beneficial, it cannot be ignored and should be strived to find a balance in implementing the new ways into the older world. Frampton breaks down the relation of man with nature or even architecture with nature. He observes that with modern development, collaboration with nature is not being considered as most sites are earth-moved and an irregular topography is flattened out for a building to easily sit on. This becomes universal design that can be applied anywhere and not site-specific, which could relate and connect to its natural site and context. This makes for unsuccessful architecture because of a cultivation

of the site and not an adaptation of it. By building into a site and taking advantage of its local climate, and light a better building and internal environment can be borne and not a building creating placelessness which contributes nothing to local landscape and cultures (Frampton, 2002: 86).

A building project that does consider culture and local conditions of light and wind and materials is Renzo Piano's Tjibaou Cultural Centre in Nouméa, New Caledonia, which was dedicated to the political leader, Jean-Marie Tjibaou who was assassinated in 1989. The main aim of the project was to honour the local Kanak culture while simultaneously respecting its traditional, history and any other sensitive aspects. Piano decided to merge European technology with the traditions and expectations of the Kanak people and resulted in a new synthesis between local traditions and global modernity. A vital factor was that Piano had to gain an understanding of the development of the Kanak culture from its history to environments and belief structure, in order to fully credit and do justice to these people's lifestyles and traditions. The architect incorporated natural materials and methods and had to draw on the natural elements of wind, light and vegetation. The structure most importantly had the reflection of the functionality of the Caledonian huts architecturally and socially.

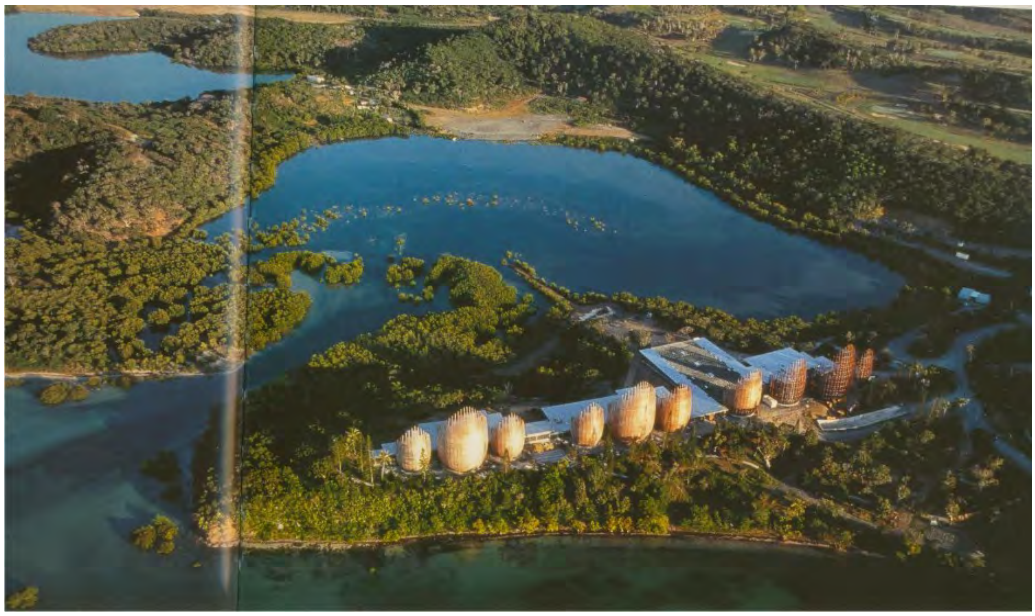


Figure 3.70 The Tjibaou Cultural Centre set within a beautiful lush green natural landscape. (Lefaivre, 2003: 83)

The centre comprises ten 'houses' with each house being different in size ranging from twenty to twenty-eight metres in height. Each hut has a different function and theme with these functions being temporary exhibitions and contains an auditorium and amphitheatre. Another series of huts holds administrative departments, research areas, a conference room and library. And the last set of houses house studios for traditional activities such as music, dance, painting and sculpture (*fig 3.74*) (Lefaivre, 2003: 82).

The building reinforces two factors, the identity of the Kanak people and a relationship with the natural landscape (*fig 3.70*). Situated on a peninsula between a stormy Pacific Ocean and calm lagoon the building design maximizes the prevailing winds from the ocean side through natural ventilation (*fig 3.72*). Horizontal wooden slats composed of iroko wood (a local type of wood that is impervious to rot and can withstand cyclone-force winds) sit on the outer façade facing the ocean and filter the wind into a second layer of skin, an inner façade of glass louvers which open or close according to wind speed, allowing wind to flow through the building for passive ventilation. The double layer of skin also filters the warm air upward functioning similar to a chimney. Adjustable skylights on the roofs allow for natural climate control and the soothing sounds of Pacific breezes (web 15). This building encapsulates the idea of Critical Regionalism by delicately balancing the traditional forces of local culture and materials while adapting it to a larger technology (*fig 3.73*) creating a heritage landmark that is at the same time contemporary.

Figure 3.71 The differing heights of the houses and the unusual form. (Lefaivre, 2003: 85)

Figure 3.72 The Cultural Centre lit up at night facing the Pacific Ocean. (http://www.dailyicon.net/2009/03/icon-tjibaou-centre-cultural-by-renzo-piano/)

Figure 3.73 A close up detail of the modern technology anchor construction of the outer frame. (http://www.mathis.eu/references?page=ref_detail&id=118&lang=en)

Figure 3.74 a series of huts which distinguish the different functions and hierarchies of the tribe and a central alley along which the huts are dispersed. (http://www.galinsky.com/buildings/tjibaou/index.htm)

3.3 ORGANIC ARCHITECTURE

3.3.1 DEFINITION & DESIGN PRINCIPLES

A successful definition of Organic Architecture is - an organic structure is built according to nature's principles: harmonious in all its parts and with the environment, it expresses and unifies all the factors calling it into being – site, materials, client needs, and architect's philosophy, construction methods, its culture, and the nature of the problem. An organic structure defines and prophecies life, grows along with those who use it, states an idea about a social reality, and, by including everything necessary and nothing unnecessary for its purpose, is as unified and economical as nature itself.

> *"A building can only be functional when integral with environment and so formed in the nature of materials according to purpose and method as to be a living entity," Wright maintains. (Twombly, 1979)*

Blaser comments on Rudolf Steiner, an architect whose designs lead to integration with nature, that the visual connection to organic architecture is by nature's processes – these are of becoming, growing, and passing away. The notion of a building is one that needs to be seen as unique, that always relates differently with each location as it is integrated into the natural landscape. That Organic Architecture was developed from the form-shaping forces of nature's essence, and was bettered by the use of unorthodox natural materials under regional and topographical conditions. What is also vital is the attention to detail which is so important in the natural world of expression. Blaser also states that "*architectural interpretations and works that are created in unison with the location always form foundations of a cultural responsibility, as well*" (Blaser, 2002: 40). In Rudolf Steiner's lecture "*Architektur, Plastik und Malerei des Ersten Goetheanum"* at Dorach in 1982 he states: "*The building is but a piece, cut out of the world*" (Blaser, 2002: 25).

David Pearson an environmental architect states that organic architecture is inspired by life, nature, natural and biological forms. This type of architecture is one that emphasizes harmony and beauty through free-flowing curves and expressive forms sensitive to the human mind, body and spirit. Where it is stated that with Critical regionalism the new demands of technology erodes the local, traditional cultures, this same technology has enabled Organic designs to be forms into complex, creative and sophisticated shapes; and where the restriction of design has moved away from the straight line, right angle and the cube. Pearson explains that using the idea "strength through shape" stronger structures are created from curved forms such as domes, arches, and vaults, and these shapes are unrestricted to forming structures as both modern and traditional materials can be used. Organic architecture is visually poetic,

distinctive, and environmentally aware and represents harmony of place, person and materials (Pearson, 2001: 8). Organic architecture is multifaceted with numerous images that are adaptable and evolving constantly, but all coming from one main inspiration – nature. The main themes or principles of Organic Architecture as portrayed by Pearson are the following:

BUILDING AS NATURE

The most fundamental inspiration of Organic Architecture is Nature in which its living organisms from their appearance to internal functions offer ideas for successful resolved design. As it works with metamorphosis Organic Architecture "designs from within", where the building itself is seen as an organism and a part of nature growing from the inside out to form a symbioses with its natural environment (Pearson, 2001: 10).

> *"Above all, organic architecture should constantly remind us not to take Mother Nature for granted – work with her and allow her to guide your life. Inhibit her, and humanity will be the loser."* ***Kendrick Bangs Kellogg***

CONTINUOUS PRESENT

A special characteristic of Organic design is its continuous process, where it is never finished and always in a state of change. This concept brings freshness and originality to a design that should never repeat itself, just as Antoni Gaudi designed his buildings on site felling the environment and atmosphere rather than drawing lines on a piece of paper (Pearson, 2001: 12).

> *"Everything is the same except composition and as the composition is different and always going to the different everything is not the same. So then I as a contemporary creating the composition in the beginning was groping toward a continuous present, a using everything, a beginning again and again."* ***Bruce Goff***

FORM FOLLOWS FLOW

There are dynamic forces of nature around all buildings and sites, within the natural environment and to work against these forces cause negative energies and impacts of the buildings. Therefore the forms of buildings should follow the flow of energy and thereby be created by it. These energies are wind, heat and water currents, earth energies, structural forces, electric and magnetic fields, and even so far as the energies of the human body, of mind, spirit and body. These flows of nature are naturally curvilinear and so organic architecture is born (Pearson, 2001: 14).

> *"For America today Organic Architecture interprets this local embodiment of human freedom. This natural architecture seeks spaciousness, grace and openness;*

lightness and strength so completely balanced and logical that it is a new integrity…" ***Frank Lloyd Wright***

OF THE PEOPLE

Design of buildings is for the people and the communities so places special emphasis on developing sensitive, creative and individualized relationships with both client and users. So rather than designing from outside in, concern from form and structure should be shifted to functionality and comfort too. Some architects express a view that by seeing a building as an organic whole that everything including interior decoration and furniture should be looked at from design (Pearson, 2001: 16).

"Buildings are meant for people – and this includes literate, illiterate, young and old…Each individual, each community has its own preferences, hence they should be allowed to express themselves symbolically. Form should not be finite but should be amorphous so that the experience within is loose, meandering and multiple." ***Balkrishna Doshi***

OF THE HILL

The relationship of the building to site is an important aspect as Frank Lloyd Wright expresses "of the hill" instead of "on the hill". Organic Architecture preferably should have its structures grow out of the site than beplaced on it. Awkward site provide better challenges to architects to come up with unique building designs and create imaginative solutions. It is also a belief that building on urban or reused land is a better alternative to virgin, untouched land to lesses the human impact of the natural environments in terms of land and wildlife (Pearson, 2001: 18).

"Fortune has seen fit to make our abode. I hope that my work may be instructive, showing my respect for every part of the earth, with its own materials and traditions, while adding only the best part of progress, without breaking the harmony of the place." ***Cesar Manrique***

"The form…came about due to my understanding of the nature of the site and grew from it as a plant might, in the sense that it belongs there and wouldn't have come to being in this form in any other location." ***Bart Prince***

OF THE MATERIALS

The building materials chosen for building a design create organic forms by their individual qualities. Their properties allow the best form and shape of a structure. The best materials for organic architecture are traditional local materials such as earth, straw, wood, and now new

materials offer fresh opportunities for design. Innovative materials are always looked towards with organic architecture as better designs structures and forms come of these but with the natural worlds state today, it is also vitally important that the materials chosen be healthy, ecologically sound and resource efficient. Organic architecture allows the building materials to express their individual and unique characteristics instead of hiding them behind plaster and paint, giving the structure a special spirit or atmosphere (Pearson, 2001: 20).

> *"To create an architecture of meaning and beauty we need to return to the source – nature. we should make use of materials and innovation provided by the natural world and put them to good use according to their true nature, not merely to imitate the appearances of the past…But if we…use nature as a basis of design we can create a new, evolutionary architecture."* ***Eugene Tsui***

YOUTHFUL AND UNEXPECTED

Organic architects are within a movement that is not all standard and similar. The main aspect about organic architects is that they are very dissimilar, with individual characteristics and styles but yet all fall under the same umbrella of Organic Architecture. Their designs feel youthful and playful, eccentric and provocative, serious and unusual. Their building can be very powerful or completely understated but with deep underlying use of symbolism, metaphors and concepts (Pearson, 2001: 22).

> *"Designing is a journey in a way. You set off to find out, to learn. You accept the unexpected. Each project is a new start, and you are in unexplored territory. You are a Robinson Crusoe of modern times."* ***Renzo Piano***
>
> *"The environment is something to be played with as well as in. Interactive rather than passive, it also plays with you, eliciting a reaction from you as you move through it, while also sculpting your movement…As in the imagination of a child, everything can be, and is, alive."* ***Koval***

Organic design reflects an energetic, opulent, and sometimes extravagant complexity of line, form, texture, structure, and colour. Less is not always more in Organic Design, and because of this view it was disparaged by a majority of the critics, as well as how Organic architects aided philosophical ideas such as the interrelation of practical architecture, mystical nature, and progressive technology. Organic structures from walls to floors are frequently local stone drawn from the ground; the wood and brick are left unpainted, allowing the natural embedded textures to create the tone and quality of the surrounding structure (Weintraub, 2006: 6).

But organic buildings necessarily are not all alike, for example, the intricate geometric plans and ornament of the Purcell and Elmslie firm in the 1920's did not resemble the free-form

spaces of John Lautner in the 1960's at all. What is common between them is the concept of visualizing a building's design, structure, use, and life as an organic thing –as something that grows from the seed of an idea into a fully expressed, multifaceted, and cohesive architectural work of art. In the hands of Bruce Goff or Charles Haertling, these design principles resulted in buildings that literally looked more like a living thing than traditional architecture. Whereas when designed by Fay Jones or John Lautner, the individual image and character of caves, meadows, or forests could be interpreted into firm architecture. With Walter Burly Griffin or Mickey Muennig, a building could be rooted so exceptionally in its landscape that it seemed to be a part of the geology (Weintraub, 2006: 6).

On the other hand machinery just as much as raw nature makes up Organic Architecture. John Lautner created unusual shapes and dimensions in his structures due to the modern technology of earthen concrete. Bruce Goff used plastics, corrugated metal, and metal guy wires next to walls of anthracite coal laid up as masonry. The imagery of Organic Design is possible to invoke primordial caves as futuristic spacecraft. The line between indoors and outdoors is often blurred, making the outdoors livable and the indoors a garden (Weintraub: 2006: 7).

Zebi states that in history persists two distinctive trends of architecture – one leaning toward the rational and the geometrical and the other toward the irrational and the organic: two different ways in dealing with the environment. Zebi states that around 1900 Louis Sullivan said 'Organic means living, means development'. One of the most important historians of modern architecture, Behrendt, has classified what makes organic architecture portrayed in a comparative list:

	Organic Architecture	Inorganic Architecture
1.	Product of intuitive sensations	Product of thought
2.	Work of intuitive imagination	Work of constructive imagination
3.	In close contact with nature	Contemptuous of nature
4.	Delight in multiformity	Aspiring towards rule, system, law
5.	Realism	Idealism
6.	Naturalism	Stylism
7.	Irregular forms (mediaeval)	Regular forms (classic)
8.	The structure like an organism that grows in accord with the law of its own individual existence, with its own specific order in	The structure like a mechanism in which all the elements are disposed in accord with an absolute order, in accord with the

	harmony with its own functions and with its environment, like a plant or any other living organism.	immutable law of an a priori system.
9.	Dynamic forms	Static forms
10.	Forms based on freedom from geometry	Forms based on geometry and stereometry
11.	Anti-composition	Composition
12.	Product of contact with reality	Product of education

Figure 3.75: The difference between organic and Inorganic Architectural Principles according to Behrendt (Zevi, 1949: 69)

In an exhibition of domestic furniture held in New York under the title 'Organic Design' the definition included:

> *"A design may be called organic when there is a harmonious organization of the parts within the whole, according to structure, material, and purpose. Within this definition there can be no vain ornamentation or superfluity, but the part of the beauty is none the less great – in ideal choice of material, in visual refinement, and in rational elegance of things intended for use."* (Zevi, 1949: 70)

And so organic architecture is inspired by nature and reflects its principles, a vehicle for bringing the symbol of the natural world into architecture.

3.3.2 NATURE AND ORGANIC ARCHITECTURE

Described as the father of Organic Architecture, Frank Lloyd Wright around 1900 developed a fresh modern architecture that engaged both contemporary machinery and the ageless natural landscape, with a theme in the philosophy of Organic Design. Nature was so fundamental in Wright's thinking that he published a book called The Natural House in 1954. He used the word "nature" in two ways, referring the first to external nature and the second referring to human internal nature.

On the "external" level there were four ways nature informed Wright's work. The first way was that he believed people should live close to nature, as one of his main characteristics was his architectures integration with the natural environment of the site. His buildings hugged closer to the ground than any of the other the buildings in the area, as he engaged outreaching terraces and porte-cochere, casement windows, overhanging eaves, horizontal strips of trim and fenestration, and other innovations to connect the buildings with the outdoors. But Twombly critically analyses that although Wright's buildings brought people closer to nature

they were still built on top of the Prairie or earth and truly then failed to merge architecture with the environment (Twombly, 1979: 304).

This problem of failure to merge was gradually developed in his second way of being informed by nature, as by the late 1930's and 1940's some of Wright's best work emerged from sloping, dropping, or otherwise unusual sites. These newer buildings merged so closely into the site that it would not have been possible to build them anywhere else in the world as the same form. Wright had perfected the corner window which was two sheets of glass mitred directly together without the aid of a frame by cantilevering the roof to eliminate view-blocking posts. Wider, uninterrupted spans were possible with steel beams and plate glass, which lead to homes having living areas with floor-to-ceiling glazed doors and windows for "more open spaces, "he wrote, "and a closer relation to nature". The landscaping depended on the rooms indoors as every room kitchens and hallways would be orientated to look outdoors. To help people live naturally close to the great outdoors was Wright's principal objective, in which he chose to keep the visual connection of outdoors and indoor as prominent in planning as possible (Twombly, 1979: 305).

Thirdly nature taught him that the proper way to utilize materials was to allow them to be themselves. Wright chose to not paint or tarnish wood; he might bend wood to achieve curved surfaces, stain, smooth, and wax it to bring out the grain, but he never covered or twisted out of shape the natural material. When using stone he preferred them cut and laid up horizontally while leaving the exposed edges rough as it came up from the field. Wright attempted to construct with local materials as much as possible to reduce shipping costs and to express the natural surroundings of the site. "Wright stated that since each material has its own characteristics, it should never be made to resemble another. he believed that glass should always be sheltered by overhangs as it is more appealing than glare, and its function should be ultimately be linking outdoors with indoors" states Twombly (Twombly, 1979: 310).

The fourth lesson for Wright from external nature was to "go with the natural climate rather than try to fix a special artificial one." Wright sited and planned his homes to house family sociology but importantly also for heating, cooling, lighting, and energy conservation. The natural house was proposed to maximise people's contact with and use of the outdoors. Buildings were often inspired by nature's forms and processes, to let its natural materials retain their natural characteristics, and work with the local climate (Twombly, 1979: 311).

Wright's second meaning to "nature" was the concept of "internal" nature. For him a house was the personified by a few factors; the nature of the family it housed, its physical

environment, its cultural surroundings, its architect, and its construction processes. Everything in nature is constantly in the process of evolving and becoming and so Organic buildings did not just "grow" from sites as natural results of topography, but the building was also an enclosed space as its nature and essence was inside. Wright believed that the purpose of architecture was therefore to "unfold in content and express life from the within" and make space come through to the outside. The exterior of the structure was then a statement about internal functions and events. The organic building was therefore the evolving physical expression of ideas about people, environment, culture, design, and construction methods amalgamated by the architect. Wright often stated that when the whole is to the part as the part is to the whole, harmony would result and "the nature of the entire performance becomes clear as necessity". The process in which development and multiplicity were integrated into the larger scheme of organic architecture was "plasticity" and "continuity". These meant that "materials are seen flowing or growing into form instead of built out of cut and joined pieces". Twombly concludes that "everything in Wright's buildings from hardware to site plan worked toward a consistency of purpose and feeling modeled on the natural world. "When function became form, structure would be completely unified and harmonious within itself despite the variety of factors calling it into being" (Twombly, 1979: 316). One of the main aspects of design for Organic Architecture's leader Frank Lloyd Wright was the Prairie Style.

> *"Organic architecture feels at home with the ideal of unity," Frank Lloyd Wright (Twombly, 1979: 304).*

3.3.3 PRAIRIE STYLE - THE ORIGIN OF ORGANIC ARCHITECTURE

Through the prairie style Organic Architects introduced the fundamental ideas of Organic Architecture into the world. These Prairie houses intended to break down the barrier between the house and the natural site; with roof lines highlighting the extensive prairie horizon; long expansion of windows to enhance framed views; and the walls having disappeared to the extent that technology of the period allowed (*fig 3.76-78*). On the inside an organic unity was formed by having rooms interlocking to create new spaces that flowed together which thereby eliminated the boxy rooms of traditional architecture. Built-in furnishings were an element to unite structure and daily functions as well as essential modern heating, lighting, and plumbing. Over the entire structure ornamentation grew out of the rhythms created by the structure and its spaces, with unified lines enhanced by long, simple strips of woodwork and complicated, colourful art-glass windows forming bands of light along the walls. The Prairie architects also established the use of various materials – particularly new ones – that later Organic Architects would integrate. Concrete became one of the most favoured materials frequently used by Wright's apprentices (Weintraub, 2006: 12).

Figure 3.76 Meyer May House done by Frank Lloyd Wright in 1909 with horizontal planes and large overhanging eaves. (http://www.heritagehillweb.org/tour09_details.htm)

Figure 3.77 Typical Prairie home with strong horizontals hugging the ground. (http://www.floor-plans.org/frank-lloyd-wright-prairie-style/)

Figure 3.78 Robbie House in Chicago with elongated lines of form. (http://memory.loc.gov/ammem/collections/habs_haer/hhmap04.html)

The use of concrete provided a large improvement in the designs of the Organic Prairie architects to incorporated innovative philosophies. Although the final product if concrete was solid and similar to rock it could till be moulded when wet into the most unusual and complex of shapes from small blocks to monolithic structures, the limitless of the material heightened the architects inspiration to create even greater forms. Most Prairie houses were made out of low energy materials such as wood from trees and brick from the earth's mud, but the architects' interest in Organic ideas went even deeper than the use of natural materials. Architects were interested in the concept of organic building designs to evolve into a single amalgamated entity of function, site, structure, and materials. The flowing, free, innovative principles of Organic design were against the strict, direct, uncompromising principles of mainstream architecture. In the new Organic style, one architectural element connected to another in an organic, harmonious manner as the building merged with its site (Weintraub, 2006: 13).

Organic Architecture slowly embraced the machine, but it also kept a firm grip in nature and human culture. Organic design's focus on nature was confirmed in its contributions to an archetypal form: the house in the wilderness. Beginning with the mythical Primitive Hut (the invention for the first human impulse to create an artificial shelter), man's relation to nature was an essential theoretical question. Were humans a part of nature or separate from nature? Organic principals encouraged an ideal solution to this question by utilizing ultramodern engineering to create a comfortable home that completely blended within a wild place, leaving the surrounding landscape mostly untouched; Fallingwater in Pennsylvania was the proof - see chapter 5 (Weintraub, 2006: 45).

> *"A primary distinction between Wright's houses and those of his mainstream colleagues rests in his use of materials. Wright used natural, unpainted wood copiously. Brick walls form strong, warm planes, creating their own unique*

organic counterpoint to the structure. The structural grid rarely overpowers the carefully shaped living space itself. Wright's intimacy with nature enabled him to translate it into architectural terms. In the patterns of nature, the formation of a snowflake, a mountain, a crystal, a field, an ocean, a running brook, the indentations and lines in a jagged rock hanging over the sea, it was an inner beat, an inner rhythm he listened to, the inner character that he transferred to paper without copying or imitating any form, bringing never-ending variety into architecture" (Brooks, 1981: 26).

Wright was the pioneer for Organic Architecture but the true beauty of Organic design was that there were such a variety of ways in which to express these principles and while Wright started and lead the main path forward with the Prairie Style, such as a trunk of a tree, his colleagues and following architects spread the movement into braches and evolved into newer types of Organic Design.

3.3.4 TWO TYPES OF ORGANIC DESIGN

Organic design mainly followed two courses: one followed Wright's lead in form and underlying geometry, and the other began with Organic principles and pushed them further than Wright usually did. Chief among the latter smaller group were Bruce Goff (1903-1982) and John Lautner (1911-1994). Bruce Goff, the Oklahoman, was the Organic architect who explored and built a large variety of buildings using a large imaginative basis with an underlying regulating factor of lines. Goff was an architect to push boundaries starting with the principles of organic design taking it to visionary heights from Wrights tame sophistication. Goff's houses were like hidden realms just like an entrance to Aladdin's cave through an unlikely doorway. Goff's structures could redefine what architecture could be with his extraordinary shape and dimensions of space, and glittering materials and textures (Weintraub, 2006: 78).

John Lautner after working for Wright created his own offices and broke loose artistically in taking Organic principals to new directions. He first explored concrete-block systems, but truly found his appropriate medium when he first tried poured-in-place. His architecture was about shaping space and he realized that the best material with the least constraint and most amount of freedom to accomplish his client's requirements was by using concrete. He also built houses from wood and steel, but felt comfortable in the free-form spaces and shapes that concrete allowed. Lautner found a unique and surprising range of architectural solutions (Weintraub, 2006: 79).

Organic theory granted architects the freedom and license to explore a wide range of forms and structures. Bruce Goff is one of the most daring and inventive of the Organic Architects and from his building Ford House (*Fig 3.79*) in Aurora Illinois it can be seen how he has experimented with unconventional materials and bold geometries to create is unique spaces. This home built in 1947 has an extremely unusual shingled domed roof which sits upon a foundation of anthracite coal. The dome opens up just to the steel frame like curving steel ribs that are Quonset hut ribs. At the tip of the dome is a central structural mast where a skylight is visible. The smaller dome at the edge of the large dome is the bedroom. There is great contrast to the materials used on the interior with steel ribs clashing against timber ceiling panels, as well as ashlar coal walls with green glass cullet in them (*fig 3.80*). There are large glass walls sheltered from the sun by the domes extensions which keep an active visual link to the natural scenes outside (Weintraub, 2006: 83).

Figure 3.79 Bruce Goffs' Ford House portrays an organic form with a mixture of materials that create an unusual composition for a residence and yet fitting in its natural setting. (Weintraub, 2006: 83)

Figure 3.80 In the interior of Ford House the contrast of materials is apparent from ashlar walls to steel ribs to timber panelling to screed floors. But the main atmosphere is of warmth and comfort. (Weintraub, 2006: 85)

An example of over-exaggeration of form with experimenting one material would be Charles Haertling's Brenton House (*fig 3.81*), in Boulder Colorado. Built in 1969 this house must have seemed entirely futuristic and not all together weird. Haertling used polyurethane in the buildings structure and created a continuous curving form. These curving forms were created as a shell to a basic structure; a central concrete foundation core was poured with flat concrete platforms for the several floor levels. Then a steel-wire mesh was formed over the platforms and polyurethane was sprayed over it to produce the rounded shapes. Each pod was individually framed on site and were arranged radially to take advantage of the mountain views (*fig 3.82*) (Weintraub, 2006: 157).

Figure 3.81 Charles Haertling's Brenton House expresses how Organic architects manipulate materials to create unique, curvilinear, flowing forms (Weintraub, 2006: 157).

Figure 3.82 This street view of the house shows the rounded, continuous forms inspired by the way barnacles naturally cluster. (Weintraub, 2006: 154)

The Sun Valley House is a precedent of Organic Architecture that imitates its natural surroundings as well as providing inspirational form (*fig 3.83*). Designed by Bart Prince in Sun Valley, Idaho 1992, this house incorporates soft curving lines which draw attention to and mimic the gentle lines of the Idaho hills around it. Natural daylight is filtered to the central living area by the spine of skylights above (*fig 3.85 + 3.86*) and the house expands into both horizontal and vertical dimensions. The use of natural materials and colour tones fit right in with the surrounding context such as timber, copper shingles and rough stone, all giving a warm golden shimmer to the composition reflective of the hills and grasslands around the site (*fig 3.84*). These elements such as, steel diagonal supports, wood rafters and shingling, concrete foundation wall, and flagstone floors, express the buildings individual character but also creates an organic wholeness.

The intriguing aspect about Organic design through architecture is like Critical Regionalism the fundamentals and foundations of the movement were kept while attempting to move forward with technology and inventions. Organic Architecture essentially keeps reinventing itself.

Figure 3.83 Designed by Bart Prince this home in Sun Valley, Idaho expresses the surrounding landscape of golden hills with its gentle curving form and copper cladding. A successful example of merging with the natural setting aesthetically. (Weintraub, 2006: 207)

Figure 3.84 This image best portrays how the building imitates the surrounding landscape in its form and colour, providing an unobtrusive and undominating relationship with its natural surroundings. A good example of Organic principles of flowing fluid forms inspired by natural landscapes and natural building materials while providing a light, fresh interior. (Weintraub, 2006: 206)

Figure 3.85 The image is of the twisting form of the roof line with skylights running down the spine allowing light into the central living area. (Weintraub, 2006: 210)

Figure 3.86 The house structural skeleton is exposed strengthening the serpentine form. Built-in furniture plays a vital role in shaping the spaces. (Weintraub, 2006: 212)

3.3.5 THE EXPERIMENTAL NATURE OF ORGANIC DESIGN AND ITS PRACTICE TODAY

As environmentalism became a bigger interest in the 1960's so it highlighted an interest in Organic Architecture with the similar principles. By declaring the constant drawing of the natural setting for its inspiration using sun, wind, and earth to shape its form, Organic architecture was philosophically on the same wavelength with the ecological movement. The ecological movement thereby drew from the free forms and imagery of Organic design as these movements overlapped with main goals (Weintraub, 2006: 81). The freedom to explore

new forms, varied images, free-flowing spaces, and new materials marked the course of Organic design. This resulted in an astonishing range of forms and plans, of aesthetics and attitudes. The Guggenheim Museum in New York may come closest to reaching the goals of organic architecture.

Figure 3.87 The spiraling ramped interior with large central atrium of the Guggenheim. The interior views changed as the visitor moves through the building. (http://our-odyssey.blogspot.com/2010_06_01_archive.html)

Figure 3.88 Here the large, unique, organic form of the museum as a conical structure that unwinds upwards with a strong bae to anchor it to the ground, can be seen. The interior functions shape the external view. (http://sfmorrisnyc.wordpress.com/)

The objective of the Guggenheim museum was to show an entire collection, to express continuity, change, and totality all at once. Conventional museums had fixed rectangular rooms which were unsuited to sequential viewing and so Wright's solution was to twist a quarter-mile-long gallery around a central well into a spiral ramp (*fig 3.87*) of three percent grade down which viewers walked down after taking a lift to the top. The Guggenheim façade was a direct expression of its interior space, its spiral form being literally the outside of inside functions. The cone shaped spiral structure can be seen from three sides in its prominent location and becomes part of its immediate cultural environment (*fig 3.90*). Wright provided plenty of natural light (*fig 3.89*), and poured concrete was the only sensible material for such a large, curved surface (*fig 3.88*). The Guggenheim is among the most plastic of Wright's structures. Inside viewer are aware of the pervasive ebb and flow of activity, and as they follow the ramp their perspective constantly shifts. The interior tone is a preserve of human and architectural motion. Guggenheim successfully illustrates that form and function are indeed one and like Fallingwater, it effectively reflects the most important implications of organic architecture (Twombly, 1979). Form follows function is one key aspect of Organic Architecture, this term being created by Louis Sullivan as the "outward appearances resemble inner purpose" seen in the Museum.

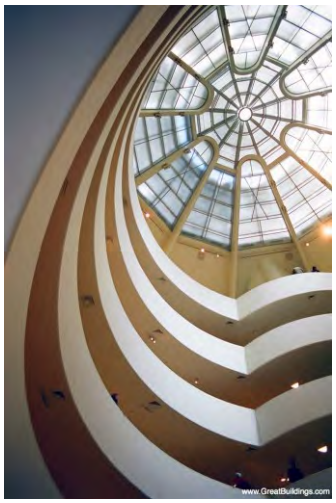


Figure 3.89 the image shows the large skylight providing a naturally lit interior of the Museum atrium. (http://www.greatbuildings.com /cgi-)

Figure 3.90 Guggenheim situated at a corner plot allows a good vantage point for viewers as well as a highly contrasting image of smooth organic flowing curves against New York's tall, glassed, and boxed skyscrapers. (http://www.greatbuildings.com/cgi-bin/gbi.cgi/Guggenheim_Museum.html/cid_cr1037_b.html)

Some Organic architects are truly inspired by natural settings and aim to blend their building into rocks, fields, hills, and lakes. Others use those images metaphorically, echoing the landscapes of nature – of caves, meadows, and forests. And yet others are inspired by the abstract principals of a natural structure – drawing inspiration from the way a tree integrates strong trunks, hidden widespread roots, and delicate leaves into a single unity. Some architects are inspired by the literal shapes of flowers, birds, bones, and crystals. Many use modern methods of construction and engineering not as an end point but as a tool to achieve their goals. Ken Kellogg provides the ideal example of what modern technology and the right natural setting can create and proves that any architecture that can be imagined can be built (Weintraub, 2006: 186).

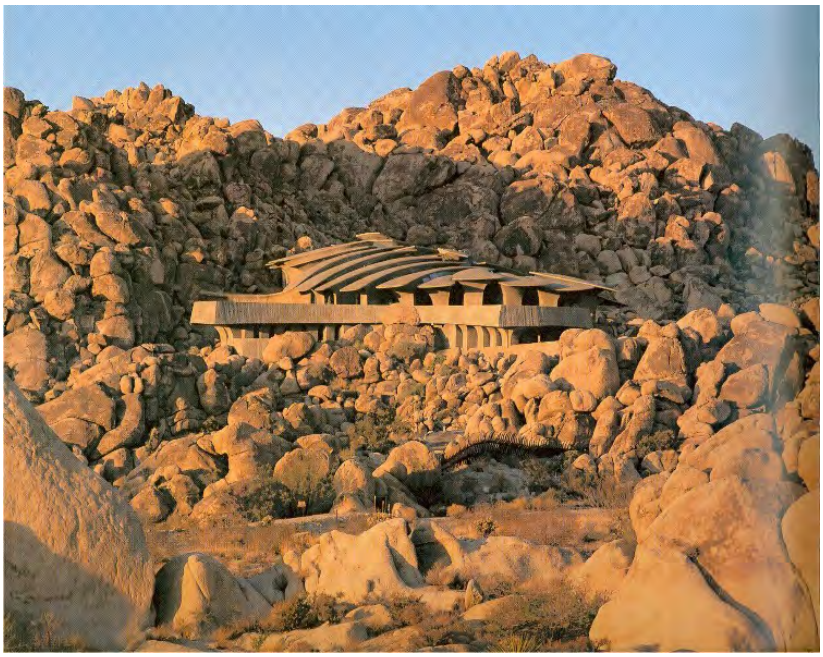
Ken Kellogg designed Desert House in Palm Springs, California, for a family that wanted to escape urban living to something more removed and private. The Desert House merges natural forms with advanced technology (as Organic houses have done since the Prairie Style), and is in the end a concrete structure. In this local American desert topography, the natural forces of catastrophe and erosion have piled up gigantic rock boulders that have been shaped by wind, water, and the ages. The house has a distinctive appearance with well-formed pillars that taper into overhead canopy roofs. The columns take their soft tan luster and roughened, unburnished textures from the living rock around it (*fig 3.91*). “The house enhances the site,” says Kellogg. The Desert House is basically one large room that steps down the hill on several terraces. The master bedroom at the top overlooks the spaces below.

The spaces between the mushroom-cap pillars are filled with glass allowing clerestory natural light to be brought into the interior spaces (*fig 3.92*). The house becomes an extension of the natural desert floor, with necessary modifications for shade and human comfort. The overall imagery of this residence is organic: skeletal, desiccated, austere, and yet shapely and beautiful (Weintraub, 2006: 188).

The design brings into focus the important elements of the location like the extreme vastness, the varied life forms, and the scorching heat of the wild desert; bringing these elements into the daily living of the family. The design provides a contradiction to what concrete structures should be, that is heavy, solid and bland. But in Kellogg's design the concrete here not only creates a playful and light image but also protects the residents from the harsh, hot climate of the desert location as well as the California's characteristic earthquakes (*fig 3.94*). The reinforced concrete pillars resist seismic jolts, and instead of taking a boxy massive form the design becomes sensual and agile and surprisingly comfortable. "Let the doors open at night," explains Kellogg, "and that keeps the temperature neutral all day." The heat stored in the dense concrete during the day radiates out to warm the house at night and then is cooled by the time morning arrives, as the cycle is repeated when the concrete absorbs the sun's rays slowly during the day and the air inside remains temperate. This allows the elimination of uneconomic air-conditioning which one would think vital in the heat of this climate (Weintraub, 2006: 189).

Architectural convention does not apply to this creation that both imaginatively solves practical problems from the difficult and harsh climate and region, as well as aesthetic problems of blending adequately into a monotone setting and yet still creates unusual beauty. Natural metaphors spring to mind when describing it such as bleached skeleton bones, a cluster of enormous, large-span mushrooms, stalactites and stalagmites, and insects (*fig 3.93*). But Kellogg believes the house in its setting designed itself as he states, "once you see the site and take it in, it's a feeling you know is going to happen". Kellogg's design created in the early twenty-first century symbolises the "spirit" of a hundred years of Organic designs. It designs around nature's elements of the sun crossing the sky, the inevitable earthquakes, and the sublime desert landscape with cutting-edge construction technology which allows freedom of imagination for the client and architect unhindered by conventional residential forms. It surpasses simple rationality to draw from deep currents of human culture and intuition (Weintraub, 2006: 189).

Figure 3.91 Desert House designed by Kellogg is another example of a merge wit the natural environment in terms of aesthetics with the structure mimicking the smooth round curves of the surrounding boulders, and even the concrete finish being the same tone of brown-grey as the boulders. (Weintraub, 2006: 254))



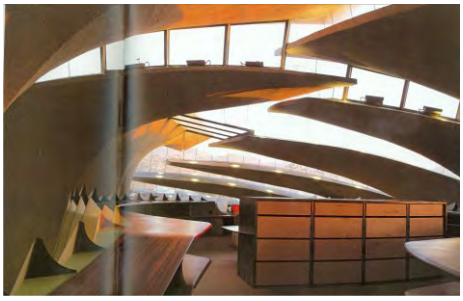


Figure 3.92 Desert House interior with natural daylight filtered through the concrete ribs. (Weintraub, 2006: 267)

Figure 3.93 the powerful curving forms of the structure are only capable by the use of concrete. (Weintraub, 2006: 259)

Figure 3.94 The concrete ribs are effective is sheltering the interior from the hot desert sun while radiating heat during the cold nights. (Weintraub, 2006: 255)

Today the future of innovative forms can be seen to be limitless as it's shaped by the imagination, passion and experimenting and not previously restricted by the limits of a structural grid. One can see the dramatic reinventions of space and contour by Frank Gehry's buildings as they unfold and awe and it is this type of Organic architecture that takes mankind into the future of ideal free form. Not forgetting that this entire ground-breaking movement is being inspired by the forces of nature, the forms of nature, the principles of nature, in creating a new fluid and expressive architecture.

3.4 CONCLUSION

David Pearson states in his view on healing architecture that, “One of the most interesting and deeply philosophical strands of healing design is organic architecture.” He stated that Frank Lloyd Wright believed organic design was much more than just style or decoration, that it was an inspiration. Wright desired that all his buildings be intimate with nature and “literally to love the ground on which they stood”. Wright also believed that the ground would exist longer than the buildings upon them and agreed in Thoreau’s understanding that we are, “but a sojourner in nature”. (Pearson, 1994: 56)

To sum up, nature is essential to human living and essential in the construction of human habitats. Nature has had a profound effect on the human built environment. Whether this process was intentional or not the lasting influences of nature’s ideologies can be clearly seen. Nature by its very existence controls itself, regulates it systems, regenerates it’s dying or problematic components, and balances all elements within a single ecosystem or as a whole universal system. Nature is filled with complex, beautiful and intriguing functions and forms that as they are discovered and analyzed provide humans and designers with a different outlook or attempts to create these same functions and forms. Nature is then a constant form of inspiration from the birth of mankind till today.

By looking into Critical Regionalism and Organic Architecture, a better understanding of nature-inspired architecture is achieved. These two theories or movements share a common component of respect and collaboration with the natural environment in the creation of human environments for the betterment of their occupants and natural surroundings. The principles for Critical Regionalism and Organic Architecture enable an understanding of nature as a working example, human culture as a design factor, natural topography as a sacred realistic element, and technology as a controlled advancement in the design of architecture. Nature has to be preserved to continue to provide and develop new understandings of the world humans inhabit, and present improved ways for living and construction that humans can apply to their own lifestyles and existence.

And so an appreciation of the importance of Nature in design has been established by Nature itself is vastly varying and for this research a more narrow form of it will be investigated, namely the element of water.

CHAPTER 4
WATER IN ARCHITECTURE

4.1 PHYSICAL PROPERTIES, ORIGINS & SYMBOLISM

4.1.1 WATER

As covered in the previous chapter nature is an integral inspiration to architecture from its forms, designs, relationships, functions, and aesthetics. As the common view is to think of nature outside humans, it is actually inaccurate because nature is apart of humans. Specifically speaking nature is in human bodies as mankind is warm-blooded, solid but about two-thirds water. And water is one of the most powerful and vital natural elements with the largest potential for healing. The ancient Greeks viewed water as the highest element and potential to create change from which the world was made (Ryrie, 1998: 20). And so it will be this main natural element from the basic elements of nature - wind, water, fire and earth - that will be investigated.

Water is determined and managed by physical laws. An understanding of how water is formed from its cycles in the natural environments, to how it cleans itself and moves is important. An understanding of how liquid acts, how it reacts to human senses, and how it symbolically relates to human beings, is necessary in order to adapt the element for healing potential.

Ultimately water is the source of all life and thereby an immense symbol for life. All forms of life from plants, to animals and insects, to humans need water to live and survive, and nothing on Earth can escape its influence as all forms of matter is touched by water whether by rain, snow, or evaporation. Water seems to be a common denominator through the ages in every culture, religion, literature and art. Without water there would be no life, is a common understanding but humans still develop habitable places that do not respect, value or incorporate water. It is understood that in the cycles of nature wind turns to rain, rain to earth, earth to sea, and back to clouds again. A significant fact to note is that the constant element through these changes is water. Centuries ago people lived surrounded by nature, never questioning the health-giving properties of flowing streams, invigorating waterfalls, or welcome rains. These people from observation and experience grew to understand the significance water plays in humans' daily lives and came to accept, respect and treasure the powers of the water. But unlike our ancestors modern cultures have limited contact and communication with the elements (Ryrie, 1998: 17).

> *"Even water is in harmony with itself and the place it has in the universe. Each phase of water's cycle reflects the other phases; no one phase can be deemed more important than another; water is vital to every cycle in life. It is part of a whole and always seeks to return to a whole."* (Ryrie, 1998: 17)

4.1.2 ORIGIN OF WATER

The origin of where water comes from was a mystery in ancient times until a scientist named Giovanni Poleni presented a paper on it in 1723. He believed that fresh water originates from one of two sources: either below ground in the form of springs or above ground as streams. When establishing the water cycle it is brought to attention how complex and large water really is in the universe. When it rains water naturally flows downhill from the mountains and hills and collects in lakes or ponds, which then feed and flow into rivers and streams (*fig 4.1*). Eventually these rivers make their way from the inland area of a continent to the coastline where they run into one of the oceans and mix with their salty waters. From the surface of every lake, river, puddle, or ocean, water evaporates into the atmosphere, where it condenses into clouds or fog. Breezy winds push and pull the clouds around the atmosphere until the right conditions (normally being blown across the continents) allow the molecules to condense and fall back to earth in the forms of storms as rain, sleet, or snow, which is then absorbed into the terrainean system, where the process or cycle can begin again (Moore and Lidz, 1994: 21). Water phenomenon creates natural features such as waterfalls, cascades, springs of the tame variety and of the ominous ones tidal waves, flooding and lack of water, drought. Waters origin may be a mystery but its importance to life is not.

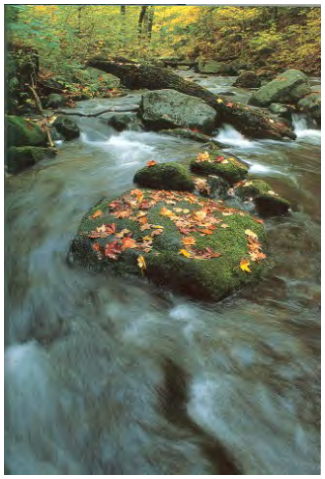


Figure 4.1 The gushing water of a river within the water cycle which will eventually lead to the oceans. (Ryrie, 1998: 95)

4.1.3 PHYSICAL PROPERTIES

It is general knowledge and observation that water is a highly mobile element, that like mercury it is difficult to contain as it slides, falls, and flows around physical matter (*fig 4.2*). Day states that, "Its mobility principle is the essence of life" (Day, 2002: 40). It is also known that water has many different forms such as ice when cooled, liquid when in average temperature, and vapour when in high temperatures. Water in movement can be fast-flowing, or still depending on its context, it is a contradiction of change and constant.

Figure 4.2 Water is a clean and pure element that is hard to contain as is spreads around and through objects moving at various speeds. (Ryrie, 1998: 106)

Moore states that pure water is odourless, tasteless, and colourless. In a chemical observation it is an oxide of hydrogen that covers about two-thirds of Earth's surface (*fig 4.3*), with nearly two-thirds of all fresh water being frozen in the polar ice caps of Antarctica. Atmospheric, surface, and groundwater are critical factors in our planet's weather systems: humidity and dew point preserve our atmosphere; ocean currents cool and warm our continental temperatures, and freeze-thaw cycle locks and releases moisture in the soil. With water movement forces and energies work together to control waters complex pathways as sprays, rapids, trickles, drops, plops, and deluges are all kinetic reactions directed by the invisible order. Through waters movement and it being the softest of substances it has the ability to wear away mountains, rocks and objects over time and so shape our topography (Day, 2002: 38). Liquid is used most common form of water but solid ice and vapour are important state of water too, all these forms interact with the built environment. Even though physics orders the action of water all over the world, the enormous range of qualities that water encompasses and atmospheres and moods its creates provides great inspiration and potential for architects to shape human environments (Moore and Lidz, 1994: 15).

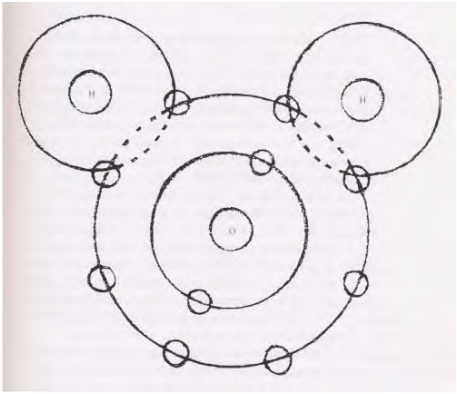


Figure 4.3 Water at a chemical level is made up of two parts hydrogen and one part oxide. (Ryrie, 1998: 47)

4.1.4 SYMBOLIC CONNECTION TO WATER

Water is the symbol for life and has been viewed this way from ancient times. People in ancient times saw water and life together as a single entity. As far as it is known almost all ancient cultures believed water as sacred and so all their gods and deities were categorised as water gods, such as the Greeks water God Poseidon. "Everything was water" say Hindu texts, and in Tantric Sanskrit manuscripts water is *prana* which means the vital breath which brings life (*fig 4.4*).

> *"Water precedes all forms and upholds all creation as most cultural stories go"* (Ryrie, 1998: 28).

In the past people had to live close to nature and thereby depended on natural elements and so dependence on water for drinking, agricultural purposes, and cleaning services, the main source were rivers and lakes. With the strong nature of water as it gushed down rivers, fell from waterfalls and flooded villages, people learned to respect nature and waters

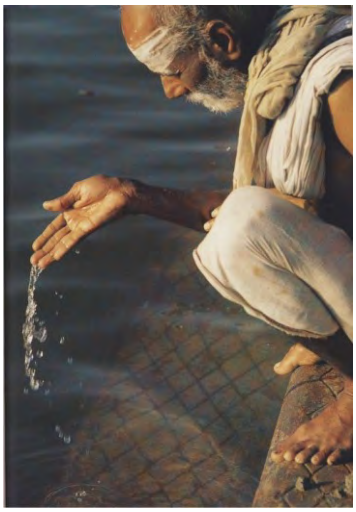


Figure 4.4 A Hindu man revering the water from the Ganges River as it is used in spiritual cleansing rituals. (Ryrie, 1998: 27)

'life giving' and 'taking' forces. Major rivers have been sacred in many societies throughout history. For example in Egypt, the Nile lies at the heart of early Egyptian religion, and is a sacred factor to society; it was later honoured by the Greeks and Romans. Today many rivers in India are still regarded as sacred, but the Ganges is the most sacred of all where the people still go to immerse themselves in its waters and be 'healed' (Ryrie, 1998: 32).

Moore states that tame water can suggest youthful health and beauty as its waters appear fresh, reflective and clear, the elements of youth. From the ancient Bath in Europe to modern Saratoga Springs in America to Japanese therapeutic springs, people have been drawn to and gathered at spas to bathe in these therapeutic pools. But not only has bathing waters seen as healing, but drinking waters have too. Good health has been believed to have been infected by drinking special waters (Moore and Lidz, 1994: 18).

Water is also viewed as a symbol of fertility when it is abundant, and when water is pure and clear, it can also signify chastity. Not only is water seen as many symbols for life and but it is also seen as an important power of cleansing. On a physical level, water is the agent with which we wash our bodies, homes, and clothes, and without it infection and disease would set in. but on an emotional level purification or interaction with water leads to spiritual rejuvenation. Symbolism of the waters entails both death and rebirth with contact with water always brings regeneration. Water makes a tangible connection to humans as it can be felt cooling or warming the skin when surrounding the body, but can also represent an intangible connection as it flows and swirls remaining ungraspable and uncontainable (Moore and Lidz, 1994: 20).

4.1.5 EMOTIONAL CONNECTION TO WATER

Water has the power and influence to affect human minds and spirits, as its qualities are highly soothing, relaxing and rejuvenating (*fig 4.5*). As the eye follow ripples on the water the mind is drawn into a soothing dream, washing away stress and invigorating our life energies. Still water such as lakes, expansive, clean and lonely, is the essence of tranquility. Water moves in different speeds and patterns but the slower and calmer the water it induces moods such as calm, disquiet, awe and energy (Day, 2002: 38).

Figure 4.5 Bamboo pole channelling water in Japan, as it emerges it white spray is captivating. (Moore, 1994: 14)

Charlie Ryrie believes that humans communicate with water on different levels - physically when humans see a river, an ocean, or a pool they want to swim, or when they are thirsty, want to drink its waters, or when they feel the need to bathe until clean – but it also speaks to us on a deeply subconscious or spiritual level. Humans are attracted to water in some way as it is always on the move, always changing in its environments which are aspects that fascinates and draws people to it. Each drop of water responds to the cosmic pull of the Moon and the sun as these elements form the waves in the oceans. The blood in our veins, the water in our cells, and every fluid in our body reacts to these same cosmic forces and from this we can understand that water is the medium that links us to the rest of the universe (Ryrie, 1998: 16).

4.1.6 WATER CULTURE

Earlier cultures seem to have understood water better than mankind does today. For example in many cultures like the ancient Chinese, Aztecs, and Africans used to keep pure water in special containers. They knew that water which was constantly on the move was effected by, and affected everything around it. They did not need technology like humans need currently to recognize that water collects, stores, and transfers physical and vibrational information or energy as it moves (Ryrie, 1998: 18). The foundation of medical philosophy and conditions was the element of water as ancient Egypt, China, Assyria, and Greece, viewed waters as the link to the cosmos (*fig 4.6+4.7*). Ryrie believes that water is the link to the five levels of human continuation: physical body, vital energy, emotional heart, mental mind and spiritual soul. He also states that at the very basic of philosophies that as humans, without healthy water, we cannot be healthy (Ryrie, 1998: 20).

Figure 4.6 the ancient Egyptian sun Goddess Nut is standing next to the Tree of Life and collecting its waters. (Ryrie, 1998: 30)

Figure 4.7 Varuna is the Hindu God of the moon who controls the rains and regulates the seasons. (Ryrie, 1998: 31)

From all cultures and religions there are rituals connected with or utilise water which are practiced all over the world, so common that sometimes it is taken for granted, or the symbolic message of sacred water is thereby lost. Such as in Christianity, to be born and named people have to be Baptised in water, or in Hinduism the dead have to be cremated on water and sent to sea or down rivers, or even in the Koran it states that water is a gift from God. Even in our daily lives we partake in a ritual which has become so common that the significance is lost. People take baths every day and once complete feel cleansed and rejuvenated. Humans bathe or shower in the morning to wake up and energise themselves, and take a bath in the evening to cleanse from the days activates, and relax the body before going to bed. Humans do not realise that they partake in water rituals but have an unconscious understanding that bathing can be a healing experience which is why it is practiced day after day. People notice and observe that walking by the sea, or by a rushing stream, or past pools with fountains makes them feel better that not being around these water aspects. Humans know water is the most refreshing drink when they are thirsty; and they know it feels good to stand under gentle rain and feel the drops on their skin. It is more obvious when seen in children as their fascination for water is ready for anyone to see; children like to watch water, and more importantly touch it and play with and in it. Children love the way it moves, the way it feels, the way it runs into spaces and fills them up; they are intrigued by its very wetness and this fascination represents waters influence on humans (*fig 4.8*) (Ryrie, 1998: 24).

Figure 4.8 Children playing in the water at Fountain Place, Dallas, Texas. (Moore, 1994: 68)

4.1.7 WATER HEALING

Of nature's four elements water is the element with the most potential to heal. It qualities may have a violent nature at times but most often it is rhythmic, flowing, soothing, and energizing.

> "*Life renewing qualities can be seen in fluid shapes, fluid movements, and forms shaped out of waters flow principles"* (Moore and Lidz, 1994: 17).

In Persian and Arabic tradition, Paradise was viewed as an enclosed courtyard with a beautiful garden and flowing water, of which these can still be seen today in

Figure 4.9 Japanese Garden in Kyoto called Saiho-li, representing life and tranquillity. Water in these environments is highly essential. (Moore, 1994: 30)

affluent residences in Eastern Europe. These utopian gardens would always include water in some forms like gently flowing streams, rippling pools, or sprouting fountains. From a Japanese perspective there are no Japanese gardens that do not incorporate water (*fig 4.9*). Water due to its qualities and characteristics has, always had a special spiritual role in meditation and relaxation. The feelings induced by a flowing stream, a splashing fountain, a breaking wave, or a roaring waterfall are anything but anger, depression or dullness and so water can touch human emotions, if approached correctly (Ryrie, 1998: 40).

On earth water is in a constant state of motion and transformation as it continually creates healthy water by collecting and transporting oxygen, nitrogen, and carbon dioxide from the air as well as calcium, potassium, manganese, sodium, and other minerals from the earth stone. Its power to dissolve substances and wear away matter allows this element to collect data, information and certain substances and transport them to any other part of the world. This dynamism means that it is an evolved connecting medium to all the other elements and species of nature as it goes randomly about changing and restructuring the world (Ryrie, 1998: 53).

Vibrations make up the world and water is a medium that can read and transmit these vibrations like messages or pulses. Water has this ability because the molecules in a cell that make up water, as a matter, interact with other cells and these molecules transfer messages through them, such as in the fluid in the bodies of humans (Ryrie, 1998: 66). Cells vibrate at different frequencies and so healthy cells have a specific frequency. These vibrations then allow the cells to pick up the right resonances from the water that enters, traverses, and leave the human body and consume the energetic messages in this healthy water to create a healthy body (*fig 4.10*). Obstructions to these energies in water can result in illness.

The health of water is not at a constant level either as any changes in temperature and movement changes the electric and magnetic vibrations. Water is so important to the human body as it interacts with 100 percent of it. Due to its importance therapies about vibrational energies of health-giving potential should be and are currently being tried out.

If water has the potential for healing, then mankind must learn from it and make full use of it (Ryrie, 1998: 68).

Figure 4.10 this drawing is showing the spiral movements of water and the positive energy that is created from it as well as ionisation. (Ryrie, 1998: 85)

Viktor Schauberger was an Austrian forester who formed different ideas about water. His theory on water was that modern technology in is production and processes should follow the natural patterns and movement of water. This was because water as well as other liquids channels in rhythmic organic movements and not straight lines. The energy created from this form of movement was seen to create better harmony than friction which is experienced in natural straight rigid paths. He believed that the principles of cycloid spiral motion were worth following in technology because the spiral motion was the basis of motion for all growth in nature (Ryrie, 1998: 81). It is a standard understanding that flowing water is better then still water as still water is stale and dead, only running water is same from infections to drink and use. Still water really is dead in a sense because there is no movement of energy in it. Only moving water is replenished with oxygen and free from contamination. Water is very similar to the heat or the blood circulation in the human body, or the waves of the oceans, all of these depend on rhythm. Water that is forced in straight channels loses vital energy and balance and therefore healing potential. As seen from natural water features such as rivers, streams and oceans never flow in straight lines but meander through the surface topography (*fig 4.11+4.12*) (Ryrie, 1998: 84).

Figure 4.11 this is an aerial image of the Ganges River in India as it runs towards the ocean from the interior of the continent. The river form is anything but straight and ordered. (Google Earth 2010)

Figure 4.12 this is an aerial map of the Gao River in Russia and its natural forms are full of rounded edges and curves as it makes its way through the natural Russian topography. (Google Earth Maps 2010)

> *Spiral movement is a constant element in the development of all living things and systems from the natural flow of water, blood or sap, to the movement of the planetary system (Ryrie, 1998: 87).*

The rhythmical patterns of movement in water create a process in which dead or sluggish water can be re-energised and made healthy. The physical form of these patterns is called flow-forms which is made into sculptures from stone or ceramic and can be inserted into any watercourses to oxygenate water and make it healthier (*fig 4.13-15*). The water absorbs

energy from the specially shaped channels. Flow-forms imitate the natural movement of water and its flow pattern that can be seen in rivers and streams and this allows water to fully reach its healing potential (Ryrie, 1998: 94).

> *"Look carefully at a drop of water, or a bubble, and you will see the same kind of circulations inside the watery sphere that you see in the steam above tea, or the movement in rivers – eddies, confluences, swirls, spirals, and separations of flow in layer upon layer. And these are the same layers in the hydrological cycle, swirls of moist air above the land, swirls of moving currents in the Earth's water, swirls of water transpiring from plant and animal life. Every single drop of water is a microcosm of the universe, containing the same rhythms and patterns – just on a different scale."* (Ryrie, 1998: 82)

> *"Water washes both soul and body. More exactly, it is, for the soul, freeing, cleansing, restful and rejuvenating – a healing power"* (Day, 2002: 38).

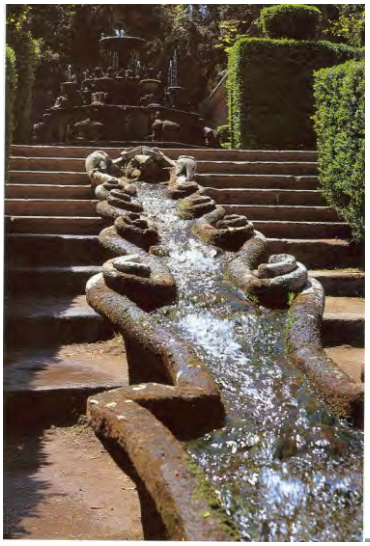


Figure 4.13 A flow-form sculptural water feature seen in Villa Lante, Bagnaia, Italy. The waters movement is refreshing and alive. (Moore, 1994: 33)

Figure 4.14 A diagrammatic sketch on the movement of water in flow-form pattern. (Ryrie, 1998: 96)

Figure 4.15 A modern version of the flow-form water feature as water cascades down levels creating soothing sounds. (Pearson, 1994: 7)

Now that an understanding about water has been established a look at its healing capacity should be focused on.

4.2 BACKGROUND OF HEALING QUALITIES OF WATER

4.2.1 MINERAL WATER BATHING

Aller defines a spa as a bathing establishment that makes use of natural materials the main aim of these establishments is to provide therapeutic environments through bathing in spring waters. Most of the natural springs provide hot water and some cold water. A bath-house that gets its supply of water from a spring can be classified a spa, if the mineral water is warm. There is enough archaeological proof to provide healing qualities, or a primordial source proclaims it as a healing site (Aller, 1998: 14). Altman terms healing spas as springs that have changing temperature which contain minerals, gases and vapours which induce specific therapeutic effects on the human body like altering body temperature and advancing the function of some of the bodies organs and systems; each country having ranging criteria's for spas (Altman, 2000: 15). Ryrie informs that Spa is not just a beauty establishment that it is known for today but rather it is a place with mineral waters (Ryrie, 1998: 134).

It is a general understanding around the world that by bathing in natural springs, wells, or rivers people could attain spiritual and physical purification. Many societies ancient and current perform this ritual purification with water. The ancient societies rang from the Native Americans, Babylonians, Persians, Greeks, Romans, to Egyptians. Current societies range from Jews, Christians, Hindus, Muslims, and Buddhists. These rituals are significant events in the life of humans are represent an underlying belief that water has properties that can heal. These water rituals were carried out in many different forms and locations and each bathhouse offered a different architectural solution according to the place. These bathhouses such as with the Romans were monumental and impressive in elegance, in Japan they were outdoor compartments to utilize the volcanic arteries spewing up hot water, in New York Saratoga Springs the bathhouses were filled with gardens, and even in the Arab regions they developed Turkish warm baths or hammams in every town (*fig 4.16+4.17*) (web 10).

Figure 4.16 Winter bathing at Kaikake Onsen, Japan, in the hot springs. (Altman, 2000: 18)

Figure 4.17 people bathing in a Polynesian spa called Rotorua in New Zealand. (Altman, 2000: 19)

Bathing in mineral waters can strengthen the body, encourage the metabolism, and fight the effects of environmental pollution that affects mankind. Ryrie states that through immersion in mineral waters, our bodies internal water structure can be manipulated to receive the healing vibrations from it; these vibrations being important enough for humans because they are our life forces. Minerals can be found in rocks, soils and waters and for humans, animals and plants it is the main source of nutrition. Minerals are nutrients which without the human body could not function appropriately, minerals aid the function and structures of cells in the human system and also balance the chemical systems in a physiological way. Bathing provides a gentle process in which important minerals for the body can be absorbed through the skin to provide a healthy nature. There are different types of bathing some of which are sea bathing, salt water bathing, spa bathing, and mud bathing, a direct way into utilising waters vital energies (Ryrie, 1998: 120).

Ryrie believes healing baths work with imprinting the healing energies through sound, scent and colour. In terms of scent there are certain fragrances which help to relax and to treat insomnia, nervous tension and muscular problems. Healthy water unlike normal waters can pick up delicate vibrations of colour so bathing environments can have colours to effectively relax, stimulate or energise during the bathing process. Water is also a potent transmitter of sound and the water in peoples bodies react to these vibrations making bathing waters therapeutic. Water sounds are soothing and relaxing which could also be played in a bathing environment (Ryrie, 1998: 126).

The knowledge of healing sounds mainly comes from the East. They believe that when you strike a harmonic resonance at the appropriate frequency it can improve the circulation of energy within the body. Practitioners have recognised this aspect to water and often suggest water treatments for overall health and specific physical problems. Healing through sound and water has been around for centuries with the Agaraian societies recently practicing the technique called *tonsingen* which guides specific sounds into water to energise and restructure it for healing (Ryrie, 1998: 132). The most relaxing and soothing noise are the sounds of water. Mineral and spring waters were not only used for healing by bathing, they were also drunk in certain quantities. This ingested method of waters was seen as far back as the Roman and Greek eras. Drinking water is good for specific ailments such as Arthritis, Asthma, Backache, Headaches, Heartburn, Constipation, high levels of Cholesterol, menstrual problems, morning sickness and stress (Ryrie, 1998: 108).

In Europe there are many types of mineral waters that are drunk for cures and are quite popular. Once seen by a doctor the patient is sent to the spring in which they must drink the

natural mineral water several times a day. These minerals get absorbed into the blood stream through the membranes of the digestive tract and positively affect kidneys, and other body functions. Drinking mineral water helps treat certain gastrointestinal, kidney, metabolic, and cardiovascular disease. There are some mineral waters that are not healthy for the body because they contain harmful chemicals such as arsenic, so the drinking waters must be carefully assessed before utilised (Altman, 2000: 22). There is also inhalation of mineral waters through water vapour or steam and is highly successful in aiding people suffering with asthma, sinus problems, allergies and other respiratory problems. Some spas even go to the extent of using herbal oils in the vapour to help decongest the respiratory systems (Altman, 2000: 25).

In the 19th century in European spas there was greater emphasis placed on drinking waters than bathing in them. This resulted in the development of separate structure to house this function which was called Trinkhallen or drinking halls. The public spend long periods of time here drinking natural spring water. The other building also separated from the bathing halls was the Inhalatorium for inhaling the vapours (web 10).

Spring water and Spa treatments are greatly beneficial for (Ryrie, 1998: 136):

- Asthma: negative ions in the air increase the function of the respiratory system, while minerals help normalize the making of histamine.
- Muscle and joint pain: improved levels of endorphins lead to reduced pain and increased mobility.
- Circulatory problems and varicose veins: minerals absorbed by the body increase and stabilise the blood stream and relieves obstructions in circulation.
- Psoriasis and eczema: antibacterial plankton and minerals balance the requirements of the skin.
- Rheumatoid Arthritis: mineralized and vigorous water aids in preventing problems with the joints and stiffness.
- Osteoarthritis and osteoporosis: minerals in the water enhance the immune system and encourages growth of white blood cells.
- Following surgery: the antibacterial and energising effects of spa water helps healing and recovery process.
- Minor infections: can be treated by balancing minerals and antibacterial plankton in the water.

The key era in which bathing and spas became a popular activity and apart of the culture was in the Roman periods with their invention of the aqueducts which completely altered their cultural society and interactions.

4.2.2 ROMAN BATHS

Bathing in the ancient world was more of an institution that a functional hygienist process. It brought forth great social and cultural habits that connected society in many ways. The current image of Roman Baths is of bathing, eating, drinking, massages and social gatherings all set against elegant backdrops. This is the correct image of Roman Baths where the influential reach stretched far. Roman baths provided an ideal setting in which to advertise oneself or recruit people whether is business, politics or friendship. The small baths were mostly privately owned and open to the public at a commercial level, while the larger baths were funded by the city and open to all. Roman baths played an important role in the health, education, and recreation of the public and so the higher ups in state made sure to make the responsibility of maintaining these establishments to priority (Yegul, 1995: 1).

In order to attract the public these baths were made to be most attractive and assessable to the people. This meant that architecturally the baths received the best positions in the urban realm that allowed them to be easily visible and on axis to main routes, and to incorporate the latest technologies of the time which in this case was concrete. Concrete allowed the aesthetics of baths to be taken to a higher level with structural features such as bold, curvilinear forms of barrel vaults, arches and domes. Another technology which was highly relevant to bathing establishments was the invention of heating, radiant floor heating to be precise, and this was termed hypocaust (Yegul, 1995: 2).

What can be determined after analyzing the remains of Roman baths and the layouts is the general traditional sequence in which the baths were used. The order consisted of cold to tepid to hot rooms which were called frigidarium, tepidarium, and caldarium respectively. Bathing was an important factor in the everyday lives of the Romans as it became a daily habit to visit them. The bathing routine even adjusted the average day in order to maximise the enjoyment of the baths. Bathing was generally reserved as an afternoon to evening activity while mornings were left to accomplish work and business. Bathing then provided a tool to integrate people into society (Yegul, 1995: 4).

Bathing in the baths presented enjoyable experiences on physical, psychological and social levels. Psychologically the sensory experience was stimulating with the warm and cold waters, the clear soft waters, the steamy atmospheres, and the quiet murmurings of bathers conversing, with fragrant smells of ointment for massage. The warm environment allowed the bathers to relax and become pleased and happy and thereby improved their moods and spiritual being. On a physical level most bathing establishments not only provided pools for bathing but facilities for exercise as well. Maintain physical health became a big priority for

the public and well as create fun environments. Socially the internal environments were of warmth and companionship with all users mutually enjoying each other's company through the common denominator of the baths. Bathing was also believed to have serious therapeutic value and so received complete support as an ancient medicine from the Greek and Roman doctors of the time. These doctors also created a detailed method or regimen of treatments using water for various diseases and disorders (Yegul, 1995: 5). These ranged from rheumatism to arthritis and even hangovers (web 10). There were more than eight hundred small baths scattered throughout Rome and eleven large therme and all were open to the public at a very small cost. Some of the bathing establishments became frequented by clubs and then housed meeting faculties such as lounges and cafe's. it was the standard that men and women were not to bath together and so it was determined that separate times would be allocated for the different genders; females to bath in the mornings, while men in the afternoons. Most establishments had separate entrances for men and women but there were shared functions as well such as both sexes used the same exercise areas and service facilities (Yegul, 1995: 33).

The bathing ritual first started on arrival at the baths with the first task being to undress in the special rooms provided which also housed cabinets or shelves for clothing and personal items. Then the Romans would move to the exercise halls to partake of some light exercise mostly for recreation such as wrestling, running, boxing and fencing (*fig 4.18+4.19*). It was believed by medical personnel that bathing, massage, exercise and diet were essential factors to good health. From the exercise spaces the Romans then moved to the baths and the order in which they were experienced ranged from warm to hot temperatures waters, the tepidarium and caldarium, and then ended with a cold plunge in the frigidarium. There were also other functions such as sweating rooms called *laconicum* (hot and dry) or *sudatorium*. The final task in the bathing process was being massaged with oils in special warm rooms called *aleipterion, destrictarium,* and *unctorium*. The bathing ritual was a process but the order was not fixed and could be altered according to the users' desires. The most amount of time spent

Figure 4.18 Cartoon view of an apodyterium from a bathhouse in Campania. (Yegul, 1992: 36)

Figure 4.19 A cartoon showing the Romans playing light sporting activities as exercise before the bathing ritual. (Yegul, 1992: 37)

in the baths was during the caldarium and frigidarium stages in the large main halls. In these halls eating and drinking would take place and well as much socializing. People would admire the high vaulted ceiling and large clerestory windows which pleasantly lit the interiors (Yegul, 1995: 38).

The Romans not only built up baths in their towns but moved to developing baths in the rural settlements. This was possible by seeking and utilizing the natural springs from far reaches in Europe. These out-skirting baths were seen at Bath and Buxton in England (*fig 4.20*), Aachen and Wiesbaden in Germany, Aix and Vichy in France, Baden in Austria, and Aquincum in Hungary. These bathhouses also became hotspots for socializing and entertainment and budgets were not an issue as these enormous buildings were required to be as impressive as possible (web 10).

Figure 4.20 An ancient Roman bath in the city of Bath in England. (Moore, 1994: 143)

Towards the 20th century the European spas had slowly developed quite an elaborate and detailed procedure in which to maximise the waters healing potential for the human body through complex bathing. To portray a good example of these procedures the bathhouse at Baden-Baden, Austria can be assessed as they claim to specialize in treating people suffering with rheumatoid arthritis. The first step in this treatment process was to visit a doctor who then prescribed a certain amount of visits to the bath. Once the patients had arrived they would pay and undress storing their personal belongings away as the bathhouse would provide towels, sheets and slippers. The first bathing task was a warm shower to awaken the body, the on to the circulating rooms were 140 degree hot air was blown for a period of twenty minutes and then onto a 150 degrees heated room for 10 minutes. This lead to the 154 degree vapour bath, followed by a quick shower and soap massage, to cleanse and circulate the blood flow. After the massage the bathers swam in a pool the same temperature as of the body and then rested in another warm room for 15 to 20 minutes. This warm room was called the “Sprudel” room and contained a pool that has a layer of sand 200mm deep at the bottom, in which carbonated water gurgled towards the surface. After the rest period a series of cold showers was administered getting colder down the line ending at a vigorous rub down by the

attendants. They were then wrapped in blankets and rested for 20 mintues to stabilize body temperature and to minimize the drastic effects of water change on the body. After these bathing systems the patients would follow strict food diets and drink special mineralized water at a prescribed amount and intervals (web 10).

An example of these baths is in Bath, an ancient Roman city that utilizes England's only hot springs which gushes out around 250 000 gallons of water a day. The city was based on the bathing traditions and not only had bathhouses but temples as well which were all dedicated to the God of water. It is through modern excavations that the layout and functions of these establishments can be recognized today. The most popular and recognized of these baths was the King's Bath which over the years and many different legions who had taken over the cities had developed with layers of building development hidden underground (*fig 4.21*) (Moore and Lidz, 1004: 42).

The main bathing establishment was fed by the nearby natural spring and was first constructed around the late first century being in use all the way through to the fourth and fifth centuries. The alteration and additions to the King's bath were numerous over the years and the obvious reason was to expand and enhance the facilities to accommodate the population and popularity increase. These modifications to the bathhouse structure can be seen in five main phases (*fig 4.22*) (Cunliffe, 1971: 43). The initial general layout was quite simple with a plain masonry building comprising of three spate areas in plan, namely a spacious entrance hall with the thermal bath to the right or East and the artificially heated rooms to the left or West. The entrance hall should have been of a high volume to awe the bather and distract him while he undresses. Once undressed, there was a choice of which to follow, either to the right and the Great Bath which was gentle warm water, or he could go left towards the hot rooms like Turkish baths for a more meticulous session. The hall acted as a dividing line between these two main treatment areas and their functions as well as a breathing space between them (Cunliffe, 1971: 45).

The main hall was entered from the North-West corner through a simple opening from the entrance hall. The Great Bath was rectangular in shape and lay in the centre of the main hall surrounded on either side at its longest length by two isles of continuous arcades. These aisles divided the bathing space in the centre from the seated relaxing space on the outer edges. There were niches, recesses and shelves shaped in rectangular and semicircular shapes that were cut in the walls to provide places for bathers to sit, rest and watch the other bathers splashing, while they conversed.

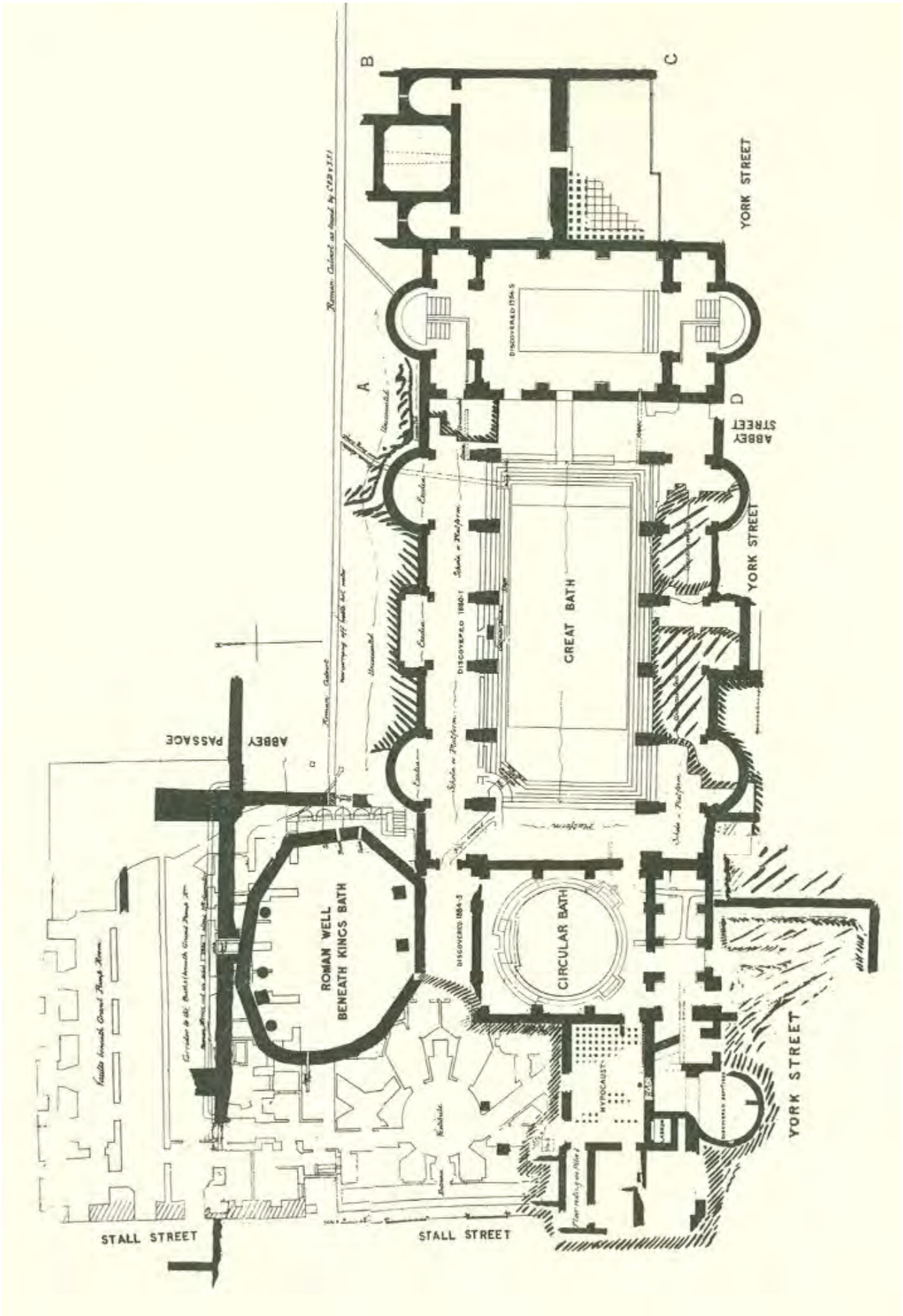


Figure 4.21 A layout drawing of the Kings Bath in Bath, England showing the three main areas namely the apodyterium, tepidarium and caldarium. (Cunliffe, 1969: 76)

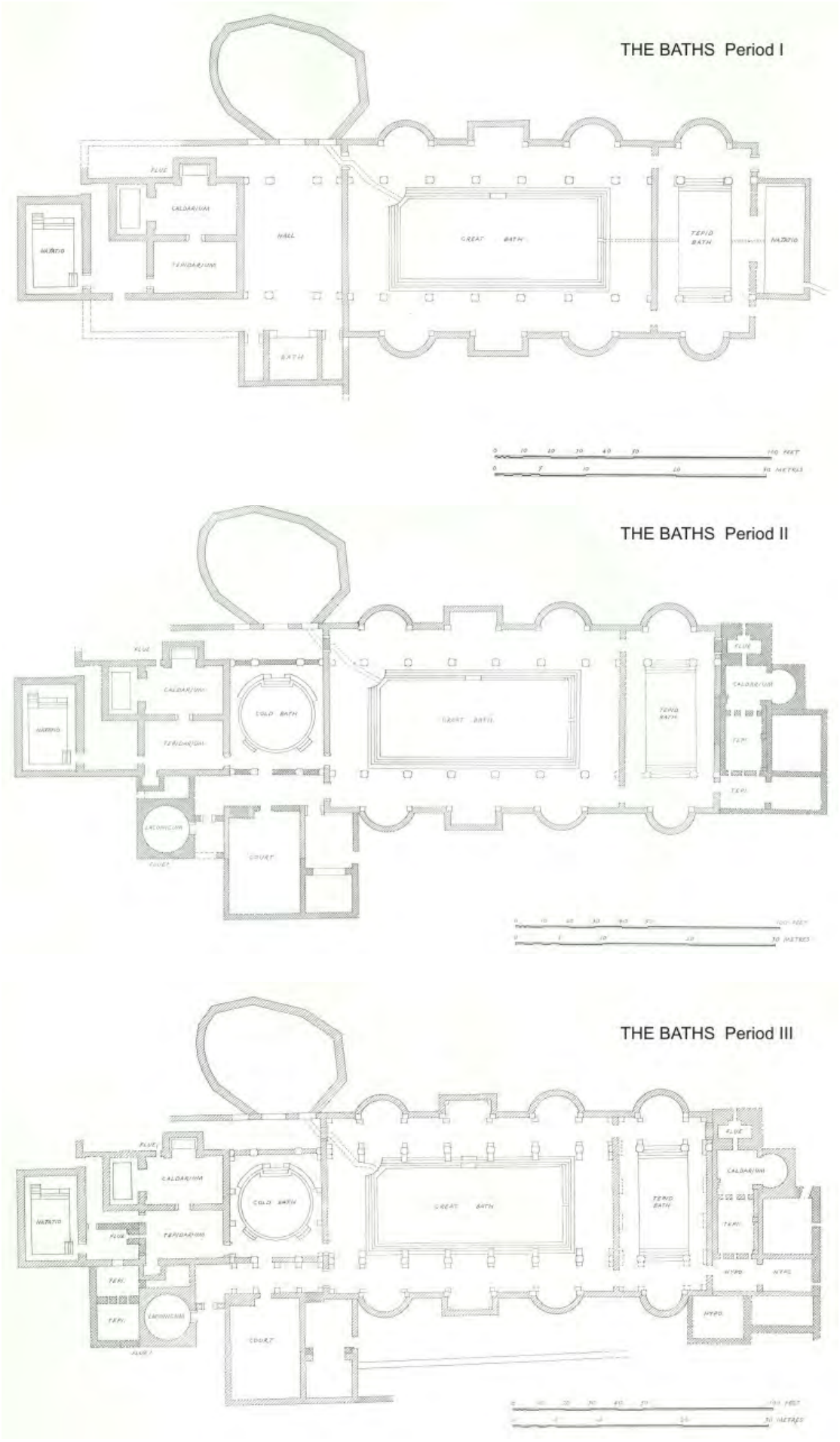
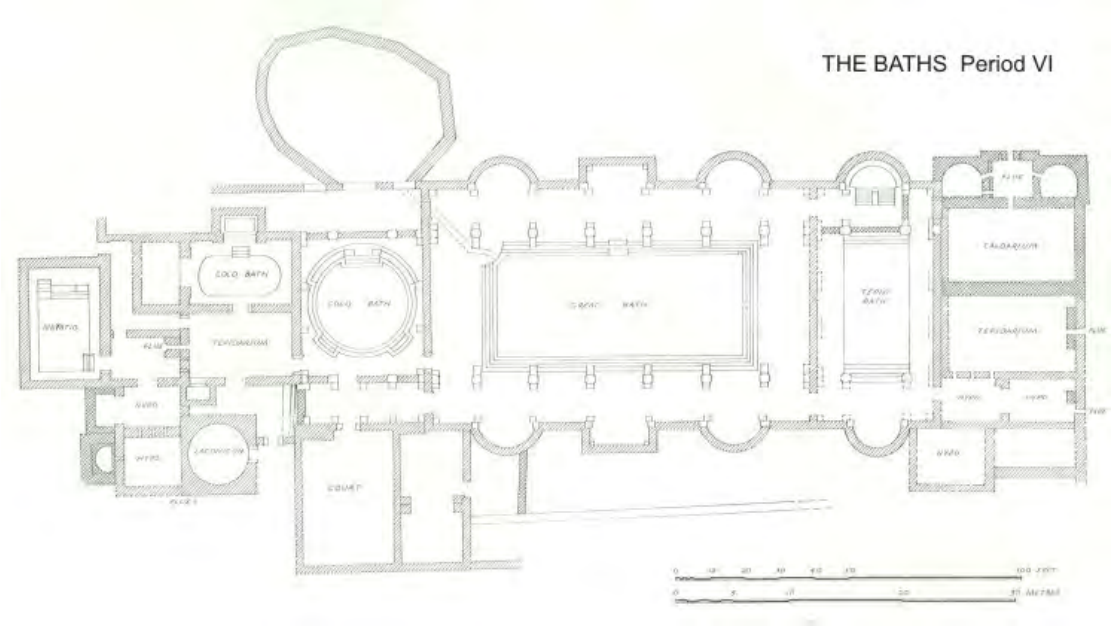


Figure 4.22 The different stages of development in the construction of Roman Bath, each period (I-IV) having more additions and alterations than the next for expansion to handle the growing rate of public demand. (Cunliffe, 1971: 44)



The main hall was constructed in stone as any other material like wood would have quickly rotted and bended in the steam filled atmosphere, not to mention timber would be a very high fire hazard. The Great Bath pool was a rectangular basin with dimensions of 21.9 by 8.8 metres which sat at a depth of 1.5 metres from the ground floor level and was accessed via four or five stone steps on all four sides (*fig 4.23*). The sunken area which was filled with water was lined with lead sheets. This flooring material was used to keep the water in and prevent other smaller springs from bubbling up and into the pool which would have cause overflow. The water was needed as it was channeled via box-pipes in the floor from the water spring reservoir (*fig 4.24*) (Cunliffe, 1971: 45).

Figure 4.23 A perspective of the Great Bath with its sunken floor and surrounded by a colonnade. (Cunliffe, 1971: 48)

Figure 4.24 An image showing the box pipes in the floors that channelled the spring water to the Great Bath and Lucas Bath. (Cunliffe, 1971: 98)

The general impression of the hall was a place of simple architecture. There were a few statures and ornamentation in the form of a fountain. The interior height of the main hall was estimated at around 13.7 metres high with the two aisle heights dropping in height in a

pyramidal form (*fig 4.26*). The difference ceiling heights from the aisle and hall allowed space for clerestory windows to be placed to allow an abundant amount of natural side-light into this large volume of space (*fig 4.25*). The lines of the roof and ceiling were bold and not overdone keeping a very function fell to the chamber (Cunliffe, 1971: 46).

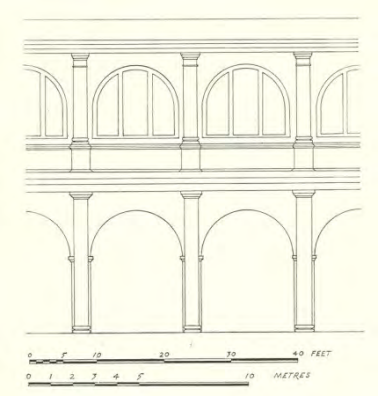


Figure 4.25 Elevation of the Great Bath arcade with colonnades and clerestory lighting. (Cunliffe, 1971: 52)

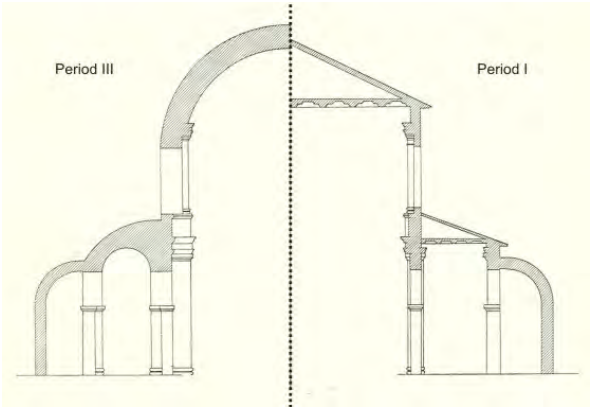


Figure 4.26 Section through the Great Bath showing period I roofing of timber which was replaced later by a barrel vaulted masonry roof. (Cunliffe, 1971: 59)

The next bath lay further down beyond the main hall and could be accessed by two doors from the Great Bath. It could be reached by a short flight of five steps and was smaller in size, called the Lucas Bath. This bath was also linked to the water supply from the Great Bath though channels in the floors with any excess water being collected and not wasted and led into a smaller bath. Two semicircular recesses sat at either ends of the hall for resting (*fig 4.27*). The Lucas Bath would have been roofed separately to the Great Bath chamber being lower and this lead to an even smaller bath termed the 1923 bath which decreased in temperature (Cunliffe, 1971: 48).

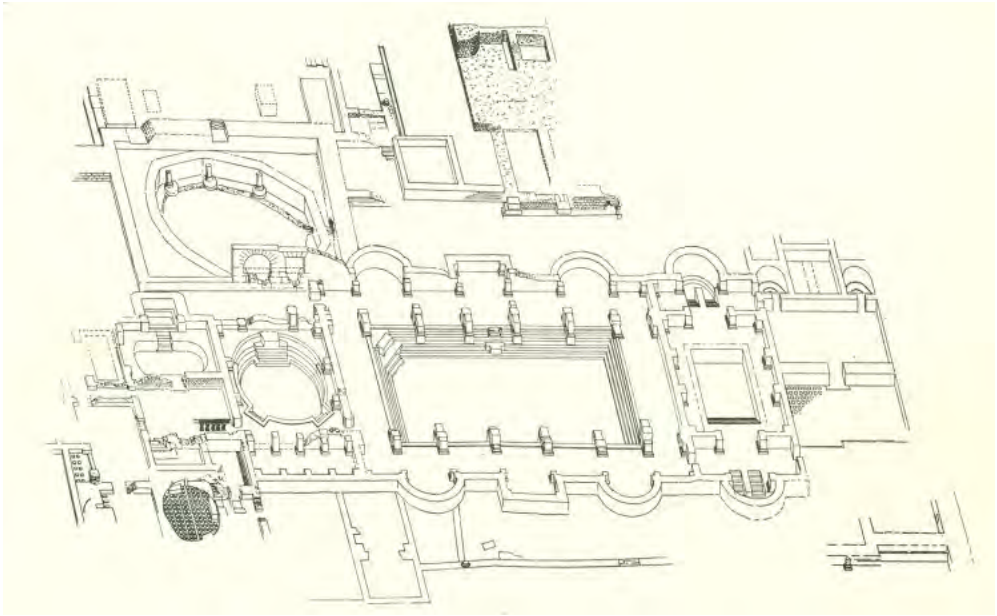


Figure 4.27 An axonometric drawing of the Kings Bath and the flow of functions from entry to warm baths and then to cold baths. (Cunliffe, 1969: 57)

The heated baths on the west side of the Great Bath chamber were much different. These rooms were smaller in size to suit their functions of retaining heat. Access to these rooms was via the entrance hall and through a corridor. This immediately led to an L-shaped room called *apodyterium* or undressing room. The bather would then move through to the adjacent *tepidarium* or warm room in which hot air was blown into the space. This was achieved from raising hot air in the vents of the North wall creating a draft and suction of more hot air from the basement hypocaust which was raised by a series of tiles; all this maintained a constant flow of hot air (*fig 4.28*). After circulating around the room the air would be extracted via flutes and extracted to the outside via chimneys in the roof. This room would prepare the bathers body for the higher heated temperature of the room following. Through the *tepidarium* lay the caldarium or hot room of the same size in which bathers could plunge into hot water which was probably heated by a stoker, and provided a more vigorous treatment. These rooms were arranged from hot to hottest similar experience to that of the Turkish baths. The body would be allowed to cool down slightly by exiting back through the *tepidarium*. The last part of the treatment was to partake in a quick swim in the *Natatio* to refresh and energize the body (Cunliffe 1971: 49).

Figure 4.28 The hypocaust system generated heated air which was channelled to the hot baths. this floor system consisted in a series of elevated paving tiles. (Cunliffe, 1971: 98)

Figure 4.29 A photograph showing the Great Bath in 1890. (Cunliffe, 1971: 48)

These thermal baths would not have required high ceilings like in the Great Bath because the heat and steam from the baths would need to be retained. The Great Bath needed higher ceilings for the steam from the warm water to rise so as not to disturb the socializing of the bathers. The heated rooms were constructed from concrete and box-tiles with vaults in the ceilings covering from the *tepidarium* and *caldarium* over to the *natatio* (Cunliffe, 1971: 49). The Great Bath on a recreational level was healing but water has the ability to become more healing specific as in the treatment of hydrotherapy.

Figure 4.30 Image of the Kings Bath, England. (Moore, 1994: 142)

4.2.3 HYDROTHERAPY

The concept of hydrotherapy as a therapeutic medium for rehabilitation has been around for many years now. Were many other forms of treatment have born and disappeared, but hydrotherapy still has a place in the healing realm. Hydrotherapy involves the use of water as an exercise and bathing procedures for rehabilitation. Water is the only other environment available to man other than land. When a body moves into the water it experiences two things – it is simultaneously reacts to two forces, the first is the downward pull of gravity and the second is the upthrust of buoyancy. These two forces experienced at the same time when in water allows the possibility of three-dimensional exercise and movement that when on dry land is hardly achievable. With the understanding in flexibility and gain of unusual movement in water, many forms of rehabilitation for different ailments can be achieved (Campion, 1997: xi).

Hydrotherapy is the utilization of water in the treatment of disease, and its therapy importantly exploits its temperature effects. Hydro- and hydrothermal therapy are traditional methods of treatment that have been used for the treatment of disease and injury by many cultures, including those of ancient Rome, China, and Japan (web 5). At a historical level the time in which hydrotherapy was first used is unknown but the first records of it dates back to 2400BC from the Proto-Indian culture, Egyptians and Assyrians, as they used mineral waters for curative purposes. Even in 1500BC the Hindus used water to combat fevers. By the 500BC the use of water took a turn towards being used in physical treatments and around 339AD baths created by the newly hygiene conscious Greeks and Romans and were used solely for healing purposes and treatment. It was used initially for symptoms of rheumatic disease, paralysis and after effects of injuries. Around the 4th century AD almost every Arab town had hammams or Turkish baths (a process of cleansing and relaxation through steam baths).Only recently in the 1920's was therapeutic pool exercises developed. Today hydrotherapy is evolving into a valued natural medical therapy on both physical and psychological levels (Campion, 1997: xii).

Physiological, Therapeutic and Psychological Effects of Activity in Water

The physiological effects are characterised by the combination of exercise and warmth of water. These two elements in water are on a physical level advantageous to the human body. The therapeutic effects of exercise in water are related to:

- The relief of pain and muscle spasm
- The maintainence or increase in range of motion of joints
- The strengthening of weak muscles and an increase in their tolerance to exercise
- The re-education of paralysed muscles

- The improvement of the circulation
- The encouragement of functional activities
- The maintainence and improvement of balance, co-ordination and posture

As mentioned water has the potential for a more three dimensional body movement compared to when on dry land but it also can provide a level of perceptual stimulation such as:

- Visually, as the eyes are continually accommodating to the changing environments from being in water to airborne and back to water
- Aurally, as the ears are forced to experience greater pressure under water than in air
- Via the skin proprioceptors, as the skin reacts and recognizes the sensation of waves and pressure of water on the body
- By heat, from the different temperature changes between water and air.

On a psychological level there is much documented research on the waters effect of mental illness, and currently the sedative effects of warm water are recognized (Campion, 1997: 3-4).

The recuperative and healing properties of hydrotherapy are founded on its mechanical and thermal results. Heat quietens and soothes the body, slowing down the activity of internal organs, whereas cold contrastingly stimulates and invigorates which, increases internal activity. Hydrotherapy takes advantage of the body's response to hot and cold stimuli, to the prolonged application of heat, to pressure exerted by the water and to the sensation it gives. The body's nerves carry impulses felt on the surface of the skin deeper into the body, where they are influential in stimulating the immune system, influence the production of stress hormones, revitalizing the circulation and digestion, encouraging blood flow, and decreasing pain sensitivity, thereby releasing tight muscles (web 5).

Techniques of Water Exercise and Therapeutic Swimming [1]*

It is important to understand that water and land are two different environments that have differing physical properties, states Campion. The distinctiveness of water is the buoyancy achieved, when in it. This buoyancy is a counter to gravity as it supports the body instead of allowing it to sink or drop. An advantage of this is how it induces relaxation in one way by relieving pain as the body feels lighter, with a decrease in force to pull the limps and torso down, thus relieving pressure to any injuries or joints or areas in pain. It also creates a greater freedom of movement by the body's weightlessness in the water medium. But there are more factors that the body reacts to when in water ,other than buoyancy, and these are cohesion, viscosity, turbulence, and friction. There is much more resistance experienced in the movement of water than the air as water is a denser matter and more forces is necessary to

* *See Appendix II – Hydrotherapy Exercise and Forms*

move through it, but this applies and is proportional to the speed and the shape of the object in movement. Types of exercise techniques in water for the use of physiotherapists are buoyancy exercise, Bad Ragaz patterns, hold-relax techniques, stabilizations, repeated contractions, breathing exercises, spinal mobilisations and hydrodynamic exercises (Campion, 1997: 177).
A number of general techniques are available for hydrotherapy which include: baths and showers, neutral baths, sitz baths, contrast sitz baths, foot baths, cold mitten friction rub, steam inhalation, hot compresses, cold compresses, alternating hot and cold compresses, heating compresses, body wrap, wet sheet pack, and salt glow, sauna and steam baths. Water temperatures are an important factor in the recuperative process and must be followed as exact as possible to produce the correct effect for the body in water. These temperatures vary according to techniques, but to provide an idea for an overall tension reduction the use of a neutral bath is adequate, with temperature between 33 to 35 degrees Celsius. But for a water therapy to tight, tense muscles and reducing the pain of stress-related conditions such as backache, temperature between 38 to 41 degrees Celsius is needed. Using temperatures higher than 41 degrees is not recommended because it can raise the body temperature too fast creating an artificial fever (web 5).

Campion believes that swimming is an important water treatment and is part of hydrotherapy and forms part of a patient's general rehabilitation. Swimming is a most useful therapy, as it can be modified and adapted to suit the user in their needs and capabilities, both for the able and disabled alike. In actual fact, the more severe the disability, the more beneficial the water therapy. Due to the density of the liquid as well as the turbulence, more energy is required to move in the medium and so this assists in the strengthening of the muscles and flexibility. Water therapies also offer independence to disabled users as most are unhindered as compared to land with crutches, wheelchairs and such. On a social level most swimming therapy is carried out in groups at a community level enabling the disabled a motivation to socialise (Campion, 1997: 183).

Water cures advanced in the 18th century from the many natural springs being found and a specific farmer called Vincent Preissnitz gave treatments up in the mountains to patients from a simple diet, to exercise and massage therapy. The patients' also drank up to five liters of water a day to cleanse the toxins from the body. Sebastian Kneipp developed Preissnitz work and came up with ways to improve the healing process and better overall health from different ways in utilising water. He sought to and developed a hydrotherapy routine which addresses specific conditions rather than general health such as other spas and springs. Fundamental to his healing waters theories was the basic knowledge that water temperature effects the circulation in the body and so used alternate hot and cold water techniques (Ryrie, 1998: 112).

Paediatric Disability Hydrotherapy

1. *Disorders of Bones, Joints and Muscle*

- Juvenile chronic arthritis

  This disease is about the inflammation in the tissues surrounding the joints and bones and their cartilages. The joints that are commonly affected are those of the knees, hips, ankles, wrists and cervical spine. The condition my be singular to one joint or varied in many. The condition usually sets in at a young age and so treatment times run for long periods of time. This time frame affects the important life stages both physically and emotionally with normal development being disrupted. Programmes must be implemented for joint range and function with daily exercise routine which hydrotherapy can provide (Campion, 1997: 135).

- Muscular dystrophy

  This disease is characterised by a progressive degenerative process of the skeletal muscles and muscle weaknesses. Muscular dystrophy is gender linked and usually seen in males. The disease can be indicted in the first four years of life of the person with difficulty in walking which progresses into being unable to walk. The muscle weaknesses combined with gravity creates difficulties in maintaining correct posture which in turn affects respiratory functions. Due to the severity of the progression the earlier a daily routine is created the better in forming a resistance to the deformities that come with this disease (Campion, 1997: 137).

- Congenital abnormalities

  This condition is where there is a lack of full development in all four limbs or even an absence of limbs. It is essential to teach these children to swim and move in rotational movement in the one sport that can be achieved (Campion, 1997: 139).

- Spina bifida

  This condition refers to Congenial Abnormalities where there is a failure in the closing of bony or soft tissue and is the most common of them. Of the two types the one most water related is spina bifida cystica with lack of sensation as well as social and psychological factors (Champion, 1997: 139).

- Osteogenesis imperfecta

  This is a rare disease but one that can be physically treated in water. It is a severe congenital form which is caused by frequent fractures from minor injuries that do not heal well. Following surgery to correct deformity water therapy to correct and maintain posture is necessary (Champion, 197: 143).

- Burns

  The water in motion can remove the dead or damaged tissue in a non-traumatic method rather than surgery, with the whirlpool effects and active movements aiding the healing process and improvement of remaining healthy tissue (Campion, 1997: 144).

2. *Neurological and Developmental Disorders*
   - Cerebral palsy

     This disease is highly common as a handicap and ranges in severity, distribution and the intellectual effect of people. This condition results from disorders of movement and tone called spasticity, rigidity, flaccidity, athetosis and ataxia and are followed by disorders of sight and hearing, perceptive problems as well as intellectual retardation. Water therapy is an aid in helping the alteration in body shape and density from the disease (Campion, 1997: 145).
   - Head injury

     Water therapies can be used in the recuperation of patients suffering from head injures such as caused by accidents from cars, sports or industrial. People having head injuries often experience a range of intense sudden emotions and hydrotherapy goals can be to promote relaxation, encourage movement, and stimulate the right reactions and better breathing and functional patterns (Campion, 1997: 152).
   - Epilepsy

     Epilepsy is the disturbance of cerebral function created by abnormal neurons in the body and it different in each person with location and duration. Normally it occurs with convulsions and unconsciousness. It is not specific to any age groups , gender, or intellectual activity. Highly interesting in fact is that epileptic seizures are very uncommon in water (Campion, 1997: 155).
   - Infections of the central nervous system

     There are many causes to infections of the brain and spinal cord which a high number of children recover from, but some leave permanent damage to the neurological system from the effects of inflammation. Hydrotherapy treatment aims to prevent contractures, maintain circulation and strengthen the affected muscles (Campion, 1997: 156).
3. *Sensory Disorders*
   - The Blind Child

     Blindness is a serious handicap for children which results in delays in motor, language, cognitive, social, emotional and self-care development. There is a general view that blind people cannot enjoy the activity of water but that is

incorrect as this is highly possible with an improvement in balance and free movement (Campion, 1997: 158).

- The Deaf Child

  Many deaf children even partial hearing tend to tilt their heads in order to hear faint sounds and these positions become habitat which alter body posture. Water therapies help in correcting this (Campion, 1997: 159).

4. *Learning Difficulties and Behaviour Disorders*
   - Severe learning difficulties
   - Mild learning difficulties
   - Autistic children
   - The hyperkinetic syndrome
   - Perceptual disabilities
   - The clumsy child

   Children with learning difficulties can greatly benefit from hydrotherapy and apply the changes and skills learnt into their everyday lives. Children with learning disabilities are generally mobile and so are separated from children with mental and physical disabilities. Children suffering with learning difficulties are because there has been a delay in development and so these children battle to learn and adapt to society. As the child partakes in water activities they lose a lot of tension and learn to develop social skills (Campion, 1997: 161).

5. *Respiratory Disorders*
   - Asthma

     Research has shown that asthmatics can use water exercise to develop better breathing pattern and strengthen the lung capacity better enabling these children to deal with asthma attacks. Water activity also helps at a fitness level and improves breathing and posture which also affects the respiratory system (Campion, 1997: 167).

Adult Hydrotherapy

1. *Neurosurgical and head injuries*

   Patients suffering from these conditions could be due to brain trauma motor vehicle accidents, motor cycle accidents, industrial and sporting injuries. These patients experience extremes in conscious states from being fully awake to almost comatose. Individualised treatment programme are necessary with a programme varies to the point of covering respiratory and orthopaedic physiotherapy, movement rehabilitation, and cardiovascular fitness training. The desired goals from hydrotherapy when dealing with head traumas is (Campion, 1997: 189):

   - Decreased tone

- To stimulate movement
- Retain and stimulate righting reactions
- Augment and increase in the range of weak movements
- Preserve centralised, rotational patterns of movement
- Access functional movement patterns
- Encourage and develop breath control and voice production
- Produce psychological effects
- Offer opportunities for recreation and socialisation

2. *Neurological rehabilitation*

   Hydrotherapy has a much more defined experience and benefits in the treatment of neurologically injured patients. The central nervous system (CNS) has a great ability to adapt and change as it registers information from a person's surroundings and acts accordingly. When any part of the CNS is damaged the patient attempts to move against gravity, not to mention that the organisational and monitoring ability of the brain becomes affected. Therapeutic water treatment means to stimulate a reaction from patients without pushing too far past the damaged systems limitations and reduce abnormal responses. The neuromuscular effects of immersion in water are (Campion, 1997: 205):

   - Changed points of reference for balance
   - Tonal adaptations
   - Access to the components of movement

3. *Spinal mobilizations*

   There are two treatment approaches to hydrotherapy practice for spinal mobility problems; these are passive manual mobilization (PMM) and passive mobilization using turbulent drag (PMTD). Also others exercise techniques for this condition is Bad Ragaz and Halliwick techniques. Spinal pain and lower back pain is a highly common public health issue that affects people in their most productive years. This condition is the cause of 60 percent of all physiotherapy practice cases with high reoccurrence rate. Spinal pain is a major medical and social issue in society. Hydrotherapy methods is a good treatment method for people suffering from back pain as this medium aids in assisting mobility without as much pain on dry land , with the buoyancy factor reducing force of gravity on the region reducing pain and stiffness (Campion, 1997: 226).

4. *Spinal Cord Injuries*

   Spinal cord injury can effect anyone at any time in their life. It can lead to paralysis either through trauma or disease and can affect motor power, sensation and control of

the bladder, bowel and sexual function. Hydrotherapy provides a part in the rehabilitation stages and in no other medium can a person with spinal injuries have as much independence. The main aims of hydrotherapy treatment are (Campion, 1997: 242):

- Reduction of spasticity
- Relief of pain
- Increase range of movement
- Improve muscle power
- Increase aerobatic capacity
- Re-educate gait and swimming

5. *Rheumatic Disease*

- Inflammatory Arthritis
- Rheumatoid Arthritis
- Degenerative Arthritis
- Spondyloarthropathies

Common indications and symptoms of rheumatic disorders are pain occurring around affected joints, creating tension and muscle spasms; decreased range of motion and increased stiffness of joints; muscle weaknesses; deformities in some conditions and a reduction in functional ability. The advantages of hydrotherapy for people suffering with rheumatic disease if the warmth of the water which decreases pain and muscle spasm and the waters buoyancy reduces forces and strains on the joints reliving stress and pain. The aims of treatment in water for Rheumatism are (Campion, 1997: 254):

- Relief of pain, swelling and stiffness
- Promotion of relaxation
- Joint mobilization
- Muscle strengthening
- Correction/ prevention of contractures
- Improvement of coordination and functional ability

6. *Orthopaedics*

Orthopaedics is the learning of the musculoskeletal system which includes bones, joints, ligaments, tendons, muscles, and verves (web 11). On immersion in a heated pool the warmth of the water will result in the relaxation of them muscles. The buoyancy of the water will decrease weight and pressure on the joints and reduce pain, and the sympathetic nervous system is suppressed which drops the perceptions of pain experienced. Hydrotherapy can treat orthopedic conditions such as pain and

muscle spasm, decreased range in movement, muscle weakness, poor balance, poor posture, and decreased cardiovascular fitness. Parts of the body that can be treated are the shoulder girdle, glenohumeral joint, elbow joint, wrist and hand joints, pelvis, hip joint, fractured femur, knee joint, fractured patella, ankle joint and cervical spine (Campion, 1997: 269).

7. *Sports Injuries*

   Hydrotherapy in the treatment of sports injuries is mainly the reduction of pain and the remodeling and healing of injured tissue. The main advantage of hydrotherapy in regard to treatment is that the buoyancy property of water allows controlled loading of tissues which cannot be achieved on dry land (Campion, 1997: 284).

8. *Aquanatal Exercise*

   The weightlessness of water decreases the forces of gravity in pregnant women and so reduces back pain which is a common symptom in the later stages of pregnancy. The water immersion also reduces characteristic feet and ankle swelling. The immersion in water also increases blood circulation as in the twenty-fifth week there is a 40% increase in the amount of blood flowing in the women's system increasing the risk of stroke (Campion, 1997: 299).

Hydrotherapy and bathing can also be used as a treatment process for common ailments or illnesses such as (web 4,5) [2]*:

- Arthritis - steam bath; cold double compress; spa treatments; sauna; mud baths or mud packs; floatation
- Asthma - spa treatments; body brushing
- Backache - spa treatments; floatation; body brushing
- Bites and stings - cold compress with essential oil of melissa
- Bronchitis - steam baths
- Burns - cold water followed by cold compress.
- Circulation - spa treatments; saunas effective when combined with cold showers;
- Colds - sauna as damp heat helps discharge blocked energies related with colds and sinus trouble
- Complexion - enhances skins health, immersion
- Constipation - shallow cold bath
- Cystitis - hot shallow bath or neutral bath

* *See Appendix I – Medical Dictionary of Illnesses*

- Depression - spa treatments; energising shower; cold foot baths; cold compress to head; warm bath with oil of basil
- Detox - hot bath with Epsom salts; spa treatments, flotation
- Diarrhoea - cold baths
- Eczema - sea bathing; spa treatments; saunas
- Eyestrain - bath eyes with chamomile
- Fatigue - cold foot baths; sauna; sea bathing; flotation
- Haemorrhoids - alternate hot and cold baths
- Headaches - cold compress on back of neck and forehead; warm foot bath
- Insomnia - warm bath before bed with chamomile
- Menstrual Pain - hot shallow bath
- Muscle spasms, stiffness, aches, and pains - warm bath; warm compress; whirlpool baths; spa treatment; mud bath
- Respiratory problems - Turkish baths – dry heat effective; sauna with pine oil
- Rheumatism - whirlpool baths; spa treatments; mud baths/wraps; hot compress
- Sciatica - hot compress followed by short cold shower
- Skin Irritation - warm oatmeal baths
- Skin problems - sea bathing; spa treatment
- Sprains - ice compresses; alternate cold and hot compresses
- Stomach ache - hot shallow baths
- Stress, tension, anxiety, worry
- Toothache - alternate hot and cold foot bath
- Wounds - cold salt water bath then ice compress after
- Varicose Veins - leg immersion in hot water

4.3 WATERS INTEGRATION WITH ARCHITECTURE

Water is an alluring element as it is both simple and complex. Because of this people are drawn to water sources and attracted to its existence. As people stare at a flowing river under a bridge they are entranced, to see water as it sheets over the marble rim of a fountain they want to feel it, and to sit and listen for hours to the sound of a gurgling stream or waves at the beach as they are spellbound. From tea gardens to glamorous hotel lobbies humans have continued in using water in the built environments (Moore and Lidz, 1994: 15). It has been established that water flows through all living things such as a figure of 15000 gallons that

flows through a human body in an average life span. It is also relevant to note that large quantities of water flow through buildings with functions such as taps in kitchens, showers and baths in bathrooms, toilet flushing, washing gardens, cars and pets (Day, 2002: 39).

> *"When the fusion of architecture and water is treated carefully and creatively, the potential for meaningful expression is practically limitless", states Moore* (Moore and Lidz, 1994: 22).

The world of water is embraced by all cultures with each one having their own individualistic way in incorporating water in their built environments. The general ways that architecture and water can be interrelated is divided among four general stages of the water cycle – fountains, rivers, pools, and oceans (Moore and Lidz, 1994: 20).

4.3.1 FOUNTAINS OF LIFE

From history fountains have represented a sacred water source that almost symbolized the origin of life. They also symbolize both the appearance and disappearance of fresh water. From the beginning of time there was water and any species that was alive fed of it for survival, so as humans depended on fresh water they tended to gravitate to its sources and make these places important. Wherever there was water people slowly gathered, settlements started to flourish, and cities became established such as Cairo, England and Brisbane. (Moore and Lidz, 1994: 21). Before the modern invention of plumbing, wells and natural water sources were the only fresh water sources and so towns and cities built around these. Their importance was established by ornamentation and decoration of the town's history on their bases. This meant that fountains represented important urban places in ancient times. Within our towns fountains represent important urban places (Moore and lidz, 1994: 42).

Moore states that the solution to making successful and attractive fountains is to control the way water moves thereby manipulating the water effect desired such as animating, enlivening, relaxing, soothing, exploding, dancing, swirling, or splashing, all without losing control of the water or ruining the imagery of the fountain with tangles of pipes and gizmos in transporting the water. The best inspiration for the movement of water is from Nature itself with natural water movements of turbulent brooks, falling in drops or sheets of rain, bubbling up from pools, thundering over falls, rolling onto beaches in waves and crashing against rocks or condensing in dew drops. Fountains also represented a mastery over nature as designers sought to create different environments by using different types of fountains. These designers took still water and mechanically worked against gravity in sprouting water from jest and nozzles. This was not the same attitude of the Oriental designers who rather sought complete calmness and natural flow. It is assumed that the European designers with the fountain nozzles did not try to upstage nature but experiment in creating different water effects on

environments. Bernard de Belidor published an encyclopedia of water and architecture called Architecture Hydraulique in which he suggested ways architects could use moving water in the gardens of clients. This promoted the development of jetting water in these principle water shapes (Moore and Lidz, 1994: 43-45):

- *Jets d'eau*: they shoot up vertically from the ground forcing water out of its natural horizontal plane (*fig 4.31*)
- *Nappes:* when water flows in thin sheets over smooth ledges, the streams are called nappes (*fig 4.32*)
- *Cascades:* imitate splashy waterfalls, their surfaces are not smooth and glassy but broken up into fractured streams, white foam, and wild squirts (*fig 4.33*)
- *Grottes:* caves that contain mythical water sources, traditionally built underground with stone vaults to synthesize moss-covered caverns. (*fig 4.34*)

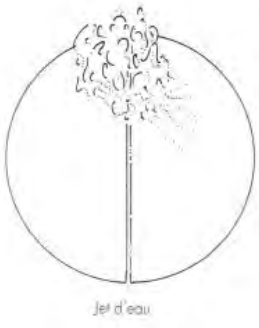


Figure 4.31 Sketch of Jet d'eau fountain (Moore, 1994: 44)

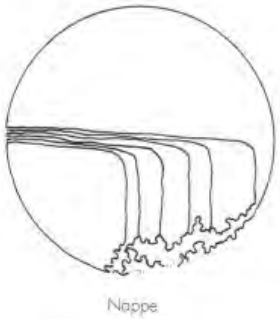


Figure 4.32 Sketch of Nappe Fountain (Moore, 1994: 44)

Figure 4.33 Sketch of Casade effect (Moore, 1994: 45)

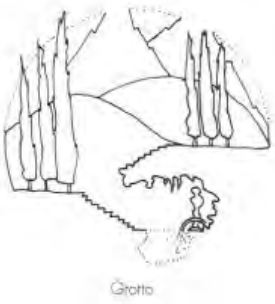


Figure 4.34 Sketch of Grotto cave (Moore, 1994: 45)

- *Bassins:* pools that collect and contain water from jets, nappes, or cascades and are sized to harmonize with the available space and positioned to take advantage of their reflective surfaces. (*fig 4.35*)
- *Grills:* a multiplication of berceaux forming a rhythmic pattern (*fig 4.36*)
- *Berceaux:* circular pods arranged in two rows send blobs of water leaping through the air and fountains. Many of these fountain forms were derived from nature. (*fig 4.37*)

Figure 4.35 Sketch of bassin pool (Moore, 1994: 45)

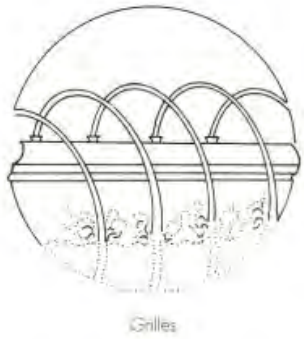


Figure 4.36 Sketch of Fountain grilles (Moore, 1994: 45)

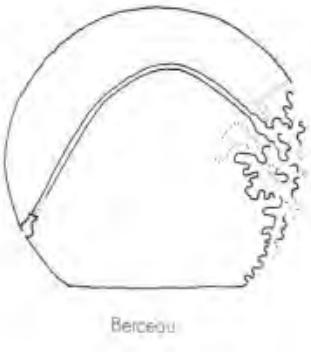


Figure 4.37 Sketch of Berceau fountain (Moore, 1994: 44)

The advantage of fountains is that these water systems can be mixed and matched to create many different variables and ultimately effects (*fig 4.38+4.39*). Fountains do not have to be grand for them to be effective, as a simple fountain of flowing water from a bowl still has the same soothing principles as ten jetting fountains in a row. Fountains are seen as hypnotic as psychologically they are attracting from the sounds of flowing water to the visual changes and light it refracts. Fountains provide more fascination to people and cities that are landlocked and at the same time provide the water connection to the endless oceans surrounding the continents (Moore and Lidz, 1994: 46).

> *"...water is a natural material, although controlled by gravity and natural laws, it can be coaxed, shaped, and transformed"* (Moore and lidz, 1994: 48).

Figure 4.38 Barcaccia Fountain, Rome Italy, portraying playful fountain design. (Moore, 1994: 60)

Figure 4.39 L'Esposizione Universale di Roma, Rome, Italy. Showing drama, symmetry and creativity. (Moore, 1994: 64)

In Sebatu, Bali, gushing quintets of fountains spill into a series of deep bathing pits that are surrounded by lush and fertile palm canopies (*fig 4.40*). On the ledge above each basin, a council of stone deities meditate as sacred waters flow below their knees. The five fountains keep the water in constant motion. Bathers descend into the pit between high stone walls that sink directly into the water, reinforcing their removal from the world at large and connecting them more intimately with the water source and nature (Moore and Lidz, 1994: 43).

Figure 4.40 Series if fountains at Villa d'Este in Italy. (Moore, 1994: 51)

4.3.2 RIVERS OF CONNECTION

Rivers and canals are the arteries of the water system that connect and communicate with countries and different places. The flow of rivers establishes a continuous movement of water that communicates ideas and expressions while connecting places and time. What this means is that rivers are kinetic, full of moving and changing water so they are never the same thing twice. Rivers continually renew themselves as the rain from mountains and hills flow down to valleys and from rivers carrying the water to the lowest level, the sea. Moore's expresses what Lewis Mumford stated, "*I have left to the last the dynamic component of the city, without which it could not have continued to increase in size and scope and productivity: this is the first efficient means of mass transport. The waterway. That the first growth of cities should have taken place in river valleys in no accident, and the rise of the city is contemporaneous with improvements in navigation, from the floating bundle of rushes or logs to the boat powered by oars and sails*". A few rivers such as the Nile has earned legendary status and it is because these rivers are the connectors that link mankind's present to ancient civilizations and cultures of the past (Moore and Lidz, 1994: 78).

Rivers were important tools for developing cites as they helped trade to expand and prosper, sustained agriculture with irrigation, and supplied hydropower for mills and factories (Moore and Lidz, 1994: 21). Since humans have constructed cities along rivers the layout of these cities have had to flow the edges and streams, and so rivers have affected city designs. The pattern of city compositions based on rives are endless as no two rivers are the same in the world as they are influenced by topography, climate, and heights. A key element to river cities is how these cities form an edge to the rivers almost keeping them at bay. These zones are highly energetic as the region of transitions between moving water and immobile land have large potentials for drama.

A few examples are looked at of popular river cities and their layouts. In Pittsburgh, Pennsylvania (*fig 4.41*), this city is connected to three rivers, the Allegheny river, the Monongahela river, as they both converge and form the Ohio river. The grids of the city runs parallel to the rivers until they meet at an angle

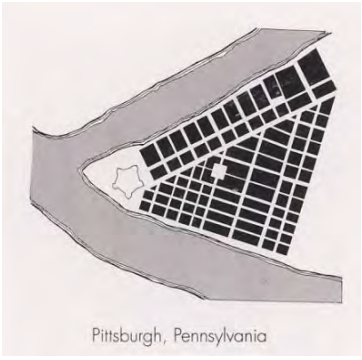


Figure 4.41 City plan of Pittsburgh Pennsylvania and the Allegheny river. (Moore, 1994: 78)

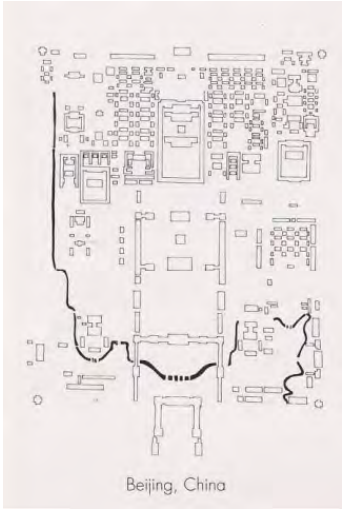


Figure 4.42 City Plan of Bejing China. (Moore, 1994: 79)

which create an axis leading straight down to the tip or point of the triangular land shaped by the rivers converging. This is completely unlike Beijing, China where the river is snakelike and winding compared to the ordered, grid-like imperial palaces and temples (*fig 4.42*) (Moore and Lidz, 1994: 79).

Manhattan in New York is a generally rectangular piece of land which is squeezed between the Rivers East and Hudson (*fig 4.43*). From the long, stretched shape of the land the main arteries, axes or pathways of the city follow the longest length. Philadelphia in Pennsylvania is more ordered with the city being fit between two quite evenly parallel rivers called Delaware and Schuylkill (*fig 4.44*). This has lead to the city being planned and set out in square with horizontal and vertical axes with a central point where they meet. Rome in Italy, is locked on the elbow of the Tiber river, as the city lays itself out forming an edge to the river with almost random pathway planning, almost representing a hard shell protecting the inner body (*fig 4.45*) (Moore and Lidz, 1994: 79).

Figure 4.43 City plan of Manhattan in New York City, an island surrounded by water and grid system to maximise land coverage. (Moore, 1994: 79)

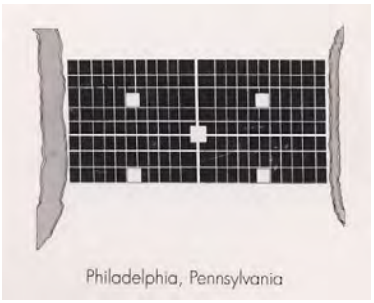


Figure 4.44 City Plan of Philadelphia situated between two rivers. (Moore, 1994: 79)

Figure 4.45 Rome city plan surrounded by the Tiber rover as it shapes the city edge. (Moore, 1994: 80)

San Antonio in Texas, has the San Antonio river cutting through the city where it forms a loop and rejoins the main river (*fig 4.46*). Within this loop are a series of bridges that connects the isolated piece of land in the loop. This area is known as the 'River Walk' and is a great source of commerce. This river gives the city its centre. Paris in France still has a great connection to the river that runs through it called the Seine (*fig 4.47*). As the Seine makes its way through the city it is a journey punctuated by monuments, squares, parks, and landmarks

with tree-lined banks. And finally in Venice, Italy its city is an organic network of waterways and canals that were carefully designed to carry away filth and garbage into the sea. Buildings and squares are packed between these canals and overlaid with a series of bridges connecting these land elements (Moore and Lidz, 1994: 80).

Figure 4.46 the city plan of San Antonia in Texas, showing the River Walk area where the river is looped making it an urban centre. (Moore, 1994: 80)

Figure 4.47 A city plan of Paris, France, and the Seine River at is moves through the city and linked across with numerous bridges. (Moore, 1994: 81)

Set against wide bodies of water and rivers bridges formed an integral part of urban design as these architectural elements solely allowed pieces of land to be connected by people (*fig 4.48+4.49*). Without these factors, people who have to cross rivers on boats, would have ultimately been time consuming and disadvantageous. To maximise at an urban level, bridges have also become place in which buildings can be built on. With new technologies bridges can span enormous bodies of water unlike the olden days with stone pillars and arches having been restricted in span. Some cities create individualised imagery with their bridges such as Paris with its some 25 bridges spanning across the Seine (Moore and Lidz, 1994: 81).

Figure 4.48 A photograph showing Venice Italy and its waterways between buildings. (Moore, 1994: 87)

Figure 4.49 A photograph showing the River Walk of San Antonia where the river edge is full of human activity. (Moore, 1994: 88)

4.3.3 POOLS OF REFLECTION

Lakes and pools are unlike the rivers, stream and fountains of the world with their gushing movements, in comparison they are the collectors for these rapid waters. These large bodies of water represent still waters which bring three characteristics factors to view, namely that they are contained under a horizontal surface unlike most waters, that the bodies of water inspire contemplativeness in psychology and the span of the still surface allows for great elements of reflection (Moore and Lidz, 1994: 121). The physical effect of stationary waters is reflection which is a mirrored surface that absorbs, repels, and refracts its surroundings whether landscape or buildings (*fig 4.50-52*). These images of reflection of the real surroundings extend space to a person's foreground filling up the vision and creating a larger more encompassing scene, from the detail and colour of buildings to the vast clear skies (Moore and Lidz, 1994: 124).

Figure 4.50 Roman Pool at the Hearst Castle in San Simeon, California, the still waters provide a mirror image of the room. (Moore, 1994: 139)

Figure 4.51 the wondrous effect of reflection at Temple West garden in Suzhou, China. (Moore, 1994: 151)

Figure 4.52 Urban landscaping can incorporate water into land locked places and create various effects. (Moore, 1994:

Ponds and pools are usually smaller bodies of water that can be easily walked around, whereas lakes are larger in size and stretch in many different shapes with long shorelines that are much longer to go around. For their characteristics of contemplation and silent stillness lakes have traditionally represented an "indwelling

Figure 4.53 An image of Pulteney Bridge in Bath, England and cascading water feature. (Moore, 1994: 100)

spirit" (*fig 4.53*). But in the East is where this 'spirit' of nature has been most popular as the Orient believes that not only do humans have spirit but that everything in nature is inspirited too. That is why ponds and pools are fond in most Oriental gardens as they are believed to be the souls of the world (*fig 4.54+4.55*) (Moore and lidz, 1994: 122).

Throughout history lakes have provided ideal settings for people to live near water forming cities and towns. And where there was no water body designers' create artificial lakes and ponds, in other words an imitation of nature. Although artificial some of these ponds come quite close to the real thing by the exaggerated shapes and the way in which the banks connect harmoniously to the surrounding landscape (Moore and Lidz, 1994: 125). Unlike natural pools, artificial ones are not limited in their shape and some draw attention to this fact by being completely geometric with a sudden transition between ground and water (*fig 4.56*). Some artificial pools form part of the enhancement for design as seen for example in the Taj Mahal in India where the rectangular pool in front reflects the buildings symmetrical façade as well as enhances the symmetry by proving to be a central axis in the composition (*fig 4.57*). Pools can also have a magical effect on the viewer when coloured lights are mixed into the appearance as the reflection and refraction of water creates a glittering attraction (Moore and Lidz, 1994: 127).

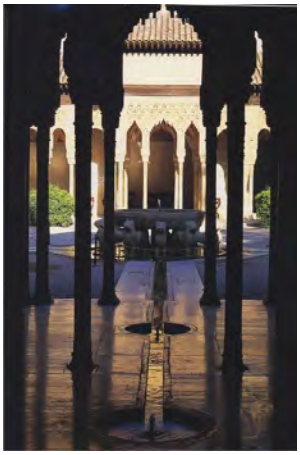


Figure 4.54 Court of the lions seen in The Alhambra located in Granada, Spain with a combination of water channels and fountains. (Moore, 1994: 117)

Figure 4.55 Water feature shaped as a channel in the ground seen in Brion Cemtery, San Vito d'Altivole, Italy. (Moore, 1994: 114)

Figure 4.56 The artificial body of water set in front of Washington Monument in Washington DC. (Moore, 1994: 131)

Figure 4.57 Taj Mahal in India is a good example of water used to highlight design with the rectangular body of water providing an approach and axis to the building composition. (http://www.dailytravelphotos.com/archive/2009/12/28/)

Lakes symbolize quiet, their calm surfaces providing the correct atmosphere in order to lose the mind to memories, plans and thoughts and in general a heightened psychological sense which is a great contrast to the energized atmospheres created by fountains and rivers (Moore and Lidz, 1994: 21).

4.3.4 OCEANS OF INFINITY

The sea is the biggest water element of contrast, where at one moment calm and serene, and the next violent and brutal in its waves. The sea makes up most of our planet and astronomers state that our world with its water source is almost singularly unique as is the fact that humans, life, could not live without it. That also provides another contradiction as water gives life as well as takes it as the sea persistently slashes continents, drowns ships, and overcomes anything in its way. The oceans are the one constant on earth that signifies the insignificance of humans in a way that makes a person understand their infinitesimal place in the world. When seen from the shore it seems never-ending and vast and truly overwhelming. But it is also approachable as people can swim in it, dive in it, and explore it (*fig 4.59+4.60*) (Moore and Lidz, 1994: 157).

Figure 4.58 The island with a large castle, Mon-Saint-Michel, set atop it completely surrounded by water in Normandy, France. (Moore, 1994: 167)

Oceans and seas are enormous bodies of water within which have its own systems and patterns from the rhythms of the waves crashing on shore to the warm and cold currents swirling beneath the surface. Waves are the best indication of the seas power and violent nature in its daily rhythms of back and forth movement on the shore. But it's also important for its sounds which vary between the loud crashing of the surf on rocks, to the gentle constant lapping of water coming in and pulling back (Moore and Lidz, 1994: 157).

Figure 4.59 The setting of cities on water edges are scenic and beautiful such as Piazza San Marco in Venice, Italy. (Moore, 1994: 184)

Figure 4.60 The town of Portofino, Italy. A contrast of civilisation against nature with the expanse of the sea beyond. (Moore, 1994: 186)

The main connecting points of land to sea are harbour cities, which bring water into their depths for ships. Here it can be seen that people who live in or visit these cities commonly feel the need to approach as close to the water's edge as possible as the inspiration and awe drives them in. This is the reason for the creation of piers, boardwalks and decks, to provide points in which man can venture out into the water about it safely and experience its powers of contact. One aspect of seas is that it holds pieces of land in it called islands isolated from the mass of continents and at mercy to the powers of the oceans (*fig 4.58+4.61*). Islands represent mystery and solitude as they sit alone amongst volumes of immense water (Moore and Lidz, 1994: 162).The seas have the most power to challenge society with its never-ending volumes of water and suggestion of infinite space. It is an aspect of the world that can never be forgotten or exploited by mankind and even not ever fully conquered.

Figure 4.61 The isolated and serene, almost untouchable, Water temples in Lake Bratan located in Ulu Danu, Bali. (Moore, 1994: 171)

4.3.5 VALUE OF WATER IN ARCHITECTURE

Architecture can bring out waters intrinsic qualities through the design and incorporation of water into urban environments. Most people are not situated close to a water source, or even the sea, and so architectural interventions with water enable a connection to water through design and landscaping. Architecture allows people to engage with water through sight, sound, and touch in numerous ways. Designers utilize the natural phenomenon of reflection of light on still and moving water surfaces that end up creating patterns on surrounding surfaces and appear dazzling to the human eye. This in turn captures the individual's attention and distracts them from anything they are thinking. Designers also use the appearance of depth and large bodies of water to instill clam and contemplation in the individual, while relieving people of claustrophobia. Viewing large bodies of open water help a person to feel freer and a small part of a big space, unlike the experience of cities where every individual space is restricted (Moore and Lidz, 1994: 199).

By incorporating channels of water into a site, it provides an efficient tool for unifying complex architectural arrangements and creating a factor of continuity to tie the development or project together. Water has the ability to highlight and enliven architecture with its reflective qualities. It can do this by filling shaded areas with light, texturing with patterns dull and lifeless wall and floor surfaces and lighten darker dreary colours (Moore and Lidz,

1994: 201). Not only the visual aspects of water, but the perceived sounds it creates, can enliven spaces. Water is an element that makes sounds when it moves and differs in pitch and intensity according to the water course and speeds. When water is falling like as a waterfall, the sound is magnified, and when the water is trickling along a minimal gradient surface, it is subtle and quiet. All these sounds effects have different affects on the human sensory experience. Rushing water and its sounds excite the individual, while smooth flowing water soothe the individual, even bubbling water creates a feeling of playfulness. These water sounds can be used within architectural environments to create different atmospheres for different areas, and thereby make the experience through a development or building more diverse and memorable, constantly drawing the individual back again. With the attentive collaboration of water and architecture human environments can induce meaningful, intriguing and healing spaces that also provide a connection to nature or at least incorporate a part of nature into the daily lives of people (*fig 4.62-65*) (Moore and Lidz, 1994: 201).

Figure 4.62 Water within the urban landscape bringing a refreshing quality to dull dense environments and areas for recreation and playfulness. Fort Worth Gardens in Texas. (Moore, 1994: 72)

Figure 4.63 Fort Worth Gardens urban water feature. (Moore, 1994: 73)

Figure 4.64 Deep within urban environments water can be enchanting and refreshing, Bank of China, Hong Kong. (Moore, 1994: 32)

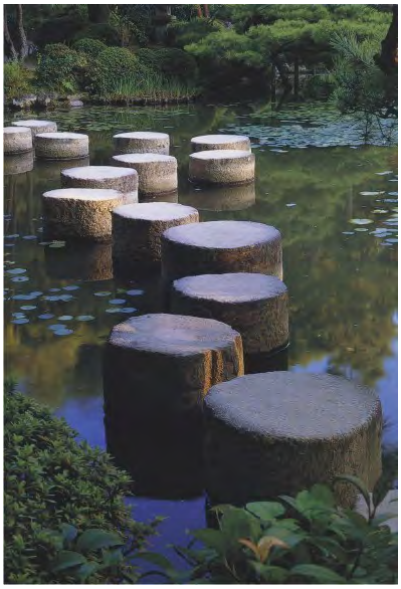
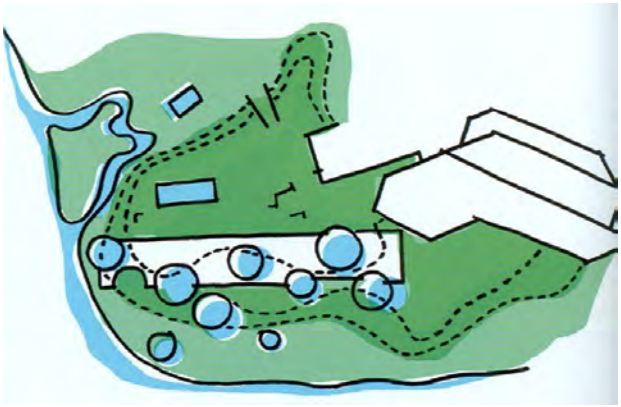


Figure 4.65 The created interaction between water and humans is essential for stress free recreation and restfulness. Stepping stones engage the individual in being above water moving across a flat expanse of water. (Moore, 1994: 175)

4.4 AN EXPRESSION OF WATER HEALING:

Behnisch Arkitekten – Thermal Baths, Aibling

The thermal Baths site is located on a 22 000 square meters area outside of the historic centre of the Bavarian town of Bad Aibling. The site is close to one of the streams that run across the town and on it sits a modern spa complex in southern Germany. The design by Behnisch Architekten in 2003 won first prize in a competition and the commission was to convert and revamp an existing sports centre with ice rink, sauna and swimming pools and crucially add a new spa. Working with the long spa tradition of the area, the architects have built a large curative and rest therapy complex. The overall Imageability was of separate hemispherical cells, scattered with porthole openings, sit on undulating ground in the midst of lush vegetation (*fig 4.66+4.67*). Nature plays a prominent role in the buildings surrounding, as it harmoniously frames and surrounds the building as it seem anchored to the edge of the waterway (Capezzuto, 2008: 25).



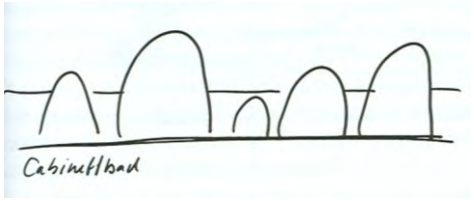


Figure 4.66 A concept sketch indicating the unusual domes against a solid horizontal line that ties them together. (Mork, 2008: 76)

Figure 4.67 A sketch site plan showing the round domed thermal baths at the edge of the river. (Mork, 2008: 76)

In 1845, a German doctor, Desiderius Beck, started covering his patients with beat pulp from the marsh near his home which was 20 miles from Munich. This treatment became recognized for its healing properties and soon became an attraction. But the major drawcard occurred when drilling in 2000 bought thermal waters to the town. The towns image then became transformed to the 'cure' town which was a significant achievement as spa treatment are generally used in this country as a healthcare facility. "*The dome is a traditional element in hammams or in the spas in Budapest. Without being too historical, the choice made sense to us,*" said Stefan Behnisch (*fig 4.68*) (Beautyman, 2008: 182).

Figure 4.68 Traditional forms of the dome set within a rectangular building against a lush vegetative backdrop. (Beautyman, 2008: 187)

Figure 4.69 The Therme Bad Aibling main entrance lit up at night with the prominent form of the domes. (Matzig, 2008: 82)

Figure 4.70 The spa's main building's steel-framed glass facade overlooks one of the outdoor ceramic-tiled swimming pools. The play of reflection on the waters surface is extremely compelling and mystical. (Beautyman, 2008: 181)

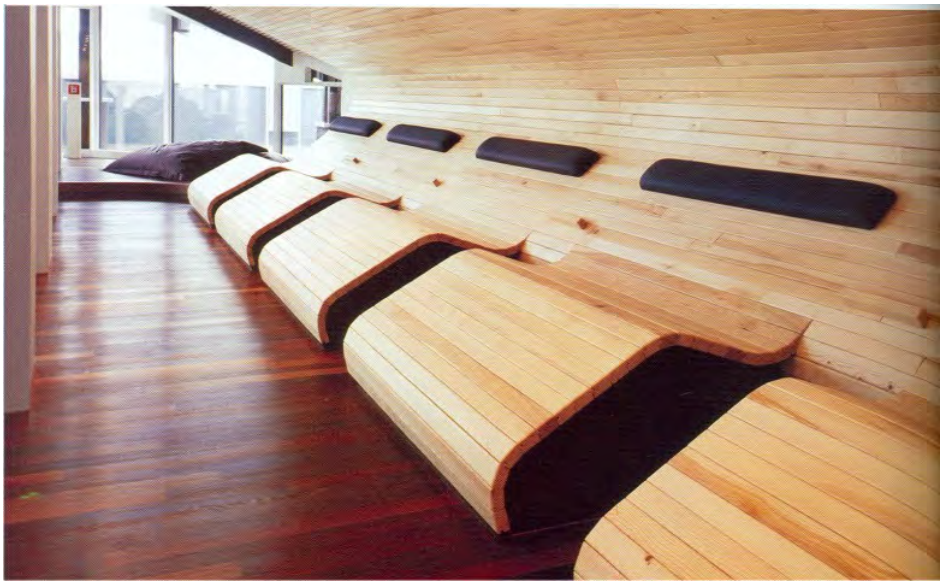


Figure 4.71 In the Relaxation area of the sauna building, ash slats wrap down to form chaise lunges with vinyl-covered headrests. The chaise's feet rest on the flooring of smoked oak. Warm tones are created for comfort. (Beautyman, 2008: 186)

The clients main design intention was to create a different type of bathing hall to the standard one. This new bathing hall would stray away from the noisy and large atmospheres and instead become an advanced wellness centre that focused on providing a variety of differing experiences within this development. This would be shaped by different sections which would each have a different mood or atmosphere and range in special impressions. The general bathing experience was expected to be more contemplative and relaxing than energetic and amusing. The different moods created would be due to different design elements, materials, finishes and interior decoration, all while the different entry of light from the portholes would produce different effects (Monk, 2008: 76).

The architects wanted to enhance and work with the natural topography as much as possible, which were different levels of up to 6 meters throughout the site. The diverse functional areas of the project determined a logical structuring if the site with the new sauna becoming integrated into the existing structures on the south side. The site was divided by a straight line at an East-West axis with the thermal baths below it to the south and the outdoor pool above it to the North. All areas surrounding the spa were then landscaped curving upwards from the lowest to the highest point and ranging in rhythm. This system of landscaping resulted in the outdoor pool being of the same height as the spa building roof which was a good position to catch a panoramic view of the Belvedere Mountains to the South (*fig 4.72+4.73*). With the amalgamation of the sites levels and functions it resulted in a variety of interior and exterior special experiences that when experienced simulating the individual and the cupola domes became known as the intimate, relaxing and protected areas of the design (Monk, 2008: 76).

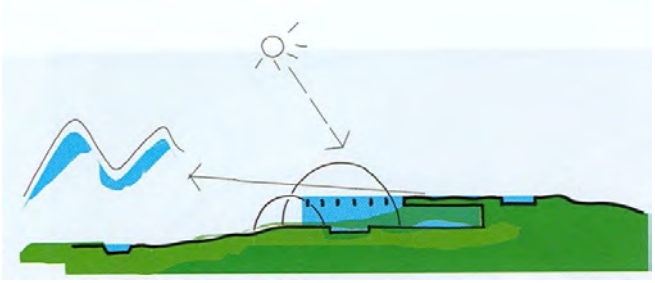


Figure 4.72 An elevational sketch showing the differing heights of the site and the outdoor pool level with the spa roof, and the positioning to create good views to the nearby mountains. (Mork, 2008: 76)

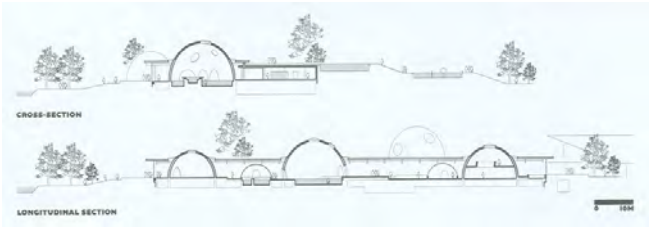


Figure 4.73 Sections through the spa complex with the prominent curved forms of the domes. (Capezzuto, 2008: 29)

The traditional age-old white monolithic domes interrupts the horizontal land as it rises to the sky and is integrated into the wellness centre building which gracefully ties the domes together by a flat wooden roof. The thermal baths and spa facilities are spread over a single floor in a narrow linear structure which looks slightly planetary in form and slightly oriental

in the interior design. These concrete constructed domes receive light through the randomly scattered portholes that vary in size and created a unique visual image of the project, and functionally are suitable in height for the internal conditioning, ventilation and noise reduction. There are skylights in the flat wooden roof which filter sunlight into the interiors lighting them up and connecting the bathers to the times of day and weather changes outside (*fig 4.77*) (Capezzuto, 2008: 25).

Figure 4.74 The interior of the "Dome of Experience" with its blue colour scheme and water-massage pool. (Mork, 2008: 79)

There are eight domes in total on the site of the Therme Bad Aibling with each dome being unique in atmosphere and interior design (*fig 4.83*). The main building that the domes are integrated into has a full glazed façade at the rear facing south, which is framed in steel and views the swimming pool outside and the waterway beyond. Domes inside the main building contain different spa experiences and are individually named. Six of the eight domes are insulated by concrete lining with acoustical material. The **Hot-Cold Dome** (*fig 4.76*) is frosted acrylic scattered with a pattern of clear dots with the hot and cold baths being done in red and blue pools respectively. The acoustic effect of the smooth domed walls transforms quietly rippling water into intensive water sounds. The **Hammam's Dome** (*fig 4.75*) is finished with gold-painted polystyrene foam brings to mind the famous Turkish baths of Constantinople. At 16 metres in diameter The Dome of Experience and the Dome of the Senses are the largest and possibly the most impressive of the baths. The **Dome of Experience** (*fig 4.74*) is outfitted with an extensive array of water attractions that almost advertise the complete dynamic nature and mechanical strength of water as it is whirling, tumbling, gurgling and gushing created

Figure 4.75 The romantic and war atmosphere of the "Hammam Dome". (Matzig, 2008: 86)

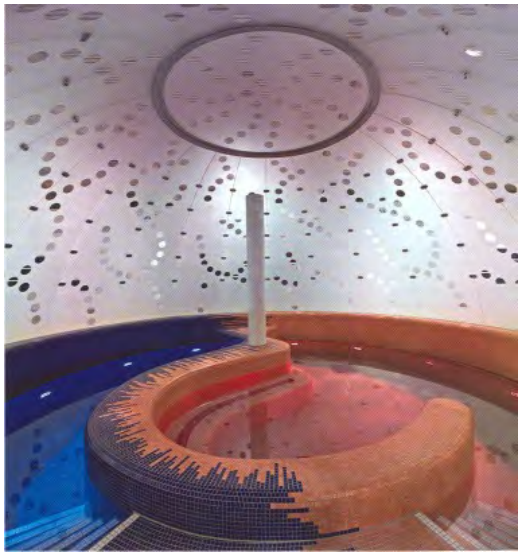


Figure 4.76 The "Hot-Cold Dome" with contrasting red for hot and blue for cold waters. (Matzig, 2008: 86)

deafening sounds like that of being right next to a vicious river in nature. This bathing area includes a round mosaic –tiled whirlpool rising 4 feet above the rest of the water. Ripples from the jets and massage ducts bounce off the whirlpool's blue and white surface, throwing reflections on the white ceiling. At the **Dome of the Senses** an individual experiences a surprise for the sense of hearing in the form of underwater instrumental music. Slightly smaller at 12.5 metres in diameter is the pale emerald-painted **Thermal Dome or Spa Dome** which seems to be on the same wavelength with the natural environment as it boasts stylized growing reeds which "grow" out of the surface water and are actually fiberglass stalks that are fitted with LED lights. Water is generally pumped into the complex sits at a natural 32 degrees in temperature, and flows around the elliptical windows which offer generous views to the flourishing green gardens outside. The **Relaxation Dome** appears as a dark room where nature films are projected across the ceiling while toweled-off visitors lounge in beanbags and chairs and relax; this creates a "multi-media cave" effect. The four-story Beauty-Wellness Dome is mostly feminine with floral curtains separating the treatment stations. The circulation spaces between these watered domes are finished with milled granite flooring (*fig 4.78*) (Beautyman, 2008: 183).

Figure 4.77 A view of the entrance lobby where the wooden roof sits above the winter garden featuring wide glass sections extends between the domes providing shelter against the atmospheric events and making the complex look like one seamless unit. (Mork, 2008: 78)

Figure 4.78 Inside the main building most of the eight domes are insulated cement, with one of them being made from acrylic. The granite floor tiles flow around them in circulation spaces. (Beautyman, 2008: 182)

The dome's shape is an actual benefit for the spa's energy savings of up to 40% when compared to a rectangular shape of the same size. "*Water attractions require humid air at a temperature very close to the water temperature to avoid evaporation. Here the water is under the domes, so areas outside can remain at comfortable levels of heat and humidity,"* says Behnisch (Beautyman, 2008: 182). Next to the main building set at an angle is the larger sauna building at 16 000 square metres done elegantly in glass. Behnisch designed the building to face south to maximise views and achieve solar gain to heat the building in winter. In the summer season shade is created by a three metres wide overhang, providing a cool interior for the building that houses six saunas. There are three other saunas located on the

outside built as cabins and accessed through the gardens and concrete paths winding through the outdoor swimming pools. These sauna cabins sit jutting over the water and are fitted with outdoor showers (*fig 4.79+4.80*). In the design of these cabins a rectangular glass window is placed at foot height so the occupants can view the river on which it overhangs (Beautyman, 2008: 186). This thermal baths complex maximizes the sensory experience with the thermal body sensation of hot and cold, stimulates the eyes and moods with the contrasting and interesting colours, and captures the individual's attention with the overall unusual form and interior design ornamentation and detail (*fig 4.82*). A person experiencing this space will be induced to feeling many different sensation sand moods in one visit, making it a memorable experience and with the power and wonder of the water features and activities their bodies leave refreshed, de-stressed, healed and their minds soothed and quieted.

Figure 4.79 An interior view of one of the three sauna cabin by the river made of warm toned timber. (Beautyman, 2008: 187)

Figure 4.80 The small sauna pavilion built in the traditional style, facing the waterway that flows alongside the spa site. (Capezzuto, 2008: 32)

Figure 4.81 The beauty-care dome occupies three levels, connected by a spiral staircase, with the upper part emerging from the roof of the main building. (Capezzuto, 2008: 29)

Figure 4.82 In the yellow toned Meditation dome the guests relax with music in the water. At the centre is an outsized "magic lantern" - an illuminated cylindrical body housing the Turkish bath. (Capezzuto, 2008: 31)

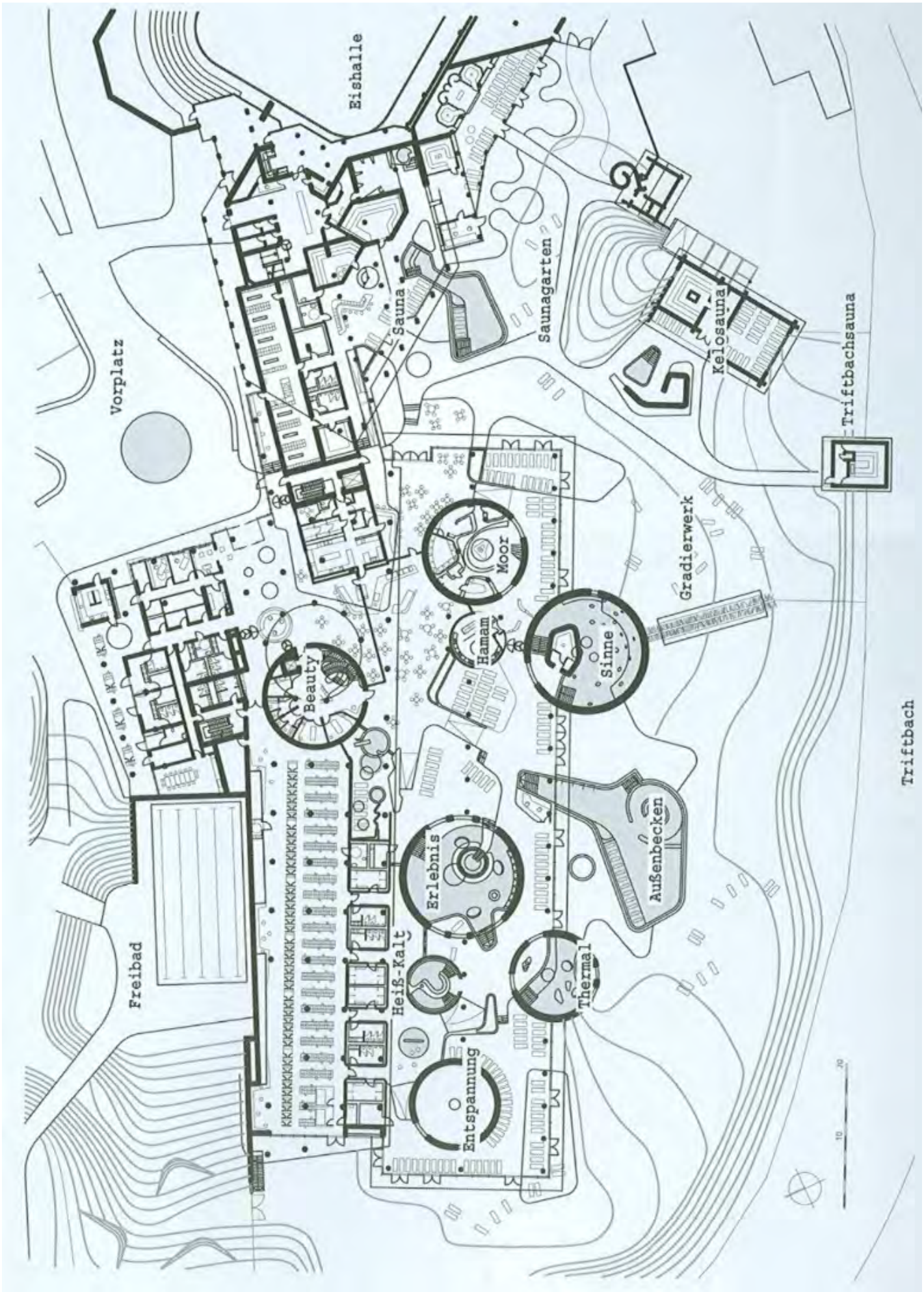


Figure 4.83 The plan and layout of the thermal baths, sauna, outdoor pools and main building. (Matzig, 2008: 87)

4.5 CONCLUSION

Water is a natural material of the world that does not change its appearance. It appears both in the natural and built environments. The use of water in architecture has great possibilities as Moore states that:

"...if we can effectively incorporate water's symbolism, history, and physical nature, then our water and architecture can a have a potential for wonder unmatched by any other material that we can include in our environments" (Moore and Lidz, 1994: 199).

Water is symbolic of the vitality in life and is a key to the sacredness of a healing site and living environment. Water has qualities that affect humans on a physical and emotional level, and these can be incorporated into architecture to suitably enhance the built environment in its healing properties. Water physically can help people with sicknesses through hydrotherapy and the human body, and sensationally captivate people with the senses, and finally emotionally transform people into calm, soothed, and energised beings. Water is limitless in its forms and inter-actions with people, and the possibilities it rings forward with regard to healing is vast. Architecture then is the tool that brings water into humans' everyday environment and should link its healing properties in such a way that everyone can experience and benefit from it.

Knowing that water in architecture can become healing is advantageous but it is also important to understand architecture itself as a healing environment, so that water can then enhance this feature.

CHAPTER 5
HEALING ARCHITECTURE

5.1 HOW ARCHITECTURE CAN PROVIDE SENSITIVE ENVIRONMENTS

5.1.1 THE CONCEPT OF HEALING

Healing and place are never two separate components. Gesler states that people unconsciously associate places with healing and that the important aspects of the concept of healing are (1) its multidimensional character, (2) wholeness, connectedness, or integration, (3) healing from within, (4) an ongoing process with meaning in one's everyday life, and (5) healing as a humanistic approach. He states that there is a claim that there are four "environments" that contribute to a healing sense of place: natural, built, symbolic, and social. We know that many societies around the world believe nature has healing powers. Within natural environments people can attain physical, mental and spiritual healing. This is supported by the idea of *biophilia* hypothesis, stating that as humans evolve they obtain a kinship for nature and gain comfort from it. Water is seen as the most important element in nature that holds healing powers and is another aspect to natural environments becoming healing and therapeutic (Gesler, 2003: 2).

ASPECTS OF HEALING ENVIRONMENTS	
Environment	***Aspects***
Natural	Belief in nature as a healer
	Beauty, aesthetic pleasure
	Remoteness, immersion in nature
	Specific elements of nature
Built	Sense of trust and security
	Affects the senses
	Pride in building history
	Symbolic power of design
Symbolic	Creation of meaning
	Physical objects as symbols
	Importance of Rituals
Social	Equality in social relations
	Legitimization and marginalization
	Therapeutic community concept
	Social support

Figure 5. 1 Gesler's table representing the four aspects of healing environments and their advantageous characteristics. (Gesler, 2003: 8)

The World Health Organization defines health in its 1948 constitution as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' (Web 8). One way to express health is a state of renewal, balance and development (Day, 2002: 181). Christopher Day believes that all environments have a healing potential because as seen throughout mankind's history from Feng-Shui and Vedic to Islamic and Gothic architecture there have always been a sacred architecture created by humans according to their cultures and forms, but now with a modern era there is a lost link from these architectures in which lessons should be learnt (Day, 2002: 7). There are an increasing amount of surroundings in the urban context in terms or forms and spaces that negatively affect and weaken the senses and comfort levels of people. The idea is to understand how places affect humans, how surroundings influence experience and with these results utilize them to create positive healing environments that are individual, invigorating and everywhere.

There are flowing energies all around the world in every space and place and the term to classify these energies according to the Orientals is Feng-Shui. Feng-Shui means "wind and water' and is based on the interconnected life flowing principles of *chi* which is energy flow, *yin-tang* which is balance between parts, and the compatibility of natures elemental traits (Day, 2002: 123). In order to create healing environments the manipulation and collaboration with these energies and principles is largely advantageous in order to enliven human environments.

Venolia states that good health means that humans need to contribute in the vibrant web of life and its cycles, because people, animals and plants gain sustenance from the sun, sir, water, earth, so should in partnership mankind return the hand by contributing their creativity, labour, vision, and love to earth. She believes that health is not a stationary state of perfection, but rather a process of relating with everything around and inside the human world in ways that encourage development and energy. Our built environments create atmospheres that cater to almost any dimension or state of health, harmful or helpful. Disharmonious human environments can be a cause of physical and mental stress but also relaxing and soothing too (Venolia, 1988: 7-10). Venolia observes that while buildings keep people warm, dry and safe not to mention organised and plentiful, these buildings often provide an obstacle in the thriving of its occupants (Venolia, 1988: 19). Venolia proposes that healing environments should:

1. Stimulate positive awareness of mankind;

Human environments can enhance their responsiveness of body, mind, and soul, can aid in awareness of their past and future potential. Human environments offer possibilities to

understand wholeness and contentment while lift the need to explore and expand current knowledge.

2. Enhance connections with nature, culture, and people;

People have a need to feel as though they have a place in the world and the means in which to root themselves to the earth would be by buildings, and these buildings have to reflect their individuality through religion or heritage. Buildings have a walled closed-of nature which in turn isolates occupants from the sun, seasons and plants but provide a barrier between other people. This tends to break apart communities and not embrace the concept of being a whole.

3. Allow for privacy;

The need for privacy is elemental in order to allow people control of the lives. People need reprieve as much as social contact and private space is necessary in order to rebalance your emotions form time to time. In privacy people can become aware of themselves, strengthen their identity, and restore inner balance.

4. Do us no physical harm;

Toxic materials, stressful lighting, unnerving noise, and unhealthy heating and air conditioning systems all take a demand on people's bodies and state of mind and are most common in contemporary buildings. Buildings need to readjust the construction processes in order to achieve a healthy well-being for users.

5. Provide meaningful, changing stimuli;

Mankind's bodies require change in order o adapt and strengthen and thrive and being exposed to unchanging temperatures, lighting and noise can hinder how we function, but in a fine balance a large amount of stimulation can put strain on the senses till their systems shut down.

6. Support times of relaxation;

Relaxation is vital for an optimum level if health in mind, body and spirit and environments that help people to relax contain peaceful sounds, calming colours, soft lighting, comfortable furniture, and enjoyable surroundings with no interruptions.

7. Allow people to interact effectively with them;

People taking responsibility for their individual environment allows them to feel powerful and not helpless and shows a sense of achievement increasing their sense of potential, allowing a process of thinking that they can change the world.

8. Balance between dependability and flexibility;

Humans need to have freedom, while at the same time feeling stimulated, all the while being safe and secure. Due to these needs human environments need to reflect this stable, yet flexible atmosphere. Healing environments have the ability to reflect both changes in the season with windows to connect to the outside, and nature's changes, and reflects in the people who inhabit them with flexible furniture and adaptive deisgn.

9. Be beautiful.

The creation and experience of beauty is instantaneous, whole and healing. With the experience of wonder and joy to beautiful surrounds, people's senses are enlivened while the body becomes relaxed and the attraction draws people to the composition, becoming part of it.

Venolia proposes that by observing the structure of nature and applying its teachings to the design of indoor spaces, what can be created around people would be diversity, richness, and stimulation. There needs to be a greater physical connection with the indoors and outdoors in order to adequately connect nature to humans, and so by preventing rigid boundaries, people can attain wholesome flow and mediation between indoors and outdoors, humans and nature (Venolia, 1988: 21).

What individualizes humans from all other living creatures in the world is their ability to distinguish the act of right and wrong, like and dislike. In their surroundings and built environments, they access and judge, what is enjoyable or overkill. The surrounding therefore must appeal to their aesthetic senses, as well as emotional ones, in order to uplift their spirits. Being artistic is certainly a way in which to do this. By establishing a certain architectural criteria to bring joy and contentment to the human spirit can take the built environment from being merely functional to a level of healing (Day, 2004: 23).

5.1.2 PHYSICAL QUALITIES OF SPACE

In terms of buildings the biggest physical aspect is ergonomic design, as people experience space with its singular dimensions and shapes in relation to their bodily scale, proportions and movements. For example Old Norwegian farmhouses or African huts have low doors and to enter you must bend and in doing so make yourself vulnerable and thus humbling yourself before entering the building space. In contrast palace doors are huge so visitors feel small and inferior in relation to the status and power of the place which is brought to their attention. Therefore scale and proportion can increate feelings like restfulness, vitality, impulsiveness, insecurity, awe, and oppression from the physical solidity, energy and proportional correlation. While factors of order and organization are important there is also more to human life and more to what we required from our environs (Day, 2002: 184).

Architecture has the potential to alter physical health whether support or damage. In terms of support the concept is very straight forward to keeping the body at an ideal temperature and not exposed to long durations of harsh weather. But in terms of damage, the materials and design qualities can affect the comfort levels of the person into felling drained or even

claustrophobic. These factors do not have to be very extreme or unbalanced to have an effect on the occupants body (Day, 2004: 20).

In sequential order we do not experience a building initially by walking through the front door, but actually start a relationship to the journey from the first view of the building. This journey's introduction to a building then advances to the front door or entrance and is followed by entering and finally exploring the building. Experiencing the aesthetics and atmosphere of the structure from the outside is when receptiveness to health giving qualities can be felt, which only is heightened as one advances closer to the building and while experiencing the indoors. This transformation process of levels of feeling and awareness of the architecture to the spirit or mind or body is all being initiated by outer means against the human body. Therefore expressing that hard and soft surroundings effect the human body. The approach and entry into a building are highly important aspects to the process (*fig 5.2*) because in order to grasp a healing first impression, the building architecture needs to speak to the observer. Healing can be achieved from these transformations and journeys between the built environment and people. (Day, 2004: 25).

Figure 5.2 The Confrontational and de-confrontational approaches create first impression to the user and determine the way in which a person experiences the spaces thereafter. (Day, 2002: 132)

Man-made environments are a part of the everyday life of humans and consist of form and space which are two different elements to building. Forms are objects and shapes that have fields of influence which can be touched and looked at, forming edges and boundaries in which to hold space. Spaces are invisible elements that contain energy and are contained by form. Places are spaces with identity and character and these are varied, according to the location and people who use them, this is what makes 'spirit of place' (Day, 2002: 120).

When taking the image of a tree into consideration we do not see the tree by itself, but also the ground to which it is anchored. The tree is not a separate element to the ground or vise versa. The tree spreads and digs its roots deep into the ground from which it intertwines with other roots from surrounding tress. These roots merge and come together to form a trunk which then disperses to form branches and disperses more to become stems and then leaves. These leaves and branches attract birds and insects and give off clean air. This entire process

from a simple element of nature shows the complexity of nature and ecology. But once a tree is termed 'tree' and given a mental image in which to go with the name, it thenbecomes in human minds a concept with form. And form is determined by lines. Form and line from man-made environments are basically human concepts because they do not exist in nature. Different lines create diverse effects such as straight lines which are powerful, while swirling lines express energy. Straight lines are almost never seen in the natural living world, like the tree mentioned above and not even seen in the human body, and yet straight lines are vital to rationally human thinking and building design. Straight lines are simple ordinary elements that are restricting in creativity when compared to the varied figures of nature's complex and fractal twirling lines. Research has indicated that water directed in straight lines loses it life-supporting character, but rhythmic curvilinear flow enhances them (*fig 5.4*). The difference between straight lines and fluid curves are great and respectively represent strict, structured order and free, energetic, random life (Day, 2002: 120-23).

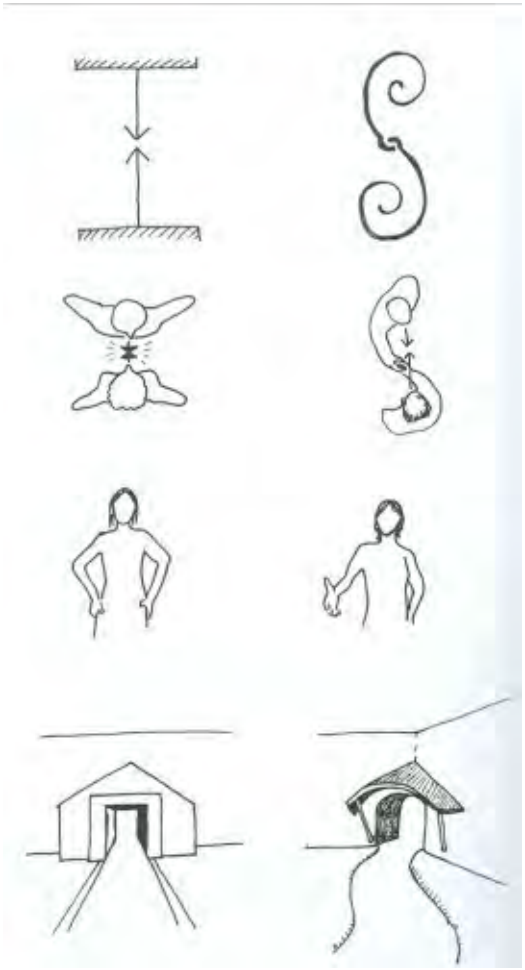


Figure 5.3 Confrontational and de-confrontational meetings and how with asymmetrical approaches absorb the confrontational dominating energies leaving a freer and unrushed energy to approach an entrance or person. (Day, 2002: 132)

Not only do form, shape and energies affect the impacts of environments, but material matter of our surroundings does too. They have the ability to unite us with life, due to natural materials impression and aura which is healthier than synthetic materials. The moods stimulated by our surroundings, if harmonized to a situation, can nourish, balance, and heal. This opens a whole array of sensory qualities in

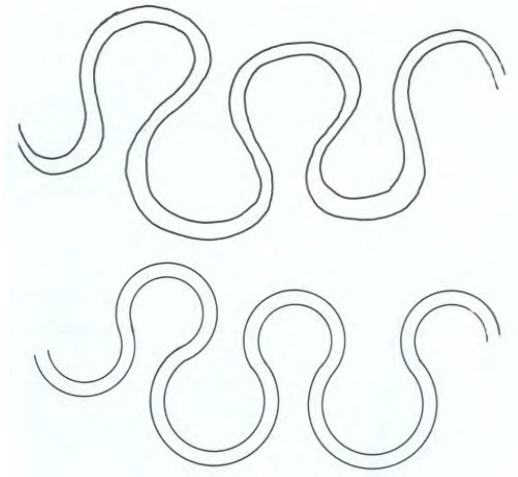


Figure 5.4 freer less constrained lines (top) feel more energetic than the restricted and constrained lines (below) but in general curves provide more character than straight lines. (Day, 2004: 130)

which to work with in establishing healing environments such as colour and texture to acoustic properties (Day, 2002: 9-10).

Exterior and interior built environments create moods and atmospheres that all people react to. Every person would react at an individualized level to certain elements of design. Architecture is a highly varied and creative field of a juxtaposition of ideas and materials. It is from these compositions that sometimes harmony or discomfort can be felt. Architecture has a responsibility to create environments that are as healing as possible, since mankind spends at least two thirds of their lives in or around the built environments. One of the most harmful effects of the build environments is stress to the body and mind of an individual from noise or harsh visual aesthetics to environmental pollution, and it has been researched since the 1980's that stress is known to affect hormones of the body thereby the development of concealed illness which reduces the body's ability to combat disease. This means that environments have a goal to create stress free impacts and experiences for the people in order to fully satisfy the human daily needs. The question then stands as how to improve man-made environments to a place in which human balance, wholeness, and support is achieved (Day, 2002: 181)?

5.1.3 EMOTIONAL QUALITIES OF SPACE

Feelings are only experienced by humans and animals distinguishing then from plants. And it is these feelings that determine how people will ultimately view their surroundings and in turn affect their behaviour. These experiences of feelings in a particular place are mostly unconscious as most people do not analyze their surroundings first off. It is only once they notice change or a strong felling of happiness or fear that they will be forced to critically analyze their environments. Some environments make people feel irritable and cramped while others stimulate relaxation and a social atmosphere. These environments then in turn affect the stress levels of people, the more enjoyable a space the less stressful it is to move in it. So to 'de-stress' a space it is only basic to remove the elements that are harsh or aid in creating uncomfortable environments such as eliminating loud noise and vibration, changing colour and lighting, softening and harmonizing shapes and forms, replacing friendly textures for repelling ones. The motions of stress and peacefulness have hormonal and psychological costs which are apparent in sickness and health, and environments can significantly act to remove these harmful stresses (Day, 2002:186).

Life energy is the cycles of nature and the aspect of connection between humans and these cycles; the seasonal and diurnal rhythms of light, activity, sounds and scents, growth and decay. Humans need to be fundamentally aware of nature's patterns and rhythms to understand the value and system of life. Humans need to become mentally part of this cycle in

order to connect to nature. In terms of de-stressing the colours, lights, sounds and smells of nature provide strong reactions in people's moods to induce a relaxed state. As the earth and nature has cycles, so does the individual human with different rooms in a house, housing different activities suited to people's daily rhythms and these rooms need to be atmospherically synchronized to the activity and function of the rooms, so that the appropriate moods are created. Life energy is based on spirit, as each person has this quality and the healthier and more whole a person's spirit is, the healthier the entire body and mind becomes. The places that are sprit nurturing are of changing beauty mostly found on nature that inspire, motivate, fulfill, and give meaning to human existence (Day, 2002: 186).

5.1.4 SOCIAL QUALITIES OF SPACE

People lead varying lives, but every person at some point in time will experience boredom, stress, insecurity or loneliness and feel the need to overcome these feeling. People tend to go out and take walks or go for drives or go to a mall, this is just indicative of a need to connect to something other than their routines and the source of their discomfort. Human environments offer a large variety of atmospheres within its realm such as interest or activity, harmony, tranquility or relaxation, connected and social spaces, all of these meeting some need for the human soul (Day, 2004: 32). To be in a certain environment and its forms daily, the quality of the space or place works its way into the soul and shapes the individual and human spirit. Form and space potentially can shape people and communities, whether negatively or positively, but definitely at both a social and individual level. All parts of human environments influence people on all levels but in term of social scale it can be personal, cultural and universal.

At a personal level every person has individual tastes and preferences and so how people react to their surroundings is therefore also on an individual level, but this does not mean that it is a purely subjective reasoning as our physiological reactions are highly reactive as well. For instance peoples physiological reactions to colour, air temperature, light and noise is generally at a common level whereas people's psychological reactions are more complicated varying and individual. At a cultural level, people respond in groups according to their religion, heritage, upbringing and fancy. For example, for some cultures black is associated with death whereas other cultures view white as this. And where some places are meaningless in the urban fabric, a few hold special memory and meaning to a large group of people. At a universal level most people react to varying stimulants and places in exactly the same manner as the next person. In general places that hold hard or soft visual and physical qualities effect how people behave and feel such as the angular firm planes encourage intellectuality while on an emotional level, can be appealing or repelling at the same time. The elastic and soft planes

can be seen as sensuous or clingy. Universally places affect people either one way or another and not varying degrees like the personal or cultural scale (Day, 2002: 111-112).

When analyzing the human world it can be observed that the places most vibrant and populated are meeting places, in an urban context, is cafes and squares, and at a natural context where elements meet such as rivers and meadows. To find harmony people are naturally drawn to the natural environments in which two or more natural elements meet. These places prove to be full of vital force and energy as well as intriguing atmospheres. This reflects that in order for a space or place to healing it has to be harmonious and harmonized with its surrounding elements. At an urban level this means using organic change to stop new building and rather adapting old unnecessary buildings into becoming responsive to their surroundings (Day, 2004: 34).

Environmental qualities whether confrontational or harmonious, relaxing or demanding, all vibrate within the human body. Socially good spaces create social harmony while bad space create social disharmony. For societies to sustain good relations and atmospheres the spaces being allocated for them need to focus of psychological awareness of the people using the spaces together and how to bring everyone to the same emotional level.

> *"Beautiful places are invariably underpinned by 'rightness in place' – ecological health. They have integrity, wholeness, balance. Their spirit of place is reinforced by our valuing it. This shapes how we act, even who we are," states Day (Day, 2002: 113).*

> *Harmony is healing, but harmonious environments aren't enough on its own. We need surroundings which can de-stress, renew, re-integrate and enliven us – especially places of tranquility, delight, human-vitality, and social warmth (Day, 2002: 233).*

5.1.5 BUILDING RELATED ILLNESS

The most commonly recognized architectural related illness condition is the sick building syndrome. 'Sick buildings' have been around for awhile now with symptoms such as building related bronchitis, rheumatism and tuberculosis. But there is another condition which created illness which is evident in old buildings. A majority of the buildings constructed in societies were constructed from materials that were as close to their natural state as possible and this lasted until the 1950's. But after technology and advancement these buildings utilized materials that became highly processed and highly unable to decompose back to nature,

unlike the older more natural materials. Buildings built after this period are currently old buildings and to be healthy environments for their occupants, need to be well maintained and looked after, just as much as loving care is vital to healing, according to Christopher Day. Whereas the older buildings were constructed in different materials, with not as neat or precise a finish as the modern buildings of today, they seem to be a better product for healthy living (Holdsworth, 1992: 6). Modern buildings for example are more air-tight and therefore achieve less ventilation which results in mould. Natural materials, like on the older buildings are life-compatible, as they are borrowed and keep as close to nature as they can. 'Man-made' materials, being made by industrial and not natural processes, have no instinctive connection with life, and thereby life forces and energies. To prevent this occurrence Day suggests use of both non-toxic materials and 'breathing' construction. Not to mention the important fact that 'natural' materials are closer to source, so they reduce the amount of harmful industrial processing and link us to the living cycles and processes of nature, of which all life depends on to ultimately lead a healthier existence (Day, 2002: 187).

5.2 THE ARCHITECTURAL ELEMENTS TO HEALING

To create places that are meaningful and healing, that leaves lasting impressions on the users of the place, attention and consideration needs to go into the qualities of the spaces (Day, 2004:71). Human environments have the power to heal or harm the individual with its qualities of space and only those that are beautiful, honest, and tranquil will be places of healing to the human body and spirit. These places not only will heal an individual but will also encourage a communal growth, a desire to become and do better, and be content with life without the aid of material objects (Day, 2002: 117).

> *Colour, harmony, and multi-sensory delight support our feeling life, particular moods redressing personal and situational imbalances. Journey sequences, beauty and care-imprinted environment can nurture our spiritual development. Buildings built upon these principles are buildings to nurture the whole human being (Day, 2002: 187).*

In order to understand spaces and their contributory aspects, people need to develop how they sense a place and its values, by observing the way in which places are built and maintained and utilized. By becoming acquainted with observing and sensing places, one can start to noticeably see the individuality of places and what elements make these spaces a good social, private, meaningful, or healing place, as every space has a unique and different atmosphere and spirit to them. Humans must rely on their senses in order to establish whether space and places are beneficial or harmful in order to combat these negative influences and solve them by modifying them to be generally curative (Day, 2004: 75).

5.2.1 THE SENSES

When people move through spaces they interact with their surroundings and are also influenced physically and emotionally by them. These influences and signals are received and processed by their bodily senses. The five senses of the human body provide a opening between their own personal experience on the inside and the reality of the outside world. All the places that people experience whether good or bad, beautiful or unpleasant is all filtered through their senses. So the human senses play an important role in the experience of architecture. People experience architecture through the external sense of sight, smell, taste, sound and warmth and these human elements informs people about what is essential and unnecessary in their surroundings. Architecture aims to nurture these senses to achieve the best impressions and connection to the users.

All people unconsciously respond to the effects of background visual stimulation which creates a backdrop and atmosphere for any environment, through visual moods. These visual moods are comprised of colour, scale, visual texture, and good standard of how elements meet (Day, 2004: 73). The urban environments of today are bustling with many varying stimulants (such as human and vehicular traffic) which are extremely hard not to focus on, and this disturbance is called involuntary attention by environmental psychologists and this condition can lead to harmfully increased stress levels. In comparison there is voluntary attention found in peaceful landscape settings with just as many sound, sight, and smell stimulants as an urban settings but the difference here is that there is a choice, as to how much one experiences these. With this understanding it is clearer why natural surroundings appear as places of sanctuary and serenity, with a therapeutic relationship to the observer as they connect to the energies of harmonious relationships of life, symbiosis, companionship, parasitism, and predation. By experiencing these natural elements and their harmonious qualities through our senses allows correct balance of the soul to the individual leading to a healthier life (Day, 2002:214).

When it comes to the senses a large amount of human response is due to light quality (Day, 2004: 73) as human sight is a highly developed sense because between all the sense organs the optic nerve is the largest in size. The eyes do not see objects and shapes but rather movement, tones and colour, with colour as an unavoidable element which has a great effect on the influence of peoples moods. The desired colour effects rely on specific design of elements on lighting, space, exposure and importantly time length, as the requirements for colour design depend on if it's a short term stimulant or long-term creation of atmosphere. Within the modern urban environment colour is largely used to a high level in most surroundings due to the competition of advertising and attractions, but this creates a negative

effect on humans, as overuse of bright colour decrease a person's reaction to subtle colours, which leads to people viewing nature or similar sensitive environments as dull or expressionless (Day, 2002: 214).

Touch is a different sense to sight as it involves contact between people and physical objects and not just a visual impression. In order to comprehend what people see they have to touch them, which involves people moving their hands to do this action, which results in a certain amount of effort on the person's part. This means that touch is a very active sense to humans; it can promote people to become drawn in and touch textures or could adversely create feelings of exclusion. Some textures can only be touched with the eye and so draws eye movement from the pattern creating inner movement of the, mind making people feel undemanded, clam, rhythmic motion or energizing movement (Day, 2002: 214). Textures have the influence to attract people or repel them in different places according to the desired effect as softer comfortable textures invite interaction while rough hard textures deter people from contact (Day, 2004: 73).

The world and humans are in a constant state of vibration and any sound resonates with vibrations which in turn affects the human body. Not only does the sense of sound affect human's bodies but their moods as well, so to create an inner balance for people to achieve wellness a correct frequency or the appropriate sounds should be determined (Web 9). Auditory environments are powerful architectural influences on humans and influence their behaviour to a certain extent (Day, 2002: 215).

Sound and scent are a very similar sense, as they both share a common factor, and that is sounds and scents are experienced by people without their choosing, as they cannot be controlled and they both allow people to recognize changes in environment, but not distinguish atmospheres of a place. Buildings are large sources of smells, not just the functions that they house like restaurants but their very building materials as well. These smells convey to people subconscious messages that induce unconscious reacts such as the smell of wood and natural oils will send imagery of the forest or outdoors to the person experiencing the space. Flowers will support a light mood while synthetic material smells like plastics will drop the mood created as these are not natural scents and actually foreign bodies that are very unrelatable to humans. Aromatherapy is a successful treatment with scents and is used often in certain buildings and has proven to change customer's moods to the desired effects through the air conditioning systems. Smells also prove an internal warning system as generally smoke smells signify fire which people recognize as dangerous or they can smell dirt and unpleasant smells meaning harmful or unappealing surroundings (Day, 2002: 215).

Scent plays an expressive role in inducing people's feeling such as fresh bread or coffee smells can use their merchandise scents as an advertisement to draw people from the street into their shops. It is important to create living environments that appeal to the human's sense of smell as it is the fastest sense in which people react to, wanting to escape an unpleasant smell (Day, 2004: 73).

Warmth is a significant influence on the body and a basic physical human requirement. The levels in warmth create different effects on the body with a certain temperature provoking relaxation and others being fatiguing or energizing. Even sudden temperature change can drastically affect the human body and cause ill effects such as cool temperatures reduce energy and therefore work production in an office environment. The effects of cooler temperatures on the body cause it to slightly shut down and to combat this, people layer themselves with clothing which in turn reduces mobility and comfort and requires more effort in which to move about. Thermal contrast in certain environments stimulate the bodies such as in saunas and cold baths, this causes a rejuvenating effect but these contrasts affect people differently with younger and older people more susceptible to negative effects (Day, 2002: 216). Warmth in a living environment especially in colder regions such as a fireplace or stove, draws the occupants to it creating cozy and comfortable spaces in which to share, communicate and relax, which in its own way is a healing environment (Day, 2004: 73).

Research in the field of senses has proved that every cell in the human body is synchronized by sensory experience such as sight affecting the endocrine system, smell affecting bio-rhythms, and sound affecting electric charge. Designers of spaces fall into the notion that sight is the most important sense and play upon this sensory aspect but not realizing that the four others sense of sound, scent, warmth and touch are just as powerful in their owns ways and by ignoring these ,an environment with true and complete healing qualities cannot be achieved (Day, 2002: 216).

5.2.2 LIGHT HEALING

Lightness and darkness are universal elements. For humans, light symbolises kindness, affection, inspiration, motion, and spiritual enlightenment, while darkness symbolises coldness, fear and mystery. The sun is the most powerful element that affects Earth and without it the world could not function. The sun powers all life on the planet, the water cycles, compels the wind, and rotates the earth. This makes light a substantial life-giving factor that is essential to health (Day, 2004: 180). Sunlight therapy for health can been seen as far back as the Assyrians, Babylonians and Egyptians a thousand years ago in the form of sunbathing (Venolia, 1988: 49). In recent years increasing amounts of knowledge has been

gained that sunlight (natural global solar radiation) has a deep influence on the human being (Mahnke, 1996: 102).

> *"The reason for this is firstly that solar radiation was important for the genesis of life itself; actually without light there would be no life. Environmental light produces numerous biological effects related to health beyond simply affecting vision and cutaneous pigmentation. Some of these involve direst responses of circulating or cutaneous chemicals to light waves; others are mediated by the brain and neuroendocine organs." 1984 New York Academy of Sciences conference on medical and biological effects of light (Mahnke, 1996: 102)*

Light is fundamental to human health because of the way people live in the modern world, a daily pattern in which people spend too much time indoors working and living that they do not utilize one tenth of the outdoor daylight, essential indicating that people are not getting the right kind of light (*fig 5.5*) and rather increased amounts of harmful artificial indoor lighting (*fig 5.6*) (Day, 2002: 193). Sunlight contributes to many of the body's functions caused by the patterns of night and day as well as the spectral characteristics of sunlight, functions such as the endocrine system, timing of the biological clocks, immunologic responsiveness, sexual development, regulation of stress and fatigue, management of infections, and the nervous system. Ultraviolet (UV) light, a part of sunlight, has biological importance that is mostly not has beneficial as it should be to humans because it cannot be felt indoors. UV radiation can fuel blood circulation, increase protein metabolism, lessen fatigue, lower blood pressure, stimulate white blood cells, prevent rickets, boost production of vitamin D and the release of endorphins (Venolia, 1988: 50).

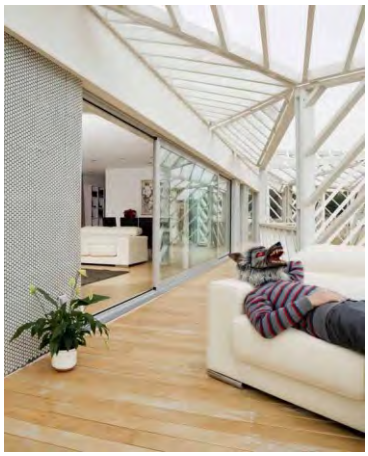


Figure 5.5 An image showing a well lit room with natural lighting and the refreshing atmosphere created. (http://www.architeria.com/apartment-building/st-falls-apartment-building-design-in-victoria-by-elenberg-fraser-architecture)

Figure 5.6 An artificially lit office interior with harsh fluorescent lighting which has been proven to increase stress and bad eye conditions. (http://hubpages.com/hub/Workplace-Lighting---Office-Lighting)

In just the same way as bones and muscle need to adapt and develop via exercise and sport, so does the optical human eyes need to strengthen from movement and changes of light and shade. The most universal form of light that is mainly beneficial to the eyes is daylight, a light that varies in colour and intensity during the different times of day. Another human health factor affected by light is hormone-regulated organs such as the pituitary, pineal and hypothalamus glands. Results in a lack of adequate light to the human body can lead to depression on a hormonal level and other effects on a physical and social level. Natural light and interior lighting can affect human moods to a high degree with environments being termed gloomy, harsh, gentle, or refreshing because of the abundance or inadequacy of light in an interior (Day, 2002: 201).

In the built environment, natural lighting is the best way to experience these vital spectrums of light for the body. There are design elements with architecture that cater for this need to draw natural light indoors by means of skylights(*fig 5.11+5.12*), courtyards(*fig 5.7+5.8*), atriums (*fig 5.9+5.10*) and solariums in order for people to interact with this light while control of this light in internal environments is important to prevent overheating and tarnishing of furniture. Lighting can alter and change moods of interiors and so to create an interesting space experience, a variety of lighting effects should be implemented, to stray from a monotonous atmosphere (Venolia, 1988: 54). For functions such as social rooms they need warm lighting to create a comforting atmosphere while reflective rooms need gentler light for a gentle soft atmosphere. Study's with intellectual functions need lots of light, while bedrooms not so much.

Figure 5.7 A courtyard with fountain and lush vegetation that provides a refreshing atmosphere. (http://www.blazerweb.com/sedona/)

Figure 5.8 A contemporary internal courtyard of a residence with trees growing in the middle providing shade and landscaping tones that are warm and comfortable. (http://archnewhome.com/lake-house-design/lake-travis-retreat-house-by-dick-clark-architecture)

Figure 5.9 The glass atrium winter garden, a prominent architectural feature, of the University's new Chicago GSB Hyde Park Center (http://chronicle.uchicago.edu/040923/gsb.shtml)

Figure 5.10 'Cocoon' building in Zurich. The centre piece of the building is an upwardly widening atrium with skylight at the top which floods the whole area with light making it a bright and airy place to be. (http://www.workspacestyle.com/2009/11/cocoon-gives-office-design-whirl.html)

Figure 5.11 Skylights are used to bring light into deep badly lit areas and bring natural light indoors. (http://www.archintoo.com/interior/architectural-glass-skylights)

Figure 5.12 Skylights are good practical design features and can lighten up even the most industrial of buildings. (http://www.skylightrepairs.com/)

Daylight is an extremely varied form of light as it is an environmental feature that is time dependent, working in cycles from darkness to light and back to darkness, which all follows the natural rhythm of nature and its four seasons. With the obvious light changes of the day the colour of daylight also changes noticeably according to the sky direction or orientation, time of day, and cloud cover. These factors of daylight produce important aspects that need to be considered in the design of architecture so that buildings may take maximum advantage of daylighting in the interiors. For example south facing rooms in the southern hemisphere of the world experience no direct sunlight and so these rooms are left generally feeling cool and bland, whereas with north facing rooms they experience a large amount of daylight during the day so are warm and full of light colour. Sunlight coming for the East where the sun rises is bright and light compared to the westerly setting sunlight which feels heavier and glaring. The

different qualities of daylight allow the varied effects of moods in architecture, individualities of spaces within buildings, and also connect the occupants to the changing external rhythms of nature and the Earths environments (Day, 2002: 201).

In architecture the higher the number of windows placed, the better the distribution of light, not to mention the placing of windows, as windows placed on three sides of a room allow the occupants an opportunity to orientate themselves with the rotation of the sun coming through the windows. Windows are elements that aid in connecting artificial indoor realms to the world of life and activity outdoors, such as the view of the ever-changing weather. When people house rooms which are windowless, they feel claustrophobic and caged as well as trapped not knowing what time of day it is. Windows are important stress relieving elements in buildings, as people unconsciously use them to calm themselves by gazing out at the external environments at regular intervals (Day, 2002: 202).

Although sunlight may flow in straight lines, daylighting comes from the entire sky and so is reflected in entire interiors. To do its reach, this light then becomes affected by internal interior factors such as colour, texture and tones of surfaces. Light is also linked to reflection and can create various effects and patterns from it (*fig 5.13*), for example reflection of light on water creates attractive and compelling images on wall surfaces which can intrigue people within these environments (Day, 2002: 204).

> *"The more living the light the more appealing the places" (Day, 2002: 202).*
>
> *"There is basically no substitute for daylight" (Day, 2004: 74).*

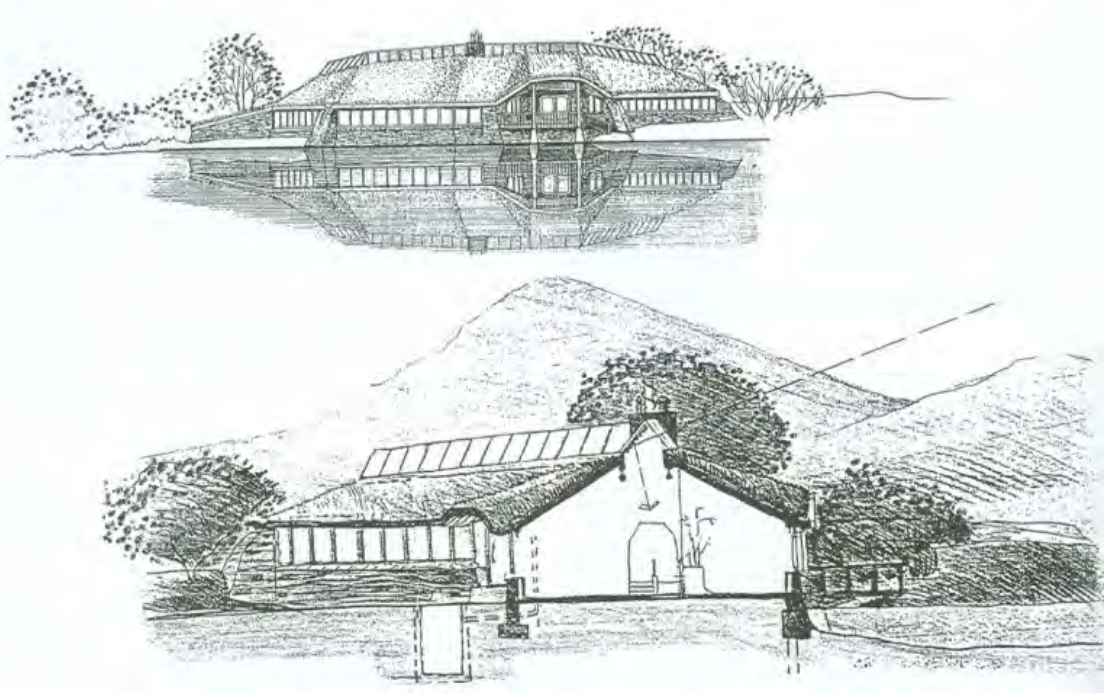


Figure 5.13 Two ways to get sunlight deep within buildings: reflection from water and reflective clerestories. (Day, 2002: 68)

5.2.3 COLOUR HEALING

Colour and the viewing of to the human eye are created by light, which makes it a form of energy. This energy affects human body function as well as mind and emotion making it both a psychological and physiological influence. Studies carried out have shown that richer colours such as red have longer wavelengths and prove to be more arousing for people than colours with shorter wavelengths such as green. There needs to be a balance of colour when considering the effects to the human mind and body as extreme unity or monotony of colour can result in understimulation with symptoms of restlessness, low levels of concentration, irritation and excessive negative emotions (*fig 5.14*). Extreme complexity of colour on the other hand causes overstimulation to the observer causing increased heart and pulse rates, increase blood pressure and increased muscle tension (*fig 5.15*). Long periods spent in these environments result in these causes having lasting effects to the human health system (Mahnke, 1987: 1). Colour affects muscular tension, brain wave activity, heart rate, respiration, and other functions of the autonomic nervous system. It produces emotional states of mind and aesthetic responses that can be both pleasant and unpleasant, and colour can transport humans to an uplifting condition of calm (Venolia, 1988: 58).

Figure 5.14 Monotonous and monotone environments that under-stimulate the individual. (http://www.newhouseofart.com/modern-simple-interior-design-ideas-contemporary-styles-kara-mann/)

Figure 5.15 Confusing and extensive colour palette that over stimulate the individual. (http://www.modernhomez.net/tag/lounge-casino/)

Colour can draw individual responsiveness in people as it is a highly personal preference but it also has a universal approach to some aspects. The general observation is such that red is a stimulating colour, while blue is a calming colour, and a majority of people would view it as such with a few exceptions. It has been indicated that different colours affect and boost different glands in the body such as yellow stimulates the thyroid, blue the pituitary, red the male sexual glands and violet the female sexual glands. It is important to take this understanding of colour and its effect on people in order to adapt it to use therapeutically on people in the built environment (Day, 2004: 72). All colours have universal effects at a full body experience. These effects are produced not through small areas of colour, but rather

large areas in an environment completely coloured such as coloured light for an entire room or walls and ceilings (Day, 2004: 73).

> *"Colour has the ability to serve man's physiological and psychological needs and to keep him on an even keel in times of stress" Faber Birren (Venolia, 1988: 57).*

The history of colour in society is vast as the recognition of colour and its apparent effects to human can be seen as far back as the Neanderthal era, as colour was utilised for its sacred powers in providing protection and help. Primitive African priests were known to adorn their cave walls with traditional patterns in certain colours because of their symbolic healing qualities. Later in history the Romans and Greeks used colour heavily in their healing methods as well as the Middle Ages used coloured cloth to treat the diseased patients (Venolia, 1988: 58).

At a psychological level colour can change the size and temperature of a room that is experienced, it can bring to mind memories and connection, support introversion or extroversion, provoke anger or peacefulness, and overall influence people's moods. Once an understanding of colour and its affects on the human responses has been achieved, environments to balance well-being and harmonise surroundings and moods can be designed for, by engaging with the spectrum of colours and their effects (Venolia, 1988: 57).

When assigning colours to a room the amount of daylight entering it is important, because it will highlight or reduce the effect of the colour. A cooler room can be warmed with highlights of warm colours such as reds, oranges, and yellows or a warm room can be cooled with cool colours such as blues, greens and greys. The room function is also an important factor to consider as colours effect mood and thereby the room's effectiveness to create the right atmosphere for the occupant. For example, blue is a cool colour that does not simulate social activity and so would not be suitable for social areas; peaches boost the appetite so would be good to colour eating areas; and red creates tension so would not be suitable for conference or negotiating rooms. The key to colour is balance, balance between dark and light, balance between dull and light, balance between warm and cool, active and passive. Ultimately colour needs to be harmonising on the occupants with a sense of order and unity for the room to be healing. Nature is also a good example of how colour should be treated as every aspect of nature whether in plant life, animals, or topography have a specific function (*fig 5.17+5.18*). Contrasting colours together heighten each colour's intensity and in nature this is apparent when viewing a violet flower with bright yellow centre or blue bird with yellow highlights (*fig 5.16*). Nature adequately expresses colours individuality and expressiveness (Venolia, 1988: 60).

Figure 5.16 A yellow bird with blue wings from Australia, a good example of the contrast of primary colours, straight from nature. (http://www.divedownbelow.com/sabah-travel-centre/land-day-trips/river-cruise/)

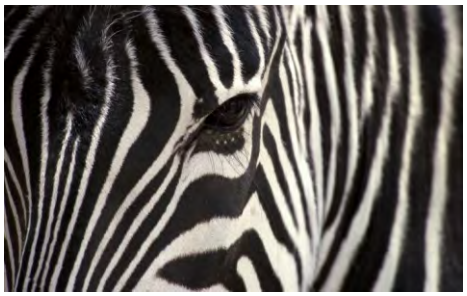


Figure 5.17 The black and white contrasting colours and resulting pattern created by the natural colouring of the Zebra skin. All Zebras have this effect without even one having a smudged or vague meeting of the two colours. This shows natures exact colour intension. (http://wallpaperboy.com/animals/zebra/zebra-upclose/)

Figure 5.18 The camouflage of a lizard in relation to the tree branch it is perched on. The accurate and realistic blending of colours is uncanny. (http://www.meterdown.com/2009/10/15-awesome-lizards-camouflage-photos.html)

Here is a look at individual colours and their characteristics and affects on the human body and mind[1]:

- *Red*

  Red incites warmth, excitement and exhilaration. It is the colour of blood and fire and thereby related to emotions like anger and passion. Red stimulates and energizes the human body as it enhances blood circulation and pressure, respiration, heart rate, muscular action, nervous tension, and hormonal and sexual activity. Red boosts the nervous system, liver, adrenals, and in general the senses. Within the built environment the stimulation of red can be beneficial where physical exercise is important or where people require initiative (*fig 5.19+5.20*). Red should be kept away from environments that need to reflect calm and rest such as bedrooms, study areas, and meditation rooms (Venolia, 1988: 63).

Figure 5.19 Red colour tones are vibrant and energetic and make the individual feel excited. (http://www.woovaa.com/tag/red-tone-example/)

Figure 5.20 Red tones internally seem to make the room warmer. (http://www.bestinterior.org/tag/Colors/page/9/)

[1] *See Appendix III – Characteristics of Colour in Man-made Environments*

- *Yellow*

Yellow boosts drive to mental activity and feelings of joy. The sun is yellow and the colour symbolises enlightenment, divine power, immortality, happiness, intellectual power, and mental creativity. Yellow increases blood pressure, pulse, and respiration, but not as much as red. It stimulates the muscles and nerves, and frequently is helpful for the skin. Yellow alleviates depression, tension, and fear and can soothe mental and nervous exhaustion. As an intellectual, creative colour, yellow is fitting to utilise in libraries and study areas (*fig 5.21+5.22*) (Venolia, 1988: 64).

Figure 5.21 Yellow rooms are bright and cheerful and stimulate joy in the user. (http://archzine.org/homes/category/decoration/)

Figure 5.22 Yellow tones are soothing and comfortable. (http://modernhomedesigning.com/interior-design/warm-and-cold-tone-design)

- *Blue*

Blue the colour of the sky and water and symbolises inspiration, creativity, truth, revelation, wisdom, serenity, loyalty, faith, and is highly connected with harmony. Blue's affect on the human body decreases blood pressure, pulse rate, heartbeat, muscle activity, eye-blinks, and brain waves. The effect of these symptoms is calming and sedating, resulting in stillness, gentleness, contentment and composure (*fig 5.23+5.24*). Blue as a

Figure 5.23 Blue toned rooms are highly soothing and calming. (http://dreamfunhouse.com/interior-design/bright-rich-shade-of-azure-in-royal-house-interior-design)

Figure 5.24 Blue show be used in bedrooms but here it is used for a dining room a more social space. (http://dreamfunhouse.com/interior-design/bright-rich-shade-of-azure-in-royal-house-interior-design)

colour used in architecture produces a reduction in the hyperactivity of schoolchildren quite significantly, but in a social area would be unsuitable and could lead to a lack in communication. A good environment to utilise blue would be in bedrooms as its calming effects is suitable for inducing sleep, and it is also appropriate for spiritual, meditation and contemplation areas (Venolia, 1988: 64).

- *Orange*

The colour orange is the amalgamation of red and yellow so considered a more disciplined and practical adaptation of red. Orange symbolises optimism, courage, enthusiasm, and confidence. Orange regulates the body's energy especially when energy levels and vitality are low. It is an influential physical and mental stimulant as it enhances energy and excitement. Orange is viewed as a social colour and therefore commonly used in community centres, family rooms or meeting places. As the colour of ideas, orange is a good colour to use in areas for creative study. This colour stimulates the appetite so can be used in eating areas and kitchens (*fig 5.25+5.26*). It is also sometimes considered as a common healer and so can be employed in hospital rooms and intensive care units. Caution is advised with orange because it is best used in moderation as a highlight colour (Venolia, 1988: 65).

Figure 5.25 Orange is an energetic colour creating the same feeling in people. (http://modern-decors.com/decorations/tag/luxury-bedroom-furniture/page/2/)

Figure 5.26 Warm toned of orange. (http://homes-designing.org/category/furnitures/)

- *Green*

Green is the combination of blue and yellow and is universally linked with nature and its cycles of birth, death and transformation. It represents both abundance and unripeness, and symbolises balance, harmony, growth, healing, love, peace, and hope. Sometimes called 'the master healer' green affects the whole body and is especially advantageous to the central nervous system. It has a sedative effect, reducing irritation and exhaustion. Green suppresses nervousness and tension and is appropriate for concentration and meditation and soothes mental disorders and nervous headaches. Calming green is best used in areas

for rest and relaxation such as bedrooms and hospital rooms (*fig 5.27+5.28*); and because of its harmonious qualities is considered a good colour for political rooms (Venolia, 1988: 65).

Figure 5.27 Green is a calming colour best used in bedrooms. http://homedecorhousedesign.com/bedroom-with-green-tone-more-beautiful-and-comfortable)

Figure 5.28 Green is a colour that relieves tension and increases concentration. (http://nskwood.net/Design/Bathroom/What_colour_bathroom_design_decor_interior.html)

- *Purple*

  Purple is an amalgamation of red with blue and suggests dignity. Because of this effect the colour is frequently used in rituals both spiritual and political. The colour equally accelerates and suppresses all the procedures of the body, mind and spirit. Purple induces relaxation and sleep, lowers body temperature, and decreases sensitivity to pain while also being a stimulant that increases the activity of the veins (Venolia, 1988: 66). The quietest room colour is found to be purple (*fig 5.29+5.30*) (Day, 2004: 208).

Figure 5.29 Soothing purple toned room. (http://lapouyette-unddiedingedeslebens.blogspot.com/2011/05/color-purple-in-interiors-nature-art.html)

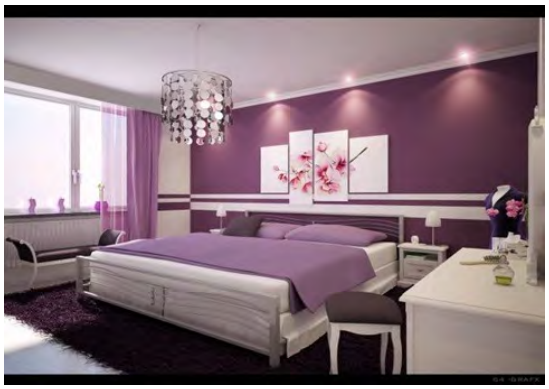


Figure 5.30 Purple is good to use in bedrooms. (http://www.luxury-interior-design.info/2010/01/luxury-color-interior-decoration.html)

- *White*

  White incorporates all the qualities of all the colours. It is associated with both life and death, and symbolises wholeness, purity, positivity and innocence. White when added to any colour is believed to provide greater spiritual characteristics. On an aesthetic level white visually intensifies other colours when placed beside them. It encompasses suggestions of coolness, purity, and cleanliness (Venolia, 1988: 67).

From the six primary colours a colour pallet can be created and these variations are used to create and highlight all sorts of environments for humans. Some of these secondary and unusual colours are pink, turquoise, magenta, scarlet, brown, grey, gold, silver, peach and cream (*fig 5.31*). Colour is one of the most important aspects of interior design in order to create the perfect mood and has become a subtle art of balance and innovation. Colour does have the potential to be a healing aid in architecture when used cleverly.

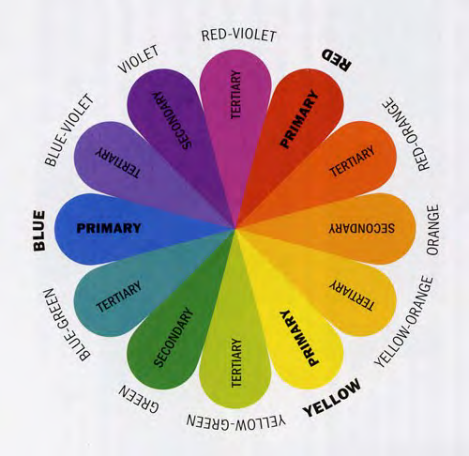


Figure 5.31 The colour wheel indicating the three primary, three secondary, and three tertiary colours. (http://screamingheretic.com/2011/04/23/color-theory/)

5.2.4 TEXTURE HEALING

Texture can be considered from a visual or physical perspective. On a visual level textures can be seen from the patterns of light and shade that is projected onto walls and floors, the refection of water on ceilings and walls, the random patterns of tree branches overhead. At a visual level the human eye 'touches' and registers the textures. On a physical level textures are differences of surfaces whether they are smooth and rough or soft and hard, bumpy, sharp, rounded or weaved (*fig 5.32-34*). Every architectural surface and object has a surface and most of them are in contact with humans. Textures is the least recognized sense to be manipulated but when considering how people move through and use buildings touch is fundamental. Touch is required most frequently for openings such as windows, doors,

Figure 5.32 Rough gravel texture. (http://www.uniquetextures.com/00106.htm)

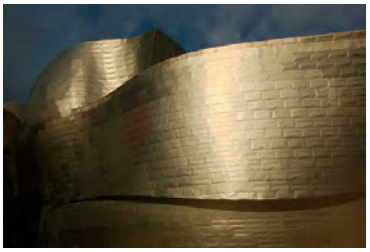


Figure 5.33 Smooth metal sheeting texture. (http://www.flickr.com/photos/freddshome/3811352471/)

Figure 5.34 Rough texture of bark. (http://fineartamerica.com/featured/rough-textures-olga-paulescu.html)

drawers, and chairs.

Texture is an element best used when highlighting specific aspects of rooms and is highly suitable when trying to bring the feel for outdoors inside with elements such as bark or rough wood, stone walls or pebbles. Textures provide aesthetic qualities in a three dimensional way that gives depth and character to spaces and avoids flat and unstimulating appearances. Texture can enliven and captivate otherwise unexceptional forms (Day, 2002: 217).

Figure 5.35 Textures can enliven, even enchant, otherwise unexceptional forms such as the rhythm of roof tiles making this building in Greece look interesting. (Day, 2002: 217)

5.2.5 SILENCE HEALING

Silence is one of the best healing forces, its qualities of tranquility being extremely therapeutic. When considering silence it is not meant as an absent of complete sound but instead an absence of harmful unnatural sounds. Silence is becoming rarer in today's society, within the urban environment and beyond its borders are large levels of noise. The normal human environments have become noisy worlds with cars hooting, mechanical equipment, endless traffic, cellphones and alarms. Finding areas with a quiet atmosphere is much harder. All this noise is quite harmful to the human temperament with most people being unaware of the harmful consequences to themselves because they are surrounded by noise constantly. For some individuals noise is such a constant that a lack of it makes them seem uncomfortable (Day, 2004: 204).

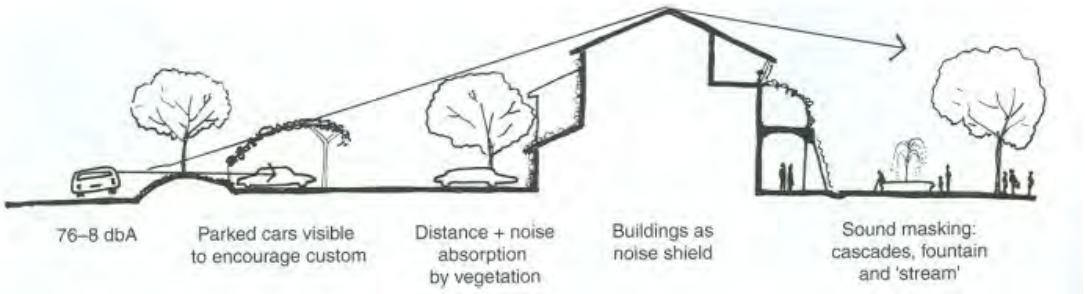


Figure 5.36 A sketch or diagram showing urban noise reduction from the vegetation around buildings, to the buildings themselves and lastly the fountains. (Day, 2002: 86)

The most extreme form of noise illness is complete hearing loss but there ranges other negative symptoms to harmful sound such as physically high blood pressure, tension, headaches, fatigue, ulcers, poor digestion, hyperactivity, cardiovascular disease, neurological disorders and disturbed sleep. Mentally high inappropriate noise levels can result in irritability, low concentration levels, low performance and productivity and moodiness. The human body recognizes sudden noises as warning signals whether there is danger or not as the noise causes the human heart rate to increase and the blood pressure rapidly increases which

results in the speeding up of breath, tensing of muscles, and appropriate hormones being released in the body. With constant, repetitious, loud, sudden noises in the modern environment, humans natural reflexive action is becoming immune to these warning signals induced by sound, not to mention the constant tensing of muscles from the warning system in the body that causes fatigue. The main aim for sound and its advance warning methods can be seen in nature through animals, for example, when a herd of buffalo are grazing or any other animal and a sudden noise can cause the entire herd to shift and run away, warning them of a dangerous predator.

Noise and sound is easily endured by humans when there is an understanding of why it is a certain loudness or length, or even when in control of the producing noise. This can be observed within the everyday home environment as there are constant producers of noise here; things such as dishwashers, vacuum cleaners, ceiling fans, televisions, washing machines, hairdryers, toasters, fridges, lawnmowers, doorbells, toilet flushing systems, telephones, and garbage disposals. The human ear can detect sounds ranging from 0db to 150db in wavelength. In the wilderness the average sound level is 15 to 20db, this increase in farm areas with a range of 30 to 35db. In residential suburbs and small towns sound levels sit between 35 to 40db with ambient city noise at 45 to 75db. Shopping areas are about 80 to 100db with standard human conversation between 50 to 75db. It has been proven that excessive sound levels of 85 db and higher can lead to hearing loss and as it can be seen environments are frequently at this sound level. The World Health Organization's guideline for safe noise levels in undisturbed sleep is estimated at 30db but on average night time noises in cities sit above 60db (Venolia, 1988: 84).

It has been determined by research that the effects of noise to the overall health of humans is environmental hazard, and so buildings needs to combat the level of noise to their surroundings in some way (Holdsworth, 1992: 46). Some techniques have been created in order to reduce noise levels in the living environment such as obstruction (with walls, banks and buildings), absorption (by vegetation and filters), sensitive zoning areas, and masking (rustling leaves, moving water, songs of birds), all implemented to combat harsh outdoor noise (*fig 5.36*). The reason silence is healing is because it is gentle on the human senses allowing relaxation, contemplation, and clam in any environment that incorporates it. Healing silence is unobtrusive and best experienced with the sounds of nature such as the wind brushing through the leaves of a tree, or the water moving about in a stream. These qualities of endlessness and quiet rhythm can aid in creating living silent architecture (Day, 2004: 204).

Numerous spiritualists throughout the years have tried musical vibrations for methods of healing and spiritual development. According to Hazrat Inayat Khan, a Sufi who lectured and taught classical music in the 1920's, believes that, *"the whole mechanism, the muscles, the blood circulation and the nerves are all moved by the power of vibration"*. He states that there is a resonance for every sound and the human body is receptive and reactive to these resonances. Sound affects every individual cell of the human body, and once reacts to the vibrations of sound leads to vibrating the glands, the blood circulation and pulsation of the heart. This means that the body has a deep physical reaction to sound, frequencies and resonances, which when accurately established with the manipulation of certain sounds, can be used for therapeutic purposes (Balwat, 2009: 26).

Once people are made aware of the harmful and disturbing noises of the surrounding environments, design measures can be taken to adapt living environments for a more quietened atmosphere. The most direct method would be to distance the environment form the noise source, but most of the time this is unavoidable and out of a person's control and so to create places of healing power that feel life-renewing and incorporate healing silence, the following methods can be utilised (Venolia, 1988: 90):

- *Avoidance*

  In the process of choosing a house or site consideration should go into the surroundings and their ambient sound levels and sources, so that factors creating large noise pollution can be avoided. These functions include airports, freeways, and factories. This process can be increased by detailing all noise producers and their levels such as shopping malls, schools, flight paths, parking lots and playgrounds, and circumvented (Venolia, 1988: 90).

- *Landscaping*

  Landscaping around a building provides a barrier or boundary around the living or working area in which the noise intensity can be reduced. The use of earth embankments, berms and rows of thick shrubs or trees, absorb and reflect sound before it reaches the building. Fences made of brick, stone or concrete would have the same effect as well. "Acoustical" plantings have numerous functions too because they are aesthetically pleasing (*fig 5.39*), they help in cleaning and cooling the surrounding air, they hide the source of noise from public view, and on a psychological level have less of an impact to the birdlife and wildlife and so can attract birds to the site and benefit from their soothing songs and calls. The most appropriate shrubs for acoustical absorbsion are thick leafy plants with thin stalks to allow vibration and movement in wind. When planting tree belts

is it good to note the taller and wider the trees widths and heights the better the effect (*fig 5.37+5.38*) (Venolia, 1988: 91).

Figure 5.37 An image of a green belt of dense trees that protect the farm from harsh wind and unnecessary sound absorption. (http://www.stockphotos.it/image.php?img_id=17867070&img_type=1)

Figure 5.38 A winter white vegetative belt that forms a protective barrier. (http://www.superstock.com/stock-photos-images/1990-37386)

Figure 5.39 A building that has 'living walls' or 'green walls' with vegetation on them that are a sound absorbing element and simultaneously cleaning the surrounding air. (http://pingmag.jp/2006/12/08/vertical-garden-the-art-of-organic-architecture/)

- *Construction*

  A more complete sound barrier that landscaping and vegetation is construction partitions such as concrete or masonry as these materials will absorb more sound that is airborne than any light construction. Another technique may be to add a second skin to the building with an airspace between (something like a cavity wall) as this space will minimise vibrations going through to building interiors. Buildings can also be sealed more thoroughly and effectively which not only make the building soundproof but thermally efficient (Venolia, 1988: 91).

- *Indoor Noise Control*

  As mentioned earlier the living spaces and home environments consist of many noise making items. If an investigation into the appliances and objects in the house was to be carried out and noise levels determined then small measures could be taken to reduce sound like adding padding to heavily vibrating objects such as washing machines, blenders and tumble dryers. The home design can also consider separating these functions into soundproof separate rooms away from the social areas to reduce disruptive sound flow (Venolia, 1988: 93).

- *Absorption*

  The interior furnishings and finishes of a living or working environment are important elements in combating unnecessary sound. Once a noise has entered the space an attempt can be made to decease the sound with absorptive materials. Soft, porous materials such as carpets, drapes, and acoustic panels can dampen noise levels while hard dense

materials reflect sound forming echoes and amplifying sound such as glass, plaster, concrete and plastics (Venolia, 1988: 94).

- *Healing Sounds*

  Constant noises as well as constant silence are unnatural levels of sound and the best sound environments are those that soothe and delight the occupant. Healing environments can mask unpleasant sound in order to create the right atmospheres for relaxation and calm, elements that draw birdlife and so an experience their sounds such as bird baths or fruit trees. Some trees create specific sounds like bamboo with creaking and whistling unusual noises. Accessories like wind chime and bells hung in gardens and courtyards create subtle soothing music according to the breezes. Water is also a significant masker of sound as the bubbling, and splashing of fountains, streams and water features create a playful and soothing atmosphere that it reminiscent of the natural outdoors (*fig 5.40*). In the modern day the most soothing music used and played in the living interiors are recordings of sounds of the sea, waves, streams, dolphins, whales, winds. Carefully selected sounds can create environments that are complete tranquil and serene and provide opportunities for people to experience beauty through their imagination. These calming sounds can help with relaxation, concentration, meditation, creativity, digestions, moods, and muscle responses (Venolia, 1988: 94).

Figure 5.40 An image of a flowform. Flowforms are specifically proportioned vessels which induce rhythmic oscillations in streaming water so left-and right-handed vortices combine in figure-of-eight movements. They enhance the constantly spiraling movements natural to flowing water, which help keep it fresh and invigorating. (Day, 2004: 56)

5.2.6 INDOOR AIR QUALITY HEALING

Indoor air quality is an important internal health factor which determines whether transmition of air carries unpleasant elements. Within a closed environment people breathe the same air whether when awake or asleep. Large volumes of air surround people in all environments consisting not only of health fresh oxygen but also harmful chemicals. The type of air inside buildings commonly contains off-gas from building materials, carbon dioxide, micro-organisms, germs, body-odours, and dust particles which makes air inside buildings five times more polluted than that of external air. It is important that buildings interiors get

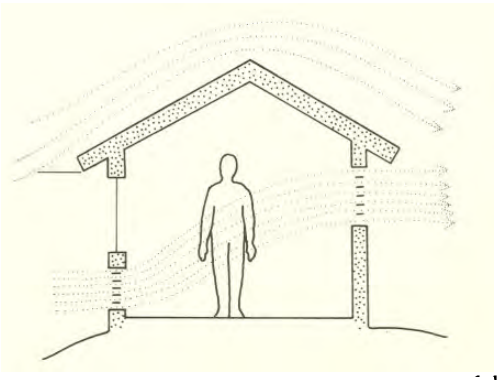


Figure 5.41 Fresh air is essential to human living environments and natural ventilation is the best way to allow air into buildings keeping the interiors fresh. (Venolia, 1988: 119)

enough fresh clean quantities of air into the interiors. Humans are highly susceptible to changes in air quality around then that within a slightly unbalanced environment such as an increase in CO2 levels that people lose concentration and with less fresh air people become fatigued (Day, 2002: 190). More than 300 chemical compounds were found when researchers from the US Environmental Protection Agency analyzed a single building (Holdsworth, 1992: 63). Fresh air is essential for healthy environments, making the common building appliance of air-conditioners unhealthy, as they circulate used and polluted air by drying it out and taking all the water from it. Natural fresh air on the other hand carries scents and sounds of the outdoor seasons, weather, and flora which refresh the human body and respiratory system (*fig 5.41*). By naturally ventilating building environments not only does it maximise good indoor air quality but also provides an economical solution compared to the high energy consumption of air-conditioning (*fig 5.42*) (Day, 2004: 51).

Room size is a factor to consider as larger rooms are more difficult to ventilate than smaller rooms, and the same can be said about heating spaces. Air that has been trapped in buildings for long periods of time becomes stale and the environment stuffy so the air becomes heated, dry and polluted. To refresh air that is not completely clean, other than ventilating rooms by wind or fans, is through moving water. Moving water absorbs unpleasant smells and dust particles. An effective method of moving water in living environments are flowforms or cascades which ionize or clean the air through the rhythmic movement of flowing water (Day, 2002: 190).

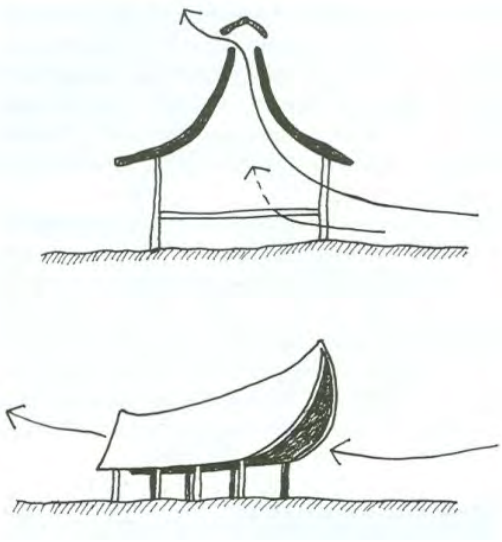


Figure 5.42 Building and roof shape can enhance and influence the faintest of air movement and can even create airflow. this design strategy can channel fresh air into buildings more effectively. (Day, 2002: 96)

Sink Building Syndrome as mentioned is this chapter previously (4.2.5) is usually related to poor air quality of buildings. Two factors are associated with this, the increased use of volatile synthetic materials which are harmful toxic gas producers over time and decreased ventilation in order to save energy costs of buildings. This leads to germs and chemicals being spread throughout the internal spaces and can severely affect people with respiratory conditions as well as people with low immune systems. The average natural atmosphere that humans breathe in always carries some form of negative elements such as dust, bacteria, spores and molds, but in the modern age with new constructions, materials and technology that are new

toxins within the internal living environments. These chemicals and negative ions are almost always more concentrated indoors than outdoors and result in higher risk of infection. Some of these contaminants can be smelt immediately while others are not easily noticed as they are colourless and odourless but not less powerful and harmful to the human body as most people spend 90% of there time indoors working, relaxing or sleeping. Steps are being taken in the construction industry in eliminating some of these harmful factors such as asbestos and VOC's (volatile organic compounds) in paint being eliminated, but some chemicals and toxins are still lurking within human environments. Below are a few of the harmful major indoor air pollutants (Venolia, 1988: 98):

- Formaldehyde - any furniture or material containing urea-formaldehyde
- Combustion Products - tobacco smoke, wood and coal burning stoves, fireplaces, anything with gas
- Radon - it is a colourless, odourless gas that is a by product of decaying uranium in rocks and soil.
- Asbestos - asbestos is used inside buildings for fireproofing, decoration, thermal, electrical and acoustical insulation.
- House Dust - composed of molds, mites, pollen, human and animal hair and dandruff, leftover food, and decomposed material.
- Mold - molds exist is the air throughout the year in varying concentrations which as light and easily carried by air currents.
- Lead - found in paint and old cracked pipes water

Ventilation is best source of protection for major indoor air pollutants. Ventilation can reduce and dilute the level of effect that air pollutants have and also can make the average person's respiratory system stronger. Whether ventilation is carried out naturally or mechanically, it is always important to keep internal liveable spaces clean with fresh air especially in winter cold climates where there is a tendency to close the buildings because of the low temperatures. Heaters add to this harmful effects if interior air by drying it out (Venolia, 1988: 119).

5.2.7 MATERIALS HEALING

All building materials have their own unique and individual characteristics. Wood is warm representing nature through the tree from which it originates, brick and masonry feels warm as it retains its warm colour from the burning kilns, steel is cold and hard representing the powerful machines that compress it into shape, plastic feels somewhat unnatural from it smooth and morphed forms, reinforced concrete appears solid and unrestricted (*fig 5.43-47*). These qualities of materials allow them to create character and atmospheres in human

environments. Even the age of materials enhance spaces with timber and wood being a long standing building material, the representation of history and nature comes through, while plastics and steel are more contemporary materials and so feel modern and new. These virtues therefore enhance certain building impressions to the public (Day, 2004: 168).

Figure 5.43 Warm and natural wood. (http://www.shutterstock.com/pic-26210362/stock-photo-timber-wall-background.html)

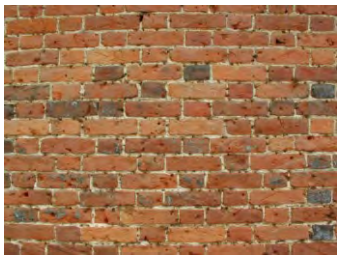


Figure 5.44 Warm and simple masonry. (http://4umi.com/image/wallpaper/)

Figure 5.45 Cold and hard steel. (http://www.123rf.com/photo_3728851_some-corrugated-metal--building-material-with-vertical-ridges--a-great-background-texture.html)

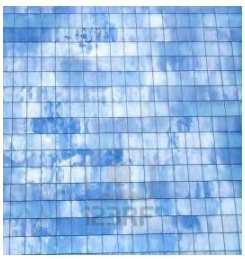


Figure 5.46 Cold, bright and fragile glass. (http://www.123rf.com/photo_1683735_tall-building-glass-facade-reflecting-cloudy-blue-sky--background.html)

Figure 5.48 Unusual forms of plastic. (http://www.dreamstime.com/green-plastic-object-imagefree254528)

Figure 5.47 Smooth, solid, cold concrete. (http://www.arroway-textures.com/catalog_static/3/172)

Materials also range according to personal preference just as colour does, as qualities of these materials determine individual characteristics in space, and thereby allow people to individualize their living environments. Materials are most felt through the sense of touch and slightly through the sense of sight, and so appearance and texture are highly relevant. Also the structural associations of materials are important when creating building impressions and aesthetics, for example concrete is generally viewed as a strong building material so it is unsuitable to build a garden shed out of it, while timber is only structurally strong in small scales so building a skyscraper with it seems inappropriate. There are also many other smaller materials within interiors that can be considered such as the traditional materials of thatch,

Figure 5.48 Traditional material of thatch is a warm insulator but has a very rough texture. (http://mrossymross.blogspot.com/2009/04/097.html)

Figure 5.49 interesting wall textures of clay plastering on external wall. (http://www.flickr.com/photos/phil_marion/5573364716/)

Figure 5.50 Rough texture but highly ecological material of stone. (http://www.northlandconstruction.com/product/walnut-sls/)

mud and straw, affluent materials like marble, limestone, and glass. These varieties of materials create opportunities to express many different room functions and person qualities to the occupant's desires.

Each material creates a certain psychological feeling in humans which effects the environments in which they live, work and play. Building materials such as concrete, steel, and plastic are not good materials to live within compared to brick and wood which are more warmer and approachable materials. Materials also determine thermal interior levels for environments as well as shape. When a person wants to express a unique form for a building they would be restricted in steel and timber, and so the only course to follow would be in using reinforced concrete, while buildings that need to fit into a natural setting would not look suitable it constructed out of steel rather than timber or mud.

Another important factor to consider when choosing materials is local availability. Local materials are more appropriate because they reduce transport costs and energies, mostly suit the local climate of the selected site and reinforced local identity and culture. This is not to mention the benefits of thereby utilizing local man power and employees enhancing community development. The more natural the material the healthier the environment. Natural materials are less processed and thereby less harmful to the earth's environment (*fig 5.48-50*) (Day, 2002: 78). For humans it would be normal to feel more at ease within a space made form natural materials rather than synthetic ones (Day, 2004: 168). Building materials also determine a buildings life-span. Generally tougher materials such as concrete have long life-spans where timber degrade and rots over time. But although wood, mud and straw have short life-spans they have low building costs and if detailed, constructed and maintained carefully can last for hundreds of years (*fig 5.51*) (Day, 2002: 80).

Commercial Buildings	***Lifespan of different layers***
Structure	30-100 years
Skin	15-25 years
Services	8-15 years
Space Plan	2-10 years
Contents	Always Changing

Figure 5.51 Table as an example of the general lifespan of the parts of a commercial building and so which needs to be the strongest form of construction and materials. (Day, 2002: 81)

5.2.8 VEGETATION HEALING

The garden space is the transition space between indoors and outdoors, between the individual private realm and the public natural world. Gardens allow people to interact with nature at their leisure to enjoy the sun, wind, rain, and beauty of the outdoors. By having a garden, people are forced to live with and appreciate nature around them, while being forced to notice growth, the seasons, and the exceptional uniqueness of all things in nature from flowers, to plants, to insects. Gardening is a great way to stay healthy as it provides opportunities to soak up the effective sunlight while doing exercise and also constantly keeping in touch both physically and mentally with nature. All buildings should incorporate garden environments into their interiors or surrounding at utilize its therapeutic and healing potential (Venolia, 1988: 130).

Hard, lifeless surrounding creates a dull atmosphere that is unapproachable and unenjoyable while gardens bring softness to them. Gardens are alive with growth of flora and faunas as well as birdlife and insects. Gardens provide an environment for humans to relax and renew their balance in as there is no rush and bustle experienced from urban populated areas (*fig 5.52*). Not only does vegetation provide pleasant visual aesthetics but it also has practical functions as well. Vegetation is a defense to humidity as the transpiration from the foliage can cool the surrounding air through evaporation by around 4'C, and the shading from the leaves can reduce temperatures by 15'C (*fig 5.54*). Human traffic and activity results in environmental pollution with increased levels in hat and sound, plants and vegetation help in trapping dust, absorbing high levels of carbon dioxide, oxygenating air and reducing and masking harmful levels of sound. In the current day and forms of modern living there are increasing level of carbon dioxide within human air and plants and trees are the only source of oxygen that humans have. It is essential

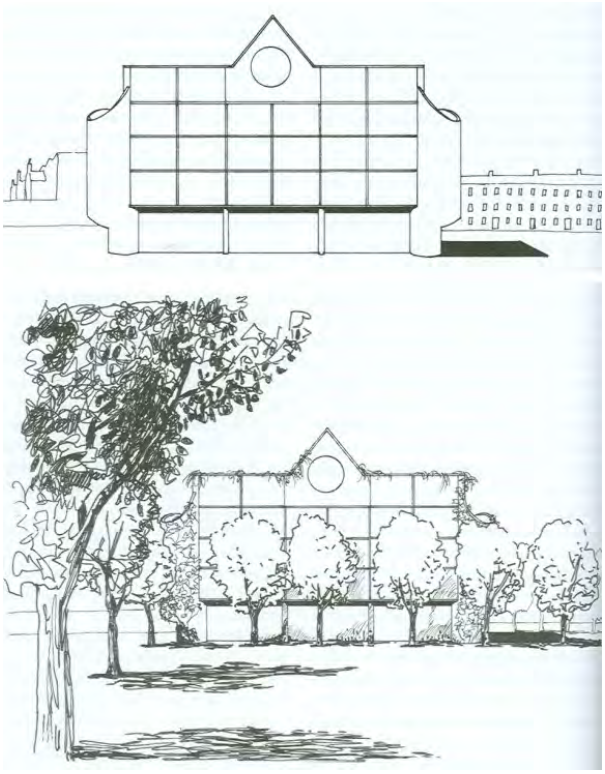


Figure 5.52 As well as improving air quality by oxygenation, humidity regulation, ion breeding, dust absorption and smell masking, plants soften the impact of hard materials and shapes, harsh light and hard acoustics. Their transformative effect greatly outweighs their cost. (Day, 2004: 76)

to combat and create balance in environmental pollution through the use of vegetation; this is also significant in indoor environments as well. Within vegetative areas healing water plays an important role.

Fountains, water wall features, misters, canals, and waterways cool overheated streets and roads by evaporation. Flow-forms, and water features drop temperatures in courtyards and induce cooling breezes around buildings (*fig 5.53*). Vegetation is also varying in species and so the right plants need to be used in the right areas in order to fit adequately into the natural wilderness (Day, 2004: 77).

Figure 5.53 Sewage water has a negative connotation attached to it but this water can be highly useful. Here by using a series of flowforms and open vegetated ponds the movement-nurtured biological processes of implementing oxygen into the water transforms it to more usable water. (Day, 2004: 126)

Healing gardens provide a link to the overall universe and cosmos, as it draws inspiration from nature and its forms. When designing healing gardens, rigidity and preconceived notions of design should be ignored and a more organic form of thinking adopted to reflect the organic forms of nature. This means an avoidance of symmetry, straight lines, and steep volumes and planes. Gardens supports a healing social atmosphere with people interacting through the function of gardening, resting in seated areas, or walking along its pathways. In external environments such as these promotions of connection between all ages, race groups' and genders can be achieved as the main aim of experiencing this space for all individuals is recreation and relaxation drawing people together. Gardens therefore require hierarchy of spaces and seating arrangements for more public and private meetings and gatherings. Gardens enable an interaction between the observer and nature which is important to human health and balance. A healing garden should provide a multitude of choices such as varying seating spaces, walking pathways, areas in which to observe people, areas to reflect and meditate, and areas to explore nature's natural wonders. Garden designs must provide chances

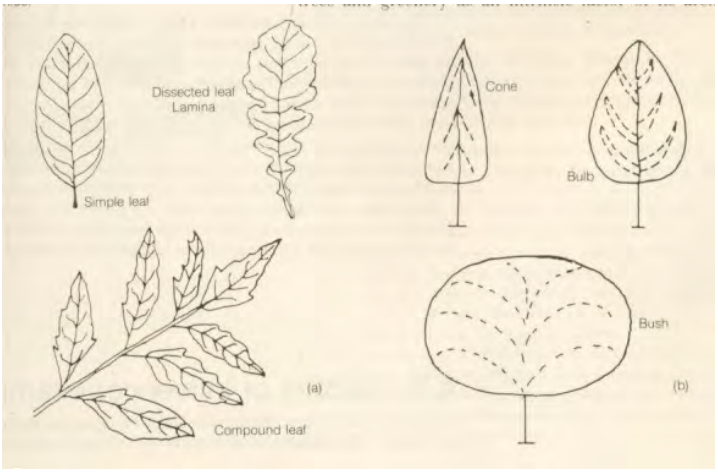


Figure 5.54 These are examples of plants that are either good dust collectors or good breathing leaves. (Holdsworth, 1992: 88)

for human movement and exercise since these influence human health and prevent depression by uplifting and energising the person experiencing the space (Stark, A). Natural vegetation should be reintroduced into any new or old building sites as much as possible to maximise environmental growth especially in the urban realms (Holdsworth, 1992: 49).

Gardens and nature are very therapeutic elements for humans and is highly recommended for patients in recovery as most individuals heal faster with movement and fresh air (Gesler, 2003: 2). Gardens in urban environments provide break away spaces in which to escape harsh noise, extreme visual stimulants, and rushed atmospheres and just enjoy a sedate pace of watching trees sway in the breeze and water moving around features. Within the hectic stressful human environments gardens are healing in providing that necessary escape.

A good example of a therapeutic healing garden is the garden based at The Oregon Burn Centre and Legacy Emanuel Hospital in Portland, Oregon (*fig 5.55*). This centre provides care for patients suffering from fire traumas and skin disorders. It is the first hospital in the nation to offer a therapeutic garden with burn patient rooms at first floor so they can view the garden below. The garden incorporates moveable garden furniture in attractive settings and allows spaces for patients and visitors to rest while outdoors (*fig 5.56*). The garden importantly provides a variety of walkable floor surfaces such as concrete pavers, gravel and grass wound through different areas of the garden. This is really an important aspect as patients often suffer from leg burns and grafts and injuries, so in recovery need to learn to walk again. Handrails along these pathways assist the patient's movement (*fig 5.57*). For the small size of the garden, it has quite a big impact on the patients and includes a large number of plants and flowers ranging from Japanese stewartia, western dogwood, weeping sequoia, to roses, marigolds, lavender, and rosemary. The varying colours, sights and scents of the fauna essentially aid in distracting the patient for their pain for a short time (Marcus, 2008: 78).

Figure 5.55 The therapeutic garden for Oregon Burn Centre where there are shade structures, handrails and wide pathways to support the needs of burn patients. (Marcus, 2008: 78)

Figure 5.56 The garden provides a variety of walking and seating options and a wide variety of plants. (Marcus, 2008: 80)

Not all gardens are therapeutic and have to be designed with recovery and care in mind in addition to the needs of the staff and patients. The garden provides the ideal opportunity to reconnect the patients with the real outside world after being bedridden for long periods of time. Gardens enliven patient's moods from being stuck in the interiors and alleviate depression and moodiness. The seating options vary from wooden benches to solid concrete benches under the shady areas (*fig 5.58*). Quick folding chairs can be placed in a specific area for a certain view. At a sensory level in this garden there are numerous enchanting sounds such as the bubbling of the fountain, the wind chimes, and the birds' song as they are drawn to the berry-filled trees. These types of environments really do heal humans mentally and physically and provide an oasis to their individual troubles (Marcus, 2008: 83).

Figure 5.57 In this picture a patient is seen walking around the garden with the occupational therapist and the handy handrails are clearly visible. (Marcus, 2008: 84)

Figure 5.58 wide pathways and curb edges provide a setting where it is easy for a person in a wheelchair to negotiate the garden environment. (Marcus, 2008: 85)

5.2.9 THERMAL ENVIRONMENT HEALING

Building types are influenced in part by their thermal internal environments as it is essential to provide comfortable living spaces for humans. With the invention of air-conditioning and central heating many building typologies have been created because there were no restrictions as a constantly comfortable internal temperature could be adjusted and continuously maintained. Before these technologies came about the structure of the building had to be able to maintain heat in colder regions and in warmer regions had to ventilate to cool the buildings. This resulted in closed solid structures for cold regions and open transparent structures for warmer regions. This has now changed but at a very expensive cost (Day, 2002: 93).

Internal thermal temperatures of buildings are highly important for the comfort of the living conditions for humans and affect them even at a slight misbalance. The general standard of human comfort level is determined by the cold and heat of an environment. Every individual has a different balance to the cold and heat levels of a space and this differs slightly. In regard to thermal activity, these conditions are not restricted to certain areas and actually encompass

every inch of the given room and so the thermal conditions cannot be avoided. Thermal environment affects humans at both a physical and emotional level. At a physical level the human body has a universal standard body temperature that maintains a certain temperature in any environment and external temperature that the body is exposed to. The human body reacts to increased cold temperatures by raising the heat production of the body, and reacts to increased warm temperatures by secreting sweat which is then evaporated to the environment which in turn cools the body down (Venolia, 1988: 69).

Cold weather temperatures cause the human body to undergo certain reactions such as an increase of heart attacks, asthma attacks, arthritis joint pain, slow and delayed body movement, epileptic seizures, and headaches. In cold regions, because there is no control over the climatic conditions, people with these symptoms are recommended to move away to better climatic regions. Cold has certain positive effects on the human body by invigorating and revitalising lethargic bodies by being submerged for a short period of time. This process is used in spa treatments. High weather temperature cause sluggish levels in the human body, reducing reaction time and reflexes, aggravates irritation and increases the effects of stress.
Research has indicated that there is a temperature zone within a range of climatic situations for maximum physical strength and mental capacity, and this zone on average rages between 20 to 26'C and 1 to 15'C relative humidity. Sickness can be caught when experiencing extreme temperature changes frequently over a short time period and these unhealthy temperatures can only be prevented by maintaining indoor temperatures at a close range to the outdoor temperatures, and also utilising natural cooling methods (such as shading, evaporation, and cross ventilation) and heating methods (such as heat absorbing mass materials and absorbing colours) (Venolia, 1988: 72).

By enabling a comfortable thermal internal temperature and finding economic ways in which to accomplish this would greatly benefit the overall affects on the human body. In most office environments the air-conditioning system is constantly on and always at a level too cold for comfort. This causes extreme heat change when moving in and out of the office causing the body to become strained and sick and low work productivity as the body cannot maintain its energy levels. In creating the ideal comfort zones in building environments, it minimalises sickness and overall uncomfortableness. This in turn will have a higher potential for being a healing environment. Ways in which to reduce building heat or cooling without the use of energy should be undertaken.

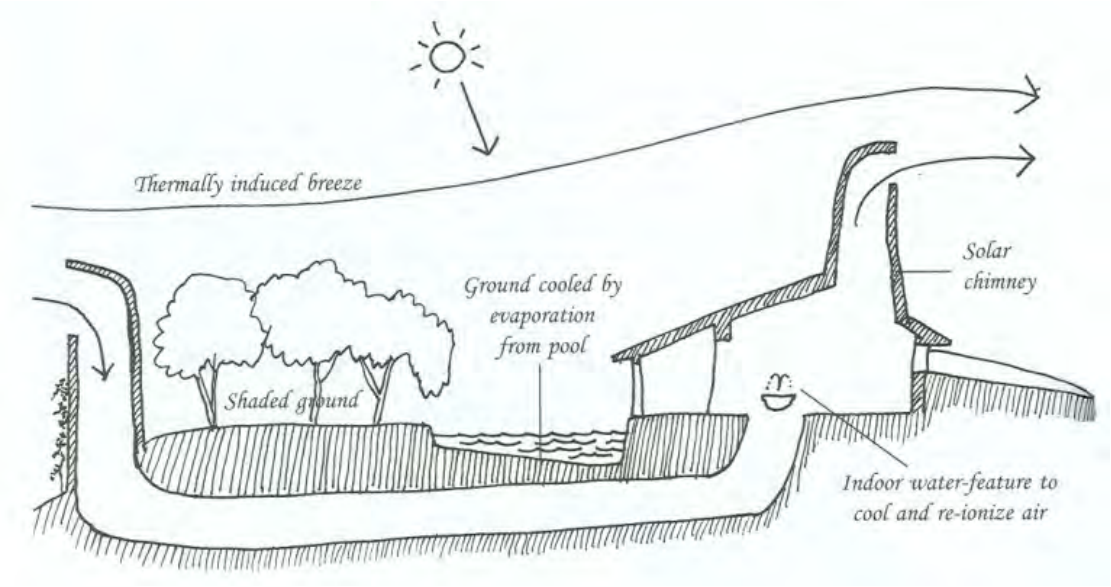


Figure 5.59 The different types of solar-driven cooling - the modern hybrid adaption of traditional wind-catching towers, earth cooling and evaporative cooling. (Day, 2004: 52)

Materials that stay cool in warm climates are ceramic tiles, glass which allows heat to escape, and concrete, with reflective wall surfaces and roof covering with light colours. Heavy materials are ones that best store heat such as clay, brick, stone, concrete, thatch and even plaster. They are most effective if coloured in dark tones to absorb the heat in which they have to be fully exposed to the sun.

Six basic principles for solar heating:

- Excellent insulation
- Large south windows
- Movable insulation for night-time
- High well orientated thermal mass
- Buffering spaces
- Overheating prevention: movable or seasonal shading, particularly in the afternoon and good ventilation (Day, 2004: 48)

5.2.10 DESIGN ELEMENTS TO HEALING

How can the building environment nurture the characteristics and qualities of human life and guide it to a healthy end. It is importantly much to do with energies that are created and channeled. According to Venolia many factors are involved in creating the energy of a place such as orientation, colour, sound, symbol, materials, form, climate, vista, and electromagnetism. These factors combine to make unique places to heal. Fluidly formed places that are structured to manipulate and maximise the natural energies of a place are necessary, such as to maximise the natural existing conditions like the capturing of sunlight and fresh air, the use of natural materials and proper colour co-ordination, and the design of forms and spaces to become invigorating and serene through architecture (Venolia, 1988: 173).

Naturalist May Theilgaard Watts believed that the shapes of rooms and buildings had a significant effect on how individuals felt about a place and that the square form was a highly negative element and rarely appeared in the natural world in comparison it is the main factor for the human environment. The shapes and forms that do appear continuously are the spiral, the circle, the five-pointed star and the triangle. According to Watts rectangular enclosures had four corners in its interiors and these corners kept stagnant unmoving energy because flow of energy is difficult to work in corners. This consequence was wasted energy in areas of places mostly not used and an overall decreased impact on the healing of that space. To contrast the rigid and boxed modern human environment people that lived in yurts and tipis felt a better wholeness and response to their living spaces. Native American Black Elk observed that "the Power of the World always works in circles and that here can be no power in a square". Architect Charles Harker, of the Tao Design Group in Austin, Texas, studied organic growth development to create a "habitable sculpture." He stated that *"...many persons expressed feelings of 'harmony' and 'unity' while in proximity to this flowing, organic form. Others felt a 'closeness to nature.'...emotional qualities of form...might be developed as a means to re-establishing the psychological ties which are necessary to a healthy, symbiotic relationship of man to the natural environment.*" (Venolia, 1988: 176)

In creating healing environments, enlivening human surroundings and preventing environments and buildings from becoming too institutional like hospitals, factors can be incorporated into design for example:

- Angling walls so that entrances, routes and seating positions avoid confrontation with wall planes
- Creating niches and larger points in corridors to differentiate stopping places from routes, with plants and water features
- Insetting doorways so that each room feels special at entry
- Numerous openings to the outside world, such as windows and balconies that view lush gardens and water features and colourful foliage
- Interweaving daylight from different directions
- Softer, gentle and varied artificial light
- Meaningful variety in materials, especially flooring, ceiling heights and door, window and ceiling elements
- Different textures to engage the individual to interact and touch the environment (Day, 2002: 231)

Healing is the progression of re-establishing harmony with the organism or in this case human environment. Human sickness means that there is a loss in this essential balance and there is a new requirement for the human body's natural ability to be reintegrated with the surrounding built environment to heal and regenerate. Spaces can be assumed to be fully healing participants to human's through materials structure and equipment, but importantly as well is the land, the site, the surrounding context, the people, the history and culture and spirit. Working with all these forces can result in conscious creation of vibrant, functional, and healing spaces that can well contributed to the individuals' participation in wanting and creating these spaces for themselves. A healing formation is the responsibility of:

1. **The community**: to educate, to inspire, and to act as the storehouse for wisdom in which the future generations can learn from and access;
2. **Nature**: to preserve and care for all of life and its material resources that is vital to human survival;
3. **Spirit**: to praise and nurture human aspiration and intellect and guide inspiration to fruition;
4. **The Site**: to preserve and honour the land and its ancestry (Stark, A).

Buildings that consider siting, form, material and processes with the land create healing potential not only for the current time but, for the future generations who will utilise these buildings. Architecture must consider this consequence that will have lasting effects on social and cultural levels, not to mention ecological advancements as well. A healing site must avoid damaging and negative environments such as industrial areas, cemeteries, power plants and jails because these types of functions are not compatible with healing, and focus on healing potential areas that are full of natural features that can used and surroundings that are infusive to calming, energising growth and therapeutic healing both in body and mind (Stark, A).

"To heal, places must infuse us with life – both through living qualities imprinted into lifeless matter and ecological harmony to connect us with the rhythms, processes and life of nature. They must nourish our feeling of life through harmony and delight for all our senses" (Day. 2002: 237). "*Balance and harmony is vital to health – whether in individuals, society or ecosystems"* (Day, 2004: 186).

5.3 CONCLUSION

The widespread definition of therapy is that which heals or makes whole. Another meaning of providing environments for therapy, other than places which already incorporate therapeutic processes, is understood as creating situations which will directly contribute to and enhance any therapeutic processes. Some intellectuals believe that it is the human environment that is or should be the major therapeutic agent in any therapeutic situation (Canter, 1979: 3).

Architecture has the potential to heal and harm and it seems that currently it does more to harm the people that use them. But valid and useful design elements exist in order to reduce these negative effects and the need should be increasingly stressed to incorporate these in all forms of architecture.

There is a surprising amount of factors of healing influence that form every part of the built environment and so if all these factors were incorporated the epitome architectural healing is possible. What can be noticed from the pattern yet again links to nature with all forms of natural heating, cooling, ventilation and materials all contributing significantly to better architecture design, in the path of wellbeing and healing. And so architecture can be, not is, healing.

CHAPTER 6

CASE STUDIES

6.1 CASE STUDY ONE: BUDDHIST RETREAT CENTRE – IXOPO

6.1.1 INTRODUCTION

Van Loon describes what is practiced at the BRC (Buddhist Retreat Centre) as "uBuntu Buddhism", influenced both by the spirit of Africa, the concept of uBuntu, and the culture of the West. "*I think Western science and psychology, African philosophy and art have an incredible richness and depth which can contribute to an exciting new Buddhism*," he says. For more than twenty years people of all religions and more have come to this centre to experience peace and tranquility. It is a gentle, sympathetic space, where one can be still and get in touch with oneself, and reflect on the things that crowd one's life. The Retreat Centre offers a tranquil environment for the study and practice of philosophy, psychology, meditation and the arts associated with Buddhist culture. The Centre therefore encourages adherence to traditional moral principles during retreats, such as respect for all forms of life, abstinence from alcoholic drinks and hallucinogenic drugs and, during some traditional, intensive meditation retreats, the practice of Noble Silence. Radios and pets are not allowed at the Centre.

6.1.2 JUSTIFICATION OF THE STUDY

The Buddhist Retreat Centre is set far apart from the bustle and stress of the busy city. It is set in the wilderness working with nature instead of dominating over it. Studying this centre provides a precedent or example of a group of buildings that has been integrated into a purely natural setting and has tried to maintain an ecological balance with the surrounding environment and community. The spaces are considered to be healing being designed with this intention from its inception.

6.1.3 LOCATION

Perched on a ridge of an exquisite 125 hectare country estate, at the head of a valley in the Umkomaas river system in KwaZulu-Natal, near the town of Ixopo in South Africa's KwaZulu-Natal province, the Buddhist retreat Centre looks out on a panorama of indigenous valleys, forests and rolling hills receding like waves in the blue distance. It is 90 kilometers south of Pietermaritzburg, one and a half hours' drive from Durban (web 12) (*Fig 6.1*).

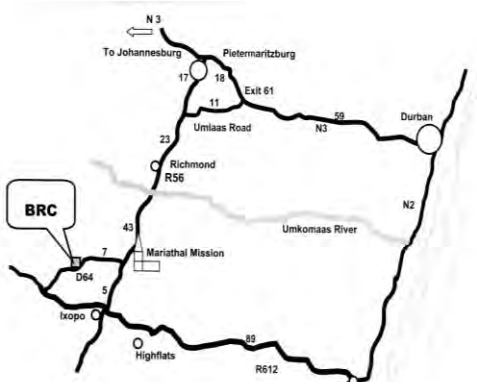


Figure 6. 1 A directional map indicating the two routes possible to take to BRC from Durban and PMB and the distant it is away from the busy cities. (www.brcixopo.co.za)

6.1.4 HISTORICAL AND SOCIAL CONTEXT

When Durban-based Dutch architect Louis van Loon bought 140 hectares of derelict farmland in 1970, it was what he describes as a "wild wattle wilderness". Over the next decade he dug up pine seedlings on the roadside and replanted them on the farm to get a fast-growing forest going. Then he added indigenous trees. There are thousands of them now, attracting 160 species of birds, including the endangered blue swallow. For both accomplishments, the centre has been awarded National Heritage status.

Figure 6.2 An early render of the BRC proposed layout done by architect and owner Louis Van Loon. Photograph taken by Author.

The centre's buildings started at one or two but grew into many more shown by the image taken the architect had a vision for the Buddhist Centre. The buildings are seemingly almost random sprawl but integrated with the site. The current state of the centre does not completely follow Louis's visionary map (*Fig 6.2*) but still has the main elements as you can see in the hand drawn map (*Fig 6.3*).

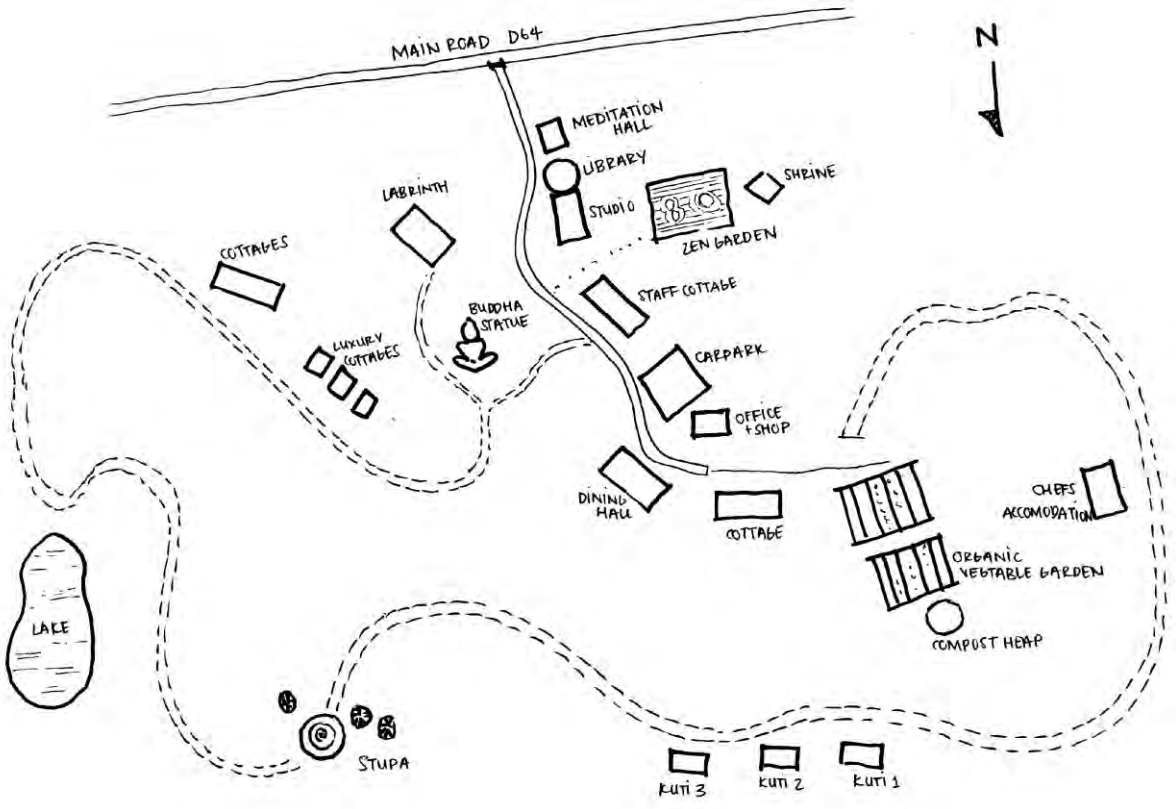


Figure 6.3 Sketch of Buddhist Retreat Centre layout indicating building layout and pathways for hiking and walking. Sketch done by Author.

- COMMUNITY

Paths threading the 300 acre property each bring their own revelation: follow the pine-scented path to the dam; walk past ancient cycads to the tracks of early Voortrekker wagons; discover an assegai-sharpening stone on a hillside; or point your feet towards the rocky outcrop that provides a perfect seat for contemplating the valley below. Socially the 23 staff necessary for the maintenance and routine of the centre comes from the local community. There is also a community based project that was founded at the BRC in April 2000 called Woza Moya, which has been moved in 2005 to their new community centre next to BRC also built by Louis Van Loon.

- WILDLIFE

The centre is among the most beautiful spots on the planet, with paths winding through a paradise of indigenous trees, rare orchids and tree ferns. Duiker and vervet monkeys live in the forest; otters have been spotted in the dam below the centre; there are horses there, and rescued cats and their progeny patrol the grounds. Nearby are the breeding sites of the exquisite, but rare Blue Swallow of which the Endangered Wildlife Trust has appointed the BRC a custodian. Their presence, together with the BRC's commitment to encouraging the indigenous biodiversity of the area, has led to the Centre being declared a Natural Heritage Site by former President Nelson Mandela. It is a birder's paradise with more than 160 species recorded (web 13).

6.1.5 EMPIRICAL DATA

- SCHEDULE OF ACCOMODATION

Forty retreatants can be accommodated in single and twin-bedded rooms, en-suite cottages and thatched chalets overlooking the secluded valleys on the property (*Fig 6.5,6,8*) – a short distance away. The cottages range in price to offer options to affluent as well as the average visitor. To enhance the sense of meaningful aloneness, accommodation for men and women is separate with separate ablution facilities. Integrated into this natural, peaceful setting is the Centre's buildings, the dining room (*Fig 6.7*), office (*Fig 6.4*), shop, library, studio (*Fig 6.9*) and meditation hall. The Centre is justly famous for its fine lacto-ovo vegetarian cuisine immortalized in its own recipe book, Quiet Food. It includes organically grown vegetables and farm-baked bread. There are raked Zen gardens, a traditional stupa (pagoda), and the largest hand-crafted Buddha image in the western and southern hemispheres. It is just as well that the surroundings are inspirational, because the accommodation is spartan. Most visitors stay in a rambling residence - one narrow bed, shelves for clothes behind a muslin curtain, and a shared bathroom across the hall, as in an old-fashioned hotel. The only

criticism is that there is no continuity between the different accommodations and seem randomly placed but they are extremely private and secluded to allow reflection time.

Figure 6.4 The exterior view of the Buddhist Retreat Centre's office building with lots of vegetative growth at the edges. Photograph by Author.

Figure 6.5 A perspective view of the upper class accommodation with good view across the valley and a very climate responsive architecture. Photograph by Author.

Figure 6.6 Other standard forms of accommodation that is almost completely covered by vegetation and does not disrupt the natural beauty of the site. Photograph taken by Author.

Figure 6.7 A picture of the dining hall that is partially hidden from view by trees and bushes and vines. The light through the trees create a nice effect. Photo by Author.

Figure 6.8 Accommodation that is completely hidden from view by the natural surroundings. Photograph taken by Author.

Figure 6.9 The studio building with thatched roof fitting in context and thick vines growing on the pergola. Photograph by Author.

- FEATURES

Retreaters or day visitors can walk through a forest up a gentle slope to the enormous white landmark that can be seen from the main road, namely the stupa (*Fig 6.10*) or shrine (*Fig 6.12*), and look across the valley to the clusters of homesteads that make up Chibini village. During the day distant sounds of the cows mooing can be heard. Retreaters can be seen stretching through a session of "mindful yoga" in a hall with cool parquet floors and tall windows that frame the greenery outside. There is no cell phone reception or technology such as computers and internet in the centre, thereby completely cutting off the visitor from the outside bustling world, to focus on the retreat and themselves. The came peaceful atmosphere can be felt when walking through or near the giant Buddha statue (*Fig 6.11*) or the serene Zen garden (*Fig 6.13*).

Figure 6.10 The large white landmark facing the valley is the Stupa where ceremonies take place. (http://www.southafrica.info/travel/cultural/ixopo.htm)

Figure 6.11 A picture of the enormous sized Buddha statue that sits emerging from the lush greenery, an attractive feature for this areas of BRC. Photograph taken by Author.

Figure 6.12 The Buddha figure also sits into a dedicated shrine in a thatched rondavel ornamented with bamboo. Photograph taken by Author.

Figure 6.13 An important and popular feature of the BRC is the peaceful Zen Garden where one can sit along the edge and contemplate or engage with it by lining the sand with a wooden rake. Photograph by Author.

The only form of water on the property is a lake or dam (*Fig 6.14-16*). It is on the Northern area of the site nestled at the bottom of two hills meeting. This lake is accessible and can be reached via demarcated trails or walks through the forest. The main issue with the dam is that it is not close enough to the centre to provide a useful feature, and only those that venture around can benefit from it. The use of water in terms of viewing its distracting reflections and rhythmic flowing patterns is absent in the centre. A better function or recommendation would be to integrate water within and around the bulk of the centres buildings so that the musical and relaxing sounds of water can be heard when meditating, practicing yoga or even cooking or just plainly sleeping.

Figure 6.14 - 6.16 These images show the lake on the BRC property that can be accessed via walking trails and is a peaceful and cool environment to rest and relax. Photograph taken by Author.

- COLOUR, LIGHT, TEXTURE & SOUND

According to the theory of healing architecture, environments need to design with colour, light, texture and sound both internally and externally. When surrounded with spaces that are positive designed by these elements people can be influenced to 'heal'. The buildings in the centre are all of a neutral cream colour which is a soft tone to the eye and better than bright colours such as blues, yellows and oranges (*fig 6.17*). Most exteriors of the buildings are plastered with a rough texture which fits into the vegetative surrounds better than smooth facades and are more interesting and stimulating to the eye. Most interiors have wooden parquet flooring, wooden furniture, bamboo or dark timber ceilings, paper lanterns and light coloured interiors (*fig 6.18-20*). These interior design elements bring the natural colours and

textures inside with the warm tones of the wood. There are large amounts of wide open windows in all the buildings to let lots of light into them. The windows are not covered with curtains or blinds during the day, and when blinds are used they are light coloured timber or bamboo blinds that create patterned shadows on the interior spaces. The more light that penetrates the interior of the buildings, the more airy, fresh, and alive they feel (*fig 6.21+6.22*). It is stated in theory that the heavy and busy sounds of the city are harmful to humans in that they induce high stress levels. Within the centre due to the vegetation and location away from any main highways and roads, the centre is surrounded by the silence of the forest. The site is silent to the extent where even a person's footsteps are seemingly loud. The only sounds heard while walking through the centre are the wildlife such as birds and the wind blowing the trees, all creating tranquil and serene spaces that are good for focusing on oneself and healing.

Figure 6.17 The interior colour scheme of the BRC office is subtle and light feeling refreshed and alive. Photograph taken by Author.

Figure 6.18 Here is the Studio interior with plain timber and plaster finish and lots of natural lighting coming through. Photograph by Author.

Figure 6.19 The dining hall is filled with natural light with no artificial air-con or heating. Photograph taken by Author.

Figure 6.20 An interior view of the library which is simple room with thatched roof and light coloured furnishings and finishes. Photograph taken by Author.

Figure 6. 21 + 6.22 Portray the Meditation Hall that is an unobstructed space dedicated to meditation with no distractions and plenty of natural healthy light.

- MATERIALS

The materials used in the construction of the centre's buildings are entirely natural. Most of the public buildings in the centre such as the studio, library, dining hall, and office have been constructed simply out of brick and plastered with a rough texture (*Fig 6.22*). The accommodation is mostly built from brick as well. Almost all of the roofs of both public and private buildings have thatch roofs with only a few having corrugated iron sheeting (*Fig 6.23-24*). There are timber painted window frames and no ceilings to view the thatched roof timber frame. Where ceilings are needed timber poles have been used. Where timber has been used on the interior it has been left in its natural form and not sanded, painted or varnished. There is no use of concrete, ceramic tiles, aluminium or any other high energy material.

Figure 6.23 An image showing the rough exterior texture common on most buildings. Photograph taken by Author.

Figure 6.24 + 6.25 Indicate the thatch and corrugated irons roofs found on the site. Photograph taken by Author.

- LANDSCAPING

All trails are natural sand and not paved. The only paved area is the vehicular route or path to the carpark. If there is a need for demarcating the walking trail paths then bamboo sticks form the barrier (*Fig 6.25+6.26*). All directional signage is made from timber or bamboo. Some surfaces of the paths are stones or fallen vegetation and leaves (*Fig 6.27+6.28*). These landscaping methods show the value and importance of nature and the respect for the environment within the design process of the centre.

Figure 6.26 A bamboo structure makes the entrance or exit to the walking trails and is a point of reference. Very simple and natural. Photograph taken by Author.

Figure 6.27 The use of Bamboo is seen to demarcate the walking trails, natural material compared to brick or concrete. Photograph taken by Author.

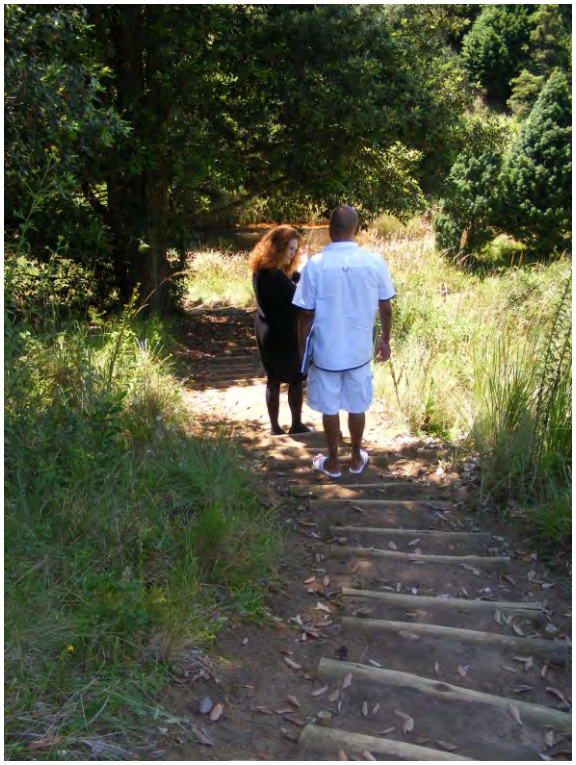


Figure 6.28 The use of natural materials again with the use of logs to create steps in the downhill trail. Photograph taken by Author.

Figure 6.29 The step leading to a n eating area in the sun next to the dining hall uses gravel to smooth out the stepped pathway. Photograph taken by Author.

- INTEGRATION WITH NATURE

All buildings on the BRC site are unobtrusive, passive, and fully integrated with nature. The plants and vegetation grow right up to, in, on, above and around the buildings (*Fig 6.30*). Some buildings are extremely difficult to see, through the vegetation surrounding it, creating completely secluded and private areas (*Fig 6.29*). This also shows how nature is allowed to be and grow as it wishes and the development does not dominate its surroundings. This provides a good balance between man and nature in which they work together. In terms of recycling and ecological systems the centre has a bore-hole water system in which they water the plants and vegetable garden as well as wash linen. The centre's staff has also created a compost heap situated in the organic vegetable garden from leftover vegetables and off-cuts (*Fig 6.31+6.32*). In the daily food and salads these freshly grown vegetables are used. The only suggestion that could be made would be to have some buildings exteriors slide open to provide no barrier between inside and outside thereby fully integrating the natural scenic and peaceful nature into the buildings.

Figure 6.30 A view of the edge of the hill where the accommodation buildings seem nestled into the natural landscape just peeking through the vegetation. This type of design does not dominate but work with nature. Photograph taken by Author.

Figure 6.31 Here what can be seen is the creeper vegetation that has over time began growing on the wooden pergola of the studio building and now developed so that it seems as if its enveloping the building into the natural setting. Photograph taken by Author.

Figure 6.32 An image of the Organic Vegetable Garden grown by the kitchen staff who recycle their leftovers and vegetables to create home-made compost and with the resulting vegetables serve these with the meals to the guests. Photograph taken by Author.

Figure 6.33 A picture of the compost heap towards the back of the garden that shows the ecological and initiative thinking patterns of the employees of BRC. Photograph taken by Author.

6.1.6 ANALYSIS & CONCLUSION

The Buddhist Retreat Centre in its function incorporates light, silence, natural colour tones and materials, and nature to create a healing environment. When fully experiencing the spaces the effect was overwhelming in its silence and peacefulness just after one visit. The form of silence healing was Buddhist Retreat Centre's best feature, where even the sound of a person's footsteps where loud. The buildings and daily processes firstly cater for the environment and then the humans. They are not dominating or overpowering, to the extent where nature becomes the main feature of the Centre and not the buildings.

The adverse effect was the randomness in placement of buildings. There should have been better links between buildings and spaces and placement of the accommodation was varied but at least most accommodation had a chance at a view at the surround valley and hills. The only relevant peaceful relaxing and healing generator or element that was missing was water. Water as previously covered, is essential to life and highly therapeutic in sight and sound and a better incorporation of this material into the architectural environment at Buddhist Retreat Centre would have been more suitable and advantageous.

6.2 CASE STUDY TWO: KARKLOOF SPA: WELLNESS & WILDLIFE RETREAT

6.2.1 INTRODUCTION

International award winning Karkloof Spa is home to the most expansive eco-friendly spa in Africa. Magnificently set on a 3500 hectare game reserve it blends the best of the globes major spas with a uniquely African sensibility. It offers a tranquil but uplifting haven for those setting out on a journey to wellness and restoration away from urban pressure. The Karkloof Spa property professes to provide the ideal surroundings to ensure that your journey towards wellness occurs in a sanctuary of peace and tranquility. Their journey has been one of re-claiming the land back to its natural diversity and abundance.

Figure 6.35 Nature is an important aspect of Karkloof Spa and fully utilised for healing. (www.karkloofspa.com)

6.2.2 JUSTIFICATION OF THE STUDY

Karkloof Spa boasts many varied natural environments that the Spa has been integrated into (*Fig 6.34+6.35*). It aims to conserve and protect all natural wildlife in the area and tries to use nature in the treatment methods of the place. The environment it is situated in an area far from the busy cities and traffic.

Figure 6.34 It's apparent that the buildings have a close relationship with nature. (www.karkloospa.com)

6.2.3 LOCATION

Located just 24kms North from Pietermaritzburg, in Kwa-Zulu Natal's midlands, it is easily accessible by Otto's Bluff Road from PMB and is a 10 minute drive. The spa property is completely quiet due to its out of the way location and with glimpses of Albert Falls Dam on the way to the destination (*fig 6.36*).

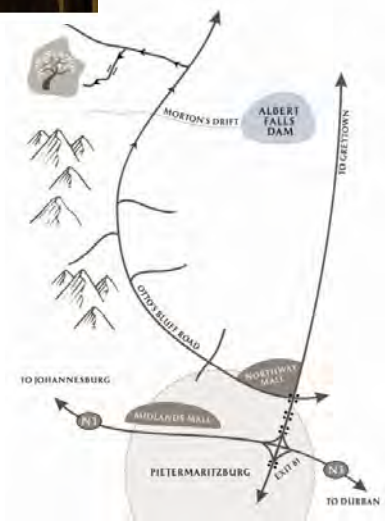


Figure 6.36 A location map of Karkloof spa in relation to Durban with directions. (www.karkloofspa.com)

Figure 6.37 The natural landscape to Karkloof Spa is rolling lush green hills and valleys with this particular spa being located in the middle of a valley leading to a waterfall. It is indicated by the red arrow on the image. Photograph by Author.

6.2.4 HISTORICAL AND SOCIAL CONTEXT

The Karkloof Spa Wellness and Wildlife retreat was established or opened in September 2008 and took four years to build. The German owner and managing director, Fred Worner, had a specific vision in mind for the resort and has hand a continuous hands in approach from the first stages of design, through constructions phases, till general running of the retreat. The property had on it existing before being undertaken to become a wellness and wildlife retreat, 5 villas and a main building and used to be a Safari Sanctuary. The surrounding areas and property beyond the tops of the surrounding hills where the resort boundary lies, are farming land (*fig 6.37*). Just a few kilometres down a trail will take you to the base of Karkloof Falls at the end of the valley.

There are an estimated 70 staff with on site accommodation separated into maintainence, spa, kitchens, game drives, housekeeping and management. The owner also has a property on site enabling a close connection with the running and staff of the retreat. The history of the establishment is very rich and precious as can be seen by the celebrated wall of photos of the past and present staff (*fig 6.38*). There are also framed photos hanging on walls of the lodge or villas

Figure 6.38 The past and present employees are kept memorised by framed photographs. Photo by Author.

Figure 6.39 Photographs keep memorised the construction process of the spa and displayed in the lounge. Photograph by Author.

which are all taken of Karkloof Retreat's property of fauna, flora and wildlife as well as photos of the people constructing the establishment (*fig 6.39*). All flowers that are decorating the interiors have been taken on the property.

No private vehicles are allowed up to the main retreat area and so guest's cars park at reception for the duration of their stay while the visitor gets driven to the resort via safari van. This is to ensure that the animals and wildlife are not disturbed and the reduction of noise for the area in general. On a crucial note there are ecological consultants that come in on a weekly basis to access and report on the statuses of the vegetation and wildlife on site. These consultants would ensure that the correct types of trees are planted; that the bird life is flourishing or not; that the alien forms of vegetation are kept to a minimum.

6.2.5 EMPIRICAL DATA

- SCHEDULE OF ACCOMMODATION

Karkloof Spa Wellness and Wildlife boasts one of, if not the biggest, spas in South Africa. The site has incorporated a main lodge with and office, boutique store, kitchens, lounges with fireplaces, library, dining hall, and wrap around deck with outdoor swimming pool. There are 16 individually decorated villas, one being disability friendly, with private lounges, bedrooms and bathrooms with two being large interconnecting villas for families or friends (*fig 6.40*).

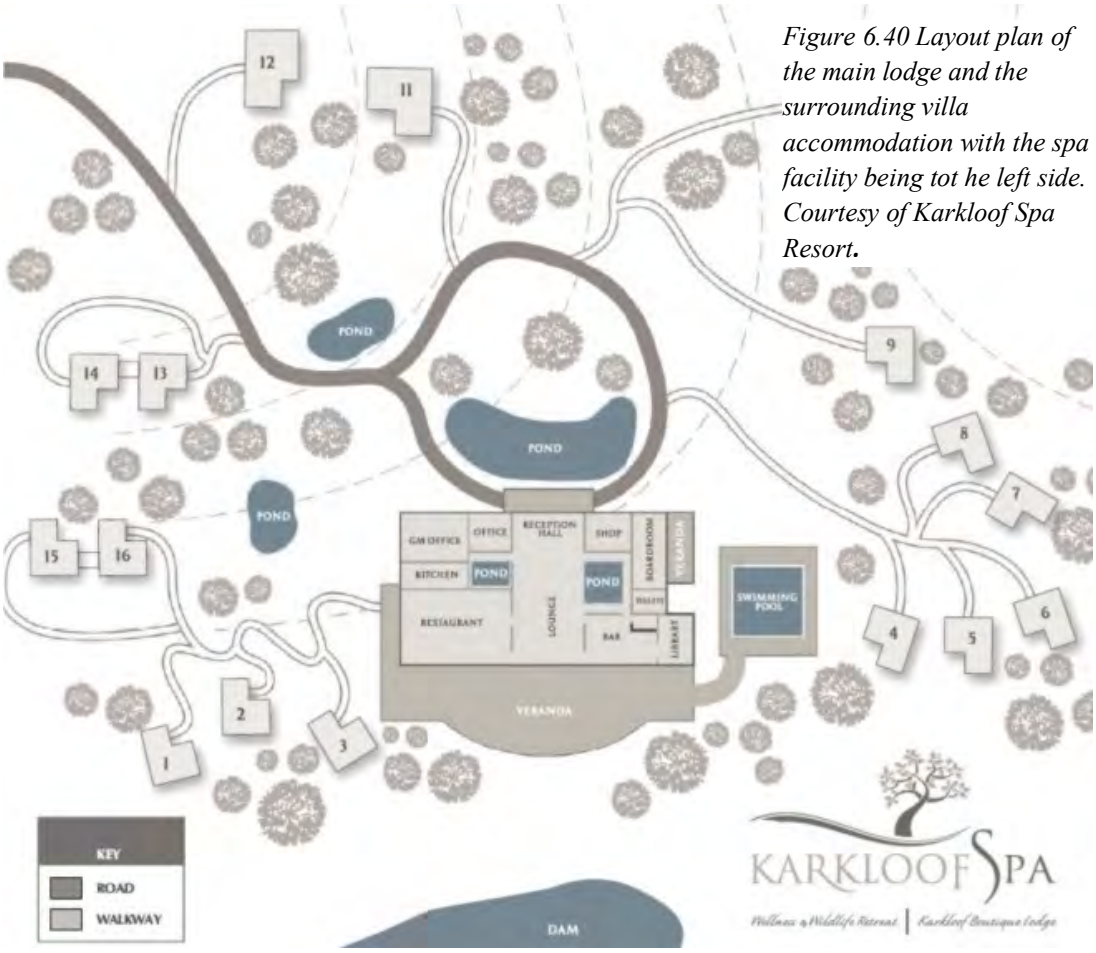


Figure 6.40 Layout plan of the main lodge and the surrounding villa accommodation with the spa facility being tot he left side. Courtesy of Karkloof Spa Resort.

There is staff accommodation as previously mentioned as well as the owner's house. The spa features 17 generous treatment rooms, all with wonderful views over the native bush and surrounding gardens and offers many facilities which include a glass fronted four-chair Manicure/Pedicure lounge, Moroccan flavoured Rassoul, Flotation Pool, Roman Bath and Kneipp Therapy Pools hot and cold), open-air Jacuzzi, Sauna and Steam rooms and a Reflections lounge. There is also the standard reception area and a café in which to dine or snack. All the buildings have incorporated the luxuries of air-conditioning and under-floor heating for the hotter and colder months of the year.

- INTEGRATION WITH NATURE

The buildings on site are all of an unobtrusive manner, with lush vegetation allowed to grow around them. All of the buildings have not taken away from the existing landscape to the extent where decking is built around tree trunks, and boulders are incorporated into the building where they are on site (*fig 6.42-44*). The building roofs are thatch to provide a natural façade which can easily fit into the wildlife context and allow wildlife to explore areas close to the lodge and villas.

Figure 6.41 The resort incorporates green roofs into the design as the buildings effortlessly merge with the hillside and the thatched roofing material attracts birds and wildlife. From this image it is easy to see the integration into nature as the buildings hardly seem to take prominence even with the luxurious interiors. Photograph taken by Author.

The colour scheme of the walls is of an earthy brown-purple in which all the buildings and even the cars are painted. The main environmental friendly aspect of the resort is how the building seems to merge with the slope of the landscape and hasn't been excavated out to sit a building on. The hills seem to envelope the build with the grass stretching over the buildings and onto the roofs to form green roofs, and from most angles then aid the building in blending with the natural context and landscape (*fig 6.41*). This construction system also adds to retaining heat in the buildings in the cold temperatures of winter increased by being located in a valley.

Figure 6.42 The decking system works around the existing tree leaving space for it to continue growing. Photograph by Author.

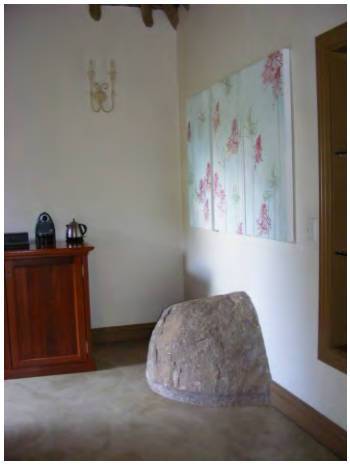


Figure 6.43 The existing boulders have been integrated into the villa space creating an unusual interior space. Photograph by Author.

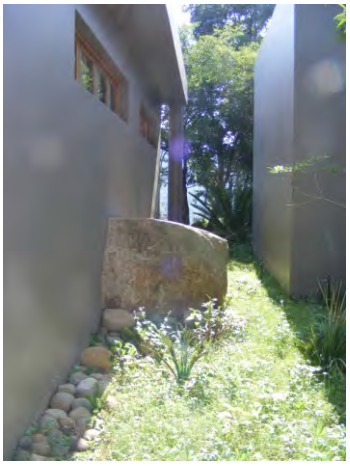


Figure 6.44 A large boulder is protruding out of a building leaving natural landscaping untouched. Photograph by

- WATER

Enhanced with the big heart of African sensibility Karkloof Spa will capture your senses as it is inspired by flowing water. There is a river that runs through the Karkloof Spa property called Karkloof River. This river has amongst the cleanest water in the country, and enters the property at the spectacular Karkloof Falls (*Fig 6.48*), the second highest waterfall in KwaZulu Natal which flows through a section of the property before entering the Albert Falls Dam.

With water being the main theme there is some kind of water form in every area in the resort (*fig 6.45-50*). From the bottom of the valley where the river from Albert Falls runs, to the large ponds that are scattered across the site to the small streams of water that pattern the areas around the villas. There is a small natural water feature at the entrance to the main lodge and countless numbers of man-made water features scattered through the walkways and facilities, but the

Figure 6.47 A stream ends at the entrance to the main lodge creating small waterfalls sounds as a first impression to the guest. Photograph by Author.

Figure 6.45 Water feature scatter the site and provide peaceful water sounds. Photograph by Author.

Figure 6.46 One of the three rivers or streams that run through the property. Photograph by Author.

most interesting part of the water integration is in the main lodge. There is a water feature that visitors have to walk over to get to the main lounge area and so all public and private areas have views of water as well as the soothing and relaxing sounds of it flowing down the hillside or moving inside the building.

Figure 6.48 Karkloof Falls at the end of valley. (www.karkloofspa.com)

Figure 6.49 The entrance hall as a large water feature that has a water channel that you cross on a bridge. Photograph by Author.

Figure 6.50 Still water features have lilies and link a theme throughout the resort. Photo by Author.

Another main water feature is the corridor that visitors must pass through to get from the reception point to the rest of the spa in which there is a natural rock wall with small ponds below it to catch the water falling down the rock wall (*fig 6.51*). The sounds bring the essence of water to life emphasizing the main aim of the spa as a hydrotherapy venue to relax.

Figure 6.51 A water wall feature is reminiscent in sound of a waterfall. Photograph by Author

Figure 6.52 The outdoor pool area with special design features to prevent small animals and insects from being able to exit the pool when stuck. Photograph by Author.

Figure 6.53 the water from a natural stream is controlled by a water feature restriction that cars can drive over. Photograph by Author.

HYDROTHERAPY

The water therapy facilities allow a varied and rich treatment plan of the spa by the inclusion of a Moroccan flavoured Rassoul, Flotation Pool, Kneipp Therapy Pools, Roman Bath (*fig 6.54*), open-air Jacuzzi, Sauna and Steam rooms. The water facilities allow for bathing indoors or outdoors with minerals and salts, in hot or cold water temperatures with full views of the surrounding natural landscape and lots of natural sunlight.

Figure 6.54 The water therapy bathing pools consist of a large bath with water jets and two smaller Kneipp pools with hot and cold water. This area is relaxing and well lit and colourfully arranged with coloured towels and chairs. (www.karkloofspa.com)

LANDSCAPING AND VEGETATION

The entire resort is surrounded with bush and grassland and forest areas. When the resort was first built, a large number of trees were planted, this was to aid in the cooling of the buildings from the shade it provided and also in helping to attract the birdlife of the area (*fig 6.55*). During the visit to the retreat it was observed that there are a large number of new baby trees being planted for the future neat to the accommodation units. There are boulders and stones that have been built around so the main consideration is not to disturb the natural landscape but work with it and leave the area as natural as possible (*fig 6.56*).

Figure 6.55 the pathways and landscaping elements work around the natural features of the site and only natural materials are used for these like the timber decked pathways and wooden rounded bollards. Photograph by Author.

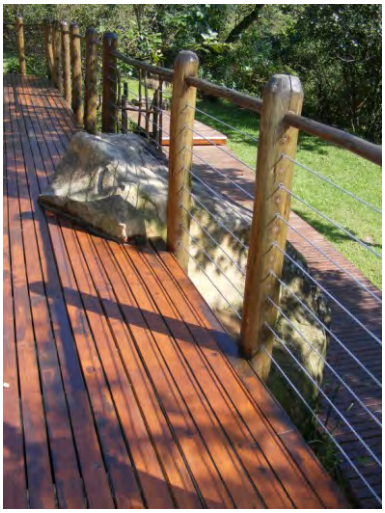


Figure 6.56 The building materials are mostly timber and the natural landscape is respected and incorporated into the architecture. Photographed by Author.

- MATERIALS, CONSTRUCTION + FORM

All the buildings in the resort are constructed with thatch roofs and no ceilings following an eco-design of natural materials. The furnishings are all timber as well as all the window frames (*fig 6.58*). The walls are plaster and painted with an earthy colour to blend into the natural surroundings. The walkways are timber decking, sided with bamboo poles, as well as any screening walls made from bamboo (*fig 6.57*). The fireplaces are made from stone quarried from the river side and the floors are all screeded and untiled. The buildings merge with the bush due to the thatch roofing as well as being settled into the hillside by living green roofs. The forms of the buildings are unobtrusive and passive within the context. The establishment took a long four years to complete and this was entirely due to maintaining a close relationship with the natural environment and mapping out the designs in which to incorporate all natural landscaping and wildlife in a truly undisturbed fashion (*fig 6.59-61*).

Figure 6.57 This image shows the timber posts, thatched roofs, and bamboo covered walkways between the spa facilities. There are lush gardens in all available spaces. Photograph by Author.

Figure 6.58 The relaxation room or lounge is a room full of lay back chairs that allow the guest to soak up sun. The rooms appears warm and comfy from the warm toned timber. Photograph by Author.

Figure 6.59 The roof garden supported by concrete slabs. Photograph by Author.

Figure 6.60 Natural stone makes up the fireplaces in the lounges. Photograph by Author.

Figure 6.61 The thatched construction is indigenous and appropriate with tones of brown, mustard, cream and grey. Photograph by Author.

- SOUND, LIGHT, COLOUR + TEXTURE

The main sounds in the resort is the sound of water, from the baths in the spa to the streams between the villas to the water features flowing water from round pots in the walkways and main lodge. The soothing and relaxing water sounds penetrate each and every area of the development. These sounds work well in conjunction with the natural wildlife sounds of trees and birds from the game reserve. A key point to notice is the total separation from urban environments and the resulting tranquility in the retreat. All the rooms are naturally lit with large windows and small internal courtyards, to clerestory windows in thatch roofs. The day-lighting in the interiors is more than adequate and enlivens the spaces. The colour scheme as

Figure 6.62 The timber poled pergola creates good shadow effects in the villas. Photographed by the Author.

Figure 6.63 the rough textures of the thatched roofs are evened out by the smooth plastered walls and animal hides on the smooth screed floors. Photograph by Author.

mentioned before are natural tones for the exterior of the buildings and the interior continues the same theme, with cream and off-white walls, and small highlights of bright colours to liven up the interiors. The rough textures of the outside world is met with the bamboo poles and thatch roof while inside the more smoother textures are suited to humanistic comfortable environments such as screed floors and plastered walls with layers of carpet and animal hide (*fig 6.62+6.63*).

- WILDLIFE

It is the variation in landscapes and local climatic conditions that has given rise to the scenic beauty and diverse habitats on Karkloof Spa, making it possible for a large range of animal and plant species to thrive and roam free, in a well-protected and conserved environment. This can all be viewed by the game drives provided for by the resort. The large mammals now found on Karkloof Spa include: White rhino, buffalo (of which they breed disease free), giraffe, zebra, blue wildebeest, eland, kudu, nyala, bushbuck, impala, red hartebeest, blesbuck, common reedbuck, mountain reedbuck, grey duiker and probably blue duiker in the forests. There are also Samango monkeys, vervet monkeys, warthogs, bushpigs, antbears and porcupines. Predators include caracal, serval, clawless otter, spottednecked otter, black-backed jackal and smaller species such as slender mongoose, water mongoose, large grey mongoose and genets. There are no large predators and so the animals are very relaxed on site. Due to the cliffs, forests, woodlands, rivers and other habitats of Karkloof Spa, over 300 species of birds occur on the property. Some of the more conspicuous are Ostrich (introduced), eagles (Fish, Crowned, Black, Long Crested, Wahlbergs and Martial), Yellow-billed Kite, Jackal and Steppe Buzzard, pigeons (Rameron, Rock and Green), doves (Tambourine, Laughing, Cinnamon, Red-eyed and Cape Turtle), Kingfishers (Giant, Pied, Half-collared, Malachite and Brown-hooded), robins (Cape, Natal, Chorister and Starred), ducks (White-faced, Yellow-billed, Black and White-backed), geese (Spurwing and Egyptian), thrushes (Groundscraper and Olive) and a host of other species. There is an impressive botanical diversity that occurs on the property. These include sponges with reed beds and wetlands, moist cool slopes with huge forest trees, open grassland savannas and dense bushveld woodlands. It is the diversity of the plant life that in turn sustains the diversity of the animal life. It therefore becomes imperative that, where humans have reduced or degraded this diversity, intervention (or management) is needed to ensure that the full spectrum of plants and animals can be sustained.

Figure 6.64 White Rhino that can be found on site. (www.karkloofspa.com)

6.3.6 ANALYSIS & CONCLUSION

The Karkloof Spa Retreat is a good example of the continuous incorporation of water within a complex development. This has been achieved by natural rivers and streams in the development to artificial streams and water features that inhabit almost every areas of the resort and so location and siting become important factors. The spa facilities are wide and varied allowing a mixture of treatments offered, and the environments that these facilities are in are calming, soothing, light and restful because of the quiet and water sounds that fill the interiors which are specially colour coordinated. The natural materials and construction methods allow the smooth integration of buildings to nature, and an allowance for the wildlife to come closer than be intimidated by the structures and functions. But the most important aspect for this resort architecturally is the living roofs which anchor and merge the complex into the landscape and become one with nature, an ecological objective that has been a success (*fig 6.65+6.66*).

Figure 6.65 A wide panorama image of the main lodge outside lounge overlooking the beautiful view of the valley in which Karkloof is located. There are no other buildings or obstacles in the way. (www.karkloofspa.com)

Figure 6.66 A view of the reception lodge were cars are collected and the guests are driven up to the main lodge and villas by a safari and guide. It creates a special first impression of the resort. (www.karkloofspa.com)

CHAPTER 7

ANALYSIS AND DISCUSSION

7.1 NATURE AS A MODEL BASIS FOR HEALING

Nature comprises of forms and principles that work within one and all life systems. From its functionality, to physical construction, and aesthetic appeal, there are elements of nature that can be aspired for and worked to, that hopefully as an end result can be implemented into human society and environments in order to improve them. Nature is a closed harmonious unit that corrects imbalances and degenerations as soon as they appear and this process is done naturally, without instruction or time limits. It is this element of nature, in the way it adapts to itself, and changes according to what's around it, that allows nature to grow and develop into something stronger and longer-lasting. This ability is what humans need to be inspired by and strive towards, creating in built environments as current human places are far from being healthy and healing. And as Portoghesi points out that subconsciously man has been attempting to do this throughout history.

Organic architecture is a movement based on the relationship of the building to its surrounding context and the appropriate way in which to work with nature, and this view is reminiscent in all of its critics and following architects such as Pearson, Wright and Kellogg. The Organic is also about making a statement that fluidity is better than curves, and technology is the best way to achieve this. Organic architecture ultimately encapsulates many different patterns, shapes, technologies and principles, but the underlying theme connecting all work and design is the fact that nature itself and preserving harmony with nature, is the most important criteria. While maintaining a natural balance is a main goal for society, the new processes of building in Organic architecture technologically can cause major setbacks in terms of its effect on nature. The very aspect that is supposed to move mankind forward meaning technology, also does cause unnecessary harm to the ecosystem, and so this begs the question - were should the line be drawn to still have both factors; technology and a balanced natural environment?

More interesting forms and compositions are being created from the new organic design processes which enliven the human built environment and moves it away from sterile rigid landscapes to generally more engaging and innovative forms. This type of architecture has less of a visual impact with nature and actually forms a kinship with its design forms but is this enough? Building systems need to be united, harmonious and regenerative at all levels and not just the visual impression. Functional buildings need to give back to the environment as much as they take away to maintain some kind of balance within the bigger ecosystem and organic architecture has been one solution to this problem. By looking at nature and successfully attempting to form a working collaboration with the environment, can bring healing spaces and qualities into the human living realm.

7.2 NATURE AS AN INSPIRATION FOR ARCHITECTURAL DESIGN

Nature has proven that it systems are unique and functional, whereas architectural systems have many holes in them that result in affecting humans quite significantly. It is understandable that nature is very complex and can inspire humans to achieve better processes in their environments, but there is the difficulty of trying to use nature's insights and fuse them with architecture. Most of the natural features researchers have discovered today completely intimidate and awe them, giving them inspiration in striving to adapt these principles somehow to architecture is the hope that human spaces and places become improved. It is highly unlikely that humans can exactly replicate natures fascinating examples, because of the complex and extremely difficult nature, but in saying this, the imitation of nature is not what should be aspire for but the adaptation of its rules and processes, to find new and better ways in which to advance human built environments and even social connections and interactions.

Critical Regionalism bases human culture and traditions as well as natural materials, elements and topography as the basis for respectful and fitting human architecture. It is something that responds to the local climate and constructions, while adapting new technology and advancement to future buildings and urban fabric. Critical Regionalism is an example of a theory that is trying to incorporate nature and people to the modern world and forming and maintaining a delicate balance between these. Nature and architecture do need a balance that can improve the current natural ecosystem and prevent more harm. One way to decipher and solve this problem is to look at nature and how it maintains its balance.

Organic Architecture and Critical Regionalism are movements based on the inspiration of nature to create beautiful designs, movements not just to be inspired by nature, but to be responsible and careful with it. In our unbalanced lifestyles architecture needs to respond to the growing natural crisis of climate change and diminishing natural resources, and so nature inspires beyond beauty and creativity to responsible sustainable architecture.

7.3 WATER'S POTENTIAL AS A HEALING AGENT AND ITS ROLE IN ARCHITECTURE

Water is a vital life source for all living things on the planet. It is important for humans and is important for building. Without water, most systems would not function such as toilets and bathrooms. Water in a natural environment is pure, clean, and healing like the fresh cold water from the highest mountains. Water with numerous minerals helps keep the body healthy internally and externally. Water is powerfully calming and powerfully dominating and needs to be treated with the respect it is due. Water also provides qualities that affect humans' sensory experience and it is through this factor that architecture incorporates water.

Water affects humans visually, through sounds, scents and even touch. Water is a natural element that every person in the world uses on a daily basis and has access to. It is highly influential from its reflective surface to its gurgling sounds.

Architecture is the vehicle that brings water into humans' daily living and working environments and provides a link to a general lost connection to the natural realm. The history of water in architecture can date back to the time humans formed habitats and moved from natural caves to constructed forms. Water has been an important tool in shaping architecture and still continues today. Urban environments are flat, hard, harsh and monotonous and by incorporating water, whether functionally or recreationally provide opportunities for water to change these atmospheres into something more energising and vibrant. Water heals the body at an emotional and physical level but not all water is good. As discussed earlier water has energies and when incorrectly adapted to human environments loose the potential for healing, such as by being channelled through rigid straight courses and limiting the free movement that enables water to have life. Water is a flowing, energetic and vital life force but architecture can reduce this and it is therefore important to incorporate water in the human environment while preventing it from becoming anything less than healthy and healing.

7.4 WATER HEALING THROUGH HYDROTHERAPY

Water therapy or Hydrotherapy has been implemented with societies for over one thousand years and has proven to be healing too many different causes and symptoms. Hydrotherapy proves water is more than just a natural substance that cleanses, that it can be drunk to provide fluids, meaning it is a medium through which medical treatment can be achieved. Water in general is a completely diverse substance with varying effects on the human body. Then most influential effect is the phenomenon of buoyancy which reduces the force of gravity and thereby the downward force on the human body. This effect creates more potential for heavier and diverse body movement that can be utilised in the form of treatment for illness. There is a large range of conditions that significantly and slightly can be treated or rehabilitated with the use of water therapy, and these can be carried out through immersion with exercise. The medical professionals who carry out these therapies are physiotherapists who deal with patients on a close range one-on-one basis in trying to improve their illnesses.

After compiling and sending out a simple questionnaire to a few physiotherapists, what was analysed was that hydrotherapy plays an important role in the medical field, alleviating symptoms for conditions such as arthritis, rheumatism, paraplegic, muscle disorders, and neurological conditions to name a few. Hydrotherapy then is not a treatment for a specific form of disease but actually has a wide range of influences. Hydrotherapy is highly useful in

the relief of pain, relaxing of muscles, and aids blood circulation. Another fact that has been established is that there is no strong history of hydrotherapy in South Africa and these facilities are not completely readily available. Most facilities are situated in government hospitals and there has been no one building dedicated for this medical treatment function. The physiotherapists that answered the questionnaires felt that there was a need for a dedicated hydrotherapy facility for the community, and consequently because of this disarray estimated statistics of people being treated by hydrotherapy is not general knowledge. A separate facility would allow researchers the opportunity to form statistics as to how many citizens utilise this kind of treatment and how many people are unaware of its benefits. It is important to note that half of the medical staff questioned was unfamiliar with 'Building Sickness Syndrome' and its effects.

Essentially, hydrotherapy is a form of water in buildings, water in architecture that can successfully heal and treat people. It takes the general sound, sight and touch healing qualities of water and magnifies it into a conclusive healing environment.

7.5 ARCHITECTURE AS A HEALING AID TO HUMANS

Architecture has the potential to heal and to harm humans. It has been established that the majority of peoples lives are spent in building either working, shopping, sleeping or relaxing. What people do not consider or know is that different environments affect people differently and that space can be harmful long-term. Day and Venolia similarly attribute that factors that contribute to creating negative and potentially damaging human environments are artificial light, artificial ventilation, artificial heating, spaces with no vegetation and foliage, overwhelming visual stimulants and lastly and most importantly increased noise and sounds. The more of these factors the environments have, the more damaging they become to their occupants. Architecture being the habitation that provides safety, shelter and comfort should also provide healing.

There are design strategies that can and must be implemented into every human environment from rural to urban worlds and many of these are entirely pleasant and beneficial, instead of functional. Elements such as natural lighting, natural ventilation, and natural materials are significant and if one notices the constant use of the word natural, it means nature should be increased in connection and increased in integration in human environments, because above any new technology, it is the fastest and cheapest way to heal buildings. It has been proven that buildings induce illnesses both physically and emotionally and it should be the aim of every architect and designer to better the environments for the people who use and care for these spaces everyday.

7.6 NATURE VERSUS WATER VERSUS ARCHITECTURE

In the precedents and case studies carried out in the document, what can be gained is that there are a few working collaborations between nature and architecture in the world but none have been focused into created a healthy or healing place for people who require it or can benefit from it. Mainly this is experimentation has been explored at a small scale or with residential buildings, but not in a fully fledge development that intends to heal at a medical level.

These studies have proved that Nature and architecture can co-exist and can create and maintain a balance together, thereby solve building issues of providing healing environments. Nature, water and architecture are all linked with humans. Water is apart of nature as is architecture. Water influences nature and architecture both. Architecture utilizes water and nature in its construction and functions. These three factors are interconnected in some ways, but the connection is staggered and rugged, and in order to create great healing spaces it is a requirement to find an improved way to link to each other, a balance. And so the key to creating healing environments is in connecting nature, water and architecture.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

The dissertation has investigated the relationships between nature, water and architecture as well as how these systems and elements work separately on the human body and living environment. Each system plays a significant role in influencing the experience of space for the human individual whether positively or negatively but the research carried out in the study shows that there are greater ways in which to improve the built environment for healing, by not working separately, but together.

- Nature has the potential to heal and so does mankind have the potential to help.
- Nature provides the ideal example of a working, regenerating and united organism that is efficient and harmonious as human environments aught to be.
- A sensitive incorporation of nature and architecture proves to aid the current state of the natural ecosystem by minimising the abuse of natural sources and improves the quality of architecture functionally for the occupants.
- Nature can provide a balance to the human world if humans can respect and appropriately utilise its resources and ecosystems.
- Water plays a vital role as part of nature and a part of human lives. It is the element most suitable for healing because of its therapeutic properties and characteristics. It contributes to making people and buildings healthy. Water should be utilised in creating healing environments because it has many healing properties of the mind and body. The most beneficial method of treatment to aid injured or sick people in direct contact is through the medical treatment of hydrotherapy.
- Hydrotherapy uses waters' unique principles to treat and rehabilitate numerous illnesses and enables water to contribute to the healing of humans.
- Architecture can provide healing and healthier internal systems for humans, but design strategies and implementations need to be put in place. An architectural intervention on a general scale is necessary.
- Architecture needs improved lighting, breathing, aesthetic and atmospheric qualities which mostly nature can contribute to, in providing healing environments and spaces for humans to rest, rejuvenate and be at peace.

In conclusion, what can be claimed is that nature, water and architecture each have qualities and potentials for healing, but when combined can create great healing environments for mankind. Architecture has a duty and responsibility to look after the people that use its spaces and even to heal and constantly balance them in this stressful modern age. The need for healthier buildings and spaces in the human realm is relevant, and necessary, and a collaboration of water, nature and architecture can make this possible.

BIBLIOGRAPHY

- Aguar, C E and B., 2002, ***Wrightscapes: Frank Lloyd Wright's Landscape Designs***, McGraw-Hill, New York
- Altman, N., 2000, ***Healing Springs: The Ultimate Guide to Taking the Waters***, Healing Arts Press, Vermont
- Blaser, W., 2002, ***Nature in Building – Rudolf Steiner in Dornach,*** Birkhauser, Berlin
- Brooks, A., 1981, ***Writings on Wright: Selected Comment on Frank Lloyd Wright***, The MIT Press, Massachusetts
- Campion, M.R. 1997, ***Hydrotherapy: Principles and Practice***, Butterworth Heinemann, Oxford
- Canter, D., 1979, ***Designing for Theraputic Environments: A Review of Research***, John Wiley & Sons, Chichester
- Chaitow, L., 1987, ***Arthritis: Self Help***, Thorsons Publishing Group, Vermont
- Crowe, N., 1995, *Nature* ***and the Idea of a Man-Made World,*** The MIT Press, London.
- Cunliffe, B., 1971, ***Roman Bath Discovered***, Routledge & Kegan Paul, London
- Cunliffe, B., 1969, ***Roman Bath***, The Society of Antiquaries, London
- Davis, B., 1988, ***Hydrotherapy in Practice***, Churchill Livingstone, London
- Day, C., 2002, ***Spirit and Place*****: *Healing our Environment,*** Architectural Press, Oxford
- Day, C., 2004, *Places* ***of the Soul: Architecture and Environmental Design as a Healing Art***, Architectural Press, Oxford.
- Frampton, K., 2002, ***Labour, Work and Architecture - Towards a Critical Regionalism Six Points for an Architecture of Resistance***, Phaidon, London.
- Gesler, W., 2003, ***Healing Places***, Roweman & Littlefield Publishers Inc, Lanham
- Hildebrand, G., 1991, ***The Wright Space: Pattern and Meaning in Frank Lloyd Wright's Houses***, University of Washington Press, Seattle
- Hitchcock, H R., 1942**, *In the Nature of Materials: 1887-1941 The Buildings of Frank Lloyd Wright***, Trewin Copplestone Publishing Ltd, London
- Hoffmann, D., 1978, ***Frank Lloyd Wright's Fallingwater: The House and Its History***, Dover Publications, New York
- Holdsworth, B., 1992, ***Healthy Buildings: A Design Primer for a Living Environment***, Longman Group, London
- Lefaivre, L., 2003, ***Critical regionalism: architecture and identity in a globalized world***, Prestel, Munich.

- Mahnke, F., 1987, ***Colour and Light in Man-Mae Environments: The psychological and biological effects of colour and light, with detailed recommendations for their use,*** Van Nostrand Reinhold, New York

- Mahnke, F., 1996, ***Colour, Environment & Human Response***, Van Nostrand Reinhold, New York

- Mateo, J., 2007, ***Natural Metaphor: An Anthology of Essays on Architecture and Nature***, Actar, New York

- Moore, C. and Lidz, J., 1994, ***Water + Architecture,*** Thames and Hudson, London.

- Pearson, D., 1994, ***In Search of Natural Architecture***, Gaia Books Limited, London.

- Pearson, D., 2001, ***New Organic Architecture: The Breaking Wave***, Gaia Books Limited, London

- Portoghesi, P., 2000, ***Nature and Architecture***, Skira Editore, Milan

- Ryrie, C., 1998, ***The Healing Energies of Water***, Gaia Books Limited, London

- Smith, V., 2007***, Clean: A History of Personal Hygiene and Purity***, Oxford University Press, New York

- Storrer, W A., 1974, ***The Architecture of Frank Lloyd Wright,*** The MIT Press, New York

- Tsui, E., 1999, ***Evolutionary Architecture: Nature as a Basis for Design***, John Wiley & Sons, Canada

- Twombly, R., 1979, ***Frank Lloyd Wright: His Life and His Architecture***, John Wiley & Sons, Canada

- Venolia, C., 1988, ***Healing Environments: Your Guide to Indoor Well-Being***, Celestial Arts, Berkeley

- Waggoner, L., 1996, ***Fallingwater: Frank Lloyd Wright's Romance with Nature***, Universe Publishing, New York

- Weintraub, A. and Hess, A., 2006, ***Organic Architecture: the Other Modernism,*** Gibbs Smith, Utah.

- Wells, M., 1981, ***Gentle Architecture***, McCraw-Hill Book Company, New York

- Wright, F L., 1939, ***An Organic Architecture: The Architecture of Democracy,*** Lund Humphries & Co. Ltd, London

- Yegul, F., 1992, ***Baths and Bathing in Classical Antiquity***, The MIT Press, London

- Zevi, B., 1949, ***Towards an Organic Architecture***, Faber & Faber Limited, London

PUBLISHED THESIS

- Aller, T., 1998, ***Roman Healing Spas In Italy: A Study in Design and Function***, University of Alberta, Edmonton

- Zetterquist, AG., 2009, *Healing* ***Environments: Elements of Retreat***, Montana State University, Montana

JOURNAL REFERENCES

- Balwant, S., 2009, ***"Healing through Architecture and Music", Architecture + Design***, March, pp. 26-36

- Beautyman, M., 2008, ***"Bubble Bath", Interior Design,*** February, pp. 180-187

- Betsky, A., 1995, ***"Take Me To The Water: Dipping in the History of Water in Architecture", Architectural Design,*** Vol 65, pp.10-16

- Capezzuto, R., 2008, ***"A Domed Spa", Domus,*** Vol 919, November, pp. 25-31

- Davey, P., 1998, "***Water", Architectural Review***, Vol 1222, December, pp. 28-63

- Day, C., 1998, "***Ensouling Buildings", Architectural Design***, Vol 63, Nov-Dec, pp. 21-29

- Jones, J., 1995, ***"Water – Designing for Plenty and Purity", Architectural Design,*** Vol 65, pp. 17-21

- Marcus, C.C., 2008, ***"Healing Gardens", Landscape Architecture,*** Vol 98, April, pp. 78-89

- Matzig, K., 2008, ***"Therme Bad Aibling", Baumeister***, Vol 105, January, pp. 80-87

- Moore, C., 1995, ***"The Potential for Wonder", Architectural Design,*** Vol 65, pp. 23-29

- Mork, A., 2008, ***"Therme Bad Aibling: Behnisch Architekten", L'Arca***, Vol 242, December, pp. 75-85

- Portoghesi, P., 1996, "***Towards a New Organic Architecture", Domus***, Vol 780, March, pp. 4

- Robinson, S., 1993, "***Building as if in Eden", Architectural Design***,Vol 63, Nov-Dec, pp. 9-14

- Toy, M., 1993, "***Organic Architecture – Subtlety and Power", Architectural Design***, Vol 63, Nov-Dec, pp. 7

- Toy, M., 1995, ***"Architecture and Water Editorial", Architectural Design,*** Vol 65, pp. 7

- William, P., 1993, "***Water", Architectural Design***, Vol 63, Nov-Dec, pp. 4-6

INTERNET REFERENCES

- Web 1: Stark, A., "***Buildings That Heal: The use of energetic criteria in the design of healing environments***", www.alexstark.com, accessed 20th February 2011, 14:12
- Web 2: www.durban.gov.za
- Web 3: Root-Bernstein, R., 1997, "***The Bath***", accessed 17th March 2011, 20:11, http://www.ralphmag.org/bath.html
- Web 4: ***"Hydrotherapy",*** http://www.hydrotherapy.org.uk/ accessed 01 April 2011, 19:39

- Web 5: ***"Hydrotherapy",*** http://www.holistic-online.com/hydrotherapy_for_healing.htm, accessed 1st April 2011, 19:45
- Web 6: Hall, J., 1996, "***A Randomized and Controlled Trial of Hydrotherapy in Rheumatoid Arthritis***", accessed 5th April 2011, 19:54, http://www.cebp.nl/vault_public/filesystem/?ID=740
- Web 7: Root-Bernstein, R., 1997, "***The Bath***", accessed 17th March 2011 20:11 http://www.ralphmag.org/bath.html
- Web 8: ***"World Health Organization",*** http://www.who.int accessed 10 December 2011, 10:36
- Web 9: Cutherell, W., 2007, "***The healing power of sound***", http://www.wisdomofsound.com/te-healing-power-of-sound/html, accessed 20th April 2011, 19:34
- Web 10: "***Spa***", http://en.m.wikipedia.org/wiki/spa, accessed 15th March 2011, 15:26
- Web 11: "***Orthopedics***", http://en.m.wikipedia.org/wiki/Orthopedics, accessed 3rd May 2011, 12:42
- Web 12: ***"An uBuntu Buddhist Retreat in Ixopo",*** http://www.southafrica.info/travel/cultural/ixopo.html, accessed 6th March, 18:46
- Web 13: ***"Buddhist Retreat Centre"***, http://www.brcixopo.co.za, accessed 1st March 2011, 15: 43
- Web 14: ***"Karkloof Spa",*** http://www.karkloofsp.com, accessed 4th March2011, 09:17
- Web 15: ***"Renzo Piano Building Workshop 1998",*** http://www.galinsky.com/buildings/tjibaou/index.html, accessed 15th May 2011, 17:56

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APPENDIX I
MEDICAL DICTIONARY OF ILLNESSES

- **Juvenile chronic arthritis:** Juvenile Chronic Arthritis is defined as a group of Systemic Inflammatory Disorders affecting children below the age of 16 years.
  Three major subsets are described:-
  1). Pauciarticular onset - with 4 or less than 4 joints involved.
  2). Polyarticular onset - with more than 4 joints involved.
  3). Systemic onset - with fever, rash and arthritis.

  (http://www.arthritis.co.za/jra.htm 08 June 2011- Juvenile Chronic Arthritis : JRA / JCA by drdoc on-line)

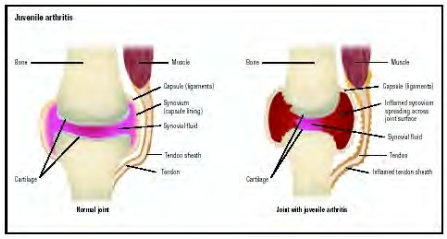


Figure : http://www.healthofchildren.com/I-K/Juvenile-Arthritis.html

- **Muscular dystrophy: Inherited myopathy, MD** Muscular dystrophy is a group of inherited disorders that involve muscle weakness and loss of muscle tissue, which get worse over time.
  (http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002172/ 08 June 2011 - Kliegman RM, Behrman RE, Jenson HB, Stanton BF. Muscular dystrophies. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, eds. *Nelson Textbook of Pediatrics*. 18th ed. Philadelphia, Pa: Saunders Elsevier; 2007:chap 608)

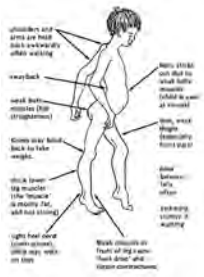


Figure :http://findmeacure.com/2008/07/10/muscular-dystrophy/

- **Congenital abnormalities:** Diseases existing at birth and often before birth, or that develop during the first month of life (INFANT, NEWBORN, DISEASES), regardless of causation. Of these diseases, those characterized by structural deformities are termed CONGENITAL ABNORMALITIES.
  (http://www.nlm.nih.gov/cgi/mesh/2011/MB_cgi?mode=&term=Congenital+Disorders 08 June 2011)

Figure :https://login.medscape.com/login/sso/getlogin?urlCache=aHR0cDovL3d3dy5tZWRzY2FwZS5jb20vdmlld2FydGljbGUvNTc5MTU2XzM=&ac=401

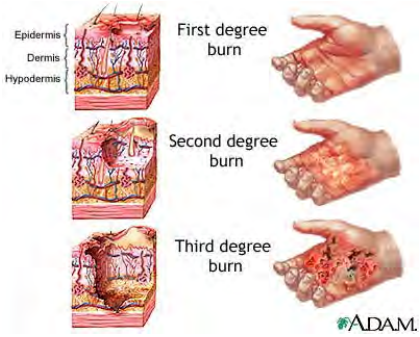
- **Spina bifida:** Myelomeningocele is a birth defect in which the backbone and spinal canal do not close before birth. The condition is a type of spina bifida.
  (http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002525/ 08 June 2011 Kinsman SL, Johnston MV. Congenital anomalies of the central nervous system. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, eds. Nelson Textbook of Pediatrics. 18th ed. Philadelphia, Pa: Saunders Elsevier; 2007:chap 592.)

Figure :http://www.nlm.nih.gov/medlineplus/ency/imagepages/19087.htm

- **Osteogenesis imperfect:** is condition causing extremely fragile bones. Osteogenesis imperfecta (OI) is a congenital disease, meaning it is present at birth. It is frequently caused by defect in the gene that produces type 1 collagen, an important building block of bone. There are many different defects that can affect this gene. The severity of OI depends on the specific gene defect.

Figure :http://www.endotext.org/parathyroid/parathyroid17/parathyroid17.

(http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002540/ 08 June 2011 Marini JC. Osteogenesis imperfecta. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, eds. *Nelson Textbook of Pediatrics.* 18th ed. Philadelphia, Pa: Saunders Elsevier; 2007:chap 699.)



- **Burns:** A burn is damage to your body's tissues caused by heat, chemicals, electricity, sunlight or radiation. Scalds from hot liquids and steam, building fires and flammable liquids and gases are the most common causes of burns. There are three types of burns:
  First-degree burns damage only the outer layer of skin
  Second-degree burns damage the outer layer and the layer underneath
  Third-degree burns damage or destroy the deepest layer of skin and tissues underneath

Figure :http://www.nlm.nih.gov/medlineplus/burns.html

- **Cerebral palsy:** Cerebral palsy is condition, sometimes thought of as a group of disorders that can involve brain and nervous system functions such as movement, learning, hearing, seeing, and thinking. There are several different types of cerebral palsy, including spastic, dyskinetic, ataxic, hypotonic, and mixed. (Johnston MV. Encephalopathies. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, eds. *Nelson Textbook of Pediatrics*. 18th ed. Philadelphia, Pa: Saunders Elsevier; 2007: chap 598.)

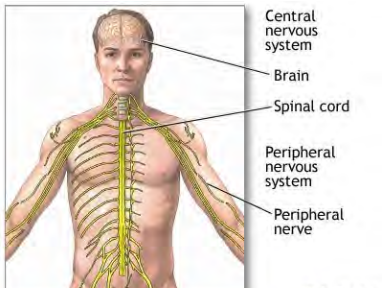


Figure: http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001734/figure/A000716.B8679/?report=objectonly

- **Head injury:** A head injury is any trauma that leads to injury of the scalp, skull, or brain. The injuries can range from a minor bump on the skull to serious brain injury.Head injury is classified as either closed or open (penetrating). A closed head injury means you received a hard blow to the head from striking an object, but the object did not break the skull.
  An open, or penetrating, head injury means you were hit with an object that broke the skull and entered the brain. This usually happens when you move at high speed, such as going through the windshield during a car accident. It can also happen from a gunshot to the head.
  Head injuries include:Concussion, the most common type of traumatic brain injury, in which the brain is shaken
  Contusion, which is a bruise on the brain
  Scalp wounds and Skull fractures

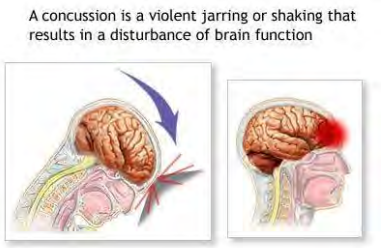


Figure :http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001095/

(Heegaard WG, Biros MH. Head. In: Marx J. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. 7th ed. St. Louis, Mo: Mosby; 2009:chap. 38.)

- **Epilepsy:** Epilepsy is a brain disorder involving repeated, spontaneous seizures of any type. Seizures ("fits," convulsions) are episodes of disturbed brain function that cause changes in attention or behavior. They are caused by abnormally excited electrical signals in the brain. (http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001714/ 08 June 2011 Duvivier EH, Pollack Jr CV. Seizures. In: Marx, JA, ed. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. 7th ed. Philadelphia, Pa: Mosby Elsevier; 2009: chap 100.)

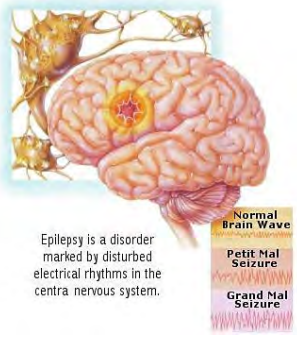


Figure :http://alldisease.blogspot.com/2009/05/epilepsy.html

Infections of the central nervous system

- **The Blind Child:** Loss of vision; No light perception (NLP); Low vision; Vision loss and blindness
  Blindness is a lack of vision. It may also refer to a loss of vision that cannot be corrected with glasses or contact lenses.
  Partial blindness means you have very limited vision.
  Complete blindness means you cannot see anything and do not see light. (Most people who use the term "blindness" mean complete blindness.)
  People with vision worse than 20/200 are considered legally blind in most states in the United States.
  Vision loss refers to the partial or complete loss of vision. This vision loss may happen suddenly or over a period of time.
  Some types of vision loss never lead to complete blindness.
  (Kraut JA. Vision rehabilitation. In: Tasman W, Jaeger Ea, eds. *Duane's Ophthalmology*. 15th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2009:chap 46.)

Figure: http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0003531/

- **The Deaf Child:** partially or wholly lacking or deprived of the sense of hearing; unable to hear.
  (http://dictionary.reference.com/browse/deaf 08 June 2011)

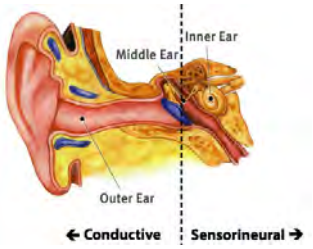


Figure: http://www.clivir.com/lessons/show/sensorineural-hearing-loss-causes-symptoms-and-treatments.html

- **Asthma:** Asthma is an inflammatory disorder of the airways, which causes attacks of wheezing, shortness of breath, chest tightness, and coughing. Asthma is caused by inflammation in the airways. When an asthma attack occurs, the muscles surrounding the airways become tight and the lining of the air passages swells. This reduces the amount of air that can pass by. In sensitive people, asthma symptoms can be triggered by breathing in allergy-causing substances (called allergens or triggers).

Figure :http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001196/figure/A000141.B19321/?report=objectonly

Learning Difficulties and Behaviour Disorders

- **Neurological rehabilitation:** Neurological rehabilitation programs can be conducted while a person is a hospital inpatient, or on an outpatient basis. The neurological rehabilitation team revolves around the patient and family. The team helps set short- and long-term treatment goals for recovery and is made up of many skilled professionals, including the following:
  - neurologist/neurosurgeon
  - orthopaedist/orthopaedic surgeon
  - physiatrist
  - internist
  - rehabilitation nurse
  - dietitian
  - physical therapist
  - occupational therapist
  - speech therapist/language therapist
  - psychologist/psychiatrist
  - recreational therapist
  - audiologist

Figure: http://www.bristolphysiotherapyclinic.co.uk/section.php/7/1/neurological_rehabilitation

- vocational therapist (http://medicalcenter.osu.edu/patientcare/healthcare_services/nervous_system/about/rehab/pages/index.aspx 08 June 2011)

- **Spinal mobilizations***:* Spinal mobilization is a type of passive movement of a spinal segment or region. It is usually performed with the aim of achieving a therapeutic effect.
  Spinal mobilization has been described as "a gentle, often oscillatory, passive movement applied to a spinal region or segment so as gently to increase the passive range of motion of that segment or region (Mierau D, Cassidy JD, Bowen V, Dupuis P, Noftall F. (1988). "Manipulation and mobilization of the third metacarpophalangeal joint.". *Manual Medicine* **3**: 135–40)

Figure: http://www.prybyloess.com/treatmentRoom.html

- **Inflammatory Arthritis:** refers to any painful inflammation of the joints. However, the term is used more generally for almost all joint problems. Inflammatory arthritis, on the other hand, refers to those conditions of the joints that involve the immune system and inflammation. For example, in osteoarthritis, the inflammation arises because the articular cartilage on the ends of ones has worn away. In rheumatoid arthritis, the joint lining becomes inflamed as part of a systemic disease. Inflammatory arthritis stiffness and pain usually appear first thing in the morning and after sitting still for a while. This distinguishes it from degenerative arthritis, in which the pain worsens at the end of the day and with activity. (http://www.caringmedical.com/conditions/Inflammatory_Arthritis.htm 08 June 2011)

Figure :http://www.nlm.nih.gov/medlineplus/ency/imagepages/8905.html

- **Rheumatoid Arthritis:** Rheumatoid arthritis (RA) is a long-term disease that leads to inflammation of the joints and surrounding tissues. It can also affect other organs. It is considered an autoimmune disease. The body's immune system normally fights off foreign substances, like viruses. But in an autoimmune disease, the immune system confuses healthy tissue for foreign substances. As a result, the body attacks itself. RA can occur at any age. Women are affected more often than men. RA usually affects joints on both sides of the body equally. Wrists, fingers, knees, feet, and ankles are the most commonly affected. The course and the severity of the illness can vary considerably. Infection, genes, and hormones may contribute to the disease. (http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001467/ 08 June 2011 Yazici Y. Treatment of rheumatoid arthritis: we are getting there. *Lancet*. 2009;374:178-180. [PubMed])

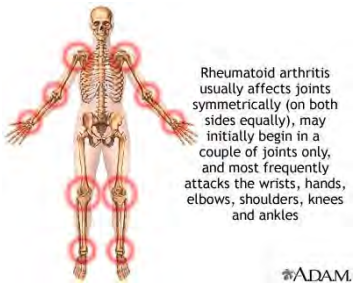


Figure: http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001467/figure/A000431.B17128/?report=objectonly

- **Degenerative Arthritis:** Degenerative arthritis is also called osteoarthritis or "wear and tear" arthritis. It is a form of arthritis that causes the gradual breakdown of the cartilage that cushions the joints. Movement then causes the bones to rub against each other, which is painful. Degenerative arthritis is characterized by inflammation, breakdown and eventual loss of the cartilage of the joints.
  It commonly affects the hands, feet, spine, and large weight-bearing joints, such as the hips and knees. It occurs when the joints receive too much wear. This can be caused by obesity, bad posture, repeated trauma or injury, and overuse. In some cases, degenerative arthritis may be hereditary. (http://www.arthritispharmacy.com/arthritis/arthritis-pain/DEGENERATIVE_ARTHRITIS.html 08 June 2011)

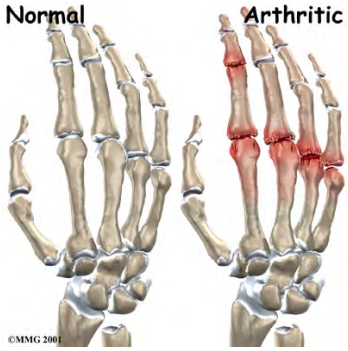


Figure: http://skillbuilders.patientsites.com/Injuries-Conditions/Hand/Hand-Issues/Arthritis-of-the-Finger-Joints/a~281/article_print.html

- **Spondyloarthropathies:** are a group of disorders that share certain characteristics :
  1. Arthritis - including peripheral arthritis and spinal involvement, usually involving also the sacroiliac joints.
  2. They are Seronegative for Rheumatoid factor.
  3. They may be involved with other medical problems - including...

  Psoriasis. Inflammatory bowel disease- ulcerative colitis or crohns disease. Post infective or reactive -to urogenital or gastrointestinal infections. Overlaps of these disorders may be seen. (http://www.arthritis.co.za/ankspond.html 08 June 2011 Dr David Gotlieb dr doc on-line Rheumatologist Cape Town South Africa)

Figure :http://arthritis.about.com/b/2010/03/04/types-of-arthritis-spondyloarthropathies.html

- **Orthopaedics:** Orthopedics, or orthopedic services, is the medical specialty that involves the treatment of the musculoskeletal system, which is made up of your body's bones, joints, ligaments, tendons, and muscles. (http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0004695/ 08 June 2011 Krabak BJ, Banks NL. Adhesive capsulitis. In: Frontera WR, Silver JK, eds. *Essentials of Physical Medicine and Rehabilitation*. 2nd ed. Philadelphia, Pa: Saunders Elsevier; 2008:chap 10)

- **Sports Injuries:** Sports injuries result from acute trauma or repetitive stress associated with athletic activities. Sports injuries can affect bones or soft tissue (ligaments, muscles, tendons). (http://medical-dictionary.thefreedictionary.com/Sports+Injuries 08 June 2011 - Beers, Mark H., MD, and Robert Berkow, MD., editors. "Common Sports Injuries." Section 5, Chapter 62 In *The Merck Manual of Diagnosis and Therapy*. Whitehouse Station, NJ: Merck Research Laboratories, 2004.)

Figure :http://www.healthofchildren.com/S/Sports-Injuries.html

- **Aquanatal Exercise:** Combines water fitness and childbirth preparation with:
  Breathing
  Dance
  Visualization
  Aerobics
  Relaxation
  and Yoga

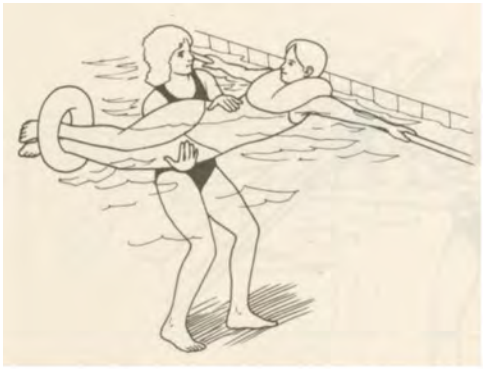
  To provide a holistic fitness and educational program in water that facilitates women's health during pregnancy, birthing and mothering. (http://www.aquanatal.com/main.php?id=1 08 June 2011

Figure :http://www.aquanatal.com/main.php?id=1

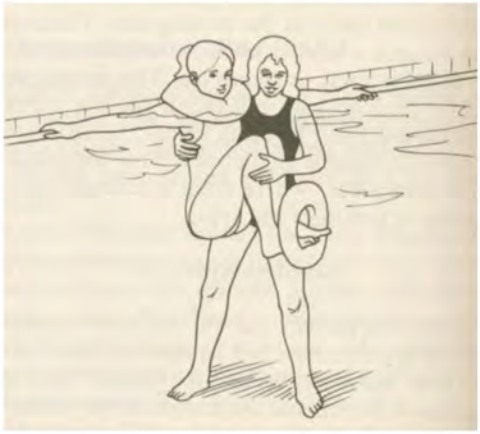
APPENDIX II

Extract from Margaret Campion – **HYDROTHERAPY: PRINCIPLES AND PRACTICE**

EXERCISES AND FORMS



Lumber spine rotation



Lumber spine flexion

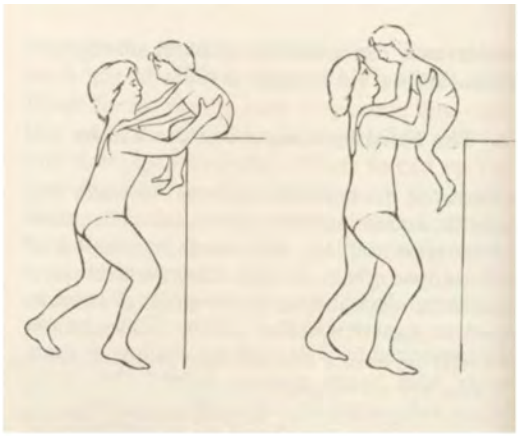
Lumber spine extension

Spinal flexion/extension

Neuromeningeal

Spinal lateral flexion

Spinal flexion/extension

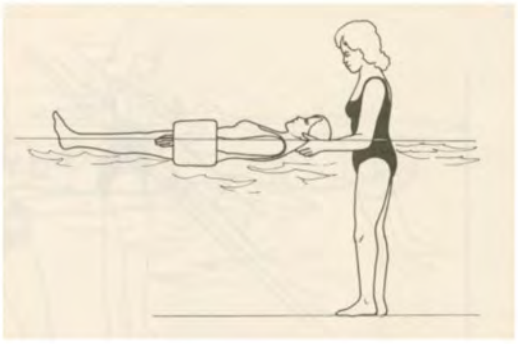


Sitting entry

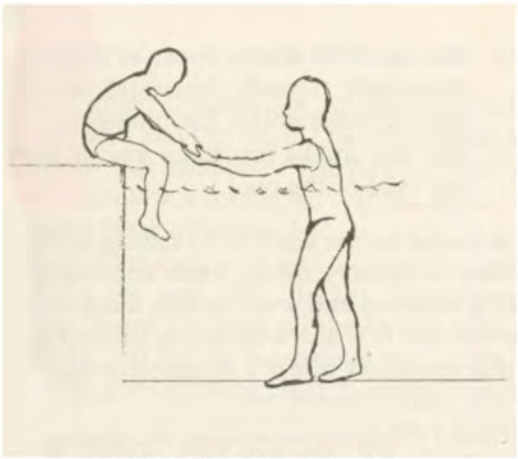
Entry - combined rotation

Thoracic spine: thoracic shunt

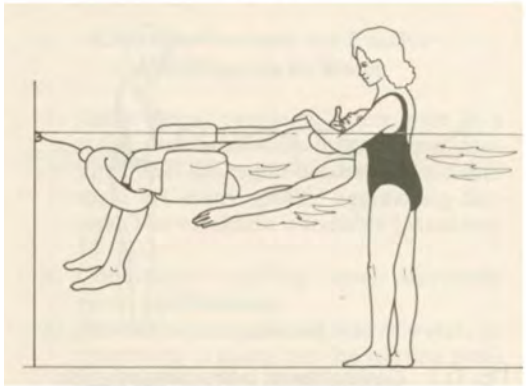
Posteroanterior glide (PA): lower thoracic (T6-T12)



Cervical spine: posteroanterior glide (PA)



Entry - hands on hands



Cervical spine rotation

APPENDIX III

Extract from Frank Mahnke – **COLUR AND LIGHT IN MAN-MADE ENVIORNMENTS**

CHARACTERISTICS OF COLOUR HUE EFFECTS

Red

- *Hue Effect*: exciting (bright red); stimulating (red)
- *Impressions or associations*: positive – passionate, fervid, active, strong, warm; negative – aggressive, raging, intense, fierce, bloody
- *Character*: Red is perhaps the most dominant and dynamic of all colours. It grabs the attention and overrules all other hues. The lens of the eye has to adjust to focus the red light wavelengths; their natural focal point lies behind the retina. Thus, red advances, creating the illusion that red objects are closer than they are
- Symbolically, red means fire, life, and strength, bit its aggressive masculine nature is also linked with combat, domination, war, and rebellion. The dynamic nature changes dramatically where the colour turns pink. It changes its gender to feminine and appears gentle and acquiescent.

Orange

- *Hue Effect:* exciting (bright orange); stimulating (orange); cheering (light orange)
- *Impressions or associations:* positive – jovial, lively, energetic, extroverted, sociable; negative – intrusive, blustering (if colour is highly saturated)
- *Character:* Orange is mellower and less primitive than red. It has virtually no negative cultural or emotional associations. Aesthetically, though, desaturated hues may appear cheap and without vigour.

Yellow

- *Hue Effect:* cheering
- *Impression or Associations:* positive – sunny, cheerful, radiant, vital, high-spirited; negative – egocentric, glaring
- *Character:* in pure form, yellow is the happiest of all colours. It radiates warmth, cheerfulness, and inspiration. Yellow is a comparatively light colour; as it loses its lightness, when modified, it ceases to be yellow.
- Symbolically, yellow signifies enlightenment (mental and spiritual), expansion, sunlight, and communication.

Green

- *Hue Effect:* retiring (light green); relaxing (green)
- *Impressions or Associations:* positive – tranquil, refreshing, quiet, natural; negative – common, tiresome, guilty
- *Character:* Psychologically, green represents a withdrawal from stimulus. Since the lens of the eye focuses green light exactly on the retina, it is also the most restful colour to the eye.
- *Colour has a character, as do humans, that often has two or more sides.* In the case of green, these are full contradictions. In its symbolic value or image, this hue represents the power of nature, of life. Yet it is also the colour of mold, decay, and sickness in humans.

Blue

- *Hue Effect:* retiring (light blue); relaxing (blue)
- *Impressions or Associations:* positive – calm, serene, comfortable, sober, contemplative; negative – frightening, depressing, melancholy, cold
- *Character:* in all aspects, blue is the antithesis of red. In its appearance, blue is transparent and wet; red is opaque and dry. Psychologically, the cool and relaxing nature of blue is in

direct opposition to the warmth and excitement of red. While red seems vulgar at times, blue exhibits a noble character. In its action upon the human organism, blue will decrease blood pressure and pulse rate while red will have the opposite effect (followed by a reversal in both cases after a period of time).

Purple

- *Hue Effect:* subduing
- *Impressions or associations:* positive – dignified, exclusive; negative – lonely, mournful, pompous, conceited
- *Character:* purple is a blend of red and blue, the two colours that are physically and psychologically most opposed. In its various tones, purple may evoke delicacy and richness or appear unsettling and degenerate. Violet is a lighter shade of purple and a pure spectral hue. Purple is a mixed colour. The two encompass vast differentiation in hue.

COLOUR EFFECTS IN THE INTERIOR SPACE

The location (top, sides, and bottom) of a colour stimulus within the interior space can make a great deal of difference in influencing a room's character, the way it is perceived psychologically, and the subsequent reactions to it. A particular hue that is perfectly suitable on the floor may elicit an entirely different reaction when applied to the ceiling.

Red

- *Ceiling:* intruding, disturbing, heavy
- *Walls:* aggressive, advancing
- *Floor:* conscious, alert
- In practical situations, pure red is seldom used, except as an accent. Although physiological arousal may be temporary, red psychologically exhibits the characteristics shown above. The overuse of saturated red adds to the complexity within a space. Modifications of pure red are much more suitable.

Pink

- *Ceiling:* delicate, comforting, or too intimate, depending on individual inclination
- *Walls:* aggression-inhibiting, weak, too sweet if not grayed
- *Floor:* perhaps too delicate, unfamiliar in this location

Brown

- *Ceiling:* oppressive and heavy (if dark)
- *Walls:* secure and assuring if wood, much less so if paint
- *Floor:* steady and stable
- The designer must be careful in using brown in certain institutions, as it may evoke fecal associations.

Orange

- *Ceiling:* stimulating, attention-seeking
- *Walls:* warm, luminous
- *Floors:* activating, motion-oriented
- This hue is more mellow than red and has more liveable charm. Reflection of the skin may enhance some skin tones.

Yellow

- *Ceiling:* light (if toward lemon), luminous, stimulating
- *Walls:* warm (if toward orange), exciting to irritating (if highly saturated)

- *Floor:* elevating, diverting
- Because of its high visibility, yellow serves many safety purposes, especially in industrial environments. It also appears brighter than white and is useful in poorly illuminated and dim spaces.

Green

- *Ceiling:* protective (reflection on skin can be unattractive)
- *Walls:* cool, secure, reliable, passive, irritating of glaring (electric green)
- *Floor:* natural (up to a certain saturation point), soft, relaxing, cold (if toward blue-green)
- Green, along with blue-green, provides a good environment for mediation and tasks involving light concentration.

Blue

- *Ceiling:* celestial, cool, less tangibly advancing (if light), heavy and oppressive (if dark)
- *Walls:* cool and distant (if light), encouraging and space-deepening (of dark)
- *Floor:* inspiring feeling of effortless movement (if light), substantial (of dark)
- Blue tends to be cold and bleak if applied to large areas, especially in hallways and long corridors. Medium or deep tones are appropriate in incidental areas. Pale blue is refracted sharply by the lens of the eye and therefore tends to cast a haze over details and objects in the environment. This may cause distress to some people confined to a particular area for a long period.

Purple

- Seldom use din the interior space except for incidental areas. In large spaces it may disturb the focus of the eye. Psychologically, it may appear disconcerting and subduing.

Grey

- *Ceiling:* shadowy
- *Walls:* neutral to boring
- *Floor:* neutral
- As is the case with all neutral hues, grey fails to have much psychotherapeutic application. A recent design trend is to use it in conjunction with pink, purple, or purple-red tomes in accent walls and furnishings. The practice has permeated all types of environments, from restaurants to health facilities. This defies all logic and is in direct opposition to many of the principles presented in this breakdown.

White

- *Ceiling:* empty (no design objections – helps to diffuse light sources and reduce shadows)
- *Walls:* neutral, empty, sterile, without energy
- *Floor:* touch-inhibiting (not to be walked upon)
- There are psychological and physiological justifications for not using white of off-white as a dominant colour in the majority of environments.

Black

- *Ceiling:* hollow to oppressive
- *Walls:* ominous, dungeon-like
- *Floor:* odd, abstract

APPENDIX IV
PHYSIOTHERAPISTS INFORMATION LETTER

20th March 2011

RE: Research for Masters of Architecture Dissertation

To Whom It May Concern,

My name is Marshnee Moodliar and I am currently a student of UKZN (Howard College). I am in my final year of Masters in Architecture (MArch) and for my thesis I am proposing to design a Hydrotherapy Health Centre. The actual topic of the research part is:

"The Incorporation of Nature into Architecture as a Healing Aid:
A Hydrotherapy Health Centre"

The main aim of my building is to incorporate nature and the natural elements to create internal and external healing environments that will provide treatment and rehabilitation. The main system or exploration is the integration of water into these buildings as a healing element.

I have done some basic research on Hydrotherapy, its principles, practices, and treatments. I understand that water exercises and immersion have a therapeutic ability to treat and rehabilitate people suffering for Rheumatism, muscular dystrophy, spina bifida, sports injuries and spinal mobilisations, etc., and how this practice significantly reduces the common symptoms of pain.

I would like a better understanding of the advantages of water therapy methods and how they are used nationally, and to determine whether there is a need for these types of facilities in our region. I understand that you must have a busy schedule so have compiled a quick, condensed questionnaire which is attached for you to look at. I would greatly appreciate any response, advice or feedback from you.

I would also, if possible, like to meet with you at a later stage in the design process for any advice in the building space functions as I am unfamiliar with these types of medical environments. Unfortunately I am on a tight deadline so a speedy response/ reply would be much appreciated.

I await your reply in anticipation.
Thank you for your time and patience!

Yours Sincerely,

Marshnee Moodliar
Department of Architecture, Planning and Housing
Student No. 204502946
Cell: 078 332 4402 Home: 031 2088269
Email: marshnee@gmail.com

APPENDIX V
PHYSIOTHERAPISTS QUESTIONNAIRE

UNIVERSITY OF KWAZULU-NATAL: School of Architecture, Planning & Housing

Questionnaire/ Interview complied and carried out by **Marshnee Moodliar** Student Number: 204502946

Name: _____ **Date:**_____

Contact Number: _____

Qualifications: _____

Work Address: _____

1. In a few words, what is Hydrotherapy and what is its relation to Physiotherapy?

   _____

2. What is your understanding of water therapy?

   _____

3. What are the different conditions and diseases that can be treated with water exercise or immersion in physiotherapy?

   _____

4. Do you think hydrotherapy / or water therapies are a useful medical treatment and why?

   _____

5. Is there a significant difference in the treatment of children to adults in water therapy?

   _____

6. Is there a strong history of hydrotherapy in South Africa?

   _____

7. Do you know of any hydrotherapy facilities in KZN or in South Africa? If yes can you give an example/s.

   _____

8. Do you think there is a need for a health centre of this function in KZN?

   _____

9. What are the average statistics for patients seeking hydrotherapy treatment in KZN?

   _____

10. Are you familiar with Building Sickness Syndrome and the theory that buildings could cause unhealthy environments?

    _____

* Dear Participant, your participation should be on a voluntary basis and should you wish you can reserve the right to withdraw your participation if you feel the need. ***Thank you for your patience, time and cooperation!***

APPENDIX IV
RHEUMATOLIGISTS INFORMATION LETTER

20th March 2011

RE: Research for Masters of Architecture Dissertation

To Whom It May Concern,

My name is Marshnee Moodliar and I am currently a student of UKZN (Howard College). I am in my final year of Masters in Architecture (MArch) and for my thesis I am proposing to design a Hydrotherapy Health Centre. The actual topic of the research part is:

"The Incorporation of Nature into Architecture as a Healing Aid:
A Hydrotherapy Health Centre"

The main aim of my building is to incorporate nature and the natural elements to create internal and external healing environments that will provide treatment and rehabilitation. The main system or exploration is the integration of water into these buildings as a healing element.

I have done some basic research on Hydrotherapy, its water principles and practices and Rheumatism's, causes, symptoms, types, and treatments. I want to focus on the relation hydrotherapy plays in the rehabilitation of people suffering from Rheumatism. I have also looked within a historical context of how in the ancient Roman period the use of water spas or bathing apparently aided in the relief of pain and as a treatment of Rheumatism at that time.

I would like a better understanding of the advantages of water therapy methods, its effects with Rheumatism, how they are used nationally, and to determine whether there is a need for these types of facilities in our region. I understand that you must have a busy schedule so have compiled a quick, condensed questionnaire which is attached for you to look at. I would greatly appreciate any response, advice or feedback from you.

I would also, if possible, like to meet with you at a later stage in the design process for any advice in the building space functions as I am unfamiliar with these types of medical environments. Unfortunately I am on a tight deadline so a speedy response/ reply would be much appreciated.

I await your reply in anticipation.
Thank you for your time and patience!

Yours Sincerely,

Marshnee Moodliar
Department of Architecture, Planning and Housing
Student No. 204502946
Cell: 078 332 4402 Home: 031 2088269
Email: marshnee@gmail.com

APPENDIX VII
RHEUMATOLOGISTS QUESTIONNAIRE

UNIVERSITY OF KWAZULU-NATAL: School of Architecture, Planning & Housing

Questionnaire/ Interview complied and carried out by **Marshnee Moodliar** Student Number: 204502946

Name: _____**Date:**_____

Contact Number: _____

Qualifications: _____

Work Address: _____

1. In a few words, what is Rheumatism?

   _____

2. What are the different treatments for Rheumatism and Arthritis?

   _____

3. What is significant of using water as a treatment for Rheumatism?

   _____

4. To what levels and time frames do patients with Rheumatism and Arthritis suffer from?

   _____

5. Ideally what kind of environments is best suited for these patients to live and work in?

   _____

6. Do you know of or have tried any other natural forms of healing for Rheumatism?

   _____

7. What type of machinery and equipment in terms of functions and sizes is needed for diagnosis and treatment?

   _____

8. Can you describe what the most painful or uncomfortable everyday physical activities people with Rheumatism would suffer from?

   _____

9. Do you know of any facilities that provide diagnosis, treatment and rehabilitation for Rheumatism in KwaZulu Natal/ South Africa?

   _____

10. Are you familiar with Building Sickness Syndrome and the theory that buildings could cause unhealthy environments?

    _____

11. What is the average statistics of Rheumatism suffers in SA who do and don't get diagnosed and treated?

    _____

12. Do you think there is a need for a Hydrotherapy Centers in KZN in which to provide a place for rehabilitation for people suffering from Rheumatism and Arthritis and other bone and muscle disorders?

    _____

* Dear Participant, your participation should be on a voluntary basis and should you wish you can reserve the right to withdraw your participation if you feel the need. ***Thank you for your patience, time and cooperation!***

THE INCORPORATION OF NATURE INTO ARCHITECTURE AS A HEALING AID:

A Hydrotherapy Health Centre

DESIGN REPORT

By

Marshnee Moodliar

A Dissertation submitted to the Faculty of Humanities, Development and Social Sciences, University of KwaZulu-Natal, in partial-fulfillment of the requirements for the degree of Master in Architecture

December 2011

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Covered in the previous part of the dissertation was the relevance of water to healing and when incorporated into architecture, creating healing architecture. The research concluded that the linking and combination of these elements of water, nature and architecture would finally derive healing environments for the public in a positive step forward. But now that this has been established, how will this be carried forward into an actual building in which to prove these statements? A research method as to what type of building and function should be developed leads to the design and creation of a Hydrotherapy Health Centre which deals with water in architecture. Then the incorporation of this building into nature also must be developed.

1.2 PROJECT DESCRIPTION

This project is a hydrotherapy health centre, a centre for the treatment and rehabilitation of physical medical conditions and chronic diseases. The growing demand for a facility like this is evident in the increasing number for people suffering from conditions like rheumatism which use water therapy for the relief and control of the illnesses symptoms. There are many other conditions that can be treated by water therapy or hydrotherapy and a specialised facility with the consultation component is a direct step forward within the health realm of KwaZulu Natal.

1.3 THE NOTIONAL CLIENT

1.3.1 The Client's Requirements

The proposed client is the Department of Health of South Africa. Their mission is to consolidate and build on the achievements of the past five years in improving access to health care for all and reducing inequity, and to 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, and to improve the overall efficiency of the health care delivery system.

1.3.2 The Client's Organisation

The specific Division of the Department of Health that would directly benefit from this project is the Directorate Chronic Diseases, Disabilities and Geriatrics. The Directorate is focussed on matters pertaining to chronic diseases, prevention of blindness, cancers, disabilities and rehabilitation as well as geriatrics. While individual units are responsible for the realisation of their specific objectives, desired integration and collaboration at all levels and between all sectors are strongly advocated. It is envisaged that all support offered by the Directorate to Provinces will be aligned to the Department's Vision and more especially be cogniscent of the human rights of all persons. The mission of the division is to provide an accessible, caring and high quality

service to persons who have chronic diseases, cancers, eye conditions and disabilities; those who are at risk as well as older persons (web 1).

1.3.3 Detailed Client Brief

The clients brief entails providing a facility or centre that enables people of all ages, races and gender a place for rehabilitation through water therapy. Hydrotherapy plays an important role in the treatment and rehabilitation of many chronic diseases and temporary illness and conditions for the physical body. The centre should utilise hydrotherapy in the treatment of as many medical conditions as possible while providing a site and building to adequately heal, rejuvenate and treat patients. The main medical condition to benefit from hydrotherapy practice is Rheumatism and Arthritis as well as sports and spinal injuries. These will be emphasised in the facility with not only design specific water therapy but relevant doctors' consultant and examination rooms as well.

1.3.4 Schedule of Accommodation

SCHEDULE OF ACCOMMODATION - Hydrotherapy Health Centre					
buildings	**rooms**	**quantity**	**size m2**	**total area m2**	**space description**
PUBLIC HYDRO	Foyer	1	94	94	visitors to the facility enter here and report to the reception desk
	Reception	1	104	104	reception deck
	Manager's Office	1	24	24	manager of the centre oversees entire operation
	Filing Room	1	20	20	documents and records storage
	Restaurant Eating Area	1	260	260	visitors restaurant
	Kitchen	1	150	150	kitchen for restaurant
	Dry Store	1	16	16	dry goods storage room
	Cold Store	1	16	16	frozen foods storage room
	Wash Area	1	9	9	washing area
	Bin Area	1	20	20	garbage disposal storage and collection room
	Whirlpool Bath Area	1	840	840	whirlpool baths
	Knipp Bath Area	1	600	600	kneipp baths - hot, warm and cool
	Turkish Bath Area	1	510	510	Turkish baths
	Children's Pool Area	1	392	392	Child Range Pools
	Swimming Pool Area	1	475	475	Lap Pools
	Sauna Rooms	15	6	90	Sauna steam rooms
	Pool Plant and Mechanical Room	1	35	35	maintainence storage equipment and plant room
	Rest and Locker Area	1	194	194	Resting Lounge and Locker Storage
	Male Changerooms and Showers	1	178	178	rooms for visitors to change in
	Male Ablutions	1	61	61	male ablutions with 10 wc
	Female Changerooms and Showers	1	178	178	rooms for visitors to change in
	Female Ablutions	1	61	61	female ablutions with 10 wc
				4327	
PRIVATE HYDRO	Physiotherapist Offices	9	30	270	healthcare professionals who diagnose and treat individuals of all ages with conditions that limit their abilities to move and perform functional activities
	Scanning Room	1	60	60	x-ray room for rheumatologist and occupational therapists with certain machinery
	Storage Room	1	28	28	Storage room
	Dietican	1	30	30	consultant dietician provides nutrition services and educational programs to patients
	Psychologist	1	30	30	consultant to provide stablitity and councilling to patients and families suffering with severe illness and disease

	Staff Lounge and Kitchenette	1	36	36	staff rest area
	Staff Male Ablution	1	6	6	1wc
	Staff Female Ablution	1	6	6	1wc
	Pharmacy	1	63	63	medication dispensary for patients
	Pharmacy Storage	1	30	30	storage room
	Public Restaurant/ Café	1	93	93	Restaurant eating area
	Restaurant Kitchen	1	55	55	kitchen for restaurant
	Visitors Male Ablution	1	15	15	2wc
	Visitors Female Ablution	1	15	15	3wc
	Lobby	1	241	241	visitors wait to be shown to doctors rooms or stay over facility
	Reception	1	53	53	reception desk
	Managers Office	1	30	30	manager of the centre oversees entire operation
	Filing Room	1	21	21	documents and records storage
	Hydrotherapy Information Gallery and Lounge	1	400	400	Information and educational material on water therapy and the centre
	Viewing Deck	1	100	100	viewing deck to dam
	Pool Areas		2931	2931	Pool areas consist of :
		3			Walking Education Pools
		2			Group Therapy Pools
		1			Lower Body Pool
		2			Obstacle Course Pools
		2			Upper Body Pools
		4			whirlpool baths
		1			Child Range Pool
	Male Changerooms and Showers	1	241	241	rooms for visitors to change in
	Male Ablutions	1	82	82	male ablutions with 11 wc
	Female Changerooms and Showers	1	241	241	rooms for visitors to change in
	Female Ablutions	1	82	82	female ablutions with 11 wc
	Pool Plant and Mechanical Room	1	102	102	maintainence storage equipment and plant room
	Massage Rooms	16	15	240	individual massage rooms for after water therapy treatment
	Masseurs Office	2	5	10	head masseur office with library of books on technique
	Massage Store Room	2	2	10	store of towels and water chemicals and minerals and cleaning equipment
	Group Exercise Fitness Area	1	261	261	group physical therapy with therapist in a class
	Machinery Gym Area	1	263	263	exercise area with treadmills, streching mats, walking beams, etc.
	Fitness Managers Office	1	29	29	Manager of Fitness Area and Records
	Gym Equipment Storage	1	91	91	store rooms for cleaning equipment, mats and exercise accessories

	Individual Gym Rooms	4	65	260	private therpay exercise rooms for occupational therapist to engage with specific patients
				6425	
PATIENT ACCOMMODATION	Adult Single Bedrooms	8	29	232	Including Bathroom
	Adult Double Bedrooms	4	67	268	Including Bathroom
	Elderly Single Bedrooms	12	27	324	Including Bathroom
	Elderly Double Bedrooms	6	67	402	Including Bathroom
	Children Single Bedrooms	12	27	324	Including Bathroom
	Children Group Bedroom	1	129	129	Including Bathroom
	Communal Lounge Area	1	700	700	relaxation area with deck for stay over guests or patients
	Communal Dining Area	1	500	500	patients dining room with serving area
	Kitchen	1	130	130	kitchen to prepare food for patients, health café, and staff members
	Dry Store	1	15	15	dry goods stroage room
	Cold Store	1	15	15	frozen foods storage room
	Wash Area	1	6.5	6.5	washing area
	Bin Area	1	31	31	garbage disposal storage and collection room
	Linen Storage	1	32	32	linen for bedrooms, towels for bathrooms, storage and laundry
	Childrens Play Area	1	260	260	area for children to play with toys and television
	Male Ablutions	1	53	53	male ablutions with 6 wc
	Female Ablutions	1	53	53	female ablutions with 8 wc
				3474.5	
STAFF ACCOMMODATION	Maintainence Staff Apartments	12	18	216	for staff cleaners, chef, pool maintainence person and gardeners
	Medical Staff Apartments	12	18	216	for physiotherapists and visiting doctors
				432	
		TOTAL AREA		**14658.5**	

1.4 JUSTIFICATION OF THE PROJECT

Hydrotherapy is an important portion of the treatment program of physiotherapy, alongside medication and fitness exercise. In order to understand the existing level of infrastructure and its role in health care by hydrotherapy an audit of the hydrotherapy facilities in KZN had to be carried out. A look at most of the hospitals in Durban and Pietermaritzburg was undertaken to find out how many hydrotherapy facilities were around. The list goes as follows:

Hospital	*Hospital Type*	*Area Located*	*Hydrotherapy Facility*
Addington	Provincial	Durban	**Yes**
Chatsmed Gardens	Private	Durban	No
Edendale	Provincial	Pietermaritzburg	**Yes**
Entabeni Life	Private	Durban	**Yes**
Greys	Provincial	Pietermaritzburg	**Yes**
Howick Private	Private	Howick	No
Inkosi Albert Luthuli Central	Provincial	Durban	No
King Edward VIII	Provincial	Durban	No
King George V	Provincial	Durban	No
Kingsway	Private	Durban	No
Mahathma Ghandi	Provincial	Durban	No
McCords	Provincial	Durban	No
Mount Edgecombe	Private	Durban	No
Northdale	Provincial	Pietermaritzburg	No
Parklands	Private	Durban	No
Phoenix	Private	Durban	No
Pietermaritzburg Medi-Clinic	Private	Pietermaritzburg	No
RK Khans	Provincial	Durban	**Yes**
St. Aidan's Mission	Private	Durban	No
St. Anne's	Private	Pietermaritzburg	No
St. Augustine's	Private	Durban	No
Umhlanga	Private	Durban	No
Wentworth	Private	Durban	No
Westville Life	Provincial	Durban	No

So in essence there are five hydrotherapy facilities in the region, namely at Addington Hospital, RK Khan's Hospital, Edendale Hospital, Entabeni Hospital and Grey's Hospital. And of these five facilities the only one currently in operation with patients is

Grey's Hospital in Pietermaritzburg. For the number of conditions and patients suffering with these symptoms, hydrotherapy can be a highly effective mode of treatment and rehabilitation but with this minimal amount of facilities it is essential to provide adequate facilities as there is a great need. This map (fig 1.1) shows the location of the hospitals investigated, differentiating between private and government faculties

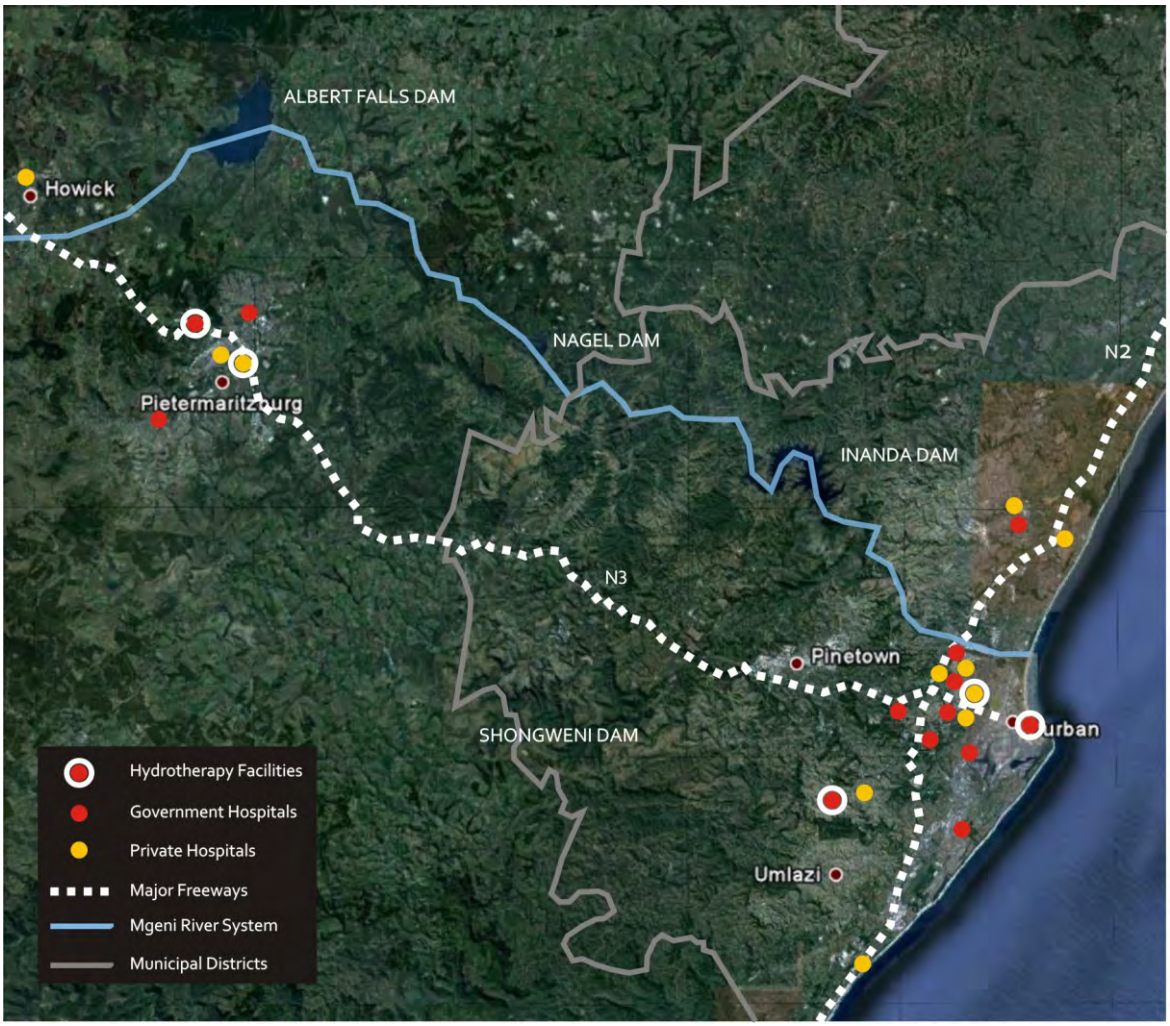


Figure 1.1: Map of KZN hospitals locations by Author

and which ones have hydrotherapy facilities or pools in their premises.

1.4 CONCLUSION

There is a need for a hydrotherapy centre within KZN in which water therapy and healing can be practiced to the benefit of the public. What needs to be established is the idea location or site that could facilitate the construction of a hydrotherapy centre to the client's brief.

CHAPTER 2
SITE SELECTION, SURVEY AND ANALYSIS

2.1 INTRODUCTION

In designing a Hydrotherapy Health Centre with regards to the research and relationship between nature, water and architecture, covered in part one, it is obvious that the location and interaction with its surroundings are extremely vital elements that need to be considered when moving forward with design and site selection. If wrongly placed this building typology and function would suffer and be unbeneficial to the research as a whole. But on a positive note South Africa as well as Kwa Zulu – Natal, has large potential due to its greenery and wide open spaces and being luck enough to have many water sources, being surrounded by the seas and having large rivers and dams throughout. What needs to be stressed though is the importance of site location due to the sensitivity of the dissertation topic of nature, water and architecture, and if avoided or not taken seriously would negatively affect the successful outcome of the Hydrotherapy Health Centre.

The concept of determining site selection criteria is to accurately decide on a site best suited for the building and best suited to carry out the theoretical framework of the research document.

2.2 SITE SELECTION CRITERIA

With the theoretical framework stating that by using nature's principles and harmonious settings as well as incorporating specific building design, healing environments can be created. One of the main factors within the research document is the significance of water, preferably moving natural water sources, as a healing element from the use of patient treatment to the use of design relaxing features. Also while trying to merge and incorporate nature a setting in the city with its bustle and limited green spaces would be disadvantageous. A suitable site would need to have the following criteria in some way:

- Proximity to Water

From the research it can be established that water is one of the most important natural elements of life. It is also a critical aspect in the creation of healing environments because the flow of water from its sound to its perceptions provides a relaxing and calming factor. Water is also one of the main focuses of healing treatment with Rheumatic patients and there will be a need to incorporate water into the selected site for this reason. It would be preferable that the water incorporated on the site be a natural feature and not man-made as this will make the location more authentic and viable. These water sources can range from lakes, dams and rivers, to springs and waterfalls - the more natural the water source the better.

- Accessibility from Durban

Accessibility is a criterion because the function of the building is to cater to the public, the specific public being patients with Arthritis and Rheumatism. It is difficult between trying to keep the site accessible and keeping it as much away from the harshness of the city as possible, but ultimately if people cannot access the site then there is no point in its location. There should then be at least a route accessible by car from the nearest city of Durban. The site has also got to be accessible for the patients' families as they are an integral part of the rehabilitation process for support.

- Setting away from high traffic and heavy city noise

The research shows that loud heavy noise such as traffic, construction, and mechanical elements are harmful to creating peaceful healing environments. What are needed are peaceful, serene and quiet natural environments. It is essential that a site then be chosen and situated far enough away from the city and further into the natural outskirts of the city.

- Natural wilderness and beauty setting

By using the principles of Nature as well as the calming and healing qualities of it in order to create the most healthy environments, the site should be fully integrated into a lush natural setting with abundant vegetation (the more untouched by man the better), wildlife and natural features. The further in nature the patients go the further away from harmful factors they get. A site with lush vegetation and trees also provide good indoor and outdoor air quality and freshness.

- Opportunity to offer local labour staff

Due to the semi-isolated position of the sight in order to fully and valuably integrate with nature, a local community should be situated close by in order to provide employees to maintain the development. The close community with be more advantageous and practical than having staff coming daily from cities or places far away. This in turn will also improve employment levels locally and thereby enrich the lives of the local community.

- Warm Climates

Rheumatism is generally negatively affected in cold climates. The cold brings greater levels of aches and pains for the joints. Understandably the cold cannot be completely avoided but the warmer the climate the better the environment for Rheumatism patients.

2.3 SITE SELECTION AND DISCUSSIONS (OPTIONS)

Firstly natural springs were looked at but none found were viable. Then River edges were looked at and found limiting and sparse land. Finally dams were looked at following the Mgeni River and Albert Falls Dam was the least developed and most opportunistic. The other dams in KZN were Midmar, Nagle, Inanda, Shongweni and Henley Dams (fig 2.1). All dams have nature reserves surrounding them with the Albert Falls Dam having a higher rate of growing development and allowance than the rest.

Figure 2.1: Map of KZN and its rivers

The areas chosen to look at are either on the outskirts of the city or set deep in natural locations. They all have lush vegetation, beautiful views, and with the main factor being a close proximity to some kind of water source (fig 2.2). These sites are:

Site One: Lilani Hot Springs – Greytown (fig 2.3)

Site Two: Albert Falls Dam – Albert Falls (fig 2.4)

Site Three: Palmiet River – East of Kloof (fig 2.5)

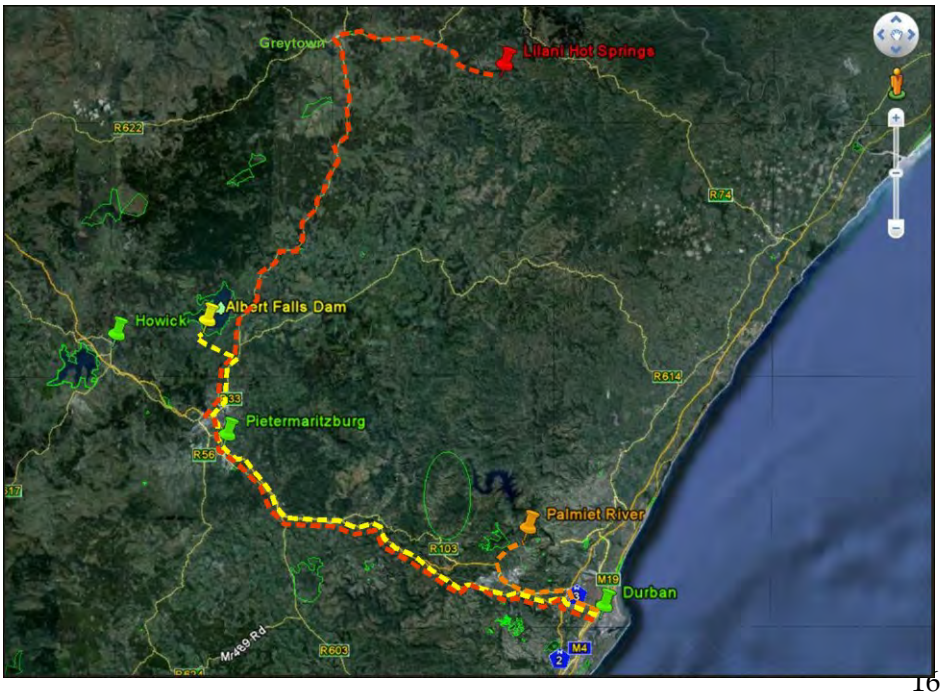


Figure 2.2: Site Selection Locations Map

Figure 2.3: Site Option One – Lilani Hot Springs

Figure 2.4: Site Option Two – Albert Falls Dam

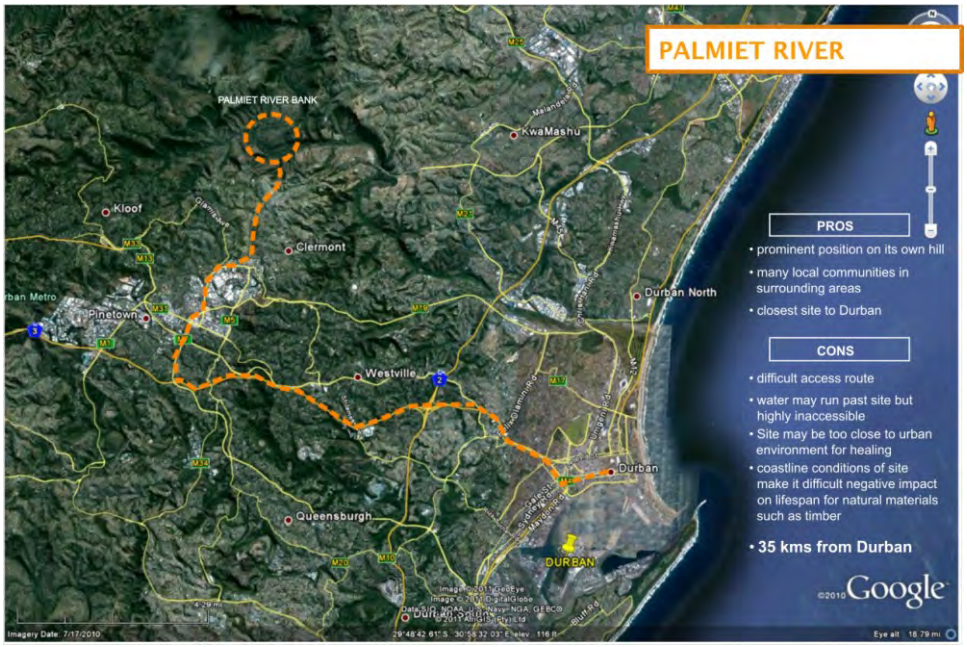
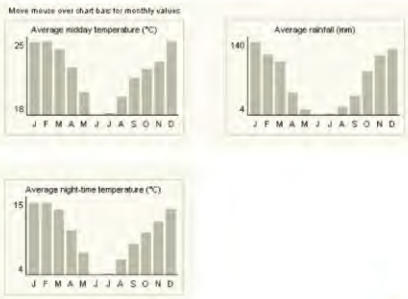
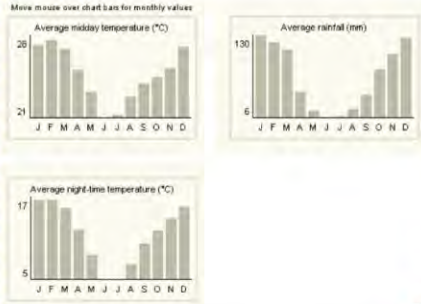
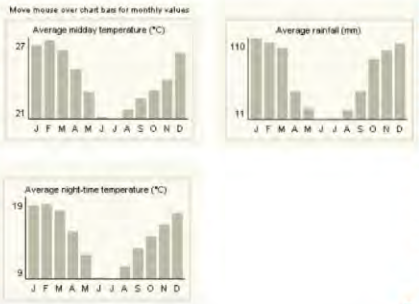


Figure 2.5: Site Option Three – Palmiet River

SITE SELECTION CRITERIA	SITE 1: LILANI HOT SPRINGS	SITE 2: ALBERT FALLS DAM	SITE 3: PALMIET RIVER
1. PROXIMITY TO WATER Justified by the theory of waters healing qualities such as reflection and soothing sounds. As well as using water in treatments in the form of baths to reduce aches and pains. 10	• Lilani has natural hot springs on site. the site is slightly developed in Phase 1 of a of a community development project with buildings for change rooms, ablutions, and offices. • The water on site only provides a practical element. 7.5	• One of the largest dams in KZN • Albert Dam creates a good backdrop or vista to the building on site. • The water in the dam can be drawn onto the site due to proximity and topography. • The water on site provides a practical and visual elements to healing theory. 8	• The river from Inanda Dam flows South and meets the stream from Kloof Gorge on the East. This river flows around the base of the hill which the site is on. • The water on site provides only a visual element. and the steep slope limit the water view from site 6
2. ACCESSIBILITY FROM CITY Due to daily active part of centre/ complex the site needs to be accessed fairly easily from a main city as well as have some form of public transport to it. 10	• Furthest site option • Set 175kms from Durban and 110kms from Pietermaritzburg, the closest town is Greytown 20kms away. • Access route is a long, twisting dirt road in relative poor condition. • Only access is by car as there are no bus routes. 3	• Equally close to Pietermaritzburg and Howick at 22kms. • Distance from Durban 77kms. • There is easy access off main roads • Accessible by car • no public transport on this side 5	• Complex access route to site through residential areas. • Closest site to Durban. • Accessible through Kloof, Clermont or KwaMashu. • 40 km from Durban • complicated access route 6
3. NATURALLY SILENT SETTING Following the theory that noise is a health hazard and naturally silent environments are more healing. Site situated away from high traffic and urban noises are preferable. 10	• Isolated position ensures quiet setting. • Site set far away from freeways and main roads and any forms of vehicular movement. • Only rural community and farming noises. 8	• Situated in location with no freeways or main roads nearby. • Large amounts of nature reserve with wildlife. • The harsh noise content is low with large unoccupied areas. 8	• Located on a hill with residential areas on all sides. • It is far away from freeways and main roads. • Only community bustle and noise of surrounding Lower Langefontein to the North, Ntuzuma to the East and Clermont in the South. 7
4. NATURAL WILDERNESS & BEAUTY Natural landscapes captivate and entrance the viewer and allow them to feel apart of Nature unlike the dominating and forceful urban environments. 10	• Situated in a steep gorge. One side is Tshani ridge with cliffs of table mountain sandstone and covered with grassland. The other is mostly shrubs. • The site is distanced from any concentrated settlement with only a few kraals and farms. 7	• Albert Falls waterfall is on the perimeter of the dam. • The dam provides a large body of water which results in a good vista and fishing. • There is large amounts of wildlife from the surrounding nature reserve such as zebra, numerous buck such as the springbok, the red hartebeest, and oribi, rhino and giraffe. 10	• Set atop a hill the site has prominent position and good 270' views. • Its elevated position allows sights of the Palmiet rivers that flows past it. • There could be possible views to Kloof Gorge on the West and the surrounds are very hilly backdrops. 6.5

SITE SELECTION CRITERIA	SITE 1: LILANI HOT SPRINGS	SITE 2: ALBERT FALLS DAM	SITE 3: PALMIET RIVER
5. LOCAL LABOUR SUPPORT Natural settings lack the Urban development advantage of readily available staff support. Isolated locations need rural or local communities for maintenance, management and running. 10	• Rural communities surrounding the site are Eshane and Sangweni. • There is already a community upliftment scheme in place. 6	• Local community is Thokozani but most labour will have to be drawn from PMB and Howick 5	• There are local communities at KwaDabeka, Motalabad, Emachobeni in the surrounding areas. 6
6. WARMER/ CONTROLLED CLIMATES Rheumatism and arthritis patients suffer or experience more pain from their conditions in colder and humid climates. the idea is that the warmer and dryer the environments and climates the less the pains and aches. 10	• 762mm rain per annum • Lowest rainfall (4mm) in June Highest rainfall (131mm) in January • Daily maximum temperature midday 18°c June to 24.6°C in Dec • coldest temperature during June at 4.3°C at night  5	• 790mm of rain per annum • Lowest rainfall (6mm) in June Highest rainfall (129mm) in January • Daily maximum temperature midday 20°C in June to 27.6°C in February • Coldest temperatures during July at 5.3°C at night  7	• 750mm of rain per annum • Lowest rainfall (11mm) in June Highest rainfall (109mm) in January • Daily maximum temperature midday at 21.4°C to 26.8°C in February • Coldest temperatures is during July at 8.6°C at night  6
7. NATURAL MATERIAL RESOURCES By using the natural environments materials the healing environment created is less harmful to construction process, as well as decreased carbon footprint and embodied energy in making man-made products. 6	• Stone from the nearby river 6	• Slate stone quarry at two areas in immediate vicinity • Large amount of grassland for weaving 8	• None • 0
8. WATER USAGE Water from a natural source would be energy efficient and due to the large amount of water in the building it is vital element. 10	• Hot Springs are already developed and very limited • There is not enough water to sustain a large hydro centre 3	• Albert Falls Dam is one of the largest in KZN and has area accessible to the waters edge. 9	• At the foot of the hill is a river but the distance from it is too steep to get water to the site. • The river itself might be enough water to sustain the development 2
TOTAL POINTS 80	45.5	61	39.5

2.4 HISTORICAL BACKGROUND OF SELECTED SITE

2.4.1 Location

The Albert Falls Dam is situated on the Mgeni River in KwaZulu Natal near the small town of New Hanover and Cramond (fig 2.6). The Mgeni River, which means "place of the acacia trees", rises near Mpendle in the Natal Midlands at an altitude of 1829m, and traverses a 258km long course before reaching the Indian Ocean at Durban. It is a perennial river and one of the more reliable large rivers in South Africa. Rainfall occurs predominantly in the summer. The mean annual rainfall generally varies from 800mm to 1000mm over the catchment area with peak values of 1400mm in parts of the upper reaches. The gross mean annual runoff of the total catchment area of 4418km^2 is estimated at 634 million m^3. The catchment area of rainfall of the Albert Falls Dam measures 1614km^2 and has a mean annual runoff of 330 million m^3. The dam site is underlain by shale of the Lower Ecca Group of the Karroo Series into which a thick sheet of dolerite has intruded (AFD DWAF).

Albert Falls Dam is a composite structure comprising a central concrete gravity section with earth embankments on both flanks. The gravity section is 239m long and 30m above riverbed level and incorporates an uncontrolled spillway section of 100m. The combined length of the two earth embankments is 1671m. The net storage capacity of the dam is 289,1 million m^3. The Albert Falls Dam forms an integral part of the Mgeni System which is managed and operated as a unit.

Figure 2.6: An Image of Albert Falls Dam

2.4.2 History

The Mgeni River is the main water source for the Durban-Pietermaritzburg metropolitan complex and supplies about 90% of the area's water requirements. The Midmar Dam, which was completed in 1965, the Albert Falls Dam, which was completed ten years later, and the Inanda Dam, completed in 1989, were planned, designed and built by the Department of Water Affairs and are the major dams on the Mgeni River. Water from the dams is supplied in bulk to Umgeni Water which is responsible for the purification and distribution of water within its statutory area. This includes the Durban-Pietermaritzburg metropolitan area.

A series of pictures (fig 2.7-9) of Albert Falls illustrates how development has changed the river environment from an extensive grassland area, with grassy riparian vegetation, to one covered with thick woody vegetation, some indigenous and some exotic, a dam and railway line (web 2).

Figure 2.7: Albert Falls Dam 1912

Figure 2.8: Albert Falls Dam 1952

Figure 2.9: Albert Falls Dam 2002

2.4.3 Function

The Albert Falls Dam provides storage on the Mgeni River and serves as a balancing dam in the Mgeni System. The dam is situated roughly halfway between the Midmar and Nagle Dams and can therefore impound spillage from the Midmar and release water to the Nagle Dam to supply Durban.

As an experiment the dam basin was not deforested before impoundment in order to establish whether submerged trees would provide a habitat for fish. The situation was monitored by the Natal Parks Board and the experiment was proved to be successful. Tilapia, a small fish species, feeds on the algae growing on the trees. The Tilapia are in turn preyed on by large-mouth bass. The downstream slopes of the embankments were seeded with indigenous grasses to prevent erosion and to make the dam wall blend in with the environment.

The climate of the area lends itself to recreation and for this purpose amenities have been made available at the dam by the Natal Parks Board (AFD DWAF).

ALBERT FALLS DAM	
CATCHMENT DETAILS	
Incremental catchment area	**728 km^2**
Total catchment area	**1654 km^2**
Mean annual precipitation	**1005 mm**
Mean annual runoff	**131.3 *$10^6 m^3$**
Annual evaporation	**1200 mm**
DAM CHARACTERISTICS	
Gauge plate zero	**634.3 m.s.l**
Full supply level	**655.9 m.s.l**
Net full supply capacity	**289.133*$10^6 m^3$**
Dead storage	**0.975*$10^6 m^3$**
Total capacity	**290.108*$10^6 m^3$**
Surface area of dam at full supply level	**23.5 km^2**
Dam type	**Concrete with earth embankments**
Material content of a dam wall	**Earthfill : 3 000 000m^3** **Concrete : 80 000m^3**
Crest length	**Spillway section : 100 m** **Non-spillway section : 1810 m**
Type of spillway	**Uncontrolled**
Capacity of spillway	**3330 m^3/s**
Future capacity once dam wall has been	**N/A**

The physical characteristics of the Area is that it has a large water body, a large and diverse land area, trees, grass, bush and shrub and is surrounded by attractive rolling and hilly landscapes. It was named for the Falls behind which the dam has been built, and prior to being a dam and reservoir, was known to the public as a "lake" area. Because of its particular combination of physical features, the place also has the property of being quiet and peaceful set away from any town or city.

2.4.4 Context

What exists around Albert Falls dam is a semi recreation zone with well-made dirt roads, camping and picnicking sites and facilities, relatively unobtrusive toilet and ablution facilities, a small group of huts and facilities for boat storage (fig 2.10).

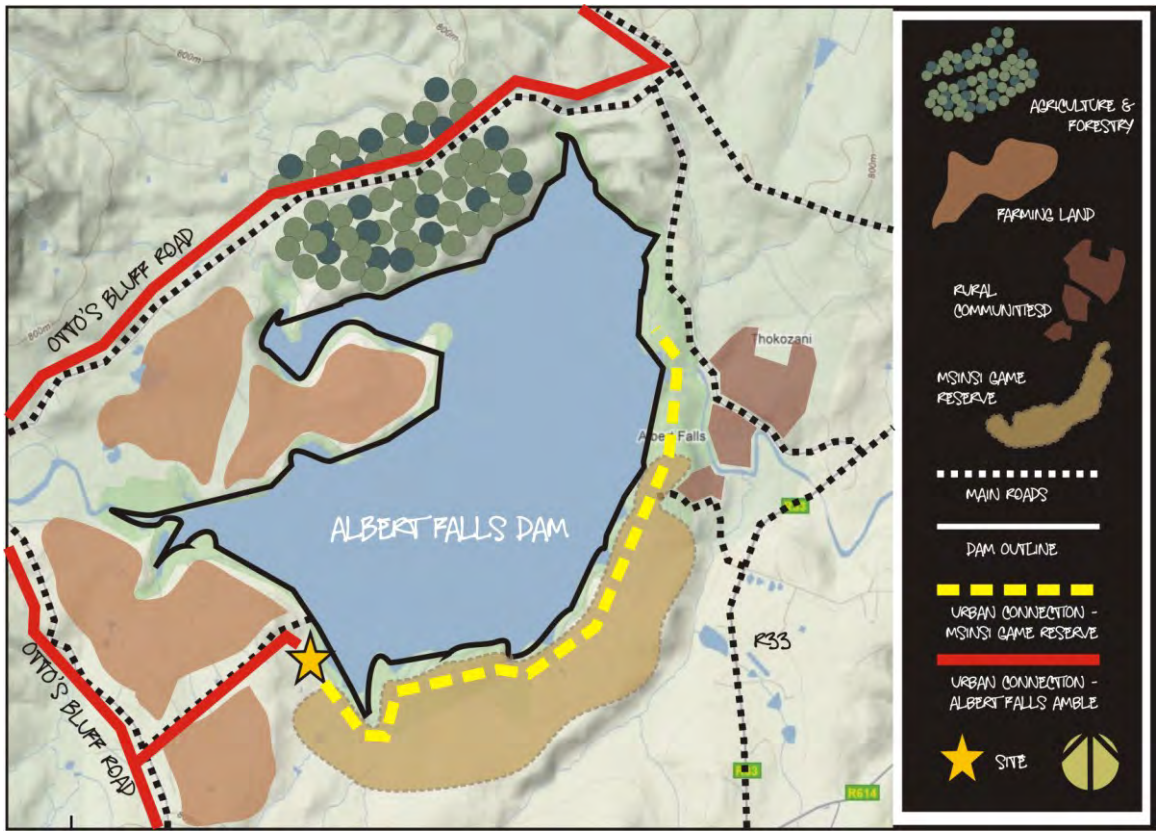


Figure 2.10: Contextual Surroundings Analysis Map

2.4.5 Wildlife

The land here is given over to tracts of mixed woodland, open grassland and small marsh areas, and in the wet seasons birdlife is abundant and includes widows, weavers, waxbills and cisticolas. Wildlife in the reserve includes zebra, numerous buck such as the springbok, impala, blesbok, reedbuck, grey duiker, the red hartebeest, and oribi, rhino and giraffe (fig 2.11-14). Albert Falls Dam, rated as one of the best bass fishing dams in the world.

Figure 2.11: Albert Falls Natural Wildlife from Msinsi Game Reserve Adjacent to Site

Figure 2.12: Albert Falls Natural Wildlife from Msinsi Game Reserve Adjacent to Site

Figure 2.13 and 2.14: Albert Falls Natural Wildlife from Msinsi Game Reserve Adjacent to Site

2.4.6 Tourism

Established in October 1997, The Albert Falls Amble has aptly chosen as its emblem the Fish Eagle, whose unique cry punctuates the area. The Amble is an arts and crafts route that takes advantage of attractions and activities in the area extending from Albert Falls to Wartburg, Dalton and New Hanover, and now includes the historic locations of Bishopstowe, Cramond, Hermannsburg and Kranskop. It has a wonderful selection of crafts, pubs and a number of private game reserves (web 3).

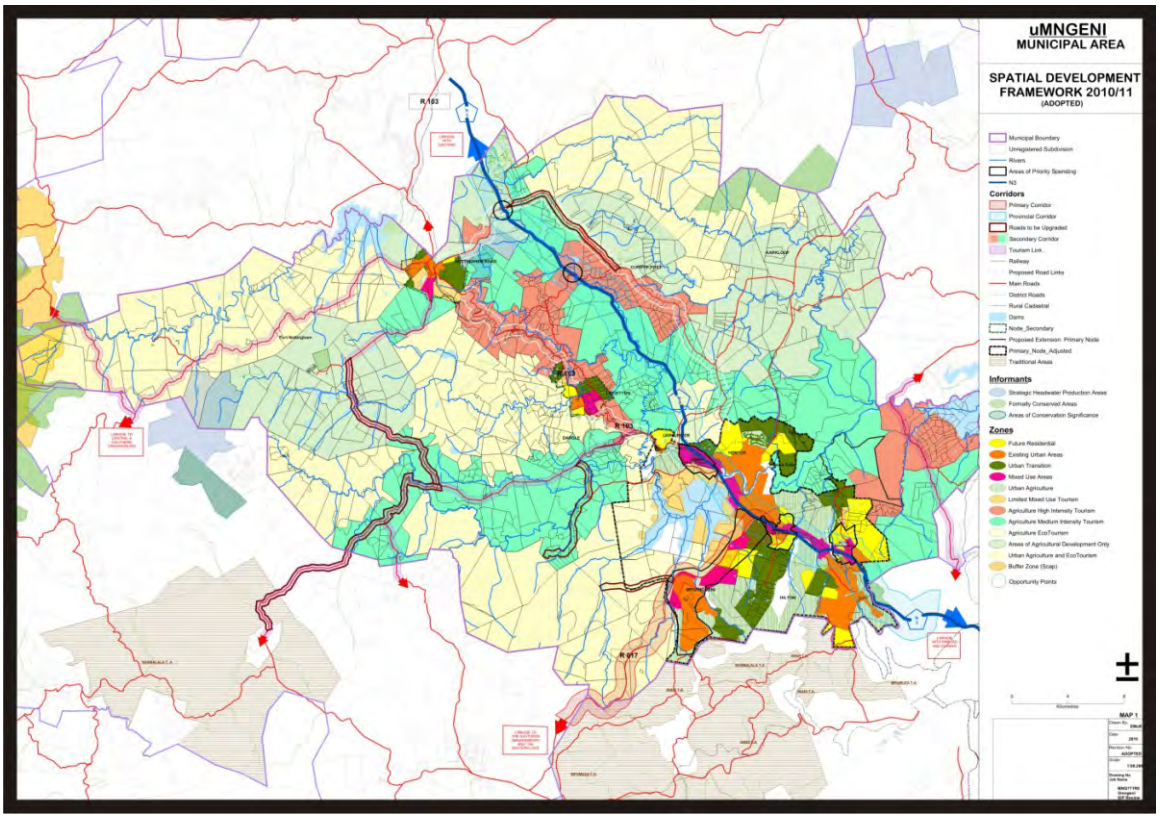


Figure 2.15: Spatial Development Framework Plan 2010/11

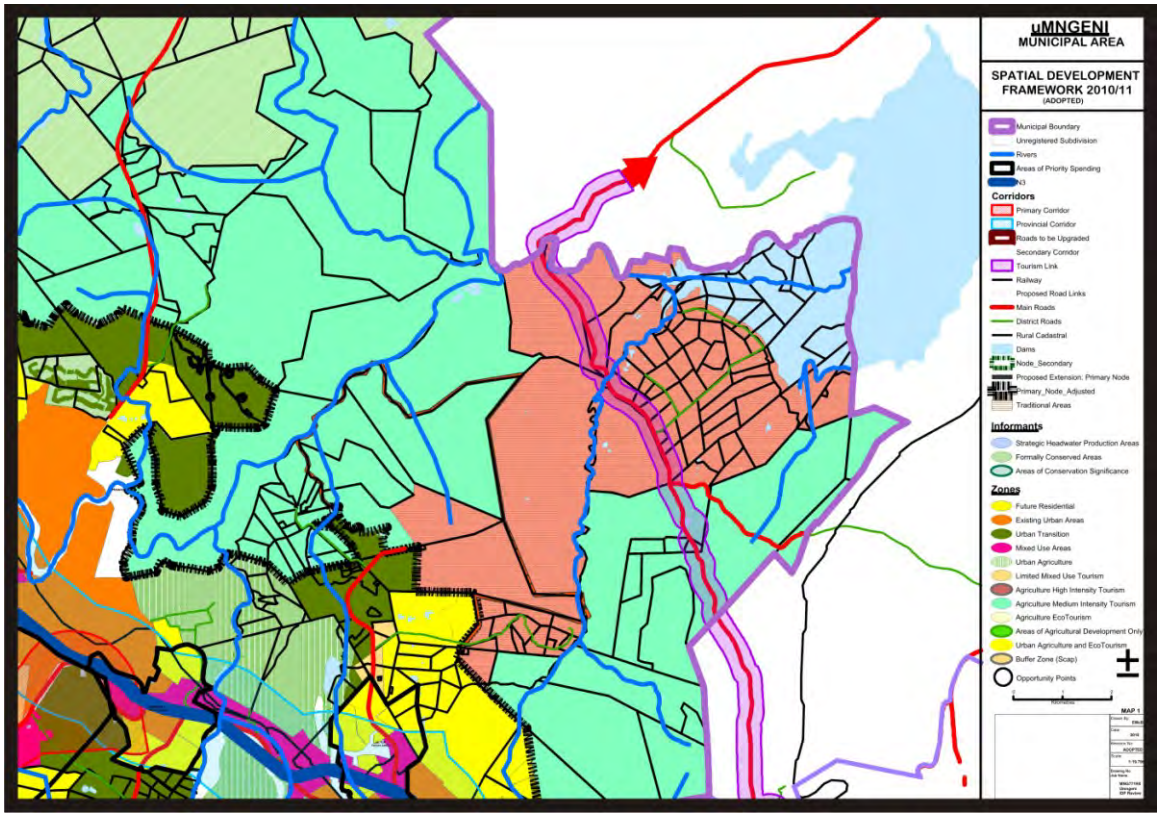


Figure 2.16: Spatial Development Framework Plan 2010/11

The fact that the Hydrotherapy Health Centre site is along this tourism route provides a good form of catalyst to rejuvenate the dam and its activities, as well as to draw the public through to the Hydrotherapy Centre. The selection of site also works within the municipality's plans for the spatial development of the area (fig 2.15-6) which has been zoned for agricultural high intensity tourism.

2.4.7 Activities

There is a wide range of activities ranging from boating, water-skiing and sailing to fishing, bird watching and game viewing. Canoe races are held regularly, starting just below the Albert Falls.

2.4 SITE ANALYSIS

The site is North – East facing which makes for good lighting conditions the entire day but while there is open unobstructed beautiful views there is not much shade on site and so this will have to be designed for in preventing heat gain. The site slopes down to the dam edge which is surrounded in grasslands, appearing rich and green in summer and dry and golden in winter. The effect is an ever-changing landscape with the seasons that can similarly alter the buildings overall appearance during the seasonal change (fig 2.17-22).

2.4 SITE ANALYSIS

Figure 2.17: View from top of site down towards Albert Falls Dam

Figure 2.18: Shale rock as a natural resource in the surrounding areas

Figure 2.19: Arcadia trees that are scattered throughout the site which do not provide much shade

Figure 2.20: High grasslands on and around the site which change colour with the season

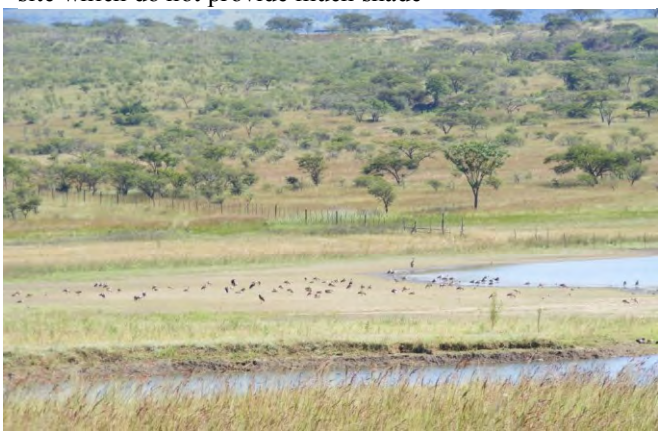


Figure 2.21: Marshlands at some point at edge of dam drawing a large variety of birdlife

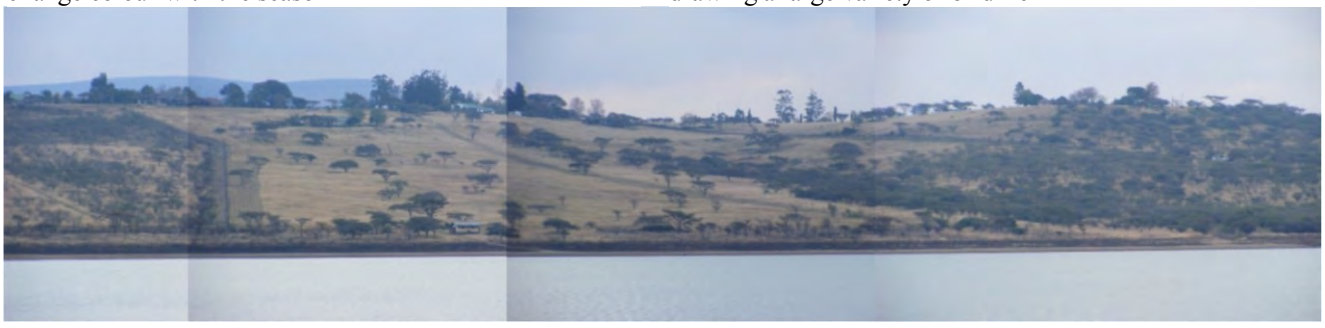


Figure 2.22: View of the site at the edge of the dam that has a gradual slope and uninterrupted scenic views

2.5 CONCLUSION

What can be conclude for this site and its significance in holding the Hydrotherapy Health Centre is that it meets the vital characteristics needed to make this building work towards being a healing environment. The incorporating and nearness of water and nature in which architecture will be integrated and interacted with is a true benefiting component. This site also has potential to grow and expand as the development needs in the future, as well as, provide a positive effect on the surrounding context. The Centre will aid in the growth of tourism to the area, as an advertisement and bringing the public straight to its doors. Albert Falls Dam is a beautiful site with high potential standards of which the Hydrotherapy Centre can aid in enhancing.

CHAPTER 3
HYDROTHERAPY IN DESIGN

3.1 INTRODUCTION

Hydrotherapy is a vital aspect in the treatment and rehabilitation within any physiotherapy department or establishment. It is a modality that is natural unlike drugs and medication within the field of physiotherapy. It also can be used on a medical or entirely general health level and therefore is not restricting in its target market.

"It has to be appreciated from the outset that there cannot be standard design for a hydrotherapy pool and that each individual department should be planned to cater fro the number and the types of patients who will need to be treated."

3.2 POOL PLANT

Most hydrotherapy treatment pools have a water circulating system which similar principles to a public swimming pool. The main function of this system to firstly to clean the water and secondly to heat the water. Generally there is an area or room that houses this system or equipment that maintain an adequate condition of he pools. The system functions as follows (fig 3.1):

Water leaves the pool or is sucked out by outlets and the bottom or floor of the pool (A), the water is drawn by the action of the pumps (B). the water then passes through the filter to clean away debris, dust and impurities (C), gets sent to the heat pumps (D) monitored by a thermostat (E) which are cylinders that emit steam onto the water carrying pipes to heat the water passing through and then moves onto the chlorifiers. The water then is flowed back to the pool through a different set of outlets (F) normally higher up and at the side of the pool. The pool also has a backup system of overflow outlets (G) at the top inside sides of the pool and also in a perimeter drain around the floor (H). The excess water collected from these pipes leads straight to the drainage system.

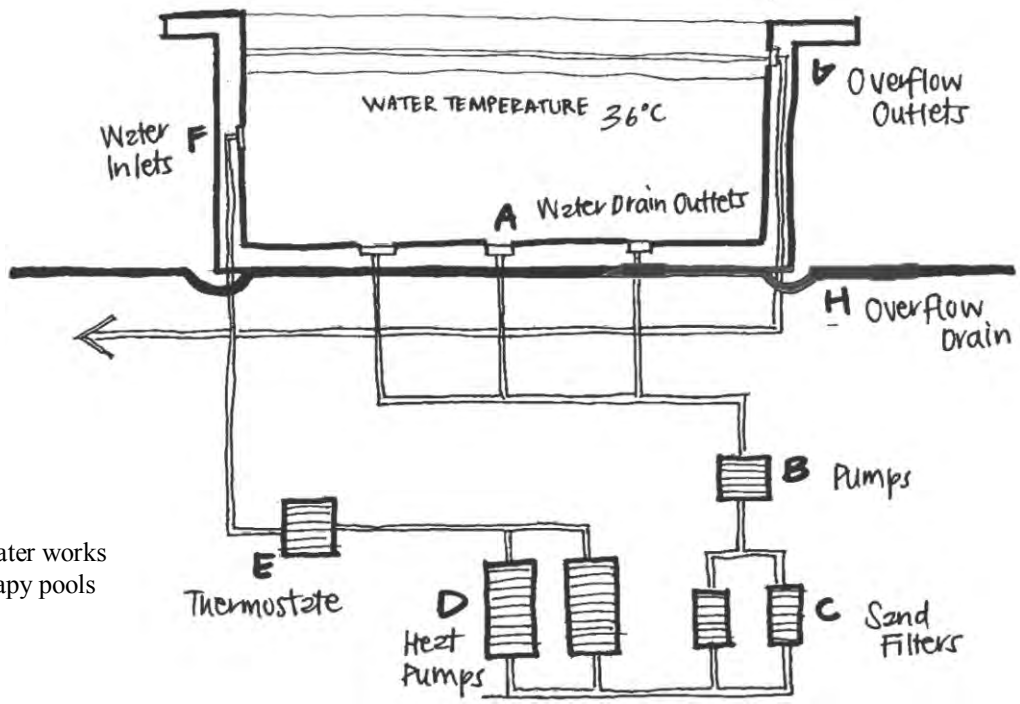


Figure 3.1: Water works for Hydrotherapy pools

The heater pumps range in size and capacity and so the bigger and more powerful the pumps the faster the rate of water circulation becomes. Although only one pump is used at a time there are usually two or more provided which connect to the system in parallel with valves attached and positioned to isolate a pump from the system to repair or service, so as to not disturb the entire cleaning and heating system circulation.

The filters are important to note as dust and debris are continuously introduced into the pool from wind or every time a bather enters the water. This debris ranges from dust to epidermis or skin cells, hair and costume lint. These factors can contaminate the waters and so the filters are constantly filtering and cleaning the waters. There are different types of filters that can be used in hydrotherapy pools which are sand and gravel filter; the diatomaceous earth filter; and the disposable cartridge filter (Davis, 1988).

3.3 POOL SIZE

Pool sizes vary in hydrotherapy with no one standard size. From a survey carried out in Britain one can see that highest percentage of pools being 30% had an area of between 5m2 and 20m2. The other ranged smaller and quite bigger too. The key factor to note is that the larger the size of the pool and the bigger the depth increase the financial costs of the department. Smaller pools are restrictive in group exercise and therapy while extremely large pools intimidate the users or patients and leave at of wasted space in the centre of the pool as most activity with patients happen around the edges of pools (fig 3.2) .

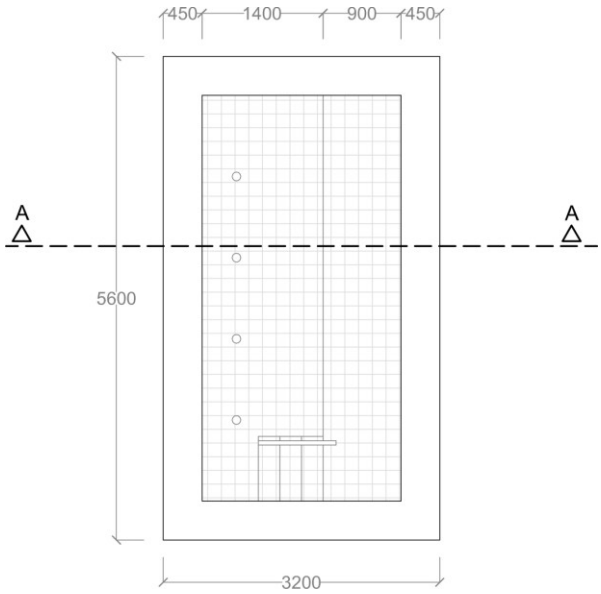


Figure 3.2: Plan of typical existing Hydrotherapy pools

3.4 POOL DEPTH

The depth of the pool is determined by the exercise and the necessary handling of the patient by the therapists in the water. A depth generally of 1 to 1.2 metres is preferable for physiotherapists but areas of the pool should vary in depth for children or progression of exercise treatment. An important aspect to consider when addressing pool depth is the treatment of the bottom of the pool. The options are sloping floor; stepped floor; or a combination of both. Sloping floors allow various depths but importantly where walking re-education plays apart in the treatment areas with

a level bottom are necessary. Stepped pools generally have two or more level lanes of differing depths which are separated and accessed by steps (fig 3.3). These lanes usually run the length of the pool. With pool depth comes treatment in and out of the water for the therapists. Two solutions for helping patients while not being in the water with them are bays and glass sided pools. Bay pools are dry bays surrounding the pools where therapists can interact and assist patients in the water at the same level while they are on dry land or outside the pool. The therapist can just bend of the edge to teach. Glass sided pools allow therapists outside the pool to see the movements of patients below water level and can instruct them such (Davis, 1988).

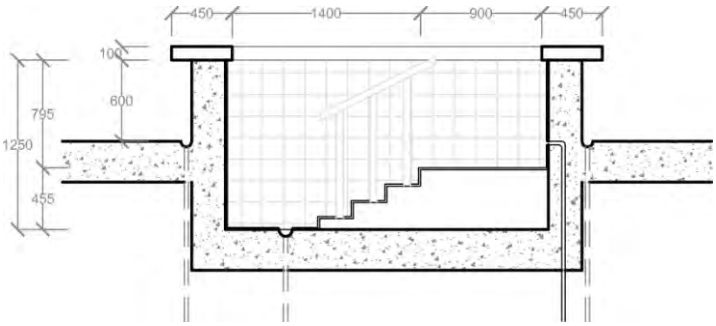


Figure 3.3: Typical Section through hydrotherapy pools

3.5 ACCESSIBILITY OR ENTRY AIDS TO WATER

Mechanical aids are an important part of hydrotherapy pool design as many patients that need to use the pool for treatment and rehabilitation or wheelchair bound or even on stretchers. This means that means in which to transfer these patients from dry lands and into the water are necessary and to do so with the minimum of discomfort to the patients. The main method for hydrotherapy pools are the use of hoists. These hoists are hydraulic, electrical, mechanical or compressed air hoists.

Hydraulic hoists consist of a large piston which is powered by water pressure from the cold water mains supply. The main principle behind this system is pressure using the water as the vehicle to lift the hoist into and out of the water. The hoist is usually fitted with two taps; one marked ‘raise’ and the other ‘lower’.

1. When the ‘raise’ tap is opened, water from the mains flows into the chamber A and the pressure forces the piston upwards carrying with it the hoist arm and the stretcher. During this time the ‘lower’ tap must be closed.

2. When the ‘lower’ tap is opened and the ‘raise’ tap is closed, the water from chamber A flows out and is lost down the drain. The weight of the piston, stretcher and patient pushes the water out of the chamber A, but because the pipe through which it is forced has such a narrow bore it can escape only slowly and the stretcher descends gently.

3. It is important to note that both taps should never be open at the same time and that when the hydraulic hoists are not in use should be kept at their lowest level.

Electrical hoists have an electrical motor which powers the lifting mechanism and travels on an overhead trackway usually suspended from a strengthened ceiling. The stretcher or wheelchair will be lifted and carried over the water and then lowered. Mechanical hoists are similar in design to hydraulic hoists but there is no connection to the water required. There is still an upright post attached to the floor and a movable side beam that lowers patients into the water. The winding manual mechanism provides a smooth ride and is simple and the post and arm can be removed from its position (Davis, 1988).

3.6 FACILITIES NEEDED

There should be change rooms that are attached to shower cubicles and toilets. Showers are a necessary part of the pre-entry procedure into the pool. There are also large amounts of equipment for exercises and cleaning of the pools and so a storage room and area is required. Rest areas are required for patients in close vicinity of the water as after exercise sessions they can become quite tired. The hydrotherapy pools have to be monitored by a person for emergencies and assistance so there should be an elevated platform for the therapist's assistant to view the water areas.

3.7 EQUIPMENT

There are different types of equipment necessary to manage the functions of the hydrotherapy pool and these ranges in size. The forms of large equipment are submerged plinths, parallel bars, handrails and underwater lighting. Submerged plinths are contraptions that are submerged just under the surface of the water and allows fixation of the patient. It is hooked of the edge of the pool or the handrails and is used for patients who are severely paralysed or in a large amount of pain. The equipment is a steel frame wrapped in fabric supporting the torso, and is a movable object. Parallel bars are also important in the use for gait and walking exercises and are generally best used in the deepest area of the pools. Parallel bars which are fixed by uprights into a platform which can be raised and lowered in the water are felt by some therapists to be very useful, especially of any children are treated in the pool with adults. Handrails are the most basic of items that should be incorporated into the pool design and should be attached at all edges of the pool at the same level of the waters surface since patients always need the security and stability in the pool. It has also being noted that secondary rails that are lower than the first under water provide better stability during certain exercises. Lastly underwater lighting is a crucial element because

lower body exercises require the patient to see what their bodies are doing under water. This type of lighting enables good clear views of what is happening under the water, not to mention aids in the therapists' view of the patients under water movements too (Davis, 1988).

For small equipment many flotation devices are required for the different exercises. Floats for resistance in exercise in strengthening the muscles are required. These can be made out of polystyrene blocks. Buoyancy aids can be neck supports, horse-shoe shaped with different sizes for adults and children making the patients comfortable in a supine position. Body supports in the form of inflated circular doughnut tubes at varying sizes for different body masses. Supports for extremities are a number of smaller inflatable rings in varying sizes used for different parts of the body. And because of this these need to be easily adjusted with air intake and outtake to achieve the correct degree of buoyancy needed for exercise by the therapist. There are also various sizes of balls for games and exercises, paddles to develop strength in the upper body, flippers used for lower extremity exercises, weighted sandals to provide stability to patients with weak muscles, and leg splints to stabile or fix a joint or leg in order to work with the other parts of the body.

3.8 SAFETY MEASURES

Hazards in a hydrotherapy facilities invariably fall into three categories, namely accidents; infection; and fatigue. When considering accidents there are many contributing factors like the type of equipment used such as hoists which as cover previous can be mechanical, hydraulic or electrical. These need to be serviced regularly to prevent locking failure and risk the lifting out or lowering in of patients into the water. This also applies to handrails and parallel bars as some of these are immovable. Steps are also a consideration under water and need to be clearly differentiated and marked for patients to determine change in level and such.

Another accident risk is the floors which when wet present high level of hazard to patients by slipping and falling. The floor surfaces of the area around and within the pool must be finished in non-slip tiling. If water gathers in areas of the tiling then stiff brooms need to be kept close by in order to frequently sweep the excess water to the drains. Wheelchairs are frequently used to bring in patients even to the extent of the immediate area surround the edge of the pool; this is dangerous and careful eye need to be kept as well as checking the wheelchairs wheels are dry before level the hydrotherapy area.

Hydrotherapy pools are almost always heated to temperatures between 35 to 37 degrees and are maintained by thermostatic controls at the plant machinery. Any temperatures higher than this should not be allowed as it is very harmful to the patients' bodies and so temperature monitoring is extremely important, this causes fatigue. It is important that all people (staff and patients) must shower prior to entry of the pool. The shower would then need to be placed close to the pools and

accommodate wheelchair users. The need to shower is to prevent any contaminants form mixing with the chemically balanced pool water such as lotions and oils.

Is the case of emergencies medical emergencies that could occur do to the type of patients using the pools could be cardiac arrest and drowning. These can often occur to patients within the pool and safety measures like a medical mat and necessary equipment need to be kept close at hand. A mechanical factor for emergencies to call for speedy assistance would be an alarm system.

In terms of infection there are three main types of factors that prevent people from using the hydrotherapy pools are these are patients with open wounds or drips which can contaminate the water, unstable blood pressure which gets even more unstable with the heated water of the pools, and lastly people that are incontinent or have no bowel control. There should be smaller pools that can be individually drained and filled for every patient so that no contamination will occur and these patients still can then benefit from Hydrotherapy practice. (Davis, 1988)

3.9 BASIC PHYSICAL PRINCIPLES TO WATER EXERCISE

The progression of exercises in water is quite different in its method to that on dry land, since there are many different factors due to waters different medium. To use dry land techniques in the hydrotherapy pool is to ignore the unique opportunities offered by this medium. In order to devise a reasoned hydrotherapy programme or to progress pool treatments and design to suit the patients' needs an understanding of the basics is needed.

Since movement in water is the basis of pool therapy, the physical principles which administer this are very important to the physiotherapist. When a floating object is propelled across the surface of the water, it encounters a resistance to its movement, the magnitude of which is partly dependent upon the object's size and partly upon the speed at which it moves. The total resistance has several components, but the two which are most practically important to the physiotherapist are caused by two familiar phenomena, namely the bow wave and the wake. The bow wave is responsible for a positive pressure in front of the moving object which is caused by the displaced of water and this tends to impede the object's forward progress. The wake which forms behind the moving object is caused by water flowing into the area immediately to the rear giving rise to disturbed turbulent water which has the effect of a negative pressure or drag. This tends to hold the object back. It has been estimated that the bow wave is responsible for only 10% of the resistance and the rest is largely due to turbulence.

During treatment the physiotherapist will constantly be required to devise exercises where the resistance is compatible both with the patient's ability and the aims of the treatment. This will require varying and progressing the exercises. The faster the movement is carried out the greater will be the resistance to that movement. If other factors remain constant then an exercise may be

progressed and the muscles strengthened purely by a gradual increase in the speed of performing the exercise (Davis, 1988).

Centre of buoyancy is very important principle of water usage. On land we take for granted the effect of gravity has on our bodies. We understand that every object has a point within it defined as its centre of gravity which is generally thought of as an invisible vertical line down the centre of the object. When a force is pushed on the object out of the centre of gravity the object would fall over but if pushed on the object remains stable. The centre of gravity can be exactly paralleled by the centre of buoyancy.

Hydrostatic Pressure:

At any point below the surface of the liquid, the pressure will be greater than that at the surface by an amount directly dependant on the depth of that point and the density of the liquid. In water this is called hydrostatic pressure and represents the weight of a column of water from the point in question to the surface. Any point in the water the pressure will be equal and opposite in all directions. Two practical implications:

1. The effect on distribution of body fluids

It has been suggested that the effect of hydrostatic pressure in the treatment pool is useful in the relief of oedema of the lower extremities. A person standing in water up to neck level is not aware of the increase in pressure on entering the water because the hydrostatic pressure is neutralised by the pressure within the body so that no pressure differential exists across the skin. What is important is the movement of intestinal fluid from the lower extremities is the shift of blood from this region during immersion to the thorax.

2. Effect on respiration

Physiotherapists have long been conscious that the possible restraint on the mechanics of respiration produced hydrostatic pressure on the chest wall and could have clinical implications in the treatment of patients with diminished vital capacities.

Latent Heat:

When a solid changes into a liquid, or a liquid to a gas, energy is required to enable the molecules to be separated and to remain separated. This energy must be supplied in the form of heat. Since the reverse is also true, when a gas becomes a liquid, or when a liquid solidifies, that same energy is released in the form of heat as the substance changes its physical state. When an ice pack is applied to the skin, the ice begins to melt and the heat required for this is taken from the tissues resulting in their being cooled. This heat which is required to change the physical state of a substance, but which does not result in a change in temperature, is known as latent heat.

We are all aware that our physical comfort is dependent not only upon the temperature of our surroundings but also on the humidity. This is because the more humid the air, the more difficult it becomes to loose heat from the skin by evaporation of sweat. In all working environments it is important to maintain the humidity in a comfortable range. In a hydrotherapy department the same can be said as too high a level of humidity may easily become a problem. For this reason it is good practice to monitor the temperature and the humidity of the pool room.

Evaporation:

Evaporation takes place when molecules 'escape' from the surface of a liquid and this phenomena takes place at all temperatures. The molecules at the surface are in constant motion, but some will have a higher kinetic energy than others and after leaving the surface of the liquid they move out of its sphere of attraction and do not return. They then become vapour in the surrounding atmosphere, and thus not only will the mass of the liquid decrease but the molecules will carry with them their kinetic energy resulting in the lowering of the temperature of the liquid. For this reason the process of evaporation is always accompanied by a cooling effect of the liquid and its surroundings.

Evaporation and hence its cooling effect are enhanced by a draught passing over the surface of the liquid which prevent accumulation of vapour at the surface and hence the loss of molecules. Evaporation is also facilitated by a large surface area of liquid and a surrounding atmosphere with a low concentration of the vapour. Evaporation and the factors influencing it are of great importance to physiotherapists in the working environment of the pools (Davis, 1988).

3.10 PHYSIOLOGICAL EFFECTS AND CONTRA-INDICATIONS TO POOL THERAPY

The physiological responses of the human body to exercise in the hydrotherapy pool are the result of the normal effect of exercise, modified by the body's reaction to an increase in the environmental temperature and pressure. Immersion of the body to the level of the neck in 36'C temperatures produces marked changes in the circulatory system and the temperature regulating mechanisms. But in the normal healthy individual these changes take place without untoward effect since the body is well able to cope with the alteration in environmental conditions. What must be considered here is the effect of changes in the immediate environment on those whose physiological responses are impaired by a pathological condition (Davis, 1988)

Effect on temperature

The human thermo-regulatory system is required to keep the core temperature of the body within very narrow limits and must therefore ensure that the heat lost exactly equals the heat produced within the body, together with the heat which may have been absorbed from the environment. For

a given level of heat production by the body, there is a set of environmental conditions which are nearest to the physiological neutral and allow the hypothalamus to regulate the temperature with least intervention. As the environmental conditions move further away from this point the responses will become greater and ultimately a point will be reached where the body will be unable to cope. The physiological mechanisms for maintaining the equilibrium are:

1. Variation in cutaneous blood supply
2. Sweating
3. Shivering
4. Increase in muscle activity.

It is important to know to what extent these mechanisms are activated by exercise in the hydrotherapy pool and whether their effects are beneficial or detrimental to the treatment. The normal body is able to meet the extra demands placed upon by pool therapy when this is given for the usual period of twenty to thirty minutes, assuming that the patient is not debilitated.

After most hydrotherapy treatments and after pool therapy it is usual to allow the Patient to rest before dressing. To this end it has been traditional to wrap patients in sheet towels and blankets and to allow them to rest for half an hour mainly to allow the patient to cool to pre-pool temperature.

Effect on blood pressure

From the physiological view point the effect of pool therapy on blood pressure cannot be studied in isolation since it is just one of the results of the inter-related adjustments being made to the circulatory system. As practical physiotherapists it is important to have quantitative data of the changes in blood pressure which may be expected to arise during a typical pool treatment.

Contra-indications to pool therapy

- Incontinence of faeces
- Incontinence of urine
- Skin conditions and other infections
- Blood pressure
- Vital capacity
- Epilepsy
- Fear of water

3.11 TECHNIQUES OF EXERCISE IN WATER

There are essentially two different ways in which the patient can be treated in the hydrotherapy pool. Treatment can be carried out with the patient supported on a submerged plinth and holding the side of this, or supported in rings and holding onto a rail, standing or sitting. The method of

exercises given with the patients supported in this manner is called the CONVENTIONAL METHOD. Alternatively there is the BAD RAGAZ or RING METHOD which is used when the physiotherapist herself provides the fixed point from which the patient works. The patient is supported in floatation rings and does not themselves hold onto any fixed equipment. The characteristics of strengthening and mobilising exercises from these two methods differ to a certain extent. In the conventional method emphasis is usually placed upon exercising one group of muscles in one plane of movement. The rotation component is not easy to assist or resist although the patient can be encouraged to move to the extremities of range with fixation being provide by the physiotherapist. Patterns of movement are utilised in the Bad Ragaz method and three elements of movement are inherent in all movement patterns. Theses are flexion – extension, abduction – adduction, and internal and external rotation.

Advantages and Disadvantages of the two methods:

- Security

When lying on a submerged plinth or holding onto the pool handrail supported by rings, the patient feels safe and secure. Any anxieties and fear of water are more easily decreased using this fixation. A patient left to float free unused to the water will be become too over-anxious to perform the exercise or focus.

- Comfort

Whilst holding onto the rail or plinth the patient sometimes experiences discomfort in the neck and shoulders so relaxation is difficult, whereas for a patient floating with rings there is more relaxation and movement achieved.

- Manual Contact

Although in the conventional method the physiotherapist can give assistance and resistance manually, the method also depends on the use of buoyancy for this purpose. Frequently the physiotherapist is providing extra fixation for instance at the pelvis. Therefore it can be concluded that with little manual contact the physiotherapist does not have the opportunity to feel quality of movement. In the Bad Ragaz method the physiotherapist by use if their manual contact and body stance provides fixation for the patient in all movements. The physiotherapist who is working dynamically with the patient is thus able to feel and assess the quality of movement and make subtle alterations in resistance through range.

- Group Work

The use of rings and other buoyant equipment in the conventional method enables the method to be used in treating groups of patients in the pool requiring only one or two physiotherapists. The advantages of group work can thus be added to that of being able to provide each patient with

specific exercises of the required strength, intensity and duration. The Bad Ragaz method can only be used for group work if there is one physiotherapist to help each patient which is difficult.

- Variation

In using the conventional method the physiotherapist is to some extent limited in variation of exercise. Different positions are used depending upon the need for resistance or assistance but limited and not specific to the patients problems. Whereas with the Bad Ragaz method the physiotherapist has much greater control of the patient having direct manual contact providing large possibilities of variation of exercise. As this method allows for such variation, both patient and physiotherapist working together are well motivated and thus enjoy the pool session.

- Size of Pool

The size of the pool for use of the conventional method is not very important. Bu what is important is the handrail around the pool at water surface level and a submerged plinth. Pool size is important however for Bad Ragaz method because the pool should not be smaller than 6m by 4m and not deeper than 1m except for areas with gait exercises in mind (Davis, 1988).

3.10.1 Conventional Method

Positioning the patient is a significant factor in the use of this method. The position of the patient will depend upon whether assistive or resistive work is to be given and to which specific muscle group. The exercises can be divided into the hip, knee, shoulder, and trunk. These exercises are generally performed with the aid of handrails and plinths to stabilise the patient while the physiotherapist guides them through the exercise and has direst contact with moving the parts of the body that need to the moved and exercised.

3.10.2 The Bad Ragaz or Ring Method

In this method, buoyancy is used in its supportive function and not as a means of providing resistance. The patient is not required to hold the rail nor does he need the support of a submerged plinth. The physiotherapist provides the fixation for the patient and she must, therefore be in the water and work on a one to-one basis with the patient, throughout the treatment sessions. As a form of resisted exercise the Bad Ragaz method is required in that the resistance is self-regulating. In other methods, provision of the maximum resistance required for muscle strengthening must be adjusted by the physiotherapist.

In the Bad Ragaz method the resistance increases as the speed of the movement increases, and providing the patient is working to his maximum, the speed and thus the resistance will adjust itself to the patients' capabilities. Use of this method of exercise in water enables the

physiotherapist to work muscles and joints in patterns of movement, rather than isolating activity to one group of muscles or to one joint.

Specific techniques such as repeated contractions, slow reversals, quick stretch and rhythmical stabilization can be used to good advantages. The rotation component of all muscle groups can be resisted or assisted, ensuring maximum response to the demand placed upon the muscle action.
Ii is very easy during treatment to disrupt the equilibrium, even though the use of floatation aids to assist in the stability of the patient in water. The physiotherapist must be aware of this tendency and handle the patient appropriately. Different patterns of movement will be used depending upon the muscle groups to be strengthened or joint range increased. The resistances which are produced by the various patterns will have limits beyond which they cannot be increased, and if at this point the muscle needs further strengthening other methods must be used (Davis, 1988).

3.12 TYPES OF CONDITIONS TREATED WITH WATER THERAPY

PAEDIATRIC HYDROTHERAPY

- Disorders of Bones,
- Joints and Muscle
  - Juvenile Chronic Arthritis
  - Muscular Dystrophy
  - Congenital Abnormalities
  - Spina Bifiden
  - Osteogenesis Imperfecta
  - Burns
- Neurological and Development Disorders
  - Cerebral Palsy
  - Head Injury
  - Epilepsy
  - Infection of Central Nervous System
- Learning Difficulties and Behaviour Disorder
  - Severe Learning Disabilities
  - Autistic Children
  - Hyperkinetic Syndrome
  - Perceptual Disabilities

ADULT HYDROTHERAPY

- Neurosurgical and Head Injuries
- Neurological Rehabilitation
  - Hemiplegia
  - Parkinson's Disease
  - Multiple Sclerosis

- Perceptual and Cognitive Problems

- Spinal Mobilisations
- Spinal Cord Injuries
- Rheumatic Diseases - Inflammatory Arthritis
  - Degenerative Arthritis
  - Spondyloarthropathies
- Orthopaedics
- Management of Sports Injuries
- Aquanatal Exercise

3.13 CONCLUSION

Hydrotherapy involves the use of water as an exercise and bathing procedures for rehabilitation. Water is the only other environment available to man other than land. When a body moves into the water it experiences two things – it is simultaneously reacts to two forces, the first is the downward pull of gravity and the second is the upthrust of buoyancy. These two forces experienced at the same time when in water allow the possibility of three-dimensional exercise and movement that when on dry land is hardly achievable. With the understanding in flexibility and gain of unusual movement in water, many forms of rehabilitation for different ailments can be achieved.

Hydrotherapy is the utilization of water in the treatment of disease and its therapy importantly exploits its temperature effects. Hydro- and hydrothermal therapy are traditional methods of treatment that have been used for the treatment of disease and injury by many cultures, including those of ancient Rome, China, and Japan. At a historical level the time in which hydrotherapy was first used is unknown but the first records of it dates back to 2400BC from the Proto-Indian culture, Egyptians and Assyrians, as they used mineral waters for curative purposes. Only recently in the 1920's was therapeutic pool exercises developed. Today hydrotherapy is evolving into a valued natural medical therapy on both physical and psychological levels.

The main goal for the hydrotherapy centre is to innovate hydrotherapy as a practice and convert standard lifeless pools into specifically designed pools that allowed patients to comfortably focus on areas of treatment with the pools instead of having one design in which the patient had to conform to.

CHAPTER 4
HYDROTHERAPY PRECEDENT AND CASE STUDIES

4.1 PINELOG HYDROTHERAPY POOLS

From our Derbyshire base we have been offering a total quality service for over 30 years. Pinelog possess the design, technical and manufacturing resources to undertake a wide range of domestic and commercial building projects, providing a full design and build service throughout. Indoor swimming pools, hydrotherapy pools, leisure centres, church halls, visitor centres, classrooms and Pinelodge holiday homes are all designed and built by Pinelog. Summerhouses, timber buildings, log cabins and garden buildings also form part of the product range.

Our hydrotherapy pools are pleasant, safe and inviting in appearance. Pinelog's expertise in designing and constructing indoor pools together with the aesthetically pleasing use of our structural glulam timber beams and other materials ensures that our pools look attractive and perform well. Pinelog's construction materials provide some of the best acoustic performance too, which is another important design consideration.

Hydrotherapy pools are warm water pools usually used by physiotherapists while treating patients who may have physical problems or special needs (fig 4.1). Pinelog construct hydrotherapy pools for private individuals, special needs schools, hospitals, private practitioners and disabled groups. The design of the hydrotherapy pool requires an assessment of the user's special needs to ensure that it provides appropriate therapeutic benefits (web 4).

Figure 4.1: Pinelog Hydrotherapy Pools

The size of the pools will vary from a small hydrotherapy pool of 6m x 4m up to much larger ones; the minimum space required for each patient is 2.5m x 2.25m, so for example a 5m x 9m hydrotherapy pool would accommodate up to eight patients. In some cases we build high pressure jets into the pool to provide a resistance to swimming or to have a massage effect. The hydrotherapy pools can also be transformed into a full sensory environment with use of specialist lighting, sound system and fun floats.

The building will have a specially designed heating and ventilation system (environmental control) which will keep the air temperature to the desired level, provide ventilation and control the humidity. Facilities within the hydrotherapy building include spacious changing areas, showers and toilets including accessible shower/s, wc/s, and wash down beds, with the number and layout being determined by the specific number of users. Separate facilities for physiotherapy staff are also generally built in. Your Pinelog hydrotherapy pool will be designed and tailored to meet your individual requirements (fig 4.2). We look after all aspects of the construction from initial design and planning permission all the way through to project completion, with our experienced contract management team ensuring the development progresses smoothly.

As members of the Spinal Injuries Association, Headway and The Centre for Accessible Environments, we seek to understand and interpret the needs of users in each hydrotherapy pool we design and build (web 4).

4.1.1 Figure 4.2: Hydrotherapy pool with a contemporary mechanical hoist to get disabled persons in and out of the water easily and comfortably.

Ashgate Croft School, Derbyshire - Hydrotherapy Pool

The children at Ashgate Croft School now enjoy all the emotional and physical benefits of hydrotherapy and have the chance to learn to swim following the opening of a hydrotherapy pool in the school grounds. The client was Ashgate Croft School, Chesterfield, is the largest school for children with special needs in Derbyshire. It offers a full range of opportunities for over 140 children aged between 3 and 19. The school once had its own swimming pool but this fell into disrepair and had to be demolished. Although some pupils were able to swim at a nearby public pool, this was not without its logistics problems and sessions were often cancelled. Realising that the only way pupils could derive the benefits of hydrotherapy on a regular basis was by having a pool on school grounds, a major appeal called "A Pool for Megan" was launched. This received considerable support and sufficient funds were raised to allow the project to proceed. Pinelog won the contract to build the new hydrotherapy pool – its long experience in this market giving it the edge.

The Specifications needed was that the main structure houses a 12m x 6m hydrotherapy pool with a constant depth of 1.2m and a number of changing facilities to meet the various needs of users. All the facilities are on one level and are connected by a specialised overhead electric hoist which can take users to showers, toilets and to the pool (fig 4.3). It is clad with facing bricks up to 2.5m high and vertical Siberian larch panels to the roof. Siberian larch was chosen because it is hard, durable and requires little maintenance. Wide automatic entry aluminium doors finished in contrasting bright blue and yellow allow easy access for those in wheelchairs.

Figure 4.3: very modern mechanical stretcher hoist

The vaulted timber roof combined with high level glazing provides an open, light-filled environment (fig 4.4). The insulated pool has several easy methods of entry and operates at 33°C – very warm water being essential for hydrotherapy treatment. The bacteria levels are controlled by an ultra-violet treatment system and climate control equipment maintains a constant air temperature of 34°C. Slip resistant floor tiles surround the pool and the walls and floors in the changing areas are finished with hygienic, heavy duty welded vinyl sheet. The pool can also be transformed into a full sensory environment with the use of specialist lighting, sound system and fun floats.

Figure 4.4: Well lit and spacious hydrotherapy pool with accessories

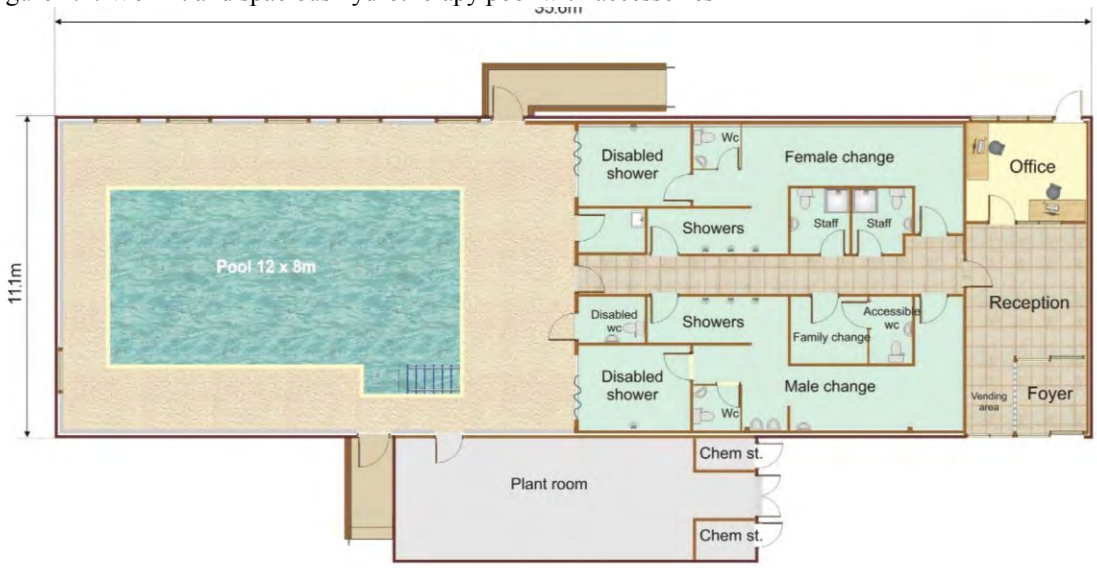


Figure 4.5: Plan of Ashgate Croft School's hydrotherapy pool layout

Head teacher Mike Meaton said: "A swimming pool at this school is as important as a classroom. Swimming gives an enormous boost in self-confidence and is sometimes the only chance pupils have to get out of a wheelchair and undertake physical activity. This wonderful pool means that all our children have the chance to learn to swim and have hydrotherapy classes to meet their needs." "Pinelog has done more than build us a pool – they've helped us build brighter futures for the children." (web 4)

4.1.2 Wessex Autistic Society, Portfield School, Dorset - Hydrotherapy Pool

A hydrotherapy pool in the grounds at Portfield School provides essential therapeutic benefits for pupils and the wider community. The client in this case was Portfield School, the first school in the UK purpose-built for children with autism, saw hydrotherapy as an essential part of the educational and therapeutic facilities available to pupils. An appeal was launched to fund an extension to accommodate such a pool in the school grounds. After receiving substantial support, Wessex Autistic Society was able to start planning its new facility by the beginning of 2007. Officials visited several Pinelog projects which convinced them to place the order.

The Specifications to the Pinelog's architects were able to minimise any planning risks by designing a linked building which replicated many of the main school's features in terms of style, height, roof pitch, materials etc. As a result, consent was obtained and the development progressed smoothly. The new facility is constructed in timber frame with glulam laminated beams and trusses, giving a vaulted roof style in the pool area (fig 4.6). It is faced externally with red brick and has a 30 degree pitched roof finished with natural slate tiles. It incorporates a covered corridor linked to the main school, reception area, 12m x 6m hydrotherapy pool with hoist, sensory bubble pool, viewing area and changing facilities.

Figure 4.6: Simple naturally lit hydrotherapy pool with minimum clutter

Figure 4.7: Accommodating entrances and movement spaces for wheelchair access

A soft play room, store rooms and plant room complete the ground floor (fig 4.7). There is also a substantial first floor, overlooking the pool below, to be used as a meeting / conference room. This floor is accessed by a staircase complete with chair lift. The insulated pool is two tiered with wide steps and handrails for easy entry and finished in bright multi-coloured mosaic tiles (fig 4.8). It operates at 33°C – very warm water being essential for hydrotherapy treatment. The

bacteria levels in the pool are controlled by an ultra-violet treatment system and climate control equipment maintains a constant air temperature of 34°C.

Figure 4.8: Wessex Autistic Society, Portfield School's hydrotherapy pool

Figure 4.9: Plan of pool and surrounding rooms

Said Kevin Medcraft, Wessex Autistic Society's Facilities & Procurement Manager: "We are delighted with the new pool which is also available for use out of school hours by children with autism and their families, many of whom do not take their children swimming because of the stresses associated with the experience. This facility therefore also offers a rare opportunity for family-wide

leisure activity away from home." (web 4)

4.1.3 Bradstow School, Broadstairs, Kent - Sensory Swimming Pool

By providing a relaxing place for regular hydrotherapy sessions and an outlet for pent-up energy and relaxation, the new state-of-the-art sensory swimming pool at Bradstow School is meeting the needs of all its pupils. The client was Bradstow School in Broadstairs, Kent is a residential school maintained by the London Borough of Wandsworth for children who are severely disabled with autism. Regular use of a swimming pool is essential for hydrotherapy sessions, as an outlet for pent-up energy and for relaxation. Although pupils were able to swim in nearby public pools, logistics problems meant that sessions often had to be cancelled. The only practical way for the school to deliver its objectives and allow its therapists to provide the benefits of hydrotherapy to each child on a regular basis, was to have a swimming pool located within its own self-contained parkland. The school embarked on a number of fund raising projects and eventually sufficient funds were raised to allow them to proceed. Chartered Architects Wilby & Burnett were appointed to project manage the scheme and in a competition involving five design and build specialists, the proposal from Pinelog was chosen. Pinelog's competitive price, many years' experience in the design and build of hydrotherapy swimming pools and the fact that it could offer a full turnkey service for all aspects of the project were all key in the selection process.

The brief was for a new fully equipped swimming pool is located on an open space adjacent but unconnected to Bradstow School. In order to secure planning permission the pool is of a design similar to surrounding residential buildings. It is timber frame construction, clad with red facing bricks with a horizontal string course of contrasting buff bricks to create aesthetic appeal. Traditionally shaped red concrete roof tiles provide a striking effect and help the building blend into its environment. The structure has an open vaulted roof and houses a reinforced concrete and tiled 12.5m x 5m hydrotherapy pool with a constant depth of 1.2m. It also has a relaxation area to calm overactive children, separate male and female changing areas, WCs and shower bays to meet the various needs of users. Slip resistant floor tiles surround the pool and the walls and floors are finished with hygienic The temperature of the water is held at 32°C. – the pool circulation equipment being designed to give a minimum water turnover of one hour with the water treated by an automatic purification system. The heating and ventilation systems keep the air temperature at this same level and control the humidity too. The exposed redwood timber frame and other materials used in the construction help to provide an excellent acoustic performance.To create a truly interactive multi-sensory facility for those with autism, a number of special features have been incorporated, including massage jets, a water curtain and a spray

mushroom (fig 4.10). The pool building can be filled with music thanks to an audio system with underwater speakers and flooded with coloured light via special underwater and roof lighting.

Marilyn Jones, Business Manager at Bradstow School says: “Our new sensory swimming pool looks fantastic and the children and young people have a great time in the water while the added sensory experiences help their development and learning. It is low energy, sustainable, aesthetically pleasing and thankfully a very robust building as it is in constant use. It is a wonderful new asset for the school.” (web 4)

Figure 4.10: Hydrotherapy pools can also be made fun and interesting for children with fountains and sprays

Figure 4.11: Bradshow School's Hydrotherapy pool layout

4.2 LIFE ENTABENI REHABILITATION CENTRE, Durban

The hydrotherapy pool at Entabeni is an outdoor pool about half the size of a standard swimming pool (3.5 x 7m). The rehabilitation houses 50 patients with the hydro pool and gym areas. This facility or pool sees about 5 to 8 patients a day due to the size of the pool. The depth of the pool is 1 meter so no diving is cautioned but the depth of pool may vary. The ideal situation is to have a shallow and deep end to allow for proper immersion.

Types of patients that were treated by hydrotherapy pool are

- Cardiac Patients
- Stroke patients
- Head Injuries
- Spinal Cord Injuries
- Sports Injuries

Patients always have a therapist in the water with them – it has been expressed that it is better to also have an assistant outside the pool for emergencies. An emergency mat should be placed next to the pool for emergencies like should a patient have cardiac arrest while in the water. There should be a panic button nearby for emergencies. Water is a good medium for exercise as they can't fall down and is easy on the joints and muscles. Plus the sensory input from water on skin is a good feeling for patients suffering from stroke where they have lost feeling in their limbs.

There is a thermometer placed in the water to check the water temperature constantly as the incorrect temperature is harmful to patients. The ideal water temperature should be between 30 to 35 degrees. There should be a special heat pump to heat water as water gets pumped the pool to it via one pipe and another pipe brings the heated water back to the pool. The pump room for the hydrotherapy pool is a brick room outdoors. The Rehabilitation Centre carries out regular water quality tests twice a month with EThekwini and have a contract with Splash Pool to clean the water and pool once a week. These sessions are around 20-30 minutes.

It is not advisable to allow patients into the water that have open sores or wounds, unstable blood pressure, or who are incontinent (have no bowel control). Railings are a vital accessory to hydrotherapy pools as they aid the patients in exercise in the water. The railing should be along the edges of the pools. In this pool they are only on one side and a suggestion was to have them on both of the longer sides.

Entabeni has the hydrotherapy pool covered by a special mat that it used to keep the heat from evaporating and cooling the pool and prevent debris and dirt from coming onto the pool (fig 4.12). But due to the shiny quality of the special mat the birds like to peck and make holes on the mat, and the heavy elements damage it. It is necessary to keep the water level as high as possible. A hoist is used to get the patients into the water. The hoist is a stainless steel contraption attached to the side of the pool. It is a steel chair that is submerged with a pole that comes up high out of the water. The chair then gets lifted up the steel pole by a hydraulic system (with is water generated from a tap close to the pool) and when at the correct height swung around to the pool ledge for patients to get on. Another method suggested by the interviewee was to have a ramp going into the water and the patients' then wheeled in the pool by a plastic wheelchair. The ideal size of a pool according to the interviewee was something bigger than the existing around 15 to 20 meters long in order to get the patients to take a few strokes before reaching the opposite side of the pool for exercise. The spaces around the pool and access to it should be wheelchair friendly. Patients can be harnessed around their waists to the side of the pool for certain exercises such as running in one spot.

Figure 4.12: Entabeni's outdoor hydrotherapy pool with covering, hydraulic hoist, thermostat, and layout

4.3 KING GEORGE HOSPITAL, Durban

Important factors to consider when designing hydrotherapy pools are the dimensions of the body and the different age groups using these pools. Depth perception is important for the patients in the pool and the lighting conditions affect this such as harsh bright water reflections or light at eye level which distorts the depth perceptions of patients in the water. Top natural lighting is more appropriate. Technology can be incorporated into hydrotherapy at a visual level with exercise videos that patients focus on in session while the therapists focus on the patients' movements and correcting them. This is more fun for the patients and more focusing for the therapists.

There should always be seating at the edges of the pool for the transition period for patients to get accustomed to water as panic and fear of water is highly common. Railing should be all around the pools to allow patients to keep to edges and for exercises and security. The ideal water temperature for hydrotherapy pools should be 35 degrees but the higher the temperature than this, results in dehydration and increased blood pressure which is extremely harsh conditions for patients. Exercise sessions should therefore be half an hour to prevent dehydration of patients and therapists.

There is an important procedure or process for the patients to follow before getting into the pool. Every patient must rinse or wash themselves in a shower before entering the pools. This is to prevent lotions and moisturizers from contaminating the waters as well as general hygiene. This results in showers cubicles with nonslip flooring like rubber mats leading from the showers to the pool. Pressure systems or whirlpool baths can be beneficial to certain types of patients but not all depending on the condition or disease. For example hypertension and unstable blood pressure is aggravated by the jets but highly therapeutic for muscle or sports injuries. Most hospitals have one pool and so do not incorporated massaging jets. Therapists find that edges of pools are very important because patients are always using them or relying on them and so the more angles a pool has the more edges can be utilized by the patients.

"Hydrotherapy is a neglected field of physiotherapy due to inadequate facilities" Eugene Augustine. This statement is supported by the fact that King George hospital after undergoing recent intensive renovation to upgrade the hospital and its facilities with state of the art equipment for the physiotherapy (Spinal Unit) department have not even considered the incorporation of a hydrotherapy pool in its midst (fig 4.13).

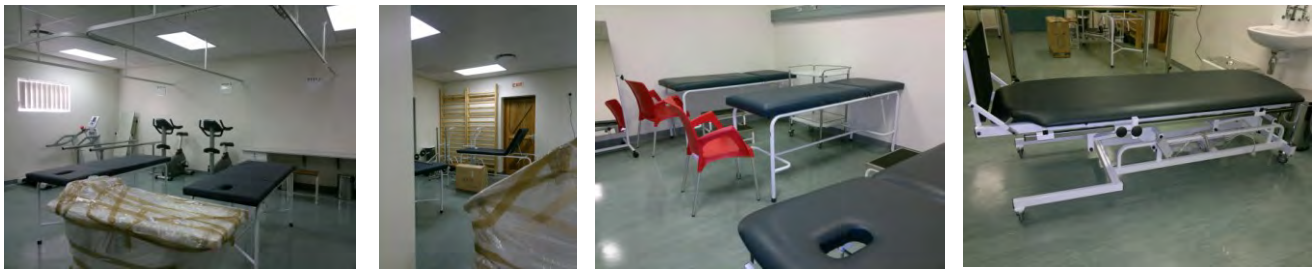


Figure 4.13: King George's physical therapy room with fitness equipment but no hydrotherapy pool

4.4 ADDINGTON HOSPITAL, Durban

Addington Hospital has an indoor hydrotherapy pool that is around 7 by 4 meters in dimension (fig 4.14). This pool has been used for the past one and a half years due to a water pipe burst which has needed to be fixed. Now that it has the pool needs to be painted before it can be filled. This pool is elevated 800mm off the ground on the second floor of the hospital with a wide 500mm edging all around. Around the pool where the pool wall meets the floor there is a drain pipe that is an extra measure to drain excess overflow water from the room. The pool itself is divided into two sections with a shallow section and deeper one with the levels being separated by a single ledge down the long length of the pool. There are a few steps at one end leading from the shallow ledge to the deeper area. There are entry outlets for water to be pumped in on the higher level and drainage pipes at the deepest end to drain water.

There is a mechanical hoist that is situated at the end of the room with leads to the pool via a rail on the ceiling and stops in the middle of the pool. This has a weight limit and has not been used in a very long time. Due to the harsh coastal conditions it has also started rusting. The pool has aids in the form of railings on all four sides for the patients t hold onto. To access the water in the pool the patient has to climb up movable steel steps and climb of swing themselves over the edge. This is quite uncomfortable for patients suffering from arthritis and serious medical injuries. There is a shower cubicle and change area for the patients to use in the next room to the pool with rubber mats leading to the entry point.

There are two small skylights that provide top lighting in a cozy shade of yellow which lightens the room considerably compared to the floor to ceiling sliding glass doors at the one end of the room. In order to fill the pool the maintainence puts a hosepipe into the pool attached from the shower cubicle and fills it. The pool is treated with chlorine and nothing else. The thermostat in down with the heater pump in the basement and so is not immediately accessible which causes delays with the therapists needing to sort out problems in temperature. The pool generally fits six people at a time but at most eight people with the corners going to the weaker patients because it has more support and the stronger patients in the middle edges.

Addington sees mostly arthritis patients and mostly utilized by out-patients. There is a therapist assigned on rotation every 3 months and the pool visit days are Monday, Wednesday and Friday. The water from the pool gets tested every Friday and is sent to the labs in the hospital for any contaminations or water growths. The problem with this pool is the difficult access, the steep step with no gradient, and the deep section which most patients do not feel comfortable in. The steam and heat of the room from the water is highly problematic with clear evidence of the paint peeling on the walls and the stained drip lines on the one wall. There are many floatation aids that are used by the patients in the pool for exercise and to make them more confident in the water and these have to be stored away such as flippers, long floating tubes, body-boards, etc.

Figure 4.14: Addington's pool that is not working, typically raised off the ground and split level with drainage ducts at edges on floor

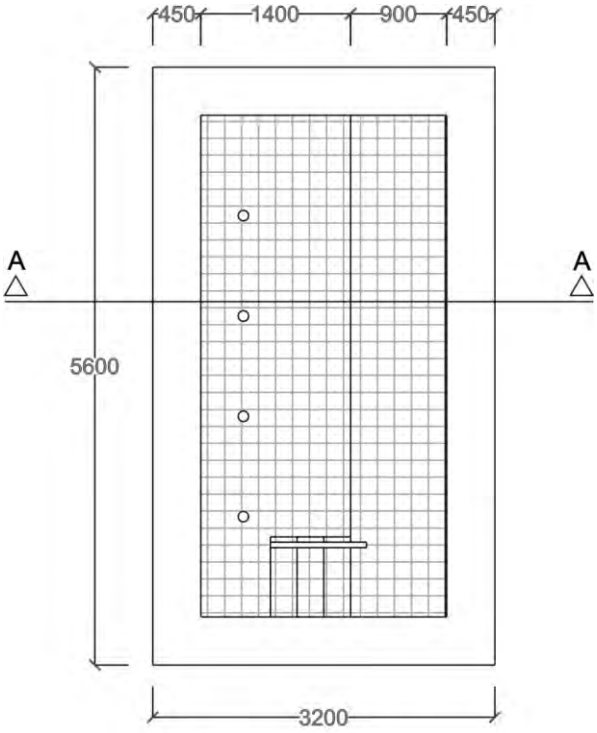
4.5 LIFE WESTVILLE HOSPITAL, Durban

Westville Physiotherapy Department has a large department for a private hospital. There is a large gym used by in patients and the only facility that allows out patients' utilizing the facility (fig 4.15). The room is about ten by seven meters with large unobstructed space and especially non slip flooring. There is a lot of equipment that goes into these rooms and so storage is important. This equipment are parallel bars, Pilates mats and bed, treadmills, cyclers, bouncing balls, dumb bells and weights, fake movable steps, ladders. Important elements in these exercise rooms are mirrors for patients to correct there posture and see their progress. Also important are precaution measure such as a defibrillator in case of cardiac attack or oxygen tank for wheezing or hypertension.

Figure 4.15: Physical therapy room at Westville, spacious with lots of equipment and mirrors

4.6 RK KHAN'S HOSPITAL, Durban

RK Khan's Hospital hydrotherapy pool is very similar to Addington's facility (fig 4.16). It is not currently working due to a broken thermostat. The actual hydrotherapy pool is raised of the ground and needs to be accessed over the wide edge. It is also laid out the same with a difference in levels joined by a small flight of steps (fig 4.17-8). The pool measures 5.6 metres by 3.2 metres. It has a 450mm wide seating rim around the perimeter and a hoist suspended over the pool. This hoist does not work. This facility also houses a Hubbard Tank which is not in use due to it leaking. There is plentiful natural lighting from the high level line of windows at the edge of the room as well as four skylights seen also in Addington hospital. The pool floor and side finish is tiles and the only pool seen thus. The rest are either fibre glass or painted. There is one shower cubicle and toilet and a storage room for equipment. The pool looks like it is filled by a hosepipe which is attached to the adjacent wall. HTH is added to the pools waters to cleanse the water.



HYDROTHERAPY POOL PLAN
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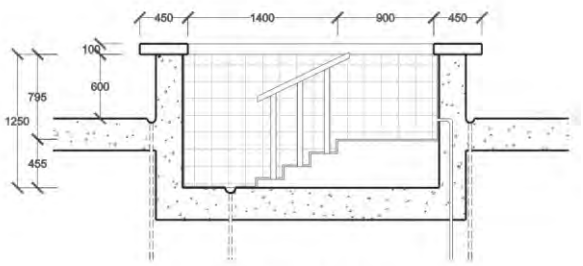


SECTION A-A

Figure 4.16: Typical raised hydrotherapy pool at RK Khans and Hubbard tank. Plan and section of pool

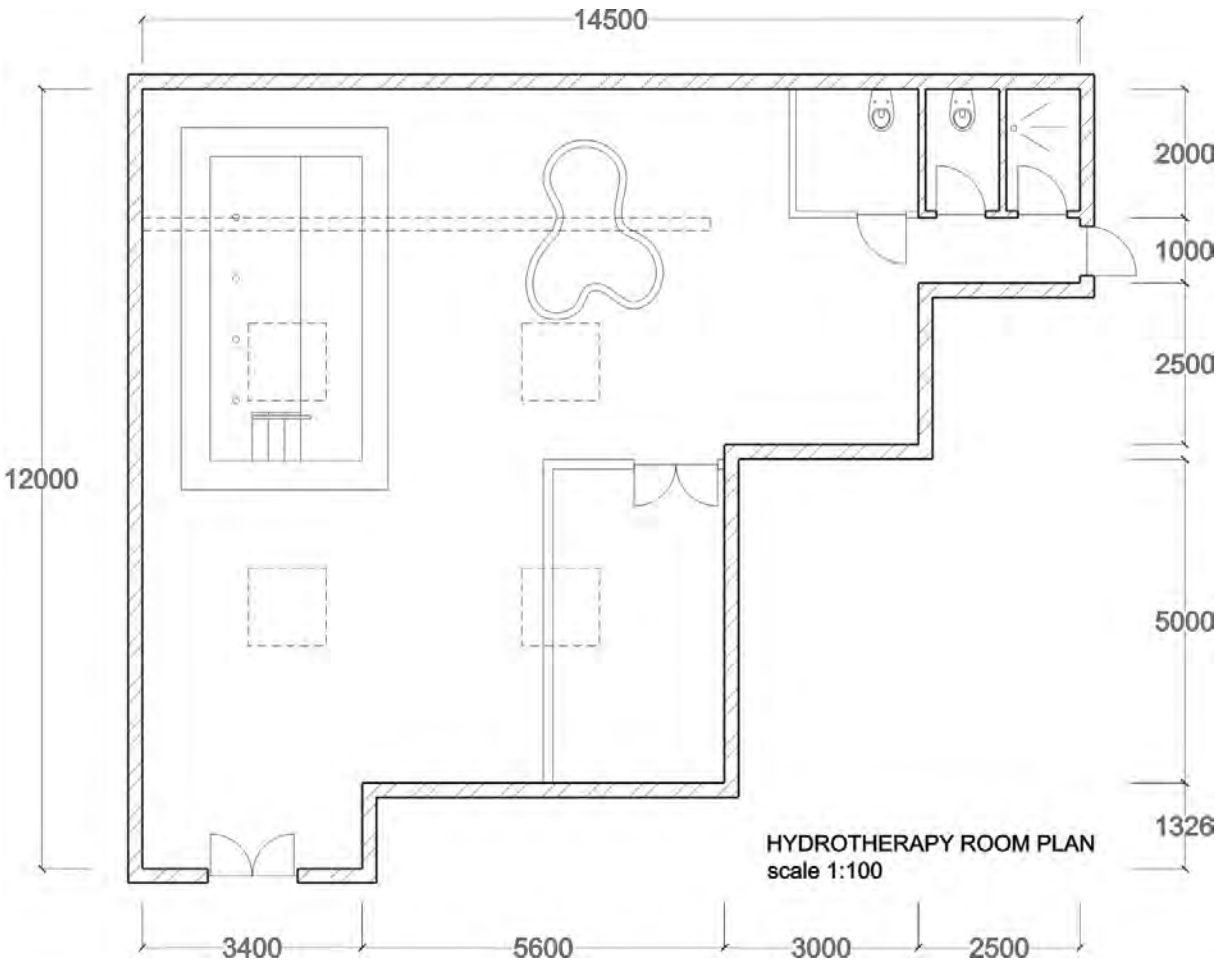


Figure 4.17: RK Khans hydrotherapy room layout

Figure 4.18: Hydrotherapy pool not working but has accessories like mechanical stretcher hoist and skylights

4.7 GREYS HOSPITAL, Pietermaritzburg

Grey's Hospital hydrotherapy pool is much better designed than most. It is a ten by five metre pool of one metre depth. It also houses a Hubbard tank. The room is entered at the highest level of the pool and then steps and ramps down on either side to the lowest end of the pool. The pool can be accessed by the mechanical hoist which runs straight through the centre of the pools length and curves to another part of the room where the Hubbard tank sits (fig 4.19).

The pool at entry point or side has a shallow step for walking patients to enter the water or can be access by the ramp leading into the pool which is used for patients in wheelchairs. In this instance Grey's uses normal wheelchairs and not plastic wheelchairs for the patients to get into the water. There are numerous railing, one set for the ramp and one around the complete edge of the pool. Like Addington there is a wide 500mm ledge to the pool. There are a few drainage systems at the pool; the first is at the shallowest point where people walk in and out of the pool which has a steel covering with holes to catch excess water from the dripping body. And then there are overflow drains around the bottom of the outside of the pool for complete major overflow of water, and minor overflow is dealt with outlets at the top inside edge of the pools circumference. On the higher level off the ramp is the inlet nozzles for water to be pumper in and on the floor of the pool down the center are four suction outlets for water to be drained.

There are male and female change rooms each with a shower cubicle and many rubber mats on the floor and leading to the pool. There is also an additional foot tub to rinse the feet before entering the pool. The pool used to be treated with special spa treatment slats but this became expensive and difficult to acquire and so the maintainence has fallen too using HTH Chlorine. The pool gets cleaned everyday and is also available for patients use daily. Monthly water quality tests are done but have to be sent to Durban's laboratories. A suggestion that a better product might be available but needs to be tested in warm water is Blue S2. The ideal temperature for vigorous exercise according to the therapists is 32 to 34 degrees Celsius. The hydrotherapy pools are used especially for pain management for conditions such as arthritis.

Ideas for better management is a swing-out seat in the shower cubicles for wheelchair patients and more than one shower cubicle as this restricts time and people. A vacuum hose system to capture dust and dirt in the water instead of very gently sweeping under water to the dirt to suction drains. And a more hands on approach to heating where the controls for water temperature is at therapists' disposal and not down in mechanical rooms.
The

Figure 4.19: Grey's hydrotherapy room which is better designed than most entering at top pool level with room ramping down to bottom - therefore easier access for patients. Importantly the only working hydrotherapy pool in KZN. With Hubbard tank, re-education walking pools, mechanical stretcher hoist, ramp into pool, and large spacious layout area.

Hubbard tanks are a good option for patients' that cannot use the public pools because of contamination. These pools can be filled and then drained and cleaned after each patient such as ones with open wounds, drips and who are incontinent.The water management system is colour coded in the mechanical room or floor in Grey's case. First the water is sucked out of the pool by the suction cups on the floor of the pool and then taken via pipes (light blue) to the sand filter (green) which filters out any debris, the water then moves to the heater pumps (red) which have the water going through the cylinder in which hot steam heats the water. This warm water is feed back to the pool in a separate pipe entering the pool at a higher level. All the overflow and

drainage outlets have a separate system (cream) and lead straight to the many drainage pipe and gets feed put of the building (fig 4.20).

Figure 4.20: The mechanical system for heating, cleaning and draining the water from the hydrotherapy pool which is on the floor above. The system is ordered by colours and has two heaters and filters for backup.

The pool gets drained once a year with fresh water being pumped in. the pool can either be lined with good quality waterproof paint or fibre glass and an important technical issue is the proper sealing of the pipes and outlets going into and out of the pool. Grey's is the only facility with a walking pool much like parallel bars on land that is a long narrow deep pool with handrails on

either side and steps to enter down. This is for walking movement and exercise and there are two, most probably for warm and cold water. This has not been used in many years.

4.8 CONCLUSION

Hydrotherapy pools currently are general standard designs that try to incorporate as much natural light as possible. The accessibility and temperatures are very important aspects due to the types of people utilising them.

Faults of existing hydrotherapy pools are:

- The pools are raised of the ground making access into the pool very difficult for people with disabilities
- the maintenance of the pool is very intensive so breaks all the time resulting in continual maintenance person being on site
- Pools are not very well lit which is an important factor for patients to visually perceive their movements in the water
- due to continual braking down the pools were unutilised to their full potential
- Important factors to consider when designing hydrotherapy pools are the dimensions of the body and the different age groups using these pools.
- Depth perception is important for the patients in the pool and the lighting conditions affect this such as harsh bright water reflections or light at eye level which distorts the depth perceptions of patients in the water. Top natural lighting is more appropriate.
- Technology can be incorporated into hydrotherapy at a visual level with exercise videos that patients focus on in session while the therapists focus on the patients' movements and correcting them. This is more fun for the patients and more focusing for the therapists.
- There should always be seating at the edges of the pool for the transition period for patients to get accustomed to water as panic and fear of water is highly common.
- Railing should be all around the pools to allow patients to keep to edges and for exercises and security.

Hydrotherapy Pools and their designs need to be looked into to better facilitate the patients, their exercise; and the spaces provided in order to fulfil the necessary requirements to become truly healing environments of water therapy and healing.

CHAPTER 5
ENVIRONMENTAL RESPONSE

5.1 GLULAM TIMBER CONSTRUCTION

5.1.1 Introduction

The natural beauty of wood is unsurpassed. Exposed structural glued laminated timber provides structures with a warmth and beauty unrivalled by other building materials such as steel or concrete. Glulam members may be textured and finished to meet contemporary, traditional or historic buildings' appearance requirements. This material offers designers a multitude of options for large, open spaces with a minimum number of columns. Structural glued laminated timber is manufactured by bonding assemblies of high-strength, kiln-dried lumber, with waterproof adhesives. Special bonding techniques allow individual lumber pieces to be joined end-to-end to form long laminations, then face-bonded to form deep timbers.

In terms of versatility the laminating process allows timbers to be produced in a variety of shapes from straight beams, tapered beams to graceful, curved arches. Glulam trusses also take many shapes, including simple pitched trusses, complicated scissors configurations and long span bowstring trusses with curved upper chords. This architectural adaptability allows glulam to extend the enduring qualities of wood into applications as varied as individual designers' imaginations. The beauty of exposed glulam construction does not require the added expense of false ceilings to cover structural framework. Common uses in residential construction include ridge beams, garage door headers, door and window headers, and columns. High strength and stiffness make glulam beams ideal for long-span girders and beams needed for commercial construction. Glulam arch systems and trusses further increase the aesthetic and structural possibilities when using laminated timber construction (fig 5.1).

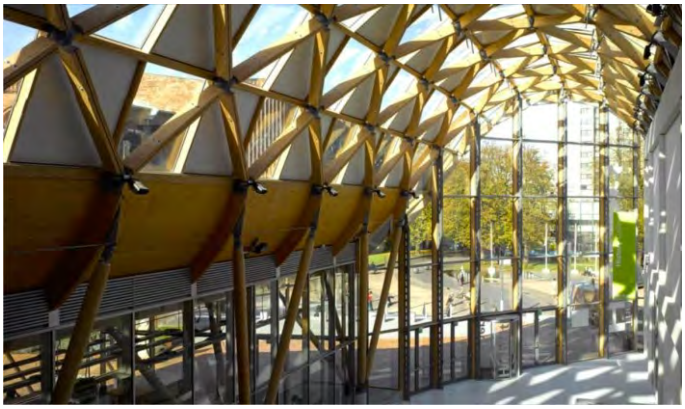


Figure 5.1: Herbert Art Gallery & Museum, Coventry

Structural qualities and strength of glulam is that specially graded laminations with high strength and stiffness properties are carefully positioned within timbers to create glulam members with exceptional structural properties. The highest grades of lumber are used in the areas of greatest stress, with lower grades used where strength is not as critical. This lay-up concept makes very efficient use of the lumber resource. In a typical glulam beam, stresses are highest near the top

and bottom of the member, so the highest grades are placed near the surfaces, with lower grades placed in the core (web 5).

The high strength and stiffness of laminated timbers enable glulam beams and arches to span large distances without intermediate columns. In commercial design, custom glulam beams can span more than 100 feet. In reticulated glulam framed dome structures, glulam arches span more than 500 feet. The size of structural glued laminated timber members is limited only by transportation and handling constraints. Widths up to 250mm to 20mm are manufactured using single laminations across the width. Wider sizes are manufactured using two or more laminations across the width of the member. Typical depths range from 125mm to 15mm up to several centimetres (feet). Glued laminated timber trusses, beams, and arches are used to provide efficient enclosures for expansive areas such as gymnasiums, educational and recreational facilities, indoor pools, auditoriums and shopping centers (fig 5.2-4). In addition, the wood's ability to absorb impact forces created by traffic and its natural resistance to chemicals, such as those used for de-icing roadways, make it ideal for these installations. Glulam has even been successfully used for pedestrian, forest, highway, and railway bridges. In commercial design, custom glulam beams can span more than 30 metres. In reticulated glulam framed dome structures, glulam arches span more than 500 feet (fig 5.5) (web 5).

Figure 5.2: Versatility of Glulam to bend

Figure 5.3: Glulam Hospital Design - Credit Valley

Figure 5.4: Drogheda Swimming Pool, Ireland

Figure 5.5: Glulam construction can span very large distances

Glulam is a dependable product for construction because structural glued laminated timbers have been used successfully in the United States for more than 70 years. In Europe, glulam has been used successfully for more than 100 years. Experience shows that wood is one of the most suitable materials for construction in and around water. Wood is resilient enough to resist battering by the ocean and docking ships, and it is naturally resistant to the destructiveness of salt water. It doesn't rust or spall; it is not affected by corrosion. Where wood is fully exposed to weather, or where protection from the elements is insufficient to ensure a moisture content of less than 20% in the glulam, pressure treatment with preservatives is required. Buildings housing wet processes, or where wood is in direct contact with the ground or water also require preservative pressure treatment.

Figure 5.6: Richmond Olympic Oval by Cannon Design, Canada

Figure 5.7: Glulam construction for rapid transit system, Canada

Fire resistance is the amount of time a structural member can support its load before collapsing. The goal of fire-resistive construction is to provide adequate fire protection for occupants to evacuate the building safely. For example, a one-hour rating means a member or assembly should be capable of supporting its full load without collapsing for at least one hour after a fire starts. Buildings constructed with large structural timbers have excellent fire-resistive qualities. U.S. model building codes recognize this and provide guidelines for ensuring fire resistant timber structures. Two distinct approaches are included in the codes: Heavy Timber Construction and Fire Resistive Construction. Heavy Timber Construction has long been recognized by the model building codes as fire resistant. To meet the requirements of Heavy Timber Construction, limitations are placed on the minimum size, including depth and thickness, of all load-carrying wood members. Other requirements include the avoidance of concealed spaces under floors and roofs and the use of approved construction details (fig 5.6-7) (web 5).

5.2.2 Advantages of Glulam

- Glulam, like all timber possesses insulation qualities so when used within a building structure it helps to eliminate the thermal bridge between structure and sub structure.
- Glulam is recognized, as renewable, environmental friendly resource of material, and because of this, the embodied energy used to produce it is six times less than the same suitable strength steel.
- Glulam is two-thirds the weight of steel and only one sixth of the weight of concrete, Glulam provides equal performance and unmatched versatility.
- Glulam is pleasing to eye in its natural state and doesn't need cladding like steel.
- Glulam application is diverse; it can be used as rafters, lintels, floor beam, columns or decking and manufacture easier than most other structural materials. The structural capabilities are endless and over the years since it was first patented it has been used for bridges, swimming pools, and large open planned office blocks and sports halls as the primary structure

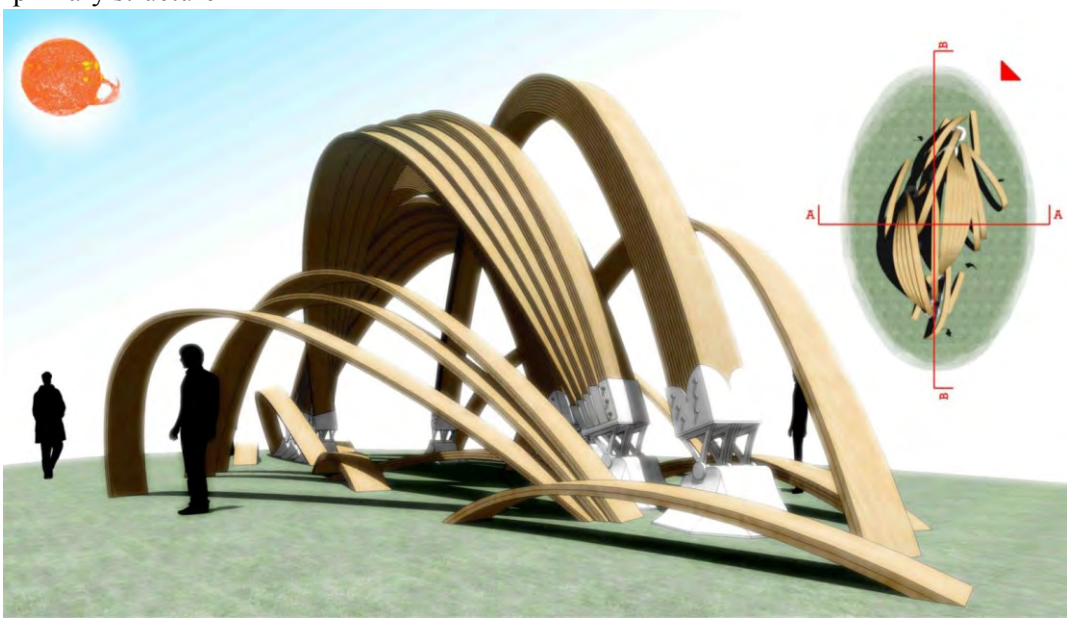


Figure 5.8: Conceptual sculptural composition of nature in wood by Igor Barteczko

- Glulam can create vast interior spaces with no internal supports, design single beams with up to a 40-metre span, although transportation considerations usually limit working lengths to approximately 24 metres. From straight beams to curved portals and complex pyramids, Glulam adds strength, structure and majesty to architecture. Rather than hiding away the building's 'skeleton', Glulam allows you to celebrate the awesome vibrancy of nature's finest creation.

- Glulam wood is naturally durable and robust. In Glulam form it offers excellent fire resistance, unlike other alternatives, and provides a known charring rate bringing safety and integrity to your structure. Glulam is chemically stable and suitable for aggressive and humid environments, expanding its scope of use across every market sector.
- Whereas many materials used in construction are dubiously claimed to be re-cyclable, all Glulam produced are totally renewable (web 6).

5.1.3 The Winter garden - Pringle Richards Sharratt Architect

One of the largest temperate glasshouses to be built in the UK during the last hundred years has created a stunning green world in the heart of the city of Sheffield. Adjacent to the Peace Gardens and the Millennium Galleries the Winter Garden provides visitors with a unique pedestrian link through the city centre. The Winter Garden is designed by Pringle Richards Sharratt Architects - who designed the adjacent Millennium Galleries. The enormous wooden arches are nearly 21 metres high, with building itself being is 70 metres long (fig 5.9). The wood used is larch, a durable timber which will, over time, turn a light silvery grey colour. The larch, derived from sustainable forests, requires no preservatives or coatings. This reduces the use of solvents and also avoids the use of chemicals that could kill the plants (web 7).

Figure 5.9: Winter Garden, Sheffield, a large glulam structured greenhouse

The primary arches are supported at ground level on sculptural steel cradles, while the intermediate arches finish at wall height and sit on elegant wooden raking struts. It has an intelligent Building Management System which controls fans and vents to make sure the plants are cooled in summer and kept warm in winter. The system will 'learn' year-on-year. The cost of the building is £5.5 million. The building was built between 1996-2002.

5.1.4 Drogheda Swimming Pool - Newenham Mulligan & Associates

Drogheda swimming pool is a well detailed building that appears to be light, airy and welcoming. It was completed in 2006 as part of a new generation of buildings which are both suitable for use in a swimming pool environment and exploits the advantages of the materials to their limit.

This delicate timber swimming pool building is formed from overlapping shells that allow a clerestory window to throw indirect light into the pool hall. Lateral stability is provided by the structural form, along with the use of a solid timber roof deck 75mm thick, which eliminated the need for any cross bracing.

The building uses curved glulam beams, tapered circular cigar shaped glulam columns under the solid timber roof (fig 5.10). Careful positioning of columns and the use of pairs of glulam beams reduced the structural depth while also allowing for discrete connections between columns and beams. The space between the pair of beams is used to conceal steel fixing plates and to overcome the high stress concentrations at the connections. Detailing of the junctions and connections was critical to the success of the design. This is a well detailed building that appears to be light, airy and welcoming (web 8).

Figure 5.10: Drogheda Swimming Pool, Ireland, sweeping curves of the timber roof structure visible inside and outside

5.1.5 Hull History Centre - Pringle Richards Sharratt Architect

Following a design competition Pringle Richards Sharratt were appointed to design the new History Centre at Hull (fig 5.11). This project is a joint venture between Hull City Council and Hull University to provide new accommodation for both the city archives/local studies collection and the University's collections. The History Centre is the first in the country to combine university and local authority archives into one, purpose-built centre, complete with staff from both organisations. The History Centre provides integrated, state-of-the-art storage and public access facilities for the archival, manuscript, book and local studies collections. It includes storage, conservation, binding, IT, teaching and learning facilities as well as office space and rooms for visitors to consult material. Above all, the Centre highly visible and accessible and a significant focus for local and community pride for generations to come. The design includes a repository on the upper floor, designed to provide a high degree of environmental control to comply with BS5454, with all the public spaces at ground level. These are flanked by a linear arcade running along the south face of the building, and a new park to the south. A long two-storey building with an elegant wide glazed arcade running full-height along the s side formed by twenty-four curved laminated timber beams covered with three-layer inflated ETFE (Ethylene Tetrafluoroethylene, a transparent polymer) cushions (web 9).

Figure 5.11: Hull History Centre, Hull with curved glulam walkway

5.1.6 Natural Curves: Organic 'Wood Wave' Floating Home Design - Robert Oshatz

The series of intersecting and overlapping organic forms creates a sense of constant movement that is clearly inspired by surrounding waves but likewise reflects the never-still nature of the structure itself. More than just a clever aesthetic trick, however, this repeated form also serves a series of architectural functions, from defining interior volumes to letting in exterior natural light at both ends and along the roof line (fig 5.12).

The repetitive use of wood both inside and out also enhances the nautical theme of the home, giving residents the abstract sense that they are within a curved sea-faring wooden vessel as much as they are floating inside of a house. Wide-open views of the water are balanced by beautiful but privacy-protecting wood-shingled surfaces on the dock side of the structure (web 10).

Figure 5.12: Natural Curves: Organic 'Wood Wave' Floating Home Design

5.2 DEWATS WASTE MANAGEMENT SYSTEM

5.2.1 Introduction

"Decentralised Wastewater Treatment Systems" (DEWATS) were developed by an international network of organisations and experts. In this handbook, the term DEWATS may be applied in singular or plural form, referring to a single specific system, to the modular systems approach or the whole range of systems, as the case may be. The approach incorporates lessons learned from the limitations of conventional centralised and decentralised wastewater-treatment systems, thereby assisting to meet the rapidly growing demand for on-site-wastewater solutions. DEWATS are characterised by the following features:

• DEWATS encompass an approach, not just a technical hardware package, i.e. besides technical and engineering aspects, the specific local economic and social situation is taken into consideration

• DEWATS provide treatment for wastewater flows with close COD/BOD ratios from 1m³ to 1000m³ per day and unit

• DEWATS can treat wastewaters from domestic or industrial sources. They can provide primary, secondary and tertiary treatment for wastewaters from sanitation facilities, housing colonies, public entities like hospitals, or from businesses, especially those involved in food production and processing.

• DEWATS can be an integral part of comprehensive wastewater strategies. The systems should be perceived as being complementary to other centralised and decentralised wastewater-treatment options

• DEWATS can provide a renewable energy source. Depending on the technical layout, biogas supplies energy for cooking, lighting or power generation

• DEWATS are based on a set of design and layout principles. Reliability, longevity, tolerance towards inflow fluctuation, cost efficiency and, most importantly, low control and maintenance requirements

• DEWATS usually function without technical energy inputs. Independence from outside energy sources and sophisticated technical equipment provides more reliable operation and, thereby, fewer fluctuations in effluent quality. Pumping may be necessary for water lifting

• DEWATS are based on a modular, technical configuration concept. Appropriate combinations of treatment modules can be selected, depending on the required treatment efficiency, costs, land availability, etc.

• DEWATS units are quality products. Though they can be constructed form locally available materials and can be implemented by the local workforce, high quality standards in planning and

construction have to be met. For sound DEWATS design a good comprehension of the process of wastewater-treatment is essential

• DEWATS require few operation and maintenance skills. While most operational tasks can be carried out by the users, some maintenance services might require a local service provider. In some cases, both operation and maintenance can be delivered by a service provider

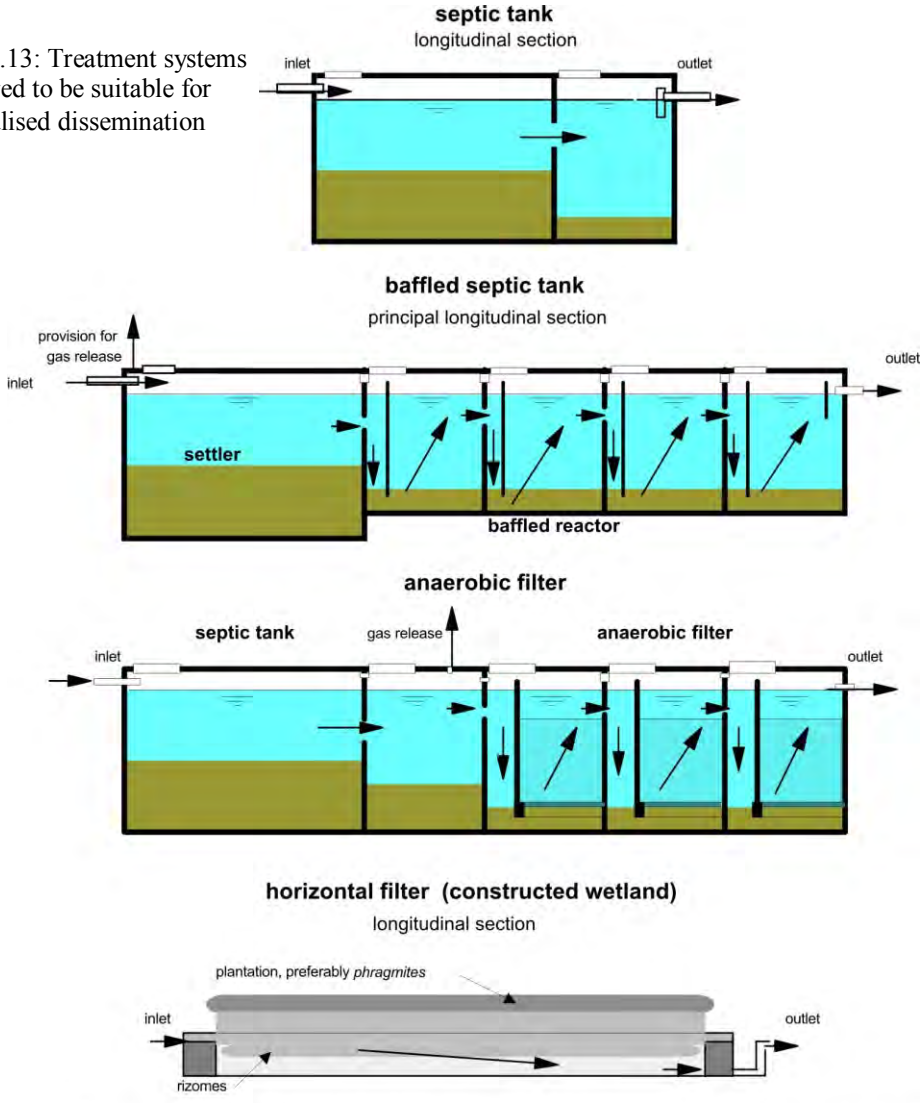
• DEWATS can reduce pollution load to fit legal requirements. Like all other wastewater-treatment systems, generated solid waste (sludge) must be handled, treated and disposed of in accordance with hygiene and environmental standards

• DEWATS consider the socio-economic environment of a given location. Neglecting these conditions will result in the failure of the technology (AFD DWAF).

5.2.2 Technical configuration and construction

Typical DEWATS combine the following technical treatment steps in a modular manner:

Figure 5.13: Treatment systems considered to be suitable for decentralised dissemination



Treatment systems considered to be suitable for decentralised dissemination

- primary treatment – in sedimentation ponds, settlers, septic tanks or biodigester
- secondary treatment – in anaerobic baffled reactors, anaerobic filters or anaerobic and facultative pond systems
- secondary aerobic/facultative treatment – in horizontal gravel filters
- post-treatment – in aerobic polishing ponds septic tank anaerobic baffled reactor anaerobic filter planted gravel filter aerobic-facultative ponds and aerobic polishing ponds sedimentation pond

DEWATS are relatively simple structures (fig 5.14). Technical details of a design, which has been adapted to local conditions, should be based on the material that is locally available and the costs of such material. Important materials are:

- concrete for basement and foundation
- brickwork or concrete blocks for walls
- water pipes of 3“, 4“ and 6“ in diameter
- filter material for anaerobic filters, such as cinder, rock chipping, or specially made plastic products
- properly sized filter material for gravel filters (uniform grain size)plastic foils for bottom sealing of filters and ponds (AFD DWAF)

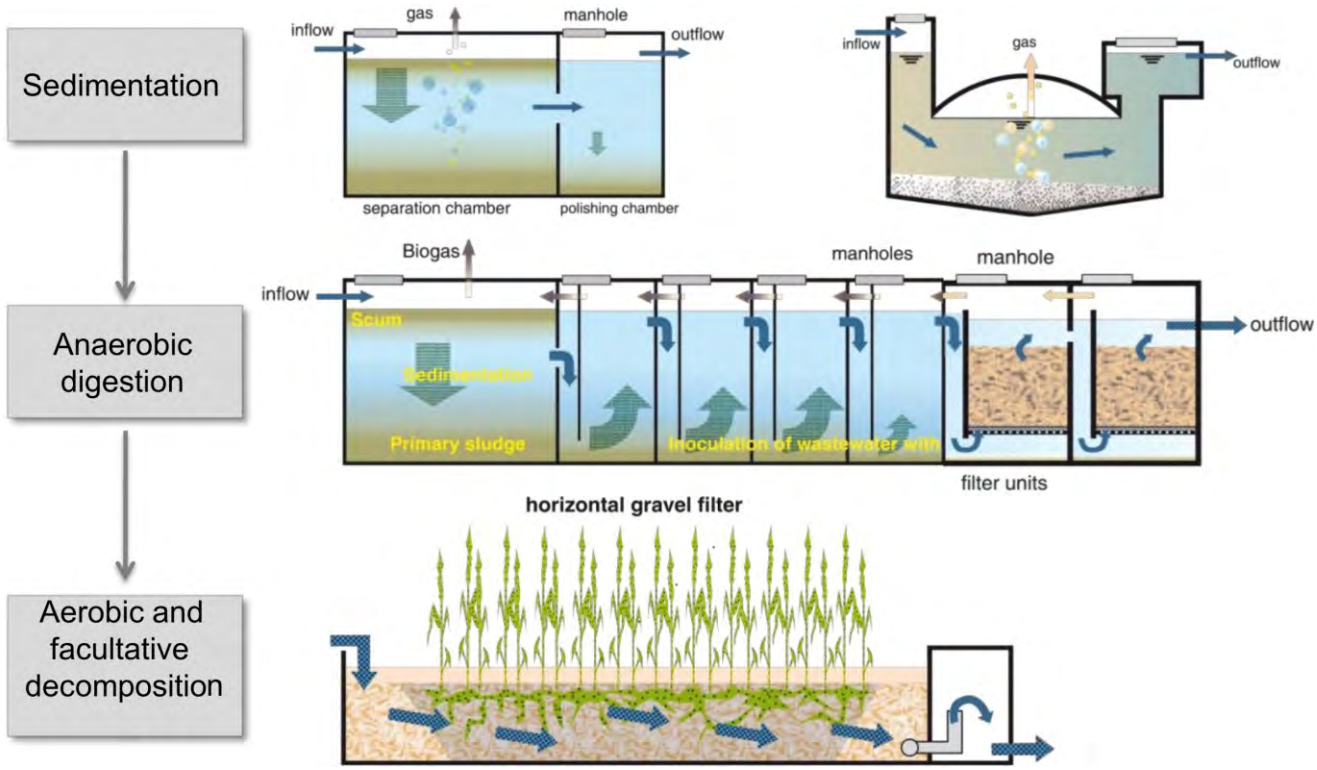


Figure 5.14: Decentralised Wastewater Treatment Systems

5.2.3 Basics of wastewater treatment

Treatment consists of a wide range of procedures that relieve the negative effect of the pollutants, by removing or changing harmful substances into a harmless or less-harmful state. DEWATS treatment depends on natural bio-chemical and physical processes including:

• Degradation of organic matter until the point at which chemical or biological reactions stop (stabilisation)

• Physical separation and removal of solids from liquids

• Removal or transformation of toxic or otherwise-dangerous substances (for example, heavy metals or phosphorous), which are likely to distort sustainable biological cycles, even after stabilisation of the organic matter

Stabilisation occurs through degradation of organic substances via chemical processes, which are biologically mediated (bio-chemical processes). The processes are the result of the metabolism by micro-organisms, in which complex and high-energy molecules are transformed into simpler, low-energy molecules. Metabolism is the break-down of organic matter (from feed to faeces) to gain energy for life, in this case for the life of micro-organisms, which store and release the gained energy in the form of ATP (adenosine triphosphate). A few chemical reactions happen without the help of micro-organisms. Most of the micro-organisms involved are biologically classified either as bacteria or as archae.

In the past, archae were viewed as an unusual group of bacteria (archaebacteria). Due to their different evolutionary history, they are now classified as a separate domain. That is why methanobacteria" according current classification are no longer bacteria but archae. In order to avoid confusion, the generic term "micro-organisms" is used. In the main, wastewater treatment is the degradation of organic compounds, and subsequent oxidisation of carbon (C) to carbon dioxide (CO_2), nitrogen (N) to nitrate (NO_3), phosphorus (P) to phosphate (PO_4) and sulphur (S) to sulphate (SO_4). Hydrogen (H) is also oxidised to water (H_2O). In anaerobic processes, some of the sulphur is formed into hydrogen sulphide (H_2S), producing the typical “rotten-egg smell”. The largest amount of oxygen (O) is required for burning carbon (“wet combustion”).

DEWATS make use of the natural biological- and physical-treatment processes discussed above to reduce and remove pollutants from wastewater. External energy supply, dosing of chemicals and movable parts are avoided to minimise both possible flaws in operation and maintenance. As the various natural-treatment processes require different boundary conditions to function efficiently, DEWATS are comprised of a series of treatment units, each providing an ideal environment for the removal of certain groups of pollutants. Stability of the treatment system is

ensured, as each treatment step only removes the "easy part" of the pollution load, sending the leftovers to the following step.

The term "phase separation" has a double meaning. On the one hand it is used for the separation of gas, liquid and solids in anaerobic reactors; on the other hand it is used to describe the technical separation of different stages of the treatment process, either in different locations or in sequences of time intervals. The latter kind of phase separation becomes necessary when suitable nutrients cannot be provided simultaneously to micro-organisms, which have differing growth rates and prefer different feeds. Some micro- organisms grow at a slower rate than others. As not all the enzymes required for degradation are initially found in all substrates, the micro-organisms take time to produce adequate amounts of the missing enzymes. As discussed previously, enzymes act as the "key which opens the lock of the food box for micro-organisms".

Substrates, for which enzymes are immediately available, can be readily degraded; substrates, which first require the microbial production of specific enzymes, are degraded much more slowly. In an environment which hosts substances that are both easy and difficult to degrade, the microbial population responsible for easy degradation tends to predominate.

To protect the "weaker" (slower) micro-organisms, it is advisable to artificially separate microbial populations in phases by providing each with its own favourable environment. The characteristics of the wastewater and the desired treatment results must be identified, before the dimensions of the treatment vessels for the different phases can be designed.

In the case of DEWATS, it is often easiest to provide longer retention times, so that the "slow" micro-organisms find their food after the "fast" ones have satisfied their demand. This process is easier to manage and, in the case of smaller plants, it is cheaper to design certain units this way. In other units, like the baffled reactor, the efficiency of the treatment in subsequent chambers justifies its higher cost; processes, which require sequencing batch operation involving technical equipment and process control, are thereby avoided.

Phase separation becomes unavoidable if different phases require either anaerobic or aerobic conditions. In the case of nitrogen removal, longer retention times alone do not provide adequate treatment conditions because the nitrifying phase needs an aerobic environment, while denitrification requires an anoxic environment. Anoxic means that nitrate (NO3) oxygen is available, but free oxygen is not. Anaerobic means that neither free oxygen nor nitrate-oxygen is available.

Nevertheless, the aerobic phase can only lead to nitrification if the retention time is long enough for the "slow" nitrifying bacterium to act, as compared to the "fast" carbon oxidisers.

In the case of the addition of plant material to an anaerobic digester, pre-composting of plant residues before anaerobic digestion is another example of simple phase separation. As lignin

cannot be digested anaerobically (it requires peroxidase enzymes usually produced by fungi), it is decomposed aerobically. Afterwards, anaerobic micro-organisms can reach the inner parts of the plant material in the digester (AFD DWAF).

5.2.4 Anaerobic Bio Reactor (ABR)

An anaerobic baffled reactor (ABR) is an improved septic tank, which, after a primary settling chamber, uses a series of baffles to force the grey-, black- or the industrial wastewater to flow under and over the baffles as it passes from the inlet to the outlet (fig 5.15). The wastewater is introduced into the chamber at the bottom, leading to an enhanced contact with the active biomass which results in an increased retention and anaerobic degradation of suspended and dissolved organic pollutants. ABRs are robust and can treat a wide range of wastewater, but both remaining sludge and effluents still need further treatment in order to be reused or discharged properly.

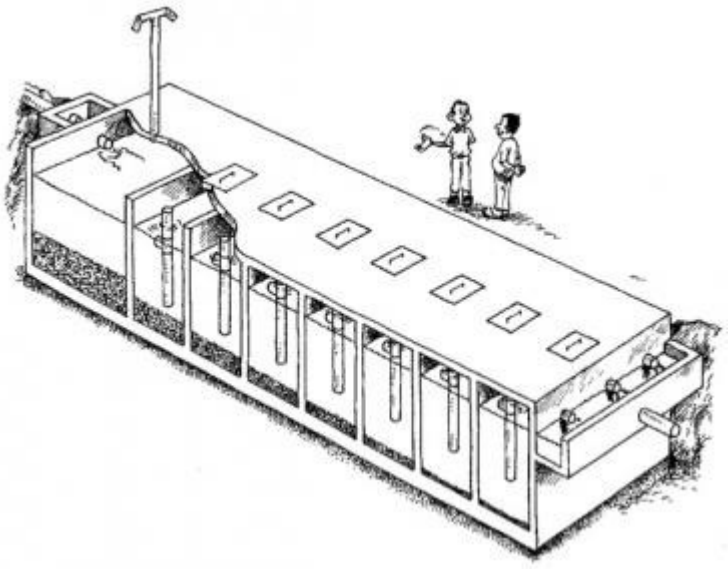


Figure 5.15: A seven compartment Anaerobic Bio Reactor

Anaerobic baffled reactors (ABR) – also called baffled or improved septic tanks – are upgraded septic tanks which aim to enhance the removal efficiency for non-settleable and dissolved solids. An ABR consist of a tank and alternating hanging and standing baffles that compartmentalise the reactors and force liquid to flow up and down from one compartment to the next, enabling an enhanced contact between the fresh wastewater entering the reactor and the residual sludge, containing the microorganisms responsible for anaerobic digestion of the organic pollutants. The compartmentalised design separates the solids retention time from the hydraulic retention time, making it possible to anaerobically treat wastewater at short retention times of only some hours (EPA 2006). The baffled design of the ABR ensures high solids retention resulting in high treatment rates, while the overall sludge production is characteristically low. They are simple to build and simple to operate, as well as very robust to hydraulic and organic shock loading. Yet, both sludge and effluent still need further treatment (web 11).

ABR's are typically applied in Decentralised Wastewater Treatment Systems (DEWATS) could be a five component system of first three anaerobic steps consisting of a biogas settler/digester; an ABR and an anaerobic up-flow filter; followed by an aerobic treatment unit such as a constructed wetlands and a maturation pond. ABR's take advantage of the easy construction, low cost and strong resistance of septic tanks but allow for higher treatment efficiency (web10).

5.2.5 Treatment Process and Basic Design Principles

The reactor always starts with a settling chamber for larger solids followed by a series of at least 2 up to 5 up-flow chambers. The wastewater enters the chambers at the bottom and needs to pass through the sludge to move to up and to the next compartment. To equally distribute the entering liquid in the chambers, they should be designed as relatively short compartments (< 75 cm of length and < 50% to 60% of the height). Treatment performance of ABRs is in the range of 65% to 90% and this is far superior to that of a conventional septic tank. ABRs can be designed for daily inflows in a range of some m3/day up to several hundreds of m3/day. During the anaerobic digestion, biogas is produced, which can be recovered and reused in the kitchen or for driving pumps and other equipment when necessary. If the gas is not recovered, the tanks need to be vented to prevent the release of the potentially harmful gases. As they do not require any electricity and are simple to construct and operate, they are generally cheaper than more mechanical, centralized technology options. ABRs can be constructed with locally available material. However, expert design is required. ABR tanks should be checked for water-tightness regularly. Also the scum and sludge levels should be monitored to ensure a well functioning tank. Sludge removal is important for ABRs and must be done every 1 to 3 years preferably by a vacuum truck or a gulper to avoid that humans get in contact with the sludge. When emptying the tanks, it is vital that some active sludge is left in each of the compartments to maintain a stable

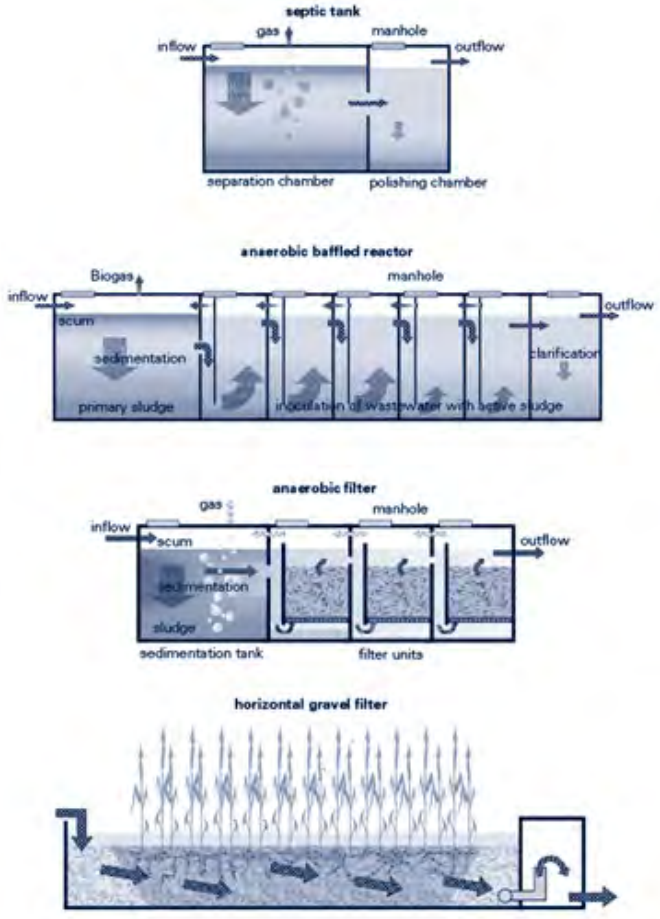


Figure 5.16: Treatment system process for DEWATS

treatment process. In general, the quality of ABR effluents has been shown to consistently meet guidelines for irrigation regarding the removal of organics for reuse in agriculture, but not for discharge to surface water. ABRs can be installed in every type of climate, although the efficiency will be affected in colder climates and ABRs are suited for the household level or for a small neighbourhood as DEWATS (fig 5.16) (AFD DWAF).

5.2.6 Advantages and Disadvantages

Advantages

- Extremely stable to hydraulic shock loads
- High treatment performance (for all, grey-, black- and industrial wastewater)
- Simple to construct and operate
- No electrical requirements (only physical mixing)
- Construction material locally available
- Low capital and operating costs, depending on economy of scale, Ability to partially separate between the various phases of anaerobic catabolism
- Low sludge generation, Reduced clogging
- Biogas can be recovered, Low HRT, long biomass retention time

Disadvantages

- Needs expert design
- Long start-up phase
- Needs strategy for faecal sludge management (effluent quality rapidly deteriorates if sludge is not removed regularly)
- Effluent requires secondary treatment and/or appropriate discharge
- Needs water to flush
- Clear design guidelines are not available yet
- Low reduction of pathogens
- Requires expert design and construction (web 11)

5.2.7 Newlands Mashu Permaculture Site - Durban

Newlands Mashu Permaculture Leaning Centre (NMPLC) is a not for profit organisation, established to cater for the growing agricultural needs of developing urban communities. We assist small-scale growers, emerging farmers and grower groups to develop self-sufficiency through practical training in organic food production programs and ongoing supportive

networking. The vision of NMPLC is to promote healthy communities through a holistic and sustainable approach to agriculture that embraces organic farming principles based on low input costs. Permaculture training workshops, emerging organic farmer training, mentorship, support and marketing are all apart of NMPLC. They also produce a low volume of organically grown produce (web 12).

Two primary partners of UKZN's Pollution Research Group (PRG) claimed top awards at the International Water Association (IWA) Development Congress held in Kuala Lumpur at the end of 2011. German NGO, the Bremen Overseas Research and Development Association (BORDA), received the IWA Development Solutions Award for its 'innovations and contributions to technology and community facilitation that transform service delivery to low income urban settlements.' The PRG's other significant collaborator, eThekwini Water and Sanitation (EWS), also walked away with two awards for its innovations in, and contributions to, the development of sustainable sanitation. The PRG enjoys a long and highly beneficial relationship with both BORDA and EWS and plays a key role in the success of their water and sanitation projects in the Durban area.

In 2006, the PRG and EWS established a relationship with BORDA, which provides basic needs services in developing countries in Asia and Africa. The collaboration centres on the sanitation needs of the eThekwini municipality and the ongoing research interests in the anaerobic baffled reactor (ABR) system - a sewage treatment system that requires no electricity and little maintenance (fig 5.17). Head of the PRG, Professor Chris Buckley, was appointed R&D Co-ordinator for the BORDA partner network.

Figure 5.17: DEWATS at Newlands-Mashu Permaculture Centre

The Newlands-Mashu Permaculture Training Centre, located in Newlands East in Durban, is the site of a demonstration Decentralised Wastewater Treatment System (DEWATS) jointly designed, constructed and financed by BORDA and EWS. This system treats sewage from more than 80 households and is being monitored by the PRG. According to Buckley, BORDA and EWS 'have provided more than R3.5 million in funding for research facilities for the Pollution Research Group at the Newlands-Mashu Permaculture Centre.' The DEWATS project, which focuses on treating and recovering wastewater for use in urban agriculture and community initiatives, has provided the perfect opportunity for multidisciplinary collaboration (fig 5.18). The PRG and the eThekwini Municipality are currently working closely with other UKZN scientists located on the Pietermaritzburg campus. The coupling of wastewater treatment processes and horticulture is a unique and sustainable way of managing an important urban waste stream for the benefit of society and the environment (fig 5.19). 'A lot of what we do is about making communities resilient against climate change by facilitating productive use of water,' said Buckley (web 13).

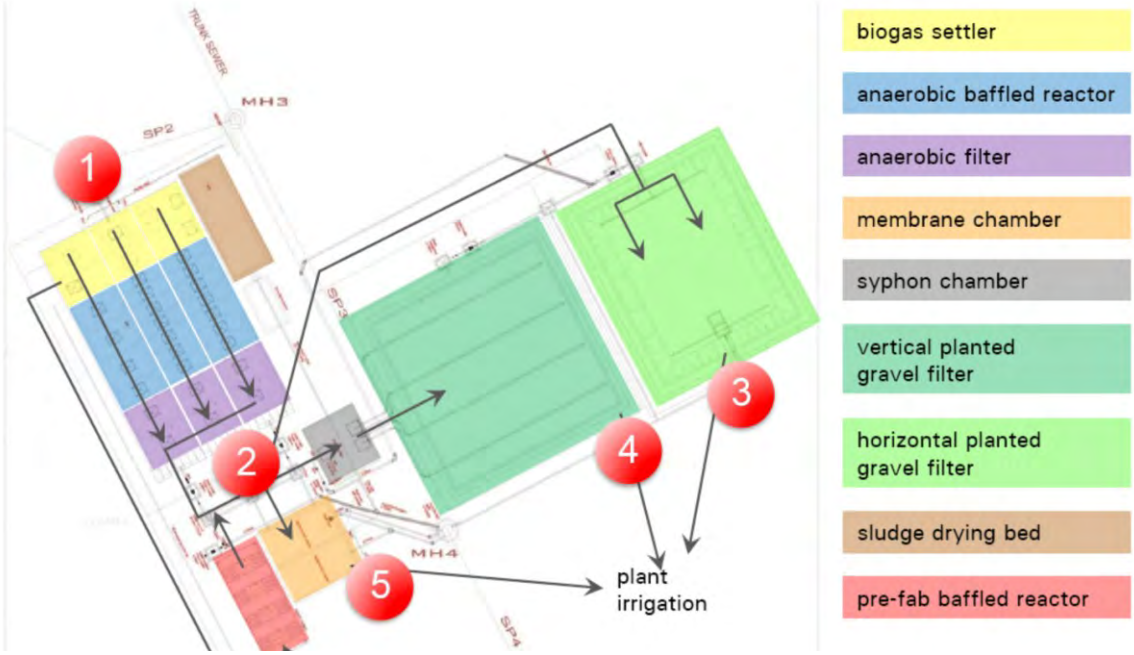
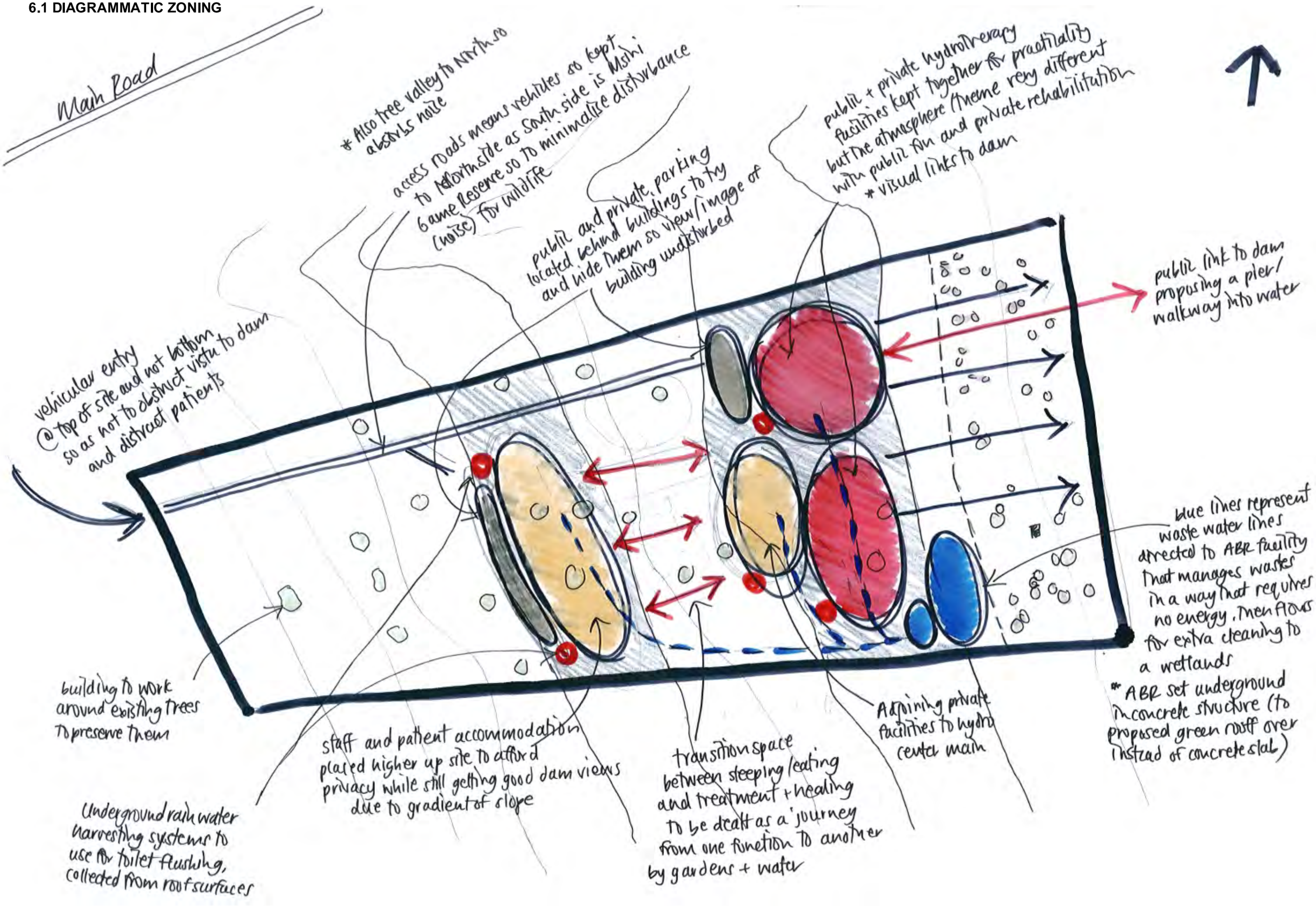


Figure 5.18: DEWATS at Newlands-Mashu Permaculture Centre layout

Figure 5.19: Images of DEWATS at Newlands-Mashu Permaculture Centre

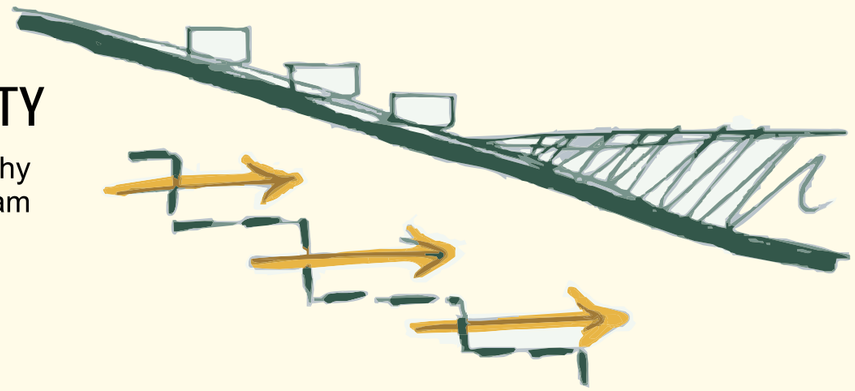
CHAPTER 6
CONCEPTUAL DESIGN DEVELOPMENT

6.1 DIAGRAMMATIC ZONING



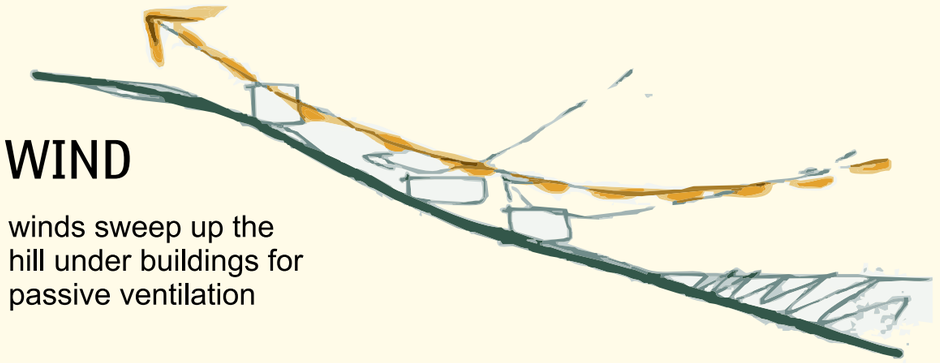
VISIBILITY

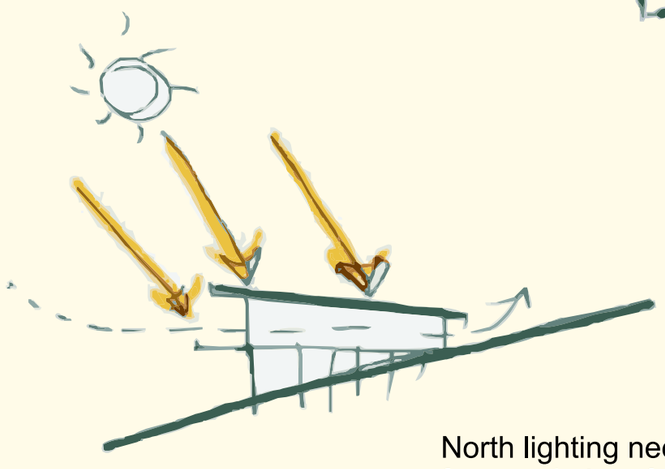
sloped landscape allows hierarchy of visibility to dam



WIND

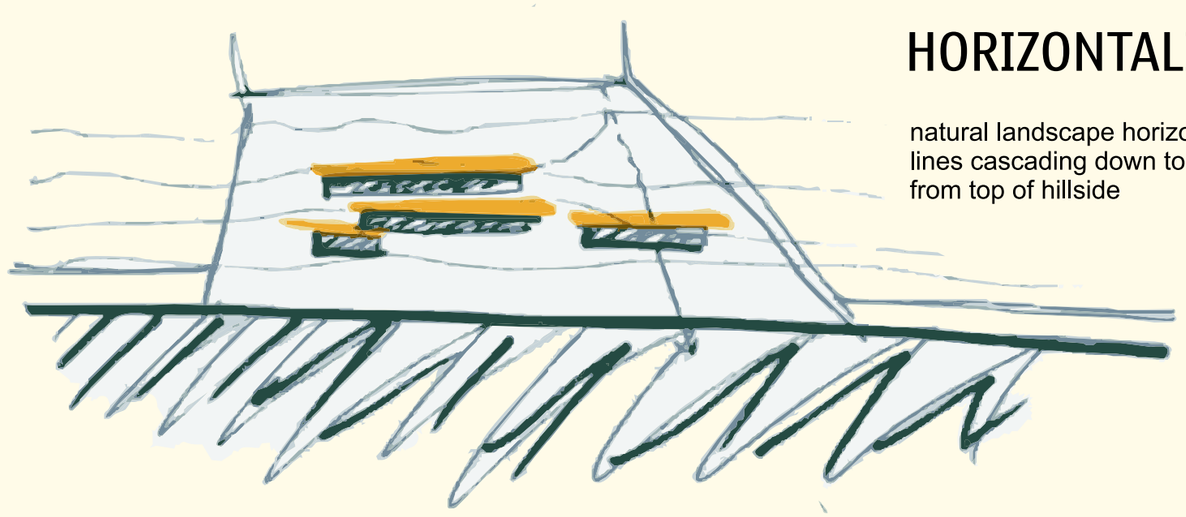
winds sweep up the hill under buildings for passive ventilation





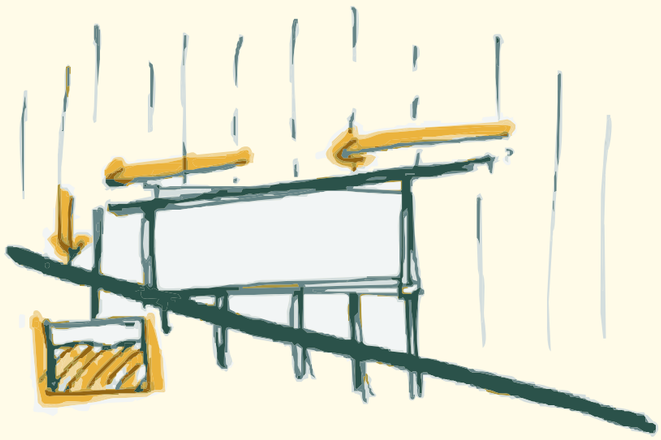
SUNLIGHT

North lighting needs to be shaded from and glare from dam overcome



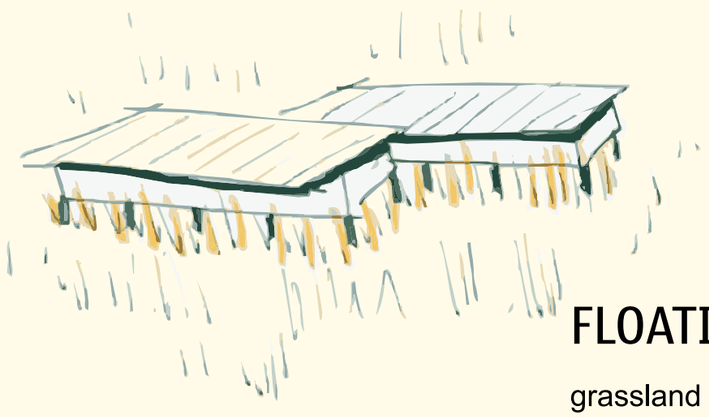
HORIZONTALITY

natural landscape horizontal lines cascading down to dam from top of hillside



RAINWATER COLLECTION

sloped smooth roofs to capture rainfall throughout the year to utilise in building fuctions and stored underground where it is cooler



FLOATING WITH GRASS

grassland aesthetic blurs ground line of buildings

6.3 WATER SPIRAL MOTION CONCEPT

"Even water is in harmony with itself and the place it has in the universe. Each phase of water's cycle reflects the other phases; no one phase can be deemed more important than another; water is vital to every cycle in life. It is part of a whole and always seeks to return to a whole."

(Ryrie, 1998: 17)

The health of water is not at a constant level either as any changes in temperature and movement changes the electric and magnetic vibrations. Viktor Schauberger was an Austrian forester who formed different ideas about water. His theory on water was that modern technology in is production and processes should follow the natural patterns and movement of water. This was because water as well as other liquids channels in rhythmic organic movements and not straight lines. The energy created from this form of movement was seen to create better harmony than friction which is experienced in natural straight rigid paths. He believed that the principles of cycloid spiral motion were worth following in technology because the spiral motion was the basis of motion for all growth in nature (fig 6.1). Still water really is dead in a sense because there is no movement of energy in it. Only moving water is replenished with oxygen and free from contamination. Water that is forced in straight channels loses vital energy and balance and therefore healing potential. As seen from natural water features such as rivers, streams and oceans never flow in straight lines but meander through the surface topography (Ryrie, 1998: 84).

Water has the power and influence to affect human minds and spirits, as its qualities are highly soothing, relaxing and rejuvenating. As the eye follow ripples on the water the mind is drawn into a soothing dream, washing away stress and invigorating our life energies. Still water such as lakes, expansive, clean and lonely, is the essence of tranquillity. Water moves in different speeds and patterns but the slower and calmer the water it induces moods such as calm, disquiet, awe and energy (Day, 2002: 38).

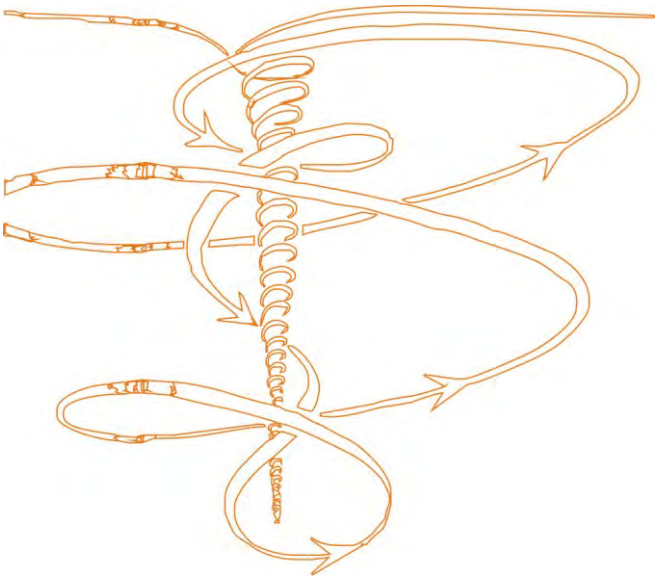


Figure 6.1: Waters natural spiral energy motion

“Life renewing qualities can be seen in fluid shapes, fluid movements, and forms shaped out of waters flow principle.”

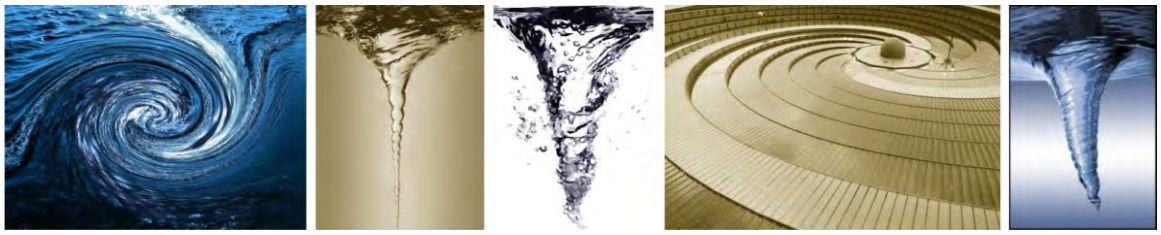


Figure 6.2: Water spiral movement and motion seen in the entire world - a natural movement in a natural resource

“Look carefully at a drop of water, or a bubble, and you will see the same kind of circulations inside the watery sphere that you see in the steam above tea, or the movement in rivers – eddies, confluences, swirls, spirals, and separations of flow in layer upon layer. And these are the same layers in the hydrological cycle, swirls of moist air above the land, swirls of moving currents in the Earth's water, swirls of water transpiring from plant and animal life. Every single drop of water is a microcosm of the universe, containing the same rhythms and patterns – just on a different scale.” (fig 6.2) (Ryrie, 1998: 82)

6.4 WALKWAY CONCEPT

The walkway forms the link between the buildings as well as an experiential journey through the site. where people get taken out into nature and then brought back into confined spaces. The walkway would be semi permeable and organic in form. The walkway forms a flowing engaging element between buildings and nature flowing down towards the dam and water as the destination point.

Elevated Brood by Paul D Nicholls is a masterful display of the application of nature inspired architecture (fig 6.3). The structure is situated in London’s Hyde Park, on the bank of Serpentine Lake. Its combination of steel and polycarbonate support elements creates a striking architectural imagery. The project was shortlisted in the 2007 Riba Student Awards. The Brood is the attachment, shelter and protection of a mother’s young. The Paper Nautilus was the main inspiration for the aquarium. It imitates the way it hangs its eggs from the strongest part of its shell by the placement of exhibit displays. The elevated, shell-like structure is a “brood” for the display chandeliers that can be lowered independently via remote control by the visitor (fig 6.4). The maintenance of the fish decreases the further out onto the water they are, inside the linear repetition of the chandeliers themselves, coupled with the solar lilies, the further structures become almost completely

independent. Elevated Brood also encourages a graceful use of water by forming a strong relationship with the Serpentine Lake.

From a strictly architectural perspective the presentation is an excellent example of a collective set of drawings and illustrations made in a way to reinforce the ideas and thoughts behind the project itself (web 14).

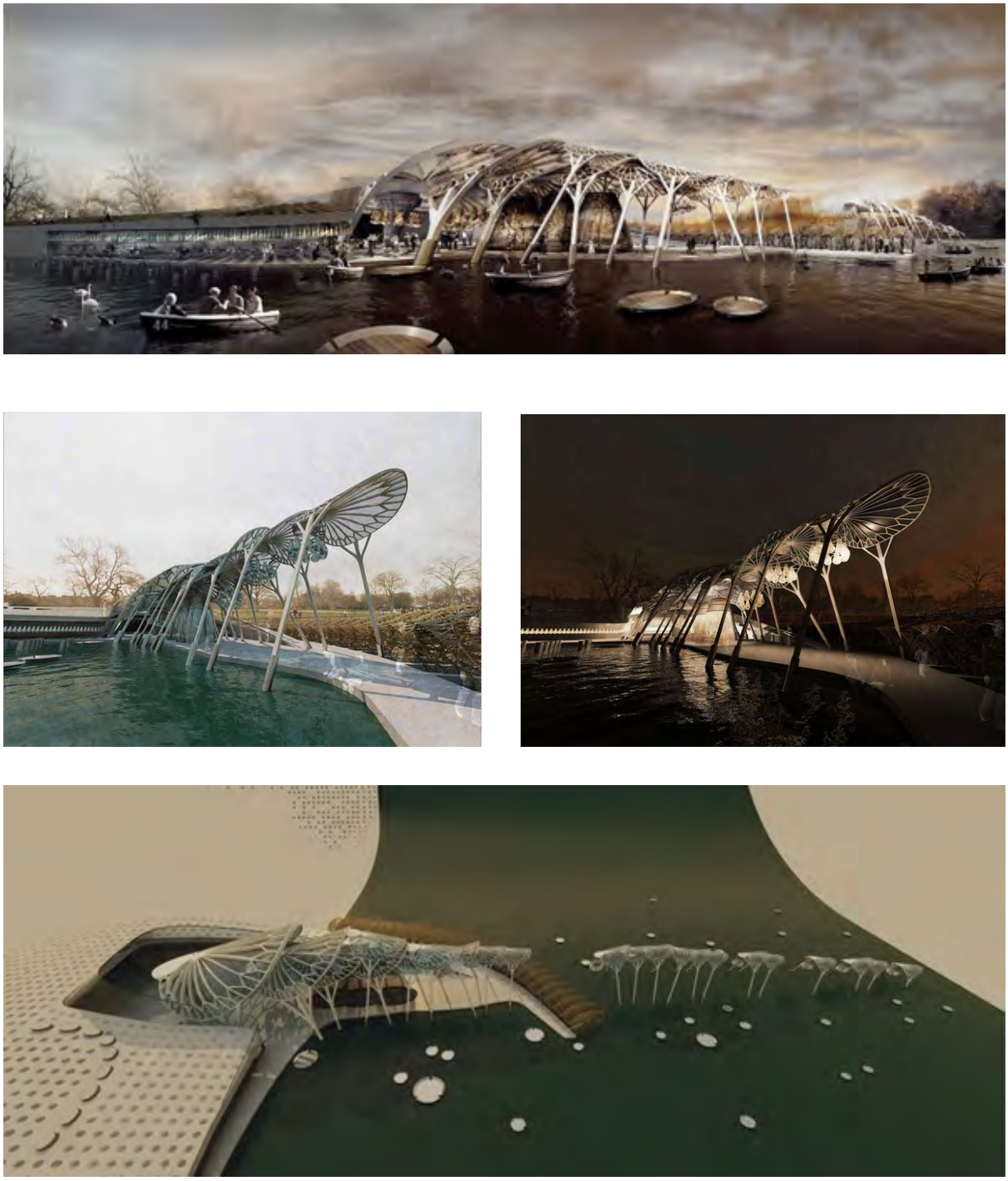


Figure 6.3: Elevated Broad – Nature inspired exhibition space / PDN STUDIO

Figure 6.4: Elevated Broad – Nature inspired exhibition space / PDN STUDIO

The example above is a very organic expression while the example below becomes more conservative and comtemporary. An Architecture has a very broad outlook to weigh in, observing an area where housing will be made whether it is potentially a good or not when viewed from the side of the business, convenience and natural beauty. As Kona residence that created by Belzberg Architects that replace on a cold stream of larvae it has aim to get two scenery around volcano mountain to the east and ocean horizons westward. This program set as arrange of pods that distributed to all property while each feature has an unique itself. The pods programmer assigned as two sleeping pods with common areas, the media, the main bedroom and main living space. To create the sensitiveness at home surrounding. Two separate array from the top, replace panel photovoltaic to balance the energy of mountain. Certain elements were incorporated to further enhance traditional elements in a contemporary arrangement. Local basket weaving culture was the inspiration for the entry pavilion which reenacts the traditional gift upon arrival ceremony (fig 6.5-6) (web 15).

Figure 6.5: Natural Kona Residence by Belzberg Architects, entrance walkway

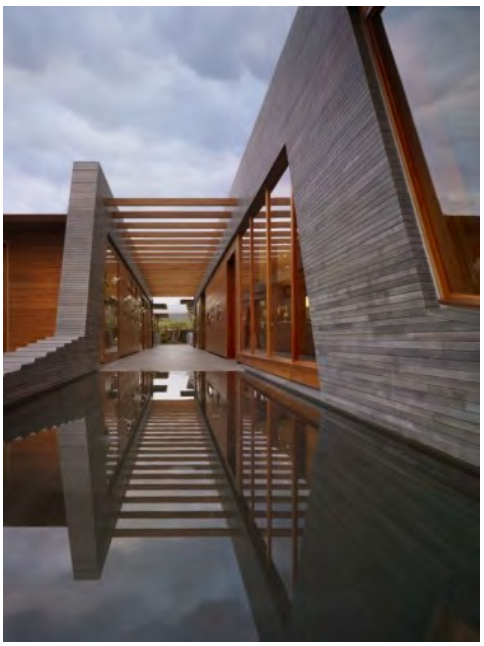
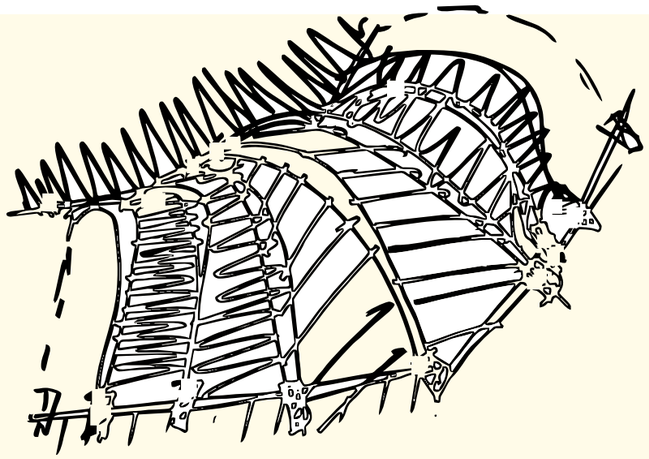
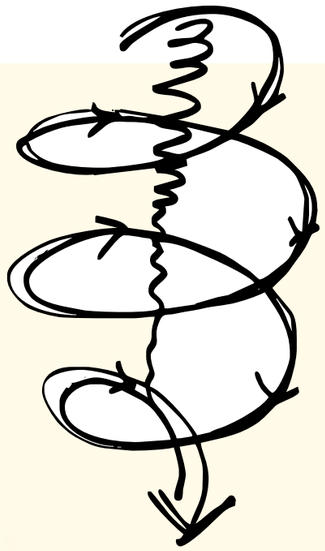
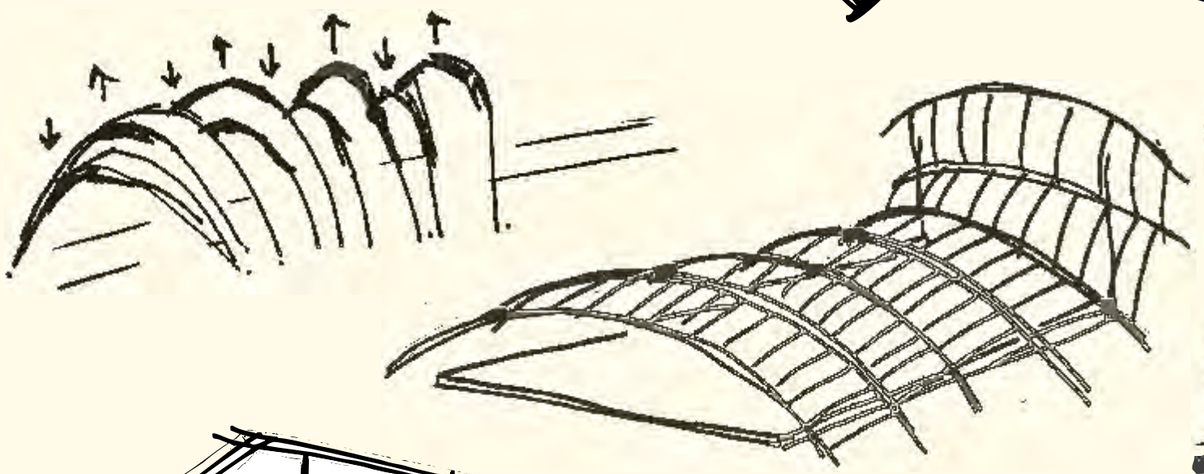


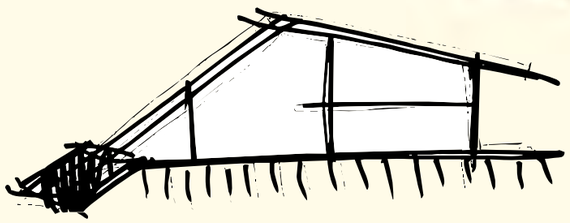
Figure 6.6: Natural Kona Residence by Belzberg Architects, incorporation of water and wood

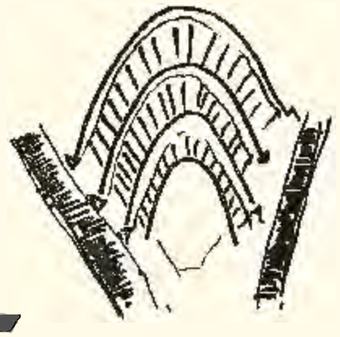
6.5 FORM CONCEPT SKETCHES

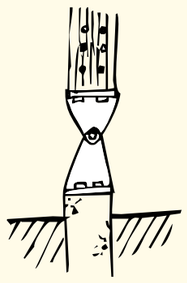


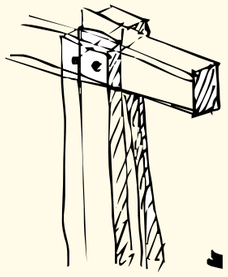


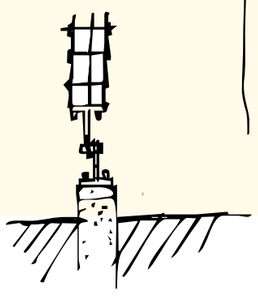


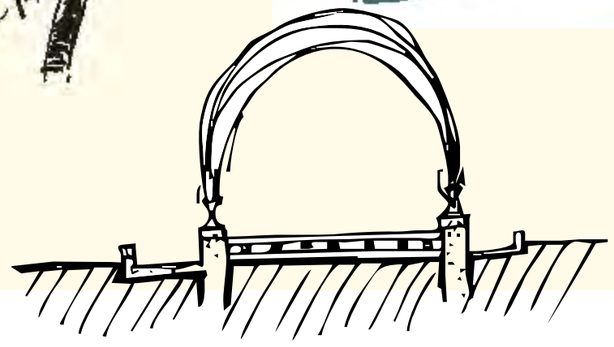


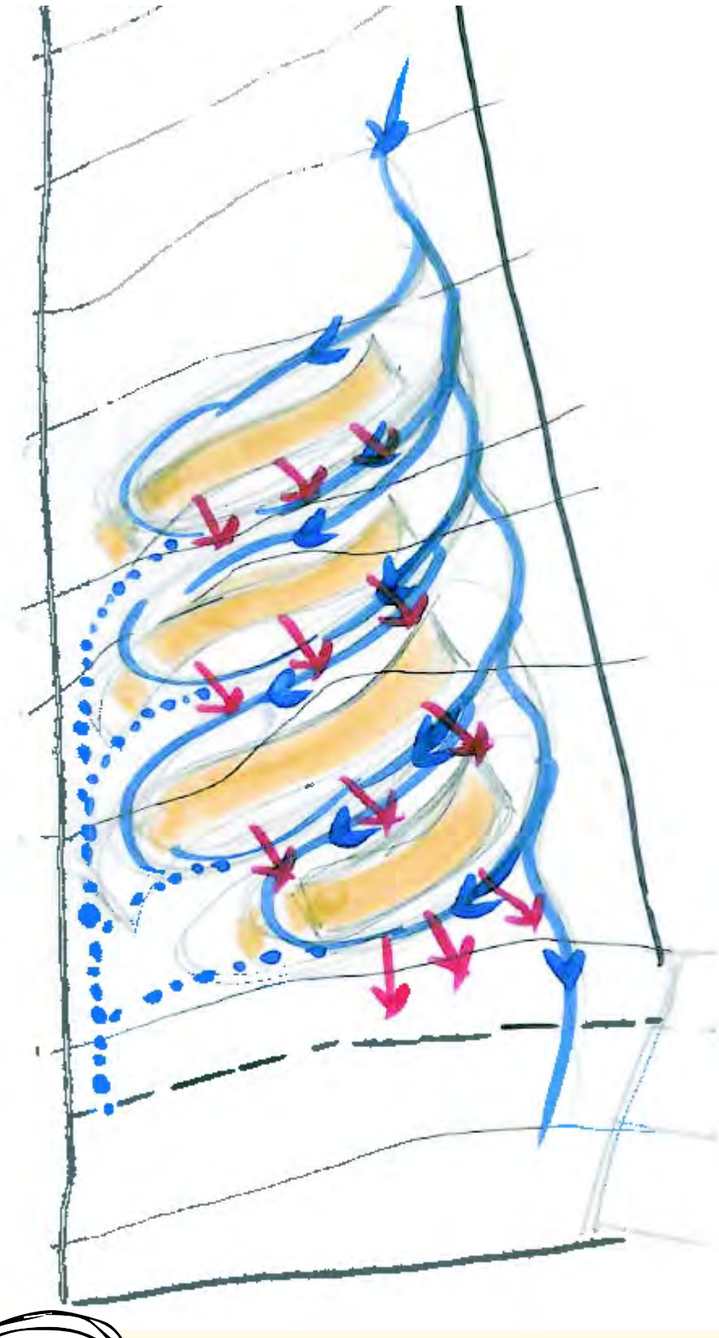












6.6 FORM CONCEPT DEVELOPMENT

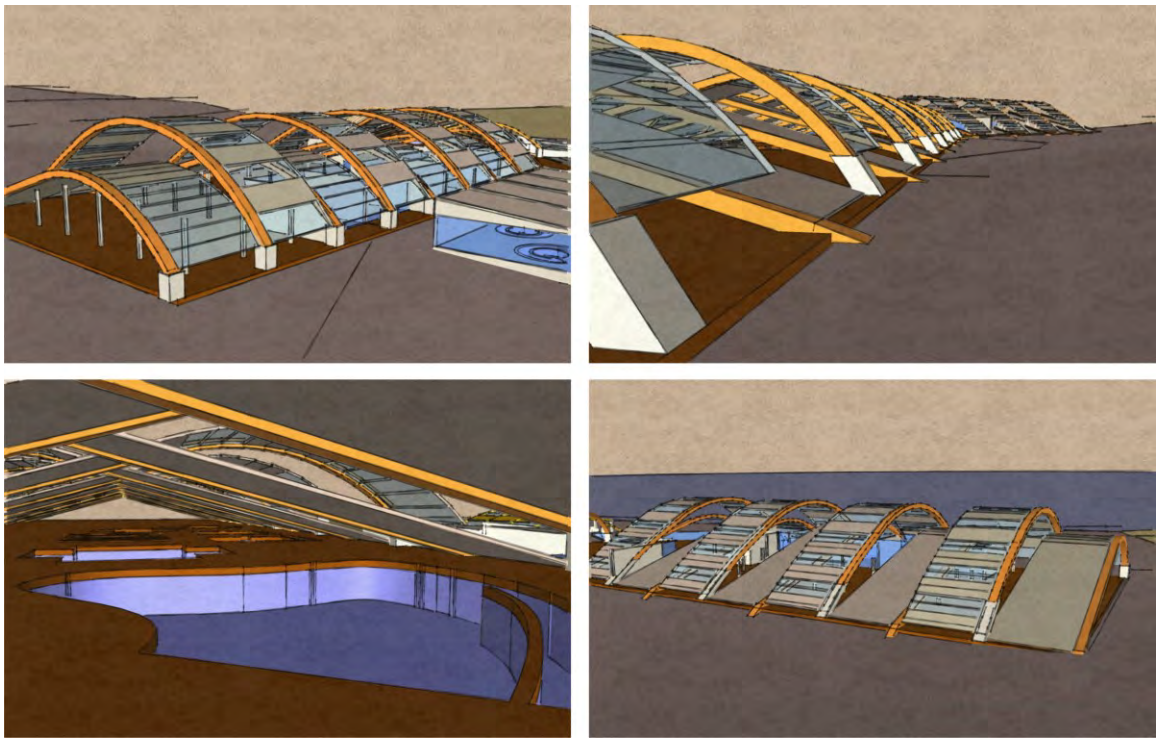


Figure 6.7: Sketchup model of form development inspired by waters natural movement and spiral energy motion

The form of the Hydrotherapy Health Centre should incorporate the principles of water and its natural flow and so the building seems to sweep down the gradient landscape towards the dam. The building seems to ripple with undulating high and low arches that mimic waves creating interesting exterior perspectives as well as a unique interior space (fig.6.7). The structural beams that span the width of the building allow clear internal spaces and glazing on the side allow for large amounts of natural light to spill inside the building.

6.7 CONCLUSION

The aim of the design is to create a relatively low lying system of buildings that speak to the gradual hills that surround the dam and the region. In how the building sits within the landscape setting the buildings within the land means a tangible connection to the earth but a large disruption of cut and fill. This approach was avoided because of the long lasting damage to site, and rather an idea of lightly touching the building to the site raising it with stilts and columns keeping it visually connected but not dominating the natural landscape. The building aesthetic would strive to be warm and comfortable as suits this setting with tones of golden browns and especially timber construction. The building attempts and succeeds to ultimately provide a healing atmosphere through the integration of water.

CHAPTER 7
ARCHITECTURAL DESIGN DRAWINGS

Research Background

The purpose of this dissertation is to establish suitable way to complement and merge the built environment with the natural environment to create the ideal healing spaces for humans. By incorporating nature, specifically the natural element of water, into architecture with design principles inspired from nature, human environments can become the best experience for people with or without sickness. Man-made environments have energy that is rushed, demanding, and harsh; whereas Nature's energy is harmonious, peaceful, and serene, all symbolic of healing.

Nature consists of the most basic and complex forms, the most intriguing relationships and interdependencies between species, and is the most inspiring expression of symbiotic compositions. It natural element of water contributes to environmental healing on a social, psychological and physical level. This dissertation asserts that to learn and integrate nature, its principals and forms into architecture will thereby inject these same symbiotic, safe and calming environments into architecture and thereby create healing environments for all humans.

Nature incorporates all types of forms and functions and while it's entire system is enormously complex it still manages to create complete harmony within itself and towards external factors. The atmosphere when experiencing nature at any level is of awe and peace and this mood is an ideal environment that could be beneficial to humans' health in the built environment. Looking deeper into the value of water symbolically and physically in treatment, rehabilitation and therapy within architecture can greatly benefit human well-being and certain diseases. Nature can therefore provide the inspiration in architecture to create architecture that heals people from stress and sickness and by incorporating nature within more advantageous solutions to specific human problems can be achieved such as targeted in this study with water and hydrotherapy practice.

Massive tree trunks of the Sequoia National Park. (Portoghesi, 2000: 129)

Incredible girth and height of the columns of a Basilica. (Portoghesi, 2000: 129)

The pattern of a spiders web works with a central circle an then radiating circles with paths to support the structure. (Portoghesi, 2000: 492)

From an aerial image of a Chinese city these same radiating lines and circles can be seen as the spider's web. (Portoghesi, 2000: 492)

The conical shape of a sea shell as a central point that radiates outward in a spiral. (Portoghesi, 2000: 311)

The same spiralling form can be seen from an aerial view of a spiral or circular staircase as the perspective view winds to a focal point. (Portoghesi, 2000: 311)

THEORETICAL FRAMEWORK FROM RESEARCH

1. Nature as a model basis for healing

More interesting forms and compositions are being created from the new organic design processes which enliven the human built environment. Building systems need to be united, harmonious and regenerative at all levels and not just the visual impression. Functional buildings need to give back to the environment as much as they take away to maintain some kind of balance within the bigger ecosystem and ecological architecture has been one result to this problem. By looking at nature and successfully attempting to form a working collaboration with the environment can bring healing spaces and qualities into the human living realm.

2. Nature as an inspiration for architectural design

Critical Regionalism bases human culture and traditions as well as natural materials, elements and topography as the basis for respectful and fitting human architecture. It is something that responds to the local climate and constructions while adapting new technology and advancement to future buildings. Critical Regionalism is an example of a theory that is trying to incorporate nature and people to the modern world and forming and maintaining a delicate balance between these through architectural means.

3. Water's potential as a healing agent and its role in Architecture

Water is a vital life source important for humans and important for building. Water in a natural environment is pure, clean, and healing like the fresh cold water from the highest mountains and can be powerfully calming and dominating and needs to be treated accordingly. Architecture is the vehicle that brings water into humans' daily living and working environments providing an easy link to the natural realm. Water is a flowing, energetic and vital life force but architecture can reduce this and it is therefore important to incorporate water in the human environment while preventing it from becoming anything less than healthy and healing.

4. Water Healing through Hydrotherapy

Water therapy or Hydrotherapy has been implemented with societies for over one thousand years and has proven to be healing to many different causes and symptoms. Hydrotherapy proves water is more than just a natural substance that cleanses and can be drank to gave fluids, it is a medium in which medical treatment can be achieved. There is a large range of conditions that significantly and slightly can be treated or rehabilitated with the use of water therapy and these can be carried out through immersion with exercise.

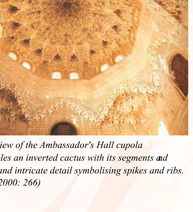
5. Architecture as a healing aid to Humans

Architecture has the potential to heal and to harm humans. Architecture being the habitation that provides safety, shelter and comfort should also provide healing. There are design strategies that can and must be implemented into every human environment from rural to urban worlds and many of these are entirely pleasant and beneficial. Elements such as natural lighting, natural ventilation, and natural materials are significant and if one notices the constant use of the word natural, it means nature should be increased in connection and increased in integration in human environments because above any new technology it is the fastest and cheapest way to heal buildings.

6. Nature verses water versus architecture

In the precedent and case studies carried out in the document what can be gained is that there are a few working collaborations between nature and architecture in the world but none have been focused into created a health or healing place for people who require it or can benefit from it. Nature, water and architecture are all linked with humans. Water is apart of nature as is architecture. Actually the key to creating healing environments is connecting nature, water and architecture.

The concentric rings forms on the surface of a body of water called ripples and forming a rhythmic moving pattern. (Portoghesi, 2000: 348)



The concentric waves on the Church ceiling also creates movement. (Portoghesi, 2000: 348)

An orchid flower seen with its layered layout of petals from the widest at the bottom to the narrowest point at the top. (Portoghesi, 200: 249)

A temple roof in Japan with similar layered composition to the orchid as well as colour tone. (Portoghesi, 2000: 249)

The patterns and irregular layout of the corn-cob. (Portoghesi, 2000: 75)

A walls built by the Incas as they drew inspiration of form from the shape and pattern of corn grown in the settlements, following the curve of the natural rock. (Portoghesi, 2000: 75)

The intricate segments of the desert cactus. (Portoghesi, 2000: 266)

An interior view of the Ambassador's Hall cupola which resembles an inverted cactus with its segments and indentations and intricate detail symbolising spikes and ribs. (Portoghesi, 2000: 266)

Nature and Architecture

Nature is a pure, complete and continuous element. It is made up of a multitude of ecosystems in which animate and inanimate organisms coincide together forming a symbiotic system that should be looked towards as inspiration to building design principles.

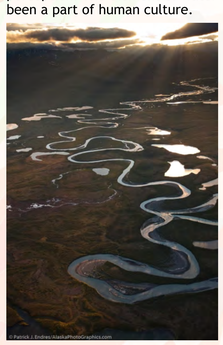
Organic Architecture - An expression of a model relationship with nature
An articulation of an absolute balance between architecture and nature can be found in Fallingwater generally viewed as the ideal response to nature. incorporating a link between inside and outside.

Critical Regionalism - The building reinforces two factors, the identity of the Kanak people and a relationship with the natural landscape. This building encapsulates the idea of Critical Regionalism by delicately balancing the traditional forces of local culture and materials while adapting it to a larger technology creating a heritage landmark that is at the same time contemporary.

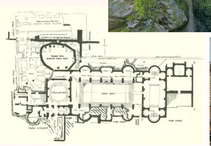
By looking into Critical Regionalism and Organic Architecture a better understanding of nature-inspired architecture is achieved. These two theories or movements share a common component of a respect and collaboration with the natural environment in the creation of human environments for the betterment of their occupants and natural surroundings.

Water in Architecture

Nature consists of many components but its greatest natural element in the world is water which is a fundamental aspect of life. It is the most abundant substance in the planet. Water encompasses many different qualities that can be utilized for healing, from its sound to perception. The element of water is full of energy and meaning throughout the ages and has been a part of human culture.



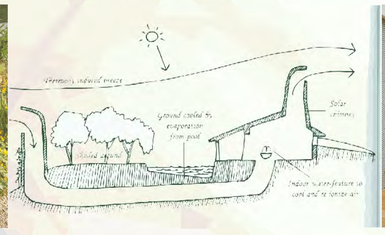
As seen from natural water features such as rivers, streams and oceans never flow in straight lines but meander through the surface topography.



Bathing in the baths presented enjoyable experiences on physical, psychological and social levels. Psychologically the sensory experience was stimulating with the warm and cold waters, the clear soft waters, the steamy atmospheres, and the quiet murmurings of bathers conversing, with fragrant smells of ointment for massage. The warm environment allowed the bathers to relax and become pleased and happy and thereby improved their moods and spiritual being.

An expression of water healing - Behnisch Arkitekten - Thermal Baths, Aibling. Working with the long spa tradition of the area, the architects have built a large curative and rest therapy complex. There are eight domes in total on the site of the Therme Bad Aibling with each dome being unique in atmosphere and interior design."Water attractions require humid air at a temperature very close to the water temperature to avoid evaporation. Here the water is under the domes, so areas outside can remain at comfortable levels of heat and humidity," says Behnisch.

Healing Architecture



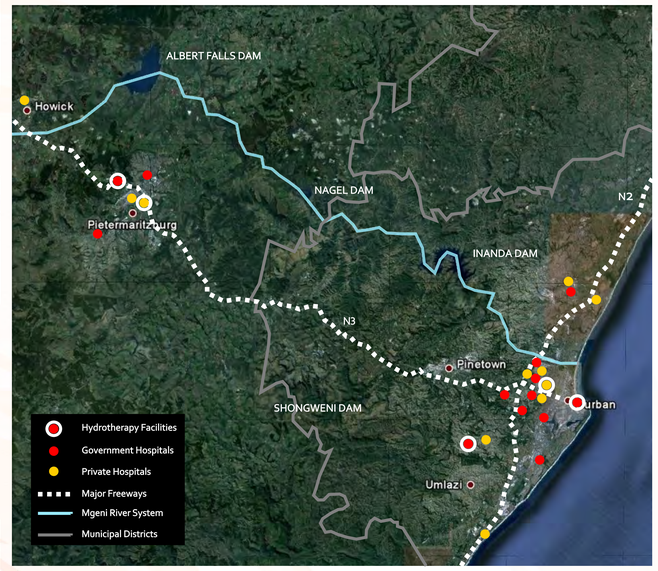
Healing and place are never two separate components. Water is seen as the most important element in nature that holds healing powers and is another aspect to natural environments becoming healing and therapeutic. By observing the structure of nature and applying its teachings to the design of indoor spaces, what can be created around people would be diversity, richness, and stimulation. There needs to be a greater physical connection with the indoors and outdoors in order to adequately connect nature to humans. Colour, harmony, and multi-sensory delight support our feeling life, particular moods redressing personal and situational imbalances. Journey sequences, beauty and care-imprinted environment can nurture our spiritual development. Buildings built upon these principles are buildings to nurture the whole human being.

Justification

Hydrotherapy is an important portion of the treatment program of physiotherapy, alongside medication and fitness exercise. In order to understand the existing level of infrastructure and its role in health care by hydrotherapy an audit of the hydrotherapy facilities in KZN had to be carried out. A look at most of the hospitals in Durban and Pietermaritzburg was undertaken to find out how many hydrotherapy facilities were around. The list goes as follows:

Hospital	*Hospital Type*	*Area Located*	*Hydrotherapy Facility*
Addington	Provincial	Durban	**Yes**
Chatsmed Gardens	Private	Durban	No
Edendale	Provincial	Pietermaritzburg	**Yes**
Entabeni Life	Private	Durban	**Yes**
Greys	Provincial	Pietermaritzburg	**Yes**
Howick Private	Private	Howick	No
Inkosi Albert Luthuli Central	Provincial	Durban	No
King Edward VIII	Provincial	Durban	No
King George V	Provincial	Durban	No
Kingsway	Private	Durban	No
Mahathma Ghandi	Provincial	Durban	No
McCords	Provincial	Durban	No
Mount Edgecombe	Private	Durban	No
Northdale	Provincial	Pietermaritzburg	No
Parklands	Private	Durban	No
Phoenix	Private	Durban	No
Pietermaritzburg Medi-Clinic	Private	Pietermaritzburg	No
RK Khans	Provincial	Durban	**Yes**
St. Aidan's Mission	Private	Durban	No
St. Anne's	Private	Pietermaritzburg	No
St. Augustine's	Private	Durban	No
Umhlanga	Private	Durban	No
Wentworth	Private	Durban	No
Westville Life	Provincial	Durban	No

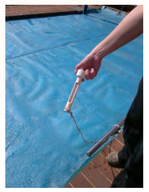
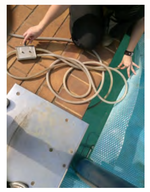
So in essence there are five hydrotherapy facilities in the region, namely at Addington Hospital, RK Khan's Hospital, Edendale Hospital, Entabeni Hospital and Grey's Hospital. And of these five facilities the only one currently in operation with patients is Grey's Hospital in Pietermaritzburg. For the number of conditions and patients suffering with these symptoms, hydrotherapy can be a highly effective mode of treatment and rehabilitation but with this minimal amount of facilities it is essential to provide adequate facilities as there is a great need.



RESEARCH CONCLUSION

In conclusion what can be ultimately claimed is that nature, water and architecture each has qualities and potentials for healing but these when combined can create great healing environments for mankind. Architecture has a duty and responsibility to look after the people that use its spaces and even to heal and constantly balance them in this stressful modern age. The need for healthy buildings and spaces in the human realm is relevant and necessary and a collaboration of water, nature and architecture can make this possible.

Hydrotherapy pools & treatments

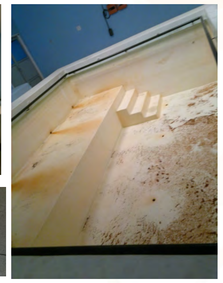



1. Life ENTABENI Rehabilitation Centre

Interviewed Sharon Roswell

The hydrotherapy pool at Entabeni is an outdoor pool about half the size of a standard swimming pool (3.5 x 7m).The rehabilitation houses 50 patients with the hydro pool and gym areas. This facility or pool sees about 5 to 8 patients a day due to the size of the pool. The depth of the pool is 1 meter so no diving is cautioned but the depth of pool may vary. The ideal situation is to have a shallow and deep end to allow for proper immersion.

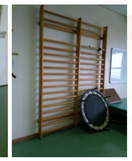
- Types of patients that were treated by hydrotherapy pool are Cardiac Patients, Stroke patients, Head Injuries, Spinal Cord Injuries, Sports Injuries. Patients always has a therapist in the water with them – it has been expressed that it is better to also have an assistant outside the pool for emergencies. An emergency mat should be placed next to the pool for emergencies like should a patient have cardiac arrest while in the water. There should be a panic button near by for emergencies.
- There is a thermometer placed in the water to check the water temperature constantly as the incorrect temperature is harmful to patients.The ideal water temperature should be between 30 to 35 degrees. There should be a special heat pump to heat water as water gets pumped the pool to it via one pipe and another pipe brings the heated water back to the pool.
- The pump room for the hydrotherapy pool is a brick room outdoors.The Rehabilitation Centre carries out regular water quality tests twice a month with EThekwini and have a contract with Splash Pool to clean the water and pool once a week. These sessions are around 20-30 minutes.
- The railing should be along the edges of the pools. In this pool they are only on one side and a suggestion was to have them on both of the longer sides.
- Entabeni has the hydrotherapy pool covered by a special mat that it used to keep the heat from evaporating and cooling the pool and prevent debris and dirt from coming onto the pool. But due to the shiny quality of the special mat the birds like to peck and make holes on the mat, and the heavy elements damage it.
- A hoist is used to get the patients into the water. The hoist is a stainless steel contraption attached to the side of the pool. It is a steel chair that is submerged with a pole that comes up high out of the water. The chair then gets lifted up the steel pole by a hydraulic system (with is water generated from a tap close to the pool) and when at the correct height swung around to the pool ledge for patients to get on.



2. Addington Hospital

Interviewed Shoba Naidoo

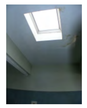
- Addington Hospital has an indoor hydrotherapy pool that is around 7 by 4 meters in dimension. This pool has been used for the past one and a half years due to a water pipe burst which has needed to be fixed. Now that it has the pool needs to be painted before it can be filled.
- This pool is elevated 800mm off the ground on the second floor of the hospital with a wide 500mm edging all around. Around the pool where the pool wall meets the floor there is a drain pipe that is an extra measure to drain excess overflow water from the room. The pool itself is divided into two sections with a shallow section and deeper one with the levels being separated by a single ledge down the long length of the pool. There are a few steps at one end leading from the shallow ledge to the deeper area. There are entry outlets for water to be pumped in on the higher level and drainage pipes at the deepest end to drain water.
- There is a mechanical hoist that is situated at the end of the room with leads to the pool via a rail on the ceiling and stops in the middle of the pool. This has a weight limit and has not been used in a very long time. Due to the harsh coastal conditions it has also started rusting.
- The pool has aids in the form of railings on all four sides for the patients t hold onto. To access the water in the pool the patient has to climb up movable steel steps and climb of swing themselves over the edge. This is quite uncomfortable for patients suffering from arthritis and serious medical injuries.
- There is a shower cubicle and change area for the patients to use in the next room to the pool with rubber mats leading to the entry point. There are two small skylights that provide top lighting in a cozy shade of yellow which lightens the room considerably compared to the floor to ceiling sliding glass doors at the one end of the room. In order to fill the pool the maintainence puts a hosepipe into the pool attached from the shower cubicle and fills it. The pool is treated with chlorine and nothing else.
- The thermostat in down with the heater pump in the basement and so is not immediately accessible which causes delays with the therapists needing to sort out problems in temperature. The pool generally fits six people at a time but at most eight people with the corners going to the weaker patients because it has more support and the stronger patients in the middle edges.
- Addington sees mostly arthritis patients and mostly utilized by out-patients. There is a therapist assigned on rotation every 3 months and the pool visit days are Monday, Wednesday and Friday.
- The problem with this pool is the difficult access, the steep step with no gradient, and the deep section which most patients do not feel comfortable in. The steam and heat of the room from the water is highly problematic with clear evidence of the paint peeling on the walls and the stained drip lines on the one wall.



3. LIFE Westville Hospital

Liesel Way Physiotherapists

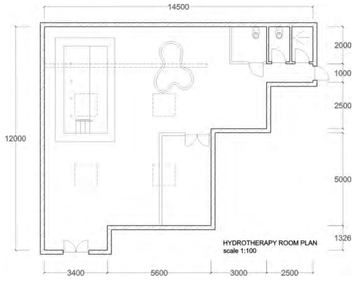
·Westville Physiotherapy Department has a large department for a private hospital.
·There is a large gym used by in patients and the only facility that allows out patients' utilizing the facility.
·The room is about ten by seven meters with large unobstructed space and especially non slip flooring.
·There is a lot of equipment that goes into these rooms and so storage is important. This equipment are parallel bars, Pilates mats and bed, treadmills, cyclers, bouncing balls, dumb bells and weights, fake movable steps, ladders.
·An important element in these exercise rooms are mirrors for patients to correct there posture and see their progress· Also important are precaution measure such as a defibrillator in case of cardiac attack or oxygen tank for wheezing or hypertension.
large open spaces are necessary for patients to perform exercises in groups or individually with their therapists.



4. RK Khan's Hospital

Interviewed Thirusha Ramsuth

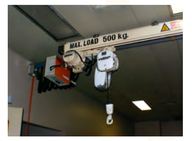
·RK Khan's Hospital hydrotherapy pool is very similar to Addington's facility. It is not currently working due to a broken thermostat. The actual hydrotherapy pool is raised of the ground and needs to be accessed over the wide edge. It is also laid out the same with a difference in levels joined by a small flight of steps.
·The pool measures 5.6 metres by 3.2 metres. It has a 450mm wide seating rim around the perimeter and a hoist suspended over the pool. This hoist does not work. This facility also houses a Hubbard Tank which is not in use due to it leaking.
·There is plentiful natural lighting from the high level line of windows at the edge of the room as well as four skylights seen also in Addington hospital.
·The pool floor and side finish is tiles and the only pool seen thus. The rest are either fibre glass or painted. There is one shower cubicle and toilet and a storage room for equipment. The pool looks like it is filled by a hosepipe which is attached to the adjacent wall. HTH is added to the pools waters to cleanse the water.



5. Grey's Hospital

Interviewed Heidi Shanahan and Phil Viljoen

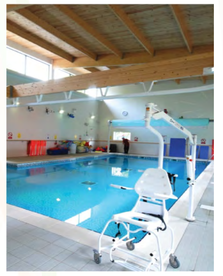
·Grey's Hospital hydrotherapy pool is much better designed than most. It is a ten by five metre pool of one metre depth. It also houses a Hubbard tank. The room is entered at the highest level of the pool and then steps and ramps down on either side to the lowest end of the pool. The pool can be accessed by the mechanical hoist which runs straight through the centre of the pools length and curves to another part of the room where the Hubbard tank sits. The pool at entry point or side has a shallow step for walking patients to enter the water or can be access by the ramp leading into the pool which is used for patients in wheelchairs. In this instance Grey's uses normal wheelchairs and not plastic wheelchairs for the patients to get into the water. There are numerous railings, one set for the ramp and one around the complete edge of the pool. Like Addington there is a wide 500mm ledge to the pool.
·There are a few drainage systems at the pool; the first is at the shallowest point where people walk in and out of the pool which has a steel covering with holes to catch excess water from the dripping body. And then there are overflow drains around the bottom of the outside of the pool for complete major overflow of water, and minor overflow is dealt with outlets at the top inside edge of the pools circumference. On the higher level off the ramp is the inlet nozzles for water to be pumper in and on the floor of the pool down the center are four suction outlets for water to be drained.
·There are male and female change rooms each with a shower cubicle and many rubber mats on the floor and leading to the pool. There is also an additional foot tub to rinse the feet before entering the pool.
·The ideal temperature for vigorous exercise according to the therapists is 32 to 34 degrees Celsius.
·The hydrotherapy pools are used especially for pain management for conditions such as arthritis.
·Ideas for better management is a swing-out seat in the shower cubicles for wheelchair patients and more than one shower cubicle as this restricts time and people. A vacuum hose system to capture dust and dirt in the water instead of very gently sweeping under water to the dirt to suction drains. And a more hands on approach to heating where the controls for water temperature is at therapists' disposal and not down in mechanical rooms.
·The Hubbard tanks are a good option for patients' that cannot use the public pools because of contamination. These pools can be filled and then drained and cleaned after each patient such as ones with open wounds, drips and who are incontinent.
·The water management system is colour coded in the mechanical room or floor in Grey's case. First the water is sucked out of the pool by the suction cups on the floor of the pool and then taken via pipes (light blue) to the sand filter (green) which filters out any debris, the water then moves to the heater pumps (red) which have the water going through the cylinder in which hot steam heats the water. This warm water is feed back to the pool in a separate pipe entering the pool at a higher level. All the overflow and drainage outlets have a separate system (cream) and lead straight to the many drainage pipe and gets feed put of the building.
·The pool gets drained once a year with fresh water being pumped in. the pool can either be lined with good quality waterproof paint or fibre glass and an important technical issue is the proper sealing of the pipes and outlets going into and out of the pool.
·Grey's is the only facility with a walking pool much like parallel bars on land that is a long narrow deep pool with handrails on either side and steps to enter down. This is for walking movement and exercise and there are two, most probably for warm and cold water. This has not been used in many years.

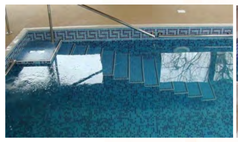


PINELOG HYDROTHERAPY POOLS

Our hydrotherapy pools are pleasant, safe and inviting in appearance. Pinelog's expertise in designing and constructing together with the aesthetically pleasing use of our structural glulam timber beams and other materials ensures that our pools look attractive and perform well. Pinelog's construction materials provide some of the best acoustic performance too, which is another important design consideration. Hydrotherapy pools are warm water pools usually used by physiotherapists while treating patients who may have physical problems or special needs. Pinelog construct hydrotherapy pools for private individuals, special needs schools, hospitals, private practitioners and disabled groups. The design of the hydrotherapy pool requires an assessment of the user's special needs to ensure that it provides appropriate therapeutic benefits.

The size of the pools will vary from a small hydrotherapy pool of 6m x 4m up to much larger ones; the minimum space required for each patient is 2.5m x 2.25m, so for example a 5m x 9m hydrotherapy pool would accommodate up to eight patients. In some cases we build high pressure jets into the pool to provide a resistance to swimming or to have a massage effect. The hydrotherapy pools can also be transformed into a full sensory environment with use of specialist lighting, sound system and fun floats.
The building will have a specially designed heating and ventilation system (environmental control) which will keep the air temperature to the desired level, provide ventilation and control the humidity. Facilities within the hydrotherapy building include spacious changing areas, showers and toilets including accessible shower/s, wc/s, and wash down beds, with the number and layout being determined by the specific number of users. Separate facilities for physiotherapy staff are also generally built in. Your Pinelog hydrotherapy pool will be designed and tailored to meet your individual requirements. We look after all aspects of the construction from initial design and planning permission all the way through to project completion, with our experienced contract management team ensuring the development progresses smoothly.





CONCLUSIONS

Hydrotherapy pools currently are general standard designs that try to incorporate as much natural light as possible. the accessibility and temperatures are very important aspects due to the types of people utilising them.

FAULTS
- the pools are raised of the ground making access into the pool very difficult for people with disabilities
- the maintenance of the pool is very intensive so breaks all the time resulting in continual maintenance person being on site
- pools are not very well lit which is an important element for patients to visually perceive their movements in the water
- due to contiual braking down the pools were unutilised to their full potential

· Important factors to consider when designing hydrotherapy pools are the dimensions of the body and the different age groups using these pools.
· Depth perception is important for the patients in the pool and the lighting conditions affect this such as harsh bright water reflections or light at eye level which distorts the depth perceptions of patients in the water. Top natural lighting is more appropriate.
· Technology can be incorporated into hydrotherapy at a visual level with exercise videos that patients focus on in session while the therapists focus on the patients' movements and correcting them. This is more fun for the patients and more focusing for the therapists.
· There should always be seating at the edges of the pool for the transition period for patients to get accustomed to water as panic and fear of water is highly common.
· Railing should be all around the pools to allow patients to keep to edges and for exercises and security.

Hydrotherapy Pools and their designs need to be looked into to better facilitate the patients and the spaces provided.

"hydrotherapy is a neglected field of physiotherapy due to inadequate facilities"

- Eugene Augustine

1.Ashgate Croft School, Derbyshire- Hydrotherapy Pool

2.Wessex Autistic Society, Portfield School, Dorset - Hydrotherapy Pool Community.

3. Bradstow School, Broadstairs, Kent - Sensory Swimming Pool

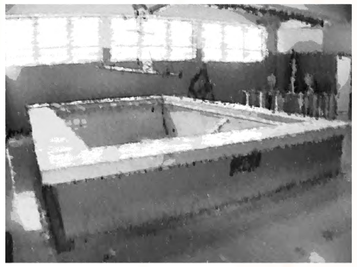
Hydrotherapy concept

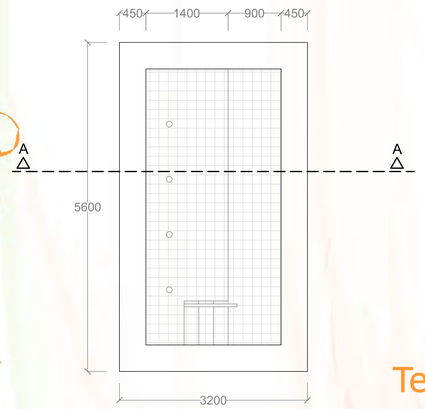
Hydrotherapy is a vital aspect in the treatment and rehabilitation within any physiotherapy department or establishment. It is a modality that is natural unlike drugs and medication within the field of physiotherapy. It also can be used on a medical or entirely general health level and therefore is not restricting in its target market.

"It has to be appreciated from the outset that there cannot be standard design for a hydrotherapy pool and that each individual department should be planned to cater fro the number and the types of patients who will need to be treated."

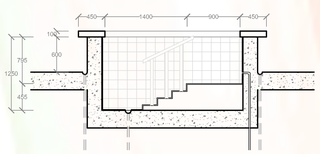
Hydrotherapy involves the use of water as an exercise and bathing procedures for rehabilitation. Water is the only other environment available to man other than land. When a body moves into the water it experiences two things - it is simultaneously reacts to two forces, the first is the downward pull of gravity and the second is the upthrust of buoyancy. These two forces experienced at the same time when in water allows the possibility of three-dimensional exercise and movement that when on dry land is hardly achievable. With the understanding in flexibility and gain of unusual movement
in water, many forms of rehabilitation for different ailments can be achieved.

Hydrotherapy is the utilization of water in the treatment of disease and its therapy importantly exploits its temperature effects. Hydro- and hydrothermal therapy are traditional methods of treatment that have been used for the treatment of disease and injury by many cultures, including those of ancient Rome, China, and Japan (web 5). At a historical level the time in which hydrotherapy was first used is unknown but the first records of it dates back to 2400BC from the Proto-Indian culture, Egyptians and Assyrians, as they





Typical Hydrotherapy Pool Plan



Typical Hydrotherapy Pool Section A-A

Types of Conditions treated with Water Therapy

PAEDIATRIC HYDROTHERAPY
- Disorders of Bones,
- Joints and Muscle - Juvenile Chronic Arthritis
  - Muscular Dystrophy
  - Congenital Abnormalities
  - Spina Bifiden
  - Osteogenesis Imperfecta
  - Burns
- Neurological and Development
- Disorders - Cerebral Palsy
  - Head Injury
  - Epilepsy
  - Infection of Central Nervous System
- Learning Difficulties and
- Behaviour Disorder - Severe Learning Disabilities
  - Autistic Children
  - Hyperkinetic Syndrome
  - Perceptual Disabilities

ADULT HYDROTHERAPY
- Neurosurgical and Head Injuries
- Neurological Rehabilitation - Hemiplegia
  - Parkinson's Disease
  - Multiple Sclerosis
  - Perceptual and Cognitive Problems
- Spinal Mobilisations
- Spinal Cord Injuries
- Rheumatic Diseases - Inflammatory Arthritis
  - Degenerative Arthritis
  - Spondyloarthropathies
- Orthopaedics
- Management of Sports Injuries
- Aquanatal Exercise

PRIVATE HYDRO POOLS FOR CENTRE

- Upper Body Pool
- Lower Body Pool
- Child Range Pool
- Walking Pool
- Obstacle Pool
- Whirlpool Bath
- Group Hydrotherapy Pool

PUBLIC HYDRO POOLS FOR CENTRE

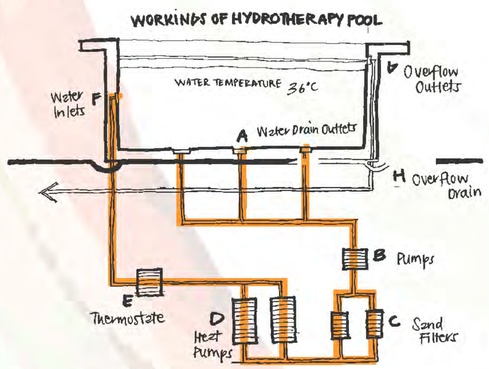
- Swimming Pool
- Kneipp Bath Hot
- Kneipp Bath Warm
- Kneipp Bath Cold
- Whirlpool Bath
- Turkish Bath
- Sauna
- Child Range Pool

Techniques of Exercise in Water

There are essentially two different ways in which the patient can be treated in the hydrotherapy pool. Treatment can be carried out with the patient supported on a submerged plinth and holding the side of this, or supported in rings and holding onto a rail, standing or sitting. The method of exercises given with the patients supported in this manner is called the CONVENTIONAL METHOD.

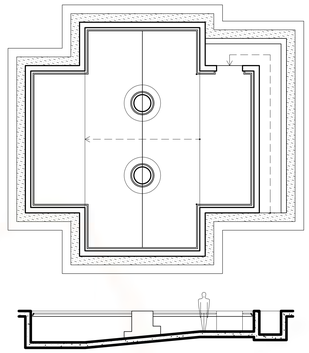
Alternatively there is the BAD RAGAZ or RING METHOD which is used when the physiotherapist herself provides the fixed point from which the patient works. The patient is supported in floatation rings and does not themselves hold onto any fixed equipment. The characteristics of strengthening and mobilising exercises from these two methods differ to a certain extent. In the conventional method emphasis is usually placed upon exercising one group of muscles in one plane of movement. The rotation component is not easy to assist or resist although the patient can be encouraged to move to the extremities of range with fixation being provide by the physiotherapist. Patterns of movement are utilised in the Bad Ragaz method and three elements of movement are inherent in all movement patterns. Theses are flexion - extension, abduction - adduction, and internal and external rotation.

Most hydrotherapy treatment pools have a water circulating system which similar principles to a public swimming pool. The main function of this system to firstly to clean the water and secondly to heat the water. Generally there is an area or room that houses this system or equipment that maintain an adequate condition of he pools. The system functions as follows:
Water leaves the pool or is sucked out by outlets and the bottom or floor of the pool (A), the water is drawn by the action of the pumps (B). the water then passes through the filter to clean away debris, dust and impurities (C), gets sent to the heat pumps (D) monitored by a thermostat (E) which are cylinders that emit steam onto the water carrying pipes to heat the water passing through and then moves onto the chlorifiers. The water then is flowed back to the pool through a different set of outlets (F) normally higher up and at the side of the pool. The pool also has a backup system of overflow outlets (G) at the top inside sides of the pool and also in a perimeter drain around the floor (H). The excess water collected from these pipes leads straight to the drainage system.

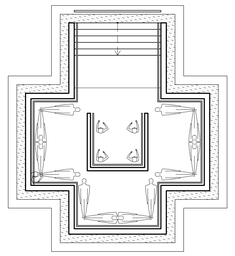


Plan and Section Views of Specially Designed Hydrotherapy Pools for Center

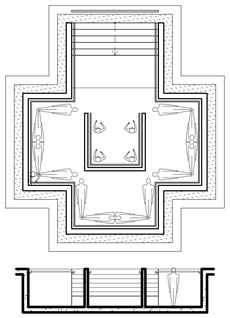
child range pool



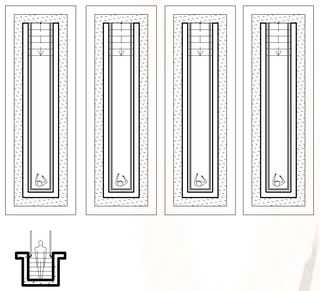
group therapy pool 1



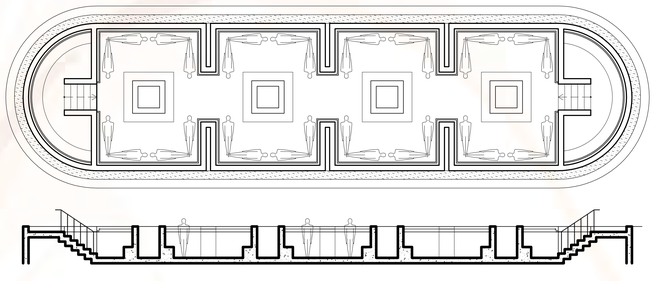
group therapy pool 2



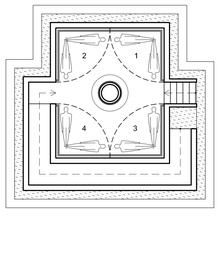
walking pools 1 - 4



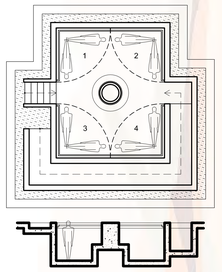
lower body pool



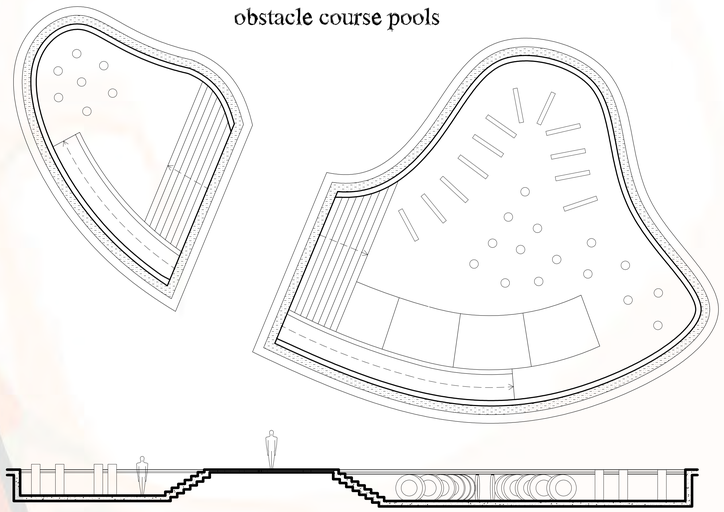
upper body pool 1



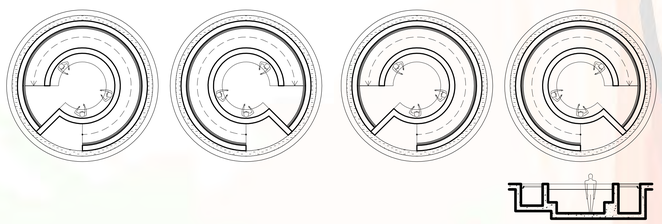
upper body pool 2



obstacle course pools



whirlpools 1 - 4



THE MAIN GOAL FOR THE HYDROTHERAPY CENTRE IS TO INNOVATE HYDROTHERAPY AS A PRACTICE AND CONVERT STANDARD LIFELESS POOLS INTO SPECIFICALLY DESIGNED POOLS THAT ALLOWED PATIENTS TO COMFORTABLY FOCUS ON AREAS OF TREATMENT WITH THE POOLS INSTEAD OF HAVING ONE DESIGN IN WHICH THE PATIENT HAD TO CONFORM TO.

Site Selection Criteria

- **Proximity to Water**

From the research it can be established that water is one of the most important natural elements of life. It is also a critical aspect in the creation of healing environments because the flow of water from its sound to its perceptions provides a relaxing and calming factor. Water is also one of the main focuses of healing treatment with Rheumatic patients and there will be a need to incorporate water into the selected site for this reason. It would be preferable that the water incorporated on the site be a natural feature and not man-made as this will make the location more authentic and viable. These water sources can range from lakes, dams and rivers, to springs and waterfalls - the more natural the water source the better.

- **Accessibility from a city or town**

Accessibility is a criterion because the function of the building is to cater to the public, the specific public being patients with Arthritis and Rheumatism. It is difficult between trying to keep the site accessible and keeping it as much away from the harshness of the city as possible, but ultimately if people cannot access the site then there is no point in its location. There should then be at least a route accessible by car from the nearest city of Pietermartizburg and town of Howick. The site has also got to be accessible for the patients' families as they are an integral part of the rehabilitation process for support.

- Setting away from high traffic and heavy city noise

The research shows that loud heavy noise such as traffic, construction, and mechanical elements are harmful to creating peaceful healing environments. What are needed are peaceful, serene and quiet natural environments. It is essential that a site then be chosen and situated far enough away from the city and further into the natural outskirts of the city.

- **Natural wilderness and beauty setting**

By using the principles of Nature as well as the calming and healing qualities of it in order to create the most healthy environments, the site should be fully integrated into a lush natural setting with abundant vegetation (the more untouched by man the better), wildlife and natural features. The further in nature the patients go the further away from harmful factors they get. A site with lush vegetation and trees also provide good indoor and outdoor air quality and freshness.

- **Opportunity to offer local labour staff**

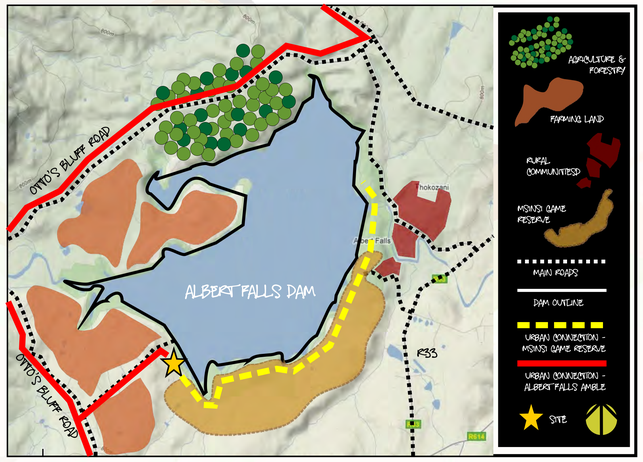
Due to the semi-isolated position of the sight in order to fully and valuably integrate with nature, a local community should be situated close by in order to provide employees to maintain the development. The close community with be more advantageous and practical than having staff coming daily from cities or places far away. This in turn will also improve employment levels locally and thereby enrich the lives of the local community.

- **Warm Climates**

Rheumatism is generally negatively affected in cold climates. The cold brings greater levels of aches and pains for the joints. Understandably the cold cannot be completely avoided but the warmer the climate the better the environment for Rheumatism patients.

SITE SELECTION CRITERIA	SITE 1: LILANI HOT SPRINGS	SITE 2: ALBERT FALLS DAM	SITE 3: PALMIET RIVER
1. PROXIMITY TO WATER Justified by the theory of waters healing qualities such as reflection and	• Lilani has natural hot springs on site, the site is slightly developed in Phase 1 of a 7,5	• One of the largest dams in KZN • Albert Dam creates a good backdrop or 6	• The river from Inanda Dam flows South and meets the stream from Kloof Gorge on the East. This river 6
2. ACCESSIBILITY FROM CITY Due to daily active part of centre/ complex the site needs to be accessed	• Furthest site option • Set 175kms from Durban and 110kms from Pietermaritzburg, the closest town is 3	• Equally close to Pietermaritzburg and Howick at 22kms. • Distance from Durban 5	• Complex access route to site through residential areas. • Closest site to Durban. 6
3. NATURALLY SILENT SETTING Following the theory that noise is a health hazard and naturally silent	• Isolated position ensures quiet setting. • Site set far away from 8	• Situated in location with no freeways or main roads nearby. 8	• Located on a hill with residential areas on all sides. • It is far away from freeways and main 7
4. NATURAL WILDERNESS & BEAUTY Natural landscapes captivate and entrance the viewer and allow them to	• Situated in a steep gorge, One side is Tshani ridge with cliffs of table mountain 7	• Albert Falls waterfall is on the perimeter of the dam. • The dam provides a large body of water 10	• Set atop a hill the site has prominent position and good 270° views. 6,5

SITE SELECTION CRITERIA	SITE 1: LILANI HOT SPRINGS	SITE 2: ALBERT FALLS DAM	SITE 3: PALMIET RIVER
5. LOCAL LABOUR SUPPORT Natural settings lack the Urban development advantage of readily	• Rural communities surrounding the site 6	• Local community is Thokozani but 5	• There are local 6
6. WARMER/ CONTROLLED CLIMATES Rheumatism and arthritis patients suffer or experience more pain	• 762mm rain per annum • Lowest rainfall (4mm) in June Highest rainfall (131mm) 5	• 790mm of rain per annum • Lowest rainfall (6mm) in June 7	• 750mm of rain per annum • Lowest rainfall (11mm) in June 6
7. NATURAL MATERIAL RESOURCES By using the natural environments materials the healing environment	• Stone from the nearby river 6	• Slate stone quarry at two areas in immediate vicinity 5	• None 0
8. WATER USAGE Water from a natural source would be energy efficient and due to the	• Hot Springs are already developed and very limited • There is not enough 3	• Albert Falls Dam is one of the largest in KZN and has area accessible to the 5	• At the foot of the hill is a river but the distance from it is too steep to get water to 2
TOTAL POINTS /80	45,5	61	39,5



Site Information

• Location

The Albert Falls Dam is situated on the Mgeni River in KwaZulu Natal near the small town of New Hanover and Cramond.The Mgeni River, which means "place of the acacia trees" feed th dam and is a perennial river and one of the more reliable large rivers in South Africa. Albert Falls Dam is a composite structure comprising a central concrete gravity section with earth embankments on both flanks. The gravity section is 239m long and 30m above riverbed level and incorporates an uncontrolled spillway section of 100m. The combined length of the two earth embankments is 1671m. The net storage capacity of the dam is 289,1 million m3. The Albert Falls Dam forms an integral part of the Mgeni System which is managed and operated as a unit.

• History

The Mgeni River is the main water source for the Durban-Pietermaritzburg metropolitan complex and supplies about 90% of the area's water requirements. The Midmar Dam, which was completed in 1965, the Albert Falls Dam, which was completed ten years later, and the Inanda Dam, completed in 1989, were planned, designed and built by the Department of Water Affairs and are the major dams on the Mgeni River. Water from the dams is supplied in bulk to Umgeni Water which is responsible for the purification and distribution of water within its statutory area. This includes the Durban-Pietermaritzburg metropolitan area.

• Function

The Albert Falls Dam provides storage on the Mgeni River and serves as a balancing dam in the Mgeni System. The dam is situated roughly halfway between the Midmar and Nagle Dams and can therefore impound spillage from the Midmar and release water to the Nagle Dam to supply Durban. The climate of the area lends itself to recreation and for this purpose amenities have been made available at the dam by the Natal Parks Board.

• Context

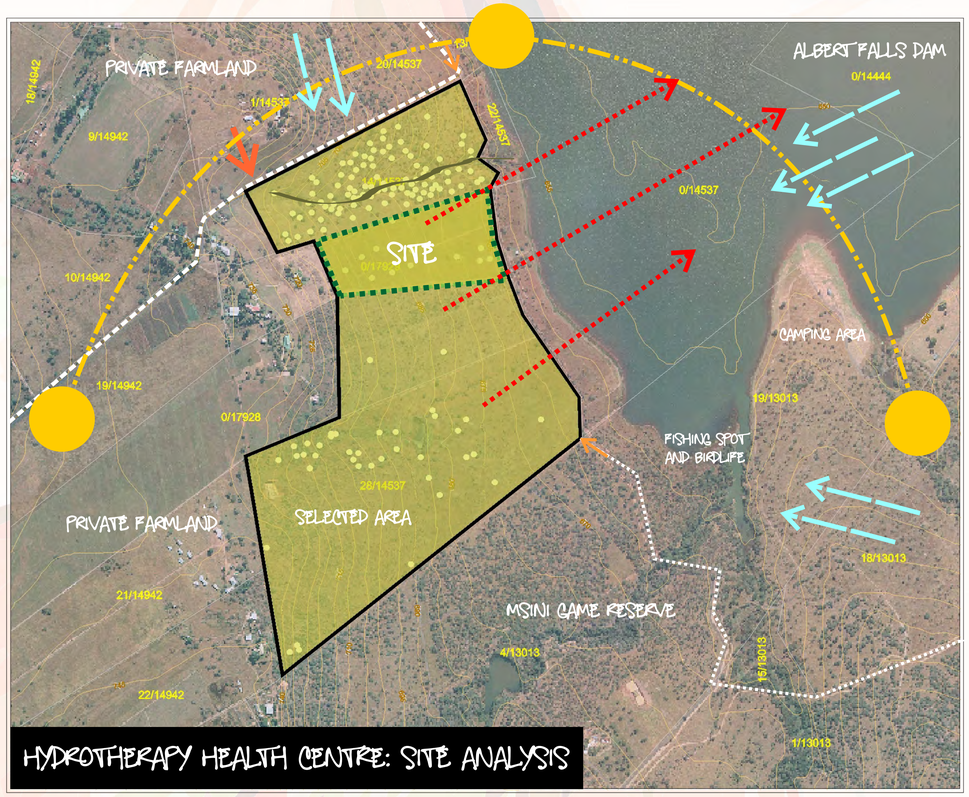
What exists around Albert Falls dam is a semi recreation zone with well-made dirt roads, camping and picnicking sites and facilities, relatively unobtrusive toilet and ablution facilities, a small group of huts and facilities for boat storage.this is from the Msinzi Game Reserve which has accommodation chalets within th area.

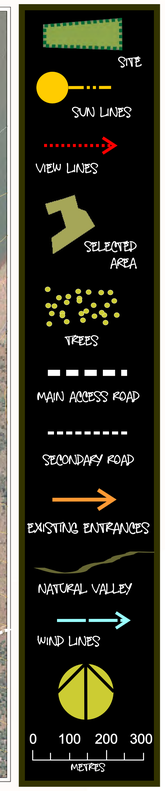
• Wildlife

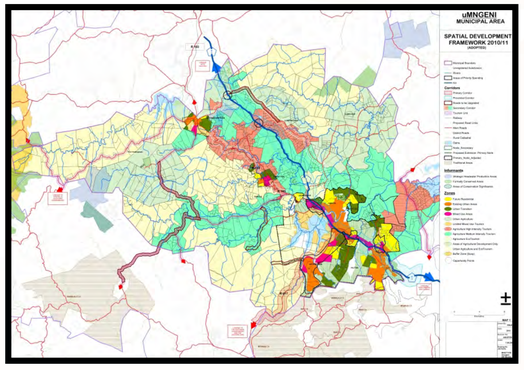
The land here is given over to tracts of mixed woodland, open grassland and small marsh areas, and in the wet seasons birdlife is abundant and includes widows, weavers, waxbills and cisticolas. Wildlife in the reserve includes zebra, numerous buck such as the springbok, impala, blesbok, reedbuck, grey duiker, the red hartebeest, and oribi, rhino and giraffe. Albert Falls Dam, rated as one of the best bass fishing dams in the world.

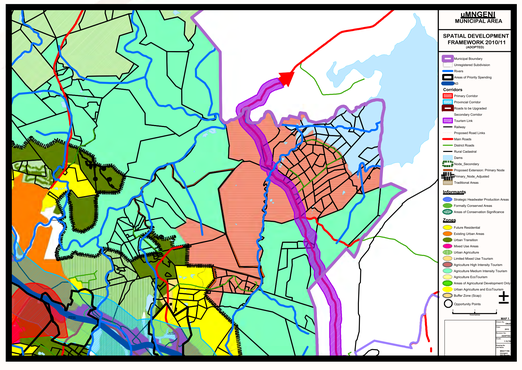
• Tourism

Established in October 1997, The Albert Falls Amble has aptly chosen as its emblem the Fish Eagle, whose unique cry punctuates the area. The Amble is an arts and crafts route that takes advantage of attractions and activities in the area extending from Albert Falls to Wartburg, Dalton and New Hanover, and now includes the historic locations of Bishopstowe, Cramond, Hermannsburg and Kranskop. It has a wonderful selection of crafts, pubs and a number of private game reserves.





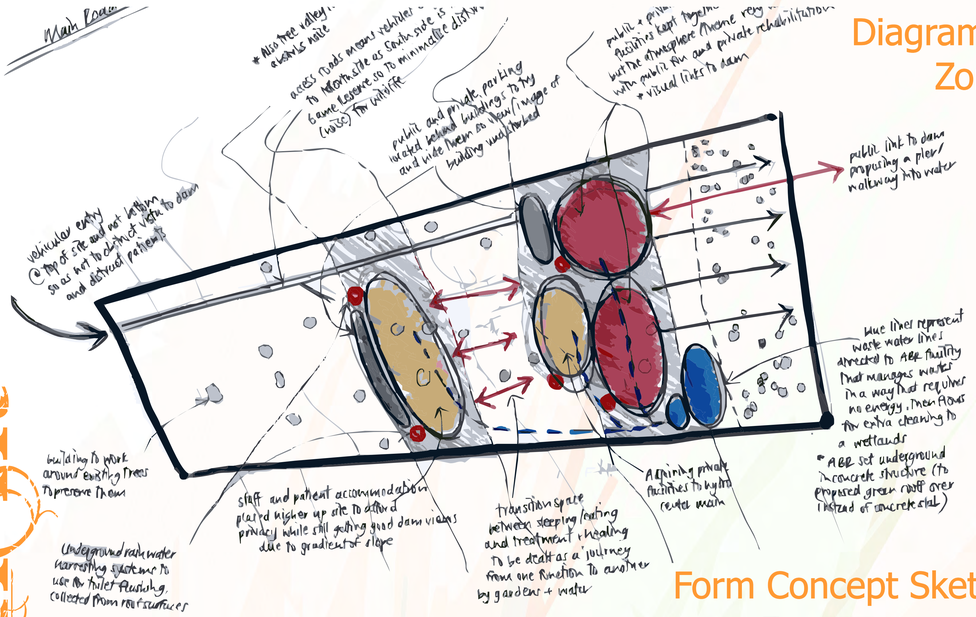




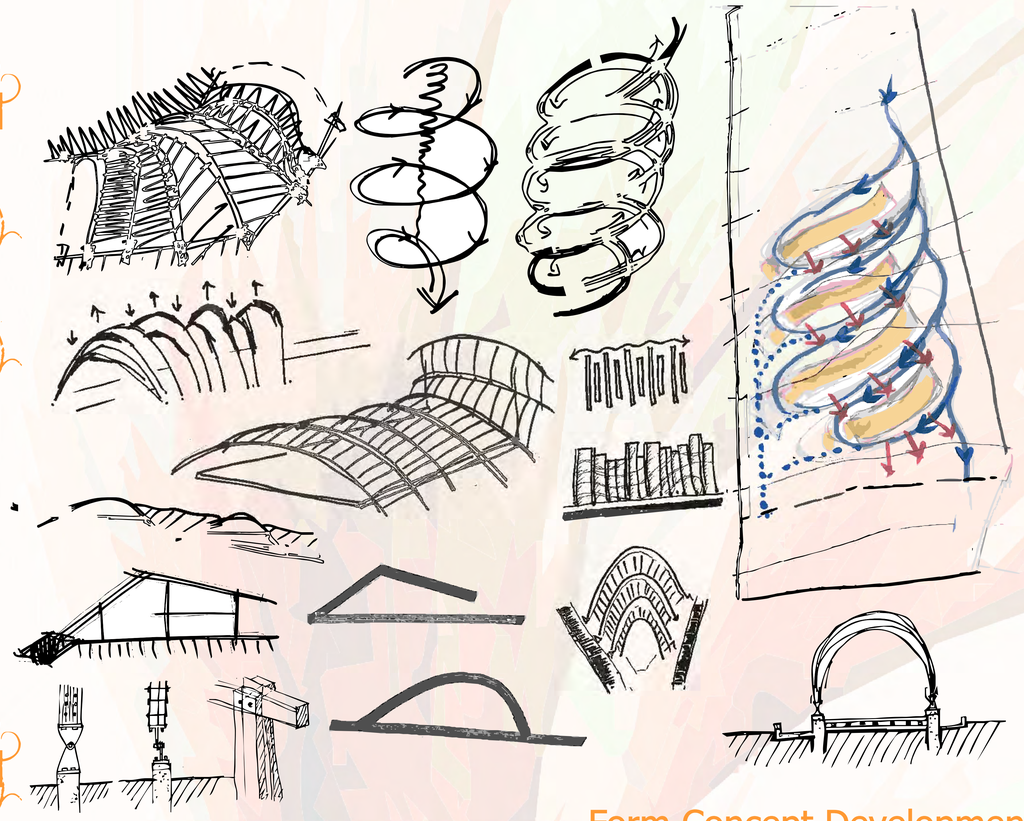
VIEW FROM AND AT HYDROTHERAPY HEALTH CENTRE SITE

Development

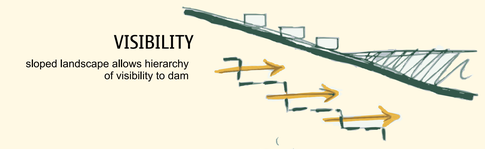
Diagramatic Zoning



Form Concept Sketches

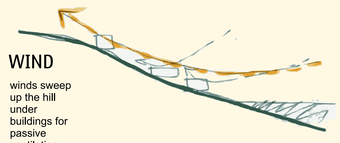


Site Concept Sketches



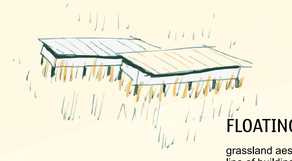
VISIBILITY

sloped landscape allows hierarchy of visibility to dam



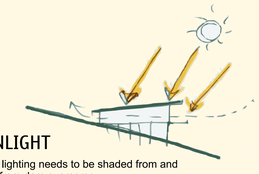
WIND

winds sweep up the hill under buildings for passive ventilation



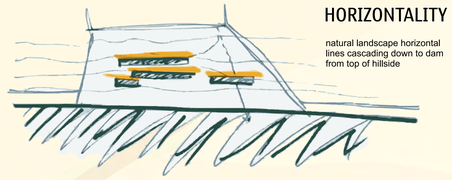
FLOATING WITH GRASS

grassland aesthetic blurs ground line of buildings



SUNLIGHT

North lighting needs to be shaded from and glare from dam overcome



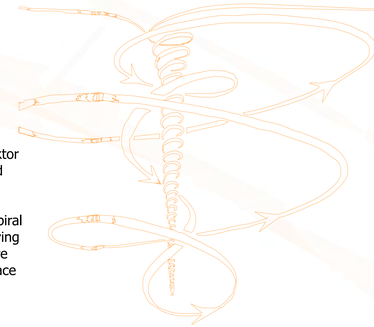
HORIZONTALITY

natural landscape horizontal lines cascading down to dam from top of hillside

RAINWATER COLLECTION

sloped smooth roofs to capture rainfall throughout the year to utilise in building fuctions and stored underground where it is cooler

Water Spiral Motion Concept



"Even water is in harmony with itself and the place it has in the universe. Each phase of water's cycle reflects the other phases; no one phase can be deemed more important than another; water is vital to every cycle in life. It is part of a whole and always seeks to return to a whole." (Ryrie, 1998: 17)

The health of water is not at a constant level either as any changes in temperature and movement changes the electric and magnetic vibrations. Viktor Schauberger was an Austrian forester who formed different ideas about water. His theory on water was that modern technology in is production and processes should follow the natural patterns and movement of water. This was because water as well as other liquids channels in rhythmic organic movements and not straight lines. The energy created from this form of movement was seen to create better harmony than friction which is experienced in natural straight rigid paths. He believed that the principles of cycloid spiral motion were worth following in technology because the spiral motion was the basis of motion for all growth in nature. Still water really is dead in a sense because there is no movement of energy in it. Only moving water is replenished with oxygen and free from contamination. Water that is forced in straight channels loses vital energy and balance and therefore healing potential. As seen from natural water features such as rivers, streams and oceans never flow in straight lines but meander through the surface topography.

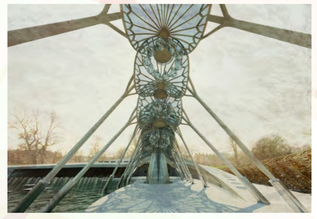
Water has the power and influence to affect human minds and spirits, as its qualities are highly soothing, relaxing and rejuvenating (fig 4.5). As the eye follow ripples on the water the mind is drawn into a soothing dream, washing away stress and invigorating our life energies. Still water such as lakes, expansive, clean and lonely, is the essence of tranquility. Water moves in different speeds and patterns but the slower and calmer the water it induces moods such as calm, disquiet, awe and energy

" life renewing qualities can be seen in fluid shapes, fluid movements, and forms shaped out of wates flow principle"

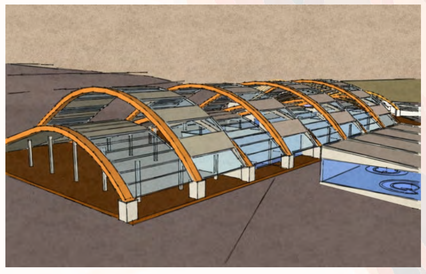
"Look carefully at a drop of water, or a bubble, and you will see the same kind of circulations inside the watery sphere that you see in the steam above tea, or the movement in rivers - eddies, confluences, swirls, spirals, and separations of flow in layer upon layer. And these are the same layers in the hydrological cycle, swirls of moist air above the land, swirls of moving currents in the Earth's water, swirls of water transpiring from plant and animal life. Every single drop of water is a microcosm of the universe, containing the same rhythms and patterns - just on a different scale." (Ryrie, 1998: 82)

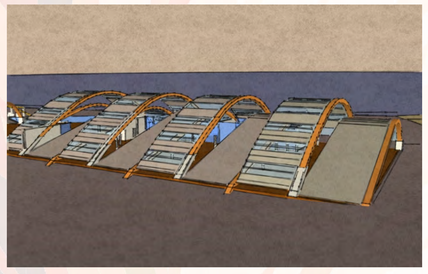
Walkway Concept

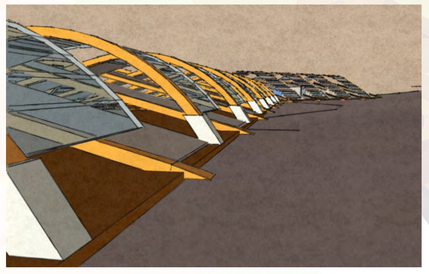
The walkway forms the link between the buildings as well as an experiential journey through the site. where people get taken out into nature and then brought back into confined spaces. The walkway would be semi permeable and organic in form. A flowing engaging element between buildings and nature flowing down towards the dam and water as the destination point.

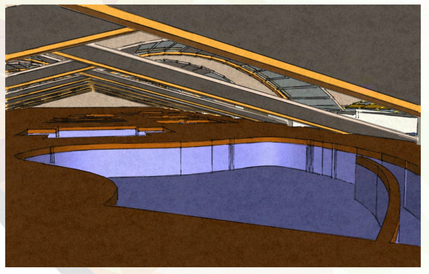


Form Concept Development







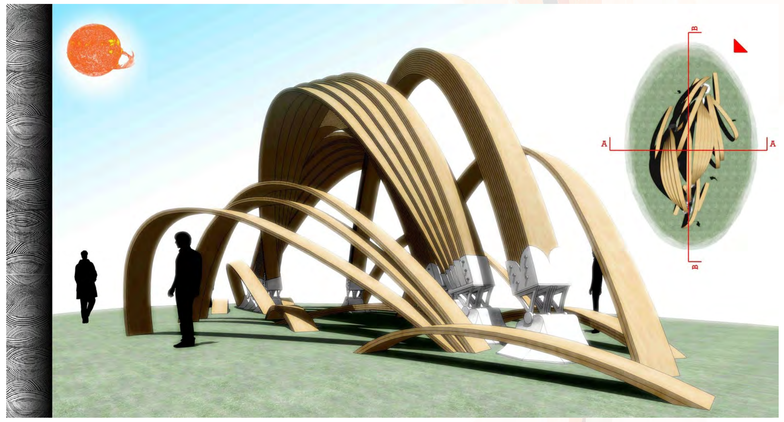


The aim of the design is to create a relatively low lying system of buildings that speak to the gradual hills that surround the dam and the region. In how the building sits within the landscape setting the buildings within the land means a tangible connection to the earth but a large disruption of cut and fill. this approach was avoided because of the long lasting damage to site, and rather an idea of lightly touching the building to the site raising it with stilts and columns keeping it visually connected but not dominating the natural landscape. The building aesthetic would strive to be warm and comfortable as suits this setting with tones of golden browns and especially timber construction.

Glulam Timber Construction

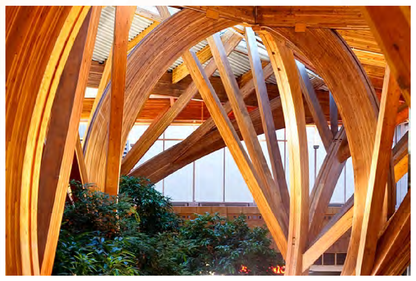
Exposed structural glued laminated timber provides structures with a warmth and beauty unrivalled by other building materials such as steel or concrete.Structural glued laminated timber is manufactured by bonding assemblies of high-strength, kiln-dried lumber, with waterproof adhesives. Special bonding techniques allow individual lumber pieces to be joined end-to-end to form long laminations, then face-bonded to form deep timbers.The laminating process allows timbers to be produced in a variety of shapes from straight beams, tapered beams to graceful, curved arches. Glulam trusses also take many shapes, including simple pitched trusses, complicated scissors configurations and long span bowstring trusses with curved upper chords.

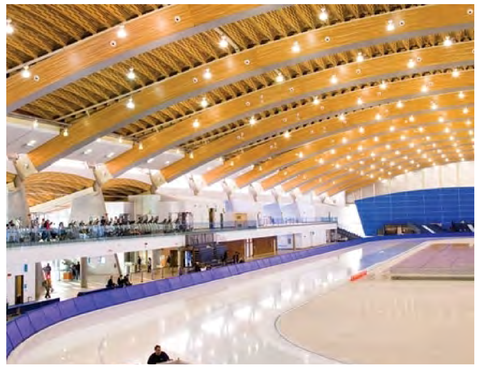
The high strength and stiffness of laminated timbers enable glulam beams and arches to span large distances without intermediate columns.
In commercial design, custom glulam beams can span more than 30 metres. In reticulated glulam framed dome structures, glulam arches span more than 500 feet.
Experience shows that wood is one of the most suitable materials for construction in and around water. Wood is resilient enough to resist battering by the ocean and docking ships, and it is naturally resistant to the destructiveness of salt water. It doesn't rust or spall; it is not affected by corrosion. Where wood is fully exposed to weather, or where protection from the elements is insufficient to ensure a moisture content of less than 20% in the glulam, pressure treatment with preservatives is required.



Advantages of using Glulam

·Glulam, like all timber possesses insulation qualities so when used within a building structure it helps to eliminate the thermal bridge between structure and sub structure.
·Glulam is recognized, as renewable, environmental friendly resource of material, and because of this, the embodied energy used to produce it is six times less than the same suitable strength steel.
·Glulam is two-thirds the weight of steel and only one sixth of the weight of concrete, Glulam provides equal performance and unmatched versatility.
·Glulam is pleasing to eye in its natural state and doesn't need cladding like steel.
·Glulam application is diverse; it can be used as rafters, lintels, floor beam, columns or decking and manufacture easier than most other structural materials. The structural capabilities are endless and over the years since it was first patented it has been used for bridges, swimming pools, and large open planned office blocks and sports halls as the primary structure
·Glulam can create vast interior spaces with no internal supports, design single beams with up to a 40-metre span, although transportation considerations usually limit working lengths to approximately 24 metres. From straight beams to curved portals and complex pyramids, Glulam adds strength, structure and majesty to architecture. Rather than hiding away the building's 'skeleton', Glulam allows you to celebrate the awesome vibrancy of nature's finest creation.
·Glulam wood is naturally durable and robust. In Glulam form it offers excellent fire resistance, unlike other alternatives, and provides a known charring rate bringing safety and integrity to your structure. Glulam is chemically stable and suitable for aggressive and humid environments, expanding its scope of use across every market sector.
·Whereas many materials used in construction are dubiously claimed to be re-cyclable, all Glulams produced are totally renewable.



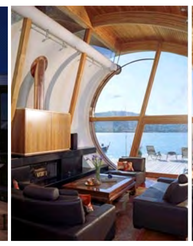


Glulam Precedents

The Winter garden - Pringle Richards Sharratt Architect
The Winter Garden is designed by Pringle Richards Sharratt Architects - who designed the adjacent Millennium Galleries.The enormous wooden arches are nearly 21 metres high. §The wood used is larch, a durable timber which will, over time, turn a light silvery grey colour. The larch, derived from sustainable forests, requires no preservatives or coatings. This reduces the use of solvents and also avoids the use of chemicals that could kill the plants. The primary arches are supported at ground level on sculptural steel cradles, while the intermediate arches finish at wall height and sit on elegant wooden raking struts.

Drogheda Swimming Pool - Newenham Mulligan & Associates
The building uses curved glulam beams, tapered circular cigar shaped glulam columns under the solid timber roof. Careful positioning of columns and the use of pairs of glulam beams reduced the structural depth while also allowing for discrete connections between columns and beams. The space between the pair of beams is used to conceal steel fixing plates and to overcome the high stress concentrations at the connections.

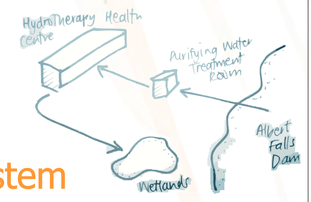
Hull History Centre - Pringle Richards Sharratt Architect
The History Centre is the first in the country to combine university and local authority archives into one, purpose-built centre, complete with staff from both organisations. A long two-storey building with an elegant wide glazed arcade running full-height along the s side formed by twenty-four curved laminated timber beams covered with three-layer inflated ETFE (Ethylene Tetrafluoroethylene, a transparent polymer) cushions.



Natural Curves: Organic 'Wood Wave' Floating Home Design - Robert Oshatz
Outside and in, from the curved wood cladding to the swooping wooden ceilings, this undulating houseboat design by Robert Oshatz evokes the dynamic movement of the river water on which it floats.The series of intersecting and overlapping organic forms creates a sense of constant movement that is clearly inspired by surrounding waves but likewise reflects the never-still nature of the structure itself.More than just a clever aesthetic trick, however, this repeated form also serves a series of architectural functions, from defining interior volumes to letting in exterior natural light at both ends and along the roof line.

Dam Water Utilisation

Due to the sites location municipal water main lines are rarely connected. The opportunity of this site is then trying to utilise the water from the dam itself by drawing the water onto site via pumping with the approval of the Department of Water Affairs. This water then gets treated on site in a water purification treatment room which runs on 12 hours a day shifts. This water will maintain the pools, bathing and drinking waters.

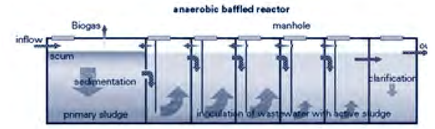


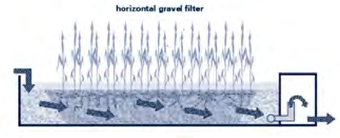
DEWATS Waste Management System

DEWATS make use of the natural biological- and physical-treatment processes to reduce and remove pollutants from wastewater. External energy supply, dosing of chemicals and movable parts are avoided to minimise both possible flaws in operation and maintenance.
A typical DEWATS could be a five component system of first three anaerobic steps consisting of a biogas settler/digester; an ABR and an anaerobic up-flow filter; followed by an aerobic treatment unit such as a constructed wetlands and a maturation pond.

TECHNICAL CONFIGURATION
Typical DEWATS combine the following technical treatment steps in a modular manner:
primary treatment – in sedimentation ponds, settlers, septic tanks or biodigester
secondary treatment – in anaerobic baffled reactors, anaerobic filters or anaerobic and facultative pond systems
secondary aerobic/facultative treatment – in horizontal gravel filters
post-treatment – in aerobic polishing ponds septic tank anaerobic baffl ed reactor anaerobic filter planted gravel filter aerobic-facultative ponds and aerobic polishing ponds sedimentation pond
CONSTRUCTION
DEWATS are relatively simple structures. Technical details of a design, which has been adapted to local conditions, should be based on the material that is locally available and the costs of such material.
Important materials are:
- concrete for basement and foundation
- brickwork or concrete blocks for walls

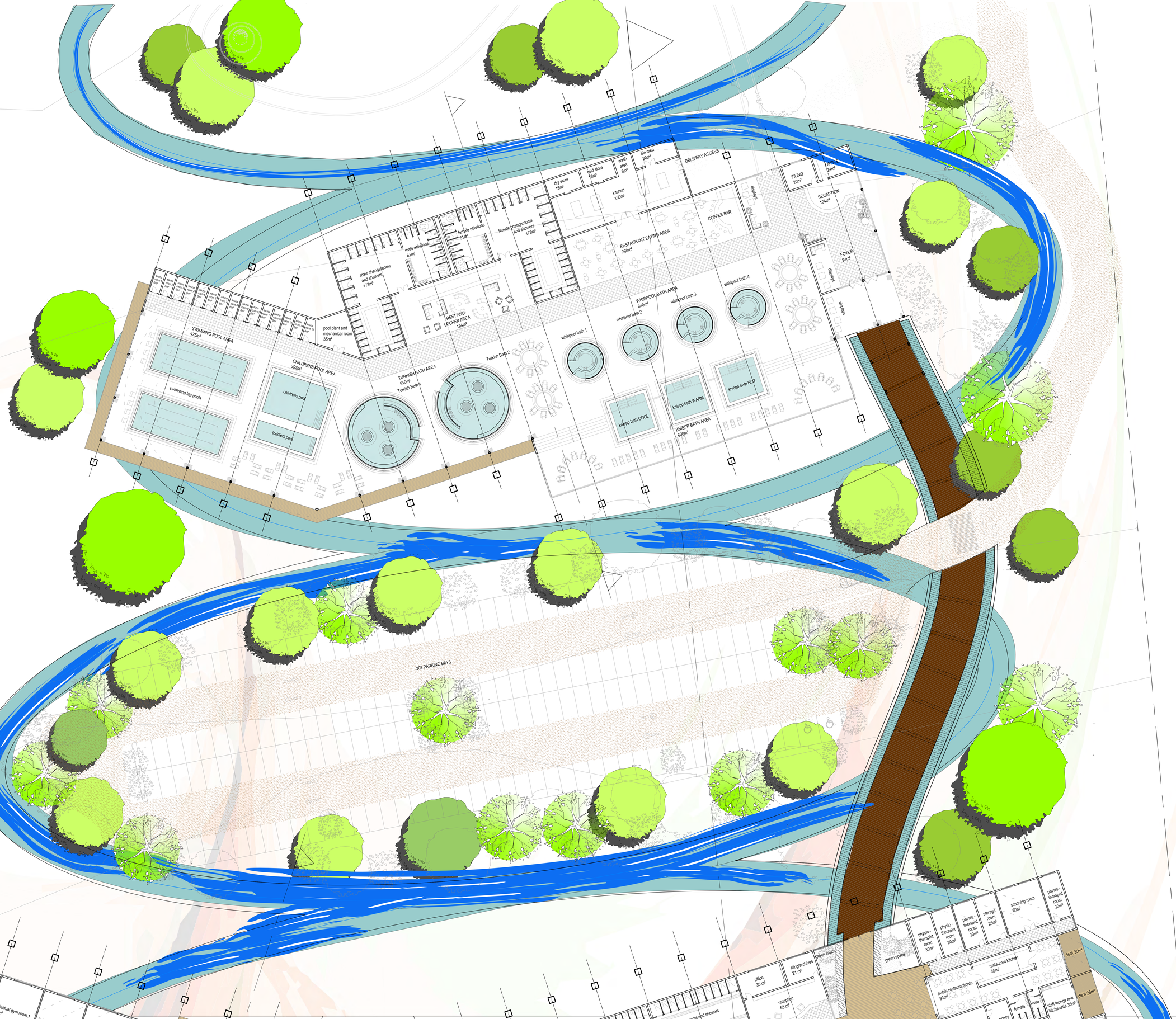
ANAEROBIC BIO REACTOR (ABR)
An anaerobic baffled reactor (ABR) is an improved septic tank, which, after a primary settling chamber, uses a series of baffles to force the grey-, black- or the industrial wastewater to flow under and over the baffles as it passes from the inlet to the outlet. The wastewater is introduced into the chamber at the bottom, leading to an enhanced contact with the active biomass which results in an increased retention and anaerobic degradation of suspended and dissolved organic pollutants. ABRs are robust and can treat a wide range of wastewater, but both remaining sludge and effluents still need further treatment in order to be reused or discharged properly.
Anaerobic baffled reactors (ABR) – also called baffled or improved septic tanks – are upgraded septic tanks which aim to enhance the removal efficiency for non-settleable and dissolved solids. An ABR consist of a tank and alternating hanging and standing baffles that compartmentalise the reactors and force liquid to flow up and down from one compartment to the next, enabling an enhanced contact between the fresh wastewater entering the reactor and the residual sludge, containing the microorganisms responsible for anaerobic digestion of the organic pollutants. The compartmentalised design separates the solids retention time from the hydraulic retention time, making it possible to anaerobically treat wastewater at short retention times of only some hours (EPA 2006). The baffled design of the ABR ensures a high solids retention resulting in high treatment rates, while the overall sludge production is characteristically low. They are simple to build and simple to operate, as well as very robust to hydraulic and organic shock loading.





Newlands Mashu Permaculture Site - Durban

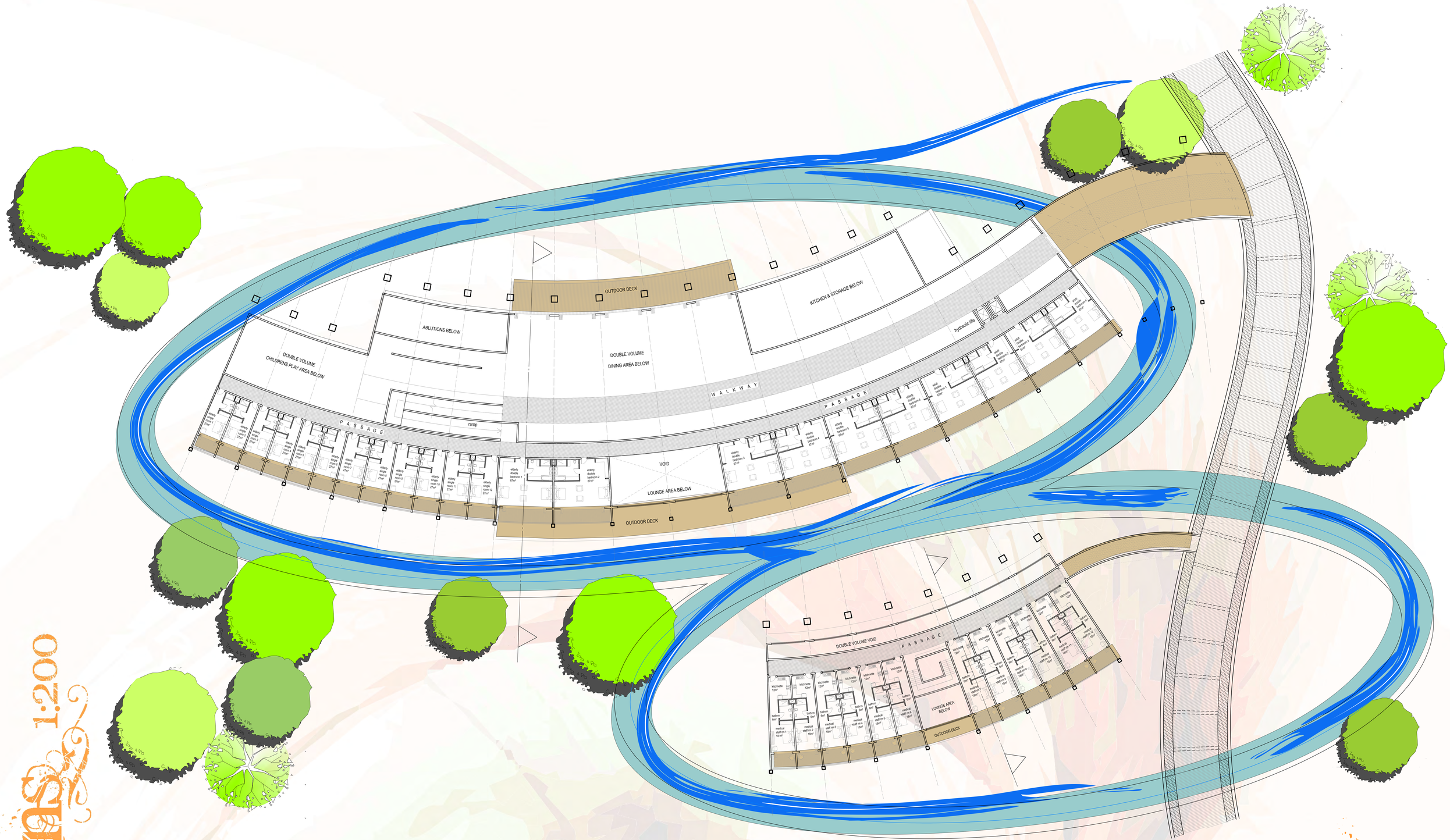
Working Principle - Vertical baffles in the tank force the pre-settled wastewater to flow under and over the baffles guaranteeing contact between wastewater and resident sludge and allowing an enhanced anaerobic digestion of suspended and dissolved solids; at least 1 sedimentation chamber and 2–5 up-flow chambers.
Capacity/Adequacy - Community (and household) level; For pre-settled domestic or (high-strength) industrial wastewater of narrow COD/BOD ration. Typically integrated in DEWATS systems; Not adapted for areas with high ground-water table or prone to flooding.
Performance - · High treatment performance (for all, grey-, black- and industrial wastewater)
Costs - Generally low-cost; simple construction, cost depending on availability of materials and economy of scale.
Self-help Compatibility - Requires expert design, but can be constructed with locally available material.
Operation & Maintenance - Should be checked for water tightness, scum and sludge levels regularly; Sludge needs to be dug out and discharged properly (e.g. in composting or drying bed); needs to be vented.
Reliability - High resistance to shock loading and changing temperature, pH or chemical composition of the influent; requires no energy.
Main strengths - Strong resistance; built from local material; biogas can be recovered.
Main weakness - Long start-up phase of three months


DELIVERY ACCESS
bin area 20m²
wash area 9m²
cold store 16m²
dry store 16m²
kitchen 150m²
FILING 20m²
OFFICE 24m²
RECEPTION 104m²
COFFEE BAR
counter
RESTAURANT EATING AREA 260m²
FOYER 94m²
male changerooms and showers 178m²
male ablutions 61m²
female ablutions 61m²
female changerooms and showers 178m²
REST AND LOCKER AREA 194m²
pool plant and mechanical room 35m²
SWIMMING POOL AREA 475m²
swimming lap pools
CHILDRENS POOL AREA 356m²
childrens pool
toddlers pool
TURKISH BATH AREA 51m²
Turkish Bath 1
Turkish Bath 2
WHIRPOOL BATH AREA 84m²
whirlpool bath 1
whirlpool bath 2
whirlpool bath 3
whirlpool bath 4
KNIEPP BATH AREA 60m²
kniepp bath COOL
kniepp bath WARM
kniepp bath HOT
208 PARKING BAYS
massage and gym storage 91 m²
individual gym room 1 65 m²
individual gym room 2 65 m²
group gym room 1 65 m²
group gym room 2 65 m²
office 30 m²
filing/archives 21 m²
reception 53 m²
green space
physio - therapist room 30m²
physio - therapist room 30m²
physio - therapist room 30m²
storage room 28m²
scanning room 60m²
physio - therapist room 30m²
deck 25m²
deck 25m²
restaurant kitchen 55m²
public restaurant/cafe 93m²
female 30m²
male 30m²
staff lounge and kitchenette 58m²

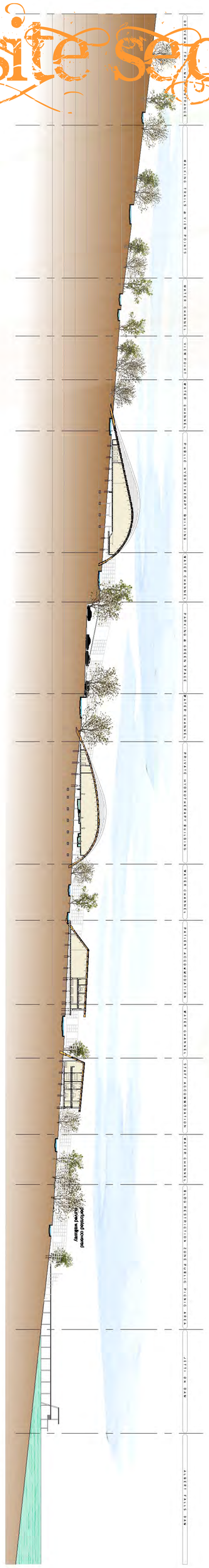
plans 1:200

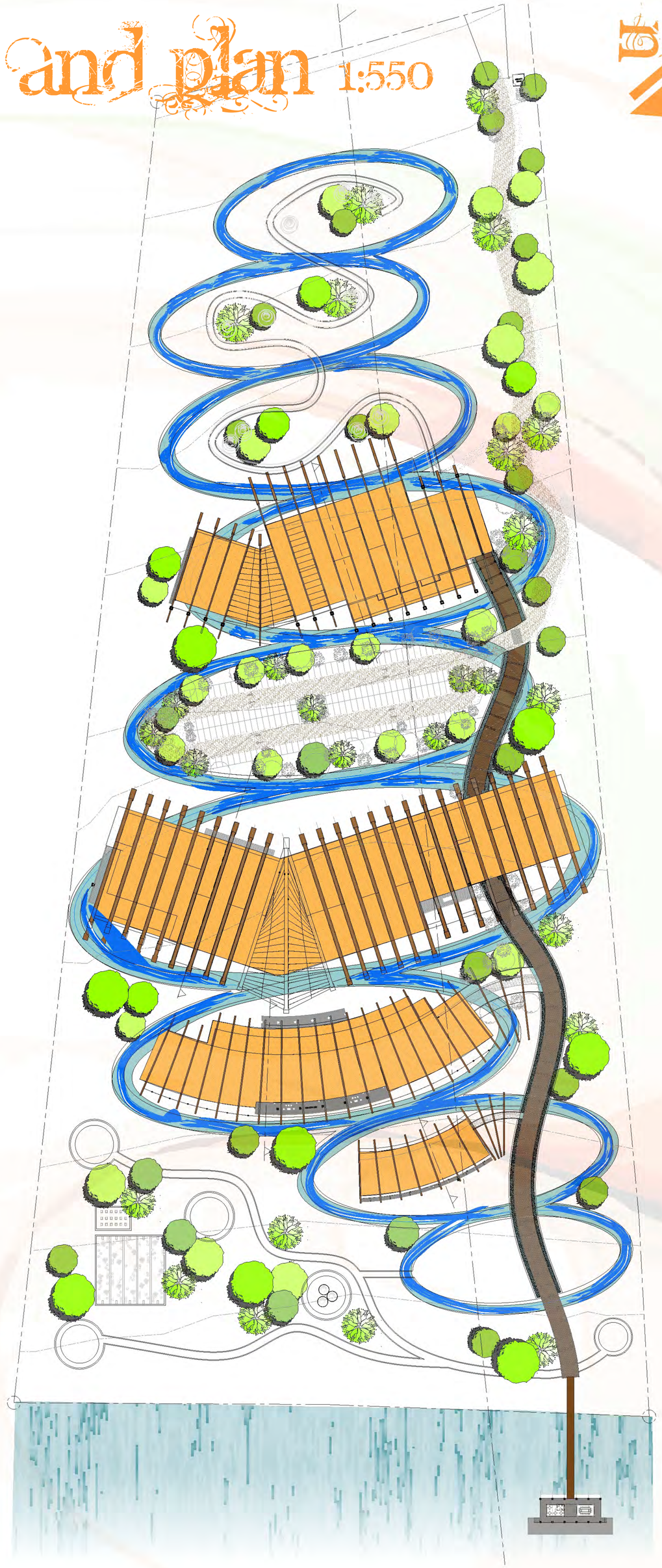
OUTDOOR DECK
DINING AREA 500m²
LOUNGE AREA 100m²
ramp
WALKWAY
OUTDOOR DECK
LOUNGE AREA
KITCHEN 130m²
dry store 15m²
cold store 15m²
wash area 6.5m²
bin area 31m²
linen store 30m²
DELIVERY ACCESS
hydraulic lift
male ablutions 53m²
female ablutions 53m²
pool areas 2231 m²
upper body pool 1
upper body pool 2
lower body pool
resting area 2
group therapy pool 1
group therapy pool 2
wading activation pools
obstacle course pool 2
obstacle course pool 1
wheelchair ramp
pool plant and mechanical room 102 m²
male changerooms and showers 241 m²
female changerooms and showers 241 m²
female ablutions 60 m²
male ablutions 60 m²
male changerooms and showers 251 m²
female changerooms and showers 241 m²
individual gym room 1 60m²
individual gym room 2 60m²
individual gym room 3 60m²
individual gym room 4 60m²
reception 282 m²
info cabinet
displays
hydrotherapy observation glazed and roof terrace 401 m²
viewing deck 101 m²
lounge
lounge
lounge

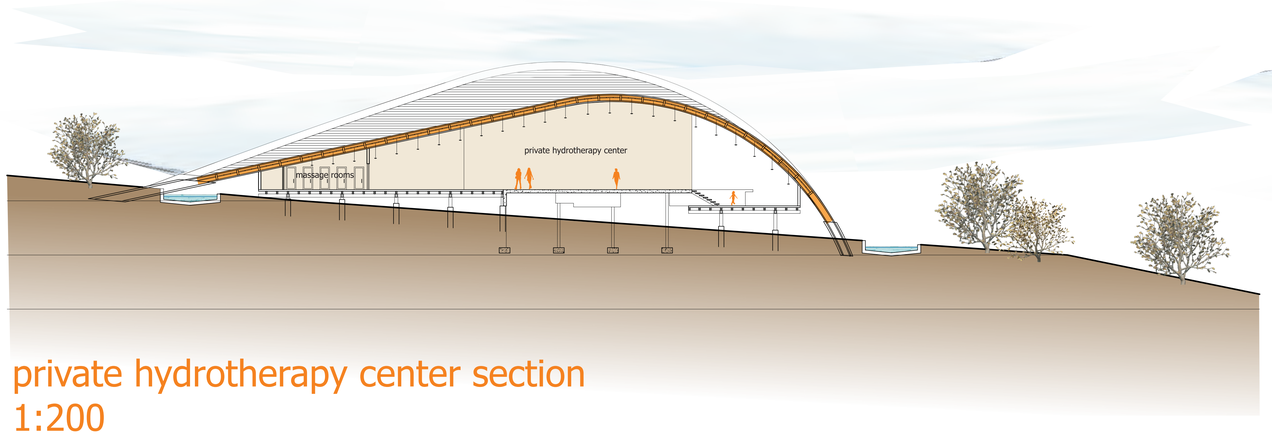
plans 1:200


OUTDOOR DECK
KITCHEN & STORAGE BELOW
ABLUTIONS BELOW
DOUBLE VOLUME
CHILDRENS PLAY AREA BELOW
DOUBLE VOLUME
DINING AREA BELOW
hydraulic lifts
WALKWAY
PASSAGE
ramp
VOID
LOUNGE AREA BELOW
OUTDOOR DECK
DOUBLE VOLUME VOID
PASSAGE
LOUNGE AREA BELOW
OUTDOOR DECK

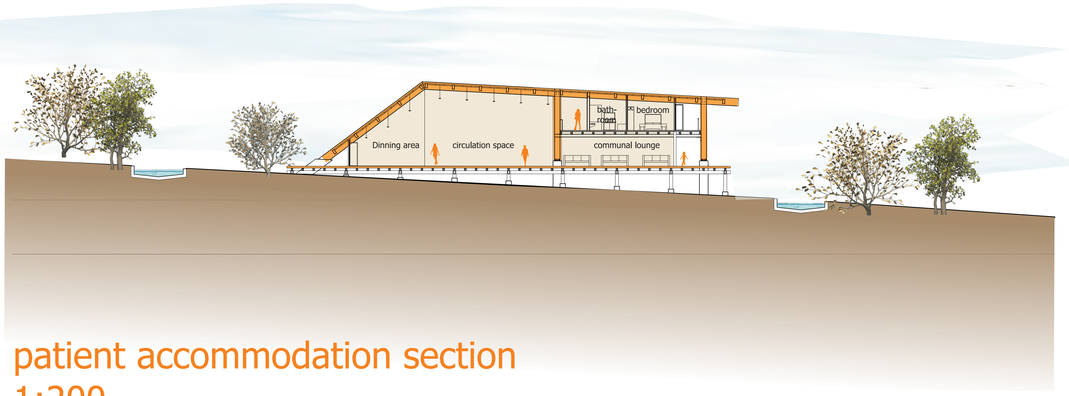
site section and plan 1:550



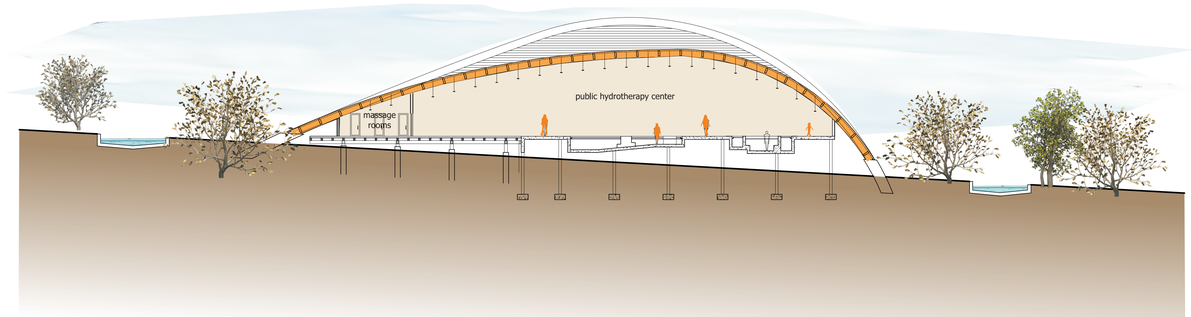




private hydrotherapy center section
1:200



patient accommodation section
1:200



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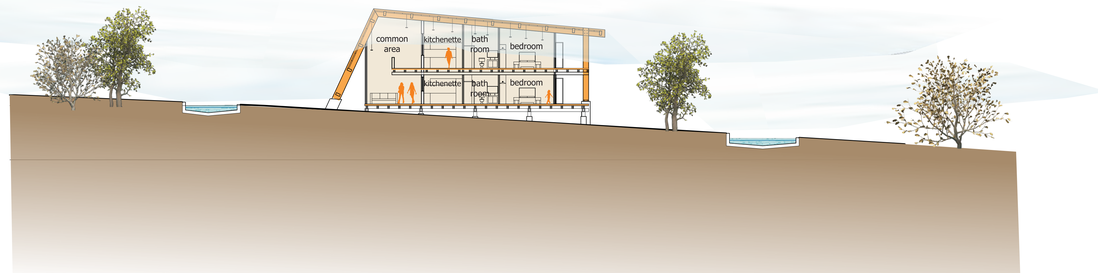
1:200



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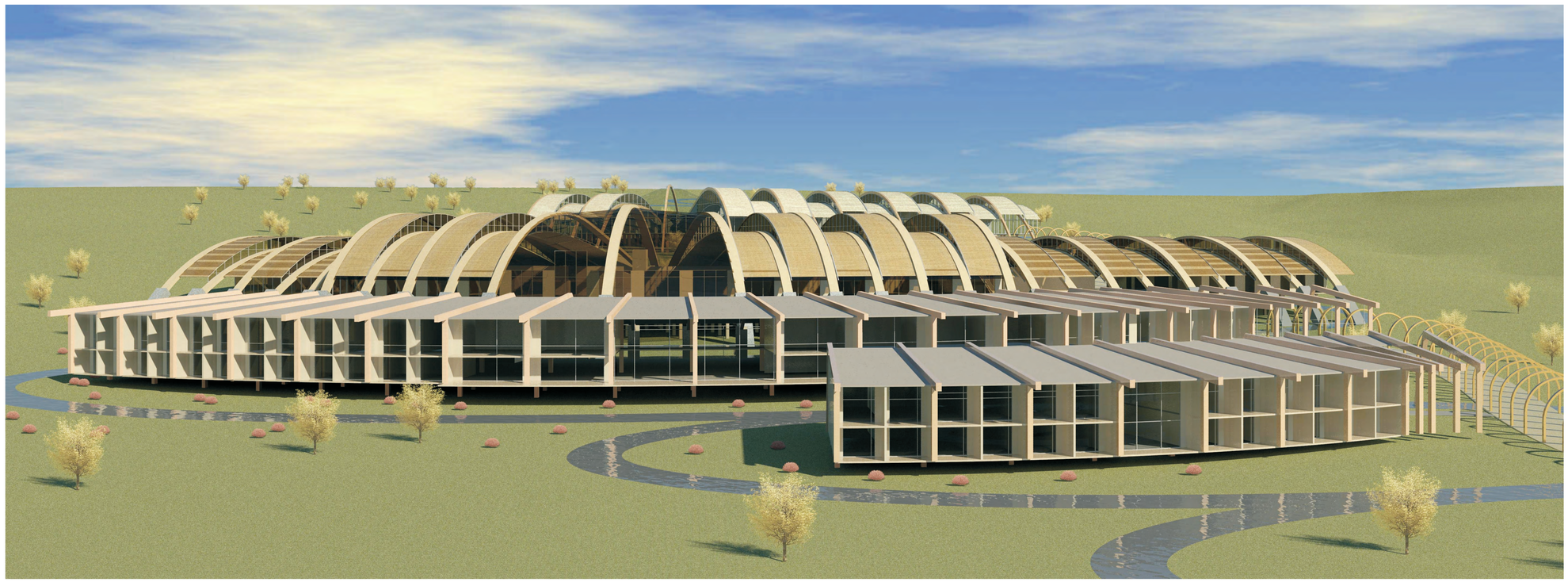

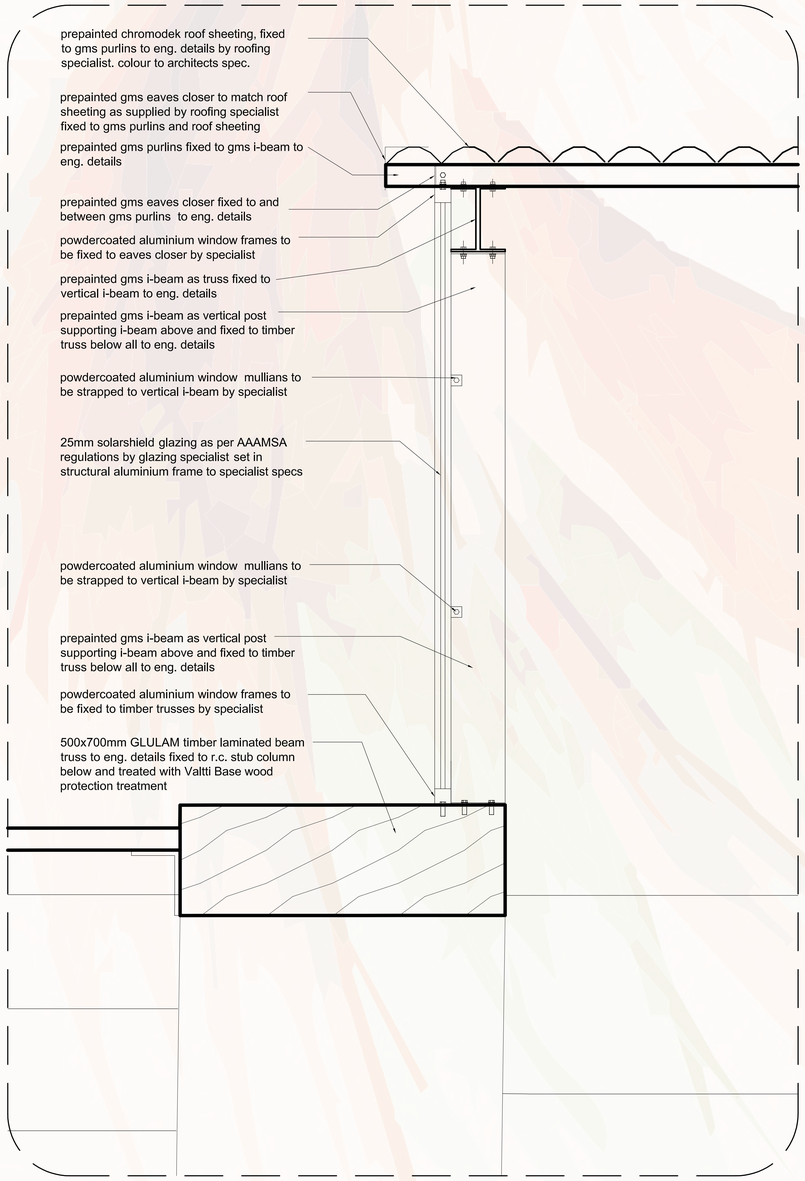

DETAIL 1
JUNCTION BETWEEN CURTAIN WALL GLAZING AND ROOF
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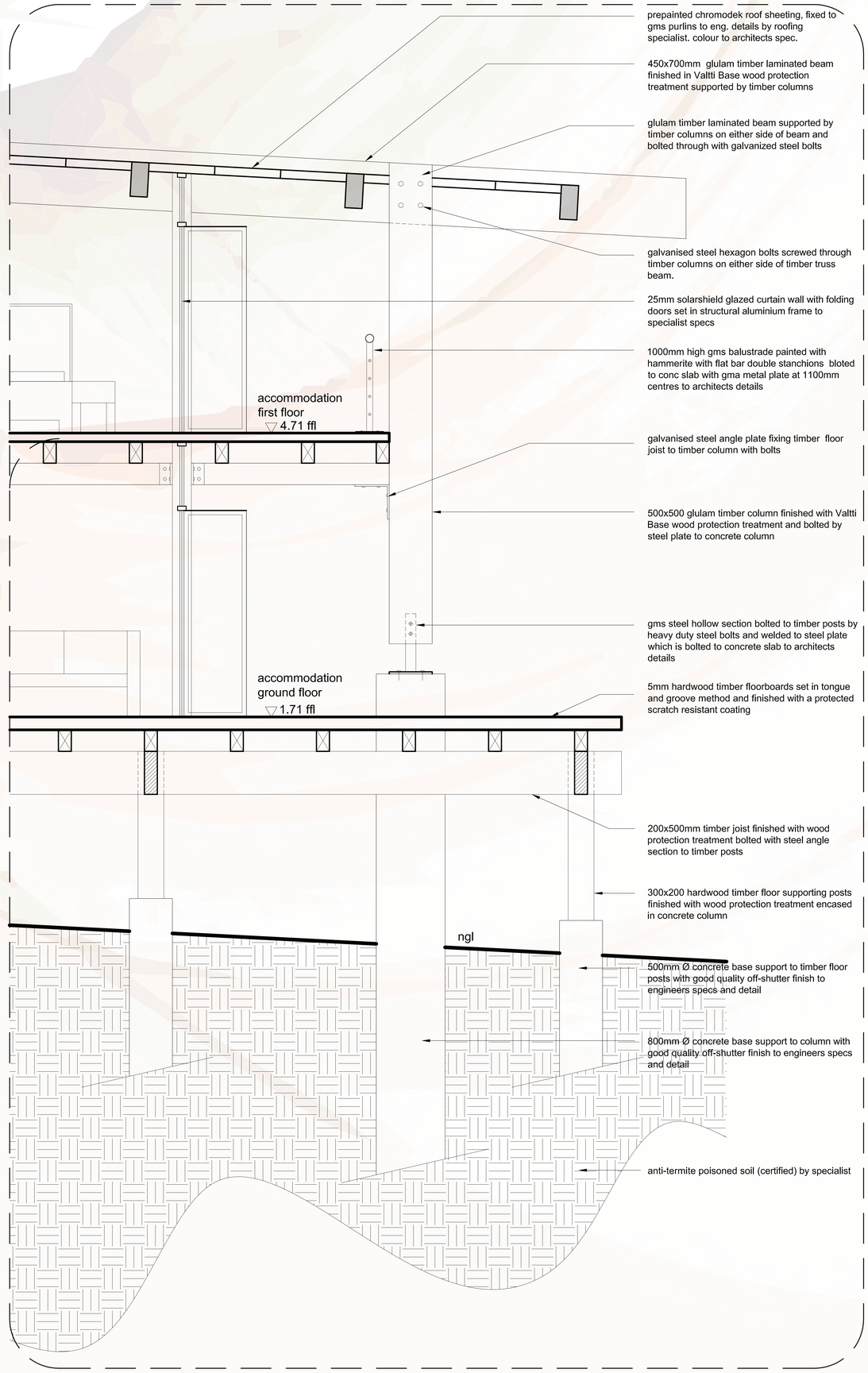

STRIP SECTION
SECTION THROUGH PATIENT ACCOMMODATION
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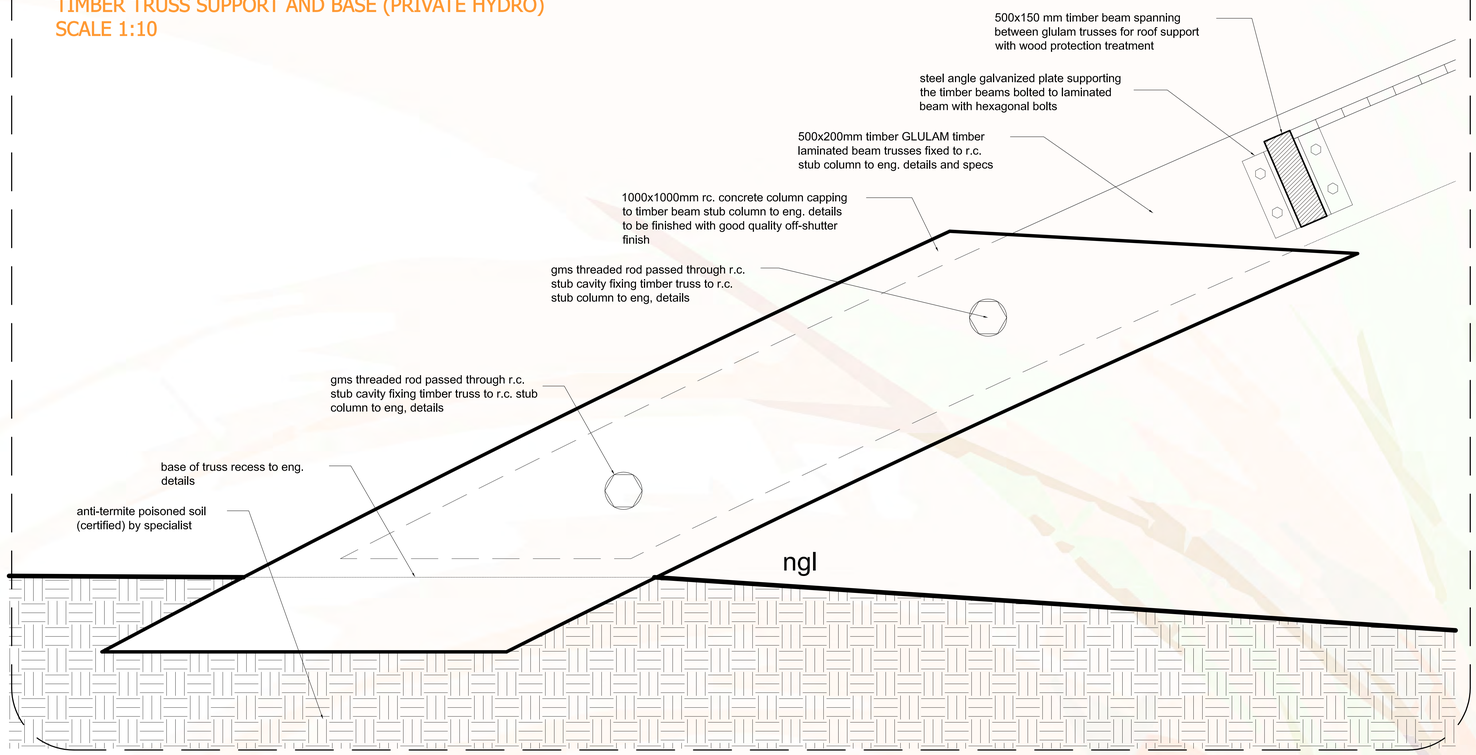
DETAIL 2
TIMBER TRUSS SUPPORT AND BASE (PRIVATE HYDRO)
SCALE 1:10



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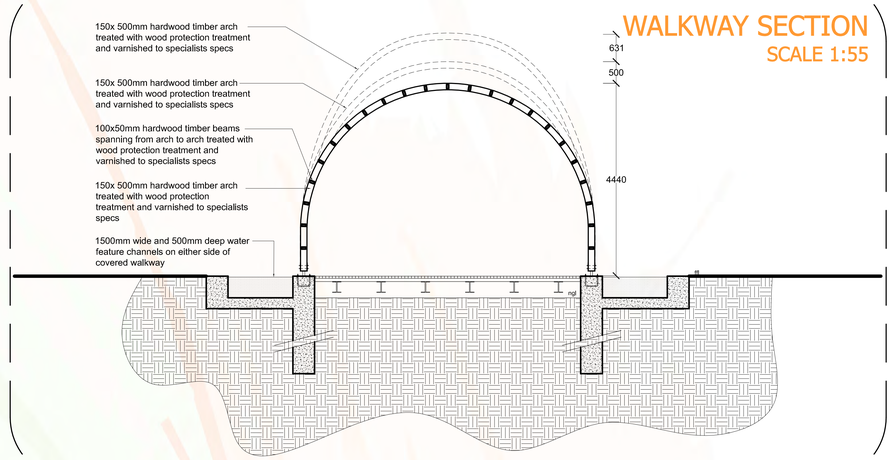

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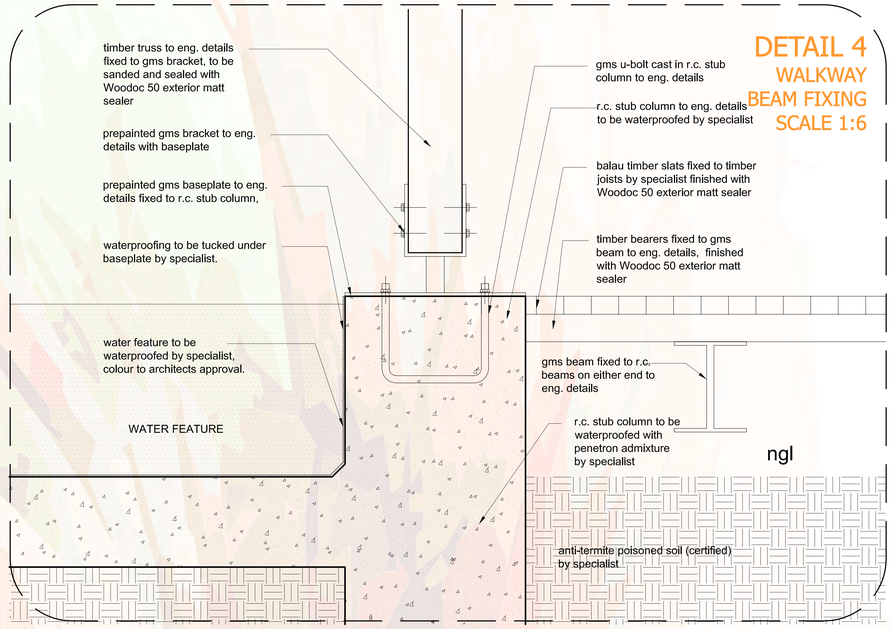

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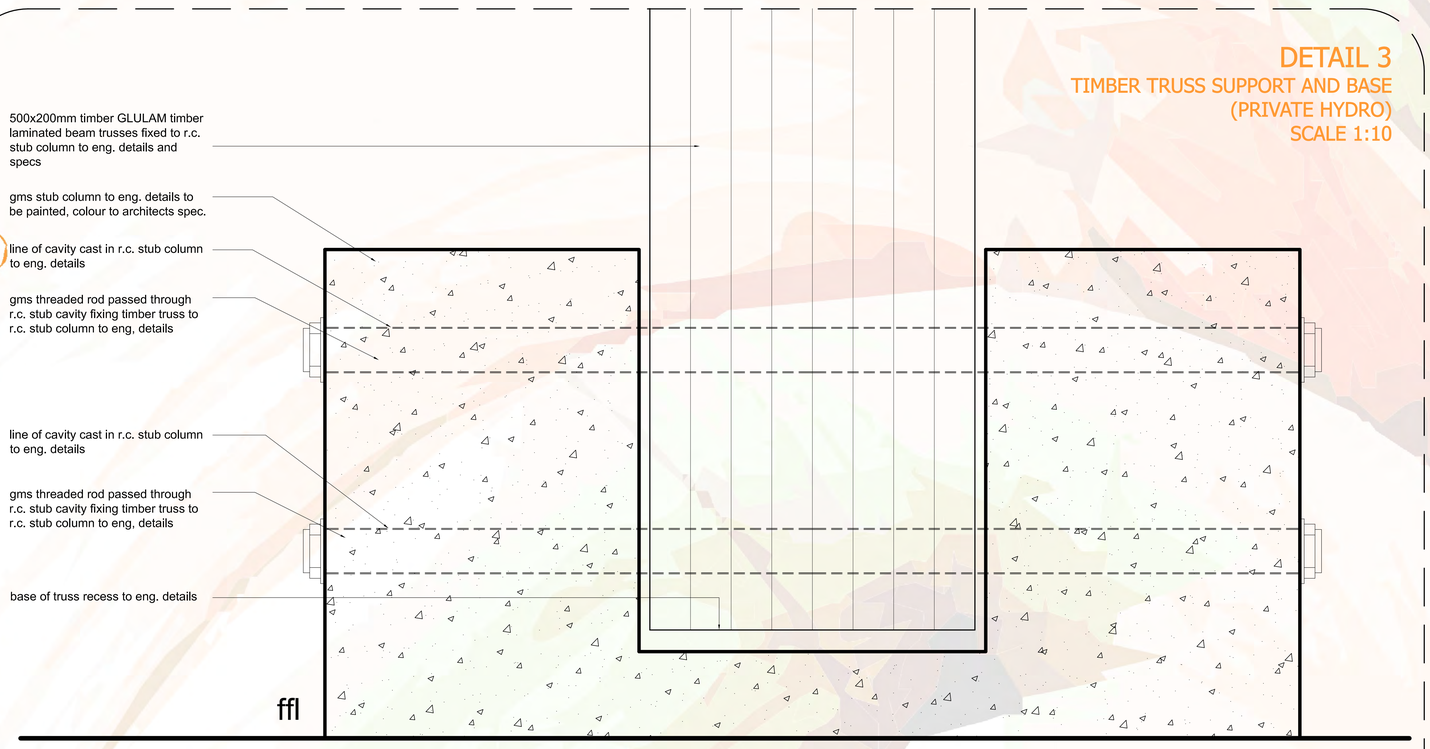

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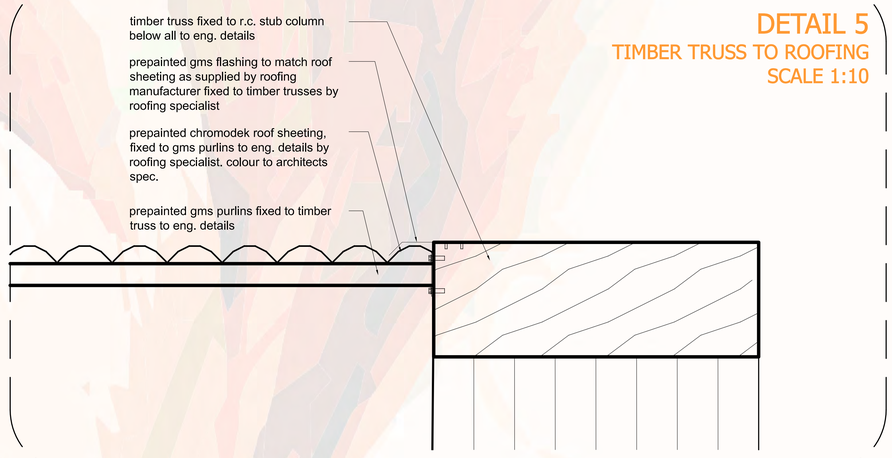

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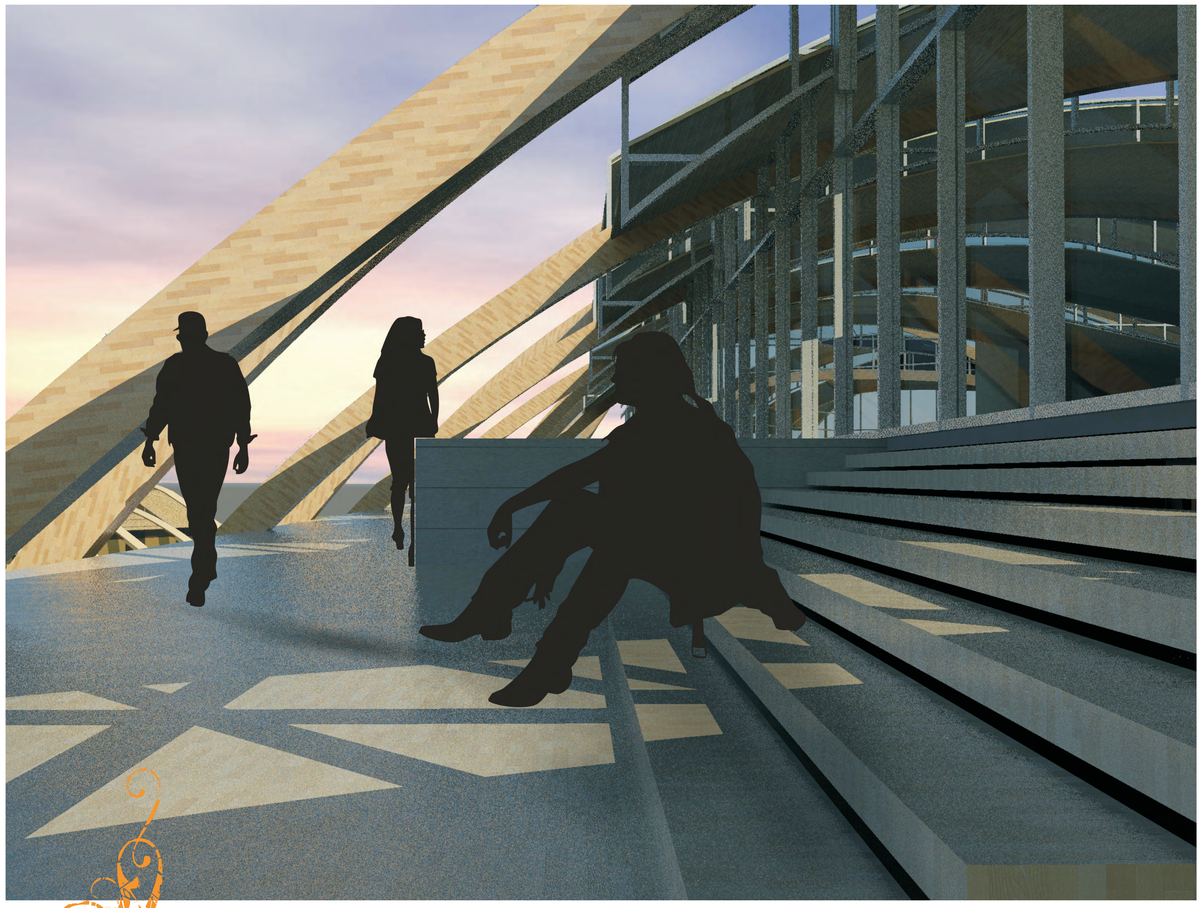
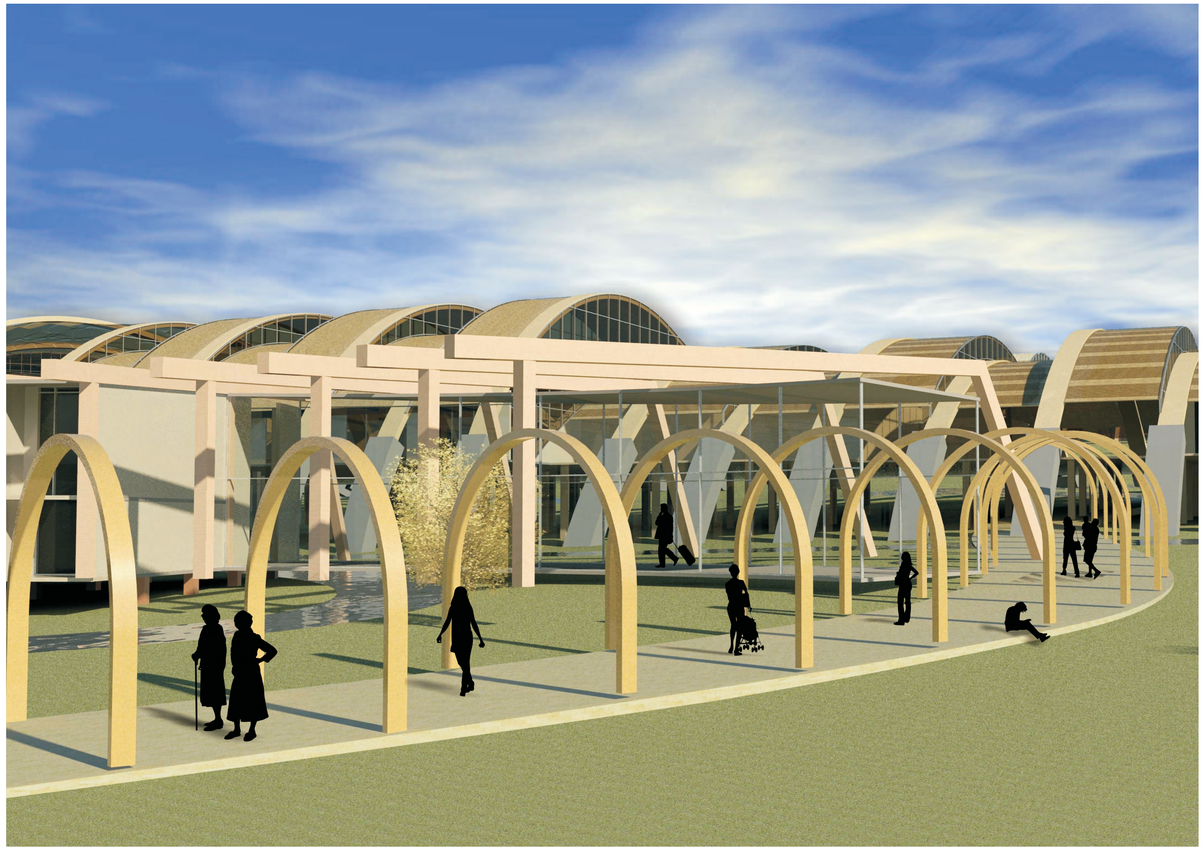
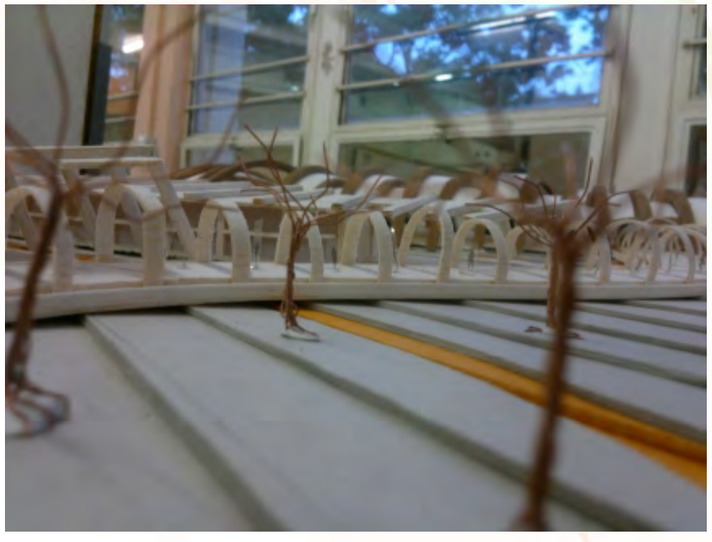




Healing Garden



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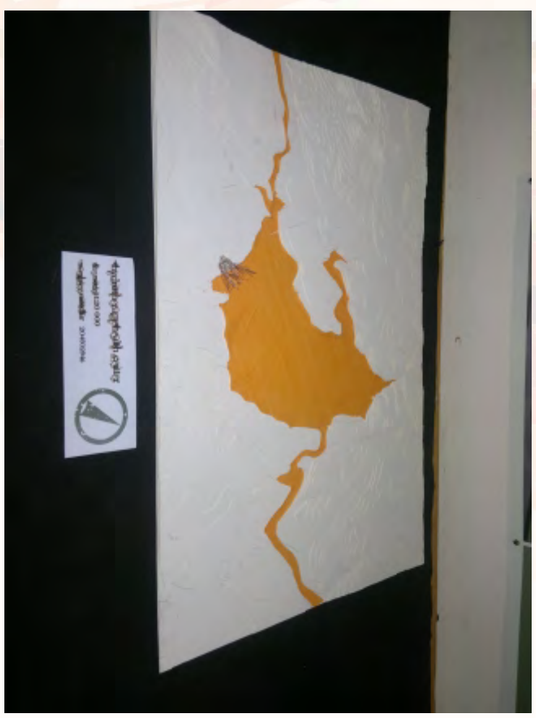

BIBLIOGRAPHY

- (AFD DWAF) South Africa. Department of Water Affairs and Forestry, ***Albert Falls Dam : Mgeni River government water scheme***
- Campion, M.R., 1997, ***Hydrotherapy: Principles and Practice***, Butterworth Heinemann, Oxford
- Davis, B., 1988, ***Hydrotherapy in Practice***, Churchill Livingstone, London
- Day, C., 2002, ***Spirit and Place*: *Healing our Environment,*** Architectural Press, Oxford
- Reuter , S, 2011, Bonn11 ***Conference: The Water, Energy and Food Security Nexus***
- Ryrie, C., 1998, ***The Healing Energies of Water***, Gaia Books Limited, London
- Sasse, L, 1998, ***DEWATS Decentralised Wastewater Treatment in Developing Countries***, Bremen, Germany
- WRC, 2002, State***-of-Rivers Report uMngeni River and neighbouring rivers and streams***, Water Research Commission, Pretoria

INTERVIEWS

- Sharon Roswell, Life Entabeni Rehabilitation Centre
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- Shiksha Ramgovind, B.Physio (UKZN), Senior Physiotherapist, King George V Hospital – Spinal Unit Physiotherapy
- Shoba Naidoo, B.Physio (UKZN), Head of Physiotherapy Department, Addington Hopsital
- Heidi Shanahan, B.Phys T (Pretoria), Physiotherapy Department, Grey's Hospital
- Phil Viljoen, Maintainence Management, Grey's Hospital
- Thirusha Ramsuth, BSc Physio (UKZN), Chief Physiotherapist, RK Khan's Hospital

INTERNET REFERENCES

Web 1 - http://www.doh.gov.za/
Web 2 – http://www.environment.gov.za/soer/reports/rivers/umgeni/uMngeni.pdf
Web 3 - http://www.midlandsreservations.co.za/the%20Amble.html
Web 4 - http://www.pinelog.co.uk/hydrotherapy-pools.html
Web 5 - http://www.aitc-glulam.org/glulam.asp
Web 6 - http://www.timberengineeringeurope.com/glu_bea.html
Web 7 - http://www.sheffield.gov.uk/out--about/parks-woodlands--countryside/gardens/the-winter-garden
Web 8 - http://www.arup.ie/index.jsp?p=139&n=195
Web 9 - http://www.prsarchitects.com/
Web 10 - http://dornob.com/natural-curves-organic-wood-wave-floating-home-design/
Web 11 - http://sswm.info/category/implementation-tools/wastewater-treatment/hardware/semi-centralised-wastewater-treatments-0
Web 12 - http://www.urbansprout.co.za/?q=node/239
Web 13 - http://enewsletter.ukzn.ac.za/NewsletterPrinter.aspx?id=65
Web 14 - - http://www.evolo.us/architecture/elevated-broad-nature-inspired-exhibition-space-pdn-studio/Elevated Broad – Nature inspired exhibition space / PDN STUDIO
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