

SE

SSUES

- + Concept of Space
 - +Threshold
 - +Public / Private

- + Network Society

- + Permaculture

- + Agriculture

- + Urban Agriculture

- + Aqualculture

- + Hydroponics

- + Aeroponics

PERMACUL[TEC]TURE

growing for the future

Creating an intervention for the rapid new urban migration of the inner city of Johannesburg

ISSUES

The following chapter looks at the issues that the author feels are key issues that best suit this thesis.

Spaces

The concept of space is quite a broad topic, therefore this thesis specifically looks at two main types of spaces, namely: threshold and public/private spaces

Threshold spaces

The idea of threshold was the first issue chosen as the connection movement and place is realized through the threshold. People are moving, be it from home to work, or visiting a friend. The fact is there is a link or connection between places. For this reason, the issue of threshold is looked at.

Public and private spaces

The arrangement of public and private spaces, both on an urban as well as domestic scale and how these spaces relate both to the individual and to the public.

Network society

Neighbourhoods are a network of people on a social level, the exploration and establishment of neighbourhood/community based on a production level would inform a programme which in turn would inform the author on a design.

Permaculture

Permaculture and the important impact it has on design and architecture

Agriculture

The importance of agriculture has grown given it has social and economical impact on society.

Urban Agriculture

Urban agriculture and the growing need to incorporate it in any design scheme and development for that scheme to be successful.

Urban Agriculture

Urban agriculture and the growing need to incorporate it in any design scheme and development for that scheme to be successful.

Aquaculture

How can livestock, in particular that of fish can be incorporated with agriculture

Hydroponics

The use of hydroponics when land is not available particularly in the city.

Aeroponics

When neither land nor medium is available for farming, how aeroponics can be utilised



Spaces influenced by the environment
(www.blog.q-taro.com)



Threshold of land and water (Dee, 2001:175)

What is space?

The Collins dictionary defines space as:
an extent or expanse of a surface or three-dimensional area: Space is defined philosophically as the "possibility of being together".

In architecture, space is considered more than a medium which is contained by boundary and solids. Space is in fact an integral part of architecture, it has a number of implications both on a physical as well as on a psychological level.

"The city is not confined to a spatial scale of the building, or indeed even that of the city itself, but encompasses the whole, multiscale landscape produced by human activity." (Borden *et al.*, 2001:4)

"Space is a historical production, at once the medium and outcome of social being. It is not a theatre or setting but a social production, a concrete abstraction-simultaneously mental and material, work and product-such that social relations have no real existence except in and through space. This relationship between the social and the spatial-in Edward Soja's term, the 'socio-dialectic'-is an interactive one, in which people make places and places make people." (Borden *et al.*, 2001:4)

Within a city, there are more than one factors that contribute to the definition of space rather than just solids and objects.

Space is often seen as an object in a 3-dimensional plane, it is often quoted, but rarely, if not at all understood by architects, planners and designers. It is because of this dilemma that the author wishes to explore this theme of space in architecture within this thesis.

Henri Lefebvre identifies space as comprising of 3 parts.

- 1) Spatial practice (la pratique spatiale)
- 2) Representations of space (les représentations de l'espace)
- 3) Spaces of representation (les espaces de représentation)

Spatial practice

This is space which exists around us in our everyday lives. "Encompassing both everyday life and urban activities, it results in the various functional spaces: ranging from single rooms and buildings to large urban sites, that form part of the material production of space.

Spatial practice is thus roughly equivalent to the economic or material base. Producing the spatial forms and practices appropriate to, and necessary for, different productive and reproductive activities. It thereby defines places, actions, and signs, the trivialised spaces of the everyday and, conversely, places made special by symbolic means. It is both a space of objects and things and a space of movements and activities." (Borden *et al.*, 2001:6)

Representation of space

"Relates to the conscious codifications of space typified by abstract understandings such as those advanced by the disciplines of planning, science, and mathematics and by artists of a 'scientific bent' representations of space.

These individuals provide the various understandings of space necessary for spatial practices to take place. Thus, they display a tendency toward intellectually constructed systems of verbal signs. This is space conceived, as 'the concept without life.'" (Borden *et al.*, 2001:6)

Spaces of representations

"Concerns those experienced as symbols and images. In part then, the spaces of representation function similarly to conceptions of reality in conditioning possibilities for action. But they are also liberatory, for at this level resistance to, and criticism of, dominant social orders can take place.

In spaces of representation, space can be invented and imagined. They are thus both the space of the experienced and the space of imagination, as lived. Spaces of representations tend towards systems of nonverbal symbols and signs; they are 'life without concepts'." (Borden *et al.*, 2001:6)

"Man has a need to orientate himself in space. The potential disorientation forces on us an awareness of our own movements as well as our spatial relationships to one another" (Joannou, 2004:34).

Space is considered to have the most direct effect on the senses. If the space disorients a person, that person will begin to search for means of orientation. This may be done by visual orientation to a familiar object or space. Relationship between various objects and/or spaces plays a vital role in orientation of oneself. For example, a water tower may give bearing to a person in unfamiliar surroundings and provide needed orientation between the person and that person's direction.

This thesis will explore the first of the three types of space as this type speaks about the physical environment, more importantly, the idea of threshold spaces.

Threshold spaces

“Aristotle defined space as a container of things – a sort of succession of all-inclusive envelopes, from what is ‘within the limits of the sky’ to the very smallest, rather like Russian dolls” (Von Meiss, 1990:101).

“For the architect, the spaces or gaps between ground, walls and ceiling is not nothingness, quite the contrary: the very reason for his activity is to create the hollow in order to contain. He will give it a concrete form to offer that hospitality and relative freedom of movement which people require” (Von Meiss, 1990:101).

There are a number of physical elements within architecture which mould and define a space. However, there are other non-physical components. One such component which will be explored is the concept of threshold.

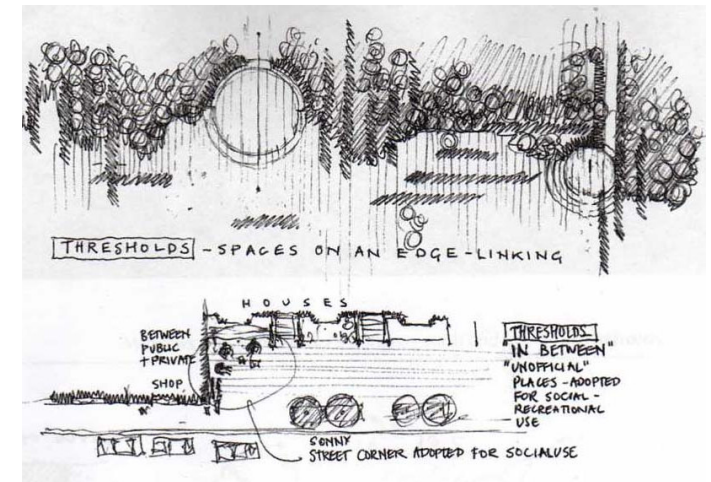
Threshold: what is it?

Catherine Dee in her book *‘Form and Fabric in Architecture’* regards it as a spatial component which provides for integrated, subtle and complex transitions. The threshold is the space that links spaces, mediums or objects.

The threshold separates the public and private sphere, private and common property, self-determined and over-directed action. As an architectural element or spatial configuration, it highlights historically specific, culturally determined zones of transition, in which certain gestures and activities are performed.



Threshold of land and water (Dee, 2001:170)



Threshold edges (Dee, 2001:174)

ISSUES

They give spatial configuration to people's need to adjust from one situation or experience to another. In a way, 'a threshold can often provide visual and physical integration of the landscape if it possesses qualities of both the spaces it connects, the environment that is left behind as well as the place being entered.' (Dee, 2001: 171)

Thresholds not only occur by entrances but rather everywhere. There are many different types of threshold.

These are broken down into various types:

- Topographical threshold
- Vegetation threshold
- Structural threshold
- Water threshold

The river Thames project looks at the visual thresholds between the river and the city. The physical elements of the city conceal and reveal the river at particular points of stop.

The concept of threshold is consistent throughout history and even now, threshold spaces are celebrated and emphasized in buildings.

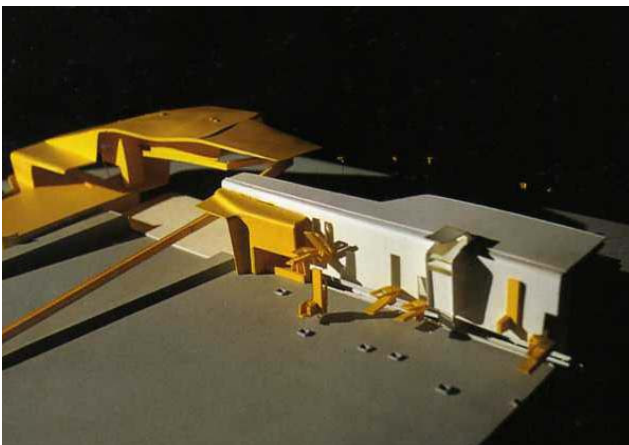
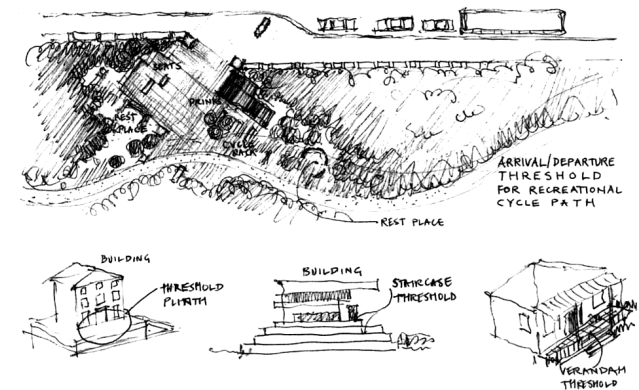


Image taken from Thames River Project
(Architectural Design May, 2001:82)



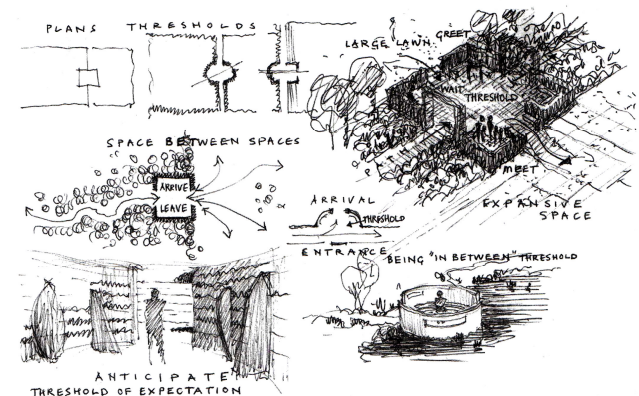
Intersection of water and form of the Thames River Project
(Architectural Design May, 2001:82)



Built thresholds
(Dee, 2001:173)



Threshold entrance of City of Chengdu
Photograph: Author's own: 2004



Threshold experience through movement
(Dee, 2001:171)

Public/ Private spaces

As mentioned before, cities are constantly growing and more people are arriving in cities every month. People travel to the city everyday in order to work and attempt to find work in the city. This increasing number of people who come into the city everyday makes interaction inevitable and therefore the city should be considered as a public realm.

Since there are increasing numbers in the amount of people in the city, the difficulty is in trying to maintain private lives away from the public realm. The issue of public and private spaces is therefore important as the amount of ground space is very limited and expensive in the city.

The problem of maintaining good private spaces and at the same time not sacrificing important public space is an important problem that will have to be looked at when designing any scheme in the city.

An comparison between the city and a residential space can be done here. A residential space can be separated into two broad sections, private (sleeping) and public (living) areas. The careful articulation of these spaces allows for the maintaining of the privacy needs in both types of spaces. The careful articulation of space with regards to privacy when building in the city is essential to the users of the specific scheme, especially if it is residential.

There are a number of architectural elements that may help to maintain the element of privacy of a scheme without compromising the public spaces.

Narrow routes leading to private spaces are less inviting and therefore maintain the separation of spaces or by keeping such routes away from main routes.

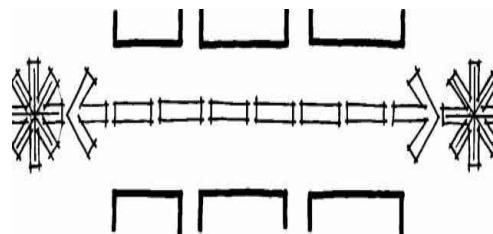
Private courtyards can help to create private sanctuaries from the hustle and bustle of the city. The raising of space above the more public ground floor also helps in creating more private spaces in the city. This may be a more viable solution in the city where there is not enough space on the ground floor to provide for private space.

An investigation of how people can be accommodated in dense cities has led the author to study the works of Charles Correa, an Indian architect who has a number of housing works particularly in India. Correa works enforce his idea of creating useful spaces for people even in overpopulated spaces where space is scarce.

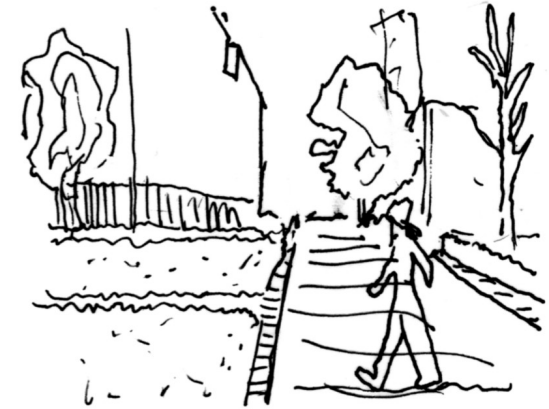
The city is a very populated space and the creation of quality space for urban living can be difficult if it has not been properly thought through.

Correa's project; Kanchanjunga Apartments, which is a 28 storey building with 32 luxury apartments. The concept behind apartment building is of interlocking apartments with split levels within double volumes which created two-storey balconies. These balconies became garden spaces which created private spaces within the building.

Internally, there is a social space which was created on every three floors in the circulation space- this helped to break the monotonous feeling of a high-rise building.



Narrow routes- privacy element
(Authors Own)



PUBLIC PARK SPACE.+GREENERY.

Sketch of pedestrian path along green space
(Authors Own)



Public green space along Main Road, Johannesburg
Photograph : Author's own: 2008

ISSUES

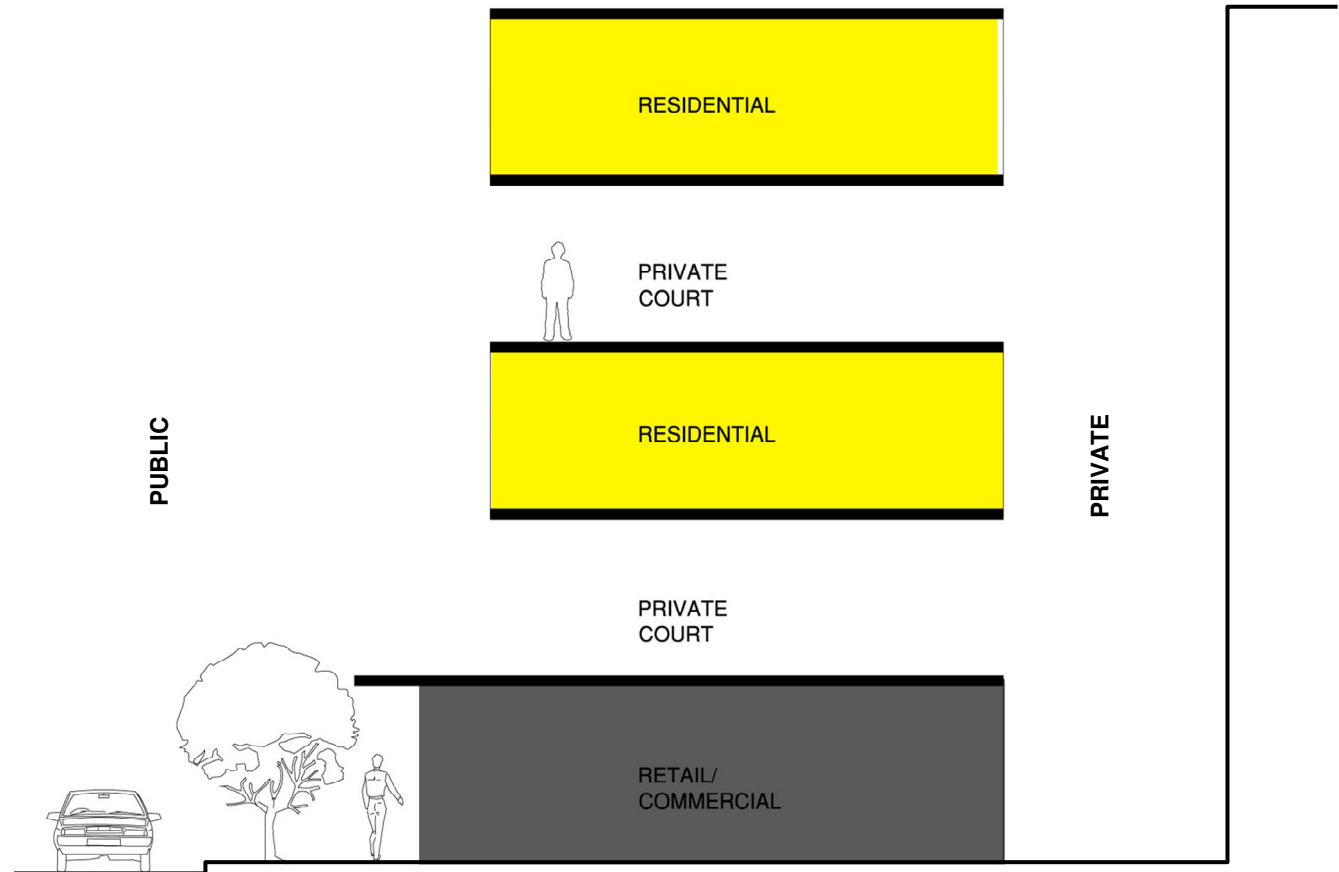
Correa, in his book (1985: 35), emphasizes that urban living involves much more than a 10sqm room. This is only a small element in a whole system of spaces that people need. He also notes that these systems tend to be hierarchical.

For example:

- The space needed by the family for cooking, sleeping, storage etc
- Areas of intimate contact i.e. porches, children's play areas, space where one can engage with the neighbours
- Community spaces, where one becomes part of a community or have a common collaboration
- Principal urban area (squares, courts)

He also further points out that the hierarchy of such spaces are dependent on one another. If one of these elements are small, the others need to increase in order to compensate for it. However, it is not required for such compensation of spaces to occur should an element be absent.

The ideas will have a distinct emphasis in the intervention of this thesis for it to become truly successful in terms of creating quality public and private spaces.



Sketch showing the vertical hierarchy of spaces in a mixed-use building. The most public function is at ground level where it has the most contact with the city, and the most private spaces is at the higher levels. This also shows a sustainable relationship between the different uses of the building with one use supporting the other.
(Authors Own)

Network Society

The theory of network societies stems that from Manuel Castell and Wellman. Castell draws on the point that at the current times we are in, what he calls the 'information age' or 'network society' where the current economic forces which affect the development of the city and a restructuring of the society, he sees it as ' the disintegration of the city as a social entity.' (Frick, 1986:4)

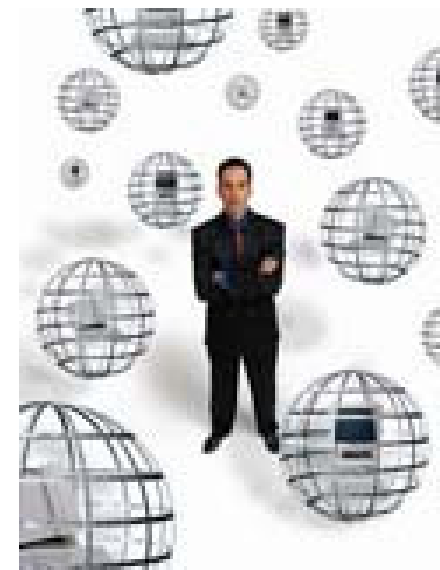
The quality of urban life has be impacted in three ways. The first is, the relationship which is established between capital and labour in the production process. The social link between capital and labour is no longer a viable component. Rather instead, capital has created better conditions and therefore allowed for investment. Social intervention has been considered to hamper the advancement of capitalist growth. Technology and the advancement of it, has been the debate where it may increase productivity but at the same time replace human involvement. The common myth is that machines suppress jobs which is incorrect, machines do not suppress jobs but they do suppress time which is the main factor in productivity.

The second way the role of the place in the economy is the social and economic goals of public spending. This has changed, where a certain amount of public spending are allocated to certain areas. "They imply the shrinkage of the urban services and therefore the abandonment of large areas in many cities as well as in declining regions. It is also the increasing process of uneven development between those regions that are suitable to this kind of development and those regions that are not. And even within region, within metropolitan areas, we also observe a tremendous difference of dynamism between those areas incorporated into the pole of growth and those areas which are in fact part of the old declining

system and which are not taken into consideration anymore." (Frick, 1986:16)

The third way is the restructuring of the societies. The ultimate goal in any economy is the locality and so production and distribution is of vital importance. The advancement of technology has allowed us to shift in functional and economic terms from a place of localities to a space of flows. In this way, we are not historically rooted or socially rooted to any particular place.

"A new pattern of production, consumption, and management, which is causing decisive regional and urban effects and is leading to a dualism in regard to the quality of urban life" (Frick, 1986:4)



Global Urban tribe and social isolation
(www.digiverse.com)

What is Permaculture?

“Permaculture is the a term used for permanent agriculture but has also included permanent culture. It is a design tool/method which two Australian’s, Bill Morrison and David Holmgren came up with during the 1970’s. With it, individuals utilise a core set of principles to design their own environments and build self-sustainable environments- in that way it reduces the society’s reliance on industrial systems of production and distribution which destroys the eco-system.” (<http://en.wikipedia.org/wiki/permaculture>)

Permaculture uses qualities of plants combined with the natural characteristics of landscapes and structures, to produce a life-supporting system for city and country, using the smallest area possible. It integrates ecology, landscape, organic gardening, architecture and agro-forestry to provide healthy food for all anywhere. Permaculture is an approach to planning human settlements that uses intelligent design to increase the abundance of natural systems, efficiency of human activities and sustainable food rich environments.

Permaculture applies techniques such as: appropriate technology, sustainable agriculture, and the wisdom of people to create sustainable human environments, at home, at work, at play, and in our communities.

The aim is the improvement of the quality of life through Permaculture. This refers to **architecture**, **space**, **urban agriculture** and **identity** and how these issues influence the quality of lives of a community.

Permaculture is both a design philosophy and a design system. As a philosophy it has a clear set of ethics that aim for the....

“Harmonious integration of landscape and people, providing their food, energy, shelter, and other material and non-material needs in a sustainable way.” (Mollison, 1988)

Permaculture is a way of designing sustainable ecological human habitats and food production systems so that resources are not polluted or exploited and more energy is created than consumed. The principle of permaculture relies in a pragmatic approach to ecological design to analyse the characteristics and potential relationships between design elements.

Key design principles

Since permaculture is not just a holistic design tool, but also a way of life. It has a three main principles which one can use in everyday life.

These three main principles are as follows:-

Earthcare: recognising that the earth is the source of all life and that it should be recognised and respected. To realise that the earth is our planet and we are a part of it.

Peoplecare: treating other people as equal. Helping each other to change the ways of living that are not harming ourselves or the plant, and to develop healthy societies.

Fairshare: to ensure that the earth’s limited resources are utilised in ways that are equitable.

Because people need to eat and drink, food production is where permaculture has its origins. It started with the belief that for people to feed themselves sustainably they need to move away from reliance on industrialised agriculture. Where industrial/commercial farming uses fossil fuel (petrol, diesel) driven technology specialising in each farm producing high yields of a single crop. Permaculture stresses the value of low inputs into the land and diversity in terms of what is grown.



Permaculture cycle of man to nature
(www.permaculture.com)

This provided people with the ability to grow foods sufficient for individual needs and creation of small scale markets and home gardens. At the same time, permaculture discourages use of pesticides for more natural organic farming methods.

“Permaculture offers a radical approach to food production and urban renewal, water, energy and pollution. It integrates ecology, landscape, organic gardening architecture and agroforestry in creating a rich and sustainable way of living” (Mollison, 1988)

ISSUES

Since permaculture is a design tool aimed at designers to help create sustainable environments. The following are a few examples of permaculture ideas being used in architecture.

Patterns: The use of patterns both in nature and architecture is often key to permaculture design. One such permaculture designer is Christopher Alexander. "All things, even the wind, the waves and the earth on its axis, moving around the sun, form patterns. In pattern application, permaculture designers are encouraged to develop:

- 1: Awareness of the patterns that exist in nature (and how these function)
- 2: Application of patterns on sites in order to satisfy design needs"

Permaculture zones: The organisation of design elements depending on frequency of use. For example, plants and crops which require constant care are located close to the house while those which do not need as much may be located farther away from the house. In this way public spaces could be found along paths of traffic. Private homes allow for a intimate spaces.

Links/connections: Establishing connections between the various plants with the site and humans.

Layers/Stacking: In permaculture, layers exist in a hierarchy manner which inform the way in which plants exist and in this way, a diverse community of life can exist in a relatively small space.

The layers are as follows:-

- The canopy
- Low tree layer (dwarf fruit trees)
- Shrubs
- Herbaceous
- Rhizosphere (root crops)
- Soil surface (cover crops)
- Vertical layer (climbers, vines)
- Mycosphere (fungi)

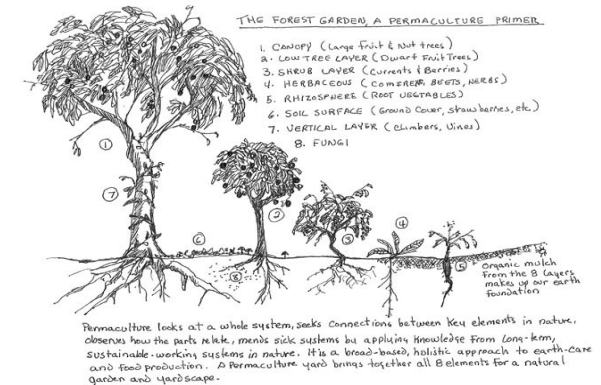
Polyculture: This is agriculture in which multiple crops are grown in the same space rather than monoculture which is found in commercial farming. Various forms of polyculture include crop rotation, multi-cropping, inter-cropping and alley cropping. This diversity in agriculture can reflect architecture by providing spaces which have multiple uses.

Guilds: This refers to groups of plants, animals and microbacteria which work well together. In architecture, particularly in green architecture, water that is collected may be used to passively cool a building down.

Increase edge: At places where various systems meet, there is a increase in productivity and useful connections. Mollison illustrates this idea by the example of the coast where land and sea meet. The majority of humankind lives within 100km of the sea. Permaculture designs mimic this creating ponds that are wavy rather than circular.

Perennial plants: The use perennial plants are usually found along edge zones and layer systems, these require less maintenance and are more robust.

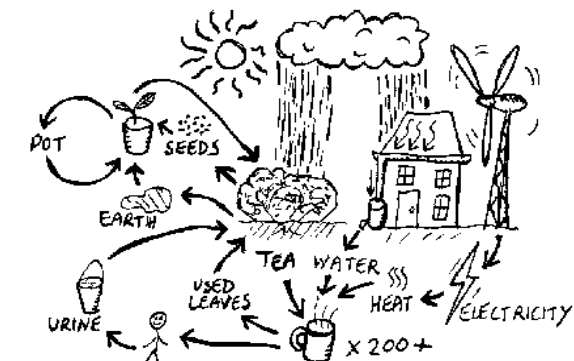
Energy: In permaculture, greater emphasis is placed on using fewer non-renewable sources such as petrol fuels. The aim is to turn towards a fully renewable food production system rather than rely on industrial/commercial agriculture which uses petrol to run equipment and supply pesticides. Pre-industrial agriculture utilised manual labour, industrial agriculture utilised fossil fuel extensively whereas permaculture is design and information intensive but fossil fuel free. Energy that is used for permaculture should ideally be from renewable sources such as wind, solar or biofuels.



Permaculture layer system
(Mollison 1988:67)



Upgraded potting shed
(Urban Green File 2008:28)



Nature cycle to consumerism
(Authors Own)

PRECEDENT STUDIES

There are various examples of permaculture social projects in South Africa from the Mamelodi, Alexandra to Soweto. All these permaculture social projects puts the individual into a situation of taking responsibility for him/herself by promoting personal empowerment and liberation through self-sufficiency and creativity.

In all the projects, the integration of permaculture principles from the beginning is important. Permaculture can be successfully incorporated into the planning of urban and rural areas, especially in many places across South Africa.

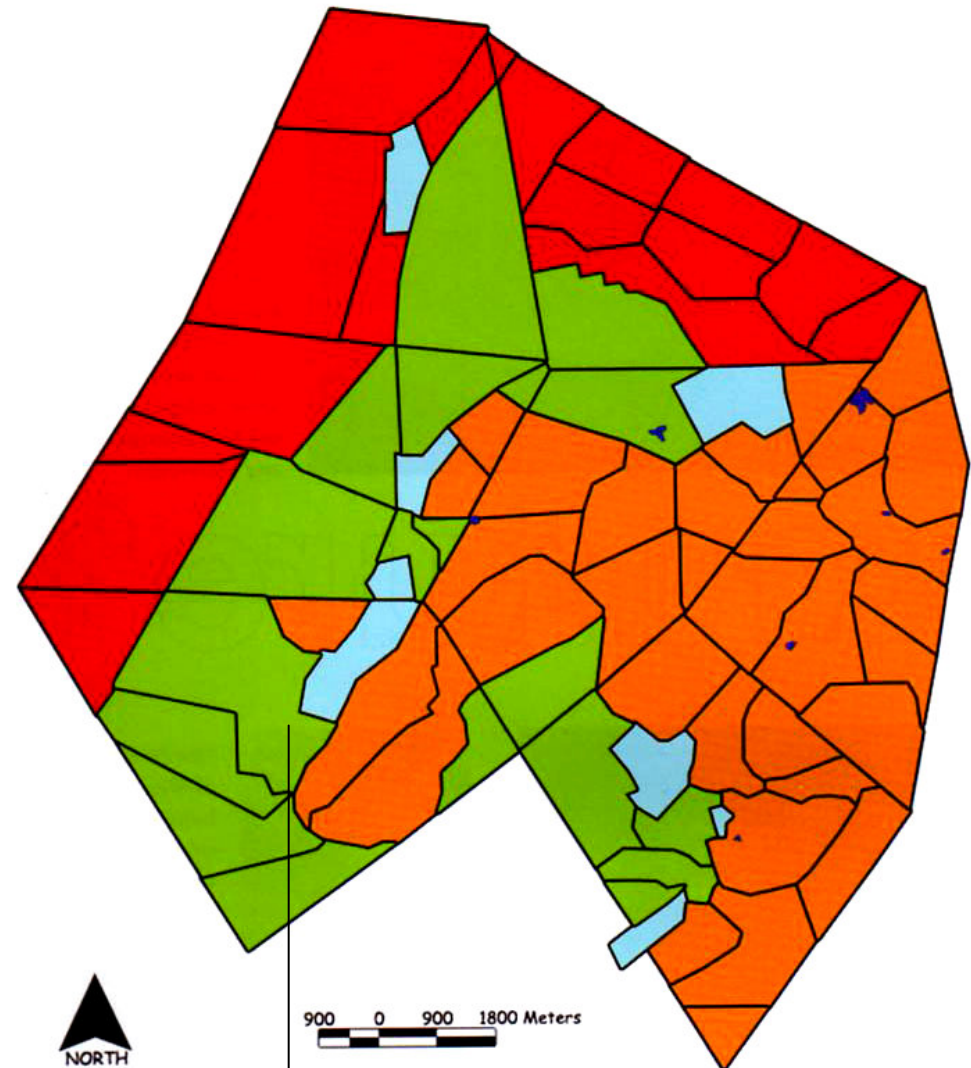
The Walter Sisulu Environmental Centre in Mamelodi hosts a community development permaculture garden. This 1,4 ha garden is cultivated by 32 gardeners with 22 volunteers (most of which are elderly) from the surrounding community. These individuals implement permaculture principles in their respective gardens and although some exhibit higher degrees of success with their gardens. Each garden has their own identity in their approach.

Conclusion

Permaculture can be viewed as the truest and most logical form of development in South Africa as it educates individuals and communities to live in an sustainable way.

“Permaculture should be treated asan essential part of development planning whether rural or urban. Open spaces should be utilised for the production of food crops in order to sustain surrounding communities rather than for recreational and aesthetic purposes only.”
(Urban green File 2008:30)

Zone	Function
0	central homestead/ business/village
1	intensive vegetable gardens, nursery and small animal systems
2	orchard or mixed food harvest (perennial species) and staple food systems (grains and tubers)
3	large-scale, semi-managed systems, such as woodlots, large animal fodder systems and aquaculture
4	semi-managed wild system of mainly indigenous species harvested for muthi and firewood, among others
5	unmanaged wild systems of indigenous species that act as a refuge for wildlife and as a place for humans to observe and soak up nature's energy



Permaculture project of Mogalakwena, Limpopo.
(Urban Green File 2008:30)

ISSUES

Agriculture, the green era

Agriculture, or farming, is the production of crop plants through cultivating the soil and the rearing of animals. The word itself derives from the latin word *agar* meaning field and the greek word *agros* which means field. (Mannion, 1995:2)

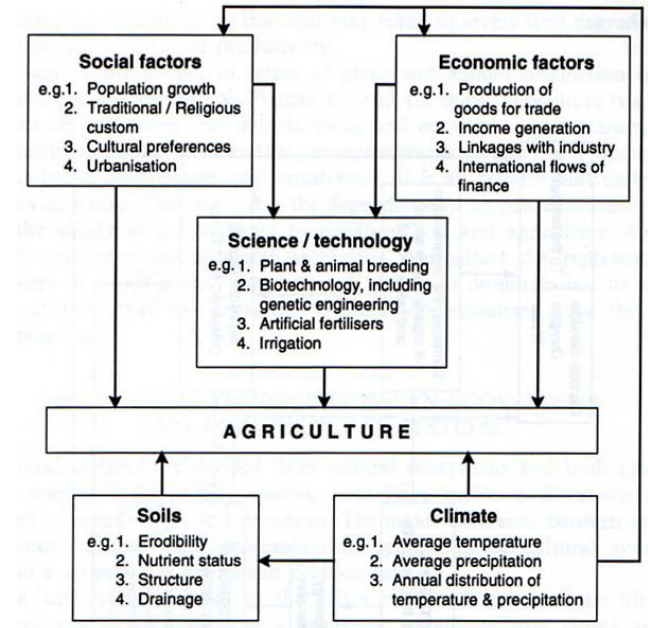
Agriculture is no longer merely simply a science of growing plants within a medium with water and sunlight. It includes the social and economic factors which are defined by environmental characteristics. If the social and economic factors change, so too does agriculture. The relationship dependency of society on agricultural systems that in turn depend on the energy and resources of the earth. In this way, agriculture is a manifestation of people and their environment.

Other systems or factors which heavily play a role in agriculture are climate and soils. Mannion (1995:2) stated that the dominant control is climate, where average temperatures and precipitation amounts and their annual distribution constrain agricultural activity more than any other environmental factors. In addition, soil type, itself related to geology, also influences agriculture; factors such as erosivity, nutrient status, structure, drainage and water content all affect the crops that can be grown."

Agriculture is a reaction to a complex set of factors that include social and economic circumstances, usually mediated through political policies that prompt scientific enquiry and which operate under an umbrella of environmental constraints. It is an activity that underpins all other human activities. This highlights the dependence of human endeavour in all its forms on the ability of green plants to produce and agriculture, directly or indirectly, is a major means of wealth generation. Agriculture also represents one of the main ways in which society attempts not simply to dominate but to subjugate nature.

Agriculture is ever changing with more emphasis given to green architecture in the last decade. We see the use of architecture in which the threshold between the built and the natural being blurred through subtle techniques and use of materials by combining both architectural forms and natural materials.

Agriculture has had an impact on the city where food has been grown along edges of the city in order to promote low food mileage- that being the distance and time it takes for food which would normally be grown on farms to be processed and sent to local supermarkets to be sold to the general public.



Factors involved in agriculture
(Mannion, 1995:3)



Aesthetic agriculture in suburbia
Photograph: Preston (2006:75)

Urban Agriculture

According to the Food and Agricultural Organisation (FAO) of the United Nations. Urban agriculture is defined as:

“An industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water disperses throughout the urban and peri-urban area, applying intensive production methods using and reusing natural resources and urban wastes to yield a diversity of crops and livestock.”

In fact, the concept of urban agriculture is generally practised to generate income or for subsistent farming.

Why is Urban farming essential?

Urban agriculture contributes to food security in two ways:-

- It increase the amount of food available to people living in cities.
- It allows fresh vegetables, fruit and meat products to be made available to consumers.

The first example of urban agriculture was found in Machu Picchu where the stepped architecture of the city created the idea of terraced farming in order to fully maximise the capture of the sun for crop growing.

This thesis aims to explore the impact and use of agriculture as the main design tool for the project from the number of units permissible on the site to the integration of greenhouses to the units.

The need for urban agriculture is highlighted in the following factors:

Economic

- Urban agriculture expands the economic base of the city through production, processing, packaging and marketing of consumable products. This results in an increase in entrepreneurial activities and the creation of job opportunities, as well as in food cost reduction and products of better quality.
- Urban agriculture represents an important opportunity for women to be a part of the informal economy of the city. Farming and selling activities can be combined more easily with household tasks and child care.
- Urban agriculture provides employment, income and access to food for urban populations, which together contributes to relieve chronic and emergency food insecurity. Chronic food insecurity refers to less affordable food and growing urban poverty, while emergency food insecurity relates to breakdowns in the chain of food distribution.

Social

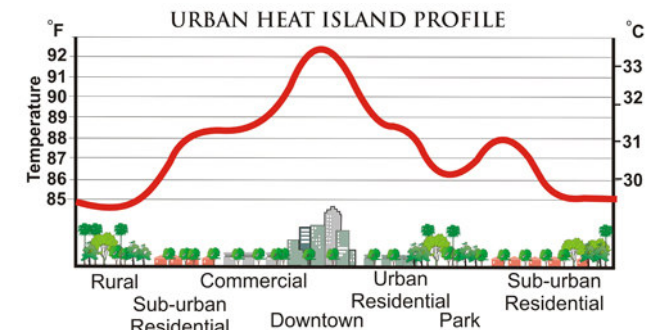
- Social benefits that have emerged from urban agricultural practices are better health and nutrition, increased income, employment, food security within the household and community social life.
- “Community and residential gardening, as well as small-scale farming, save households food dollars. They promote nutrition and free cash for non-garden foods and other items” (<http://foodsecurity.org>). In this way, income can be generated by selling to local to grocers or hawkers at the same time of supplying their own homes with needed nutrition.

Energy

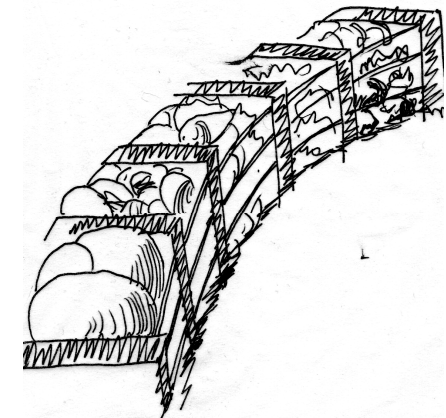
- Since industrial agriculture is the reason for high energy costs due to the use of machinery and transportation of produce, therefore the energy would be reduced significantly if urban agriculture



Mayan agriculture terraced architecture
(<http://lh6.ggpht.com>)



Green thermal oasis
Photograph: Preston (2006:75)



Garden wall feature using architecture form with natural materials
(authors own)

ISSUES

can provide cities with food which is grown locally. Energy is an issue which is becoming more serious and so perhaps the issue of self sustainability and green architecture becomes added issue. We are entering a new age where energy is an issue particularly in the modern age, the question of self sustainability is fast becoming a very important issue and how the architecture utilises new 'green' technology.

Quality of food

- Urban agriculture supports a more sustainable production of the food which attempts to abandon the use of pesticides. Preservatives would also not be needed as produce need not travel far when locally produced.

It stands to reason that the need for urban agriculture especially during current times with rising fuel and food costs.

New ways of agriculture which utilises technology is being researched more everyday. Two such types are Aeroponics and Hydroponics.

Aquaculture

The theory is simple:

"You feed the fish: the fish feed the plants. Plant help the fish by filtering fish wastes from the water. You harvest the vegetables and fish. The more natural the system is, the better it is." Lorin Burgoyne

By keeping a ration between fish and plants the size of the system can be of any size.

Aquaculture is a closed cycle, self-balancing system where mineral-salt plant food is replaced by natural nutrients from a biological system. There are three essential components to an aquaculture operation:

- Fish
- Plants
- Bacteria

The most popular fish in the world for aquaculture is tilapia. These fish are hardy, fast growing (450gm in about 9 months), disease resistant, warm-water fish native to Africa that tolerate low oxygen and poor water conditions. They are vegetation eaters and also consume algae.

Finding the relation between urban agriculture and aquaculture and how the two can work side by side, may enrich the project rather than limiting to merely vegetable farming.



Agriculture social gardens
(Urban Green File 2008:29)



Agriculture social development scheme
(Urban Green File 2008:29)



Urban Green belt
www.agnet.org

ISSUES

Hydroponics

Hydroponics is derived from the Greek words 'hydro' (water) and 'ponos' (labour). It is the method used to grow plants using solutions with mineral nutrients instead of soil. Contrary to common misconception, Hydroponics is not only the growing of plants in liquids, but also includes the growing of plants whereby the roots are in an inert medium such as perlite, gravel or mineral wool.

"In the 19th century a plant physiology researcher discovered that plants absorb essential mineral nutrients as inorganic ions in water. In natural conditions, soil acts as a mineral nutrient reservoir but the soil itself is not essential to plant growth. When the mineral nutrients are introduced into a plants water supply artificially, soil is no longer required for the plant to survive."

(<http://en.Wikipedia.org/wiki/hydroponics>)

The two main types of hydroponics are solution culture and medium culture. Solution culture does not use a solid medium for the roots, just the nutrient solution.

Three main types of solution culture are:

- **Static solution culture** - Plants are grown in containers or nutrient solution.
- **Continuous flow solution culture** - The nutrient solution constantly flows past the roots.
- **Aeroponics** - The roots of the plant are continuously saturated with a fine mist of nutrient solution. The roots are suspended in the air or an air chamber.

The medium culture method has a solid medium for the roots and is named for the type of medium. There are two main variations for each medium:

- Subirrigation where nutrients are placed in a medium through by means of capillary action, the plants receives it's nutrients.

- Top irrigation as is suggested is the method at which the nutrients is placed on the medium surface. This is generally done in large containers.

Although there are many different types of mediums with which one can use in hydroponics, the use of different materials which may also incorporate architecture will allow for a more dynamic architecture which speaks about tectonics and texture.

Hydroponics relies on the three main components:

- Plant
- Medium
- Nutrient solution

Another benefit to the use of hydroponics is that it also saves an incredible amount of water; it uses as little as 1/20 the amount as a regular farm to produce the same amount of food. The water table can be impacted by the water use and run-off of chemicals from farms, but hydroponics may minimise impact as well as having the advantage that water use and water returns are easier to measure. (<http://en.Wikipedia.org/wiki/hydroponics>)

However, although hydroponics allows one to grow vegetables without soil. There are limitations as to what vegetables can be grown. Basic agriculture is still needed for the growing of vegetable such as potato's and other subterranean produce.



Polystyrene packing peanuts



Brickshards



Gravel



Sand



Coiir



Expanded clay



Rockwool



Vermiculite



Diahydro

ISSUES

Aeroponics

Aeroponics is derived from the latin word 'aero' (air) and 'ponic' (labour). This refers to the growing of plants or vegetable in a air medium. The process mimics the orchids in tropical regions where such orchids grow freely on trees where the plant receives nutrients from the humidity or the air. This process of agriculture relies on machinery but requires no growing medium.

Aeroponics is the process where plants are supported by a medium but the roots are suspended within a closed or semi-closed air medium and the roots are fed nutrients via a fine mist which is sprayed by a high pressure hose. Hydroponics has an added advantage of being pest and disease free over standard agriculture and hydroponics as it is free from possible root rot and pests which may live in a medium.

Aeroponics relies on three main components in order for the plants to survive:-

1) Water, 2) Nutrients and 3) Air (combination of oxygen and carbon dioxide)

The benefits of growing in air is *two-fold*:

"Clean air supplies oxygen which is an excellent purifier for plants and the aeroponic environment. For natural growth to occur the plant must have unrestricted access to air. Plants must be allowed to grow in a natural manner for successful physiological development. The more confining the plant support becomes, the greater incidence of increasing disease pressure of the plant and the aeroponic system. Plants in a true aeroponic apparatus have 100% access to the CO₂ concentrations ranging from 450ppm to 780 ppm for photosynthesis. An air culture apparatus offers ability for plants to have full access to all available CO₂ in the air for photosynthesis"

(<http://en.Wikipedia.org/wiki/aeroponics>)

Advantages of aeroponics

"Aeroponic growing is considered to be safe and ecologically friendly for producing natural, healthy plants and crops. The main ecological advantages are the conservation of water and energy. When compared to hydroponics, aeroponics offers lower water and energy inputs per sq meter of growing area." (<http://en.Wikipedia.org/wiki/aeroponics>)

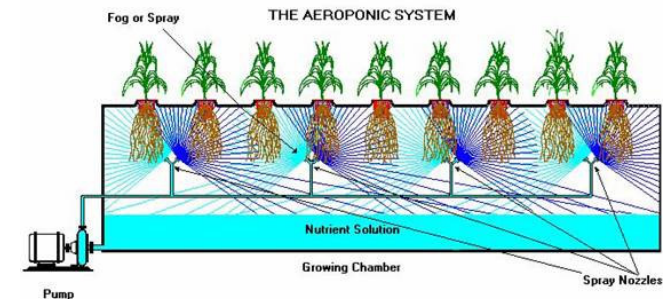
Other advantages of aeroponics is the ability for aeroponic propagation and transplants. In aeroponic propagation, this is where plant cuttings can be used to grow into another plant entirely by the extraction of either a leaf or a stem. "Numerous plants which were previously considered difficult, or impossible , to propagate from cuttings could now be replicated simply from a single stem cutting. This was a major benefit to green houses attempting to propagate delicate hardwoods or cacti- plants normally propagated by seed due to the likeliness of bacterial infection in cuttings." (<http://en.Wikipedia.org/wiki/aeroponics>)

Transplanting of aeroponic plants was much easier than hydroponic plants as hydroponic plants are more susceptible to disease, infection and failure. There is also a probability to plant shock where the plant does not take to the new medium and dies.

The only drawback to aeroponics is the need for such machinery to continuously provide nutrients in the form of a fine mist.



Orchids growing in trees
Photograph: Authors own:2008



Aeroponics diagram system
(www.wikipedia.org)