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Submitted in fulfillment of part of the requirements for the degree of March(Prof) in the faculty of Engineering, the Built Environment and Information Technology, University of Pretoria, South Africa.

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re thinking **green**

an exploration of sustainable architecture and environmental philosophy

"After all, nature is a symbol of freedom. Sometimes nature actually gives rise to and maintains the idea of freedom. If we base our technical plans on nature we have a chance to ensure that the course of development is once again in a direction in which our everyday work and all its form will increase freedom rather than decrease it."

Alvar Aalto
(Weston 1995, p98)

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"Those who look to the laws of nature as a support for their new works collaborate with the creator"

Antonio Gaudi
(Browning 2005, p.57)

Chapter 1

Brief & Project Description

Real World Background to the Problem

Sustainability, although an exhausted topic in the arena of architectural thought, is still of great relevance. Despite the debate around these issues, the influences are relatively insignificant on the South African city fabric.

Any attempt to overcome this gap with a single document is rather naive. This dissertation serves as an exploration of the mind sets and social conditions that assisted in the current environmental crisis.

The document that follows aims to highlight skills, products and awareness that will filter into the local construction industry, impacting and reaching wider than just a single intervention.

Problem Statement

A high-tech sustainable building system, research and development centre. The unit should address job creation and access to commercially viable green building systems, information and skills.

The Client & Requirements

The client is envisioned as a partnership between government and the private construction sector. The concept of skills development and establishment of small to medium enterprises is fundamental to the growth of South Africa's economy. It also aligns with some of the aims of the current government.

Due to the current shortage of skilled labour and product within the construction industry, the centre should also attract local construction companies to this venture. It is important that the enterprises created from this development feed resources and training back into the facility.

Central to the topic of environmental awareness is the reduction of the consumption of fossil fuels. To address this concern and add value and potential attraction for investment, the project will include a filling station that could act as a local distribution point for bio-diesel.

Sub Problems

This essay is divided into various sub problems, due to the vast scope of the problem statement. These need to be addressed in order to achieve the initial objectives and goals.

A study in contemporary design theory and environmental philosophy. In an attempt to establish a theoretical framework, the topic of sustainability is evaluated at the hand of different theoretical arguments. Although at times conflicting, the aim is to obtain a clear understanding of the relevant issues. The problem and the proposed intervention, articulated through illustrations.

Research into existing sustainable building systems or principles, with the aim of identifying effective systems. However, the underlying principles are of paramount importance. These should be understood first, before they can be "de-contextualized" to South Africa's current level of technological, social and economic development. Therefor, certain mainstream construction methods and their impacts on society and environment have been analyzed.

The social and historical context of the greater Pretoria, and more specifically Marabastad, is addressed Chapter 3. This was done to gain a better understanding of the existing skills in the area. Possible entrepreneurial ventures that could address unemployment through development were identified.

Certain aspects of the proposed site as well as macro and micro climatic contextual data was studied in order to assist in the implementation of sustainable building principles.

The Problem within the context

The proposed site is situated in the north west of Pretoria, just south of Marabastad. It is a brownfield site in a somewhat neglected part of Pretoria. Situated close to the main train station and taxi rank, it is part of a gateway to the city for those from outside Pretoria coming in to town. Initial site analysis seems to indicate rampant

unemployment and crime levels within the area. There are various religious activities, most popular being the Z.C.C churches. In addition a mosque and a Hindu temple is situated in the vicinity.

The following aspects have been addressed in the context analysis; physical, cultural, social, and economic context as well as history, demographics and climatic context. In addition an urban framework that was developed by Aziz Tayob Architects in 2002, was critically analyzed, in an attempt to understand various contextual influences, in order to make informed design decisions.

There is an array of entrepreneurial activities within Marabastad. These include; cooking maize cobs, tyre repair & fitment as well as car mechanics, and other informal trading. It is thus, important to maintain and facilitate development of the existing economic activity.

This study was an exploration of existing notions and ideas on sustainability within the built environment. In addition, a serious attempt was made to incorporate these within the unique South African environment.

The study area demarcated by the studio master, extends from DF Malan drive on the west to Nelson Mandela on the East, with Boom street forming the northern boundary and Church street the southern boundary.

Due to the study of the above mentioned area, an informed decision regarding site selection could be made. Subsequent to this a group of Masters students working in close proximity to one another embarked on a more detailed study with the intention to develop a group framework for the area.

This area was selected due to the many possibilities the existing urban decay created. It is also suitable because of the conveniently located railway, allowing easy access to transport for both people and products.

Literature Study

Due to the broad scope of the topic of sustainable or green architecture, it is crucial to clearly define and limit the topic to the most relevant information. For the purposes of this dissertation the focus will largely be on state-of-the-art sustainable systems, developed by keeping in mind the local context and climatic conditions. The research draws from many global precedent studies in order to learn from the successes and failures they've encountered.

The author investigated existing sustainable premises in order to generate a theoretical argument. more specifically the relationship between sustainblel architectural theory and environmental philosophy. Certain principles were evident, and these eventually informed the design.

Delimitations

The research focuses on fundamental principles of environmentally responsive architecture with the with the focus on the application to medium scale high tech commercial buildings. The study will not focus on singular systems in isolation but will attempt to explore the effectiveness of combining and overlapping different systems to attain all year round comfort through day and night.

Precedents

In the research several examples have been found of projects that showcase the potential of sustainability in architecture. They are the following, these include amongst others:

Nicholas Grimshaw's
British Pavilion
Renzo Piano's
Beyeler Foundation Museum
Michael Hopkins'
Jubilee Campus
Norman Foster's
Commerzbank Headquaters
Noero Wolf
Red Location Museum
Shigeru Ban
The Naked House

Goals & Objectives

In the architectural profession there is a responsibility to look further than the interests of clients; duties also extend beyond that of only taking into consideration the desires of mankind.

Thus, there is a need for a more holistic approach to architecture. Although much has been said on the topic of relevant architecture or sustainable architecture, it is still evident that the concepts surrounding these topics are scarcely implemented in the South African architectural practice today.

This project aims to empower the local built environment by means of a facility providing skills development for hi-tech alternative building technology. The facility will not only aim at empowering the local community, but allow for the development of small enterprises by providing necessary facilities to produce such products or develop new technologies. Furthermore this facility needs to be a commercially viable business venture.

The project aims to demystify sustainable building technologies in order to make them accessible to a broader market .The small enterprises that are developed will have an opportunity to work hand in hand with the centre, commercial developments can be used as pilot projects in order to exhibit and test the principles developed by the facility.

At this stage it is difficult to put an empirical value to the necessity for intended outcomes of such a facility. But few would doubt that it is imperative that the issues are faced.

In an industrialized capitalist society is important for us not to redefine the values of what is socially and environmentally responsible, but rather re-contextualising or “re-branding” sustainability as a commercially viable approach to architecture. This would allow sustainability to become accessible to all, enabling us to coexist with and thereby, appreciate the surroundings and natural environment.

Re thinking Design Methodology

"We had been given the task of designing the future, or at least what was possible if we dared to dream of a future where our buildings no longer took from the environment but were restorative"

Jason McLennan
(McLennan. 2005 p27)

Architecture seems to be at contrast when it attempts to enhance the natural environment through the creation of space that promotes human well-being. This design investigation questions man, nature and society in an attempt to reconcile different objectives into a single functional and aesthetic expression.

Architecture needs to be informed by context, ultimately answering the question of appropriate response. The design process needs to be informed by the collective. The product could then represent more than a singular expression.

The world at large is undoubtedly faced with an environmental crisis. The question now is not who to blame, but rather what can be done to ensure that the current impact will not adversely effect future generations.

Environmental philosophers tend to romanticise the past; specifically vernacular architecture and the related ways of life (Snyman L, 2006). Vernacular architecture was shaped through a dialogue between man and landscape that has lasted countless years. Potentially, the connection between site and nature could be restored to its former importance. However, the principles relative to the social and cultural environments need to be investigated in order to reinterpret them within the contemporary urban context.

McDonough (2005, p3) gives a strong argument that the natural world can act as an informant and determinant of architecture: "How many modern designs are as elegant and sophisticated as a tree? How many buildings have humans designed that produce oxygen? Is a high-tech building one that destroys air quality or enhances it?"

The current environmental crisis offers architects an opportunity to challenge existing design and thought processes. In the authors opinion the architect should address the amount of energy and resources that are consumed by his/her buildings, both during the construction phase and the post occupancy stage.

Architecture that relates to its physical, social, cultural, economical and environmental context will be more than "the technological and stylistic gloss of current fashion'. (McDonough, 2005, p5) An interactive dialogue between site, man and nature should create appropriate and liveable spaces. The building will then be able to exist in harmony with its site and those using it.

If we can begin to shift our conceptions of the purpose and process of development to one that heals human and natural communities, uses nature as a mentor and addresses occupants' physiological and psychological needs, then we will be on our way to integrating ecology and real estate

William D Browning
(Browning 2005, p.60)

The existing context of Marabastad was first evaluated on a macro scale. The research was executed by the 2007 final year architecture students (M Prof Arch). This resulted in an urban framework that informed site selection as well as design decisions.

Learning from the vernacular

"The tendency from the beginning of the 20th Century until the early 1980's was to regard tradition or vernacular architecture as primitive, quaint and unsophisticated: picturesque, perhaps, but certainly not worthy of serious research, or of informing contemporary form"

James Steele
(Steele.2005,p15)

A thorough study of the vernacular architecture found within a specific area should inform design intervention. The work of Hassan Fathy, Charles Correa and Balkrishna Doshi amongst others, serve as an example. They were successful in applying principles of their respective vernacular to inform an appropriate

response within a contemporary social context, albeit not in the same climatic conditions.

"For most indigenous people, land is not viewed as a commodity to be bought and sold in impersonal markets, but rather a substance endowed with sacred meanings which defines their existence and identity"
James Steele
(Steele.2005,p15)

The cultural diversity of South Africa makes it difficult to identify a single vernacular. This is equally true of Marabastad. Therefore the focus will be on an Ndebele architecture and culture, because it has historically assimilated well with others, without losing any individual identity. "Ndebele art and architecture show uniquely how a minority group existing in a multi-cultural milieu (exposed to both traditional tribal and twentieth-century Western influence) can through adaptation and appropriation develop a unique hybrid artistic and architectural expression as part of a quest to claim their cultural identity."(Rich.1995)

As with many African tribes, the settlement patterns and spatial structures seemed to form around the cattle kraal and the polygamous societal structure. While maintaining individual privacy, the wives courtyards are defined not by large walls or imposing structures but rather suggestive gradients in the form of , "layering of the courtyard walls" (Rich.1995), formal gardens or clearly defined entrances allowing interaction of each building to the others and to the surroundings. Common daily routines were accommodated in courtyard fronting home(s), relating to the streets that are formed by the "left right relationship of wives homesteads" (Rich.1995) leading to the mans dwelling.

A Ndebele matriarch proclaims "We see what we want to see and make it our own"
Peter Rich
(Rich.1995)

Unfortunately, the vernacular loses its meaning and origin when it is thoughtlessly imposed. In order to successfully implement principles of the vernacular architecture, a deeper understanding for the reasons for the architecture needs to be developed. This should result in a shifting of the focus, from architecture (or product) to the dialogue between man and his surroundings.

Urbanism & Ecology

A thorough understanding of the contemporary city, together with its place in a global village is necessary when any relationship with the environment is formed. This should allow the urban dweller (and architect) to fully grasp the impact of urbanism on the environment

Technology has always been a controversial topic in the arena of sustainable development. Whilst it main aim is possibly "to make life easier" it is exerting more pressure on society and resources alike to achieve higher levels of productivity. It could be argued that the more technology develops, the more is expected from the individual. The reality of a modern day urban experience is drawing closer to the schemes of Eric Owen Moss, where sealed buildings are connected only by tar roads and computers (Steele.2005, p.28). In general, contemporary lifestyle has separated man from his natural surroundings

According to James Steele the electronic age:" has radically changed our pace of our lives as well as our expectations, to the extent that younger generations, who have experienced nothing else, seem to abhor reflection and the complete silence that it requires and always need electronic distraction instead" (Steel 2005, p.9). This lack of introspection and engagement with the outside world is perpetuating the separation from nature, and in turn the destruction thereof.

Steele further describes the impact of the current social situation on mans relationship to history and context: "The accelerating pace of change has erased the moment, destroying previous distinctions between now and then, past and present, and essentially weakening our relationship to history and context" (Steel 2005, p.262). Existing ties to history, the natural environment and context, have been extensively severed.

Current debate

The terms “sustainable development” or “green architecture” is highly contentious, not only within the architectural fraternity, but the world at large. In an attempt to come to terms with these ideologies Steel (1997, p.18) argues we need to clarify and understand the terms themselves.

Sustainable architecture can broadly be defined as architecture that delivers present needs, without jeopardizing the environment and ultimately future generations. This research attempts to look further into the matter in order to gain a more holistic view as to the wider impacts and opportunities within the movement.

In capitalist utilitarian reality little value is placed on the intrinsic worth of the natural world and its resources. It would be rather naive to expect this to change. A more realistic attempt could be to change the perceptions about environmentally friendly architecture.

In general, perceptions surrounding green architecture vary. Often it depends on exposure to this form or type of architecture. Perceptions include statements like primitive architecture not appropriate in a commercial context. Another point of view that is often raised is the capital outlay that is deemed higher than the conventional equivalent (Browning 2005, p.60).

In a study entitled Cost of Green Revisited, David Langdon states that “there is no significant cost difference between the cost for green buildings as compared to non green buildings.”(Langdon 2007, p.2) Langdon furthermore states that until design teams realize that green design is not a retrofit to a conventional building, it will be near impossible to overcome the notion that green design is more expensive.

The pricing gap between sustainable and conventional architecture is closing. Together with social and political pressures for sustainable development, the demand for the relevant skills in the construction sector will increase proportionately.

In the quest for an architecture that restores the environment, the natural environment needs to inform the generation of form. The built environment as a whole, together with processes and methodology needs to be questioned, in order to create a sustainable future for architecture.

10 Shades of Green

In *Ten Shades of Green* Peter Buchanan highlights different aspects of sustainable architecture. The various concerns that need to be addressed in the design process are as follows:

(Buchanan 2005, p.39)

1.Low Energy/High Performance
Using the climatic context to maximise use of natural ventilation and lighting, passive cooling, layering facades and solar heating. This is shaping a building and using technology to work with natures systems and principles.

2.Replenishable Sources
Harvesting of non-depletable ambient energies such as the sun, wind, waves gravity, geo-thermal power and even magnetism.

3.Recycling
Reuse of old building materials and reuse of brown field sites.

4. Embodied Energy
Choosing materials with low embodied energy (sum of energy used in manufacturing, processing and transporting) such as timber or brick rather than alluminium

5. Long Life, Loose Fit
Designing a building that easily accomodates change and ages well in order to save on the energy needed to construct a new building in its place.

6.Total Life Cycle Costing
Involves more than initial costing, includes running costs well as social and environmental costing aspects

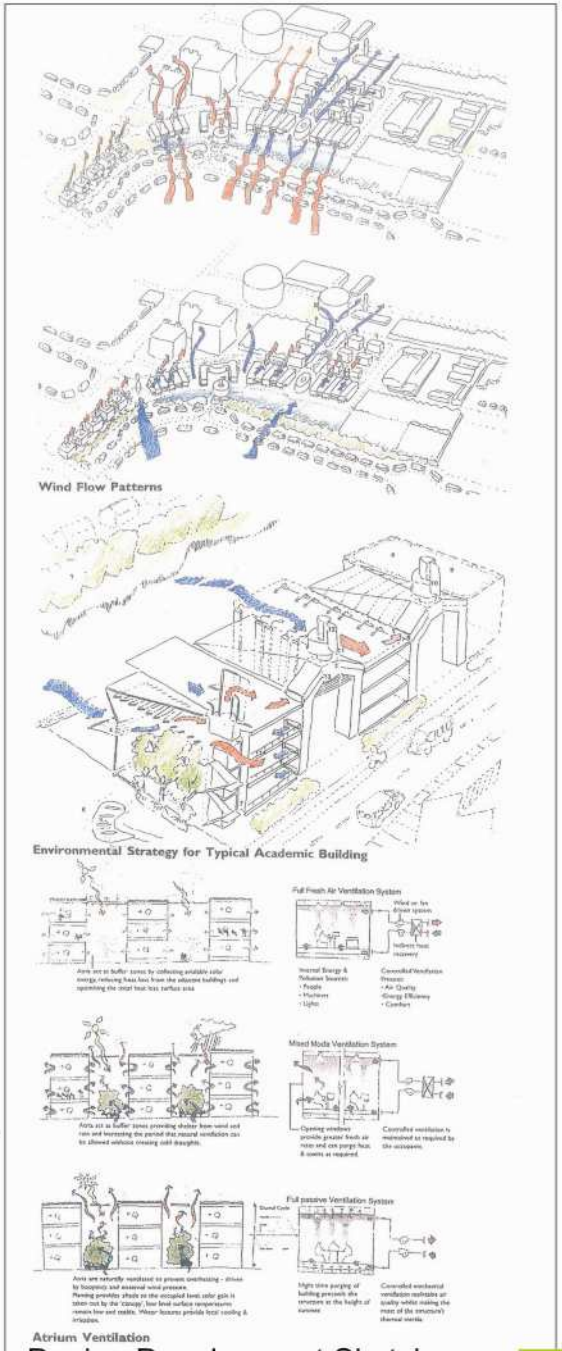
7.Embedded in Place
Seamlessly integrating a building into its site, drawing on local and imperical climate data.

8. Access and Urban Context
In order for a development to be sustainable it needs to the have access to public transport infrastructure.

9.Health and Happiness
Natural light, fresh air and contact with the outdoors have shown to increase staff productivity.

10.Community and Connection
A green building needs to regenerates a sense of community and connection to nature

In the course of the design development this dissertation will aim to address the above mentioned aspects as well as some of the other matters addressed in this chapter



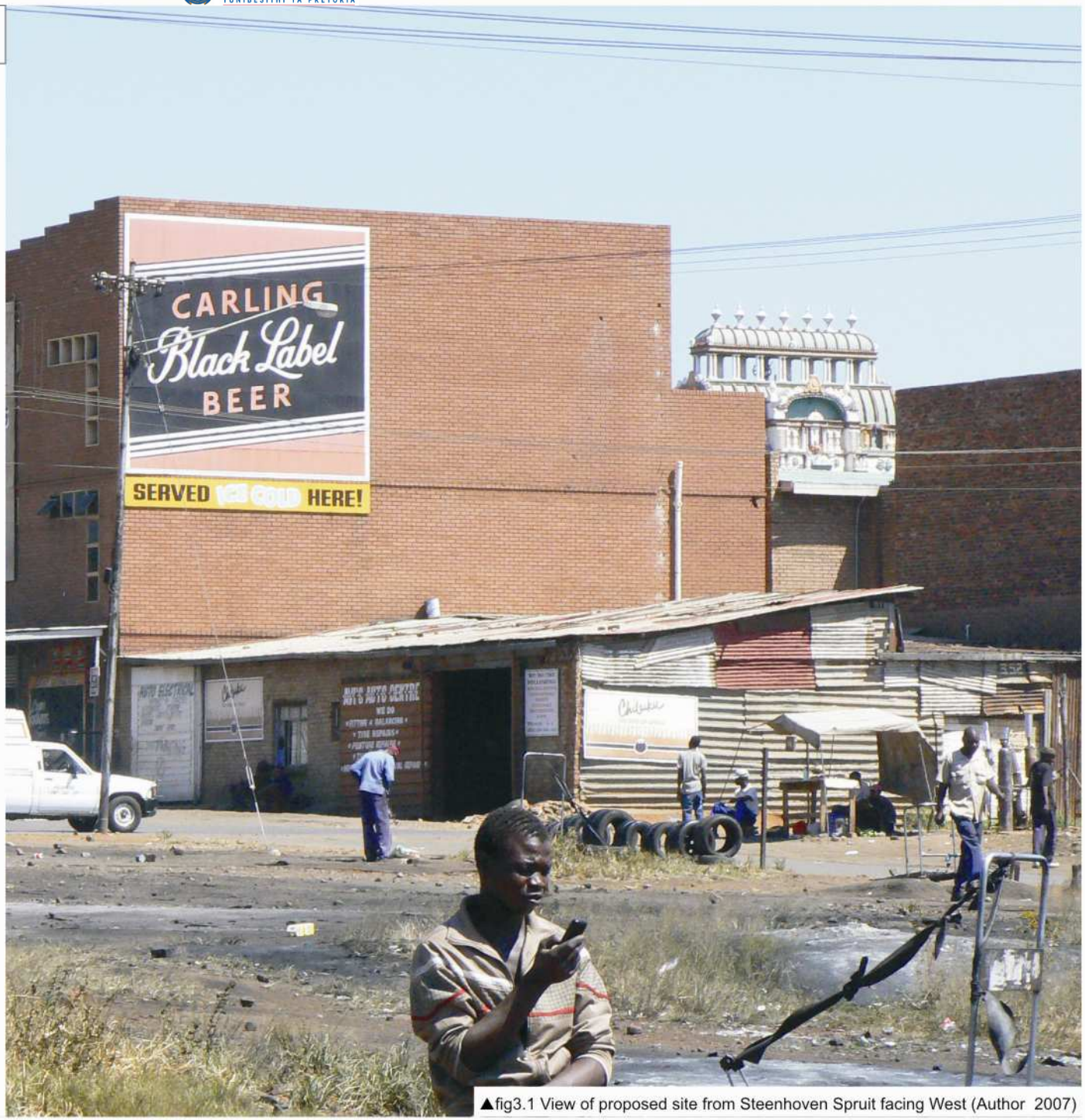
Design Development Sketches
Jubilee Campus, Michael Hopkins
▲fig 2.1(Buchanan 2005, p.78)

Sustainability " involves moving beyond technologies and techniques to thinking about how a project proactively weaves itself into the social and ecological fabric of a community"

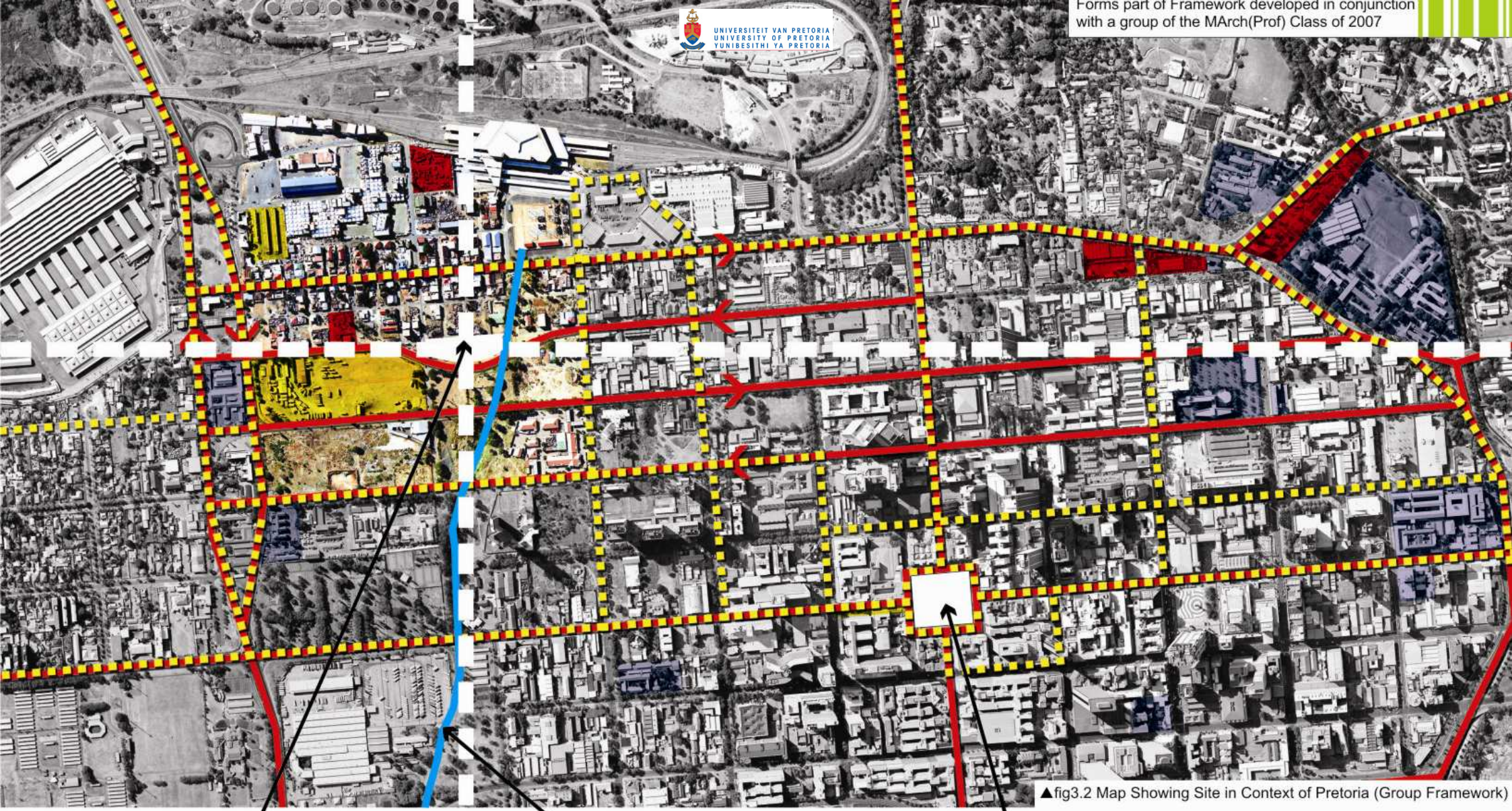
William D. Browning
(Browning 2005, p. 57)

Understanding the Context

Context Study



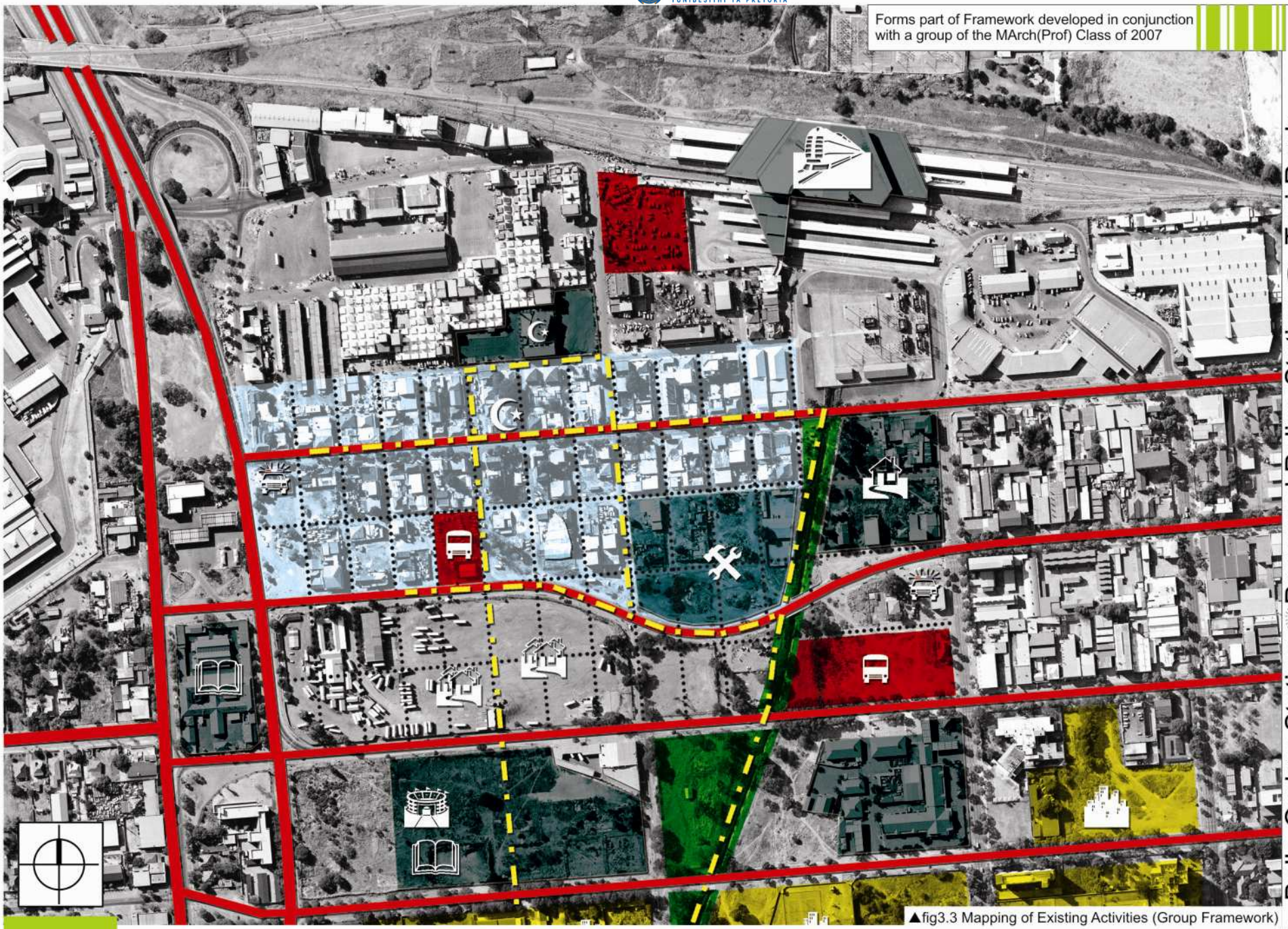
▲fig3.1 View of proposed site from Steenhoven Spruit facing West (Author 2007)



▲fig3.2 Map Showing Site in Context of Pretoria (Group Framework)

Study area in the context of Pretoria

Forms part of Framework developed in conjunction with a group of the MArch(Prof) Class of 2007



▲fig3.3 Mapping of Existing Activities (Group Framework)

Zoning as Proposed in Group Framework

▲fig3.4 Boundaries of Study Area (Group Framework)

"the apartheid regime gave brutal shape to the urban and social dynamics of South African cities, but now that such proscriptions(sic) no longer apply, what comes next in the quest for a responsive, inclusive and multi-layered urbanism?"

Lindsay Bremmer (Bremmer 2007)

Boundaries of Study Area

Ndebele leader Mzilikazi attacks and drives local tribes from the highveld

Early 1800's

Pretoria is founded and named after Voortrekker Andries Pretorius. The area around the Steenhoven spruit became known as Goedehoop and later Veldskoendorp.

1855

Chief Maraba s kraal on the western bank of the Steenhoven spruit. Black people employed as servants found accomodation there, and over time a large settlement developed now known as Marabastad

1870

Laws passed that restricted and property ownership and citizenship of Indians. Bazaars were set up where they had to trade

1885

Pretoria (fig 3) 1889

▲fig3.6 Pretoria in 1889
Aziz Tayob Architects (2002)

White voortrekkers move into area previously occupied by indigenous people

1840

Area along the east bank of the Steenhoven spruit set aside for black people. The area was named Schoolplates

1867

The First Boer War broke out after the British annexed the Transvaal

1877

1800 1850 1875 1885 1900

▲fig3.5 Watercolour by S. E. Coates
Aziz Tayob Architects (2002)

Pretoria proclaimed capital city of the Transvaal Republic

1860

Population growth among white and black people poses a potential treat to peace, white settlers proclaim certain area's as black area's and pass laws controlling the movement of black people

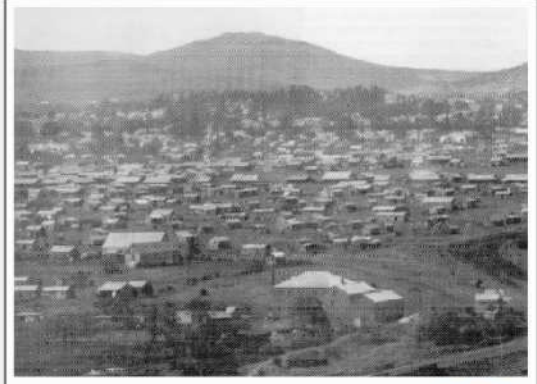
1852

Gold is discovered on the Witwatersrand

1880

First Boer War ends with the Pretoria Convention in 1881. The convention gives indian and coloured people the right to own land in the Transvaal, leading to many Indian traders migrating from Natal.

1881



Marabastad 1905

▲fig3.7 Marabastad
Aziz Tayob Architects (2002)

the **history** of marabastad

Aziz Tayob Architects (2002)

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Asiatic Bazaar established as a township on a fine grid. It later develops into a lively mixed use area **1903**

Marabastad and Schooplaats consolidated into one township set aside for black people **1905**

The Pretoria town council starts forced removal of residents of Marabastad to Bantule where Tswane University of Technology now stands. **1912**

All homes in the old Marabastad demolished **1918**

Channelisation of the Steenhoven Spruit **1920's**

Natives Act is passed due to the increase of black people migrating into town, forcing black people to live in area's demarcated as black locations **1923**

Slums Act gives authorities power to demolish area's they deem to be slums. Marabastad is declared a slum **1934**

Area between Steenhoven spruit and D.F.Malan drive, barber street & sewer works form the boundaries of the new Marabastad, which developed into a vibrant community **1925**

Authorities started to clear out the black population of Marabastad, moving many of them to atteridgeville. Only a small coloured section remained **1940**

Remaining residents of Marabastad are displaced. The Belle Ombre station is built over the Steenhoven spruit **1953**

Cape Boys Location established between Jerusalem, Bloed, Struben & 9th Streets. The location was later demolished to make way for an extravagant highway proposal **1963**

Community development act freezes all development in Marabastad. Proposed Pretoria freeway scheme would have destroyed Marabastad & the Steenhoven Spruit **1966**

Remaining residents of Marabastad are displaced. The Belle Ombre station is built over the Steenhoven spruit **1988**

Conceptual Master Plan for the Asiatic Bazaar is drawn up, but was never implemented **1987**

New Freeway Proposal, that still threatens the area today **1993**

The Birth of the New South Africa, drawing into the area many squatters, hawkers and small scaletraders **1994**

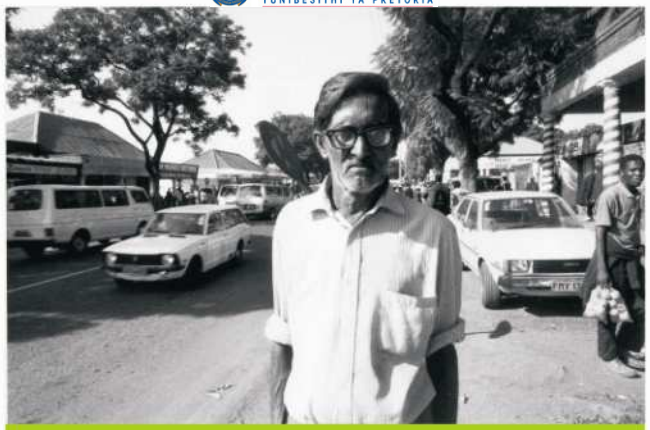
The New Constitution seeks erase all discriminating laws and policies to create a free and fair new South Africa **1996**

1900 1925 1950 1975 2000

Asiatic Bazaar, 1954
Aziz Tayob Architects (2002)

Photo 1

▲fig3.8 Asiatic Bazaar
(Aziz Tayob Architects 2002)



Images of the vibrant community Marabastad once was

Aziz Tayob Architects (2002)

▲fig3.9 Images of Marabastad (Aziz Tayob Architects 2002)

Social and Economical Aspects

People's interest in the area

A public survey was done as part of the Urban Framework for Marabastad. 69 people of the area had to fill out a questionnaire to see what their interest in and experience of the area was. Considering the time that people have spent in Marabastad, the distance they travel to get there (more than 43% of people travel longer than 45minutes) and the interest that there is to stay or own land in the area, the conclusion can be made that there is a degree of loyalty and commitment towards Marabastad by its users. Asked if they would like to live in Marabastad, 57% of the participants replied positively. (Aziz Tayob Architects – Meyer Pienaar Tayob: 2002, pp139 – 146) Before the removal of squatters from Marabastad in August 2002, 306 households were staying in informal dwellings in the area. (Statistics South Africa: 2003)

1.1 Households per dwelling type, Marabastad 2001 (Statistics South Africa: 2003)

Brick structure or house on separate yard or stand	Traditional dwelling/hut/structure made of traditional materials	Flat inside of block of flats	Informal dwelling/shack in back yard	Informal dwelling/shack NOT in back yard	Total
3	25	15	11	295	349

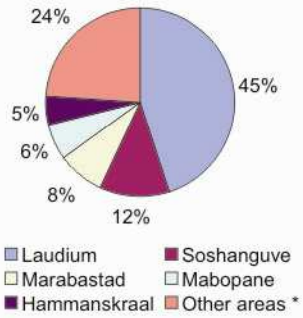
Safety and Security

Crime can be linked with other social problems, such as the slum-like environment, insufficient services, poverty, and a lack of enforcement of laws. Upliftment of the area can significantly reduce crime. What can also contribute to the social conditions and safety of the area would be if a close-knit residential community becomes settled in the area. Improving the policing within the area

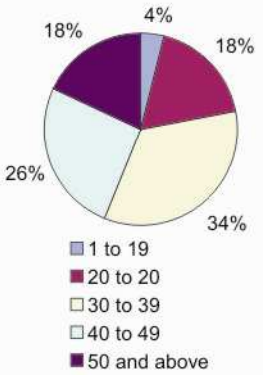
Public Survey

Information from public survey done for Marabastad Urban Framework (Aziz Tayob Architects – Meyer Pienaar Tayob: 2002. pp 139 – 146) 69 people were asked to fill out a questionnaire to see what their interest in and experience of the area was.

Place of residence

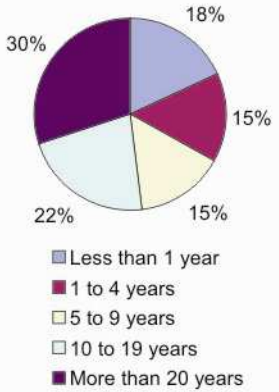


Age in years

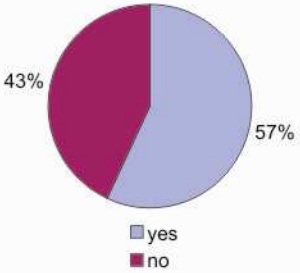


*'Other areas' – people evenly spread between: Mamelodi, City centre, Winterveld, Brits, Erasmus, Menlopark, Warmbaths, Ga Rankuwa, Kwa Ndebele, Atteridgeville, Lyttleton)

Time present in Marabastad



People who would like to live in Marabastad if there were suitable accomodation



(including services of SAPS, Metropolitan police, security guards) should be priority. (Aziz Tayob Architects – Meyer Pienaar Tayob: 2002, p185)

Illegal immigrants

Illegal immigrants who want to legalize their stay in the country have to apply for permits at Home Affairs. The fact that they are present in Marabastad is evidence of the uncontrolled and unsafe state that the area is in. (ibid, p178) Most of them are Zimbabwean. (See functions diagram for location of illegal immigrants in Marabastad The area on DF Malan drive next to Home Affairs has the highest crime rate in the area.) (Lourens, personal interview)

Informal trade

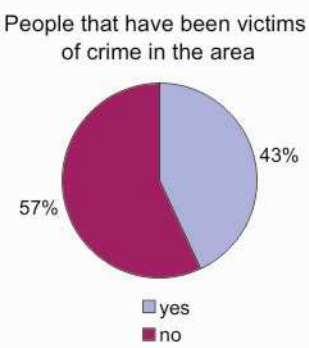
In Marabastad hawking is the way of survival for many as it provides an income for some and affordable products for others; however most of the traders are illegal. These (illegal) traders are removed and their equipment taken away every month. After each removal, traders return and go on with their business. Informal traders should be registered. For this they need a table, gazebo and licence. They may only trade between 6 in the morning and 6 at night. (ibid)

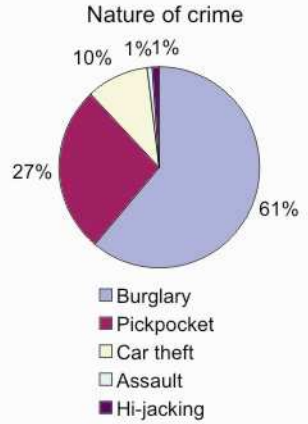
Another problem with informal traders is water. Water is taken, illegally, from the municipality's water pipes and sold to those who cook. Water bills of the area are extremely high. (ibid)

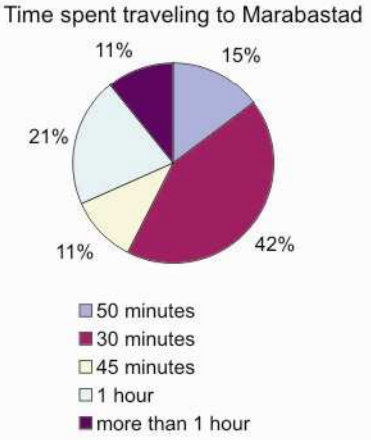
18% of informal trading in Tshwane takes place in Marabastad. In 2004 there were 658 informal businesses in Marabastad. (Ligthelm & Van Wyk: 2004, p20)

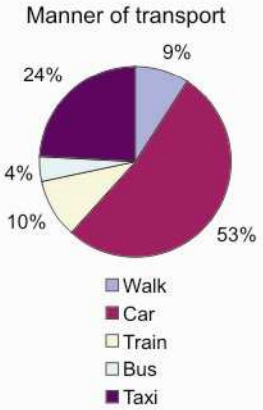
Health and welfare

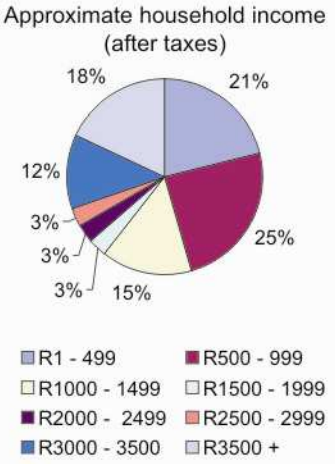
At the Pholang clinic (west of DF Malan drive) free medical services are offered to the homeless once a week. On DF Malan drive, south of the department of Home

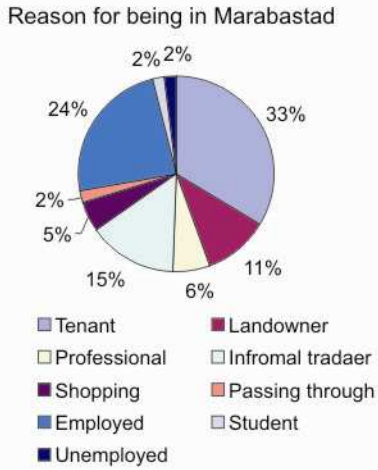












Affairs, is a family planning clinic. It is currently underutilised (Aziz Tayob Architects – Meyer Pienaar Tayob: 2002, p186)

Unemployment

Only 5% of people were unemployed according to the survey (see graphs), though 18% were earning less that R500/month. Unemployment and poverty needs to be addressed. (ibid, p 143)

The Tirisano ya Tswelopele program (located on the south eastern corner of the Maraba shopping complex) supports the community through various activities, such as counselling, referral- and information services, weekly visits and talks by experts, weekly services by visiting medical staff from Pholang clinic, skills training sessions and childcare programmes. (ibid, p188)

1.2 Informal restaurant in Marabastad
(Author 2007)

GIS spatial data, 2003, Census 2001, Statistics South Africa
Ligthelm & Van Wyk, 2004, Informal Trading in Tshwane: Regulatory, spatial and economic framework, Bureau of Market Research, University of South Africa, Pretoria
Lourens L, 2007, personal interview by author, City of Tshwane Metropolitan Municipality

Aziz Tayob Architects – Meyer Pienaar Tayob, 2002, Integrated Urban Framework for Marabastad, Chapters 3 & 7,

MICRO CONTEXT STUDY

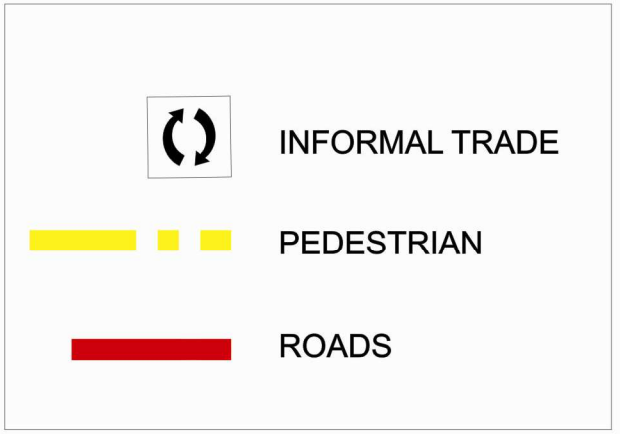
A careful context study is necessary to be able to arrive at a sustainable design solution. In order to create successful intervention that the community will take ownership of we need to understand the existing activities in and around the site as well as the opportunities and weaknesses inherent to the site. The initial contextual analysis was more broad based, focusing on a macro scale and historical and social level.

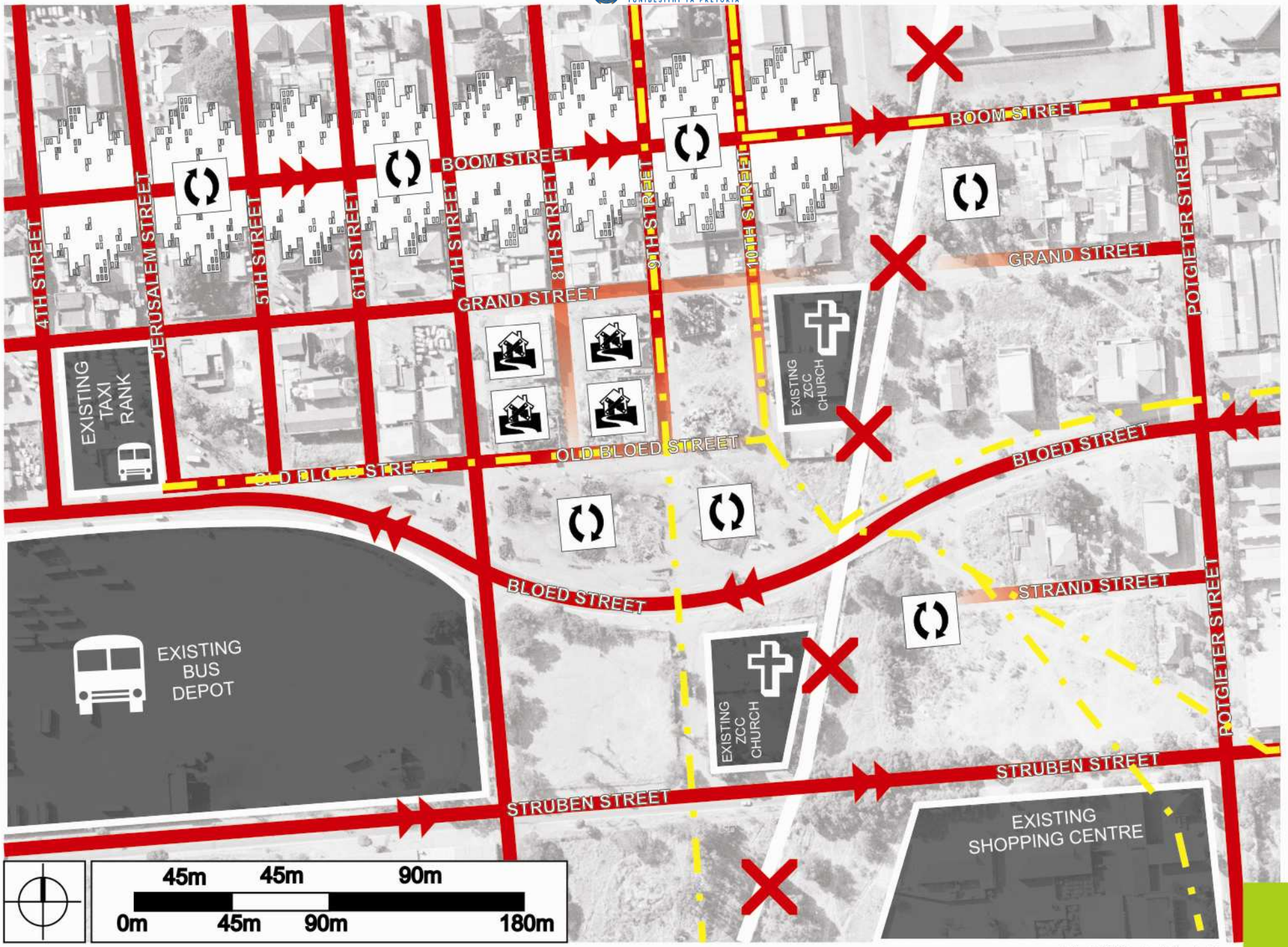
The following maps and photographs are an attempt to understand the dynamics on the existing site with the intention of highlighting opportunities and including existing programs into the design process.

▲fig3.10 View of Activities on site (Author 2007)

▲fig3.11 View of Activities on site (Author 2007)

The objective of the contextual analysis is to understand the proposed site in light of the framework developed a group of masters students, in order to appropriate it and infrom a micro developmental framework for the specific project.





▲fig4.12 Context Analysis

▲fig3.13 The Steenhoven Spruit (Author 2007)

▲fig3.14 Bloed Street adjacent to the proposed site (Author 2007)

ROADS

▲fig3.15 Boundaries (Author 2007)

MICRO DEVELOPMENTAL FRAMEWORK

The micro contextual urban framework has developed from a combination of the greater framework developed by a group of masters student (see Chapter 5) and the contextual influences on the specific site.

The intention of the micro framework is to appropriate the issues highlighted in the group framework and incorporate the opportunities and threats of the specific site.

The framework developed by Aziz Tayob Architects proposes serious infrastructure changes on and around the site, in the form of realigning of Bloed street according to a historical grid. As the condition of this portion of Bloed street is relatively good and the cost and waste of destroying good infrastructure is unnecessary, the framework developed from this research proposes leaving the existing infrastructure as it is.

The aspects that are addressed in this proposed micro framework are:

1. Reinstating the Marabastad area back into the Pretoria CBD.

2. Establishment of the pedestrian scale and intimacy characteristic of the old Marabastad

3. Creating of Green spaces and establishment of the Steenhoven Spruit as a pedestrianised green corridor.

4. Allowing accessability to public spaces and facilities.

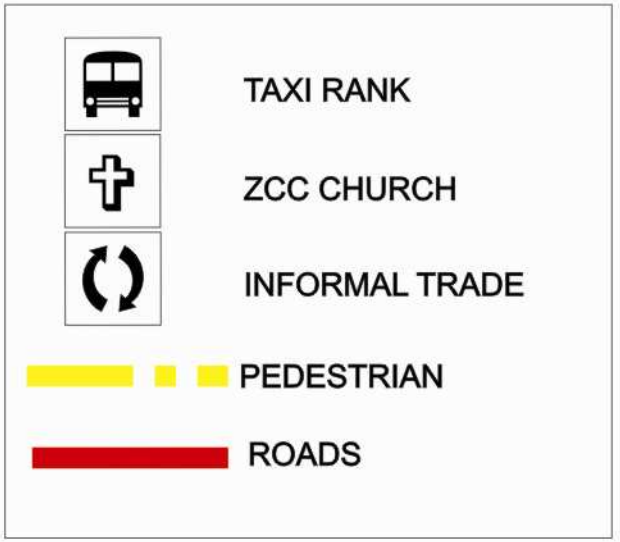
5. Establishment of community facilities including educational and recreational facilities.

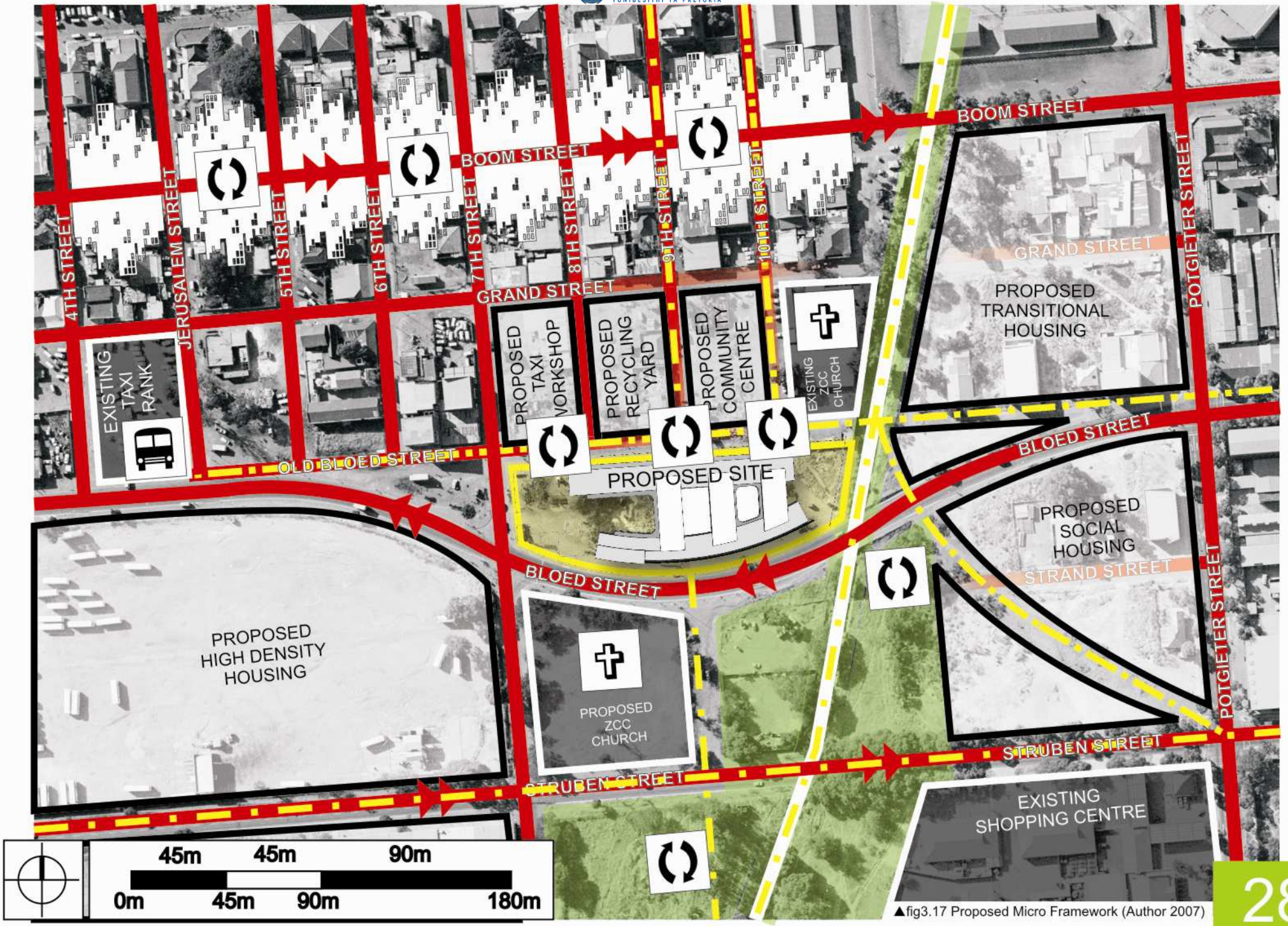
6. Enhancing the remains of the character of the old Marabastad by introducing pedestrian streets with covered walkways, and street markets.

7.Fill a void created by the degradation caused by the forced removals of people under the apartheid government.

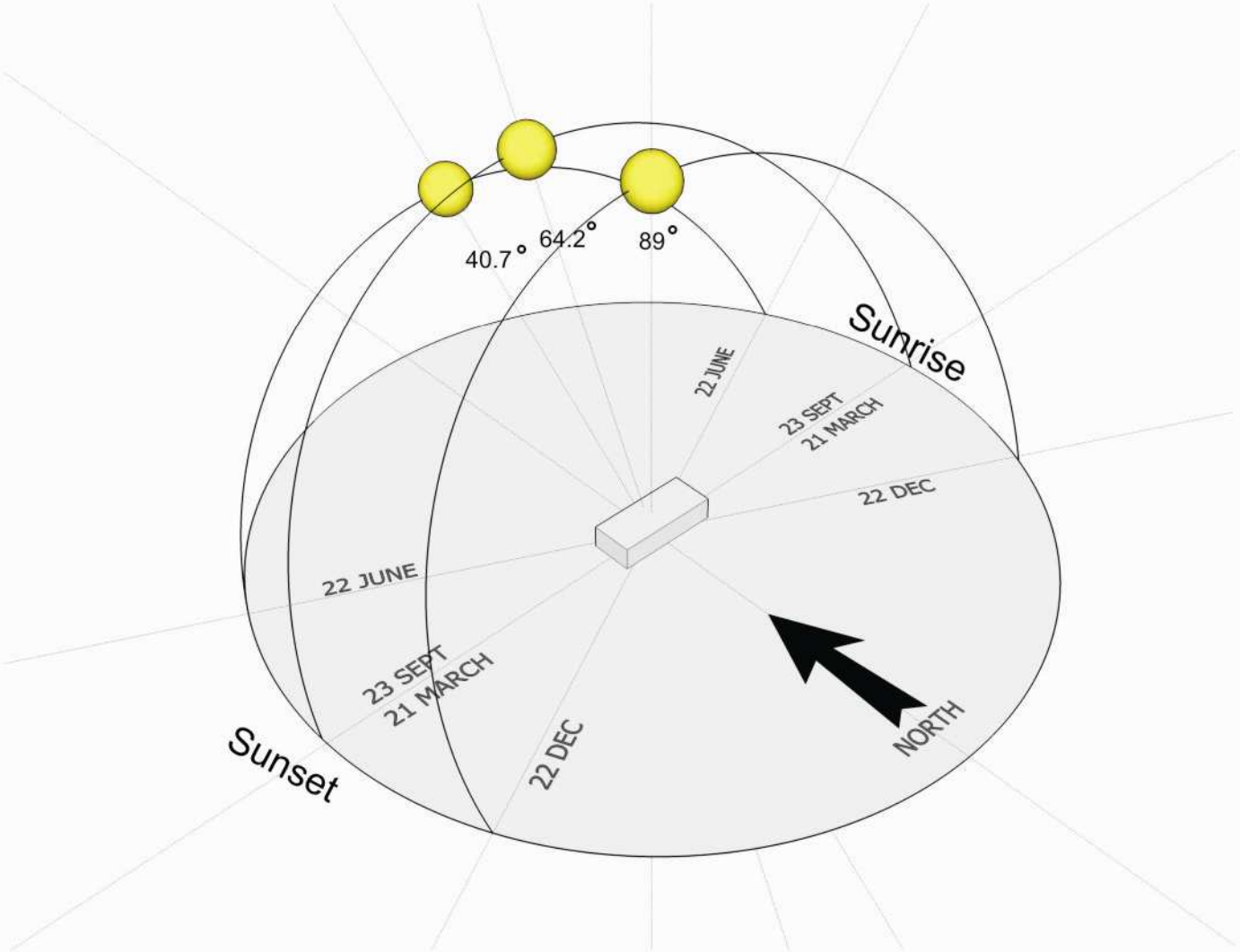
8. Create spaces that allow that can be appropriated by the local community to create opportunities for a better, richer lifestyle while enhancing and protecting the natural environment.

▲fig3.16 Proposed Pavement colonnades as a feature in the core area of Marabastad
(Aziz Tayob Architects 2002)



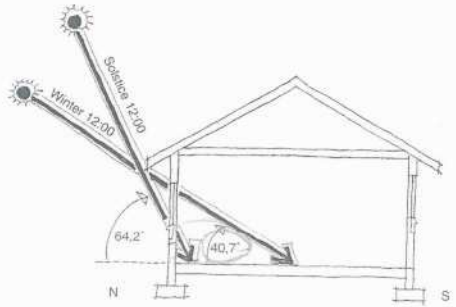


▲fig3.17 Proposed Micro Framework (Author 2007)

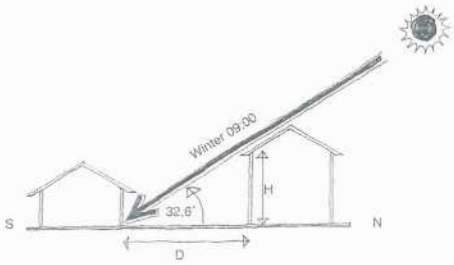


Solar Path Diagram for Pretoria

▲fig3.18 Solar Path Diagram (Author 2007)



▲fig3.19 Roof Overhang, window height and positioning for Pretoria (Holm 2001, p.72)



▲fig3.20 Solar Access for building spacing in Pretoria (Holm 2001, p.71)

SUMMER 9AM

SUMMER 12PM

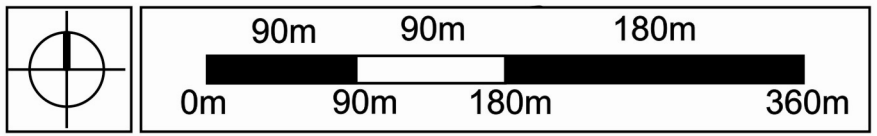
SUMMER 5PM

WINTER 9AM

WINTER 12PM

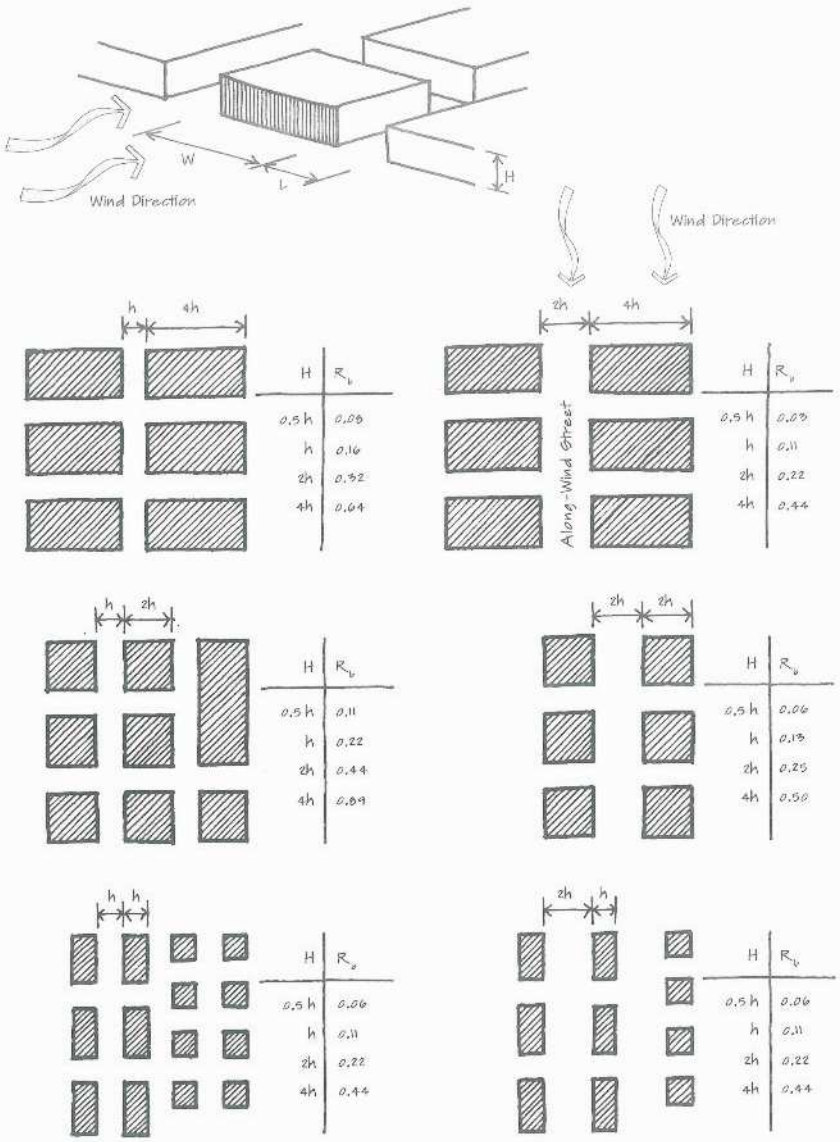
WINTER 5PM

▲fig3.21 Solar Study (Author 2007)

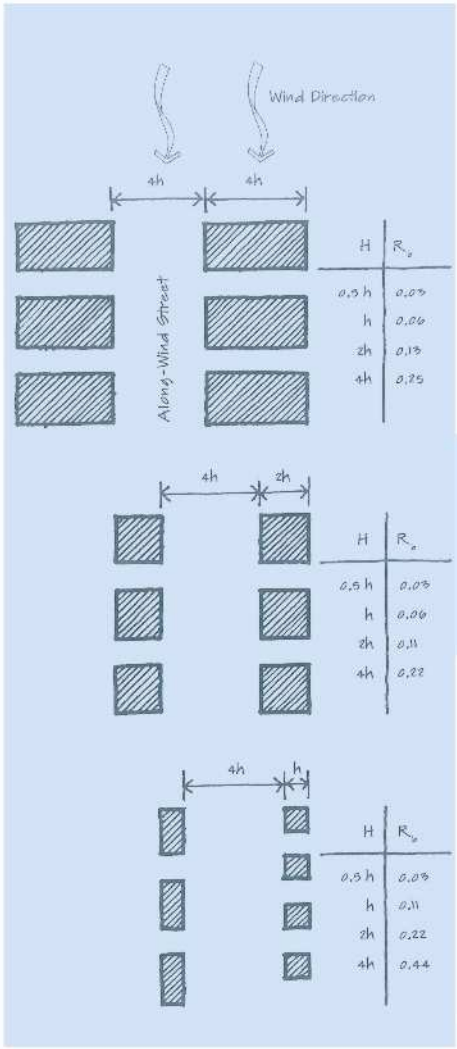


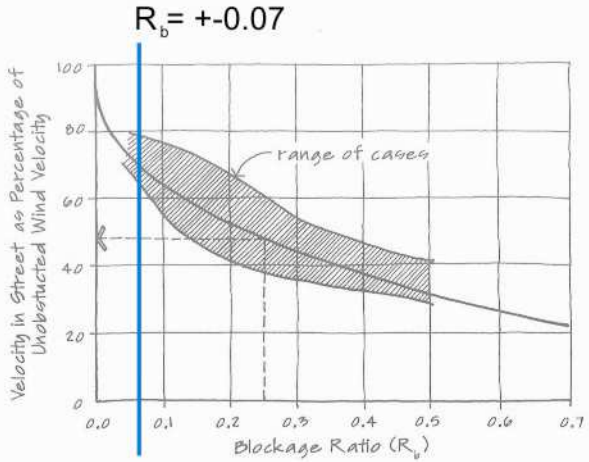
SOLAR PATH STUDY

on co-ordinates 25.75.00S 28.16.70E
Produced on Google SketchUp Pro

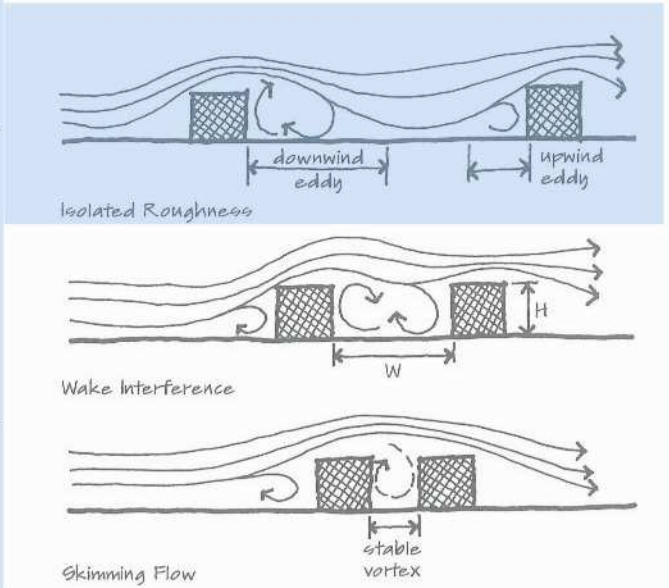


▲fig3.22 Blockage Ratios for Different Organizations of buildings and streets (Brown 2001) Edited by author





▲fig3.23 Predicting Wind Velocity (Brown 2001)



▲fig3.24 Flow Regimes Between Buildings (Brown 2001) Edited by author

WIND MOVEMENT STUDY

SUMMER WIND STUDY

◀fig3.26 Summer Wind Study (Author, 2007)

▲fig3.25 Wind Roses for Pretoria (Holm, 2001) Redrawn by author

WINTER WIND STUDY

◀fig3.27 Winter Wind Study (Author, 2007)

▲fig3.28 Wind Roses for Pretoria
(Holm, 2001) Redrawn by author

"God has leant us this earth for our life; it is a great entail. It belongs as much to those who come after us, who's names already written in the book of creation, as to us; and we have no right by anything we do or neglect, to involve them in unnecessary penalties, or deprive them of benefits that it was in our power to bequeath."

John Ruskin
(Buchanan 2005)

"...sustainability arises out of a subtle, often imperceptible interaction between built form and ambient forces that impinge upon its surface."

Kenneth Frampton
(Buchanan 2005, p.6)

Chapter 4

Precedent Studies

Beyeler Foundation Museum

Riehen, Switzerland
Renzo Piano Workshop
1992 - 1997

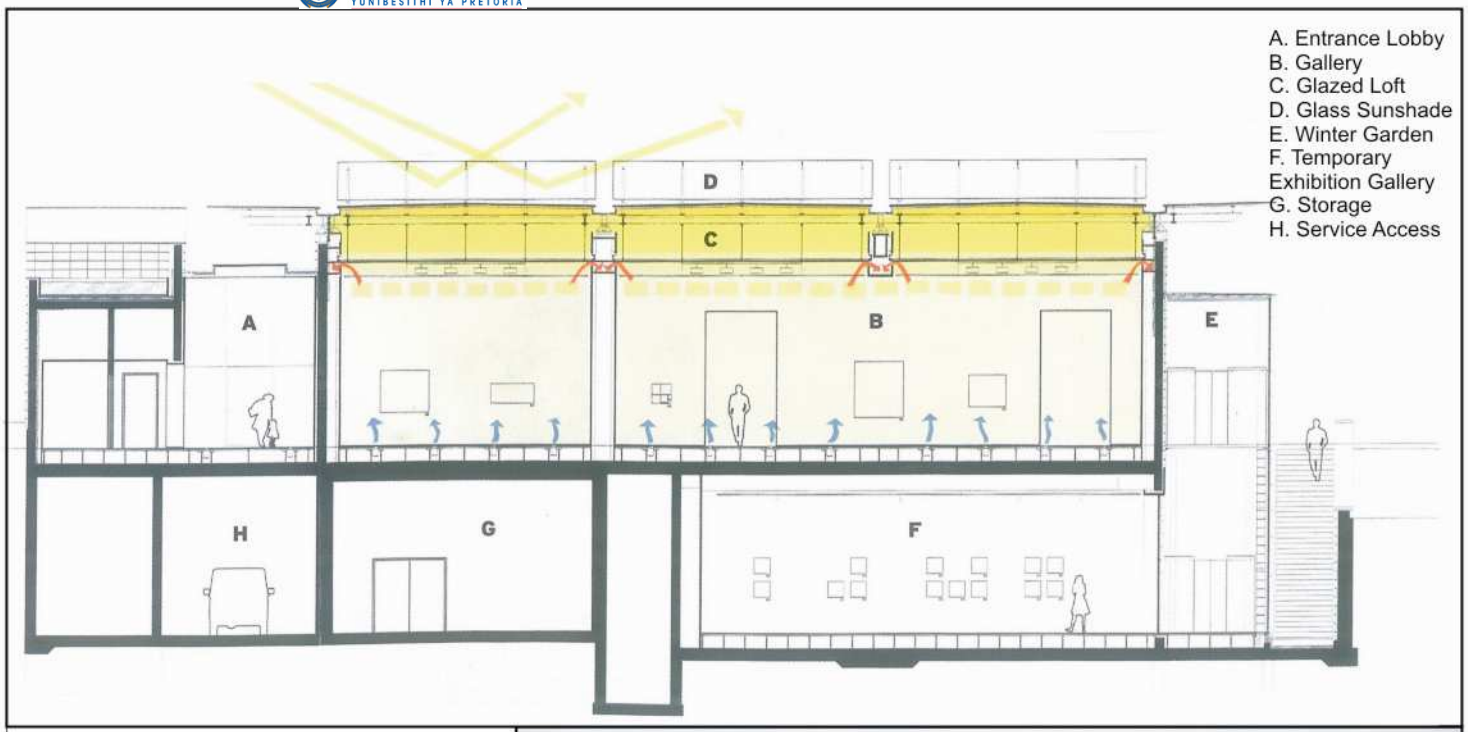
A modern art museum that personifies the interaction between nature and architecture, site and users.

The main focus of the precedent study is to learn from the innovative roofing system. Although the roof is an expanse of glass, thermal conditions are relatively tightly regulated. This is achieved through innovative and precise engineering. (Buchanan 2005, p.43).

Due to the art being viewed in natural light the users experience is different at various times in the day, avoiding isolation from nature and reconnecting one to the outside world. This layered roofing structure allows the internal spaces to be thermally well regulated while the thermal fluctuation are restricted to the ceiling cavity.

.Possible Application

- Balance between thermal control and use of natural light
- Use of ambient energy inherent in site.
- Use of passive ventilation and lighting

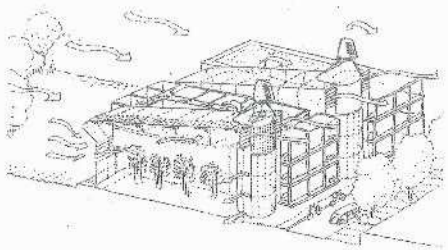


▲fig4.4 Conceptual Section indicating passive ventilation & natural lighting strategies (Buchanan 2005, p.43)

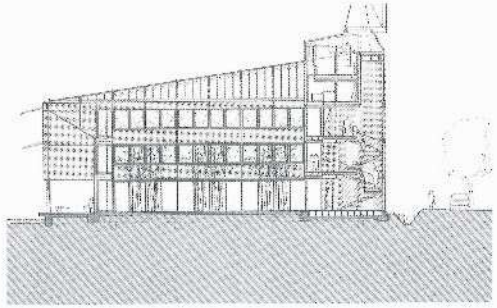
▶fig4.5 South Elevation depicting the floating glass roof
(Christian Richters)

▼fig4.6 Roof detail
(Buchanan 2005, p.43)

◀fig4.7 Central Technical Facility
(Photo: Martin Hamilton Knight)
Source: (Commission for Architecture and the Built Environment 2007)



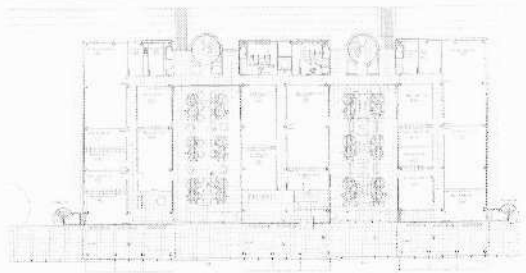
▲fig4.8 Conceptual Passive Ventilation Strategy
(Buchanan 2005, p.80)



▲fig4.9 Section Through Typical Academic Building
(Buchanan 2005, p.80)

◀fig4.10 Learning Resources in Jagged Outline
(School of Architecture, Planning and Landscape, University of Newcastle) Source: (Commission for Architecture and the Built Environment 2007)

▼fig4.11 Academic Building Plan
(Buchanan 2005, p.80)



Jubilee Campus

Nottingham University, UK
Michael Hopkins and Partners
1996 - 1999

According to Buchanan, a project that embodies all ten aspects referred to in *Ten Shades of Green,* the Jubilee Campus at the University of Nottingham is a notable example of successfully implemented sustainable design strategies.

A building that takes into account all the regional and specific climatic data and uses natural processes and principles in order to create an architecture delivering “pleasant conditions for studying and socializing.” (Buchanan 2005.)

Possible Application

- Passive ventilation strategy takes into account all seasons
- Overlapping of various systems and strategies to ensure year round comfort
- Use of local and recycled materials
- Use of brownfield site
- Re-establishes users connection to the natural environment
- Plan depth reduced to allow for natural light and ventilation throughout

British Pavilion

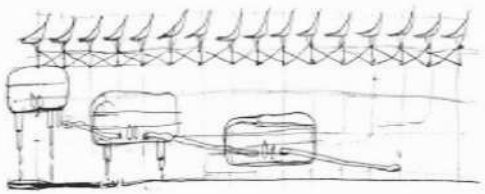
Seville, Spain
Nicholas Grimshaw
1992 - 1997

"a paradigm of environmental experimentation, proving that ecological concerns and High-Tech architecture are not mutually exclusive"
(Slessor 1997, p.88)

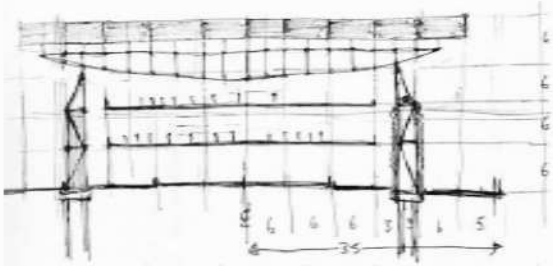
A layering of sustainable and passive design principles come together in one building to create a showpiece displaying the possibilities when architecture, nature and technology meet.

Much of the strength of this project comes from the overlapping concepts such as the S shaped solar shading devices that are covered with photovoltaic cells that are used to generate power to pump water of the glazed eastern facade while the roof is protected from excessive solar heat gain.

Possible Application
- Layering of systems creating a more reliable passive design strategy.
- The use of form to make reference to context.
- The use of technology in contemporary sustainable architecture



▲fig4.12 Concept Sketch (Bates 2007, p.11)

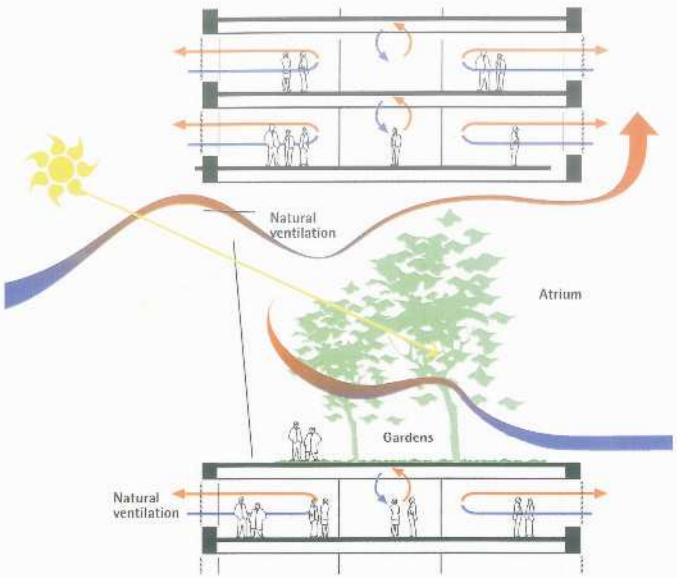


▲fig4.13 Concept Sketch (Bates 2007, p.11)

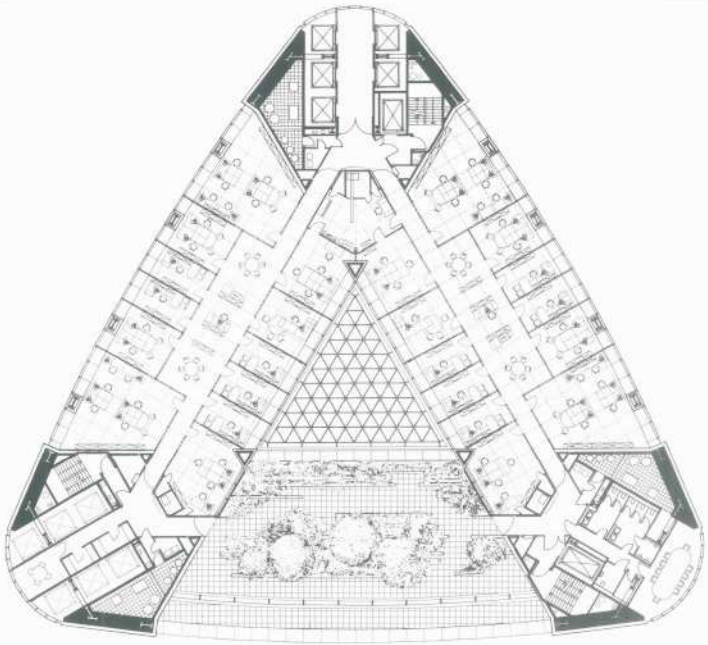
▲fig4.15 Night View (Bates 2007, p.2)

▲fig4.14 Water Wall & Solar Shading devices (Bates 2007, p.10)

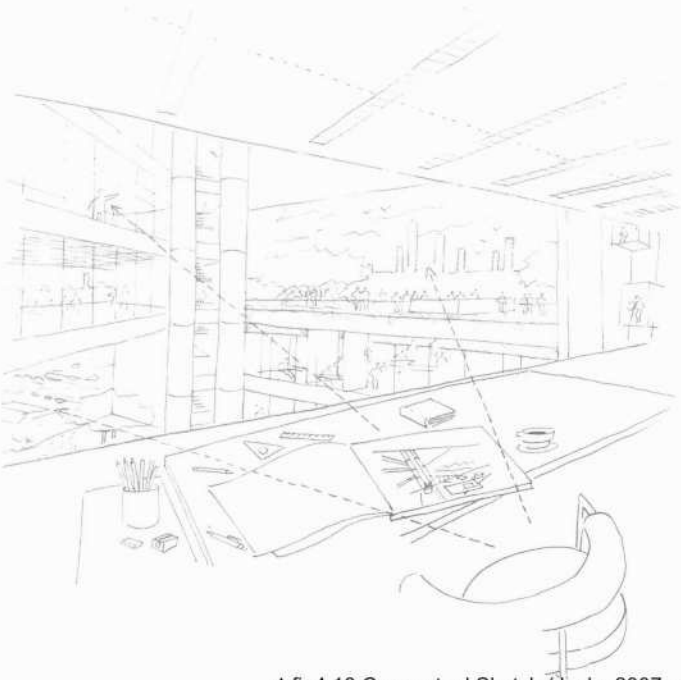
▼fig4.16 Water Wall & Solar Shading devices (Bates 2007, p.10)



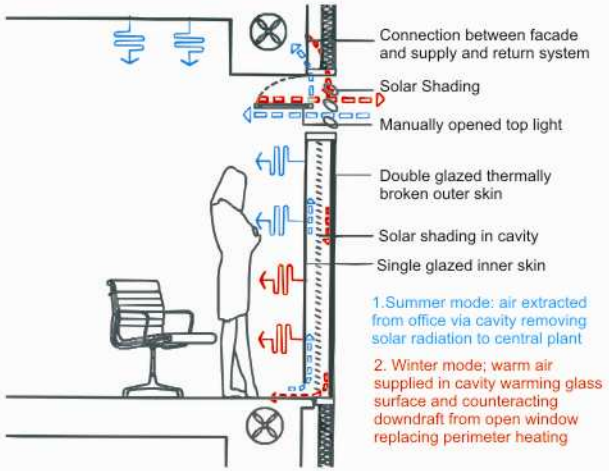
▲fig4.17 Conceptual Section (Buchanan 2007, p.52)



▲fig4.19 Floor Plan (Buchanan 2005, p.51)



▲fig4.18 Conceptual Sketch (Jacks 2007, p.6)



▲fig4.20 Sketch Of "Breathing Wall" (Jacks 2007, p.9) edited

Commerzbank Headquarters

Frankfurt, Germany
1991 - 1997

"a three sided tower with an open core around which offices are stacked to create the spiral of sky gardens which admit light and air into the central shaft"
(Buchanan 2005, p.50)

The Commerzbank Headquarters is a modern world building with all the modern creature comforts. It set a new benchmark for energy efficiency and occupant comfort and enjoyment. The ventilated double glazing "breathing wall"(Jacks 2007) is a carefully planned system developed to provide year round comfort. Developed in conjunction with curtain wall contractor Josef Gartner it is a representational of the result of correspondence and working as a team towards specific predetermined common goals.

Possible Application

- Use of natural ventilation, preventing build up of indoor pollutants.
- Ventilated double skin glazing facade, allows user interaction and thermal control while maintaining natural lighting.
- Use of vegetation to enhance occupant comfort.

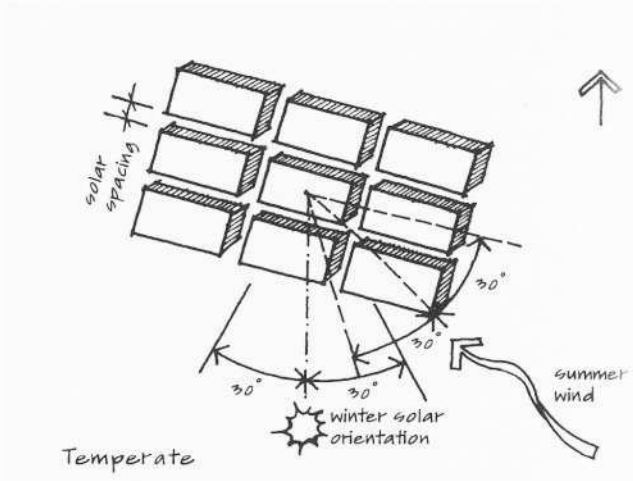
"We do not seek to imitate nature,
but rather to find the principles she uses."

Bucky(sic) Fuller
(McLennan 2005, p.27)

Chapter 5

Conceptual Design Storyboard

Concept Design Storyboard



▲fig 5.1 Recommended Urban Pattern in Temperate Climate (Brown, GZ, DeKay, M 2001, p. 102)

"If we can begin to shift our conceptions of the purpose and process of development to one that heals human and natural communities, uses nature as a mentor, and addresses occupants physiological and psychological needs, then we will be on our way to integrating ecology and real estate"

William D. Browning
(Browning 2005, p. 57)

As stated earlier, the process of form making needs to be directed by the influences on and around the site as well as climatic, social and cultural considerations.

An understanding needs to be developed as to what considerations are necessary in creating architecture that is appropriate for and responsive to its social environmental and physical context.

Although all of these considerations are intertwined, this story board will show how the form making process was an evolutionary process, developed from a dialogue between history, culture, the physical context and environmental or climactic influences on and around the site. The following aspects informed the generation of form in this design exploration

Response to Context
- Urban Framework
- Movement
- Activities
- Demographics
- Public Spaces

Social Influences
- Memory & History
- Learning from the Vernacular
- Skills Development

Climatic Influences
- Solar Access
- Solar Power
- Solar Heat Gain
- Orientation - Sun & Wind
- Wind Direction
- Wind - Passive Ventilation
- Wind - Courtyard Sizing

LEGAL FRAMEWORK:

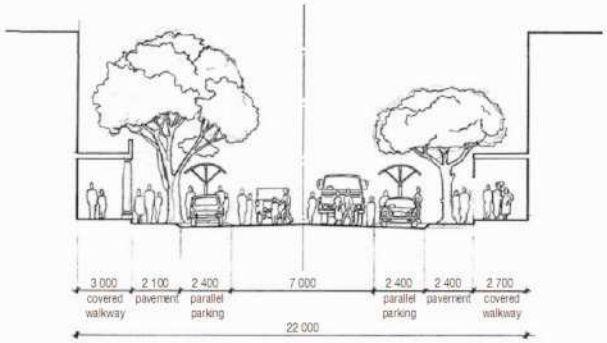
1. COUNCIL:
   - BUILDING LINES
     - -sides: 3m
     - -street boundary: 5m
   - ZONING
     - -the site is currently zoned for municipal use with consented purposes such as institutions, parking sites, places of instruction, social halls and special buildings
   - HEIGHT
     - -Zone 5: up to 3 storeys
   - FSR
     - -Zone 5: 0.8
   - COVERAGE
     - -Zone 5: 50%
   - PARKING
     - -2Bays per 100m²
   - The TITLE DEED of the site is still outstanding

Forms part of Framework developed in conjunction with a group of the MArch(Prof) Class of 2007

2. URBAN FRAMEWORK:

The framework, within which this dissertation is set, is a combination of the existing Marabastad area, the Integrated Urban Design Framework for Marabastad (done by Mayer, Pienaar, Tayob Partnership Architects and Urban designers in 1998), as well as a Marabastad Group Framework done within the masters class by a group of students working in the same area.

The main aim is to weave together the diverse strands of social, economic, legislative and physical environments within Pretoria CBD. (Tayob,1998:3.) The cavity left by the Apartheid years needs to be filled with an environmentally sustainable development with human beings at the centre of concerns (Tayob,1998:22). It needs to be reinstated within the Pretoria central business district, becoming a tourist attraction and in effect the “African Market” of Tshwane (18% of informal trade).



▲fig 5.2 Typical Section Through Street (Aziz Tayob Architects 2002)

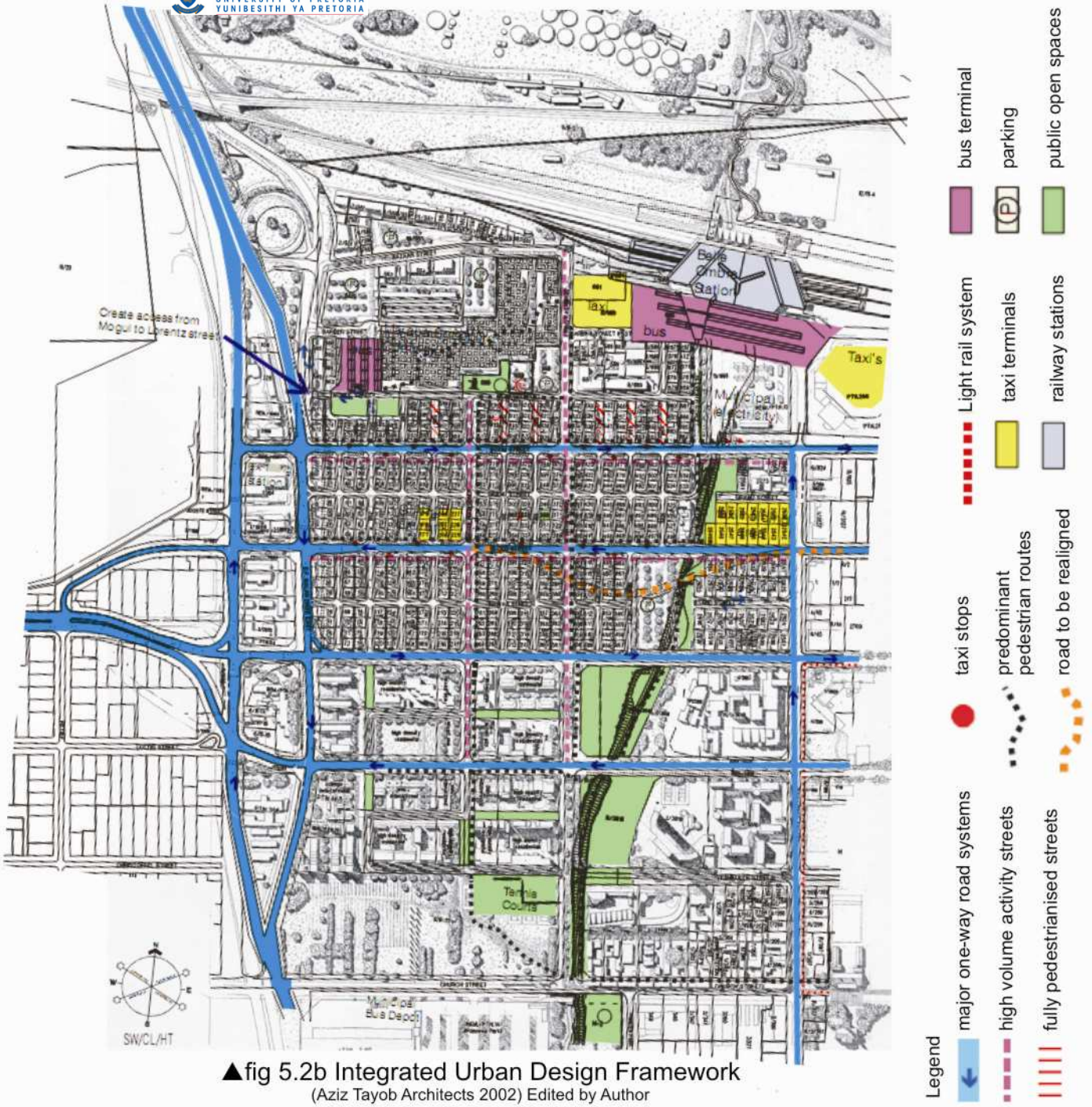
The smaller grid within Marabastad echoes the identifying grid of the rest of the inner city and emphasizes the pedestrian scale and intimacy within the community (see fig 5.2). Through keeping the smaller grid, optimum re-use of existing services is achieved while the physical historical blocks are represented. The housing proposals of the students will accompany this idea, whilst also keeping the stepping down of urban scale towards Marabastad in mind. A high density inner city housing belt of 3-6 storeys will be pulled into the area in the southern parts where the existing City Engineering Department along Proes Street will be relocated. The proposed housing is aimed at re-establishing a settled community in the area.

The idea is to create a green corridor along the Steenhoven Spruit. This project will improve the ecological functioning of the stream and also serve as infrastructure to public activities and circulation. This green belt will extend from the remainder of Princess Park in the south (creating a link with Church Street) to the electrical substation in the north, enabling the integration of, once marginalised, Marabastad into the greater urban fabric.

Due to the sufficient public transport infrastructure, accessibility is more than adequate. There are bus

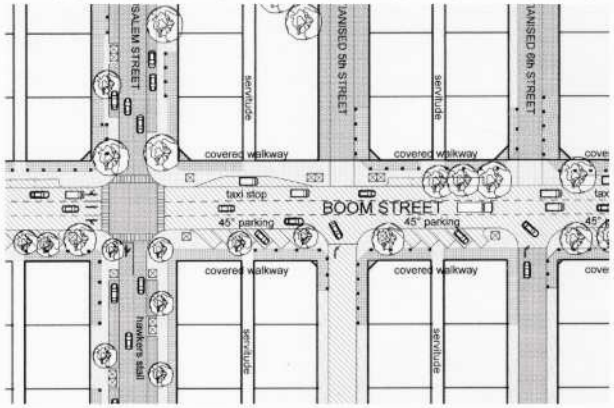
terminals and a taxi rank at the station. Taxi ranks will also be provided on the traffic island between the two DF Malan drives East and West. The flow of pedestrians across these drives will need to be addressed by pedestrian crossings. The PUTCO bus depot will also have to be relocated(possibly to the Belle Ombre loop) in order to return the smaller grid to the site and to reach high-density housing of 60 units per hectare (Tayob,1998:160). An overnight taxi holding area is proposed across the Spruit to the east, utilised during the day by existing informal trade. A police station will be provided adjacent to the trading area. From the Gap Proposal for Pretoria Inner City, there will even be a tram running along Boom and Church Street, with bus and taxi stops at the corner of Church and Cowie Street.

The historical route proposed in the Tayob framework will be expanded to become a tourist attraction and activity route. The route runs from Church Square west along Church Street and turns north through Hero's Acre cemetery. From here it travels further north past the soon to be sport educational facility along Jerusalem Street, passed the Miriammen Temple(1927) all the way up to the produce market where it turns east towards the station and continues past



▲fig 5.2b Integrated Urban Design Framework
(Aziz Tayob Architects 2002) Edited by Author

the Islamic mosque and the old empire cinema recently revamped. Then it travels down and east along Boomstreet, passing hundreds of informal trading stands that add to the identity of the area. From here the route travels south along the landscaped Steenhoven Spruit. It meanders passed educational and community centres, centres for recreation, a pub or two and even a story box for the kids. A network of public squares and green areas will create opportunities for market activities. It finally spills out onto Church Street again where visitors can take the tram for the final Pretoria



▲fig 5.3 Streetscape Plan
(Aziz Tayob Architects 2002)

experience.

There is a requirement for community based products (Tayob,1998:158) and therefore, people from the community will be employed for the actual building work in the area. The Tayob partnership has also identified that services in security, cleaning, marketing and environmental upgrading needs to be expanded.

The show grounds on Church Street west have the potential to become a world class expo and conference centre (Tayob,1998:158). The Pilditch Stadium and its associated sports facilities is an attraction in its own right and linking functions within the Marabastad area to these sites would extend its fingers and break the physical barriers of Hero's Acre and the DF Malan Drives.

In order to implement pedestrian movement, the majority of north-south routes are pedestrianised, thus, west-east routes carry faster moving traffic. Covered walkways and hawker stalls line these routes (see fig 5.2). Signage should make a positive contribution to the vibrant character of Marabastad by being liberal and creative.

Heritage in the area would be the Meriammen Temple, a former national first grade monument (Tayob,1998:161). Then there is the Islaimi Mosque, Pillay's Restaurant and along Church Street West there is the Kruger House Museum, the Reformed Church and Hero's Acre cemetery. Also of importance is the Orient and Empire Cinemas.

The Belle Ombre Tennis Club should be retained as recreational sports facility. It is already being used by community members as a basketball court on weekends. The children's playgrounds are also in need of upgrading. As for sports facilities, Pilditch Athletics Stadium was recently upgraded and there are some sports fields available on the show grounds. The Centre for Sport Education will have to incorporate these into the accommodation schedule in order to optimise opportunity.

The objective of the framework is to fill a rotting cavity within the inner city of Pretoria with a vibrant community in order to restore the impact of political history (see nolli map). The challenges remain in addressing the community's direct and indirect needs in such a way to provide them with a better, richer lifestyle, but in the process protecting the environment.

▲fig 5.3b Development Scenario
(Aziz Tayob Architects 2002)

Due to the nature of the project, site selection is critical to attaining the desired level of sustainability. Transport infrastructure plays an important role in this.

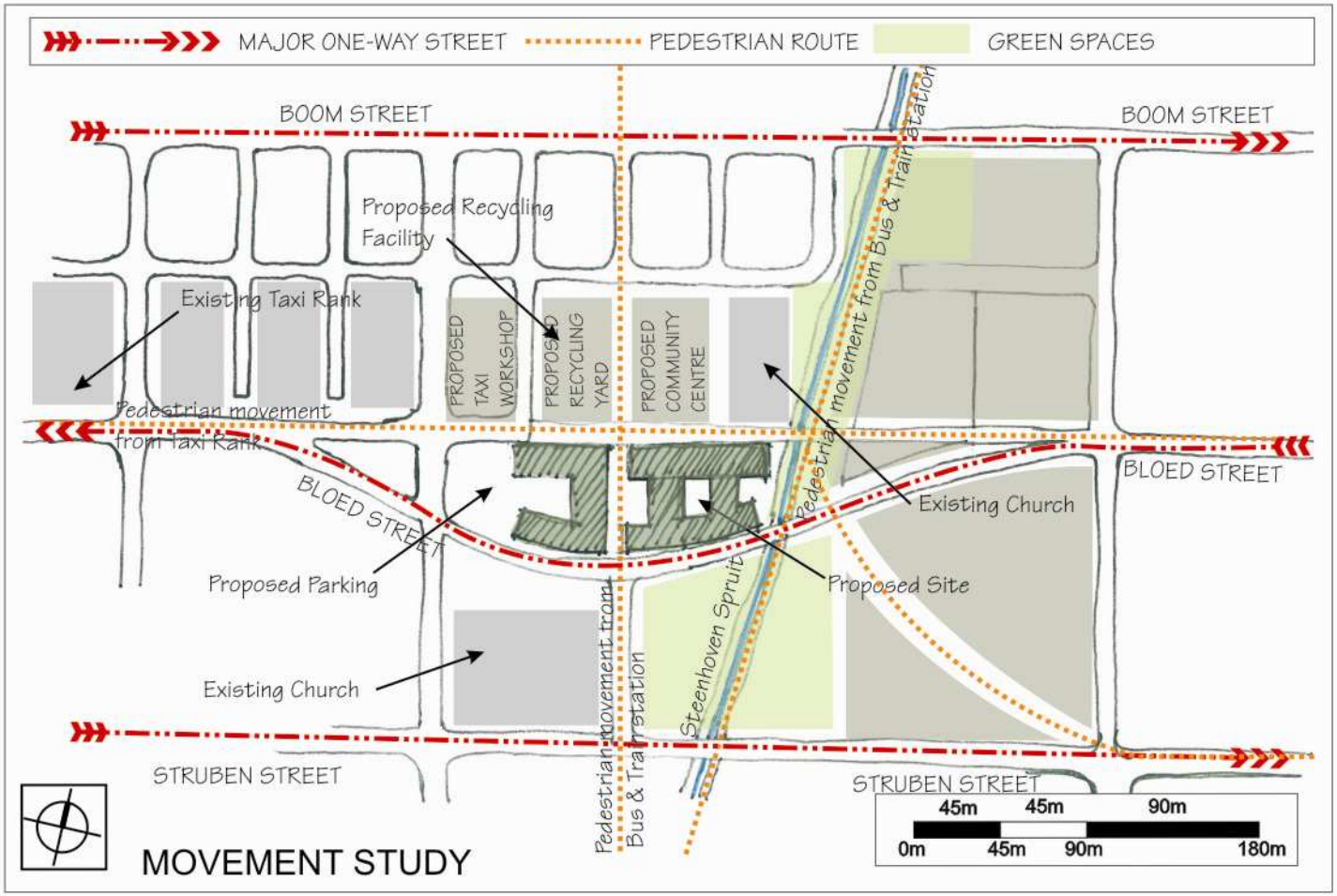
As seen in the context study the proposed site is surrounded by an array of public transport systems, including a taxi rank, the Belle Ombre Station and a proposed tram system.

In order to introduce a successful intervention it is necessary to capitalise on the opportunities that the transport industry generates and the accessability it facilitates to the proposed site.

The concept of the access through the chosen site is a combination of direct lines of movement between the different transport infrastructures and destinations such as Marabastad or the Pretoria CBD.

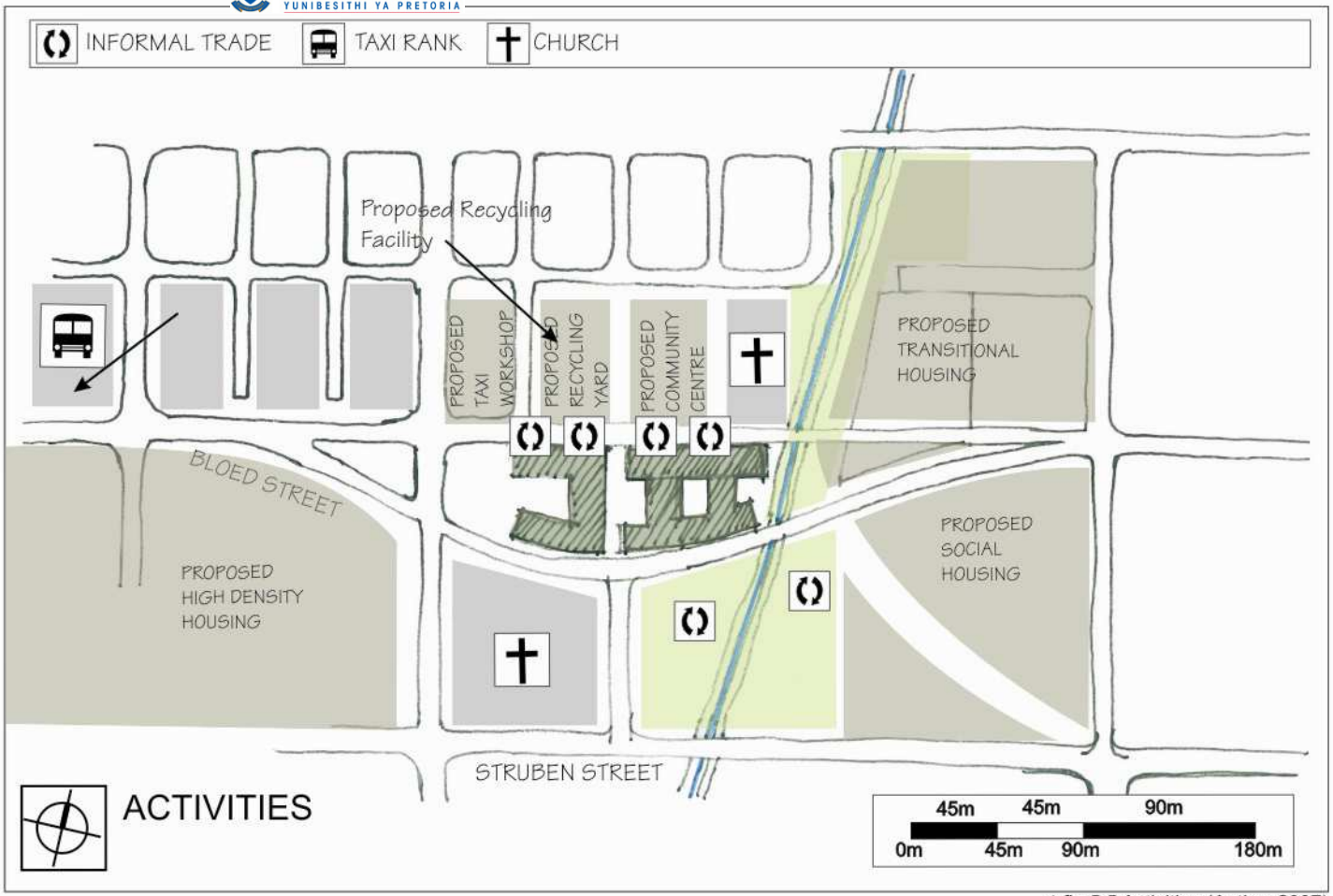
The study of the existing pedestrian movement patterns, generated the concept of the street market along the northern boundary of the above mentioned site. This emerged out of an attempt to restructure the urban fabric by re-enforcing the decaying grid of the area as a memory of what was before. Due to the movement patterns in the area informal trade has become a integral part of life in the area, it has thus become a strong influence on the development of the architecture.

"Markets can help lead to a convergence of movements and disciplines, bringing a wide range of community stakeholders together. By impacting health, open space, and local economy, markets can help demonstrate how collaboration between community agencies that typically work separately can lead to wide reaching beneficial results."
(PPS 2006)



▲fig 5.4 Movement Study (Author 2007)

Even in its current dilapidated state the proposed site hosts an array of possibilities. The ides of the design investigation is to maintain all of the existing activities and incorporate it into the design. This had lead to incorporation of facilities for the recycling of building materials and a taxi workshop on the surrounding sites and the facilities for informal traders on the proposed pedestrian street.



▲fig 5.5 Activities (Author 2007)

▲fig 5.6 Informal Traders (Author 2007)

▲fig 5.7 Informal Mielie Distribution (Author 2007)

▲fig 5.8 Taxi Repairs (Author 2007)

Part of implementing a successful sustainable design project is the incorporation of the “long life - loose fit” concept. Although it is impossible to try understand what could be a reality on the site in the years to come, there is no doubt that urbanization of South Africa’s rural communities is going to play a significant role in defining South Africa’s cities in the future. The majority of the population growth is in the unskilled workforce. Due to the lack of skilled workers in the construction industry and the resources available in a lucrative market, there is a real opportunity to empower both the unskilled workforce and construction industry.

The current demographics, as well as the projected urbanization patterns have informed and moulded the program this dissertation sets out to accommodate.

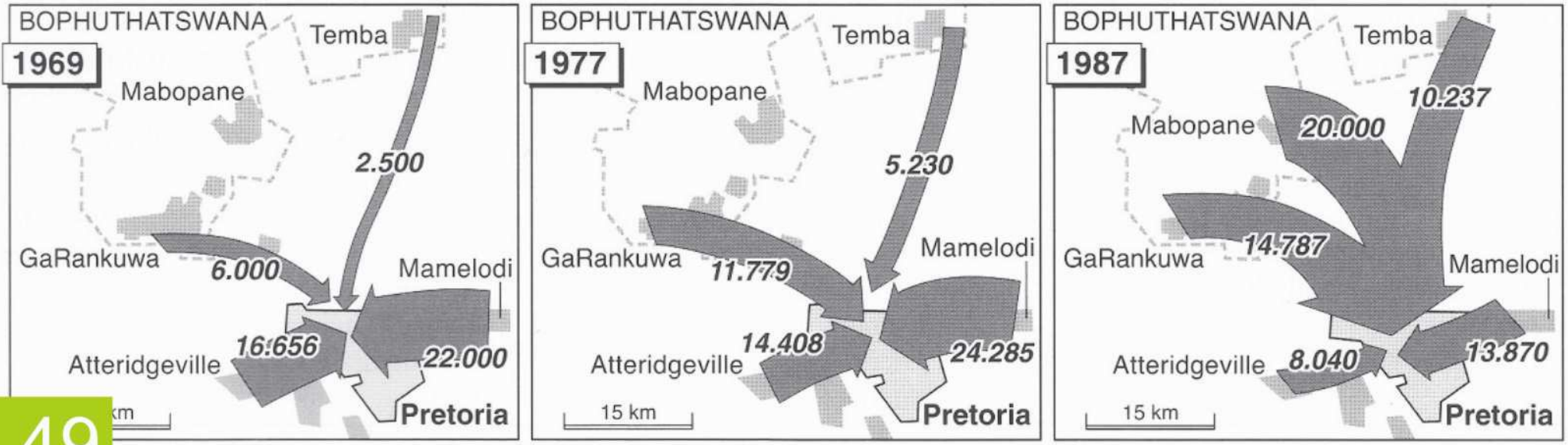
The training facility will facilitate skills development in conventional and alternative construction, creating opportunities for people moving into urban area’s and thereby filtering alternative construction skills into our built environment.

The Rate of Urbanisation in Pretoria

In a study conducted by the University of the Western Cape it was found that

“The rate of urbanisation in South Africa has been very rapid since the 1950s. Today 57% (or 21 million) of all South Africans live in towns and cities, an average level of urbanisation for a Third World country. By the year 2010, 73% of our population will be urban - 43,7 million people! Rapid urbanisation brings with it many problems as it places huge demands on land, water, housing, transport and employment.”

Jocelyn Collins
(Collins 2001)



▲fig 5.9 Black train-commuting patterns in Pretoria, 1969-87 (Brandt 2002)

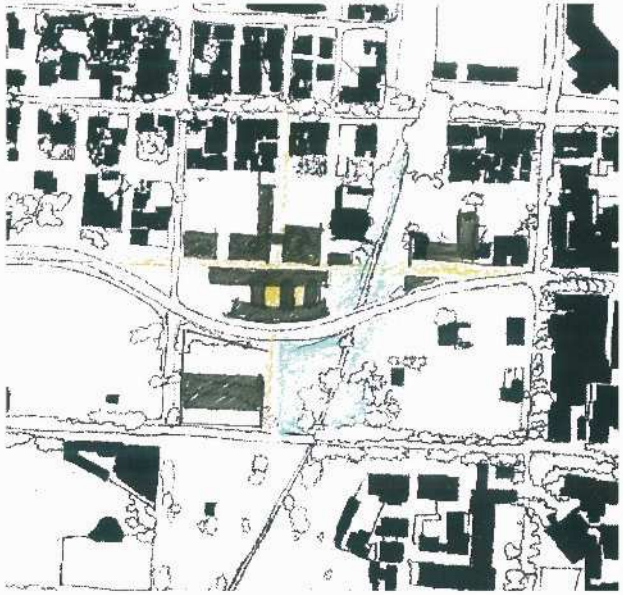
As common or public spaces in South Africa have become enclosed or fenced off, and the vibrant street life that used to form part of Marabastad has been destroyed by vehicular traffic, it is evident that accessability in public spaces had greatly diminished.

The detachment from the natural environment combined with the rural urban migration patterns, leaving people in an environment where they have lost the extended family support they enjoyed in the rural communities, has left many urban South African communities socially bankrupt.

Accessible green and public spaces are critical in the modern day urban environment. The reality is probably much closer to Eric Owen Moss's city schemes where sealed buildings connected only by rivers of asphalt and computers. This detachment from our surrounding is only feeding our environmentally destructive societies.

Existing Marabastad Fabric

▲fig 5.10 (Aziz Tayob Architects 2002)



Proposed Change in Urban Fabric

▲fig 5.11 Base Map : (Aziz Tayob Architects 2002)Edited by author

Public spaces will play a pivotal role in creating a sustainable urban environment in Marabastad.

Much has influenced the way that public and green space is dealt with in this dissertation. From *The Pattern Language* by Christopher Alexander to the vernacular architecture and spatial organization of the Ndebele people.

There are 3 main aspects derived from this research that informed the decision making process:
Accessability, Privacy Gradients or transitional spaces and security.

"In a world besieged by racial and ethnic persecution violence and wars; bearing witness to the growth of community as people work together in a common effort has been a ray of hope for me, a glimpse of human and social potential."

Karl Linn
(Linn 2005, p. 120)

The above images contrast the existing Marabastad urban fabric with the proposed fabric. It is evident in the existing fabric that due to the urban decay there is almost no well defined or safe public spaces.

"Our ecological problems have their ultimate roots in society and social problems"

Murray Bookchin
(Bookchin, 1982)

Originally a vibrant culturally diverse community like District Six or Sophiatown, Marabastad was extremely hard hit by the group area's act and other apartheid laws. The forced removal of the majority of Marabastads inhabitants is what has allowed the urban decay that we find there today.

This dissertation is an exploration of the catalytic effect a simple intervention can have in attempting to restore the diverse community that was Marabastad.

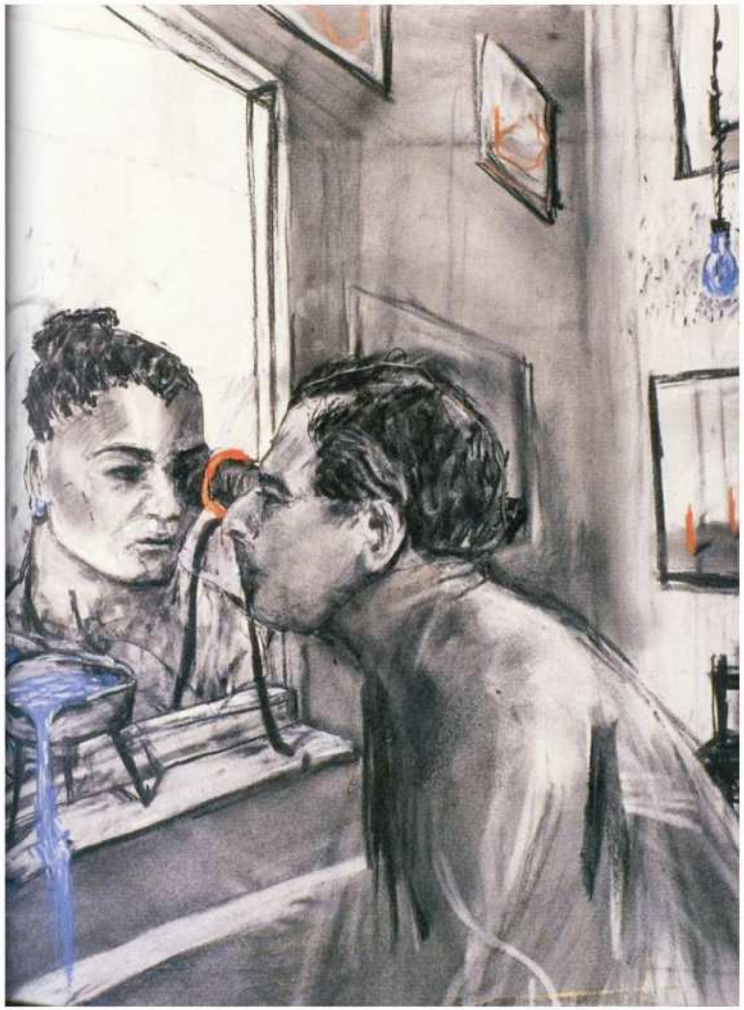
The idea of "domination of human by human" (Bookchin, 1982) seems to be synonymous with Marabastads history.

In an attempt to move Marabastad forward it is critical not to forget what happened in the past. Memory of the past is an essential element that needs to be addressed within the scope of the project.

By incorporating street art into the proposed pedestrian street, the design intervention will give a platform for expression and remembrance. By taking history out of the conventional museum or history book and incorporating it into our everyday lives, history is made accessible and legible to all.

Instead of expressing history in a chronological sequence cased in glass boxes in a museum, the public engages with a series of individual artists expressions, acting as a voice of remembrance of the past in our quest for a unified future.

The idea of memory in the architecture is again reflected by the use of the saw-tooth roof which is strongly associated with the trade unions, which provided almost the only voice for the disenfranchised in our past.



Felix in Exile by William Kentridge
▲fig 5.12 (*William Kentridge*, 1994)

"The very notion of the domination of nature by man stems from the very real domination of human by human."

Murray Bookchin
(Bookchin, 1982)

choose talent based on race. The talent available does not have enough experience to carry out some civil supervision and technical work." (Khumalo, S, Mmope, N 2007)

"Grinaker is training graduates and importing welders from countries such as Malaysia, Ireland and India. Europe has been the best recruiting ground for engineering skills." (Khumalo, S, Mmope, N 2007)

With the unemployment rate as high as it is in Marabastad and the skills shortage in the construction industry there is a real opportunity for a skills development center in the area. Using the potential of the human resources moving into Marabastad from the outlying rural areas is central to the intended program of the proposed Green Building Workshop.

Due to the incredible amount of rural urban migration in Pretoria highlighted earlier and specifically Marabastad, unemployment is rife. Many come to our urban centers only to be left unemployed and without their family support structure.

On the other side of the spectrum, much of South Africa's construction and other industries growth is stunted by a crippling skills shortage

Sibongile Khumalo And Ntebo Mmope of The Business Report stated, "Grinaker-LTA managing director Eddie Durant said the construction industry was experiencing shortages of relevant talent in key areas of operation: "Experience is a very important factor and should not be left out when addressing the skills problem," he said.

"Lack of skills in specific areas, like engineering and specialised welders, was found across all races. We can't pick and

fig 5.22 Recycling of Building Materials on Site (Author 2007)

The Barefoot College

The Barefoot college is an example of a successful skills development program. Sophisticated skills are imparted to communities to be used within those same communities.

"The Barefoot College is a place of learning and unlearning. It's a place where the teacher is the learner and the learner is the teacher. It's a place where no degrees and certificates are given because in development there are no experts-only resource persons."
(Barefoot College, 2007)

Due to the current unemployment and literacy rates in Marabastad, a hands on practical skills development facility will go a long way in uplifting the local community. The Barefoot college trains people in rural computers in fields such as engineering, medicine, teaching and many more.

They have managed to design and manufacture their own solar cookers, solar panels, rainwater harvesting systems and

Fig 5.23(Barefoot College, 2007)

Fig 5.24 (Barefoot College, 2007)

much more. The skills are then used within the community to uplift and improve general living conditions.

Fig 5.25 First Solar Powered Village in Afghanistan (Barefoot College, 2007)

- Social Influences
  - Memory & History
  - Learning from the Vernacular
  - Skills Development

In structuring the formal concept of the building, reference is made to rich architectural heritage in Ndebele planning principles.

There is much to learn from the Ndebele architecture and spatial structures, especially the way that modern day culture has been appropriated to vernacular principles while retaining individual cultural identity.

The Spatial model of Ndebele architecture is largely governed by social and climatic determinants. There is extensive use of privacy gradients and thresholds by the arrangement of housing, the courtyards and the street. Many of the same principles have been appropriated into the process of creating a building that will respond to the social, historical and

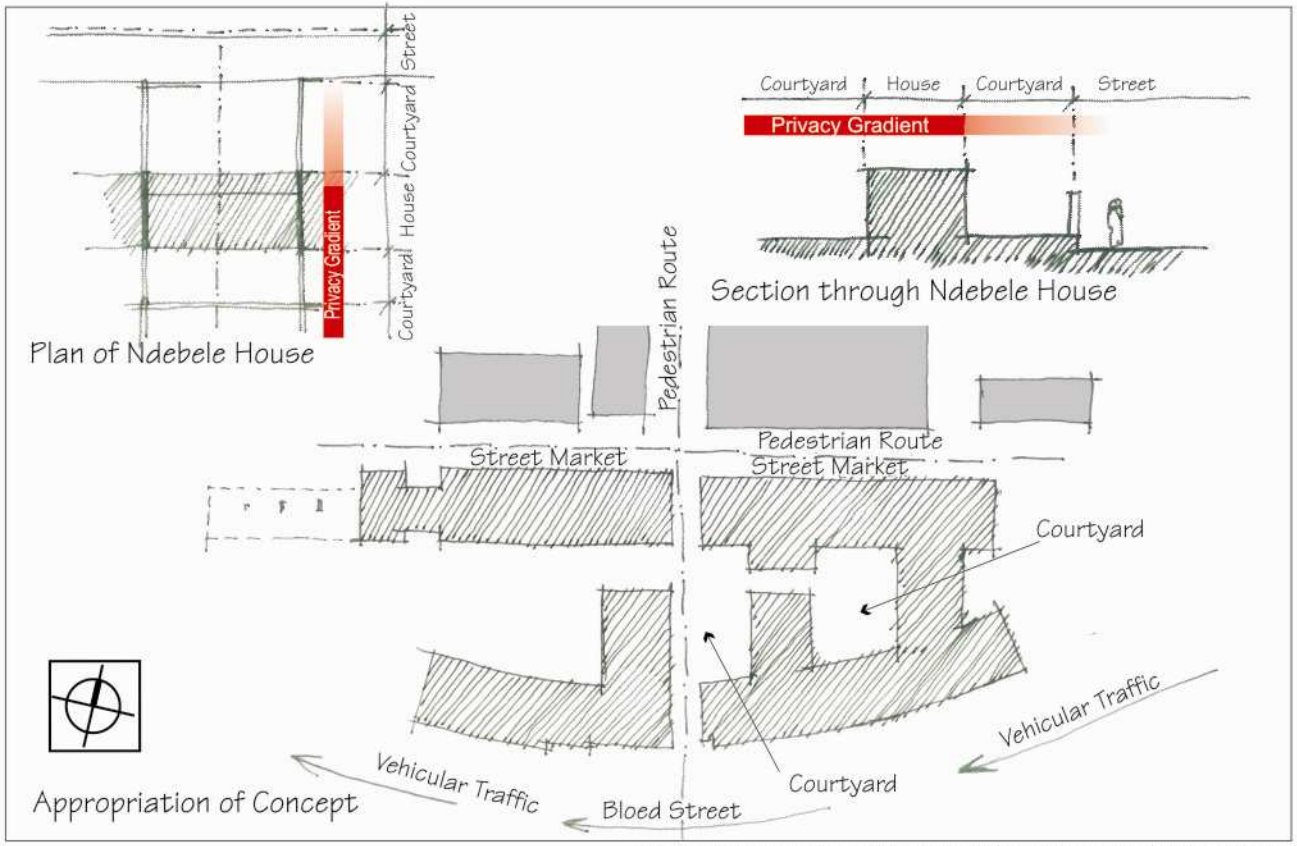
"The remarkable spatial, formal and decorative qualities of southern Ndebele art and architecture strongly affirm the identity of a displaced people"

Peter Rich
(Rich 1995)

"The architecture of the southern Ndebele is rooted in its history and context. Climate and social organisation are the basic determinants of form. Ndebele art and architecture show uniquely how a minority group existing in a multi-cultural milieu (exposed to both traditional tribal and twentieth-century Western influence) can through adaptation and appropriation develop a unique hybrid artistic and architectural expression as part of a quest to claim their cultural identity."

Peter Rich
(Rich, P 1995)

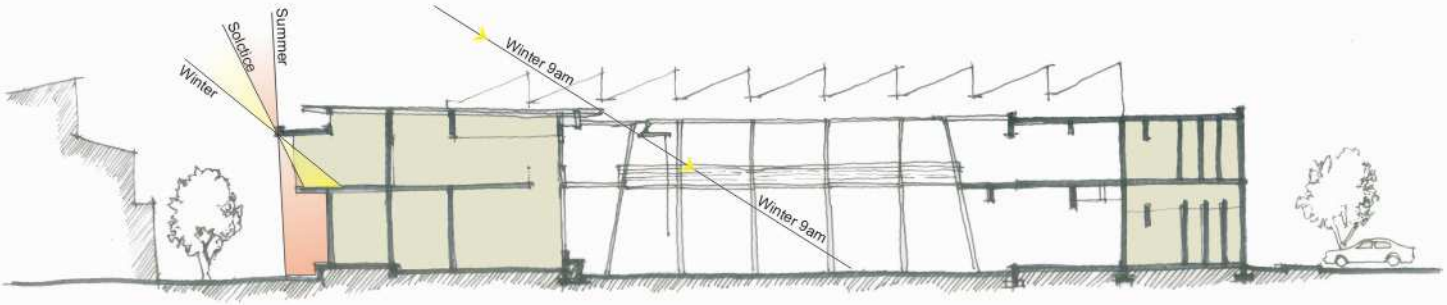
Typical Ndebele House
▲fig 5.13 (Nowitz, 2007)



▲fig 5.14 Appropriation of Ndebele Planning Concepts (Author 2007)

Climatic Influences

- **Solar Access**
- Solar Power
- Orientation - Sun & Wind
- Wind - Passive Ventilation
- Wind - Courtyard Sizing



▲fig 5.26 Conceptual Section indicating Solar Access (Author 2007)

In a climate like South Africa's, it is crucial to design with the solar path in mind. As simple as it seams, we can see in the table (fig5.27) that in Pretoria's climate our first priority in the design needs to be solar shading in the summer and the second priority is to harness the inherent value in using the winter sun and summer winds to minimize energy consumption produced by non renewable sources.

With large variances in the angle of incidence of the sun, summer shading and winter solar access is relatively easy to achieve. The main considerations in term of the passive solar design in this case was to shade the glass on the northern facade from direct sunlight during the summer months and allow the space to be heated by allowing access for winter sun. Secondly the angle of the winter morning sun was decisive in sizing the courtyard spaces and planning the building spacing.

BUILDING TYPE		RESPONSE		
Internal Loaded Buildings	Skin Loaded Buildings	1st Prioroty	2nd Prioroty	COMMMENTS
	Cold	Lee	Sun	• Strict cardinal orientation for sun. • Discontinous streets in direction of winter winds. • Space E/W streets for solar access for spring and fall.
Cold	Cool	Sun	Lee	• Cardinal orientation for sun. • Discontinous streets in direction of winter winds. • Space E/W streets for solar access at solstice.
Cool	Temperate-	Winter Sun; Summer Wind	Winter Lee; Summer Shade	• Orient +/- 30 degrees from cardinal for sun. • Adjust orientation 20-30° oblique to summer wind. • Space E/W streets for solar access. Elongate blocks E/W.
Temperate-Arid	Hot-Arid	Summer Shade	Summer Wind; Winter Sun	• Narrow N/S streets for shade. • Rotate from cardinal to increase street shading. • Space E/W streets for solar access, if needed. Elongate blocks E/W.
Temperate-Humid	Hot-Humid	Summer Wind	Summer Shade; Winter Sun	• Orient streets 20-30° oblique to summer wind. • Modify orientation by rotating from cardinal to increase street shading. • Space E/W streets for solar access if needed. Elongate blocks E/W. • Wide streets for wind flow.
Hot-Arid & Tropical-Arid	Tropical-Arid	Shade all seasons	Night Wind; Day Lee	• Narrow N/S streets for shade. • Elongate block N/S, IF E/W facades shaded. • Wider auto streets run E/W.
Hot-Humid & Tropical-Humid	Tropical-Humid	Wind all seasons	Shade	• Orient streets 20-30° oblique to predominant wind. • Respond to secondary wind direction. • Maximize street right-of-ways for wind flow, but not paving.

▲fig 5.27 Site Orientation and Layout By Climatic Priority
(Brown, GZ, DeKay, M 2001, p. 103)

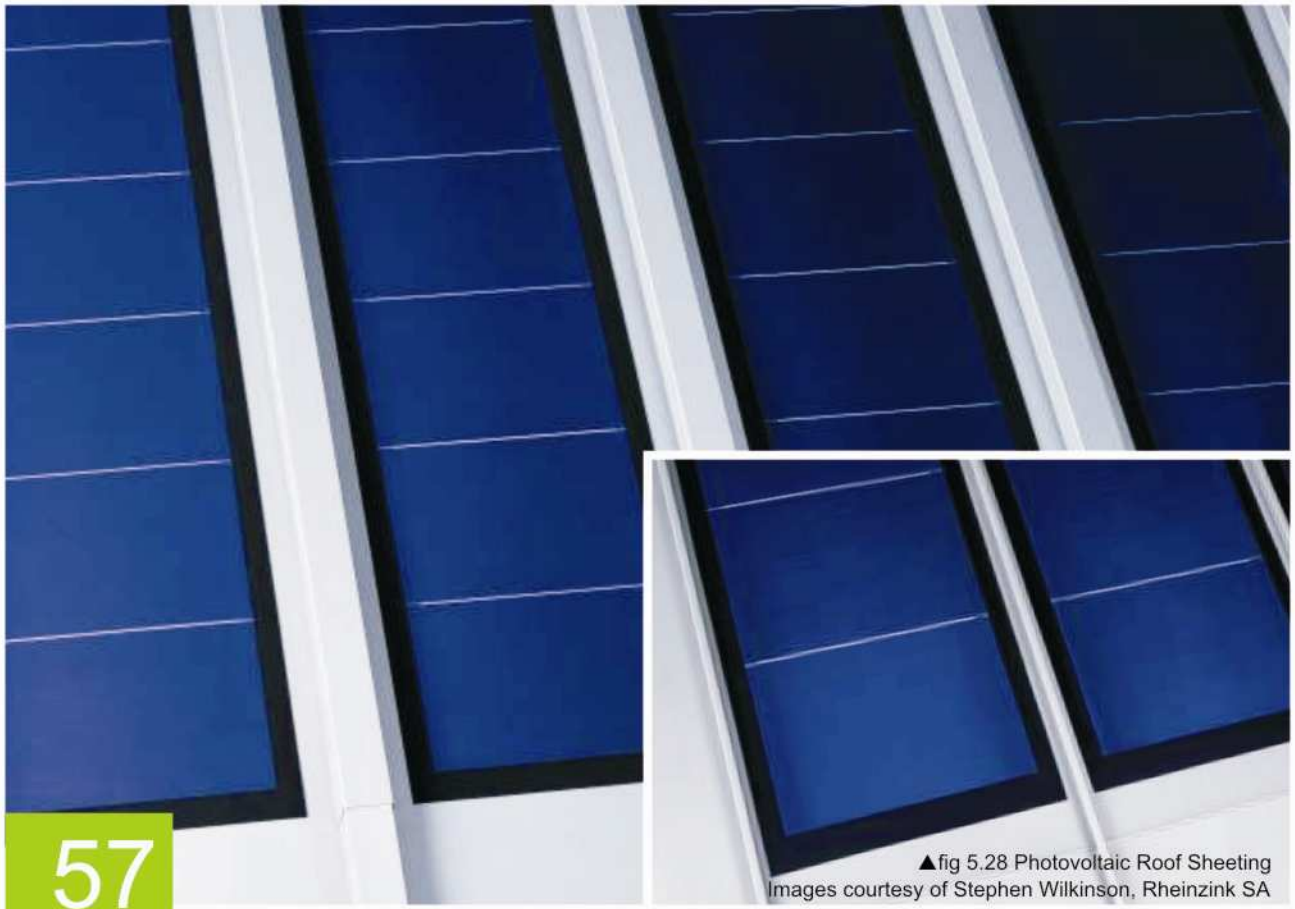
"What if Buildings produced energy instead of consuming it."
(Kiss 2005, p.29)

The combination of solar power systems becoming cheaper, more accessible and more sophisticated and the increase economic and social pressures on non-renewable resources has led to the increase in the long term feasability of photovoltaics in South Africa.

A simple calculation of the generating capacity versus the roof area, compared with average power consumption for a specific building type will allow the calculation of the possibility of supplying the buildings power requirements almost entirely from photovoltaic cells.

Average consumption for a light industrial/ commercial building is around 60w/sqm over a 24hr period. The average generating capacity for the chosen photovoltaic cells is just over 100W/sqm. In the case of this project, due to passive solar design, shading devices, solar access, passive ventilation and other architectural design strategies, a conservative estimate of the consumption due to design is expected to be reduced from 60W/sqm to 35W/sqm

In order to generate enough capacity from the photovoltaic cells 35% of the roof area needs incorporate photovoltaic cells. (Above figures from consultation with an electrical engineer, Dave Humphreys)



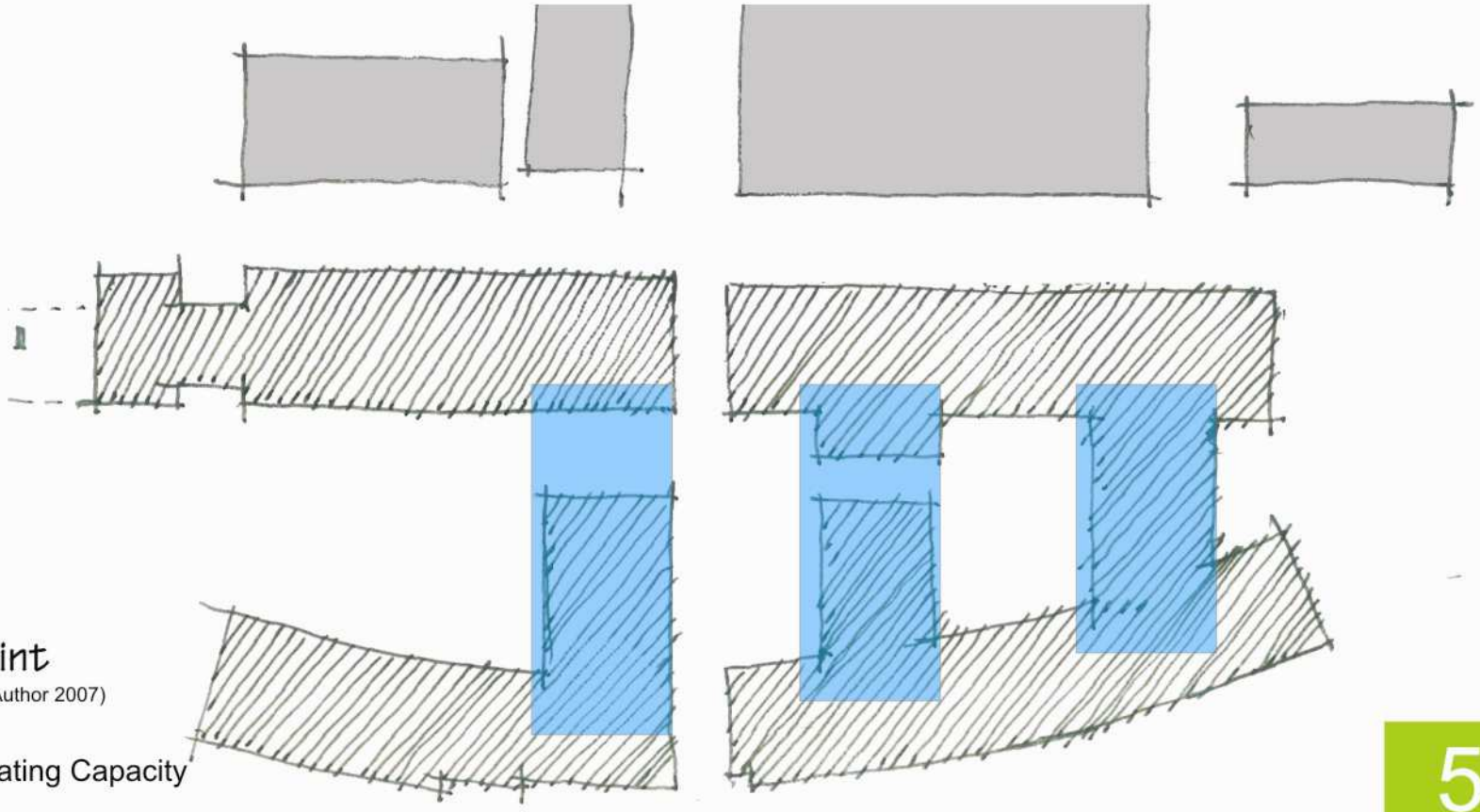
▲fig 5.28 Photovoltaic Roof Sheeting
Images courtesy of Stephen Wilkinson, Rheinzink SA

▲fig 5.29 Photovoltaic Roof Sheeting
Image courtesy of Stephen Wilkinson, Rheinzink SA

Climatic Influences

- Solar Access
- Solar Power
- Orientation - Sun & Wind
- Wind - Passive Ventilation
- Wind - Courtyard Sizing

Total Floor Area	7285m² 35W/m² =255kW
Photovoltaic Area Solar Power per sqm	1300m² 100W/m² =130kW
Water Heather Area Power Saved	140m²



Building Footprint

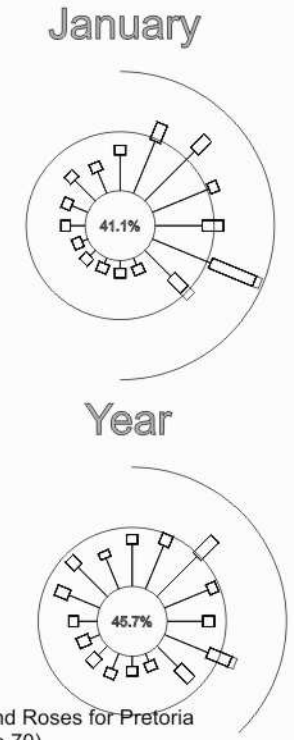
▲fig 5.30 Solar Area Sketch (Author 2007)

Roof Area with Generating Capacity

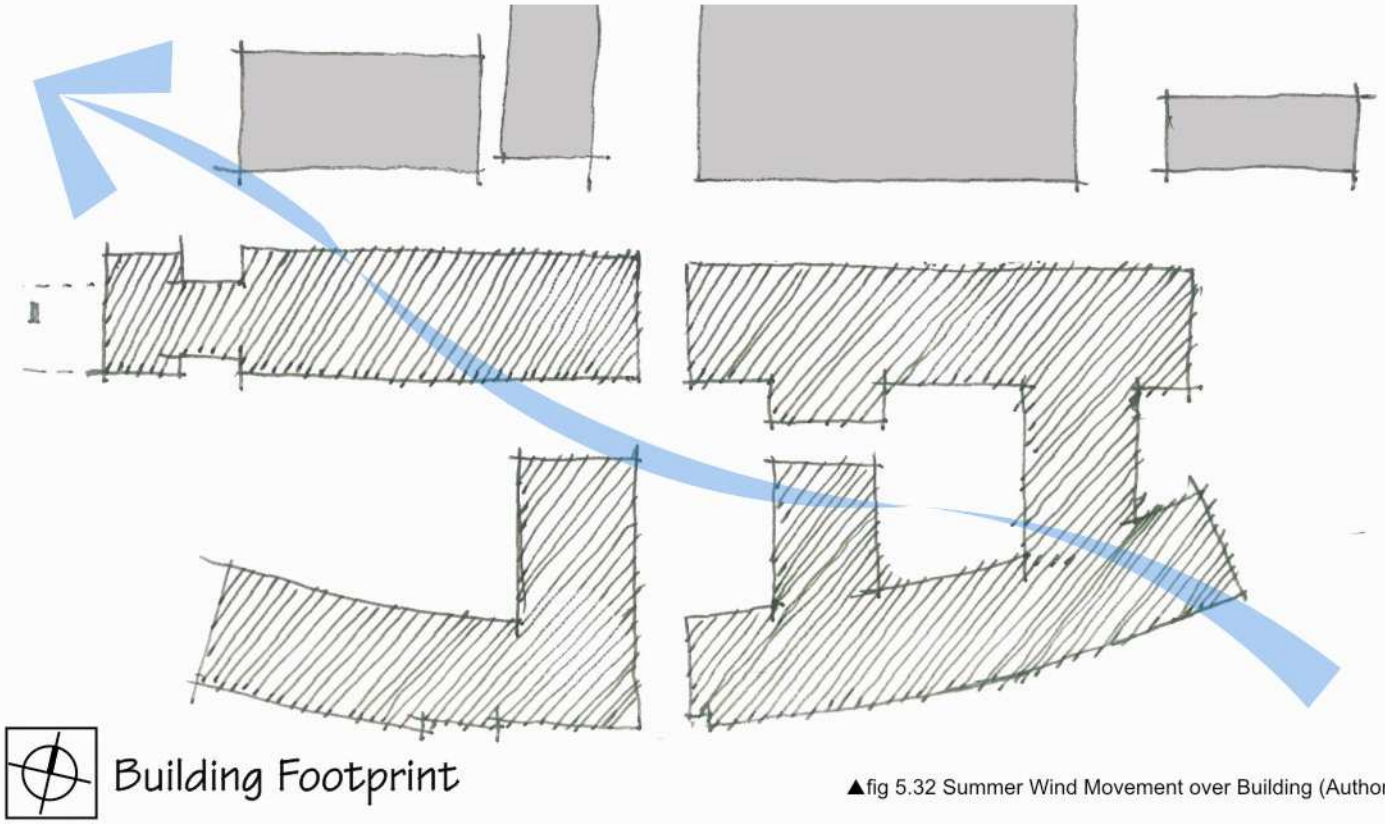
Orientation of a building is critical to the success of implementing sound sustainable design principles to the design. The ideal situation is to have a building facing north-south rather that east west, as the sun angles for the northern and southern aspects are more manageable than those on the east or west . As is evident in the building footprint below. The majority of the facade area is facing either north or south.

The buildings orientation is then further complicated by the wind direction. As stated earlier in “Solar Access” the use of summer winds should be the second priority in the sustainable design strategy.

The prevailing summer winds come from slightly south of east across the Steenhoven spruit and over the proposed site. The air that is slightly cooled from the spruit will aid in the passive ventilation of the building and dictate the sizing of the courtyard spaces



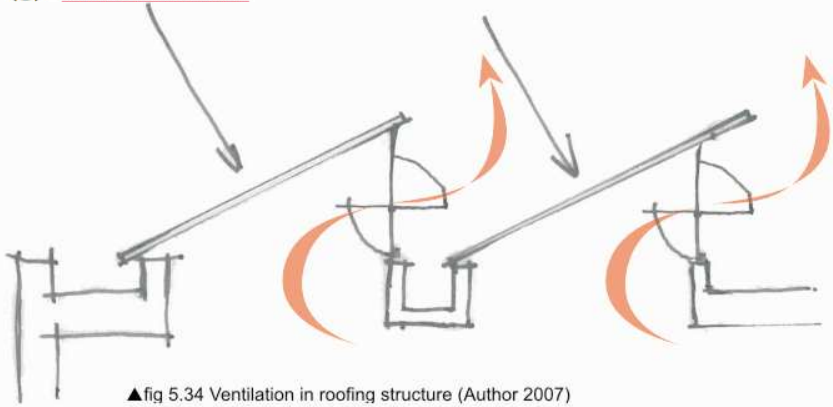
▲fig 5.31 Wind Roses for Pretoria (Holm 1999, p.70)



▲fig 5.32 Summer Wind Movement over Building (Author 2007)

Climatic Influences

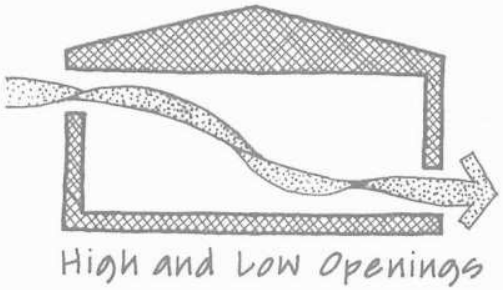
- Solar Access
- Solar Power
- Orientation - Sun & Wind
- **Wind - Passive Ventilation**
- Wind - Courtyard Sizing



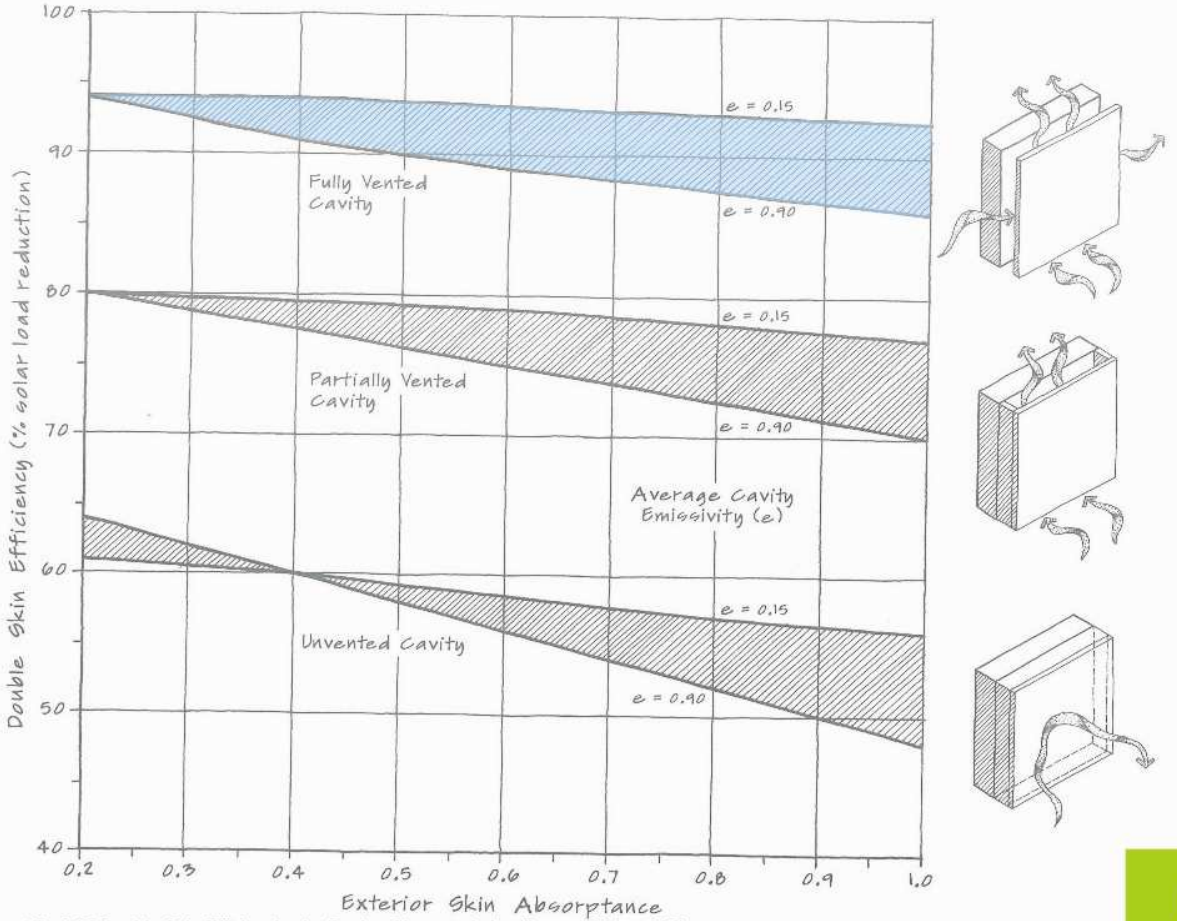
▲fig 5.34 Ventilation in roofing structure (Author 2007)

The supply of fresh air into a building prevents the build up of indoor pollutants. This is especially important in the workshop spaces.

There are various aspects that contributed to the passive ventilation strategy. The depth of the plan is restricted so as to provide all habitable spaces with windows that can be opened. The ventilated double skin wall and the saw-tooth roof both aid in optimizing the natural ventilation of the workshop. Window positions need to be optimized to take advantage of prevailing winds by allowing cross ventilation.



▲fig5.33 Positioning of openings (Brown 2001, p.242)



▲fig 5.35 Double Skin Efficiencies by Design Characteristics (Brown 2001, p.227)

Climatic Influences

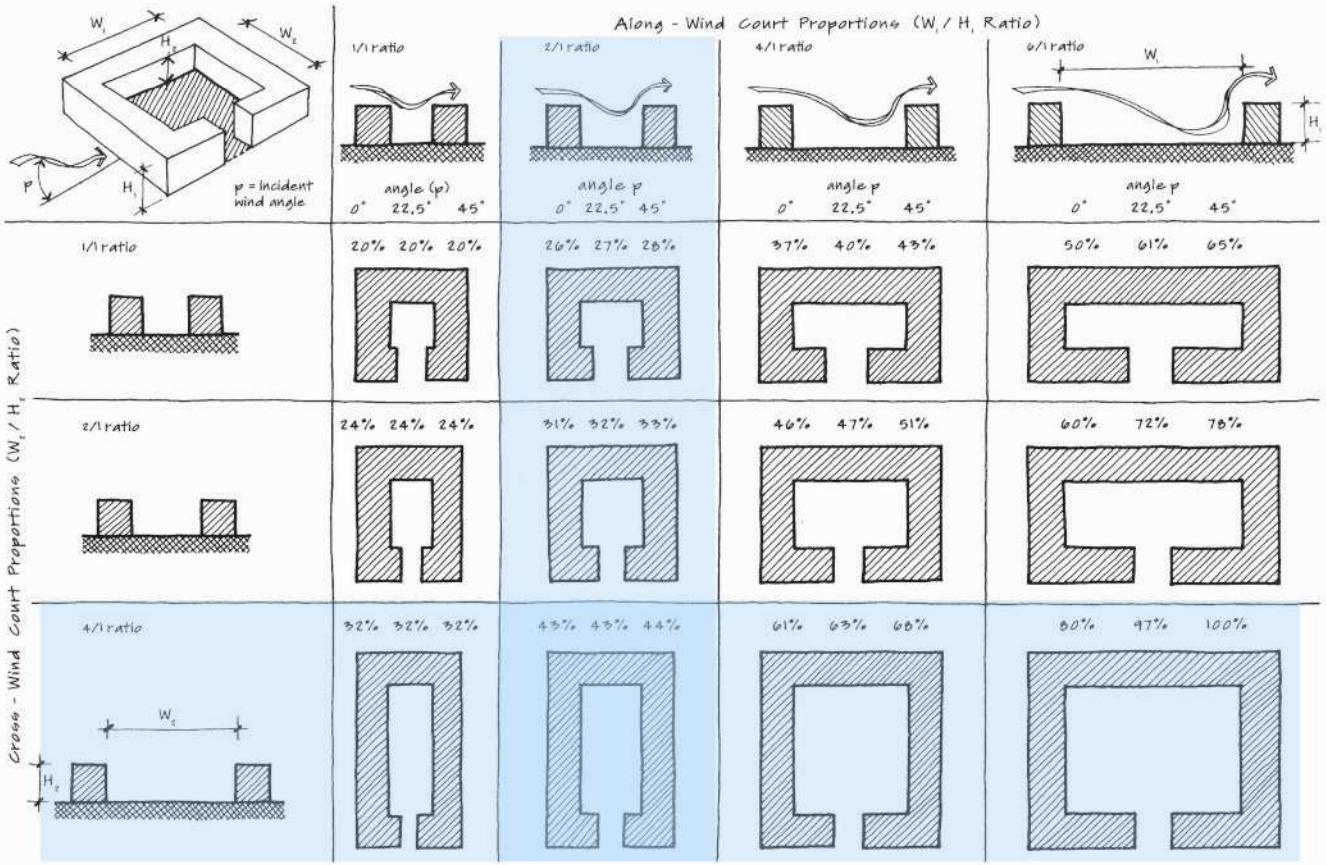
- Solar Access
- Solar Power
- Orientation - Sun & Wind
- Wind - Passive Ventilation
- **Wind - Courtyard Sizing**

Ventilation Blockage Ratio

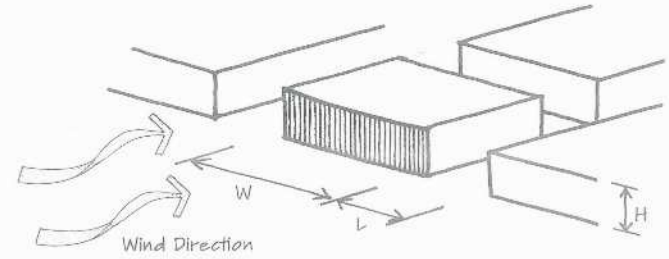
(Brown 2001, p107)

$$R_b = \frac{(W + H)}{(W + L)^2}$$

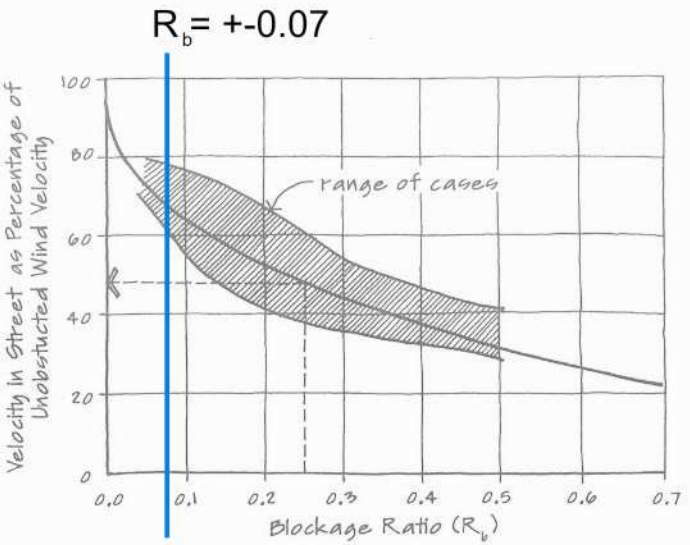
$$R_b = \frac{(13 \times 7)}{(13 + 18)^2}$$



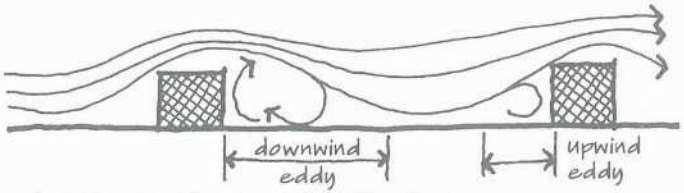
▲fig 5.36 Sizing Courtyards for Ventilation (Brown, GZ, DeKay, M 2001, p. 209) Edited by Author



▲fig 5.37 Factors in Calculating blockage ratio
(Brown, GZ, DeKay, M 2001, p. 102)



▲fig 5.38 Predicting wind velocity in streets
(Brown, GZ, DeKay, M 2001, p. 107)



▲fig 5.38 Isolated Roughness Wind Flow Regime
(Brown, GZ, DeKay, M 2001, p. 117)

"How can these disparate goals - human well-being and the enhancement of the environment - be addressed by one set of functional and aesthetic objectives"

Kirsten Childs
(Childs 2005, p.41)

"We shape our dwellings, and afterwards
our dwellings shape our lives."
Winston Churchill
(Browning 2005, p.59)

Chapter

6

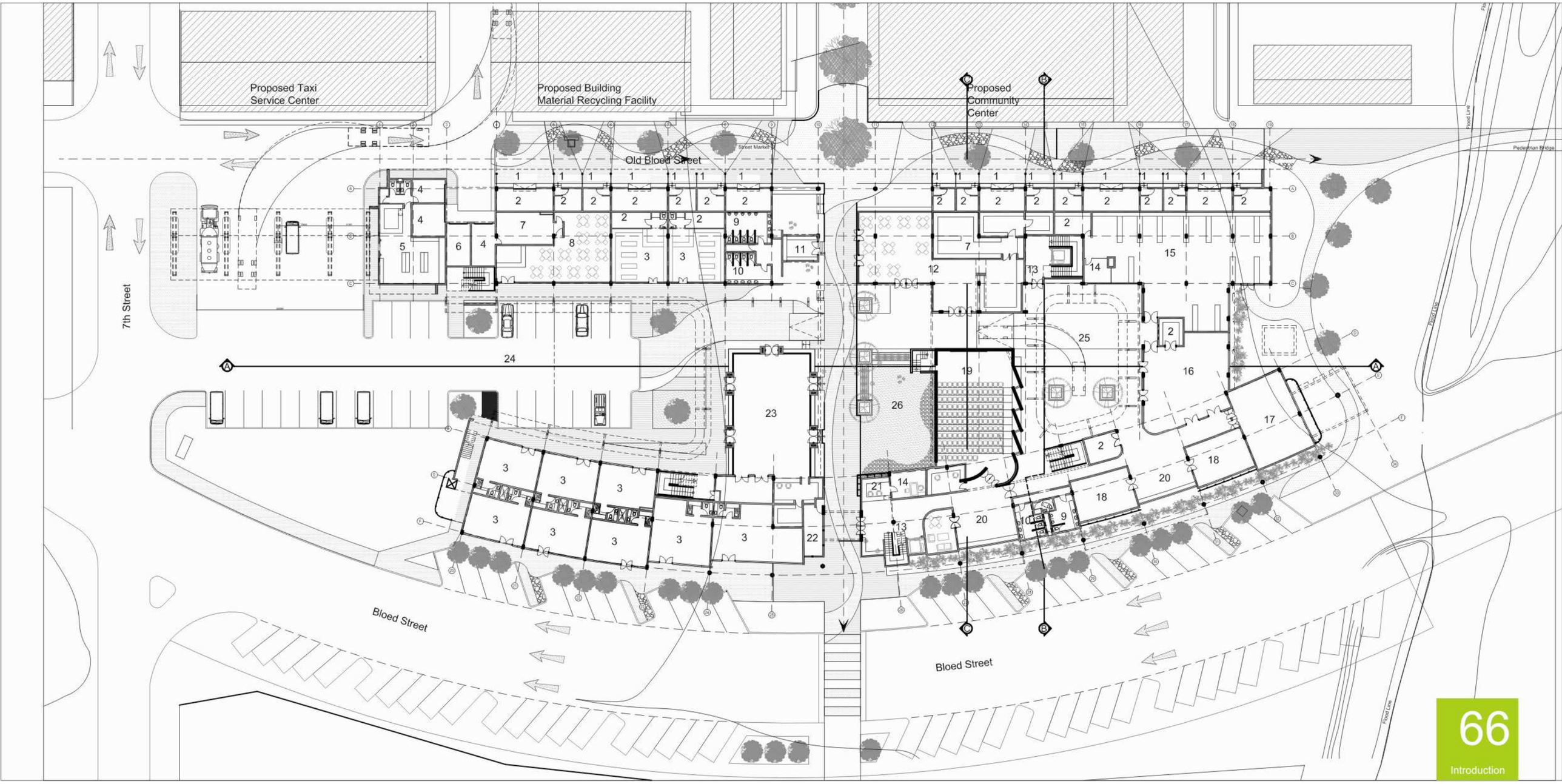
Design Outcome

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Legend

1. Informal trade
2. Storage
3. Retail
4. Goods received
5. Convenience store
6. Refuse yard
7. Kitchen
8. Restaurant
9. Men's ablutions
10. Ladies ablutions
11. Tuck Shop
12. Canteen
13. Circulation core
14. Office
15. Material & testing lab
16. Informal Lecture theatre
17. Lecture theatre
18. Seminar room
19. Auditorium 150 seater
20. Foyer
21. Reception
22. Plant room
23. Exhibition hall
24. Parking
25. Outdoor workshop space
26. Recreational
27. Commercial workshop
28. Boardroom
29. Pause area
30. Staff room & tea kitchen
31. Meeting room
32. Workshop
33. Library
34. Computer lab
35. Sewing
36. Administration

Ground Floor Plan Scale 1:500


Proposed Taxi
Service Center
Proposed Building
Material Recycling Facility
Proposed
Community
Center
Old Bloed Street
Street Market
Flood Line
Pedestrian Bridge
7th Street
24
Bloed Street
Bloed Street
Flood Line

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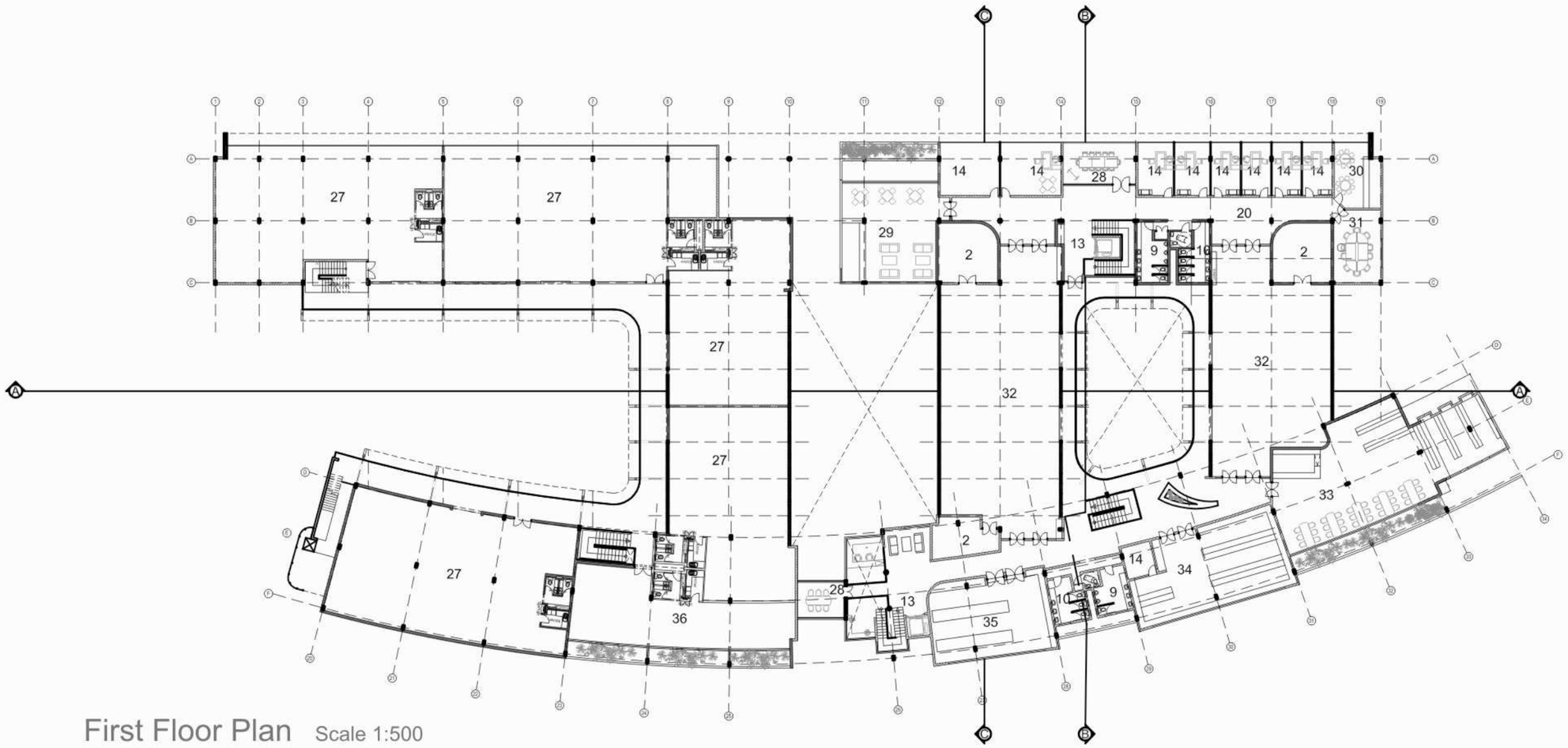
Ground Floor Plan

Legend
1. Informal trade
2. Storage
3. Retail
4. Goods received
5. Convenience store
6. Refuse yard
7. Kitchen
8. Restaurant
9. Men's ablutions
10. Ladies ablutions
11. Tuck Shop
12. Canteen
13. Circulation core
14. Office
15. Material & testing lab
16. Informal Lecture theatre
17. Lecture theatre
18. Seminar room
19. Auditorium 150 seater
20. Foyer
21. Reception
22. Plant room
23. Exhibition hall
24. Parking
25. Outdoor workshop space
26. Recreational
27. Commercial workshop
28. Boardroom
29. Pause area
30. Staff room & tea kitchen
31. Meeting room
32. Workshop
33. Library
34. Computer lab
35. Sewing
36. Administration

First Floor Plan Scale 1:500



First Floor Plan Scale 1:500

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First Floor Plan

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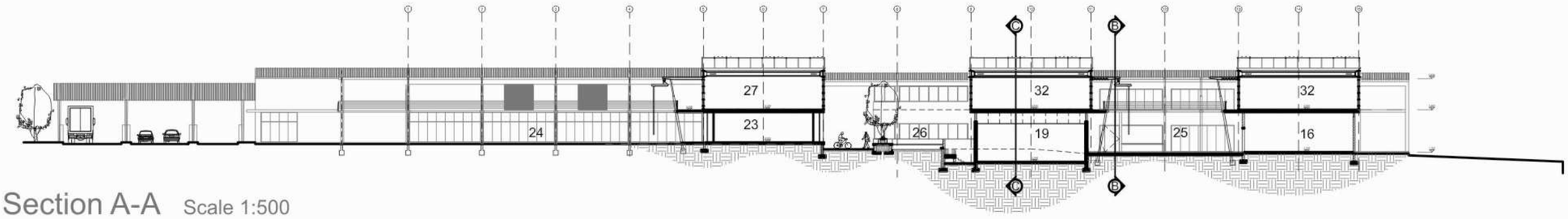
31. Meeting room
32. Workshop
33. Library
34. Computer lab
35. Sewing
36. Administration

Section A-A Scale 1:500



Section A-A Scale 1:500

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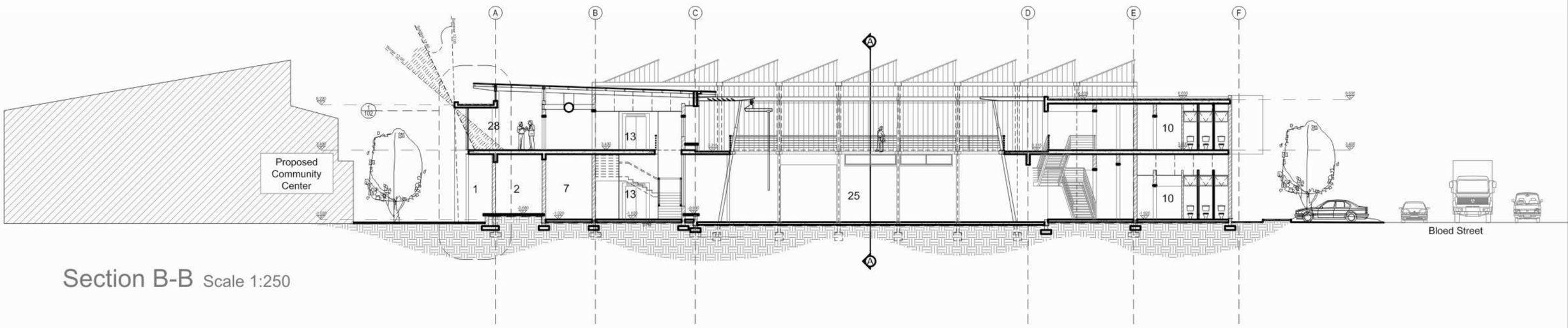
31. Meeting room
32. Workshop
33. Library
34. Computer lab
35. Sewing
36. Administration

Section A-A

Section B-B & C-C Scale 1:250



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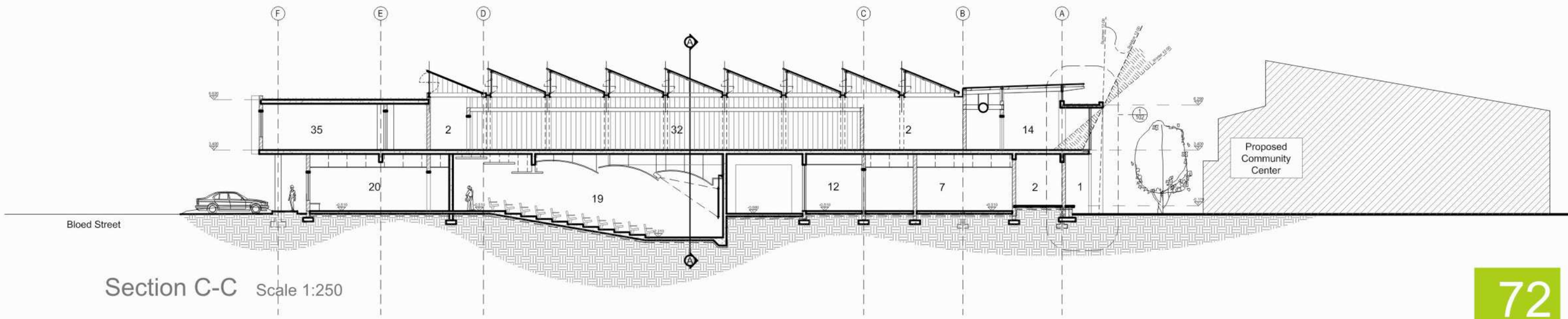

Section C-C Scale 1:250

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Sections B-B & C-C

73

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Elevations Scale 1:500

North Elevation Scale 1:500

South Elevation Scale 1:500

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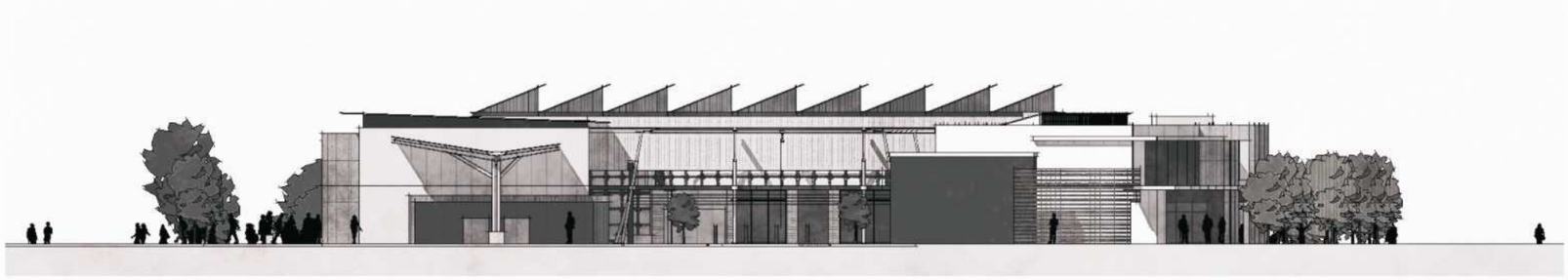
North & South Elevation

75
rethinking **green**

Elevations Scale 1:500



West Elevation Scale 1:500

East Elevation Scale 1:500

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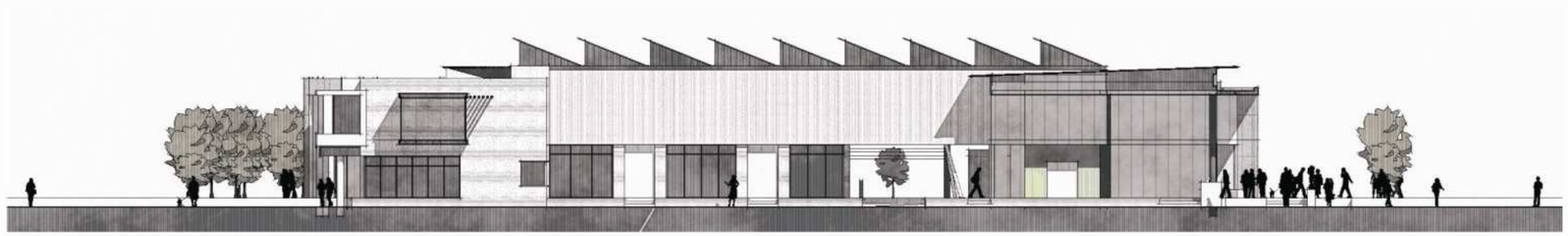
East & West Elevation

77
rethinking **green**

Courtyard Elevations Scale 1:500

Internal Courtyard Elevation 1 Scale 1:500

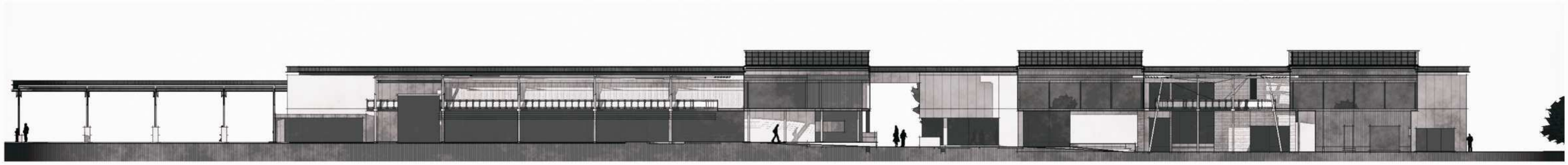


Internal Courtyard Elevation 2 Scale 1:500

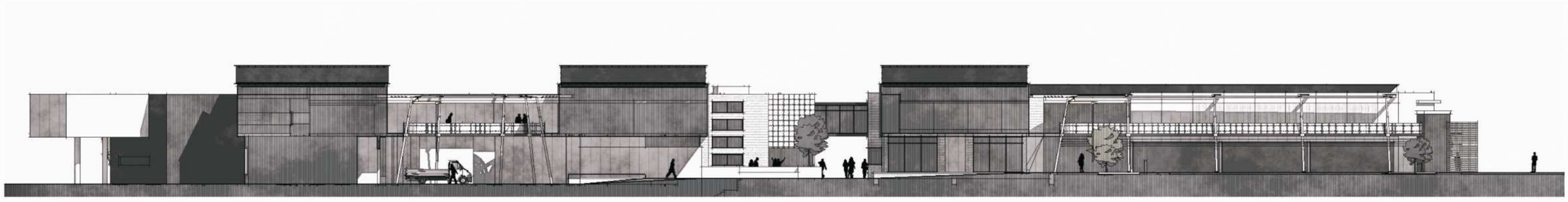
Courtyard Elevations 1 & 2

Courtyard Elevations

Scale 1:500



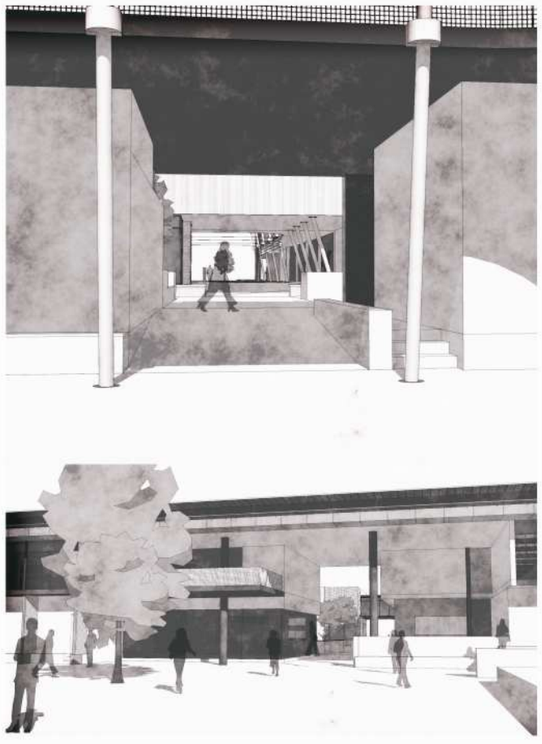
Internal Courtyard Elevation 3 Scale 1:500



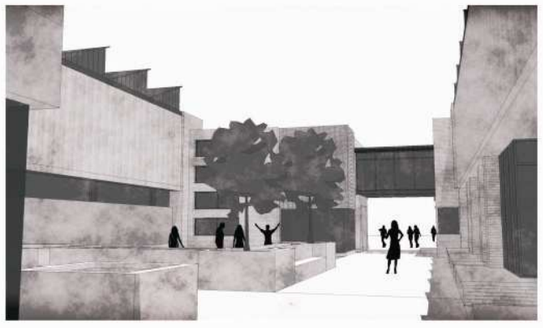
Internal Courtyard Elevation4 Scale 1:500

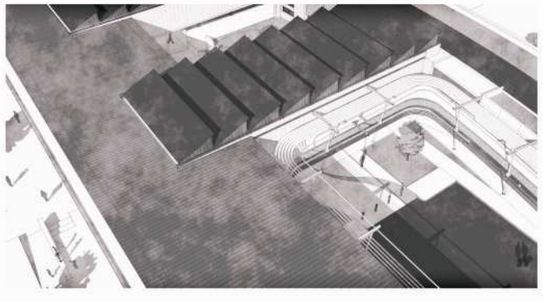
Courtyard Elevations 3 & 4

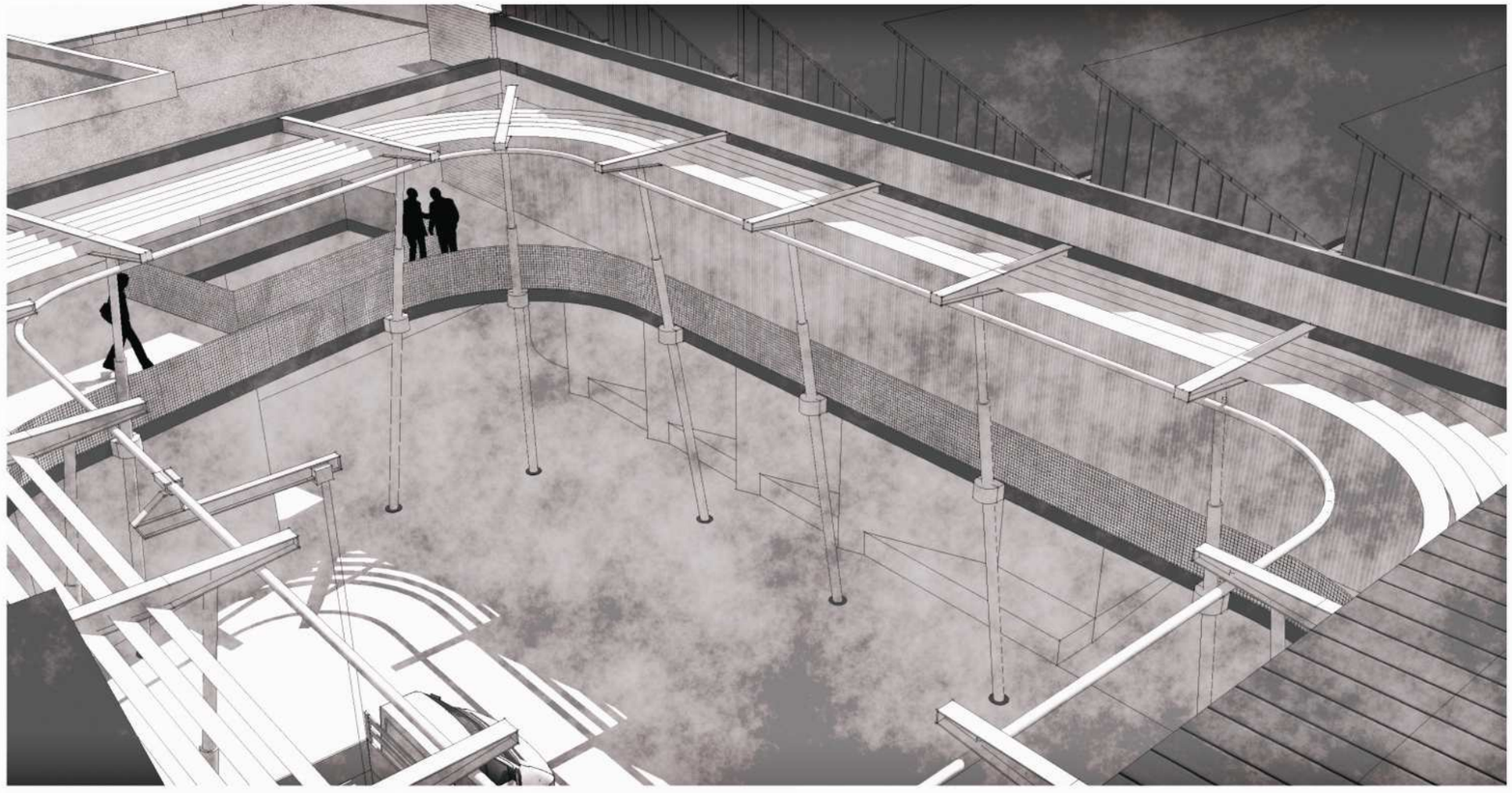
Perspectives



Perspectives

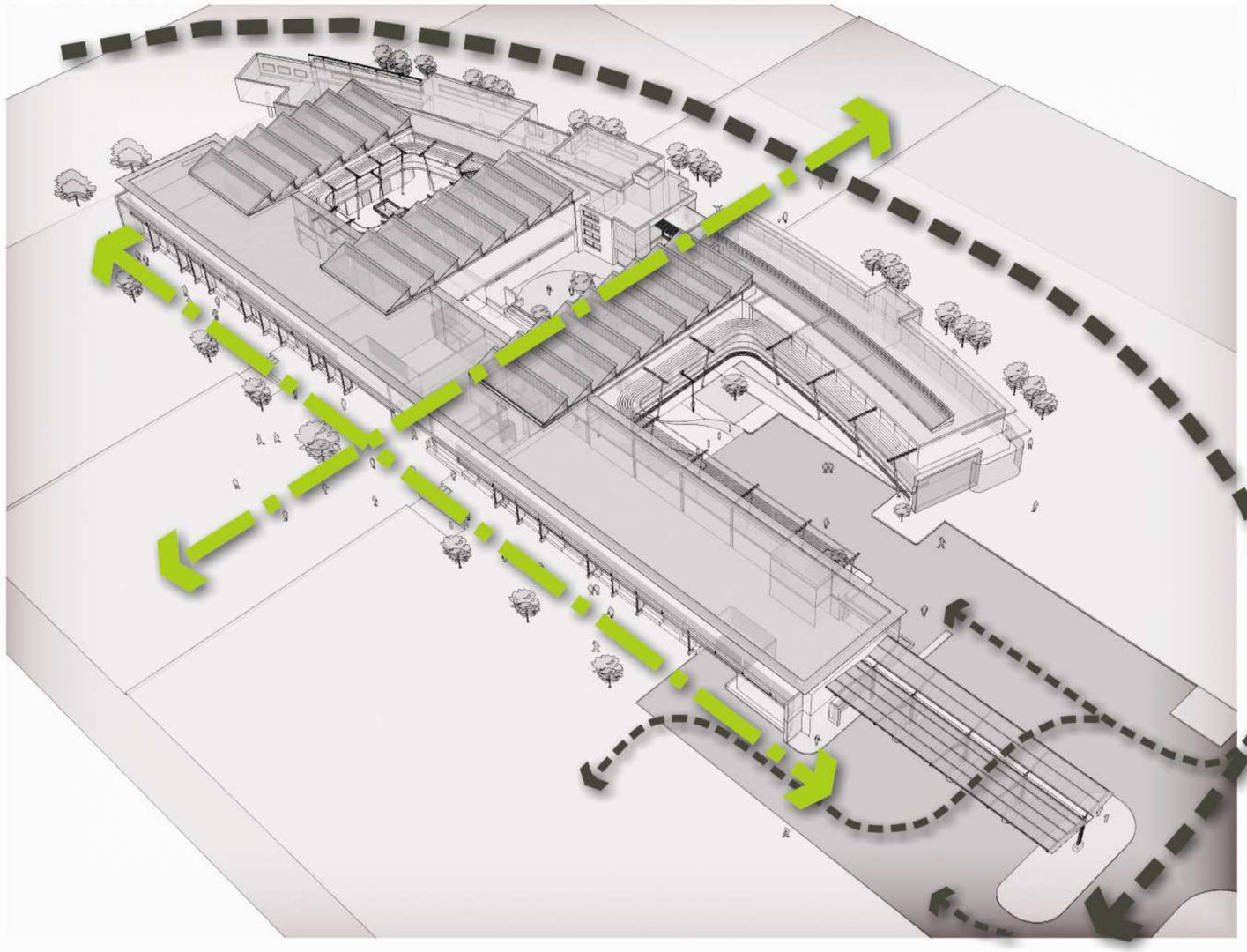






Movement\ Circulation Diagrams

Public External Circulation



Public Pedestrian Circulation

Vehicular Circulation

Movement\ Circulation Diagrams

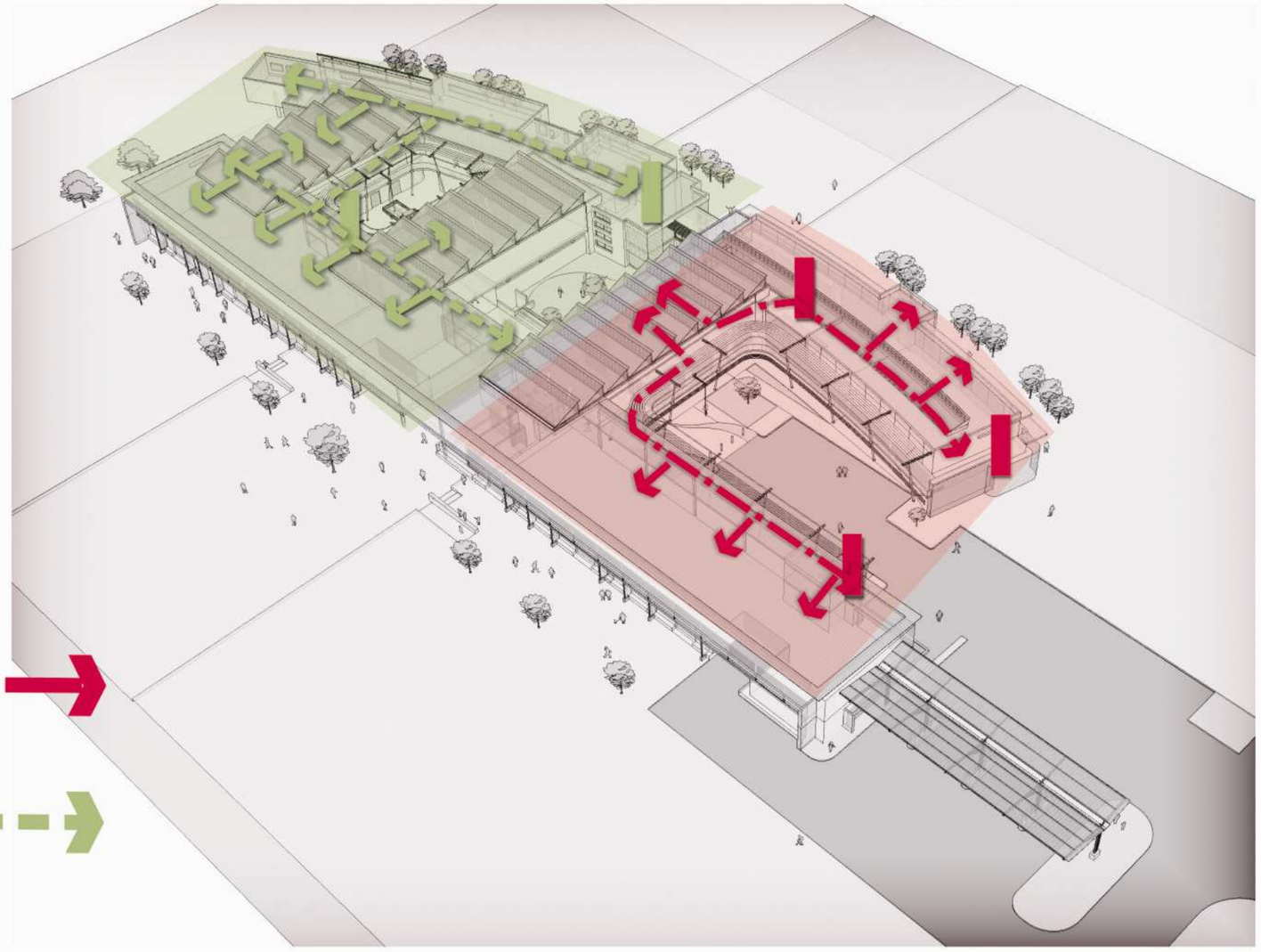
User Circulation - Ground Floor

Public Circulation

Learner Circulation

Movement\ Circulation Diagrams

User Circulation - First Floor

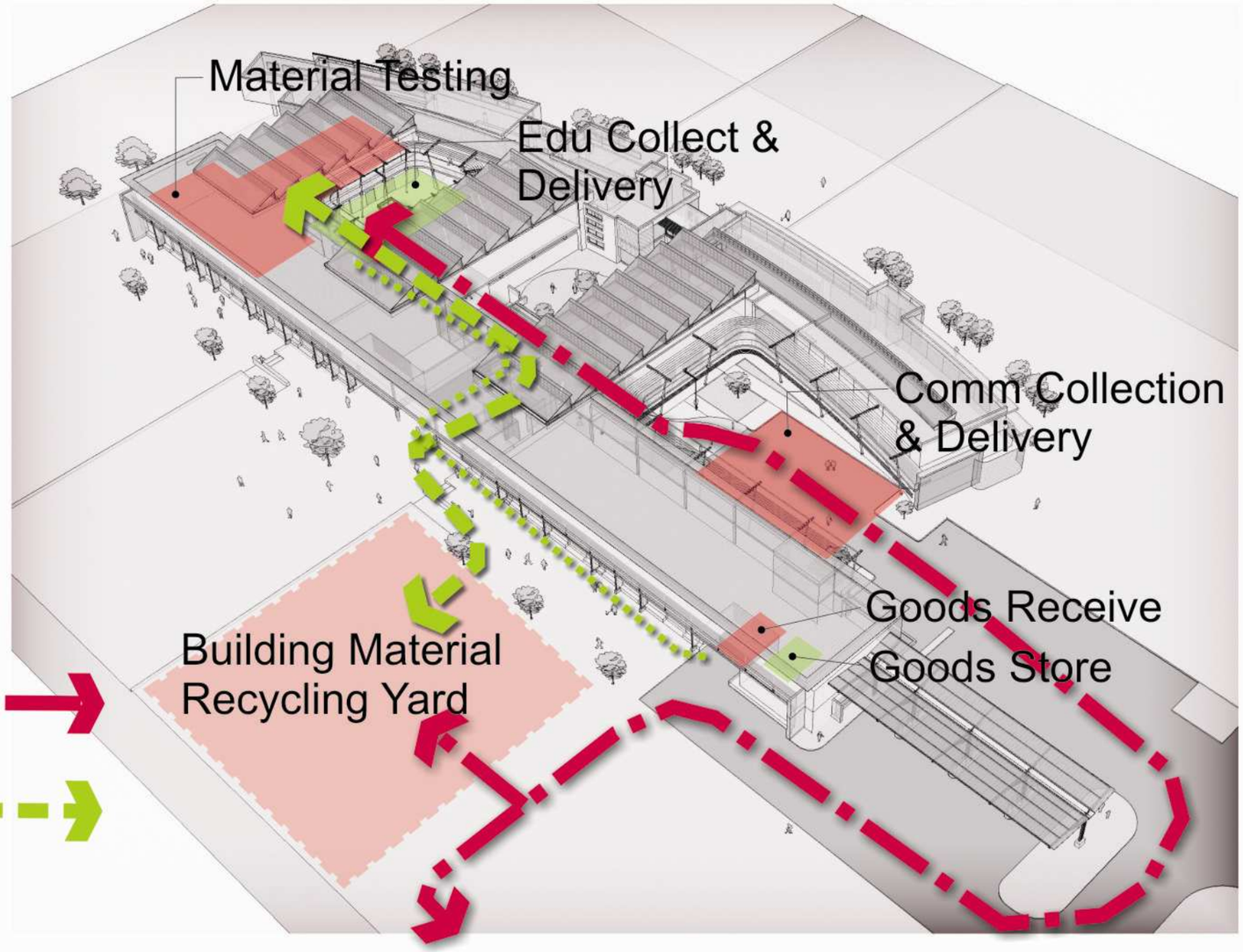


Commercial Circulation
Vertical Core

Learner Circulation
Vertical Core

Movement\ Circulation Diagrams

Goods Circulation - Ground Floor

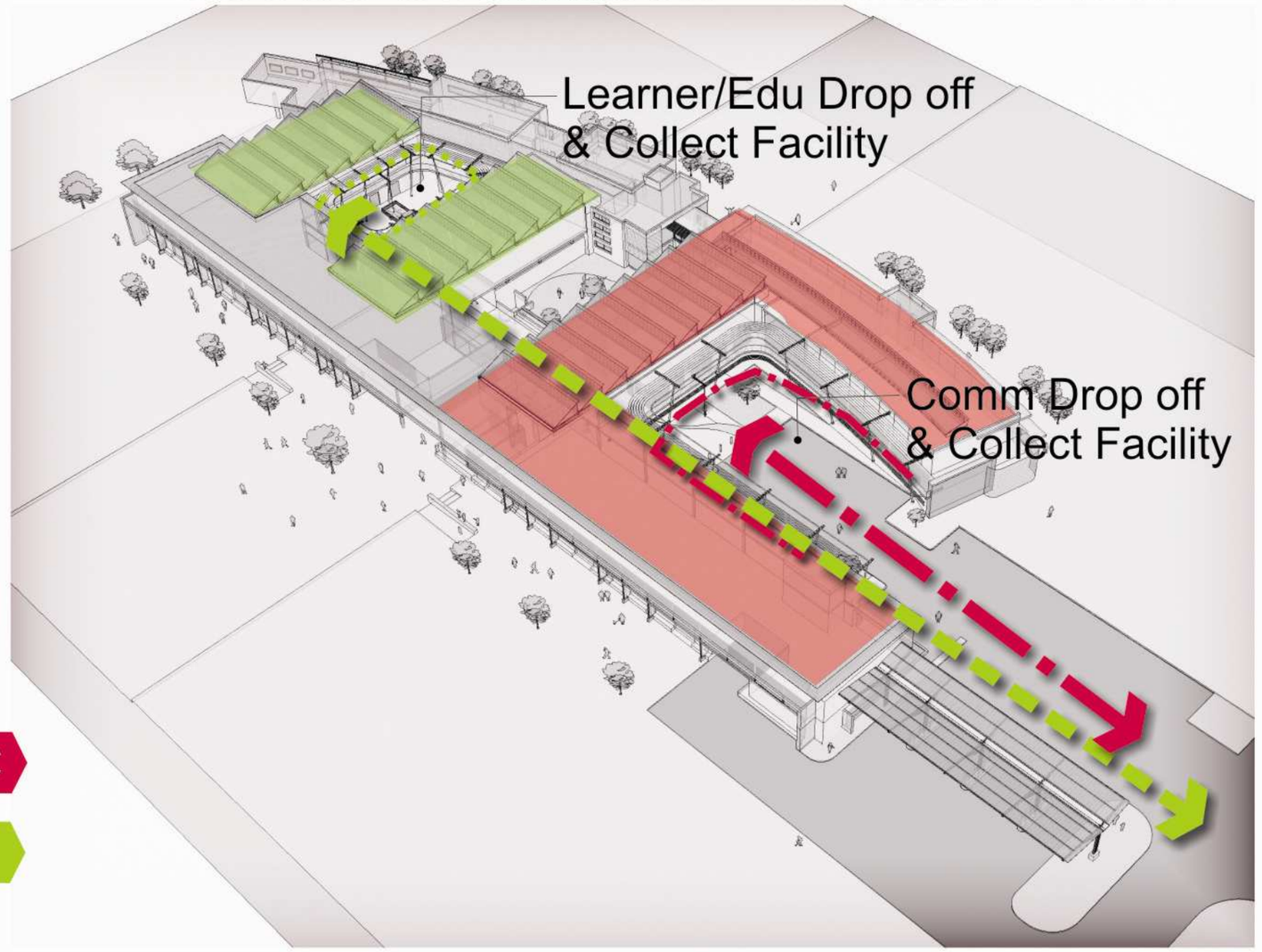


Vehicle Circulation

Pedestrian Circulation

Movement\ Circulation Diagrams

Goods Circulation - Ground Floor



Commercial Workshops

Educational Workshops

Commercial Deliver & Collect

Educational Deliver & Collect

Chapter 7

Technical Investigation

Material Selection

To arrive at a sustainable solution the building blocks of the project need to be sustainable. In order to select appropriate materials for various applications the relevant technical data regarding such a product needs to be compared with alternatives.

Although each application calls for strength in varying material aspects, there are certain factors such as embodied energy and life cycle costing that are always important in material selection

The use of recycled building materials is another practice widely recognized as sustainable. Due to the synergy between this design exploration and the proposed building material recycling yard adjacent to the proposed site, much of the proposed material selection derived out of an analysis of existing construction waste.

The boxes to the right aim to illustrate the selection of material relative to the required performance.

Wall Coating
Aqua Coat Paint

- Zero VOC Emissions
- Enhanced Thermal properties
- Non Toxic
- Locally Manufactured
- Weather Resistance

Wall Coating 2
In Situ Concrete

- Low Embodied energy
- Process creates Job Opportunities
- Locally Manufactured
- Long Life Cycle

Masonry Construction
Recycled Bricks

- Low Embodied energy
- Process creates Job Opportunities
- Locally Recycled

▲fig7.0a Material Selection (Author 2007)

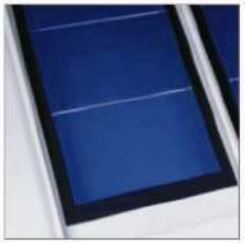
Roof Material 1
Concrete Roof
Covered with crushed
& rolled stone chips

- Shades roof surface
- Slows flow of stormwater
- Rainwater harvesting

Roof Material 2
Rheinzink

- Natural Material
- Low Embodied Energy
- 90% Recycle Rate
- Low Co2 Emissions in Production
- No toxic coating

Roof Material 3
Rheinzink PV
Sheeting



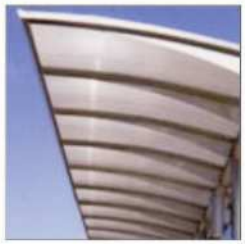
- Integrated Solar Power
- Natural Material
- Low Embodied Energy
- 90% Recycle Rate
- No toxic coating

▲fig7.0b Material Selection (Author 2007)

Glazing 1
Coolvue

- Reduces Heat gain by 50%
- Filters 99.5% UV Radiation
- Manufactured Locally

Polycarbonate
Multiwall



- Energy Efficient
- Filters 99.9% UV Radiation
- Manufactured Locally
- Transmits light & reduces heat gain
- Adaptable

Insulation
Thermocoustex

Recycled polyester board

- Energy Efficient
- Acoustic and thermal insulation
- Manufactured Locally
- 100% recyclable
- Low embodied energy

▲fig7.0c Material Selection (Author 2007)

Rainwater Managment
Rheinzink

- Natural Material
- Low Embodied Energy
- 90% Recycle Rate
- Low Co2 Emissions in Production
- No toxic coating

Rainwater Managment
Pervious Paving

- Low Embodied Energy
- Locally Manufactured
- Rainwater Harvesting
- Hard wearing surface

Sunscreen
Recycled Sunscreen

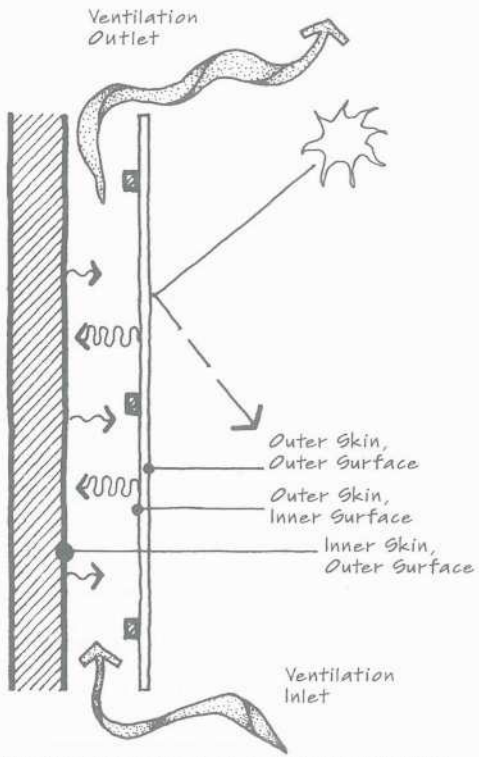
- Made from reclaimed scrap metal
- Process creates Job Opportunities

▲fig7.0d Material Selection (Author 2007)

The Envelope

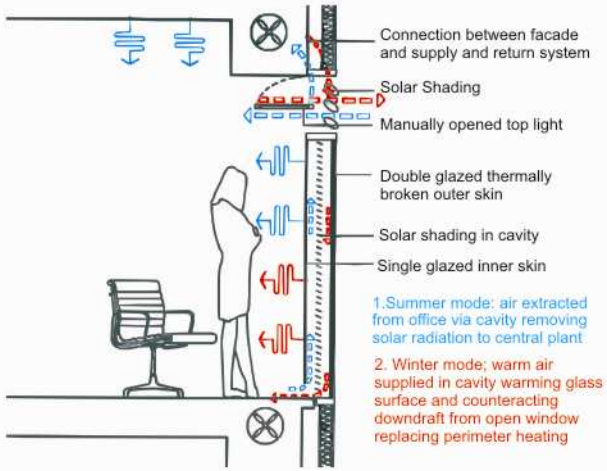
Precedent Studies

The use of a double skin ventilated wall system evolved out of a response to the problem of creating thermal mass in a light transmitting surface. The workshop's orientation is east west, making it difficult to make use of the natural light without allowing the build up of too much heat gain and excessive glare.



▲fig7.1Diagrammatic Section of Double Skin Wall (Brown, GZ, DeKay, M 2001, p. 102)

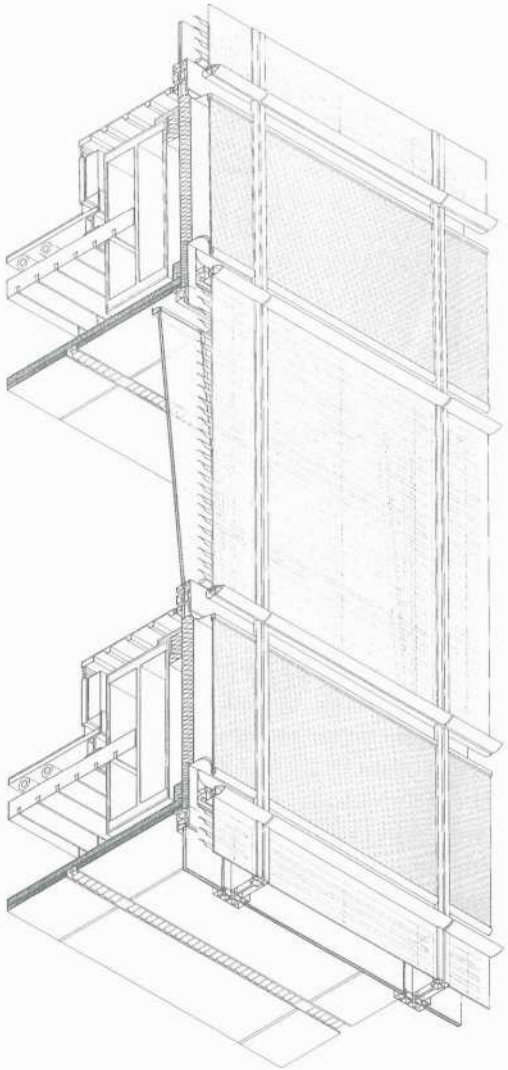
Due to the climatic variances the wall needs to be able to react differently under different situations. The heat gain has to be directed inwards during winter and outwards during summer months in order to provide year round comfort. The facade detail developed for the Commerzbank in



▲fig7.2 Sketch Of "Breathing Wall" (Jacks 2007, p.9) edited by author

Frankfurt by Norman Foster in conjunction with facade engineer Josef Gartner is designed to be able to adapt, allowing the interior environment to be manipulated by the user. This affording the user the opportunity to interact with the building and with nature.

Due to this dissertation proposing an educational facility this interaction, and the users control over the systems form an integral part of the learning process. Therefor the mechanical ventilation assistance will have a direct user interface in order for the occupants to have a hands on experience of ventilation principles and passive design.



▲fig7.3 Commerzbank Facade - 3D Detail (Lechner 2001, p.557)

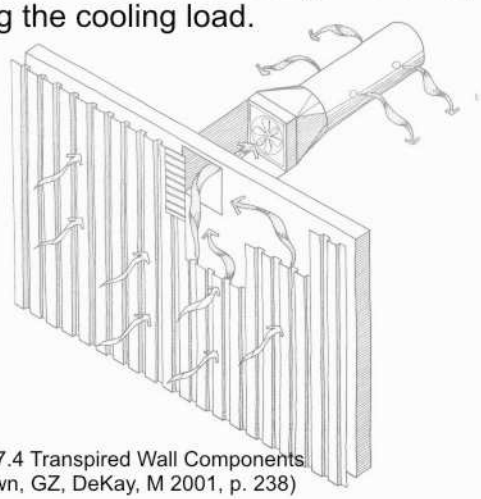
Envelope Exploration

The aim of this disertation, as stated earlier, is to look at existing sustainable building principles in order to develop an array of systems responding to the specific context of the proposed site.

Transpired Wall System

A ventilated wall system usually used to reduce heating and cooling loads by using the cavity to act thermal mass or direct airflow.

In the case of a transpired wall, solar energy is utilized to regulate internal temperatures. In winter fresh air is preheated before it is pumped into the building, and the cavity aids in reducing heat losses. In summer months an intake bypass damper is used to bring in untempered fresh air, while the preheated air in the cavity naturally ventilates the heated air to the outside insulating the building from excessive heat gain thereby reducing the cooling load.



▲fig7.4 Transpired Wall Components
(Brown, GZ, DeKay, M 2001, p. 238)

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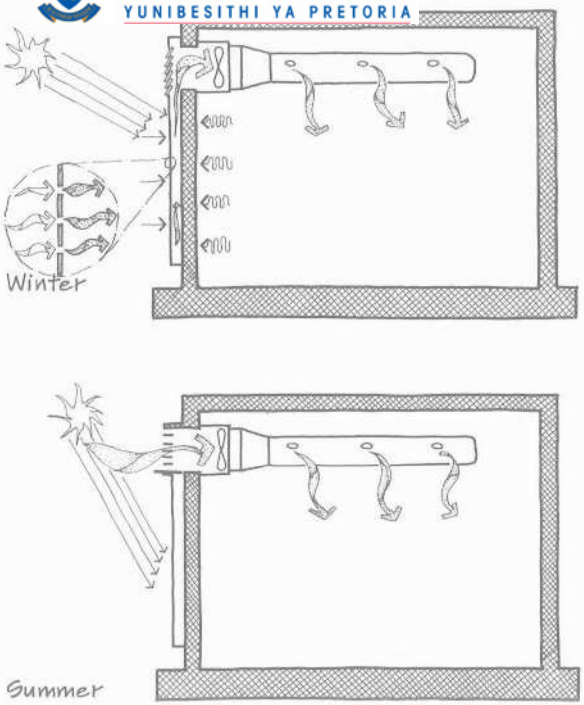
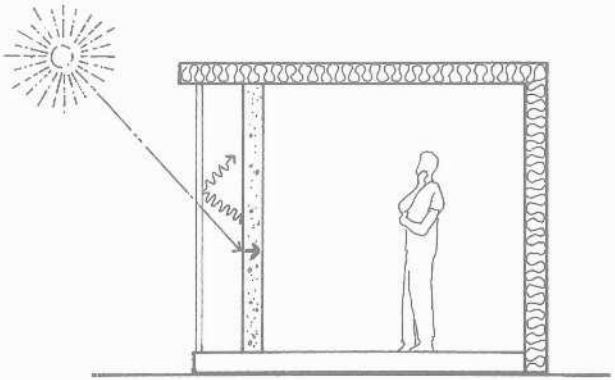


▲fig7.5 Transpired Wall Section
(Brown, GZ, DeKay, M 2001, p. 238)

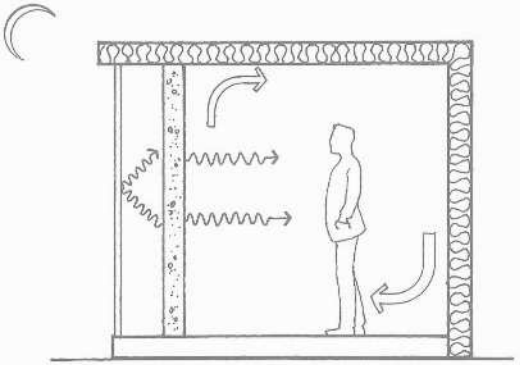
▲fig7.6 An Example of a Transpired Wall
(Brown 2001, p.238)

Trombe Wall

A simple architectural device where a pane of glass is placed just in front of a wall with a dark coating. The solar radiation is trapped in the cavity due to the greenhouse effect. The wall is in turn heated, then that heat is then slowly released into the space by convection. This regulates and stabilizes interior temperature, thereby reducing the heating or cooling load.



▲fig7.7 Trombe wall building up heat gain in day
(Lechner 2001, p.152)



▲fig7.8Trombe wall releasing heat gain at night
(Lechner 2001, p.152)

Openings in the Envelope

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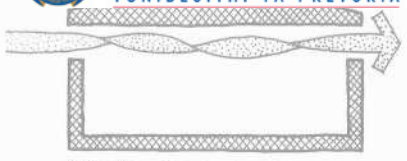
Considerations

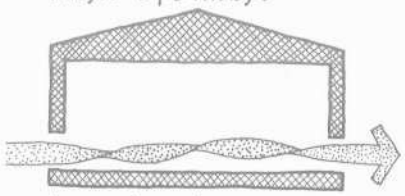
An essential component when planning any space is the sizing and locations of the openings. Optimizing the orientation, layout, sizing and relation of openings to one another can have a drastic impact on the effectiveness of a cross ventilation strategy.

The ideal situation for opening is highlighted on the image to the right, where openings are placed on opposite walls at different heights from one another.

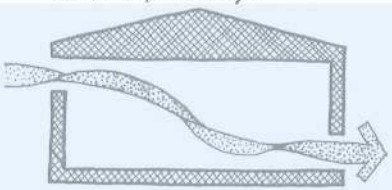
The implementation of this strategy combined with orientating the openings in order to utilize the prevailing summer winds ensures effective and optimal use of the potential of natural ventilation.



High Openings



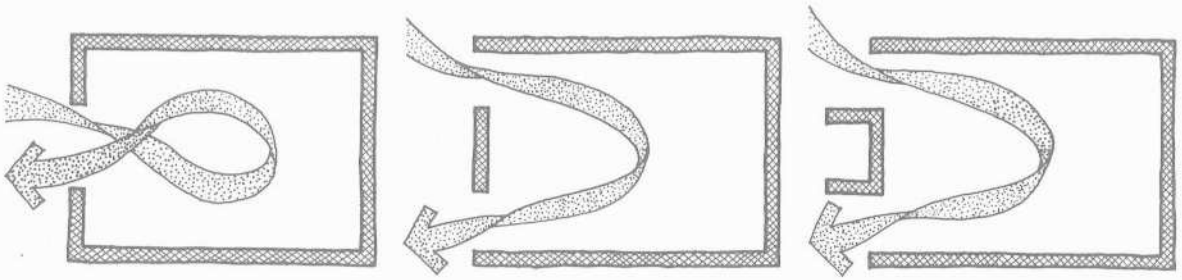
Low Openings



High and Low Openings

window height as a fraction of wall height	1/3	1/3	1/3
window width as a fraction of wall width	1/3	2/3	3/3
single opening	12-14%	13-17%	16-23%
two openings in the same wall	----	22%	23%
two openings in adjacent walls	37-45%	37-45%	40-51%
two openings in opposite walls	35-42%	37-51%	47-65%

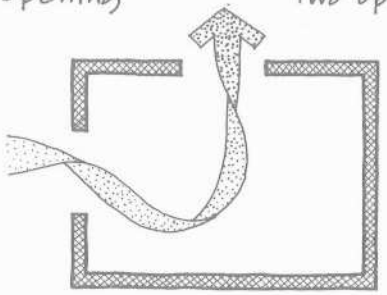
Average Interior Air Velocity as a Percentage of the Exterior Wind Velocity
range = wind 45° to perpendicular to opening



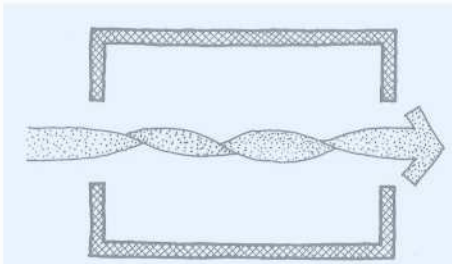
Single Opening

Two Openings-Same Wall

Two Openings With Wings



Two Openings-Adjacent Walls



Two Openings-Opposite Walls

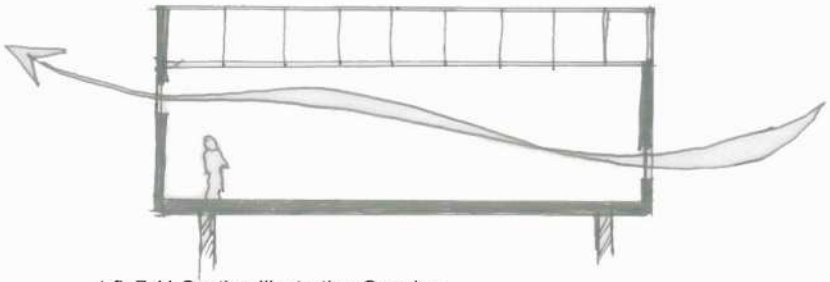
▲fig7.9 Planning opening to optimize cross ventilation (Brown 2001, p.242)

Evolution of Envelope

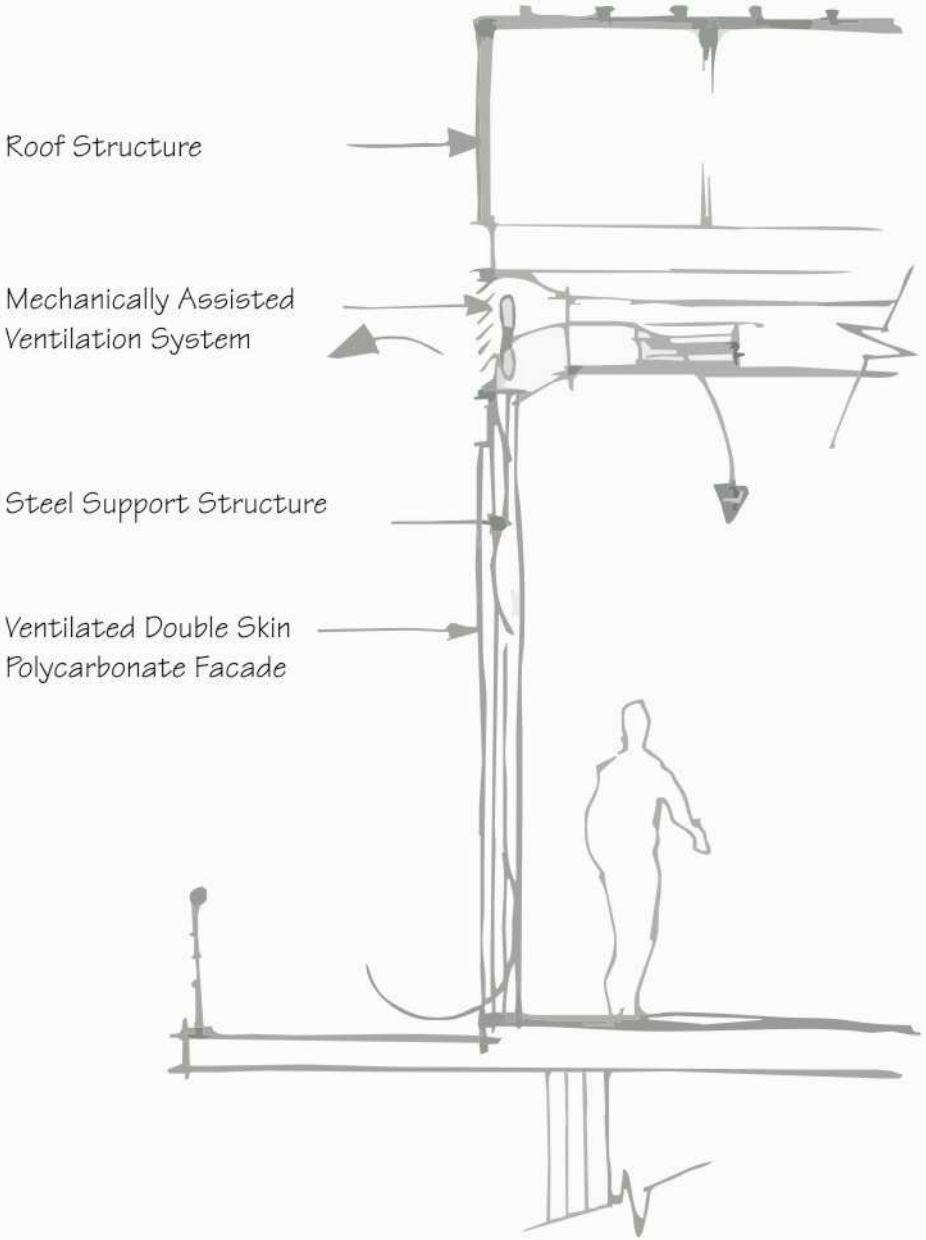
The interaction between user and building again becomes a defining concept in the evolution of the ventilated wall system.

The ventilated wall system is a combination of the envelope precedent walling systems and Shigeru Ban's *Naked House*. Elements of the transpired wall system have been combined with a double skin polycarbonate system that is easily adjustable in different climatic conditions to create a comfortable working environment.

▲fig7.10 Shigeru Ban's Naked House
(Hawthorne 2005, p.85)



▲fig7.11 Section Illustrating Opening Positions for optimal cross-ventilation



▲fig7.12 Ventilated Wall Concept
(Author 2007)

Roofing Exploration

In attempting to choose a direction for a roofing structure, the initial task was to set out parameters that the roofing system or structure needed to achieve.

Parameters\ concerns the roofing structure\ system must address include:

1. User Interface - The roofing structure must be operated and controlled by the users, whether this be automatic or manual.

2. Thermal Performance - Consideration of insulation and roofing material in terms of thermal mass.

3. Natural Ventilation - Roofing to include or create opportunities to introduce height level clerestory ventilation.

4. Day lighting - Roofing to accommodate introduction of high levels of natural diffused day lighting.

5. Solar Power - Roofing system to accommodate building integrated photovoltaic cells.

6. Integration - Roofing to be seamlessly integrated into the supporting structure.

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▲fig7.13 British Pavilion, Seville
(Steele 2005, p.122)

Nicholas Grimshaw's British Pavilion uses an independent shading device above the roof structure that incorporates photovoltaic cells that power the water pumps that cool the eastern facade.

▲fig7.14 South Elevation depicting the floating glass roof (Christian Richters)

Renzo Piano's Beyeler Foundation Museum untilised an almost all glass roof. Layers of glazing shaded by sloped panes of opaque glass. The building uses the roof as a mechanism to introduce and control natural day lighting. Given that the roof is almost entirely glass the roof performs surprisingly well thermally, due mainly to precise engineering. (Buchanan 2005, p.41)

▲fig7.15 Red Location Apartheid Museum
(Steele 2005, p.122)

The Red Location Apartheid Museum employed a saw-tooth roof, which utilizes natural light and creates opportunities for natural ventilation, The image of the saw-tooth roof is also strongly symbolic as the trade unions who provided the only voice for the disenfranchised under apartheid used the image of the saw-tooth widely in their posters and it is also a roofing form strongly associated or even synonymous with industry or production.

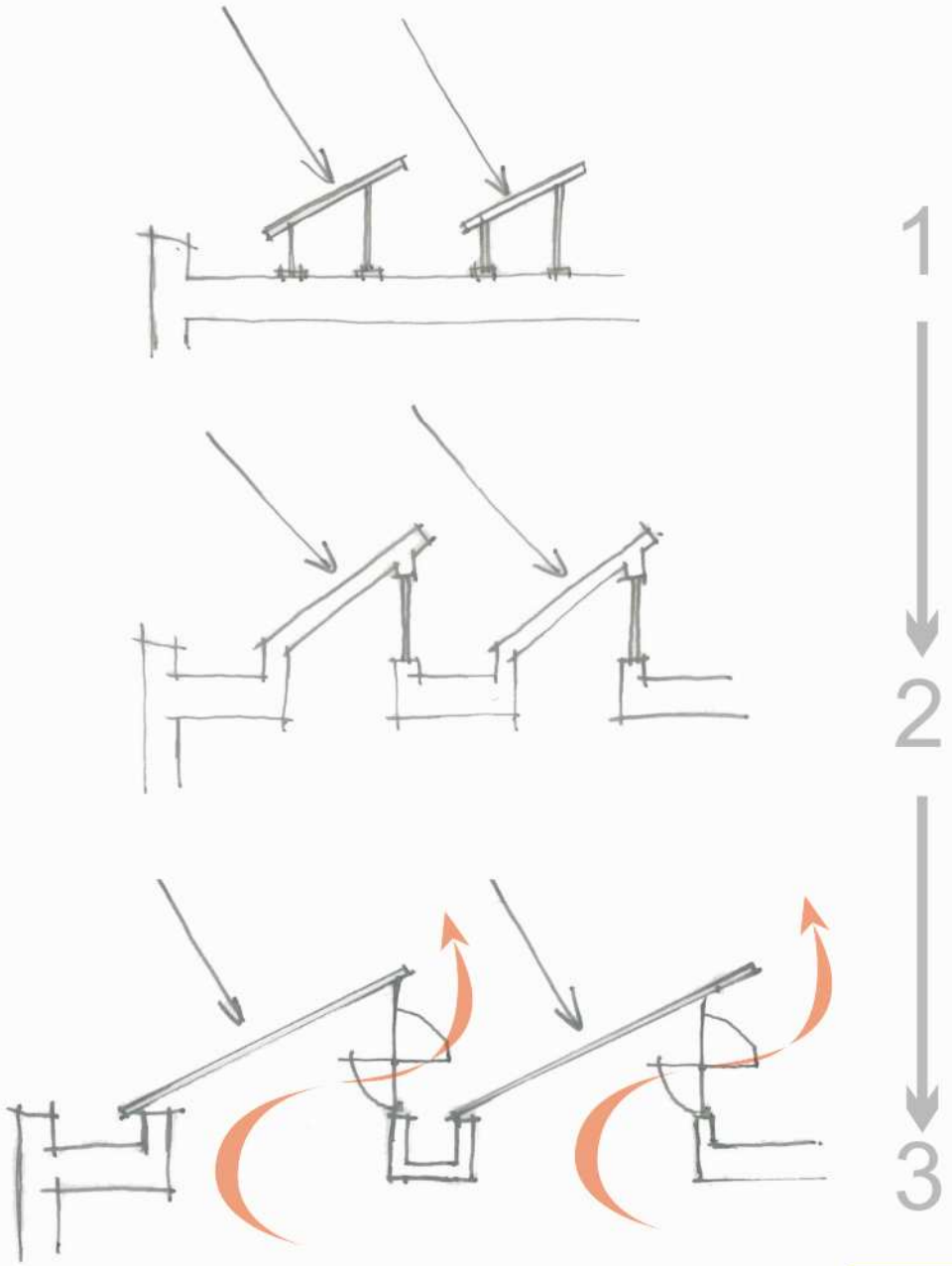
Evolution of Roofing Syste

The choice of form in terms of roofing is critical to the energy efficiency of a roof structure. An vast amount of heat gain and loss could occur due to poor detailing, material choice or insulation.

The proposed roof evolved out of a understanding of micro-climatic data, a desire for energy efficiency and social concerns.

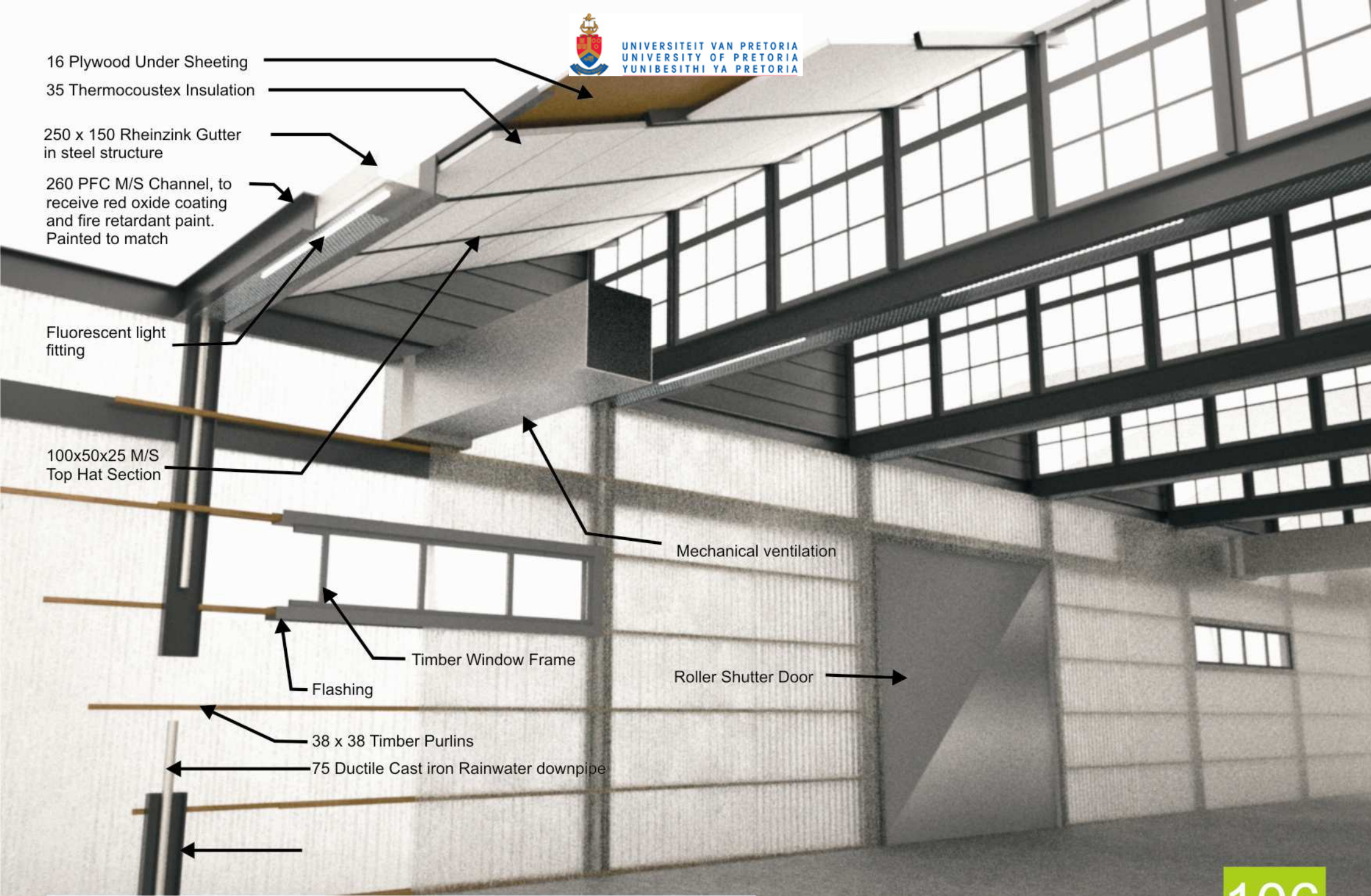
The resulting saw-tooth roof construction encompasses all of the parameters initially set, and has given the architecture a legibility related to the program.

The conceptual evolution of the roofing form is illustrated to the right. Initial investigations included shading the concrete roof structure with retrofitted solar panels. This was later adapted to a concrete roof structure optimally inclined for solar radiation. As the design progressed the roofing component changed to a lighter modular steel structure, based on the sizes of Wispeco steel school type pivot windows, was implemented to allow users to interact with the building and allow excess heat gain to escape.



▲fig7.16 Evolution of the Roofing Structure (Author 2007)

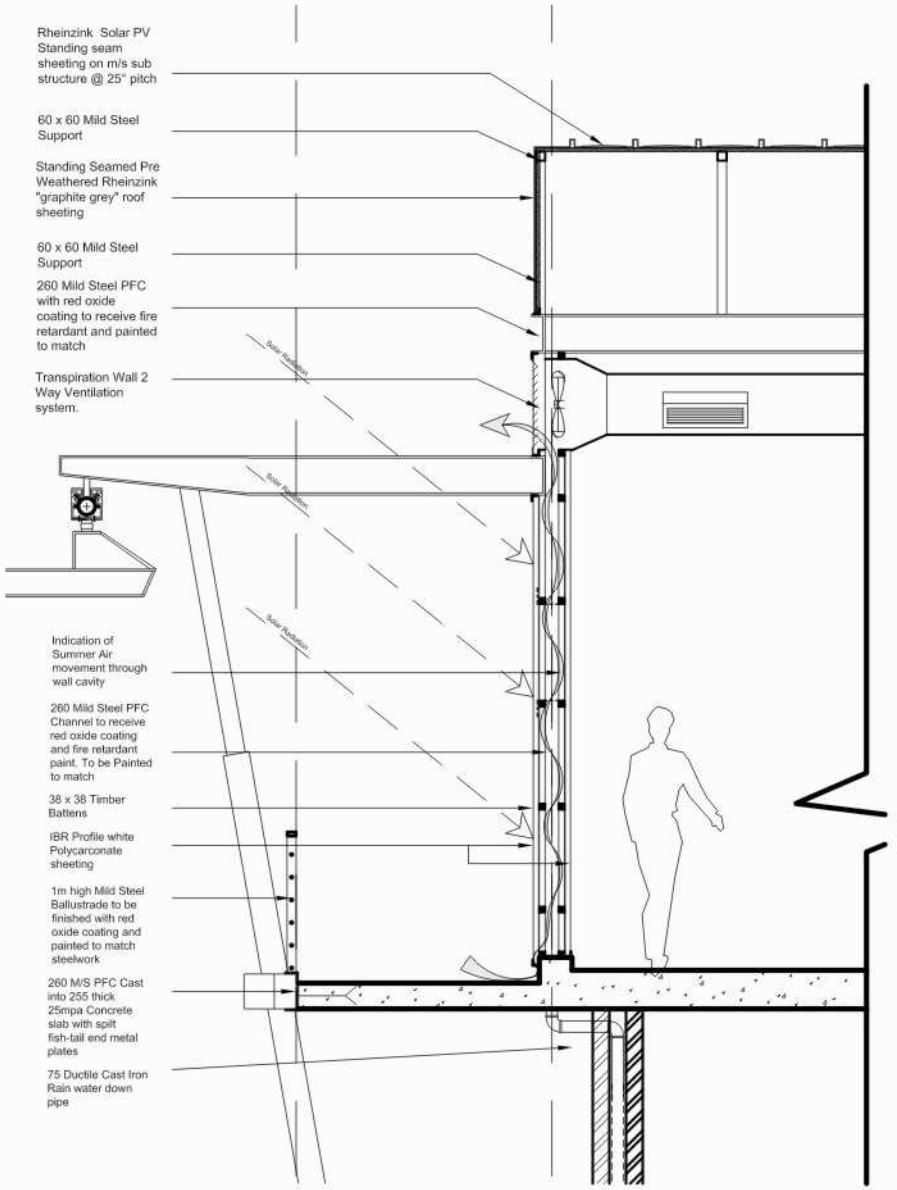
Integrated Envelope & Roofing Solution



▲fig7.17 Exploded 3D Detail Illustrating Roof & Wall Construction (Author 2007)

Wall System Detail

Scale 1:50



Roofing System Detail

Scale 1:20

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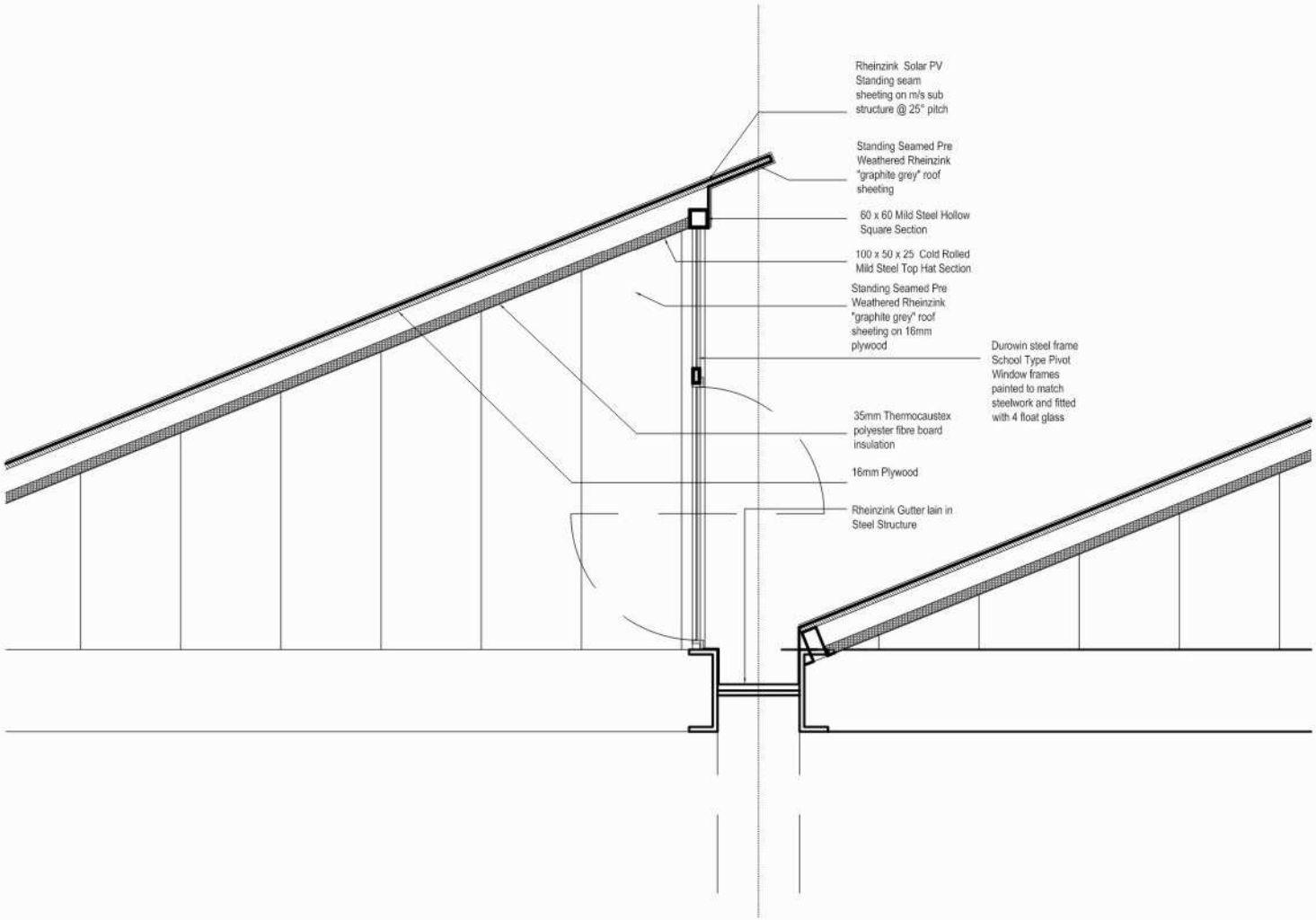

Balcony Detail

Scale 1:20

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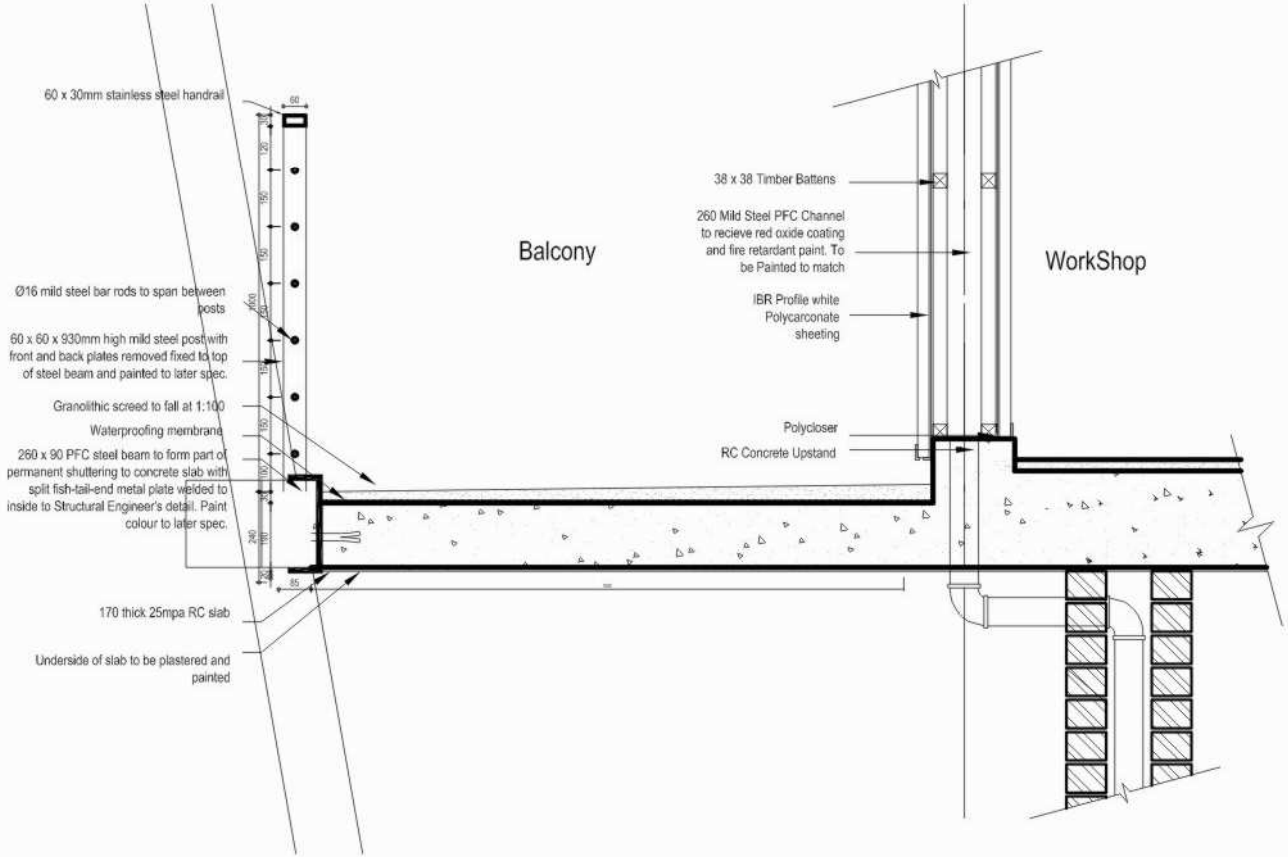


Sizing Rainwater Downpipes

Using the above criteria and assuming the highest 30year data on record, namely 160mm over a 24 hour period and using that as an hourly rate, the following discharge is needed

	Design Area	Rainfall Intensity mm/h	Reqd Gutter discharge area (mm²)	(cm²)	Actual supplied (cm²)
Roof Area 1	47sqm	160	7400	74	**90**
Roof Area 2	68sqm	160	11000	110	**156**

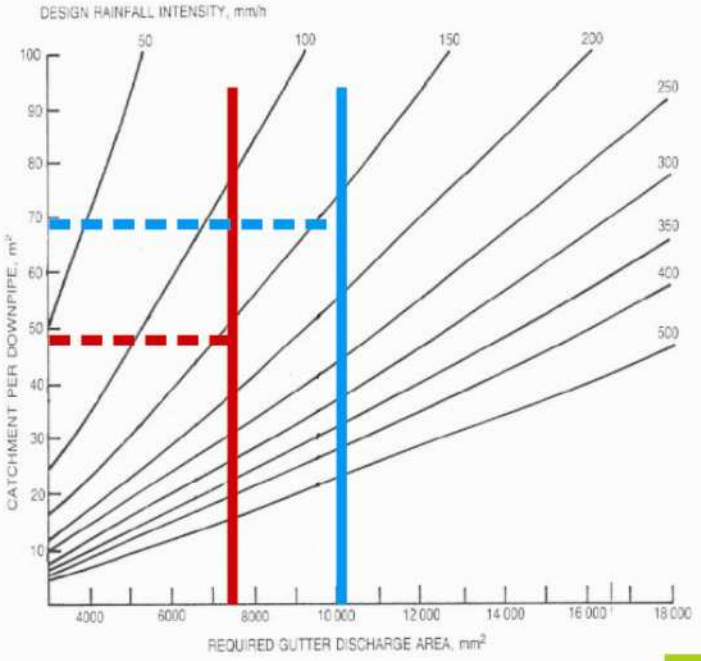
Climate data

Pretoria

Position: 25° 44' S 28° 11' E
Height: 1330m
Period: 1961-1990
This climatological information is the normal values and, according to World Meteorological Organization (WMO) prescripts, based on monthly averages for the 30-year period 1961 – 1990

Month	Temperature (° C)				Precipitation		
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded	Average Monthly (mm)	Average Number of days with >= 1mm	Highest 24 Hour Rainfall (mm)
January	36	29	18	8	136	14	160
February	36	28	17	11	75	11	95
March	35	27	16	6	82	10	84
April	33	24	12	3	51	7	72
May	29	22	8	-1	13	3	40
June	25	19	5	-6	7	1	32
July	26	20	5	-4	3	1	18
August	31	22	8	-1	6	2	15
September	34	26	12	2	22	3	43
October	36	27	14	4	71	9	108
November	36	27	16	7	98	12	67
December	35	28	17	7	110	15	50
Year	**36**	**25**	**12**	**-6**	**674**	**87**	**160**

http://www.weathersa.co.za/Climat/Climstats/PretoriaStats.jsp



Sizing Downpipes (Krige 2007)

Sustainable Building Assessm

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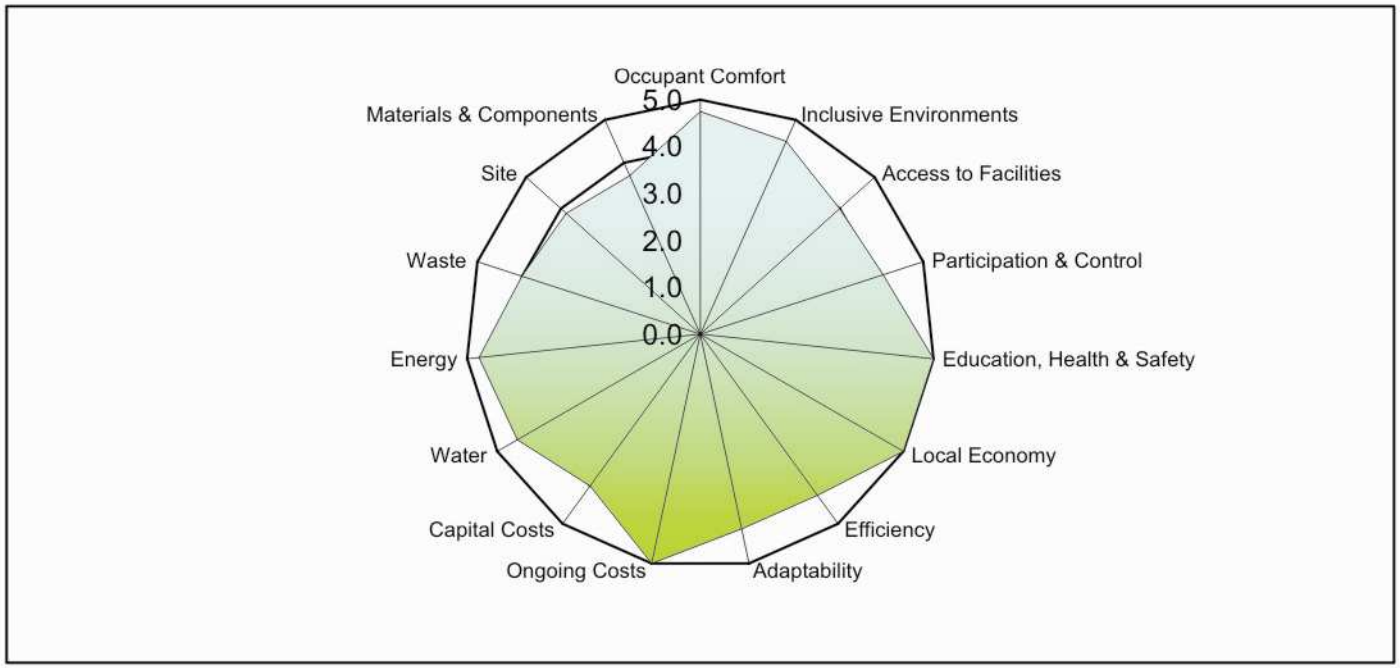
PROJECT		ASSESSMENT	
Project title:	Green Building Workshop	Date:	10-Sep-07
Location:	Marabastad, Pretoria	Undertaken by:	Mark Falconer
Building type (specify):	Commercial		
Internal area (m2):	6250		
Number of users:			
Building life cycle stage (specify):	Design		



Social	4.5	Economic	4.5	Environmental	4.2

Overall	4.4

Produced by SBAT Tool created by Jeremy Gibberd (Gibberd, 2003)

Conclusion

It has become evident that the built environment has started to recognize the effect that the environmental neglect has generated. Kirsten Childs asks “How can these disparate goals – human well being and the enhancement of the environment – be addressed by one set of functional and aesthetic objectives?” (Childs 2005, p.41)

Samuel Mockbee of the Rural Studio equates architecture with morality. He claims that evident gluttonous affluence has seduced the profession of architecture, tempting it away from its moral mandate towards 'stage-set design' that no longer takes people or place into consideration” (Steele 2005, p.233). Although this seems to be the case, this exploration of the arena of sustainability has identified various examples of projects that indicate that the perceived disparity between environmental concerns and the quest for human happiness is a misconception. “In environmental/sustainable design philosophy, it is a truism that critical factors that optimise building performance and reduce environmental impact also enhance human well being “(Childs 2005, p.41).

In the pursuit of an architectural expression of the researched sustainable design philosophy, it has become evident that it is not possible for one set of aesthetic or o address the concerns of different projects. When setting out to achieve an architectural expression that restores the natural environment as well as man's connection to this environment, each project needs to respond to its own context by evolving out of the social, cultural, climatic and physical influences in and around the site.

Much of today's contemporary architecture “is devised as an interpretation or illustration of spurious theory, rather than being grounded in a larger web of realities. The architecture of the emergent new long term paradigm must be born from an evolutionary and ecological perspective, to be good for both planet and people and grounded in the complex and sensual realities of place and lived experience (Buchanan 2005, p.29). The emergence of sustainable architectural thought, in response to the environmental crisis has awarded architects an opportunity to be part of the solution.

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