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

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

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
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 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 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.

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.

Heritage in the area would be the Meriammen Temple, a former national first grade monument (Tayob, 1998:161). Then there is the Ismaili 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.

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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 an 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)

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 STUDY
Even in its current dilapidated state the proposed site hosts an array of possibilities. The idea 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.
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)

\[\text{fig 5.9 Black train-commuting patterns in Pretoria, 1969-87 (Brandt 2002)}\]
Response to Context

- Urban Framework
- Movement
- Activities
- Demographics
- Public Spaces

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 accessibility 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.

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: Accessibility, 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.

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

Solar Access

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

In a climate like South Africa's, it is crucial to design with the solar path in mind. As simple as it seems, we can see in the table (fig 5.26) 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 terms 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.

(fig. 5.26 Conceptual Section indicating Solar Access (Author 2007

<table>
<thead>
<tr>
<th>BUILDING TYPE</th>
<th>RESPONSE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Priority</td>
<td>2nd Priority</td>
</tr>
<tr>
<td>Internal Loaded Buildings</td>
<td>Cold</td>
<td>Lee</td>
</tr>
<tr>
<td>Skin Loaded Buildings</td>
<td>Cool</td>
<td>Sun</td>
</tr>
<tr>
<td></td>
<td>Cool</td>
<td>Winter Sun; Summer Wind</td>
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<tr>
<td></td>
<td>Cool</td>
<td>Winter Sun; Summer Wind</td>
</tr>
<tr>
<td>Hot-Arid</td>
<td>Hot-Arid</td>
<td>Summer Shade</td>
</tr>
<tr>
<td>Hot-Humid</td>
<td>Hot-Humid</td>
<td>Summer Shade</td>
</tr>
<tr>
<td>Hot-Arid &amp; Tropical-Arid</td>
<td>Tropical-Arid</td>
<td>Shade all seasons</td>
</tr>
<tr>
<td>Hot-Humid &amp; Tropical-Humid</td>
<td>Tropical-Humid</td>
<td>Wind all seasons</td>
</tr>
</tbody>
</table>

(fig. 5.27 Site Orientation and Layout By Climatic Priority (Brown, GZ. DeKay, M 2001, p. 103)
Climatic Influences
- Solar Access
- Solar Power
- Orientation - Sun & Wind
- Wind - Passive Ventilation
- Wind - Courtyard Sizing

“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 feasibility 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)
Climatic Influences

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

Total Floor Area 7285m²
35W/m² = 255kW

Photovoltaic Area 1300m²
Solar Power per sqm 100W/m² = 130kW

Water Heating 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 than 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.

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

Diagram 5.32 Summer Wind Movement over Building (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.
Climatic Influences
- Solar Access
- Solar Power
- Orientation - Sun & Wind
- Wind - Passive Ventilation
- Wind - Courtyard Sizing

Ventilation Blockage Ratio
(Brown 2001, p107)

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

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

Legend:
- Wind Direction

\[R_b = +0.07\]

\[\text{fig 5.36 Sizing Courtyards for Ventilation (Brown, GZ, DeKay, M 2001, p. 209) Edited by Author}\]

\[\text{fig 5.37 Factors in Calculating blockage ratio (Brown, GZ, DeKay, M 2001, p. 102)}\]

\[\text{fig 5.38 Predicting wind velocity in streets (Brown, GZ, DeKay, M 2001, p. 107)}\]

\[\text{fig 5.38 Isolated Roughness Wind Flow Regime (Brown, GZ, DeKay, M 2001, p. 117)}\]

Building Footprint
“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)