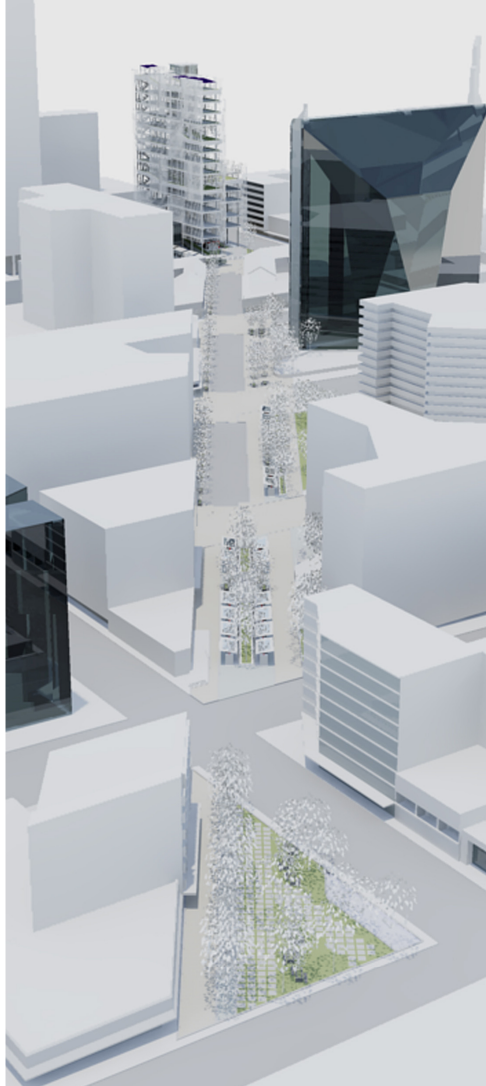




**THE BIOLOGICAL
LINK BETWEEN
URBAN SPACES**

**BY
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THIS DOCUMENT IS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE:
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1. ABSTRACT

According to the UN report released on 26 February 2008, half of the world's population has been living in cities at the beginning of this year. This rapid urban growth puts high pressure on the built and even more on the natural environment. After a long time replacing earth's natural eco systems with artificial equivalents with little thought to long-term consequences, urban citizens today are mostly depending on government infrastructures to sustain their daily consumption needs.

Local eco-systems are already unable to sustain future needs to consume non-renewable energy resources. In a (partially) developing country like South Africa, it is of utmost importance to adopt a more sustainable life-style through environmentally integrating building systems and urban infrastructural alternatives, which respond and enhance local ecosystems.

This thesis works within Johannesburg's inner city and intends to use architectural forms and practices to make the most of the ambient energy stored in nature with minimal use of conventional or alternative non-renewable energy resources. Thermal comfort will be achieved by observing and understanding what affects the local rainfall, wind, sun path,

temperature, humidity, location, orientation, and the choice of urban materials/surfaces have on a selected part of urban surroundings and built forms. Diagonal Street will serve as testing ground.

Through utilising architectural methods and technologies as a means to achieve low energy impact on the surrounding ecology of buildings, a manual can be designed on how to promote better thermal comfort levels and enhance the quality of space in existing urban fabrics by creating either new built forms or refurbishing/adapting existing buildings.

The integration of environmental building practices in the future planning of Johannesburg City becomes a powerful argument on why there needs to be a better variety of ecological diversity in urban cities today and in Johannesburg in particular. This thesis will refer to those practices as biophilic architecture.

The biologist E.O. Wilson introduced the word biophilia in 1984, dealing with the affiliation of nature and other living forms. The objective of this thesis is to stem a better symbiotic relationship between nature and the built environment.

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2. DECLARATION

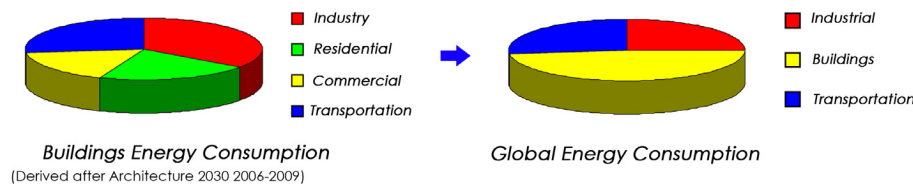
I, *Heinrich Schippers (0304840M)*, am a student registered for the degree: Master of Architecture [Professional] in the year 2009. I hereby declare the following:

I am aware that plagiarism [the use of someone else's work without permission and/or without acknowledging the original sources] is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of ideas or words in my own work.

.....
Signature

3. INTRODUCTION

The global population has reached a crises point where our natural eco-systems are declining at such a fast rate, that they are no longer able to sustain our need to consume resources, especially in the building sector. The two main reasons for the declination of our eco-systems are a result of overpopulation and the mismanagement of our natural resources. The depletion of our natural resources has also led to the rapid urbanisation of our cities, which puts more stress on our urban infrastructural support systems.



The building sector is responsible for the largest consumption of fossil fuels and natural resources used to build and operate buildings of today (Architecture 2030). Coupled with the slow adaptation of techniques/technologies to improve these inefficiencies there has been a shortfall of in-depth analysis on how best to alleviate the crisis through better sustainable building practices. Unless architecture, planning and the rest of the built environment act now and act decisively, the current design and building trends will lead to disastrous global consequences.

The key objective to my thesis is to promote a symbiotic relationship between nature and the built environment in the city of Johannesburg. People in an urban environment do not simply want to eat, sleep, work and play in a functional building. They want to be inspired, comforted and reassured by their surroundings. Biophilic architecture offers the opportunity to achieve an environmental, moral, social and economic relationship between nature and the built environment. The human species evolved out of its natural setting, it adapted to the local climate to provide shelter. Over centuries, the adaptation to the natural setting has evolved building materials, methods and forms that are specific to the region and with it developed certain cultural attributes. Every site is definite to its location, natural relief, local vegetation and its macro-, micro-climate. The question really is what kind of urbanism is embedded in our environments and not the other way around. Illich clarifies the understanding better.

“Just as the home reflects in its shape the rhythm and extent of family life, so the commons are the traces of the commonality. There can be no dwelling without its commons..... Spaces fit to bear the marks of life as basic for survival as clean water and fresh air. Human beings simply do not fit into garages, no

matter how splendidly furnished with..... energy saving devices (Illich, 1982:60)."

To address the concern of what type of urbanism is in our environments, economics might point out the problem might lie within our governance of cities. Governance might argue the environment is to blame and in response, the environment would blame the population (Roaf S. 2005:70). Urban sprawl is part of every cities growth, but it is usually detrimental to our environments. Looking at everything as a whole, the bottom line effect from an economic, social and environmental view is that all aspects influence one another. Whatever the outcome, it will affect us as a population.

We as a species are altering the temperature, light and the natural ecological flow of seasonal cycles irrationally with no knowledge of what the possible results might be (CHERMAYEFF S., ALEXANDER C 1963:14). Nature made man, man made culture. In return, culture redefined man. Man destroys nature, out of which man ultimately developed as a species. What are we doing to preserve our environment for future development? This is the role we as architects and town planners have to fulfill by creatively reconstructing our ecology.

We failed to produce satisfactory new environments and we are also losing the best of the old. Looking at ancient places, powerful symbols, historical buildings and many historical cities tell of man's evidence of communal way of life- all are either being neglected or completely destroyed. No environment, natural or man made can withstand the presence of crowds and machines for which that environment was not intended for. Even when attempts are made to preserve and protect these environments, they seem to be futile when intruding quantities of man and vehicles impose. Capsule design for submarines and spacecraft expeditions are good examples of artificial habitats. The designers of capsules (CHERMAYEFF S., ALEXANDER C 1963:46) have observed that the technical problems of providing food, air and other physical technicalities are trivial besides the point of keeping the inhabitants of the capsule humane. The greatest difficulty seems to be the stress of confinement on the capsule's inhabitants. The synthetic environment and the inability to escape, produces unbearable nervous stress on the inhabitants.

When man has taken over every natural surface on earth's planet and replaced it with a machine-made artificial environment, the capsule syndrome, as discussed, might occur. The sooner we realize in adopting a more sustainable

lifestyle approach in the way we live in urban cities today, is to develop a fully functional framework for ecological equilibrium (CHERMAYEFF S., ALEXANDER C 1963:46).

Architectural built forms offer the opportunity for urban man to regulate and define himself through the changes in season just as he regulates himself from the light of day and the darkness of night. Environmentally responsive architecture will help assist man's affiliation with nature which response to him rationally in terms of human performance and health even on a spiritual and emotional level (Almusaed A. 2006:1). Taking natural and artificial building elements, sustained by seasonal cycles, evaluated and strategically placed within an urban framework, it may benefit and facilitate urban man in terms of his daily city needs.

Through Biophilic design, I intend to utilise Diagonal street's given location and natural setting to provide a better urban environment by altering, enhancing and extending the horizontal and vertical urban surfaces/materials most beneficial to the urban dweller. The key design strategy is to identify different criteria that constitute the spirit of Diagonal Street, and then to facilitate the in-between spaces in terms of interconnected activity patterns through providing ideal thermal comfort levels. The urban man needs a natural setting

in which the human mind can evolve and culture could be further developed just as it has done over millions of years through evolution. Biophilic architecture aims to create environmentally friendly, energy-efficient buildings and promote efficient management of natural resources in the built environment.

4. METHODOLOGY

4.1. METHOD OF APPROACH

I intend to take an empirical research approach for purposes of this thesis. By having done extensive site visits to Diagonal Street and mapping out which environmental, social and economic influences the macro and micro climate, urban surfaces and built forms will have on the quality of space and on the quality of the urban user's lifestyle. This will allow me to derive a set design program influencing my design. Diagonal Street will be the focus for theoretical discussion and applying theoretical findings. The design program will allow me to reinterpret my theoretical findings and implement a design strategy on Diagonal's horizontal and vertical urban surfaces to create the ideal thermal comfort levels for the urban user. By doing so, I intend to enhance the quality of urban spaces and urban users' lifestyles and facilitate public connectivity patterns most beneficial to the local economy.

The following plan and design framework, to implement site and theoretical research into an initial planning and design approach, was done in fulfillment of the University of the Witwatersrand's Bachelor of Architectural Studies (Honours) degree program for Elective 3: Sustainable Cities and

Settlements. The theoretical research and design approach that we developed as a group of students is very similar to my thesis proposal and therefore the same method of initial planning and design implementation is adopted.

4.2. DATA COLLECTION

Site visits are my main source of obtaining data from the local climate conditions by mapping surfaces and bodies. Theoretical research, conducted from various sources, followed to determine certain outcomes and interventions. A reference list of which can be found in the back of this document.

4.3. DESIGN PROCESS

The design process is divided into two categories. The first is to approach the software issues, in which I will focus on the needs of the community according to social and economic criteria. The second approach focuses on the hardware, which is the site itself and its spaces.

Software way of approach

- Planning: city and site chosen
Choosing a site to create ideal thermal comfort levels to improve the quality of space that the urban users' desire.
- Investigating the market:
Identify urban users and cater for their unique desire that sited within the market
- Develop initial thinking: lifestyle
After researching urban user's needs and desires, form a lifestyle for the local community
- Developing principle: Urban users.
Now that you identified the urban user's needs, accommodate different urban users through activity patterns and places
- Developing a totality plan: urban user's life style
The design style must accommodate the different urban users' needs (regional integration).
- Detailed planning: management, control and development at a later stage.
After design implementation is completed, it is up to the urban user to manage and maintain the new urban intervention for future economic opportunities and growth.

Hardware way of approach

- Planning: city and site chosen
Choosing a site that will benefit from local climate conditions and ambient energy stored in nature.
- Investigating the market: environmental, economic and cultural resources.
Identify a site that has access to various types of cultural and economical amenities and desirable advantages from the local climate for future green development.
- Develop initial thinking: initial approach to space planning
Identify and allocate spaces of activity by means of block planning and colour co-ordination to relate to one another.
- Developing principle: Urban users.
Allocate different urban users based on previous research of their needs in relation with geographical locations.
- Developing a totality plan: urban use of land
Areas of different usage must be carefully distributed according to uses and accessibility. To be done in plan
- Detailed planning: developing planning.
An architectural type, orientation of building and open space needs to be planned according to the above research.

Using the software and hardware way of research, I will be able to create a better lifestyle of the different urban users' needs and quality of space that would benefit from local microclimate conditions.

4.3.2. FUNDAMENTAL RESEARCH

Investigate what effect the site's climate conditions will have on a built form and its surroundings in terms of:

- Passive mode by building configuration
- Passive mode by building orientation
- Façade Design
 - Solar control
 - Insulation
 - Passive Day-light concept
 - Colour of built form's envelope
- Wind and Natural Ventilation
- Passive mode by landscaping

4.3.3. CONTEXTUAL RESEARCH

After determining the effects the local climate has on Diagonal Street's spaces and the urban users' lifestyles, architectural practices will not only be implemented to

improve climate conditions but also to be utilised to facilitate economic growth and social integration through connecting spaces of interest and encouraging movement patterns. The context will be investigated in terms of:

- Tradition and Identity
- Spirit of Place relating to Activity and Needs
- Efficiency of Infrastructural Support Systems
- Equitable Access to a Valuable Variety
- Integrated Modes of Transport/Movement

4.3.4. DEFINING A THEME

The environmentally responsive design approach will take all the fundamental and contextual research and analysis into account and apply it to Diagonal Street's urban context to improve urban users' comfort levels, lifestyles and quality of space based on the set program that will follow out of the analysis.

4.3.5. DRAW UP CONCEPTUAL PLANNING PROGRAM

- Plan for environmental integration
- Respond to history
- Setting up an axis connecting activity patterns identified
- Zone the activities according to set program's needs
- Define facilities that need to be linked
- Link with existing and future infrastructural amenities
- Facilitate integrated movement patterns

A more detailed urban framework/program will follow in the program section of this document and a set brief will determine specific infrastructural built forms and buildings on Diagonal Street.

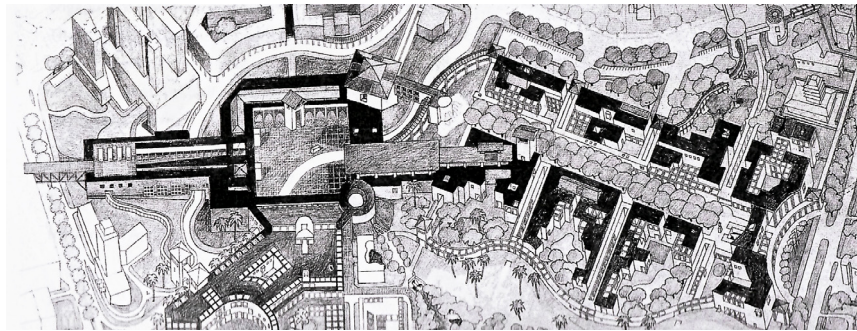
4.3.6. DRAW UP A BASIC PLAN

Out of the conceptual plan, a basic plan will follow, determined by the program and brief, where all environmental, social and economic aspects will be addressed as discussed in this document. The plan will then be further developed into working line and 3-d presentation drawings to convey the theme of this thesis. A cardboard model will also be built as part of the thesis presentation.

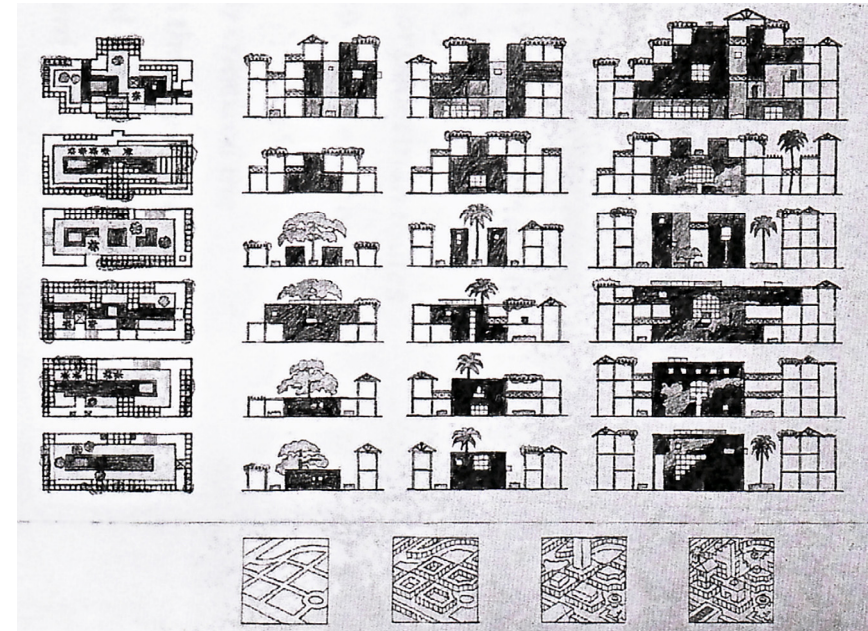
5. KEY DRIVERS, THEORIES & Principles

The spaces between buildings are as important to life of the urban dweller as the buildings themselves. The total land between buildings need to planned for maximum use at every scale to achieve full mix use potential in the inner city. As for buildings in an urban context, they also have to respond and take on a more sustainable approach towards the local environment. The building design approach of ignoring locality, wasteful land use patterns they generate, ignoring street edge interaction and the separation caused by road infrastructure and parking lots are all detrimental in promoting city life (Labaki, L. 1998).

Today's world shows there are examples in architecture, which demonstrate a successful synthesis of modernity, tradition and regional integration. It demonstrates how to frame an Architectural language, which shows an understanding of traditional values, while expressing a nation's economic ambition. Ken Yeang, who is a leading architect in bioclimatic design, submitted a design for the Kuala Lumpur Golden Triangle Urban Competition, which led to the publication of the book *The Tropical Veranda City* (Powell, R. 1999:135). It developed the concept of Kuala Lumpur as a tropical urban



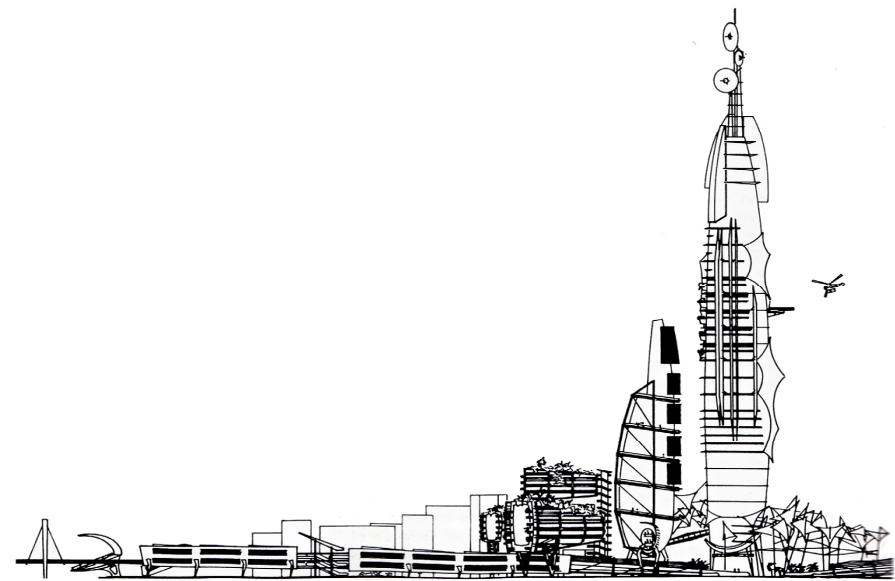
The Tropical Veranda City
(Powell R. 1999:133)



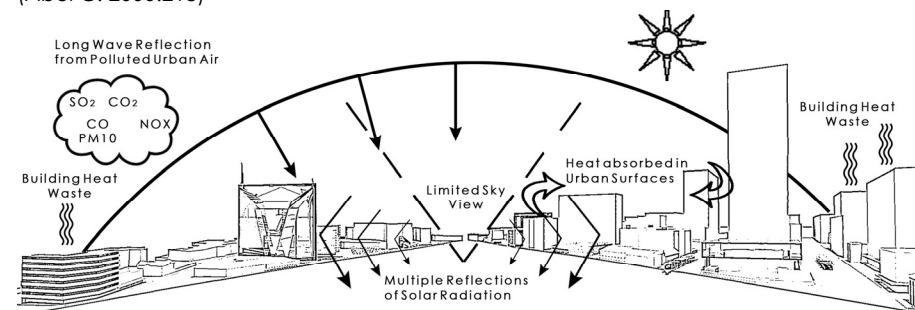
The Tropical Veranda City: the in-between spaces
(Powell R. 1999:133)

garden with landscaping, connected by systems of covered and open walkways. Major pedestrian routes were designated alongside the Klang River to provide historic linkages and to connect civic nodes. The book also examined the idea of how to explore the in-between spaces around a building. Yeang looked at the permeable edges of buildings and the layering of facades and concluded that the edges of buildings must become softer and the idea of ecologically responsive urban planning originated.

Johor Bahru 2005 is a conceptual master plan for Peninsular Malaysia's southern most city. The Bioclimatic city reacts like the human body, which adapts to its immediate environment. Just as the body maintains its stability by cooling via its extremities and by homeostatic systems, so too can the city employ cooling layers and use principles of homeostasis to maintain levels of comfort. Yeang (Powell, R. 1999:142) explains the architect and urban designer must design structures and spaces to protect and enhance climatically the local urban environment. By adding additional layers superimposed over the existing city. Some structures act as sun-shading devices over existing pedestrian routes. Urban spaces are protected by canopy structures, creating shaded places for public gatherings. Vegetation on roofs and walls in various plazas provide recreation areas and assists in cooling the city's



Bioclimatic city of Jahor Baru 2005
(Abel C. 2000:218)



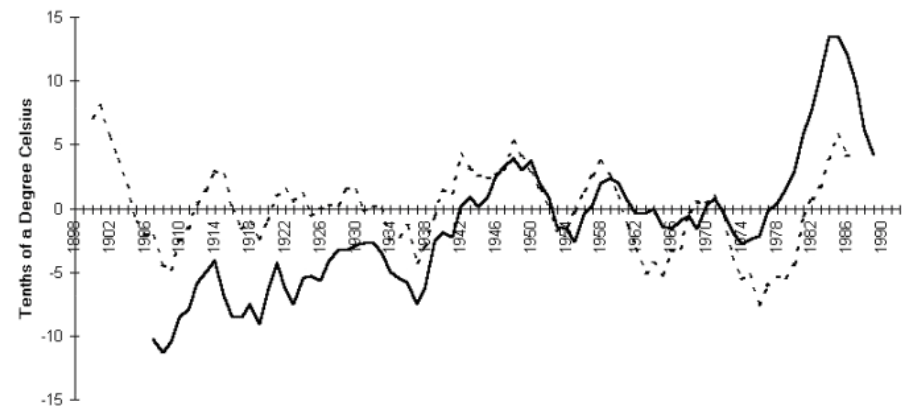
Causes of unwanted heat island effect
(Derived after Emmanuel, R. 2005:88)

structure. Wind is channeled along pedestrian areas, evaporative cooling is introduced along city streets by strategically placing water planters that coincide with seasonal winds. Wing walls are also used to redirect wind and create natural ventilation in office buildings.

Biophilic design will help to develop patterns of design that would facilitate climatically suitable urban forms which responds to human comfort and needs. Furthermore, it would promote new traditional architecture based on new technologies, which will create new and establish old cultural traditions and identities, particularly in the city. To improve human comfort, the climate has a significant effect on these systems based on a building's location. Biophilic architecture considers all passive mode design strategies to achieve a passive low energy design beneficial to our environments.

As mentioned before, humans alter their environments with no rational after thought of what the implications might be on their surrounding climatic conditions. The climatic affect of a built up area generally includes higher temperatures due to the heat island effect caused by trapped green house gasses and heat in the atmosphere above cities (Emmanuel, R. 2005:24). This caused by solar radiation, which is either reflected back into city's atmosphere or stored as heat sinks by

Johannesburg warming relative to Bulawayo Observatory.



JHB Urban Heat Island effect has grown 1°C per century
(www.warwickhughes.com)



Airborne thermal image of Johannesburg CBD (brighter – warmer)
(Goldreich, Yair 2005:4)

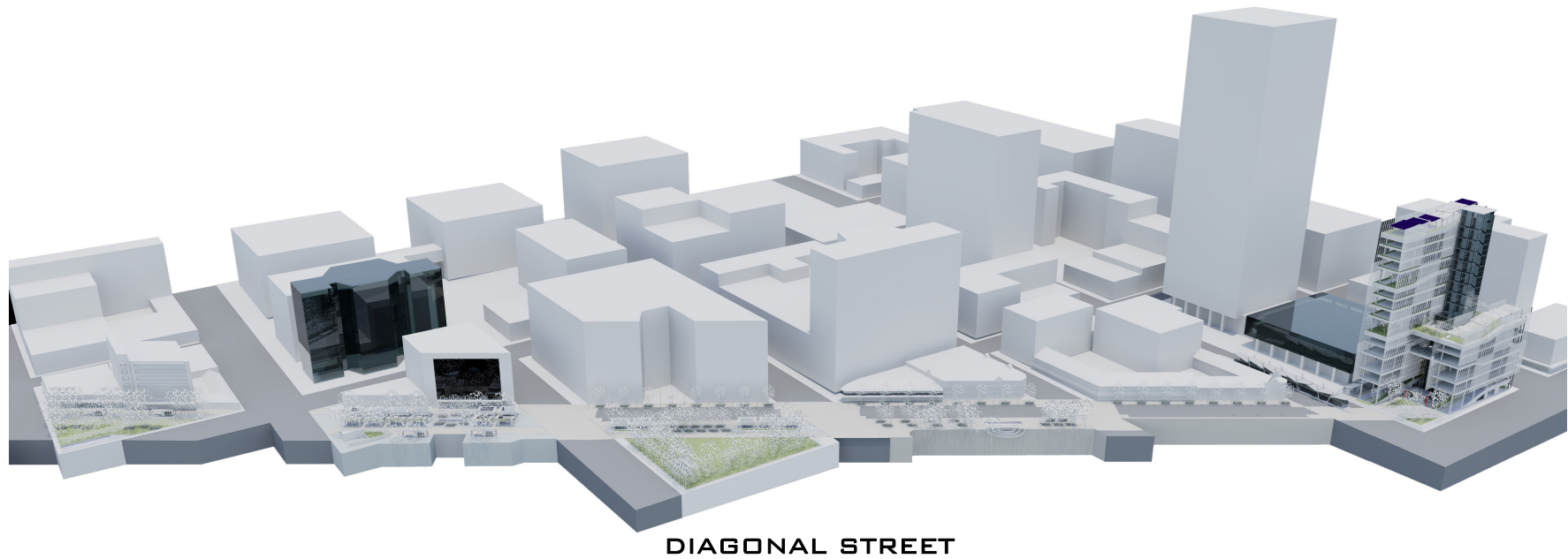
hard urban surfaces. Later on, the heat is slowly released into the atmosphere. A lack of green spaces in cities only worsens the effect, along with buildings that form wind shelters that prevent natural ventilation to dissipate heat gains (Emmanuel, R. 2005:25)

Unfortunately, many cities including Johannesburg were planned and laid out before environmental consequences were understood. It is up to us as architects and town planners to restore the balance between nature and the built environment, benefiting from the ambient energy nature has to offer.

Diagonal's location needs to be analysed by its natural or given urban features, since they can significantly affect the layout of the built form. Passive mode design produces improved human comfort conditions without the use of any non-renewable sources of energy. Biophilic architecture is in part passive mode design, which requires an understanding of the climate of that particular region. This allows the built-form to benefit from energy stored in local microclimate. Passive design methods achieve thermal comfort by using natural energy sources e.g. solar radiation, wind power, stack effects caused by rising hot air, wet surfaces, evaporative cooling by vegetation and heat sinks by thermal mass

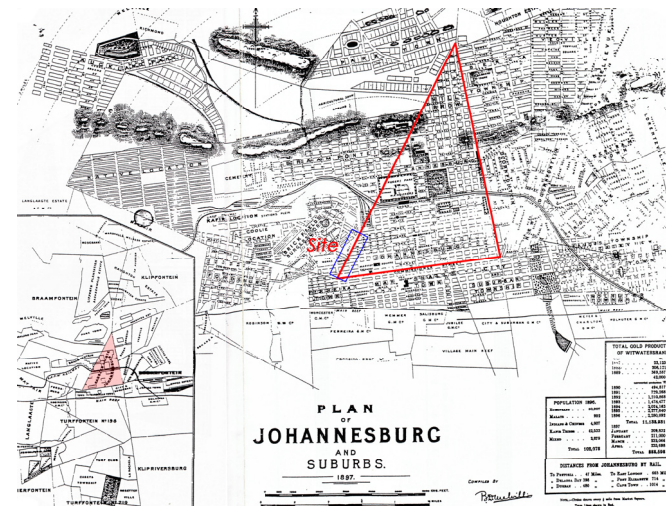
(Yeang, K. 2006:191). Obviously, each energy source is optimised differently according to local climate conditions. Some of these ambient energy sources will be maximised while others are kept to a minimum.

5.1. SITE APRAISAL

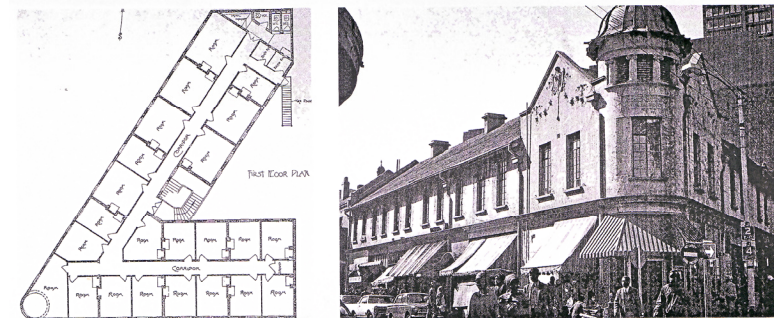


The significance of Diagonal Street is that it used to form the border between the old Johannesburg and the farm Langlaagte. Johannesburg was originally set out in a triangular shape and Diagonal Street use to form the western boundary between the city and the Indian settlements just outside the city border. There was a strict law that restricted property ownership of the coloured native races of Asia, so they settled just outside the city limits or on its edges. The Diagonal precinct became a radically mixed-use area and sometimes referred to as Jubilee Street.

In the early 20th century the Indian and native locations, which were now wedge between poor white slums, were relocated to the farm Klipspruit (Soweto today) and the area was declared a white zone only and called New Town. The relocation of the Indian settlements were brought about by the implementation of the Sanitation Act in the early 20th century, which gave the government at the time an excuse to vacate the area for political reasons and to get control over the native working class. Newtown was set out to become a commercial area for milling, produce, sugar and food procurements (Chipkin 1993:198).



(CHIPKIN, C 1993:13)

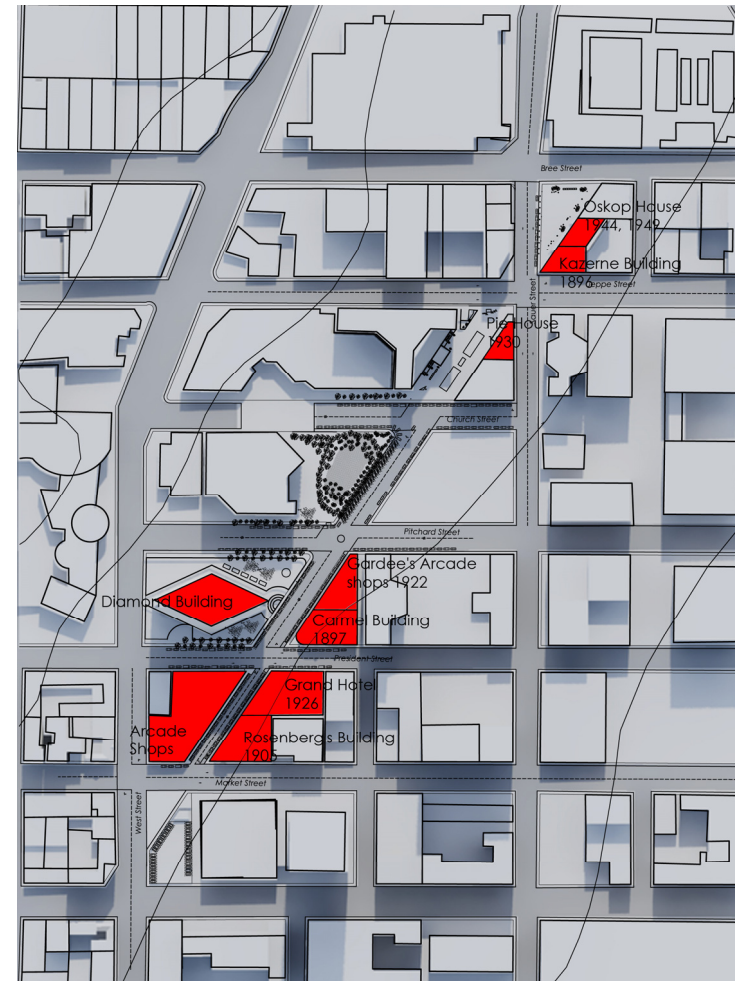


"Rosenberg's Building (1905), corner of Market and Diagonal Street, by W..H. Stucke. The diagonal plan form was dictated by the diagonal west axis of the original uitval grond. The ground floor shops have protective canopies. The upper-level accommodation was that of typical inner-city rooming house for Johannesburg's predominately male floating population. The gable enrichment reveals Stucke's connection with the art Nouveau movement. Photo taken by Jennifer Sorrel" (Chipkin 1993:28, 29)

The vibrant Diagonal Street also owes its vitality to the variety of old building types and styles, which still occupy the street edge today. The variety of architectural styles vary from modern building forms brought about by the economic boom in the late 1960's and early 1970's, to the first introduction of Edwardian and Victorian styles at the conception of Johannesburg as a city. To mention a few important buildings that still occupy Diagonal Street is the Diamond Building on 14 Diagonal Street, the Victorian neo classical Carmel building built in 1897 situated on the corner of President and Diagonal Street, the Kazerne building on the corner of Jeppe and Diagonal Street, which dates back to 1896. Gardee's Arcade, which is under renovation, forming part of the vibrant retail mixed-use shops on Diagonal Street built in 1922 and the Victorian/Edwardian Grand Hotel on 12 Diagonal Street dating back to 1926. These are just a few buildings forming the vibrant backdrop to Diagonal Street.

In the past 20 years, the region has suffered a period of disinvestment and degradation due to the decentralisation of nodes, which resulted in the low maintenance of buildings on Diagonal Street by their property owners, causing the street to decay slowly away. Some sections still flourish while other parts are laid bare or rebuilt on. In the 1990s, there was a total lack of urban management in the precinct, where crime took over.

Since then, the JDA and other private investment companies, Urban Ocean, have embarked on urban renewal programs for

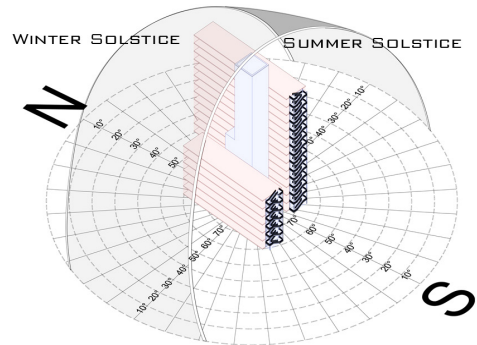


Significant Buildings on Diagonal Street

Johannesburg CBD. In recent years, continuous efforts have tried to reinstate Johannesburg's CBD as an important urban node. The region is now regarded as being a highly dynamic and evolving area, which predominately functions as a regional employment and shopping node for all residents in Gauteng, South Africa and other African countries. It is estimated that 7000 to 10 000 informal traders are located in the inner city and whose activities are regulated in terms of operation and location of market stalls- also located on Diagonal Street (JHB, RSDF Region F.: Section 2. 2008/2009:11). Johannesburg formal business sector is still flourishing today, but an increasing amount of small businesses are taking over the inner city. This was brought about by affordable rent being offered by land owners and the advantages of being centrally located to various transport nodes.

Tender applications were issued by the JDA in 2008 for the urban renewal of Diagonal Street to coincide with the greater urban scheme for JHB CBD. Gap Architects in collaboration with MNA Architects were appointed to address and implement.

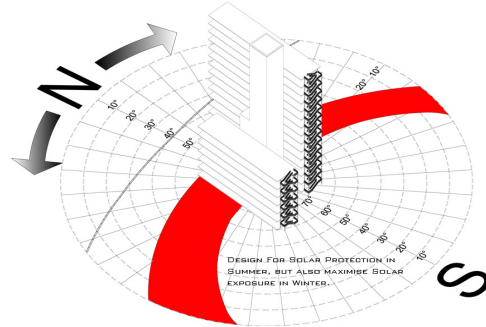
5.2. NATURE



DAILY ACTIVITIES
LOCATED ON THE
NORTH FACADE

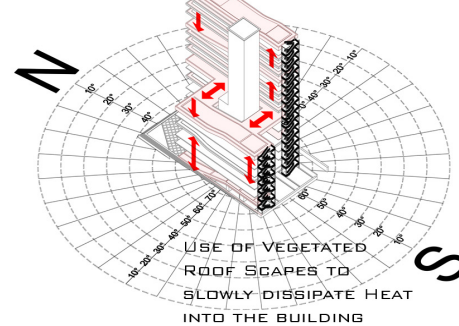
TRANSITIONAL SPACES
LOCATED ON THE
SOUTH FACADE

ORIENT BUILDING IDEALLY
BETWEEN 10°-18° NE

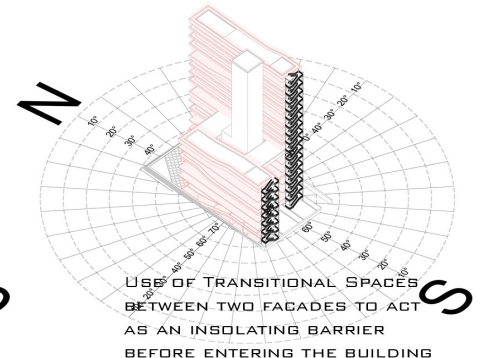


DESIGN FOR SOLAR PROTECTION IN
SUMMER, BUT ALSO MAXIMISE SOLAR
EXPOSURE IN WINTER.

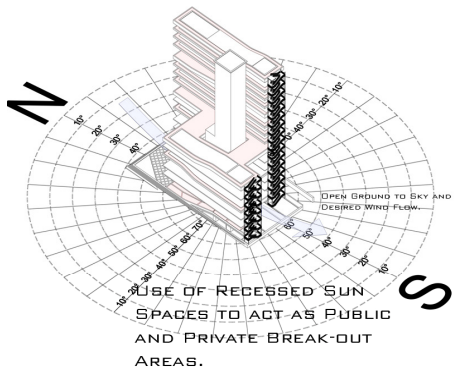
VERTICAL EXTENSION OF
HORIZONTAL LANDSCAPED
SURFACES



USE OF VEGETATED
ROOF SCAPES TO
SLOWLY DISSIPATE HEAT
INTO THE BUILDING

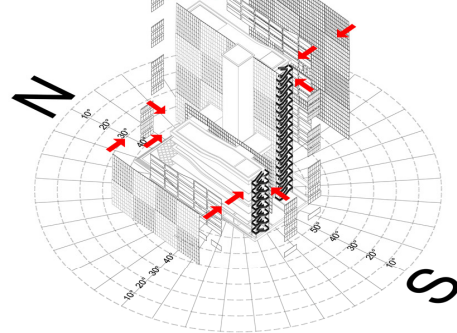


USE OF TRANSITIONAL SPACES
BETWEEN TWO FACADES TO ACT
AS AN INSULATING BARRIER
BEFORE ENTERING THE BUILDING



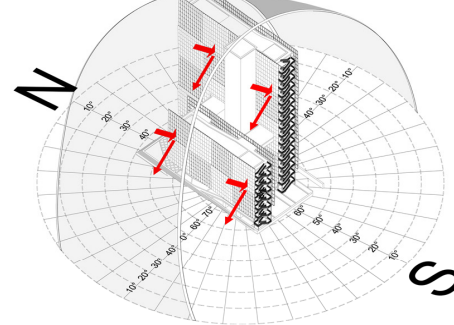
USE OF RECESSED SUN
SPACES TO ACT AS PUBLIC
AND PRIVATE BREAK-OUT
AREAS.

USE OF DOUBLED LAYERED
FACADE FOR BETTER
CLIMATE CONTROL

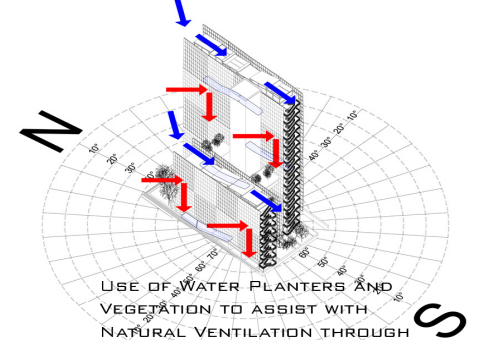


OPEN GROUND TO SKY AND
DESIRED WIND FLOW.

THE FACADE HAS TO SHADE THE
BUILDING'S OCCUPANTS FROM
UNWANTED HEAT GAIN FROM MID
DAY ONWARDS.



THE FACADE HAS TO BLOCK
UNWANTED WIND FLOW, BUT
SCOOP DESIRED WIND FLOW.

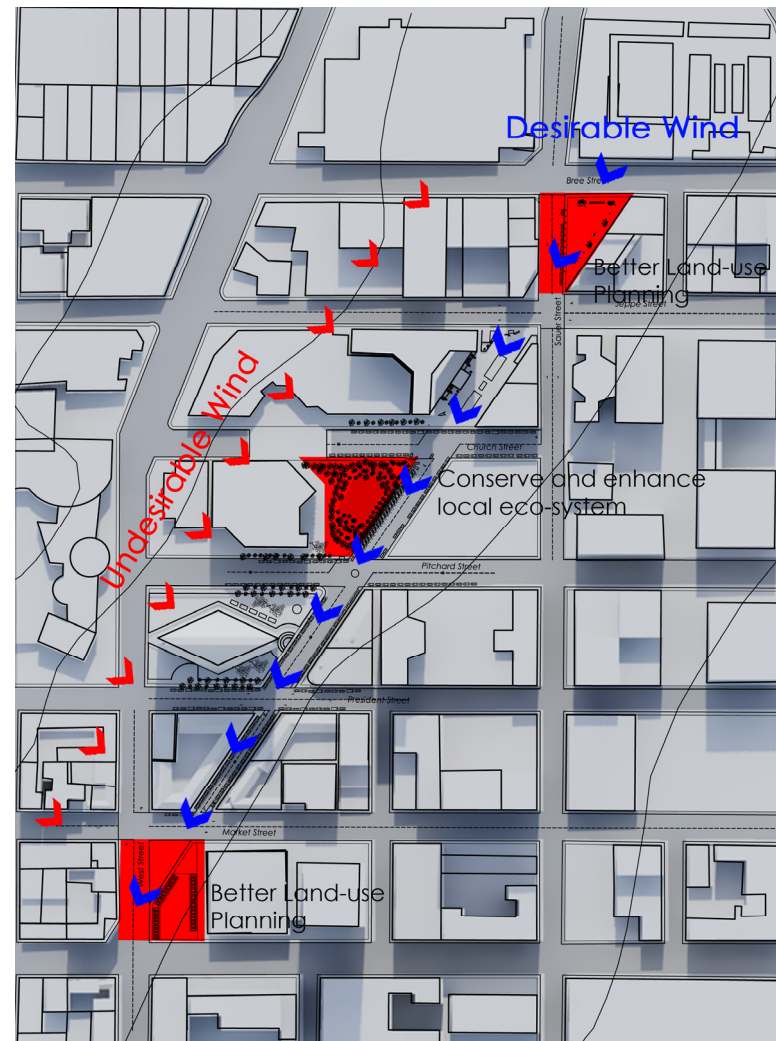


USE OF WATER PLANTERS AND
VEGETATION TO ASSIST WITH
NATURAL VENTILATION THROUGH
EVAPORATION PROCESSES.
THE DESIGN OF THE FIFTH
FACADE IN TERMS OF HAVING
MORE VEGETATED ROOF GAR-
DENS IS A CRUCIAL FACTOR IN
BIO-RESPONSIVE DESIGN.

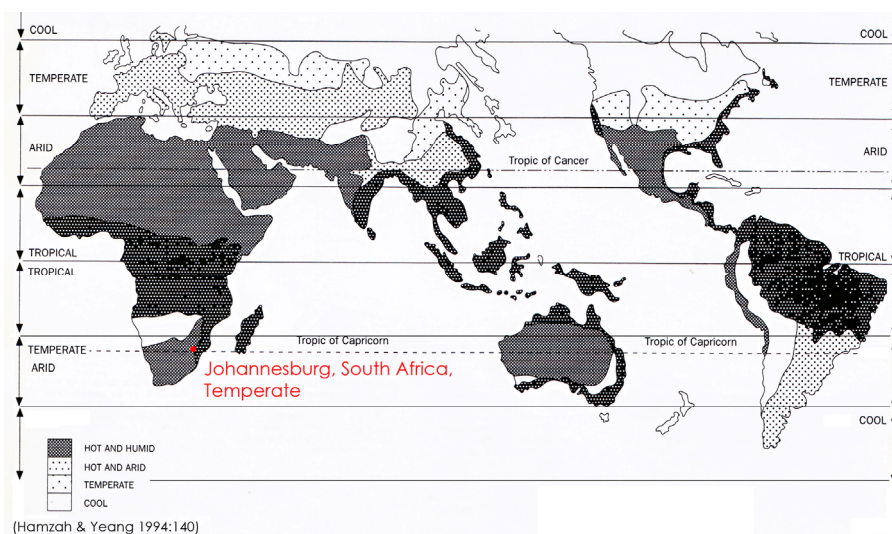
Through architectural building forms and practices, architects should aim to achieve a balance with nature in terms of the resources we consume as apposed to exploiting them by destroying ecological life support systems. An environmental assessment needs to be done on Diagonal Street to identify fragile zones to promote enhancement through conservation, better land use planning and better design of open space. This will help promote life cycle building energy consumption and pollutant emissions analysis (CIAM 2008).

The preservation of Diagonal's human habitat will be achieved through the replenishing natural cycles of the season to replace the natural resources inhabitants consume, creating an environmental equilibrium. The ecological urban balance can be maintained when fragile areas are reserved, conservation of eco systems are pursued and low intensity habitation precincts are thoughtfully identified.

The prescribed built form and building patterns chosen will depend on which passive design system is best suited for Diagonal Street's local climate to optimise on ambient energy recourses (Yeang, K. 2006:193). The chosen design forms are not based on the climate of the location but rather a response to it. The climate will not necessarily determine the buildings built form, but instead, it will have an influence on it.



Study the replenishing natural cycles on Diagonal Street to determine what effects they might have on the urban built form and environment.

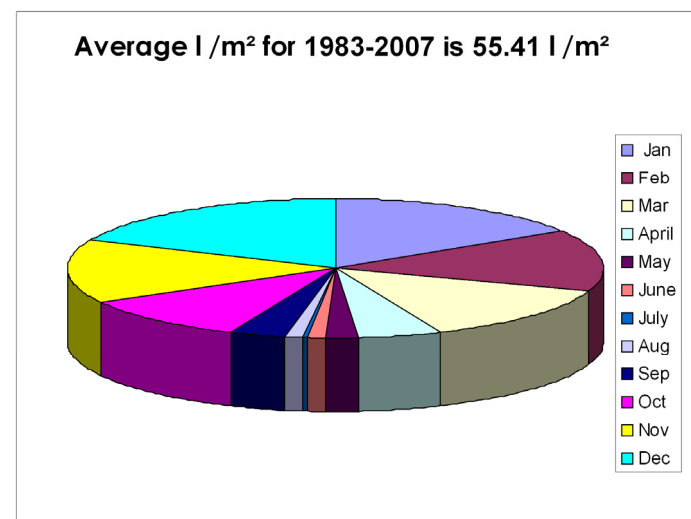


Johannesburg, South Africa falls under Temperate Climate Zone
(Hamzah & Yeang 1994:140)

Wind Speed for Johannesburg

Months of the year	Direction	Time of day wind speed in Km/h	
		AM	PM
February, March, April	Light North-Westerly	±9 Km/h	±13Km/h
May, June, July	Moderate North-Westerly	±11 Km/h	±15 Km/h
August, September, October	Light North-Westerly	±8 Km/h	±10 Km/h
November, December, Jan	Light North-Easterly	±8 Km/h	±8 Km/h

Use the wind direction in the summer months to assist in natural ventilation and block the rest of the windy seasons out to minimise heat loss.



Rain to be harvested per square metre in the city of Johannesburg for everyday water usage.

Passive systems have to take priority over active systems, for passive systems is the lowest level of energy consumption from non-renewable resources. Passive techniques in a particular built form uses various cooling and heating methods to enable indoor temperature of buildings to be modified through the use of natural energy sources. Active systems will rely more on electromechanical devices to control indoor climate, consuming more non-renewable resources. To achieve full climatic responsive design, passive systems have to take preference over active systems because of their low energy consumption needs (Yeang, K. 2006:194).

Looking at the table on the right, temperate (Johannesburg, South Africa) climates seek to use passive mode systems to cool down buildings and their surroundings in summer through applying natural ventilation principles along with evaporative cooling systems to reduce heat gain. Solar radiation will be controlled through shading devices, air movement, water convection and thermal massing will act as an insulator during the day but serve as a thermal heat source at night times. In winter, buildings in temperate climates want to store as much as possible solar radiation generated by the sun, this is where building orientation and configuration plays a vital role where heat loss is reduced to a minimum.

Climate Zones		
Passive Comfort Measures	Active Comfort Measures	Temperate
Natural Ventilation		6
	Mechanical Ventilation	3
Night Ventilation		5
	Artificial Ventilation	1
Evaporative Cooling		2
	Free cooling	3
Heavy Construction		5
Lightweight Construction		3
	Artificial Heating	6
Solar Heating		7
	Free Heating	6
Incidental Heat		6
Insulation Permeability		6
Solar Controls/Shading		5
	Artificial Lighting during Daytime	4
Daylight		6
1-----7		
No Importance		Very important

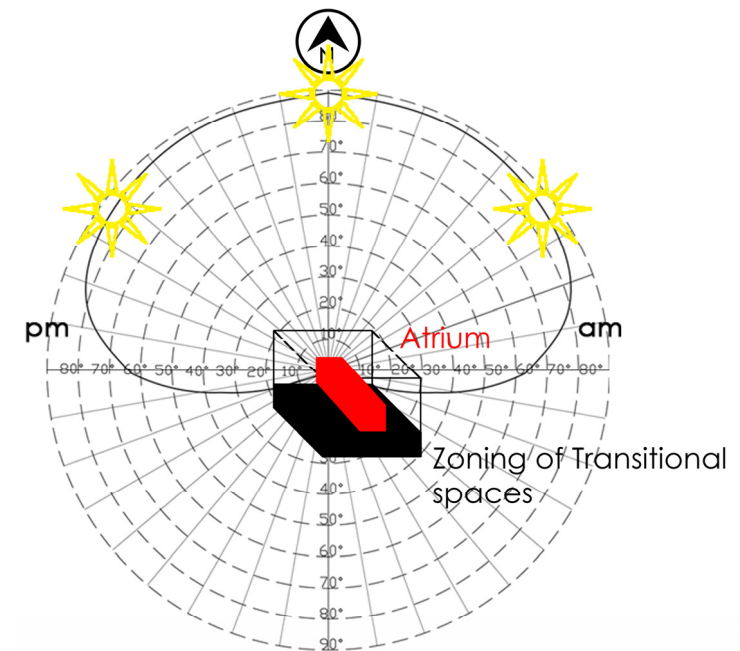
Energy savings by global means
(Derived after Yeang 2006:195)

5.2.1. PASSIVE MODE BY BUILDING CONFIGURATION

The built form and its spatial activity arrangement must be configured and planned in relation to best optimise the ambient energy of the micro climate of Johannesburg, more specifically Diagonal street and the social and economic criteria that goes with it. To achieve climatic responsive design, the relation of the built form's volume to its surface has to be considered in terms of solar radiation (see built form orientation) (Yeang, K. 2006:196). If the built form has not been orientated and configured to maximise passive benefits, then active electromechanically systems have to compensate for the design error, which defeats the point of low energy design objectives.

Studying Johannesburg's sun path, the zoning of transitional spaces, which are lobbies, stairs and walkways, are located on the South façade. These areas do not require total climatic control and natural ventilation is usually sufficient (Hamzah, T.R. and Yeang, K. 1994:145). The North façade is left open to benefit from natural ventilation and daylight penetration into building in summer. In winter, to reduce heat loss, the South façade will act as a heat sink to contain solar heat where the North façade is left open for solar heat gain. The elimination of

heating and cooling is more cost effective than reducing heating and cooling (Yeang, K. 2006:198).



Solar Path in Summer. 556.83KWh/m² to be harvested each day.
(Derived after Hamzah & Yeang 1994:145)

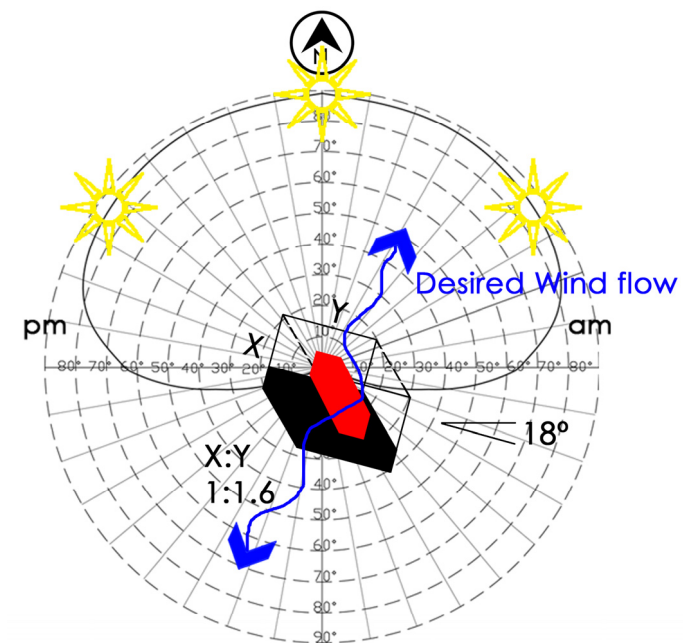
In Johannesburg, careful consideration has to be given to the shape of the building to benefit from energy savings in terms of heating and day lighting. Yeang (Yeang, K. 2006:198)

observed that older buildings were built to maximise daylight penetration by having a large surface area in relation to their volume, which caused them to lose heat quickly. A deeper plan in relation to a smaller volume compared to a shallow plan with a large volume of the same floor area, a fifty percent cost saving was observed in terms of heating saved (Yeang, K. 2006:198). The drawback of having a deeper plan means there is a loss in daylight penetration. The use of an atrium space is recommended, located in the centre of a building, to benefit from heat gain and daylight penetration. The atrium space could also be utilised as a controllable outdoor activity space, especially in winter when it acts as a heat buffer.

5.2.2. PASSIVE MODE BY BUILT FORM ORIENTATION

Passive mode by built form orientation looks at the shape of the building's floor plate, its position on the site and its orientation to the sun path and wind directions for the climatic conditions of Johannesburg. The shape of the building's floor plate is a response to the sun path in Johannesburg. The desired ratio of a floor plate's width to its length in a South African context is 1:1.6 (Hamzah, T.R. and Yeang, K. 1994:146). This is the response to the desired façade area exposed to the sun's radiation either for optimise heating or to provide solar

shading at a particular time of day. The building's form will also be a response to the direction of seasonal winds to optimise natural ventilation or to act as a wind buffer depending on the site's orientation to the prevailing wind patterns.



Building orientation and shape to respond to sun path and desired wind direction.

(Derived after Hamzah & Yeang 1994:146)

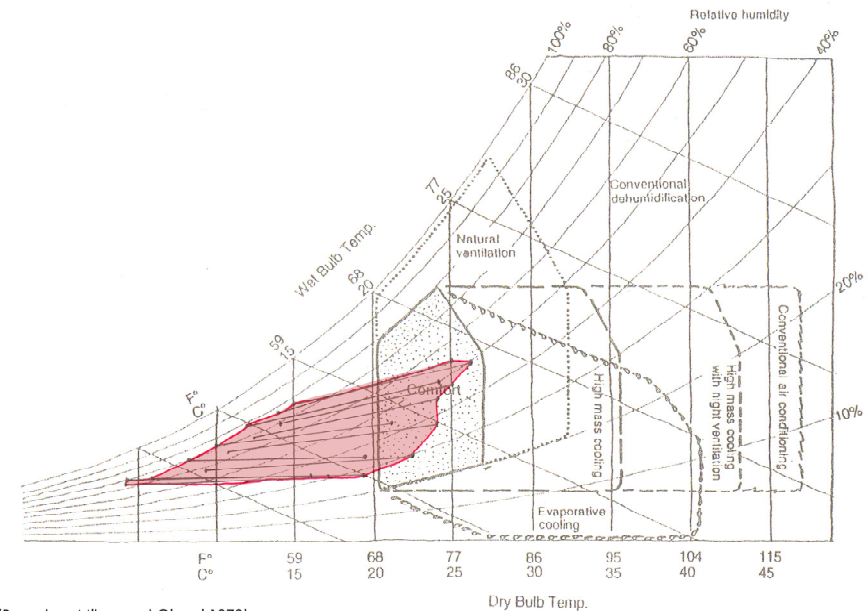
In Johannesburg, where the sun path is lower, adequate measures have to be taken to avoid excessive heat gain in summer, while ensuring that the fullest potential of heat gain is

achieved in winter. Therefore, the sun has to be designed in as well as out. A balance is achieved between heat loss on the South Façade and heat gain on the North façade by optimal building orientation, configuration and floor plate design. Johannesburg's human comfort diagram will show solar gain in the mornings is desirable to heat up the cold structure to ideal human comfort levels. In the afternoons however, human comfort is already achieved and vertical shading devices will block out undesirable solar gain (Yeang, K. 2006:201).

When orienting buildings to a site's specific sun path, make sure that the buildings orientation is responding to true North and not magnetic North. True North is approximately 11° west from magnetic North (Yeang, K. 2006:199). If misunderstood, it could have severe effects on shadow diagrams.

In response to optimise on natural ventilation and daylight penetration, internal spaces in a building are also to be arranged in relation to activity of use and to environmental requirements. General office space can be located close to ambient energy sources on the peripheries of the building's plan, where areas of high heat gain - kitchens and computer rooms, etc. - should be located on the South Façade or in the centre of buildings depending on vertical core location for mechanical ventilation (Yeang, K. 2006:200). The design

strategy for Johannesburg is to make use of stored energy in the micro-climate most beneficial to places of activity within a building's space configuration.



(Based on Milne and Givoni, 1979)

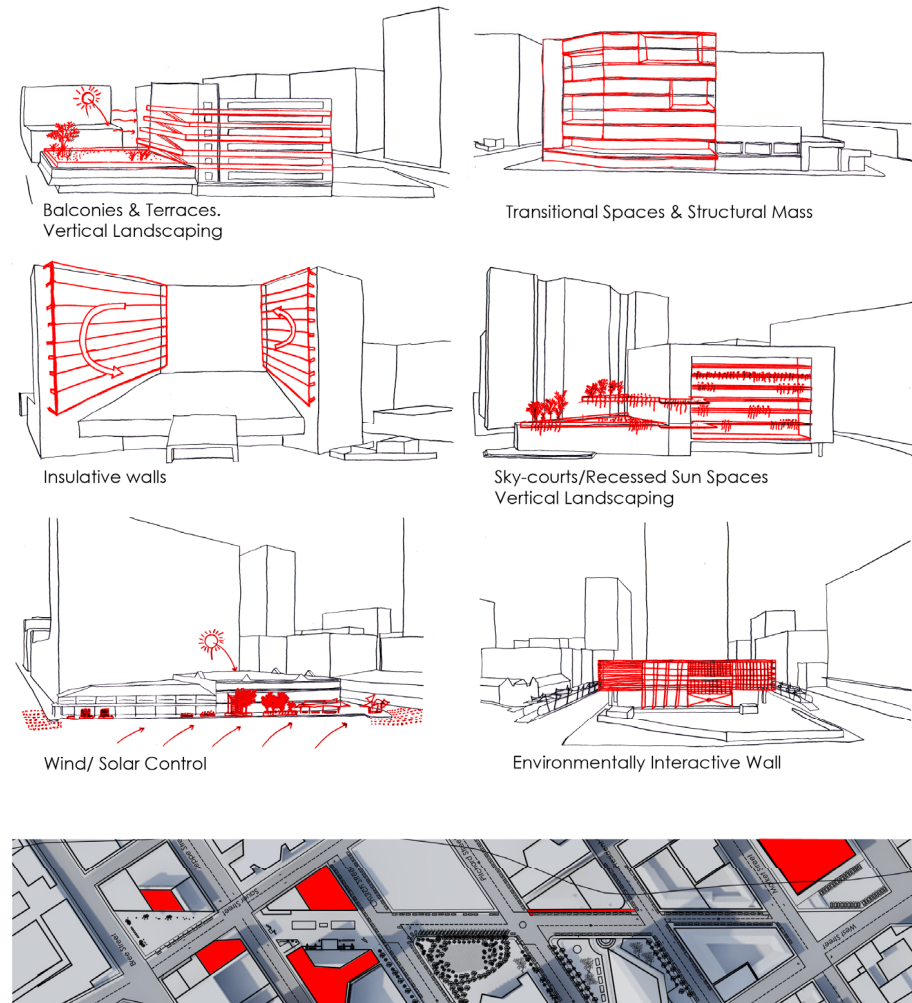
Wet and Dry Bulb figure shows JHB average monthly minimum and maximum humidity and temperature for the average year. (Derived after Hunn, B. D. 1996:117)

Therefore, every building site is unique and the design of the building exclusively relates to that site. The building will respond to that specific micro-climate and the building orientation and

location on the site will have an effect on the local climate. The building orientation will take advantage of the ambient energy from the sun and wind. A further design strategy could be implemented to optimise use of wasted heat. There is a potential to generate electricity on site by using combined heat and power schemes (CO generators) and renewable energy sources- wind turbines, photovoltaic cells, etc. to power active passive systems.

5.2.3. FACADE DESIGN

The façade will be given priority over the built form's operational systems. The façade needs to optimise on passive systems, mix mode of use and to support active systems sustained by renewable energy recourses. The façade of a building could be compared to our skin on our bodies. Just as our skin regulates hot and cold temperature differentiations, humidity, and variations in air movement to keep us at a comfortable temperature, so does the façade on a building need to regulate the influences of the micro-climate on a building (Yeang, K. 2006:202). Therefore, the skin on a building needs to be permeable to light, heat, air movement as well as visual transparency to be able to control and be modified to respond to the changing climatic conditions.

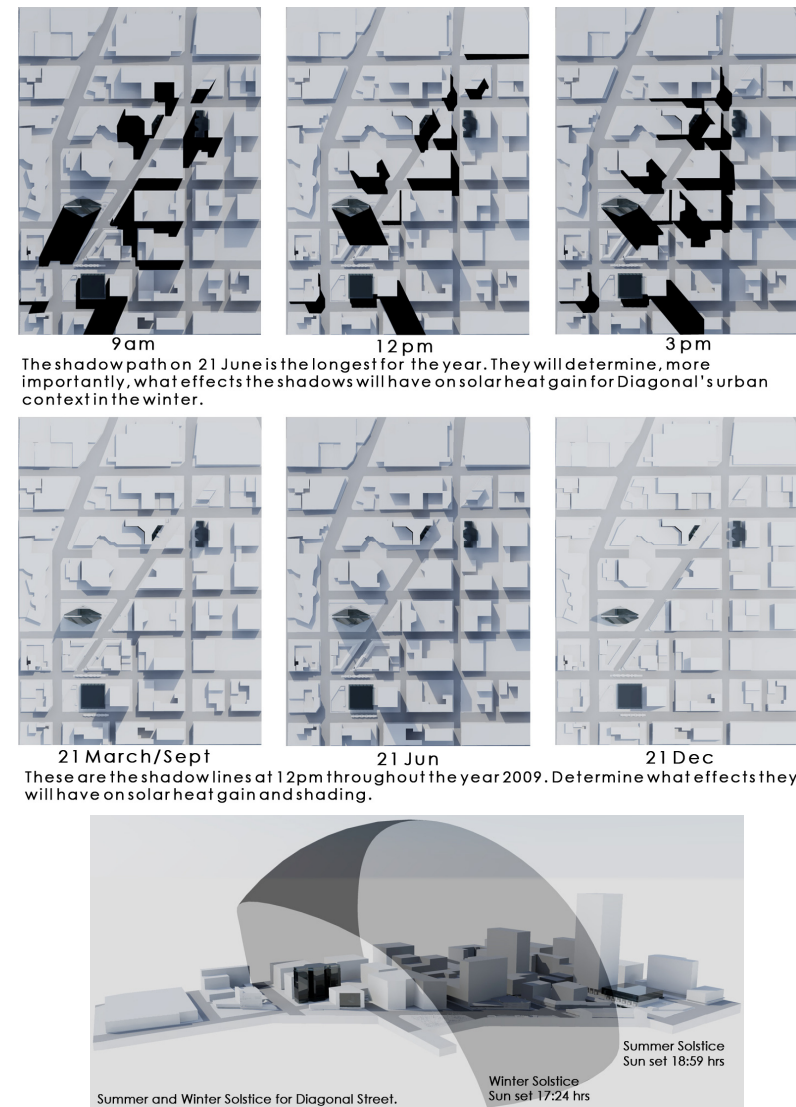


Facade Design on Diagonal Street
(Derived after Hamzah & Yeang)

The ideal façade should act as an environmental responsive filter. The façade's characteristic on Diagonal Street must incorporate the following principles: adjustable openings to provide natural ventilation, provide external views, provide efficient solar protection, regulate and harvest wind swept rain and discharge of heavy rain, provide effective insulation for hot summers and cold winters and promote a better direct relationship with the external environment (Yeang, K. 2006:202). The architectural façade must respond to environmental integration and be appose to skin facades that are completely impenetrable to sun, air and water. Through the integration of sky-courts and green facades the façade will be able to provide solar shading, natural fresh air ventilation, serve as acoustic barriers, act as insulators and provide break out areas to serve as meeting spaces or provide maintenance access.

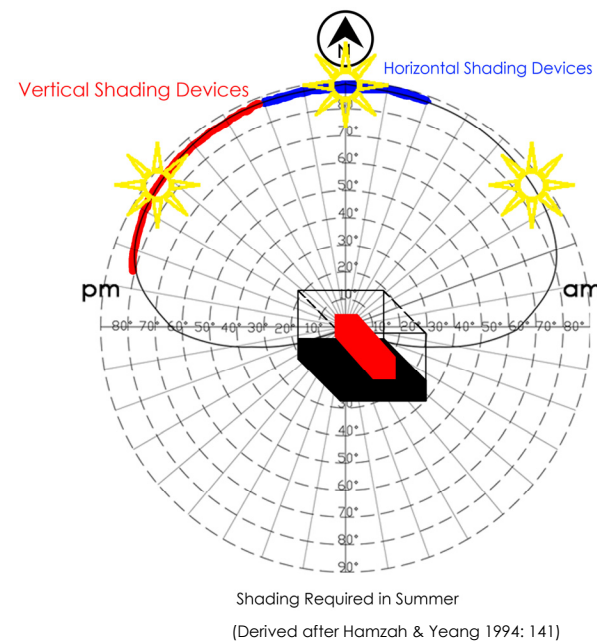
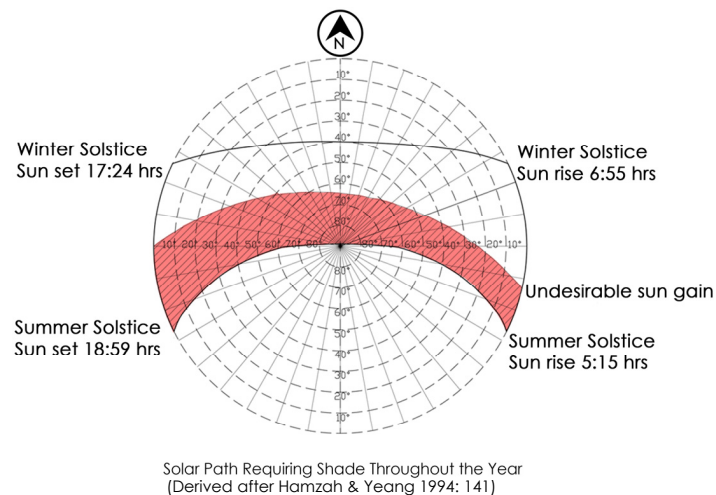
5.2.3.1 SOLAR CONTROL

Solar control in Johannesburg is a direct response to the sun's path of the region. The final design should try to reduce the need for air-conditioning in summer and the need for heating in the winter. Instead, by studying the sun path, the design should take advantage of solar gain early in the mornings and block solar radiation out from midday onwards. The strategy for



Johannesburg is to extend the mid seasons through enhanced cross-ventilation in summer, late spring and autumn. In winter, the building should capture as much of the sun's raise to reduce the need for internal heating in conjunction with enhanced external wall insulation (see insulation).

The most efficient way to deal with solar control is to provide external adaptable shading devices over clear glass windows. In winter, the sun enters through window openings to heat the building, while in summer the amount of heat gain is controlled by the adaptable façade. The thermal mass of the building as well as sufficient insulation will be used as heat sinks to achieve optimal human comfort (see building configuration) and sufficient cross-ventilation will dissipate unwanted heat gain.



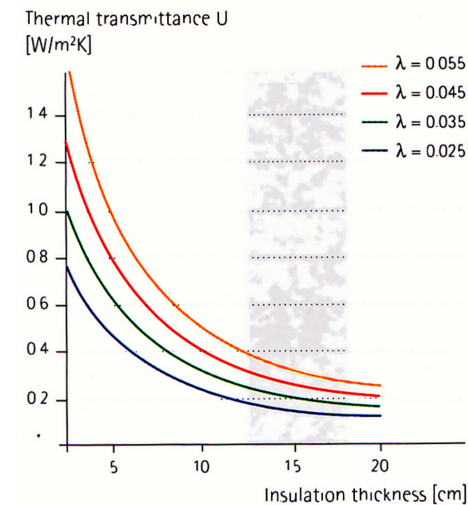
5.2.3.2. INSULATION

An effective passive way to reduce energy consumption in a building, particularly in Johannesburg, is to increase external wall insulation to reduce air leakages and thermal bridges and to lower the ratio of solid mass to glass area (Yeang, K. 2006:202). Insulation reduces the rate at which heat can flow through an element installed in a building considering the time lag when choosing a material.

The current standard, in Johannesburg, for external wall insulation is around 0.45Kw/m²/K, which is the rate heat is lost through a wall per hour (Yeang, K. 2006:203). To bring this rate down, specify that the insulation material is several times more than the current specified standard. In addition, consideration has to be given to heat loss through air leakages, otherwise it could dominate heat loss in buildings if not addressed sufficiently.

In Johannesburg, high insulation levels will reduce the rate heat is lost in both winter and summer. Sufficient insulation also reduces the potential for heat gain. Achieve a balance, where internal heat gain in the summer is not trapped and in winter not lost. The same applies for eliminating potential heat gain in summer, balanced out by potential heat gain in winter. An effective design solution is to provide sufficient solar protection in the summer, without compromising useful winter solar gains.

The thermal transmittance graph is nonlinear in respect to the insulation thickness. Going beyond an insulation thickness of 15cm will only slightly increase thermal insulation. It is more efficient then to balance out the materials conductivity in relation to its insulation thickness. The table to the right will provide the desired choice of insulation materials concerning their thermal conductivity (U-Value).



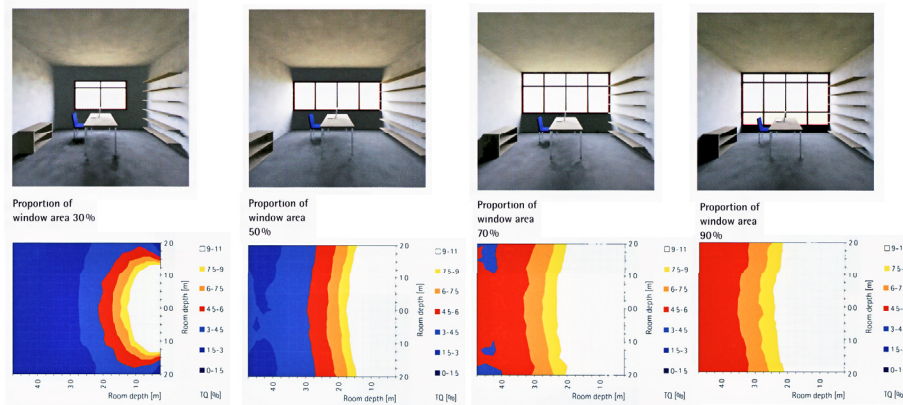
U-values shown in relation to insulation thickness and thermal conductivity (HAUSLADEN, G. 2006:122)

	Ex- panded clay	Perlite	Mineral wool	Foam- glass	Cel- lulose	Wood fibre	Wool	Cork	Poly- styrene (EPS)	Poly- styrene (XPS)	Poly- urethane (PUR)
Bulk density ρ [kg/m ³]	200-400	140-240	10-200	100-150	20-60	150-250	30-140	90-140	10-50	20-65	28-55
Thermal conductivity λ [W/mK]	0.100- 0.160	0.045- 0.065	0.030- 0.050	0.038- 0.055	0.035- 0.045	0.035- 0.060	0.035- 0.045	0.040- 0.055	0.030- 0.050	0.026- 0.040	0.020- 0.040
Primary energy content [kWh/m ³]	300- 450	90- 240	150- 500	750- 1600	50	600- 1500	40-80	65- 450	200- 760	450- 1000	800- 1500
Water vapour diffu- sion resistance μ [-]	2	5	1	∞	2	5-10	1-2	5-10	60	150	60
Fire protection class	A1	A1-B2	A1-A2	A1	B1-B2	B2	B2	B2	B1	B1	B1-B2
Material form	Loose fill, ag- gregate	Board, loose fill	Board, mat, wool	Board, loose fill	Blown- in flakes	Insula- tion boards	Mat	Board, loose fill	Board, aggre- gate	Board	Board

Insulation Materials
(HAUSLADEN, G. 2006:123)

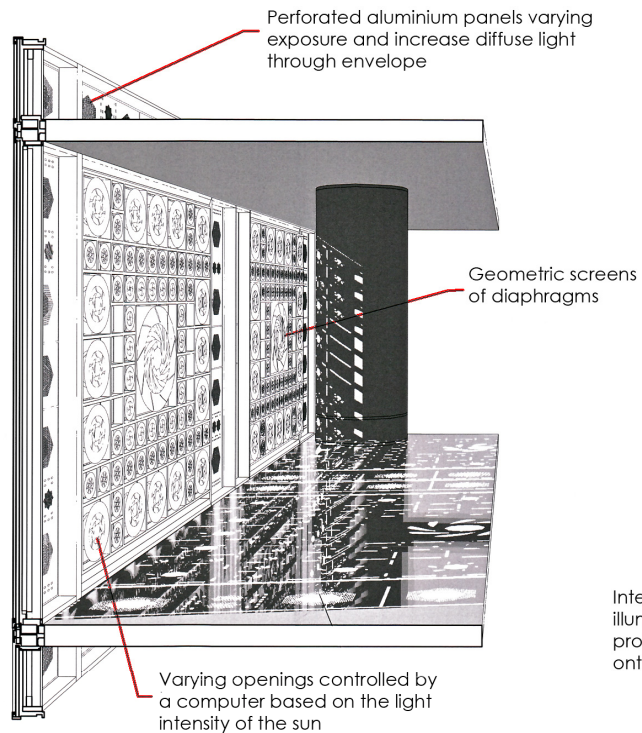
5.2.3.3. PASSIVE DAYLIGHT CONCEPT

The objective for Diagonal Street is to maximise the use of day lighting and to decrease the need for energy consuming artificial lighting. The amount of day light that enters a room depends on the window area in relation to the floor area of the room. Normal daylight devices can only provide adequate day lighting within about 4.6 meters of conventional windows (Yeang, K. 2006:207). The illustration below shows where the height to the top of the window from finished floor level relates to twice and a half the distance light would enter the room. Consider also, by achieving optimum daylight penetration, will increase solar heat gain into the building if not manage properly by façade design.

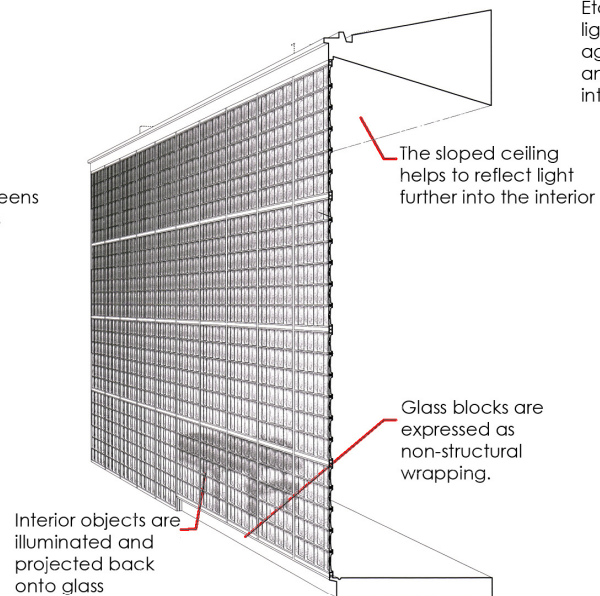


Proportion of window opening to floor area showing daylight penetration.
(HAUSLADEN, G. 2006:74)

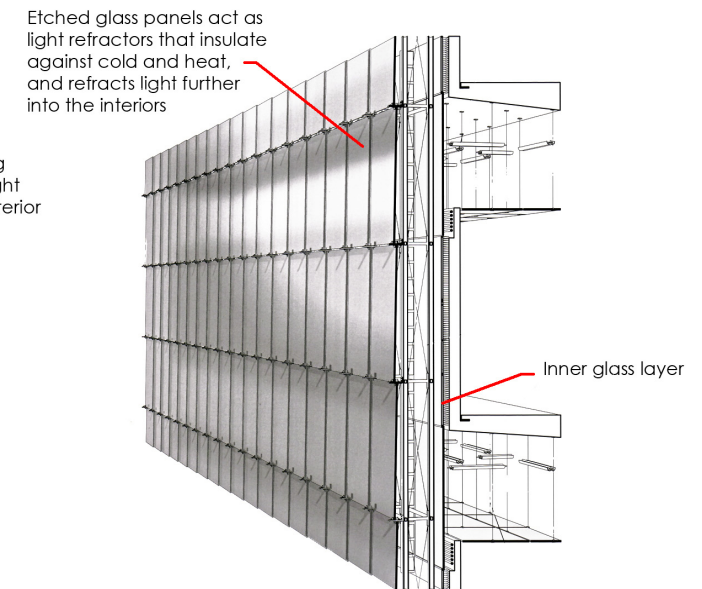
There are a number of experimental perimeter daylight systems that passively redirect beams of sun light further into the room. The systems use special films, an optimised geometry and a small glazing aperture and special glass e.g. holographic optical elements (Yeang, K. 2006:207). They can increase the distance of daylight penetration from 4 metres to 9 metres as well as distributing the light uniformly into the room. Other advanced technological systems are articulate light shelves and light pipes. Day-lighted buildings are only successful if they can effectively and reliably displace electric lighting usage, the alternative is to use renewable active systems, which will power lighting in a building e.g. photovoltaic cells or wind turbines.



The Institut du Monde Arabe
Increasing light intensity through facade design
(Derived after MOUSSAVI, Farshid & KUBO, Michael 2006:29-31)



Mason de Verre

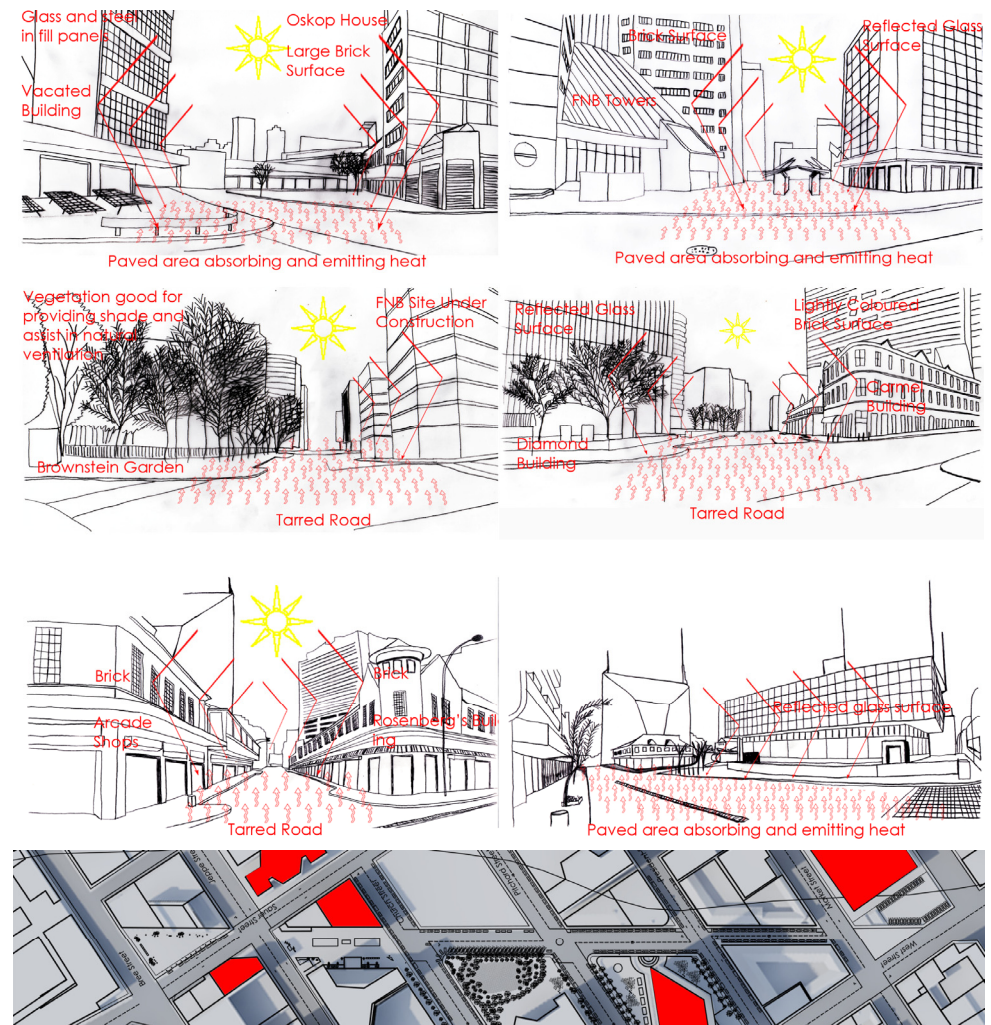


Kunsthaus Bregenz

5.2.3.4. COLOUR AND MATERIALS OF THE BUILT FORMS' ENVELOPE

By using white or lighter coloured materials, especially on roof surfaces, peak cooling is reduced by as much as 40 percent. This helps to reduce the heat island phenomena that occur in Johannesburg city today. Assisted by vegetated urban environments (see landscaping), cooling needs can be cut by 30 percent (Yeang, K. 2006:223).

To effectively provide protection against radiation impact on external surfaces on Diagonal Street, the surface materials need to be selectively chosen according to absorption and emission properties. The reflected surfaces identified on Diagonal Street contribute to the thermal heating of the surrounding area, where heat is reflected onto hard urban surfaces. These surfaces act as heat sinks and continuously release the stored heat into the urban atmosphere. A more permeable surface approach need to be taken, where facades and surfaces respond and contribute to more cooler urban environments in and around buildings on Diagonal Street. When using mass/dense surfaces, it should be in conjunction with the wind flow patterns for Diagonal Street, where the wind can dissipate unwanted heat gain.



The identified buildings have glass reflected facades that influence the human comfort levels of Diagonal's urban environment. Better facade design is called for to better integrate with Diagonal's natural surroundings improving the quality of urban space.

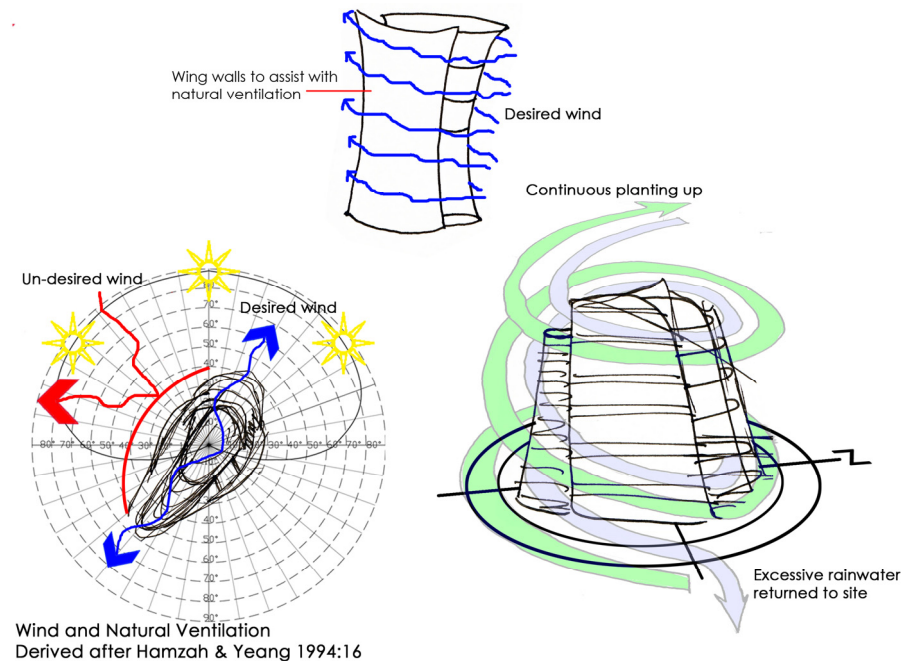
The use of water bodies along with vegetated surfaces, placed at the top and bottom of Diagonal Street, would contribute to better thermal comfort levels along the street edge. The summer wind flow would carry evaporated water down the street, cooling the urban environment. Permeable surfaces would also retain more of the annual rainwater enhancing the local bio-diversity of the region and make harvesting of rainwater so much easier for water needs (see landscaping).

5.2.4. WIND AND NATURAL VENTILATION

Natural ventilation is used to regulate human comfort levels by air movement. Natural ventilation utilises the differences between outside air pressures and inside air pressures as well as the differences between indoor and outdoor temperatures. Therefore, it is extremely important to assert and study the wind direction and speed for Diagonal Street, particularly to obtain what influences the wind patterns have on the built forms and urban spaces.

The wind in the studied area is one of the most important ambient sources of energy to be utilised based on the site's location. By understanding the desired wind direction and speed, we can manipulate the built forms and the surrounding

area to assist in natural and cross ventilation benefiting the occupants (Yeang, K. 2006:211).



Multi layered and adaptable façade design will assist with supplying natural ventilation to the interiors or the façade will act as screening devices to block strong unwanted air movement. Atrium spaces will utilise the stack effect of natural air movement to act as buffer zones. This control of air movement within an atrium space makes for the ideal public

outbreak places when outdoor temperatures are too cold in winter.

The use of natural ventilation minimises requirements for mechanical ventilation and air conditioning systems to ensure a healthier sustainable building environment. The reduction in energy consumption by natural ventilation is almost half of what a fully air-conditioned building would consume. Natural ventilation systems serve also as a capital cost saving in terms of maintenance reduced along with promoting fewer incidents of "sick building syndrome" (Yeang, K. 2006:212). Overall, natural ventilation methods reduce the need to consume non-renewable resources making buildings more environmentally responsive.

To encourage natural ventilation in buildings, provide low-level inlets and high-level exhaust openings, which allows fresh air to be drawn in and foul air to be expelled. By carefully articulating the façade, the design of wing walls and adjustable facade devices will assist in channeling airflow in the required direction to compensate changes in wind direction (see sketches above).

In Johannesburg, the objective is to provide adequate fresh air supply of 2-3 air changes per hour per person is recommended

by Ken Yeang. The desired air speed, which will not increase heat loss, is between 0.4 and 3 m/s (1-10Km/h). Air movement increases heat loss by both convection and evaporation. Therefore, the challenge is to achieve minimum necessary fresh air change without causing cold draughts or excessive heat loss (Yeang, K. 2006:215).air quality with no unnecessary increase in heat loss. A minimum

5.2.5. PASSIVE MODE BY LANDSCAPING

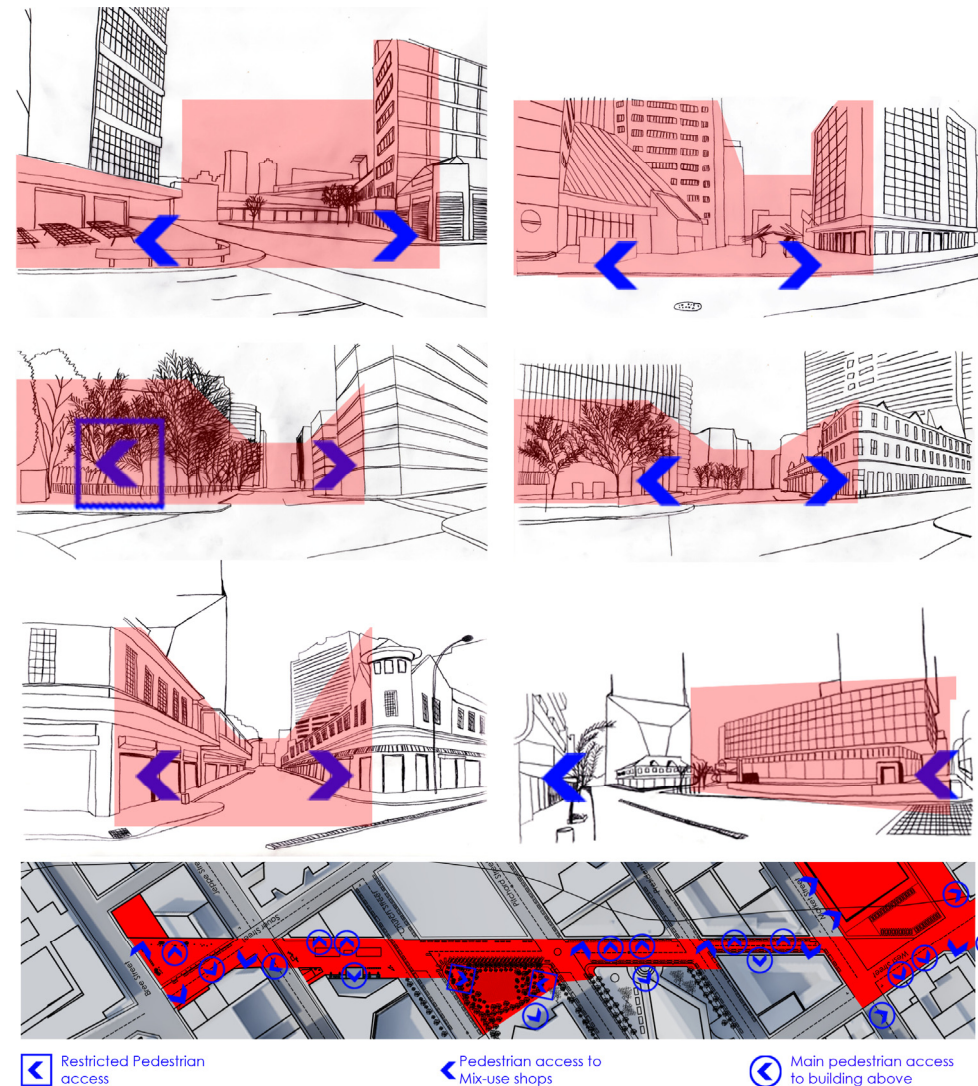
A crucial factor in environmentally responsive architecture is the counter balance of organic materials to inorganic materials in an urban context. To achieve this counter balance, the provision of vertical landscaping into the built form is to be incorporated. The treatment of the fifth façade in terms of providing more green roof-scapes are also necessary to achieve a biological urban integration.

Roof-scapes in high built forms on Diagonal Street are of less importance thermally than lower-rise built forms because of their small surface area compared to the extensive external wall area. Most traditional dark coloured roof surfaces absorb about 70 percent or even more of solar energy striking them, resulting in peak roof temperatures. In contrast, cool roofs, which are coloured lighter, are 10-16°C cooler on hot days

(Yeang, K. 2006:221). There is also an average cost saving of 20 percent less in energy consumption by air conditioners below a lightly coloured surface roof (Yeang, K. 2006:221). To further improve a capital saving in energy consumption, provide canopies over roof-scapes, pergolas, or to provide a roof garden for permaculture.

On Diagonal Street, buildings below three storey roof scapes' will be utilised in terms of roof gardens and the spaces between them. Firstly, Diagonal's diagram will show there is sufficient space between these buildings to provide public access without going into the buildings. Secondly, these roof gardens will serve as meeting spaces or breakout areas for occupants in the surrounding buildings. This will create a second street level, which will increase pedestrian movement, promoting more economic trade or commerce.

The advantages of having vegetated roof-scapes on Diagonal Street is that rain water is retained and evaporated, new wildlife habitats are created on roofs, internal insulation is improved and energy consumption is reduced. Roof gardens can half rainwater run-off, benefiting urban comfort levels by means of evaporation and reducing the heat island phenomena in Johannesburg's urban context (Yeang, K. 2006:223).



It also serves as an acoustical insulation system to the interior of the building.

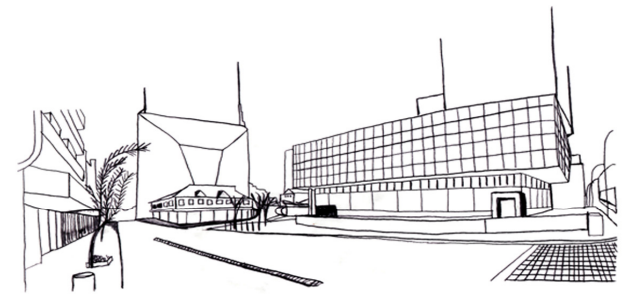
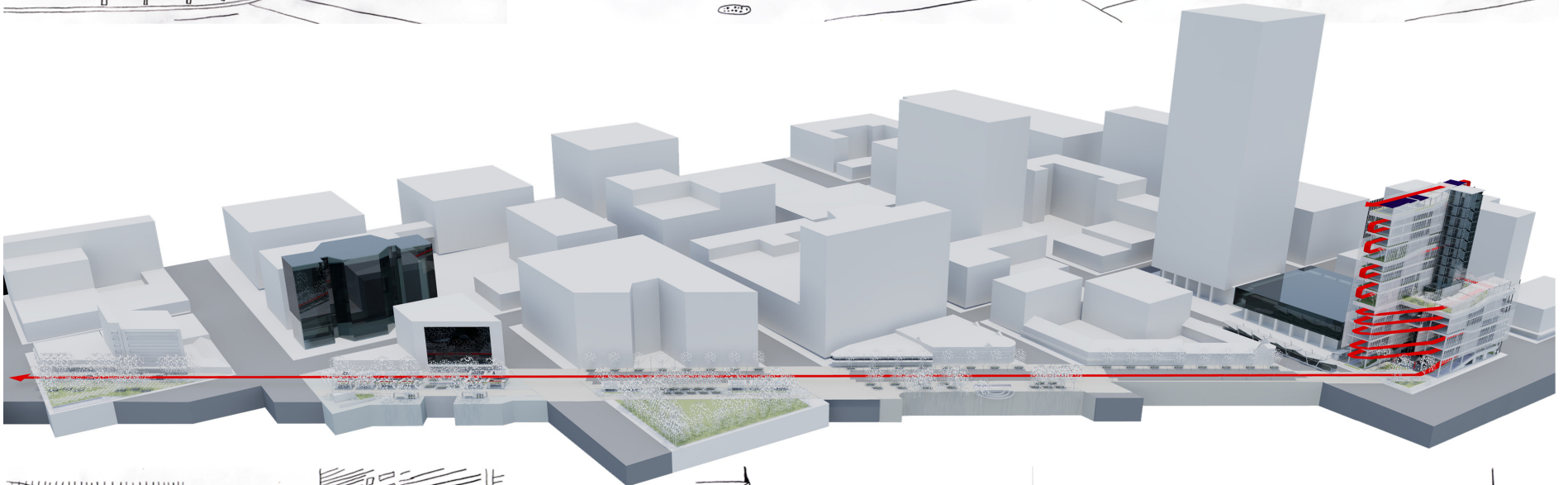
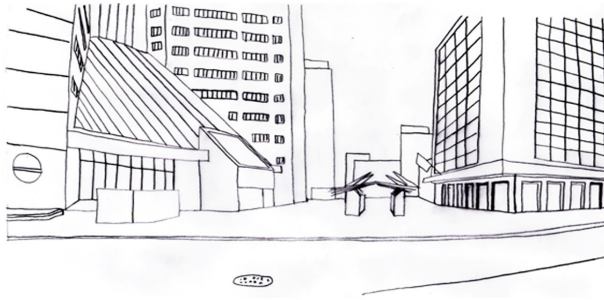
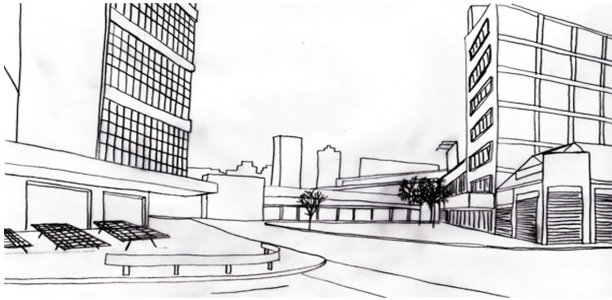
In addition to the organic counterbalancing responsibility, vertical landscaping on wall surfaces also serves part of passive means for lowering ambient temperatures around buildings and help to reduce the urban heat island affect. Plants and trees evaporate water through the metabolic processes of evaporation (Yeang, K. 2006:224). The plant or tree absorbs the water through the soil and then the water evaporates through the leaves during photosynthesis. Studies have shown even an isolated tree can transpire up to 379 litres of water per day (Emmanuel, R 2005:88). This is equivalent to the cooling provided by five 20,000 BTU (5800W/m²) air conditioners running 20 hours per day (Emmanuel, R. 2005:88).

The first step in energy efficient landscaping for Johannesburg is to see where the sun hits the wall surfaces. The unwanted solar heat gain is avoided by vertical landscaping of walls. Remember this will be in combination with façade design where a design balanced is achieved by allowing heat and light gain in winter but controlling heat gain in summer. The desired trees, surrounding the buildings on Diagonal, are deciduous trees. They provide excellent shade in summer and

allow for maximum heat gain during winter (Yeang, K. 2006:224).

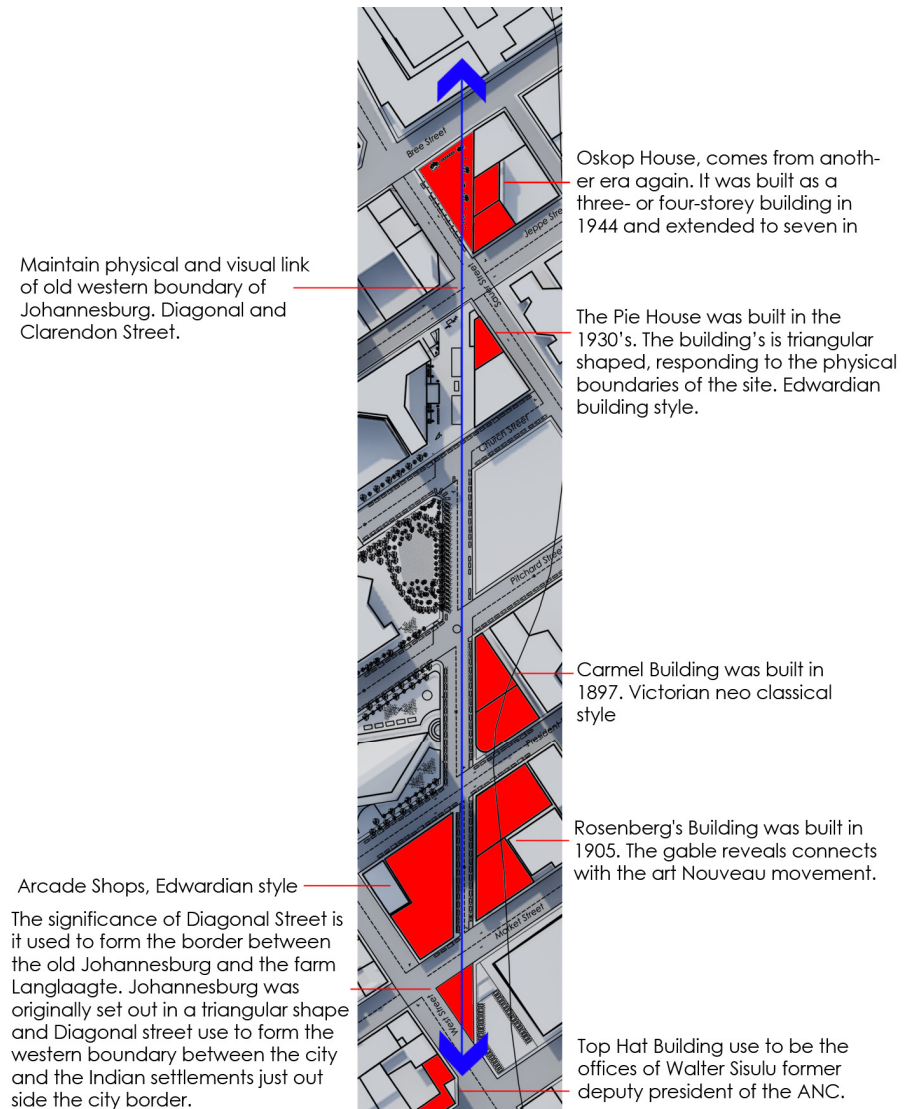
Encouraging the use of organic materials in Johannesburg's urban area, not only promotes an increase in biodiversity of the region, but also helps to improve urban comfort levels by means of heat absorption and evaporative cooling methods.

5.3. TRADITION/IDENTITY



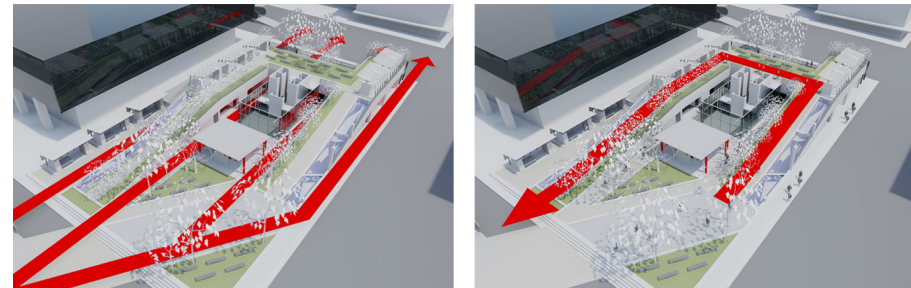
The Architectural building styles and form chosen for Diagonal street must be integrated with existing cultural assets of the region and be sensitive to traditional practices and precedents of style (CIAM 2008). Buildings of historical significance are identified on Diagonal Street to respect the cultural history of Diagonal's conception and adaptation to various cultural and economic circumstances. The building systems chosen will correspond to the adaptation to climate, social circumstances and to the availability of materials and building technology of the time. Traditional building design or vernacular architecture for example took the climate of that specific region as a given and starting point for the design process, deriving at not only building forms and practices but also generating cultural attributes. Over centuries, trial and error produced traditional designs that are climatically appropriate, culturally relevant and aesthetically pleasing.

By environmentally designing buildings that establish its significance through relating its built configuration, aesthetics, organisation and technical assembly and materials to Diagonal's location and time, the aim is to link new building technologies with the newly developed cultural attributes of Diagonal Street. The modern built forms will be a symbolic representative of Diagonal's cultural landscape, which will over time, represents cultural growth or the transformation in

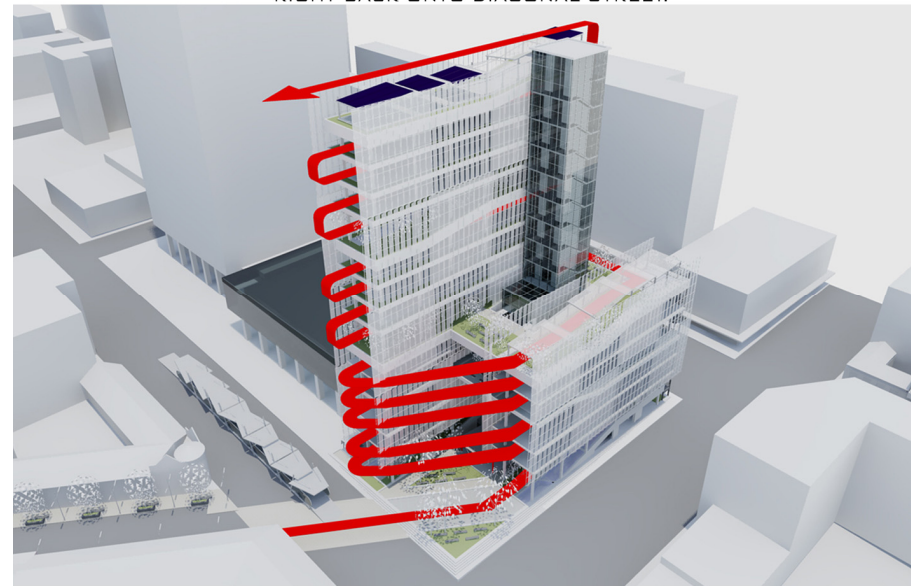


tradition. A city's cultural identities require a sequence of continuity through rituals and cultural forms constituted spatially (W.J.V. Neill 2004:10).

Attention is given to emphasise the historical link, which Diagonal forms with Clarendon Street located in Hillbrow, Johannesburg. They both used to form the western boundary of old Johannesburg and are the only traces left today of the border's existence. A visual axis will emphasise and frame the existing link between them. Knowledge of the local setting will determine the orientation and structuring of the newly proposed built forms and expressed through art, urban space and architecture. By conserving and promoting generic components and elements of Diagonal's urban fabric and history, the architectural practices chosen will achieve a balance with tradition and identity.

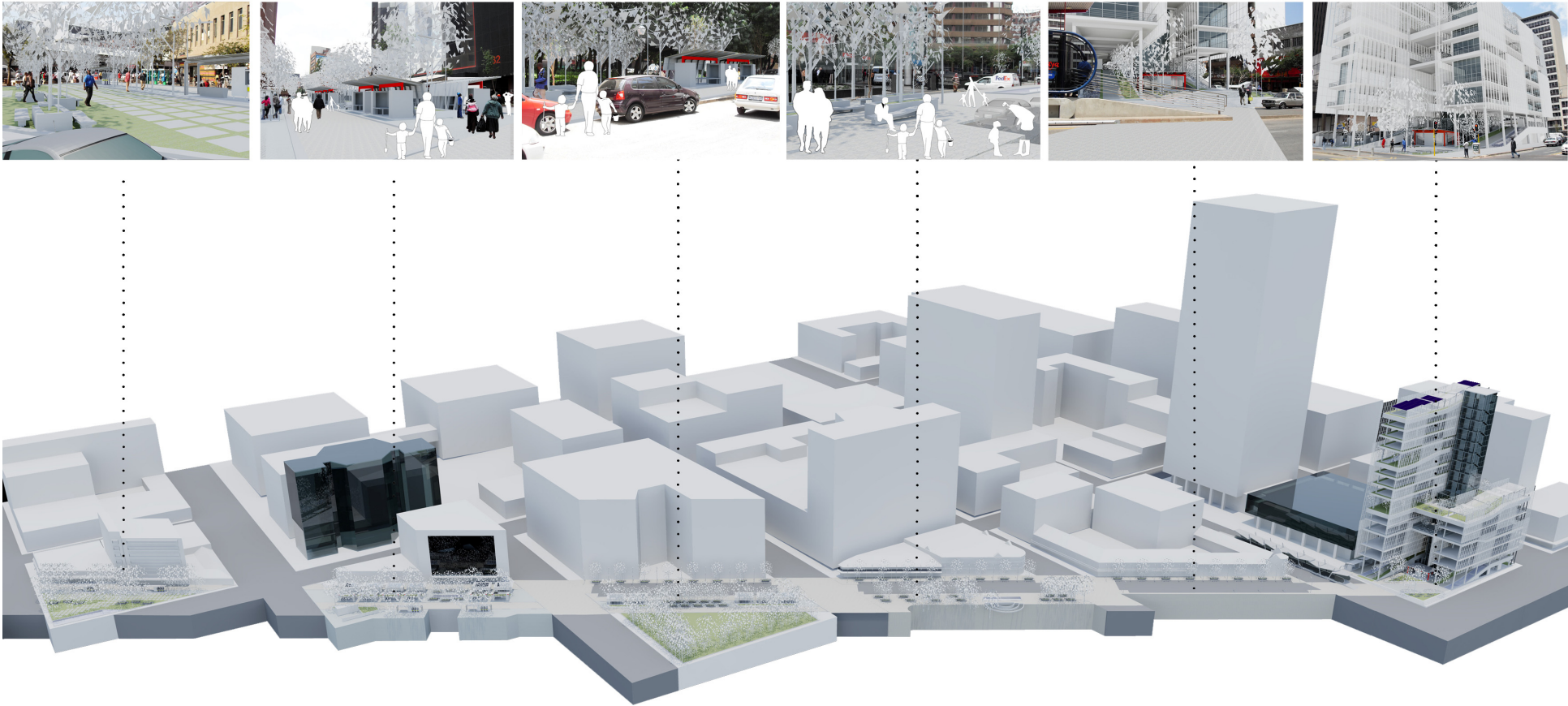


RECREATIONAL SQUARE ON GROUND AND 1ST FLOOR, FACILITATING LOCAL COMMERCE THROUGH RETAIL SHOPS AND MARKET STALLS. DIAGONAL STREET IS EXTENDED INTO THE EXISTING URBAN FABRIC THROUGH PROVIDING INTERNAL PEDESTRIANISED STREETS ON THE GROUND FLOOR ALONG WITH THE CONTINUATION UP ON TO THE FIRST FLOOR, TAKING THE URBAN USER ON A JOURNEY PAST THE MARKET SECTOR, AND ENDING RIGHT BACK ONTO DIAGONAL STREET.



THE BUILDING IS A VERTICAL EXTENSION OF DIAGONAL STREET, CONTINUING THE URBAN NOSTALGIA OF DIAGONAL STREET.

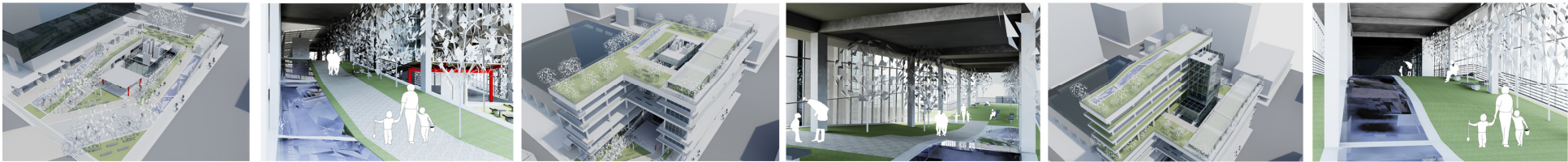
5.4. THE SPIRIT OF PLACE RELATING TO ACTIVITY AND NEEDS



PUBLIC

PRIVATE

PUBLIC



PUBLIC

SEMI-PUBLIC

PRIVATE

The sociability of a place promotes the social interaction of a place through the hierarchical structure of its public domains. Studying the Diagonal's places of use, strengthens movement patterns along Diagonal's street edge by providing visual exciting and socially engaging spaces and built forms that respond to the hierarchical structure of the urban users' social domains. Determining the different types of activities, users and periods used, will show where Diagonal street's shortcomings are and inform the program on how biophilic design principals will facilitate these needs. Societies are interactive and like social engagements. Urban patterns should offer places and opportunities where members can gather and interact with one another. A society's hierarchical social relations have to respond to the hierarchical arrangement of place and space specific where interaction is facilitated. The hierarchical structure of space is broken down as follows (CIAM 2008)

5.4.1 PERSONAL SPACE

These spaces only occur in the private dwelling units of residents on Diagonal Street. Quiet places must be provided where any individual occupying Diagonal Street could retreat from every day life and rest his consciousness and withdraw to think. The ideal places would be to provide natural pockets

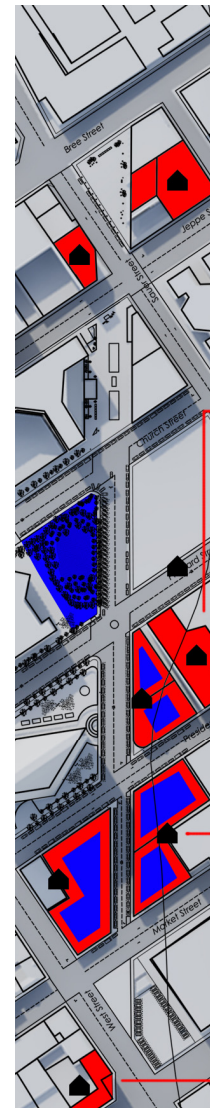
TYPE	SYMBOL	TIME SPENT	TYPE OF PLACE
SHOP KEEPERS 		8AM-6PM	NEIGHBOURLINESS
BUSINESSMEN 		7:45AM-8AM 1-2PM 4:45-5:15PM	COMMUNITY
SHOPPER 		8- 9AM 12-3PM 5-6PM	NEIGHBOURLINESS
PEDESTRIAN 		7- 8AM 1-2PM 5-6PM	CIVIC/COMMUNITY / COMPANIONSHIP
PAMPHLET 		8AM-5PM	CIVIC
TOURIST 		8- 11AM 2-4PM	NEIGHBOURLINESS / COMMUNITY / CIVIC
MOTORIST 		7- 8AM 4:30-6PM	CIVIC
RESIDENT 		6PM-7AM	PERSONAL / COMPANIONSHIP

URBAN USERS OCCUPYING DIAGONAL STREET. USE THIS KEY TO INTERPRET SOCIAL DOMAINS ON DIAGONAL STREET.

located on rooftops or on street level, where architecturally the use of ceremonial gates, directional walls and other silent devices will help focus thought and sharpen the user's control over the conscious world. The architecture must respond to human dimensions forming an intimate relationship with the user. Provide soft and natural urban edges that respond to the users senses. Quality of space will then be enhanced by incorporating environmentally responsive design elements, which relates to the user's thermal comfort needs. These spaces will be secure and accessible during any time of day where the user could go and meditate.

5.4.2. COMPANIONSHIP

These places are identified on Diagonal Street within buildings or in its surroundings where interaction and dialogue can take place. The Brownstein Garden has been identified as a place where social interaction between two individuals could be facilitated, but due to security precautions, not everyone has equal access. Places of friendship interaction will be provided on street level. By recognising a familiar face on route, the urban users will be able to retreat to a quieter and more private space where social interaction and possible new friendships are facilitated on an emotional level.



**OSKOP HOUSE
(BACK)
KAZERNE BUILDING
(FRONT)**



**FRANKLIN BUILDING
(BACK)
CARMEL BUILDING
(FRONT RIGHT)
GARDEE'S ARCADE
(FRONT LEFT)**



**ARCADE SHOPS
(LEFT)
ROSENBERG'S
BUILDING
(RIGHT)**



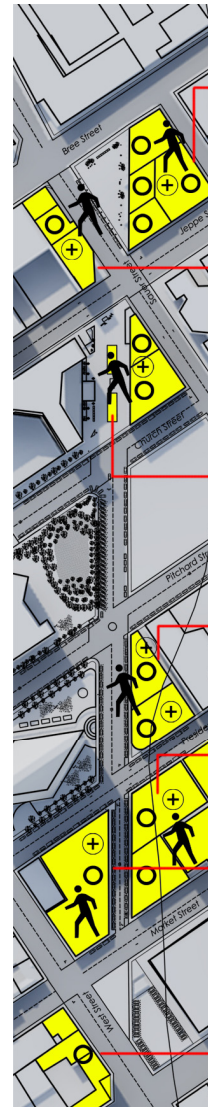
TOP HAT BUILDING

5.4.3. DOMESTICITY

Although these spaces could not have been identified on Diagonal Street, they still will be facilitated for. They are places where groups of three to five persons will meet to interact on a daily or weekly basis, located near their daily activities. These groups along Diagonal Street will organise themselves into various sizes of households in a hierarchal structure. This is necessary, for as the years progress the groups would organise themselves according to their newly developed needs. It will recognize the social group's transformation through the years. This will allow social groups to come into their own personality. The provision of various physical domains will respond to these social demands in terms of mixed-use accessibility, infrastructural amenities, and environmental integration to promote quality of space.

5.4.4. NEIGHBOURLINESS

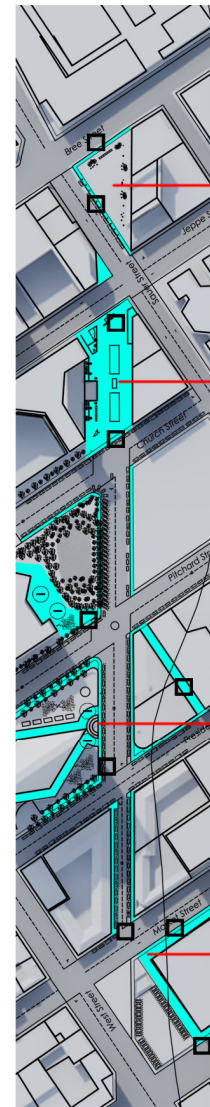
All the small social groups on Diagonal Street will eventually interact with one another forming a number of neighbourhood clusters. This will occur at various mixed-use facilities along Diagonal Street. Having access to these mixed-use facilities, will



promote movement patterns facilitating social interaction and commerce, benefiting the area. The provision of good pedestrian paths and seating arrangement along these routes through architectural intervention will link and encourage movement and interaction. Buildings that open up onto these spaces will benefit financially by encouraging pedestrians and local shoppers to slow down and spend more time on Diagonal Street.

5.4.5. COMMUNITY

The next social hierarchy is the community. This is where people share a common need to negotiate and manage their social spatial settings. Social bonds are found in the community management of security, common resources and social space. There should not be any physical barriers on Diagonal Street to these communities, however access is limited between the two JSE buildings and the space around the Diamond building. Architectural interventions should promote and facilitate equitable access and recognise their unique spatial social domains. The provision of dense walkable zones will encourage pedestrians to recognise each other's faces, share common facilities and resources. The design for a community's social space on Diagonal Street calls for a space where the whole community can participate in various



BOTTOM SQUARE ON
DIAGONAL STREET



MARKET SPACE



VIEW TOWARDS THE
DIAMOND BUILDING



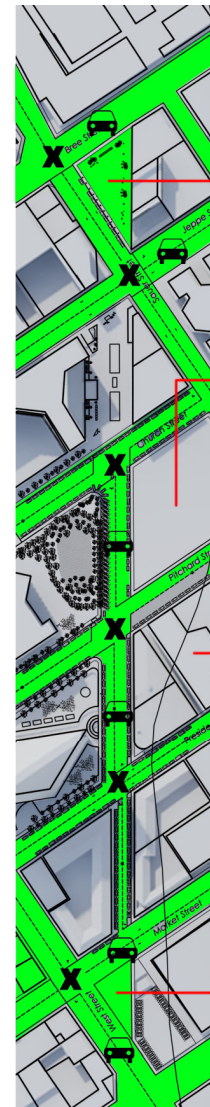
VIEW UP MARKET STREET
FROM DIAGONAL STREET

activities. These spaces will accommodate primary education and recreation areas.

5.4.6. CIVIC LIFE

The two squares at the top and the bottom of Diagonal Street are identified as civic spaces. Civic spaces are plazas, parks, stadiums, transportation hubs, promenades, passages or galleries. The bottom square will also facilitate a transportation hub due to the introduction of a BRT station on Commissioner and Market Street. These two squares are accessible to everyone. Unlike the lower social hierarchy, these spaces are defined by any biological, familiar, face-to-face or exclusive characteristic. A diverse variety of people from all over the city and the world are found here. Diagonal Street falls under New Town's urban development program, where the area is upgraded to attract local and international tourist from all over the world. By nature, these are accessible and open spaces with no physical, social and economic barriers, Mary Fitzgerald Square in New Town is a good example of such a civic space. These are places governed by the rules of social human conduct, which determines the space or domain's behavior.

The squares will foster public interaction and nurture Johannesburg's civic understanding of strength of diversity, variety, a range of cultural groups and ethnic mixes.



BOTTOM SQUARE ON
DIAGONAL STREET



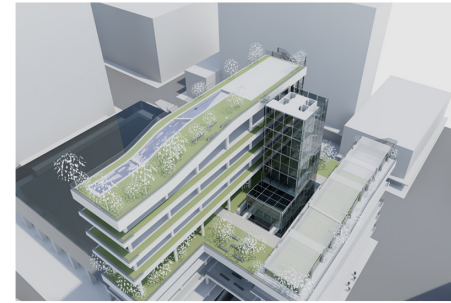
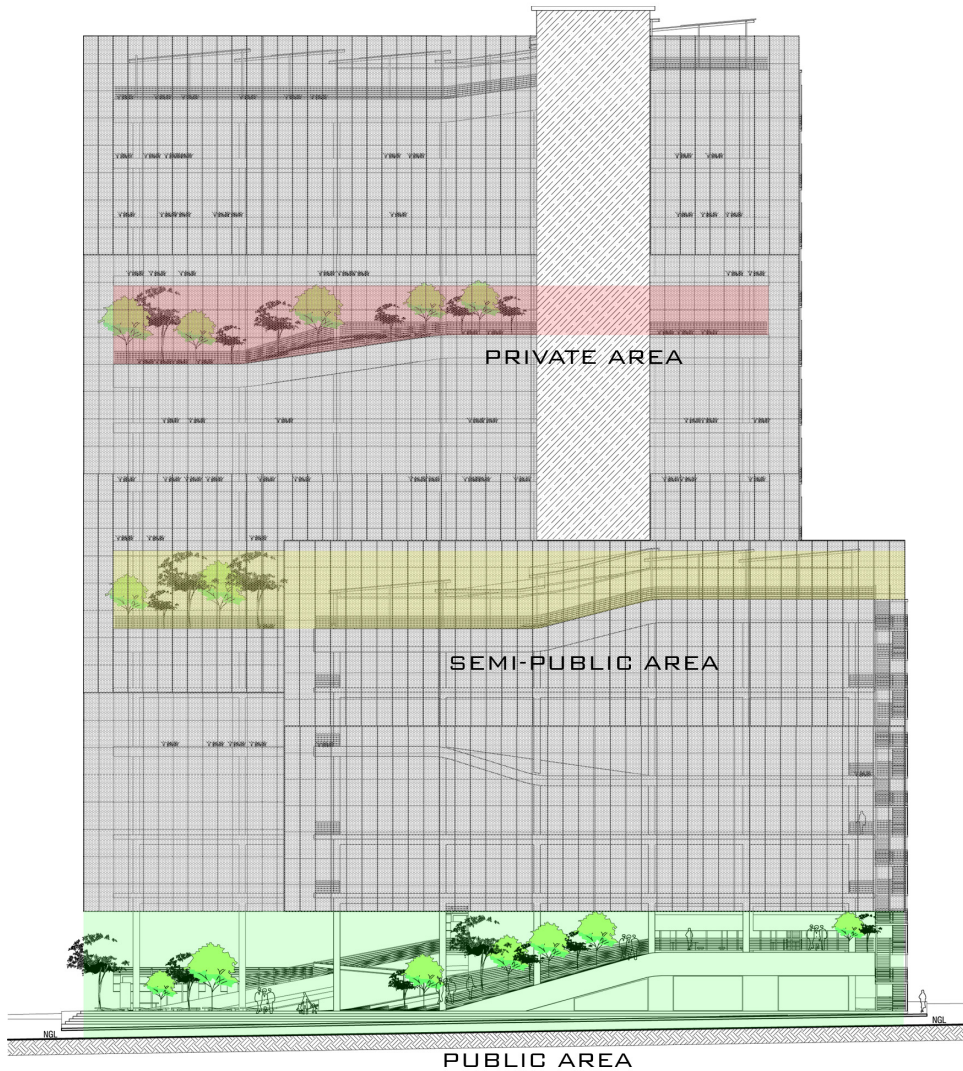
VIEW TOWARDS THE NEW
FNB CONSTRUCTION SITE



VIEW TOWARDS THE
FRANKLIN BUILDING IN
THE BACKGROUND

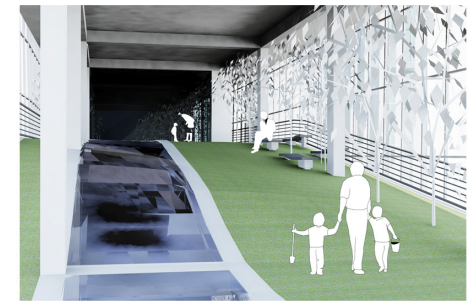


TOP SQUARE ON
DIAGONAL STREET



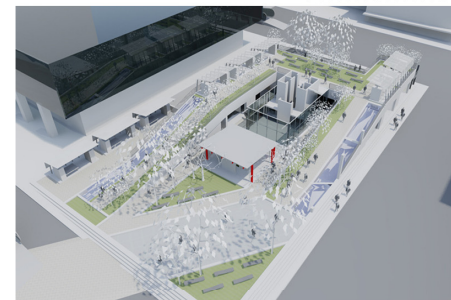
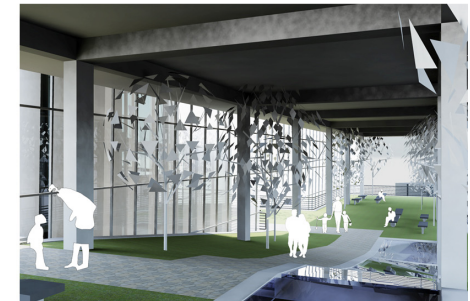
PRIVATE AREA

THIS AREA IS DESIGNATED FOR THE BUILDING'S RESIDENTS, WHERE RECREATIONAL ACTIVITIES MAY TAKE PLACE IN A SECURE AND HEALTHY ENVIRONMENT.(PERSONAL & COMPANIONSHIP LIFE)



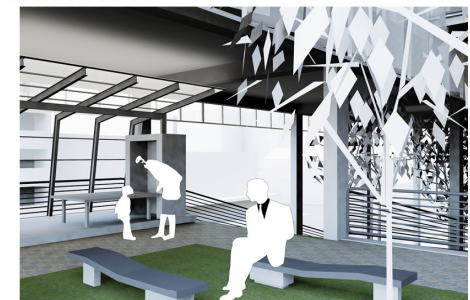
SEMI-PUBLIC AREA

ON THE 6TH FLOOR THE GREEN ROOFTOP TERRACE SERVE AS A MEETING SPACE FOR OFFICE USERS. MARKET OWNERS ALSO HAVE ACCESS TO THE NURSERY, WHERE LOCAL FOOD PRODUCE IS GROWN TO SELL AT THE MARKET. THIS HELPS REDUCE THE ENERGY CONSUMPTION ASSOCIATED WITH THE TRANSPORTATION OF FOOD AND HELPS PROMOTE THE LOCAL ECONOMY (DOMESTIC & DOMESTIC LIFE)

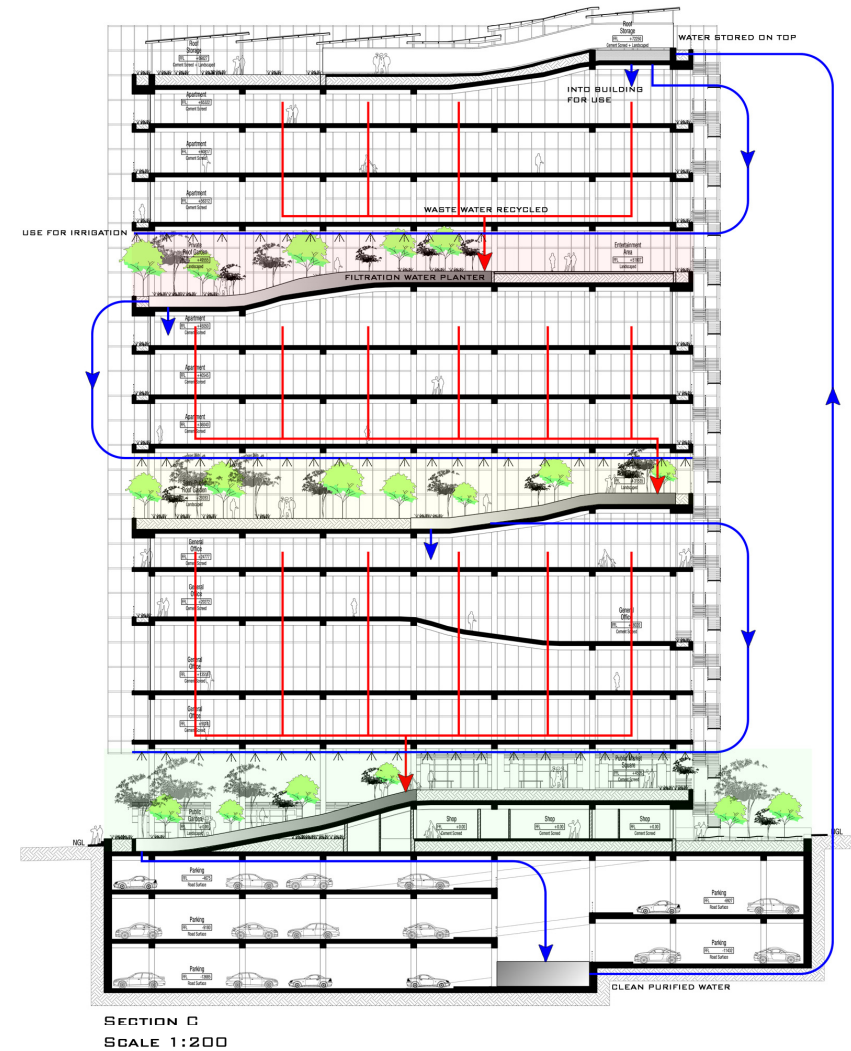
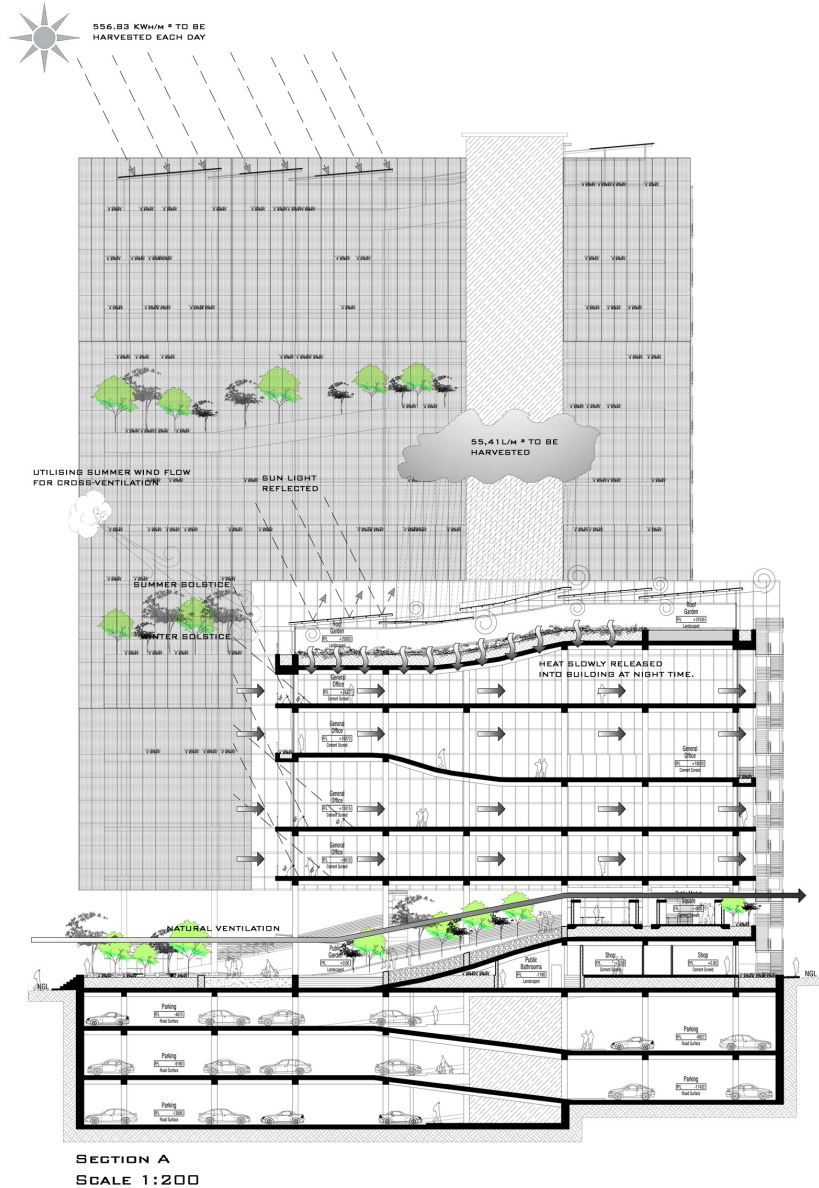


PUBLIC AREA

RECREATIONAL SQUARE ON GROUND AND 1ST FLOOR, FACILITATING LOCAL COMMERCE THROUGH RETAIL SHOPS AND MARKET STALLS. (CIVIC & COMMUNITY LIFE)



5.5. EFFICIENCY OF INFRASTRUCTURAL SUPPORT SYSTEMS



To achieve a symbiotic relationship between nature and the Diagonal's urban environment, the architectural practices implemented have to achieve equilibrium between consumption of resources and their performance. People relocate from rural areas to Johannesburg city due to a lack of poor service delivery, poverty, proximity to work and the lack of adequate housing. This all contributes to the over crowding of the city and has an impact on its infrastructural support systems effecting the health of the community.

The objective is to be efficient in carrying out functions in a cost effective manner. This is apposing to having one single densified activity zone in depended and linked only by a major transport system, soly relying on its own infrastructure to support itself (Dewar, D & Uytenbogaardt, R.S. 1991:52). Having an integrated activity zones in a linear growth pattern promotes the sharing of resources through high density, low energy living along with complimentary social amenities, convenience shopping, recreation and public services in compact, mixed-use urban settlements on Diagonal Street, along with alternative modes of transport. The sharing of infrastructure, social facilities and public services is at a less cost per unit to Diagonal's urban user, due to high-density living patterns resulting in a more efficient urban system. As shown on the right the major infrastructural support systems on Diagonal Street are

● ACCOMMODATION OF LAND USE:

- UTILISE SPACE IN TERMS OF THE HIERARCHAL STRUCTURE OF THE SOCIABILITY OF PLAGE
- PROVIDE STORAGE SPACE
- INTEGRATE MIX USE OF RESIDENTIAL AND RETAIL

🚶 SAFETY:

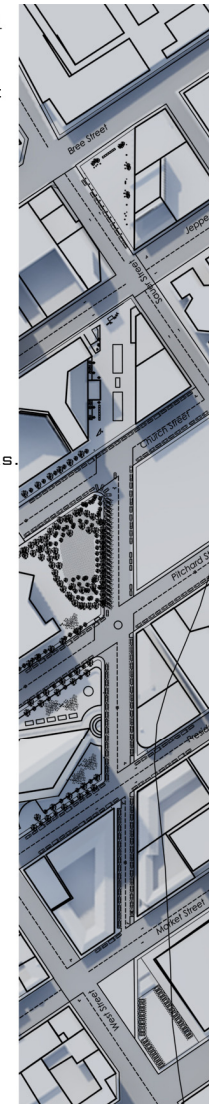
- PROVIDE FILTERS FOR SMELLS, DISEASES, LITTER, DUST.
- ACCESS POINTS TO BE SECURED INTO SURROUNDING BUILDINGS
- SEPARATE CHILDREN AND PEDESTRIANS FROM VEHICULAR MOVEMENT.
- PROVIDE EFFICIENT FIRE BARRIERS.
- ENCLOSE REFUSE AREAS

💡 ILLUMINATION:

- PROVIDE EFFICIENT LIGHTING DURING DAY AND NIGHT.

🌀 CIRCULATION:

- PROVIDE TRANSITIONAL SPACES AT ENTRIES TO BUILDINGS.
- PROVIDE EFFICIENT MOVEMENT FOR VEHICLES AT PEAK HOURS AND PEDESTRIANS.
- PROVIDE EMERGENCY ACCESS.



☔ CLIMATE CONTROL:

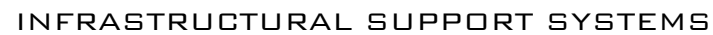
- PROVIDE SUFFICIENT PROTECTION FROM WEATHER INTERFERENCE

📞 COMMUNICATION:

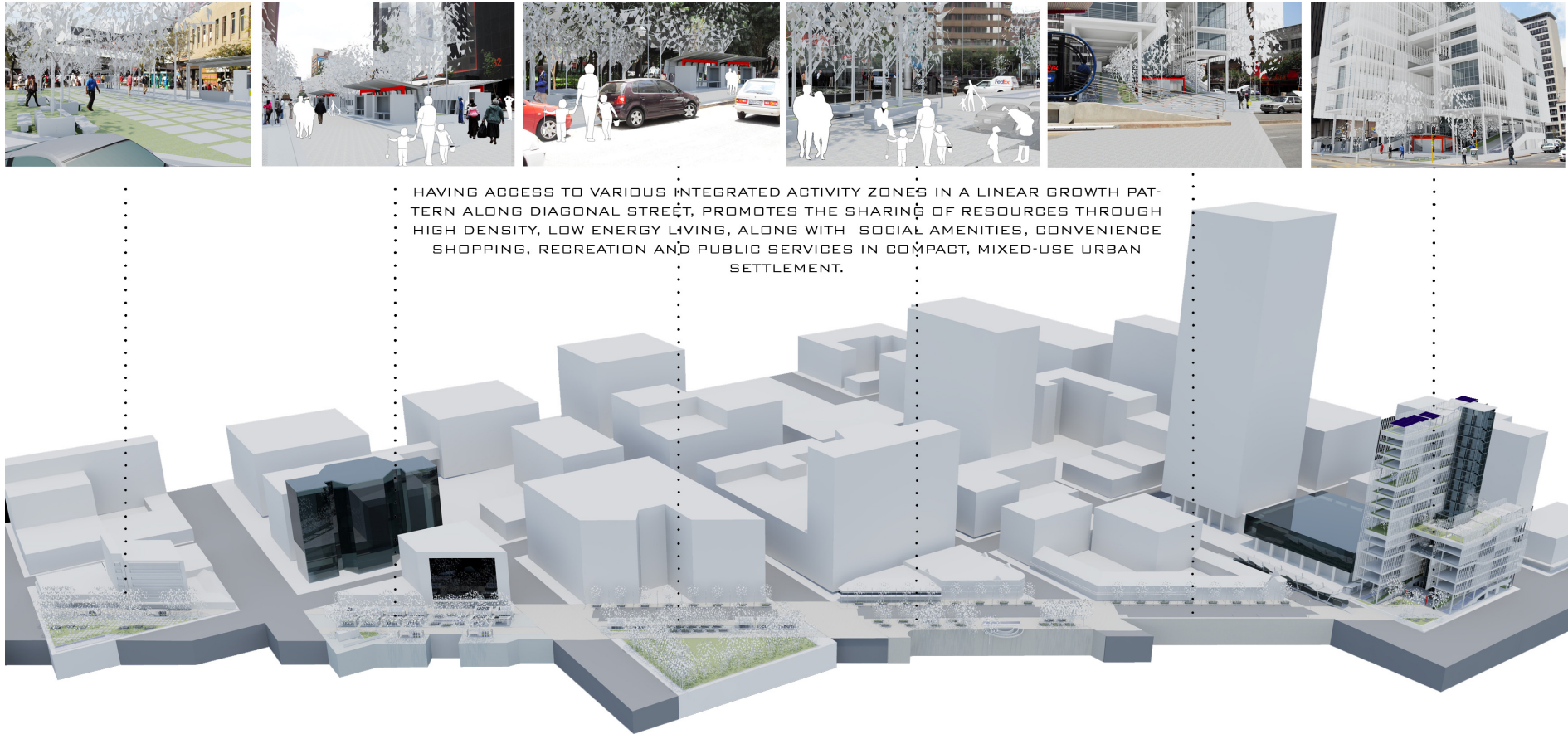
- PROVIDE EFFICIENT MOVEMENT AND PARKING FOR RESIDENTS AND VISITORS.
- PROVIDE MOST EFFICIENT TRAVELING DISTANCES FOR RESIDENTS FROM VEHICLES TO DWELLING.
- PROVIDE EFFICIENT PEDESTRIAN CIRCULATION WITHOUT CONFUSION.
- PROVIDE SAFE AND PLEASANT WALKING AREAS.

🔧 EQUIPMENT AND UTILITIES:

- PROVIDE TEMP. SPACE FOR SERVICE DELIVERY.
- PROVIDE PAUSE OR RECEPTION AREAS.
- PROVIDE FOR UTILITIES & MAINTENANCE: TELEPHONES, ELECTRICITY, WATER, SEWERAGE.



5.6. EQUITABLE ACCESS TO A VALUABLE VARIETY



Having access to a range of organisations, services, facilities and information on or close to Diagonal Street provides a variety of opportunities for education, recreation, employment, business, mobility, shelter, health, safety and basic needs. Johannesburg city is an engine for economic growth. As mentioned before people relocate to Johannesburg city due to poor service delivery and inadequate access to facilities in rural areas. People come to Johannesburg city to be inspired, build a drive to achieve and by doing so they discover and redefine their personalities, skills and intellectual curiosity (CIAM 2008). Johannesburg will serve as their opportunity system, but not everyone has access to these amenities within the city.

Diagonal's integrated movement modes along with the linear flow of mixed-use growth patterns will allow the urban dweller to have equitable access to a variety of opportunities. This will be facilitated by understanding what services and facilities Diagonal's users have access to and where certain amenities could be improved. Understanding the movement patterns and distances in and around Diagonal Street to these facilities will determine the location of these access points, which respond to the appropriate transport mode, defining the type of node (Dewar, D & Uytenbogaardt, R.S. 1991:52). Various facilities and services are identified and discussed with relation to equitable access in the diagrams on the right.



Having access to education and skill development facilities within walking distance from Diagonal Street will allow the urban user to improve his social and economical circumstances.



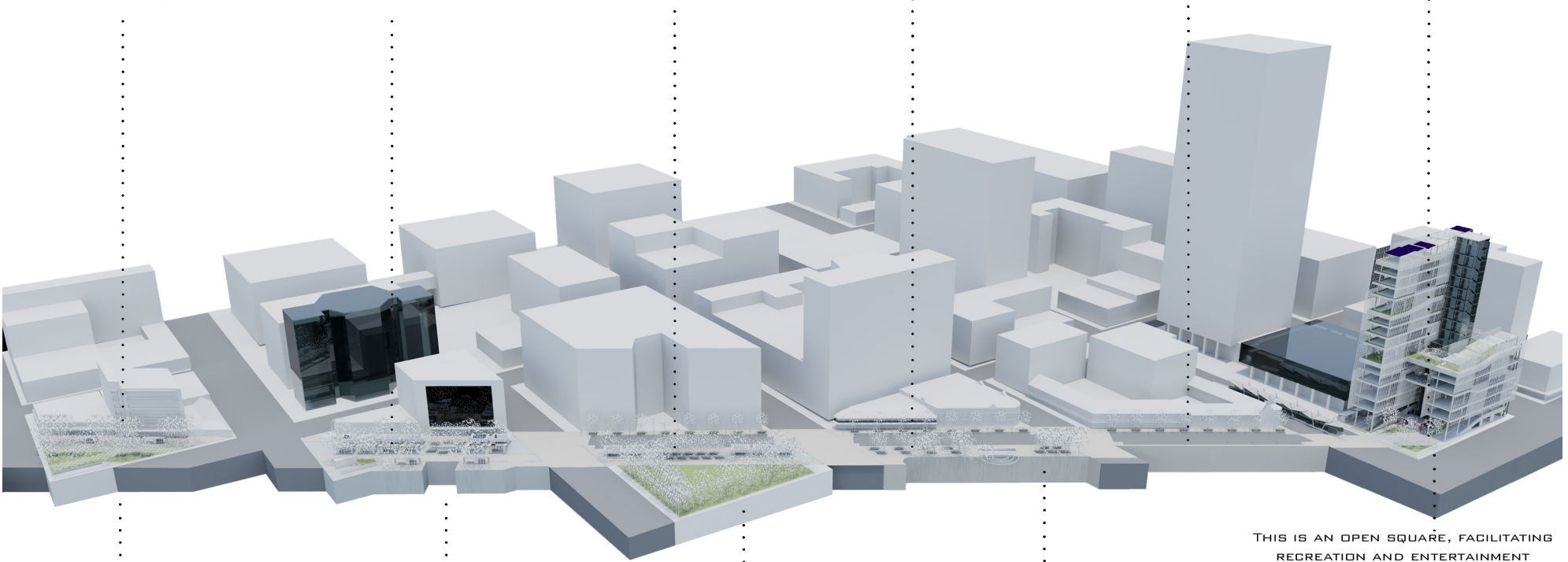
Having access to infrastructural amenities will promote better health and safety conditions within Diagonal's urban context.



Having access to recreation and entertainment facilities outside Diagonal Street within walking distances will further promote social interaction and healthier lifestyles.



To support smaller business ventures in the city of Johannesburg, having access to larger financial institutions will promote urban users' financial circumstances.



THE SQUARE AT THE BOTTOM OF DIAGONAL STREET FORMS A VITAL TRANSPORT DESTINATION AND MEETING SPACE FOR THE URBAN DWELLER. IT FORMS A PEDESTRIAN LINK BETWEEN THE BOTTOM AND TOP SQUARE. THE AREA CAN BE CLASSIFIED AS A MIX USE ZONE. THE SURROUNDING BUILDINGS FACILITATE PLACES WHERE, FOOD, ELECTRONIC DEVICES, CLOTHES, LODGING/RESIDENTIAL, TELEPHONE, RECREATION AND ENTERTAINMENT, OFFICE SPACE AND TRANSPORT MODES CAN BE ACCESSED.

MIX USE ZONE FACILITATING:

- VEGETABLE AND FRUIT MARKET.
- FOOD
- EDUCATION AND SKILL DEVELOPMENT.
- ELECTRONIC STORES
- CLOTHING AND LINEN STORES
- HARDWARE STORES
- FINANCIAL & INVESTMENT FACILITY
- BOOK SHOPS
- TAVERN

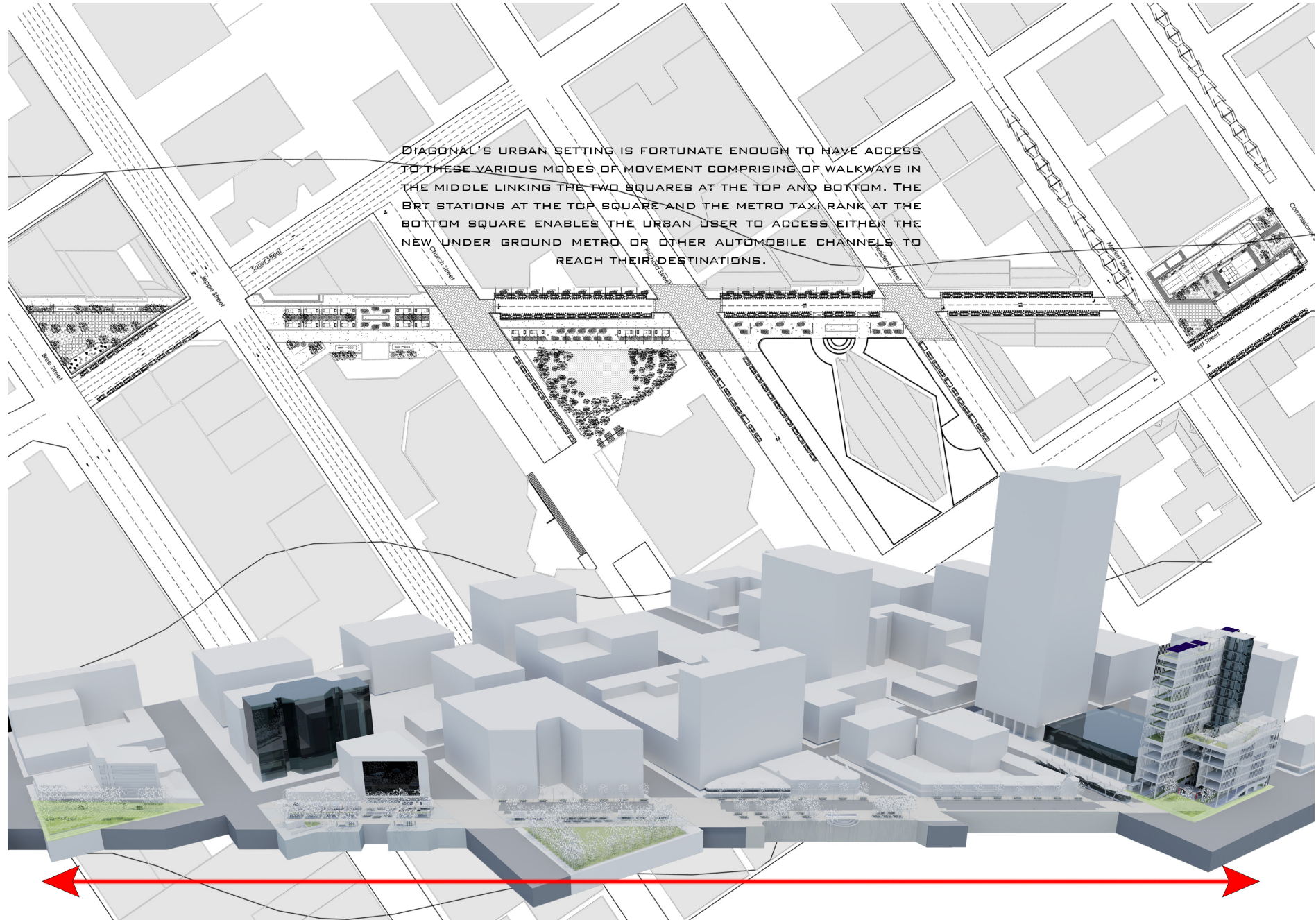
THE BROWNSTEIN GARDEN FACILITATES THE OPPORTUNITY FOR A PLACE WHERE RECREATION AND ENTERTAINMENT ACTIVITIES COULD TAKE PLACE. AT THE MOMENT ACCESS TO THE GARDEN IS RESTRICTED PROHIBITING ACCESS TO FREE BORE WATER AND COOL SHADE. THE GARDEN ALSO FORMS A VITAL PEDESTRIAN LINK BETWEEN THE BLOCKED OFF CHURCH STREET BETWEEN THE TWO JSE BUILDINGS.

MIX USE ZONE FACILITATING:

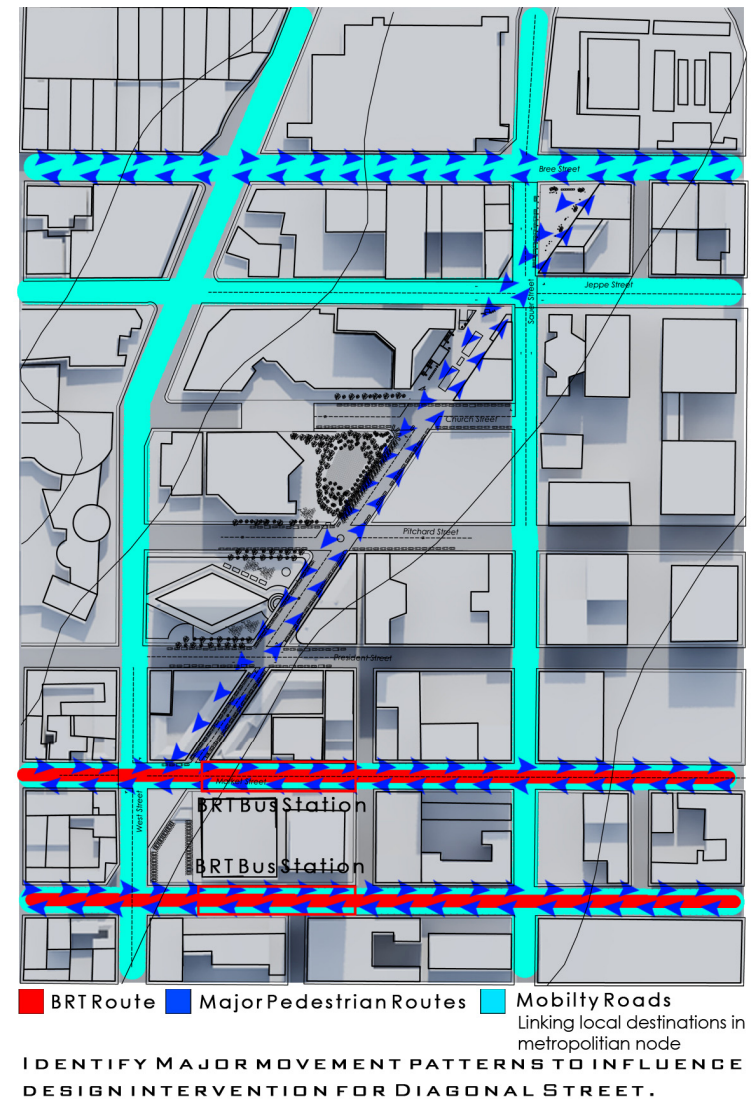
- TRADITIONAL AND MODERN MEDICAL NEEDS.
- FOOD
- LODGING/RESIDENTIAL
- ELECTRONIC STORES
- CLOTHING AND LINEN STORES
- HARDWARE STORES
- FINANCIAL & INVESTMENT FACILITY

THIS IS AN OPEN SQUARE, FACILITATING RECREATION AND ENTERTAINMENT ACTIVITIES. THE AREA CAN BE CLASSIFIED AS A MIX USE ZONE. THE SURROUNDING BUILDINGS FACILITATES OPPORTUNITIES WHERE CLOTHES, FOOD, OFFICES, LODGING/RESIDENTIAL AND FINANCIAL FACILITIES CAN BE ACCESSED. THE SQUARE ALSO GIVES ACCESS TO 2 BRT STATIONS, ONE ON MARKET STREET AND ONE ON COMMISSIONER STREET. THE SQUARE IS A VITAL LINK BETWEEN DESTINATIONS WITHIN THE CITY OF JHB, FACILITATING PEDESTRIAN AND OTHER MODES OF TRANSPORT MOVEMENT.

5.7. INTEGRATED MODES OF MOVEMENT



Public transportation is one of the key contributors to the growth of an economy in the city of Johannesburg, but it is at the ecological expense of the local environment. The primary driver for sustainable transport is the global energy crisis and the depletion of fossil fuels, due to over consumption of non-renewable fossil fuels and the resulting human-induced build up of carbon dioxide (CO₂) in the atmosphere. Diagonal's urban setting must promote appropriate modes of movement from having access to an integrated transport systems comprising of walkways, cycle lanes, bus lanes, under ground metro and automobile channels. Mobility road systems identified, move between high-density nodes and hubs in and around Johannesburg city, which interchange with lower technology movement options like the metro bus systems and the newly introduced BRT systems. These hierarchical modal nodes become the public domains around which clusters of high-density pedestrian mix use urban settlements will form in and around Diagonal Street. Diagonal Street will take advantage of the pedestrian movement on Bree Street at the top and Market, Commissioner Street at the bottom. The entire Diagonal pedestrian mixed-use node will link local and remote destinations by facilitating access to integrated modes of transport (CIAM 2008).



5.8. CONCLUSION

Biophilic architecture has developed a systematic approach to design climate responsive buildings on Diagonal Street through applying architectural methods and technologies as means to achieve a low energy impact on the surrounding ecology of buildings. Utilising the ambient energy that nature has to offer through passive mode design, the architect has achieved better human performance levels, health and reinstated the human's psychological affiliation with nature. There is also a regionalist approach by implementing environmentally responsive architecture in Diagonal's urban context. Using new building technologies will reassert Diagonal's old cultural identity and establish new cultural affirmations.

The provision of hierarchical social spaces along Diagonal's street edge will facilitate different urban users in terms of visually exciting, activity driven and private meeting spaces, developing and promoting the social character of Diagonal Street. Movement patterns will be strengthened by linking these social domains with appropriate modes of transport, allowing more freely social interaction to occur, also facilitating local commerce. To accommodate the local pressures of urban sprawl on the city of Johannesburg, Diagonal's infrastructural

support systems will be efficient in its use of natural and renewable resources balanced out with its performance. Johannesburg will serve as the backdrop of urban users' opportunity system and therefore Diagonal's linear flow of dense mix-use pockets along the street will allow equitable access to opportunity systems and daily consumption needs. Access to integrated transport systems in and around Diagonal Street will form the public domains around which these mixed-use opportunity systems developed.

This thesis aims to take the existing environmental and contextual research within Diagonal's urban context and design an environmentally integrated urban landscape by using architectural forms and practices that make the most of the ambient energy stored in nature without resorting to conventional or alternative non-renewable energy resources. A selected part on Diagonal Street will be identified and further developed according to environmentally responsive design principals to achieve ideal thermal comfort levels and enhance the quality of space in Diagonal's urban context.

The integration of environmental building practices in the future planning of Johannesburg City becomes a powerful argument on why there needs to be a better variety of

ecological diversity in urban cities today and in Johannesburg in particular.

Biophilic architecture is a means to design better human environments at no expense to the well being of the local ecological bio-diversity. The design attempts to fashion architecture in harmony with nature while keeping the comfort needs of the human as the central concern. It adds a crucial dimension to sustainable design by reminding us to fulfill a deeply felt human need, by effectively managing our natural resources with relation to the built environment.

6. URBAN FRAMEWORK

FUNDAMENTAL RESEARCH

KEY PRINCIPLE	DESIGN OBJECTIVE	DESIGN STRATEGY
NATURE	Through environmental responsive design, aim to reduce building energy consumption. Make use of ambient energy stored in nature to create better quality urban environments and human comfort levels. Create comprehensive mix use neighbourhoods that enhance communal aspects. Allow for flexible development of sites through mix use zoning. Manage sustainable consumption and production standards. Reduce heat island effect through environmental responsive design. Conserve natural habitats. Enhance natural zones. Better design of open space through better land use planning.	Passive mode by building configuration: -Buildings spatial arrangement to optimise ambient energy store in nature. -Built form's volume to its surface in terms of solar radiation. -Buildings overall shape. -Make use of Atrium spaces. Passive mode by built form's orientation: -Shape of Floor plate. -Position on site. -Orientation in relation to the sun path. -Orientation in relation to the micro climate. -Use of renewable energy sources. Facade design: -Permeable to light. -Permeable to heat. -Permeable to air movement. -Permeable to visual transparency. -Provide effective insulation. -Provide effective solar protection. -Regulate and harvest wind swept rain. -Optimise on choice of colour and choice of materials. Wind and Natural Ventilation: -Use of vegetation through evaporation. -Built form and orientation to assist in natural ventilation. -Multi-layered and adaptable façade to assist in natural ventilation. -Use of atrium spaces through stack effect. -Wind walls to assist air flow. -Low level inlets and high level exhausts. Passive mode by landscaping: -Vertical landscaping. -Use of green roof spaces. -Vegetation to assist in natural cooling. -Vegetation to serve as insulator. -Vegetation to serve in retaining on site water. -Vegetation to assist in reducing building energy consumption. -Vegetation to serve as an acoustic barrier. -Vegetation to serve as wind screens.

CONTEXTUAL RESEARCH

KEY PRINCIPLE	DESIGN OBJECTIVE	DESIGN STRATEGY
TRADITION/IDENTITY	Preserve cultural history Promote cultural history through integrating the development with the surrounding culture and activities.	Building systems must correspond to adaptation to climate, social circumstances and availability of building materials and technologies. Relate build configuration, aesthetics, organization and technical assembly and materials to building's location and time. Make use of visual axis to frame historical significance. Knowledge of local setting will determine orientation and structuring of proposed intervention through art, urban space and architecture.
THE SPIRIT OF PLACE RELATING TO ACTIVITY AND NEEDS	Promote social interaction. Promote movement patterns. Promote hierarchal social arrangement in terms of hierarchical arrangement of space and place	Hierarchal structure of social domains. Provide visually exiting and socially engaging spaces and built forms. Determine different activities, users and time periods used to help influence design. Use of roof gardens or sky terraces as meeting spaces. Architecture that responds to human dimensions. Provide natural soft urban edges that respond to the urban user's senses. Provide integrated pedestrian walkways. Provide different seating arrangements. Have equitable access to all public parks.

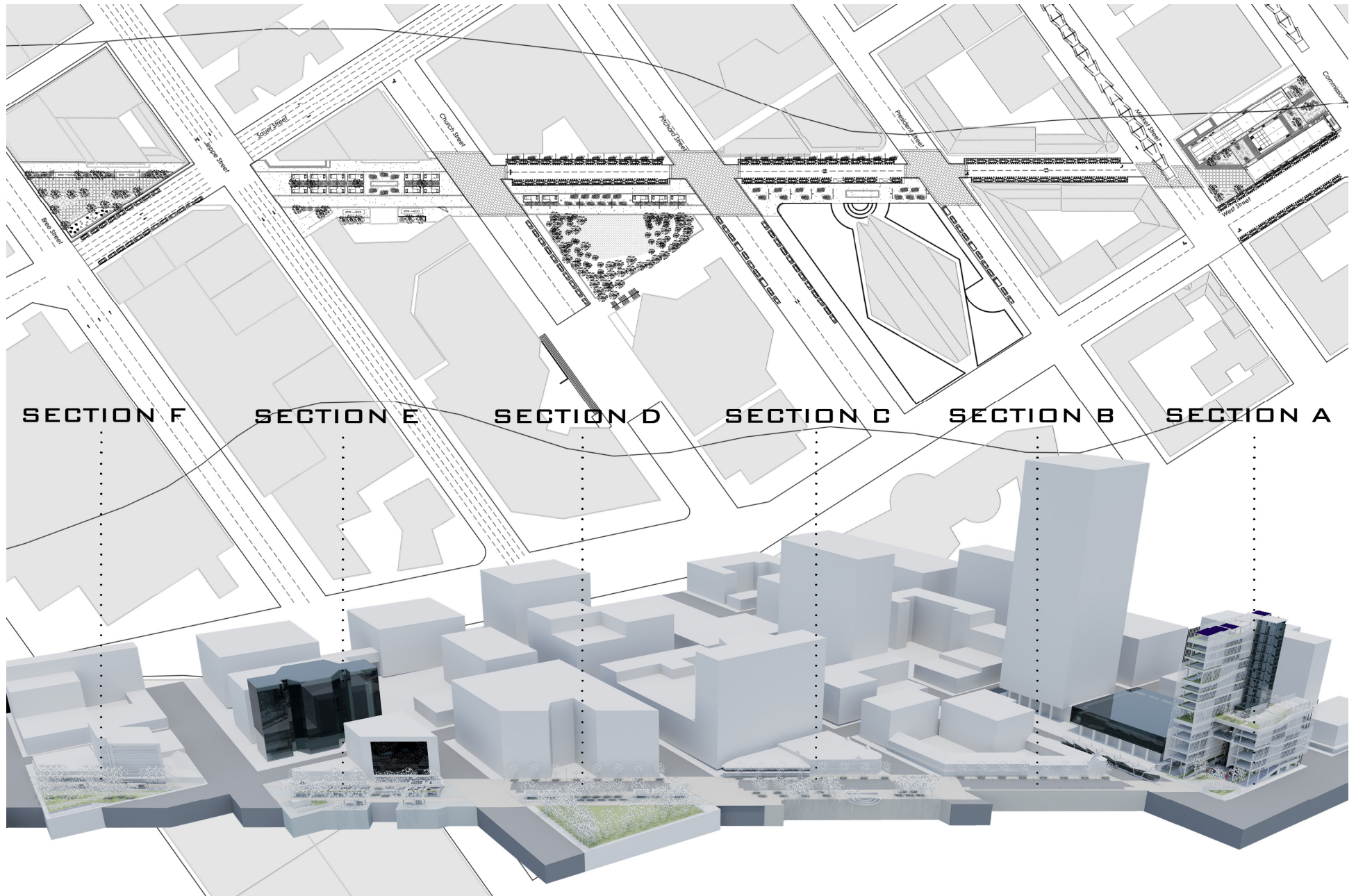
CONTEXTUAL RESEARCH

KEY PRINCIPLE	DESIGN OBJECTIVE	DESIGN STRATEGY
EFFICIENCY OF INFRASTRUCTURAL SUPPORT SYSTEMS.	Achieve an equilibrium between the consumption of resources and their performance.	Accommodation of land use: -Utilise space in terms of the hierarchical structure of the sociability of place. -Provide storage space. -Integrate mix use of residential and retail.
	Promote better healthier lifestyles.	Safety:
	Promote safety.	-Provide filters for smells, diseases, litter, dust. -Access points to be secured into surrounding buildings.
	Promote access to all infrastructural amenities.	-Separate children and pedestrians from vehicular movement. -Provide efficient fire barriers. -Enclose refuse areas.
	Reduce waste.	Climate control:
	Be efficient carrying out functions in a cost effective manner.	-Provide sufficient protection from weather interference
	Promote higher urban densities.	Acoustic control:
	Promote an integrated activity zone in a linear growth pattern.	-Provide acoustic barriers from noise generated by vehicles and urban noise.
	Provide access to alternative modes of transport.	Illumination:
	Promote low energy living.	-Provide efficient lighting during day and night.
		Circulation:
		-Provide transitional spaces at entries to buildings. -Provide efficient movement for vehicles at peak hours and pedestrians. -Provide emergency access.
		Communication:
		-Provide efficient movement and parking for residents and visitors. -Provide most efficient traveling distances for residents from vehicles to dwelling. -Provide efficient pedestrian circulation without confusion-sufficient signs. -Provide safe and pleasant walking areas.
		Equipment and utilities:
		-Provide temp. space for service delivery. -Provide pause or reception areas. -Provide for utilities & maintenance: Telephones, electricity, water, sewerage.

CONTEXTUAL RESEARCH

KEY PRINCIPLE	DESIGN OBJECTIVE	DESIGN STRATEGY
EQUITABLE ACCESS TO A VALUABLE VARIETY	Promote education.	Provide access to a range of organizations, services, facilities.
	Promote recreation opportunities.	Provide linear mixed use growth patterns along with integrated transport nodes.
	Promote employment opportunities.	Implement more green public spaces.
	Promote business opportunities.	Ensure buildings are adaptable and accessible to changing conditions and lifestyles.
	Access to different modes of transport.	Provide local agricultural opportunities with local food markets.
	Access to shelter/Residential opportunities.	Enhance local commerce in the area.
	Promote access to health facilities and to healthier lifestyles	
	Access to all infrastructural amenities.	
INTEGRATED MODES OF MOVEMENT.	Promote access to financial institutions.	
	Promote public transport.	Provide access to integrated modes of transport, which respond to nodal development in terms of:
	Promote lower energy consuming modes of transport.	-Walkways.
	Have more pedestrian orientated movement patterns.	-Cycle lanes.
	All public modes of transport is within walking distances.	-Bus lanes
	Limit on site parking above ground.	-Under ground metro.
		-New BRT system.
		-Regional freeways.

7. SITE PROGRAM



SITE PROGRAM

SECTION A

- Recreational Park/Square
- Catering for the Informal Market Sector
- Public Infrastructural Support Systems
- Integrate with BRT stations
- Mix-use Building
 - Retail shops for every day needs.
 - Green spaces to serve as Public and Private meeting spaces
 - Various types of office configurations.
 - Roof gardens for permaculture opportunities
 - Various types of Residential configurations
 - Efficient building operational systems.
 - Underground Parking.

SECTION B

- Public Infrastructural Support Systems.
- Promote Pedestrian movement.

SECTION C

- Public meeting spaces to stimulate social interaction.
- Aid Pedestrian movement.

- Infrastructural Support systems.

SECTION D

- Various types of Public meeting spaces.
- Aid Pedestrian movement.
- Infrastructural Support Systems.

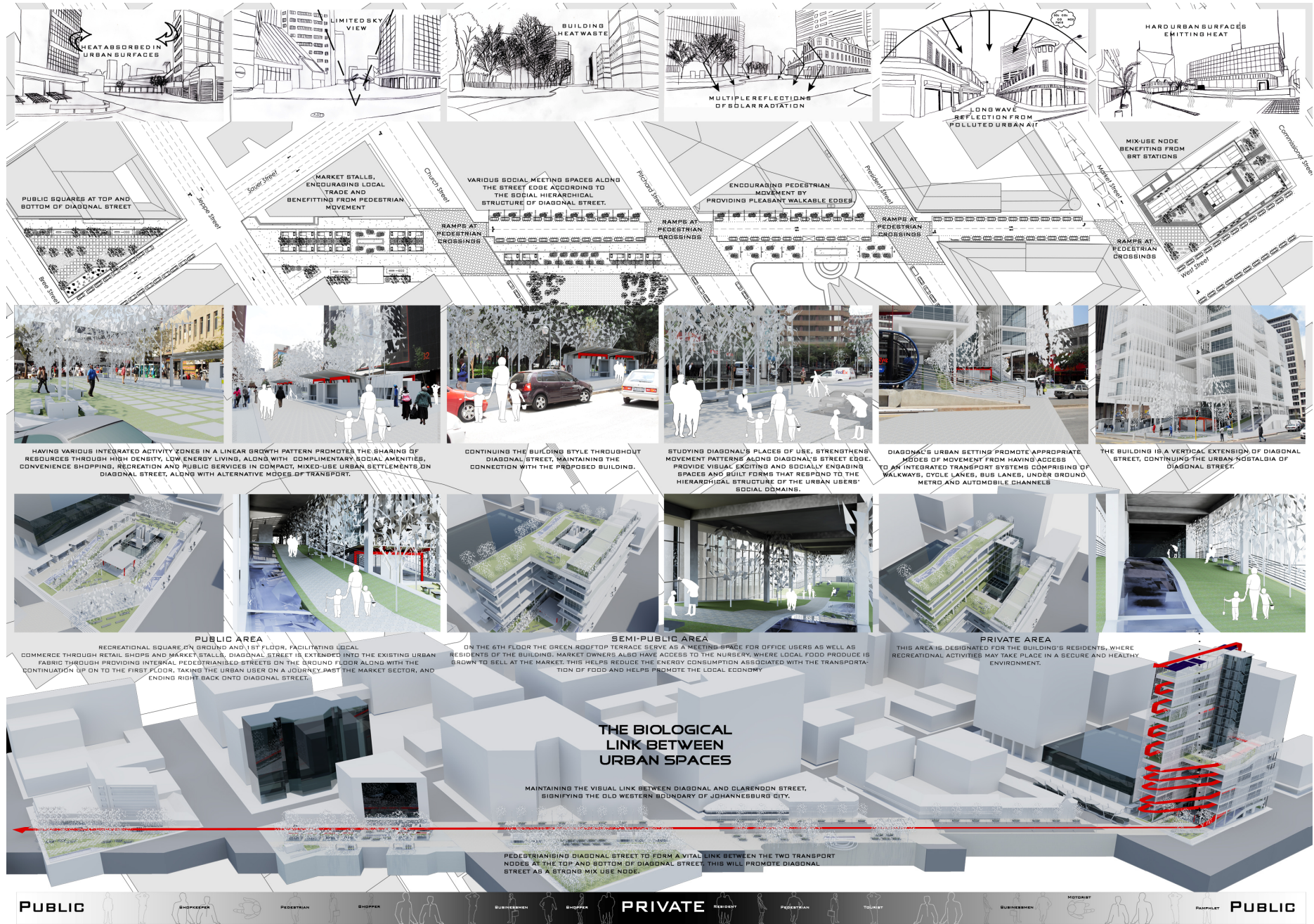
SECTION E

- Local mix-use market.
- Infrastructural Support Systems.
- Green space for permaculture opportunities
- Aid Pedestrian movement

SECTION F

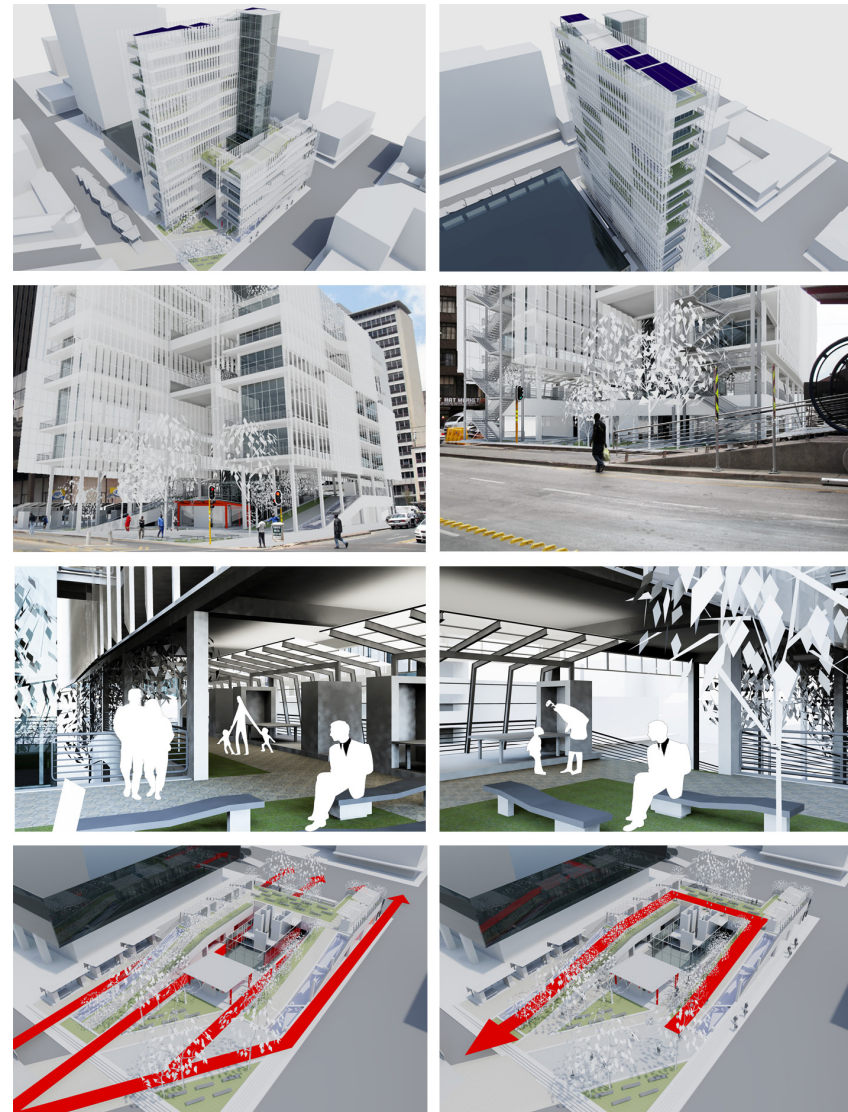
- Recreational Park/Square.
- Vegetated meeting spaces.
- Infrastructural Support Systems.

8. DESIGN



The selected site I have chosen to further develop my thesis objectives, is the open square right at the top of Diagonal Street. The site offers me various opportunities to further promote and integrate into Diagonal's environmental, social and economic circumstances. The site is one of the most important transport nodes within the city of Johannesburg, for it is located between two major mobility spines. This allows me to integrate this major transport node with various types of mix-use opportunity systems.

The propose building on this square will be a bio-responsive mix use building based on the theoretical principals set out in this document. The focus is not to take anything away from the public square itself, but rather to extend it up into the building. Keeping in mind the traditional heritage of Diagonal Street, concerning the old western border of Johannesburg city, the objective is to keep a clear visual link between Diagonal and Claredon Street and further encourage this concept right up into the building itself. This is also the main driver, which the social hierarchical structure within the building is fashioned around. Diagonal Street is extended into the existing urban fabric through providing internal pedestrianised streets on the ground floor along with the continuation up on to the first floor, taking the urban user on a journey past the market sector, and ending right back onto Diagonal Street. The raking of the floor

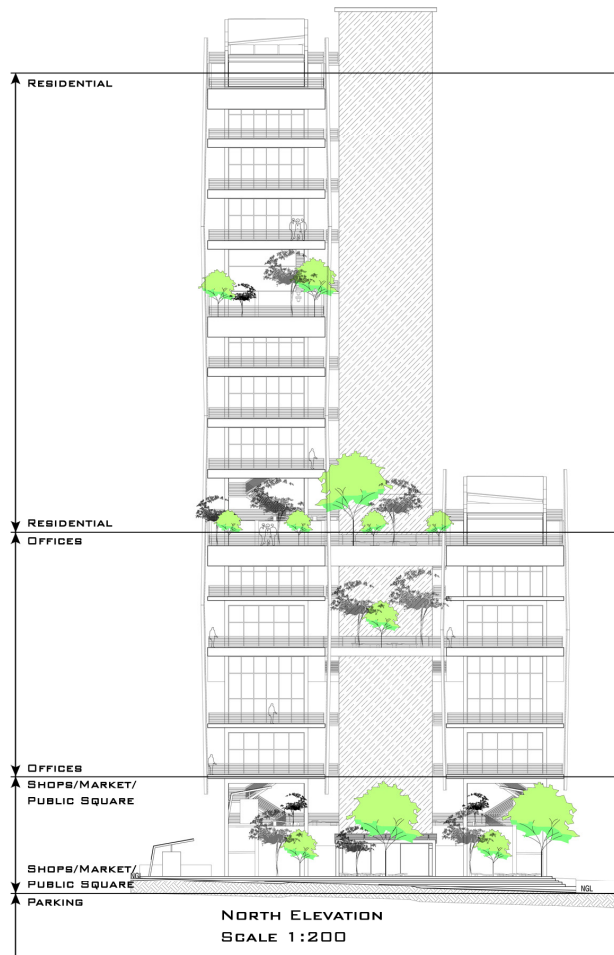


plates also suggest symbolically that Diagonal Street is extended all the way up into the building.

The ground and first floor serve as a public meeting space for urban users, while they are waiting for their public transportation to arrive and offer retail and market shopping facilities. The continues use of green recreational terraces are used further up into the building, where it serves as a semi-public meeting space for business occupants or private meeting spaces for residents in the building. The rooftop on the sixth floor also allow market owners to grow their own food produce for the market in the nursery provided, benefiting the local economy of Johannesburg.

Having a bio-responsive mix use building in Johannesburg city, not only takes enormous pressure off the infrastructural support systems, but enhances the ecological biodiversity of the region through incorporating good design principles. This is where architecture is rather practiced as sociocultural discipline and an applied science. The notion of the building is to create better human performance levels and quality urban spaces through architectural forms and practices by perceiving on how bio-responsive design can aid architecture and urban planning.





NORTH ELEVATION
SCALE 1:200

PARKING

9 SHOPS (377M²)

STAFF: 1 BAY PER MANAGERIAL
VISITORS: 1 BAY PER 25M² OF GROSS FLOOR AREA

OFFICES (2688M²)

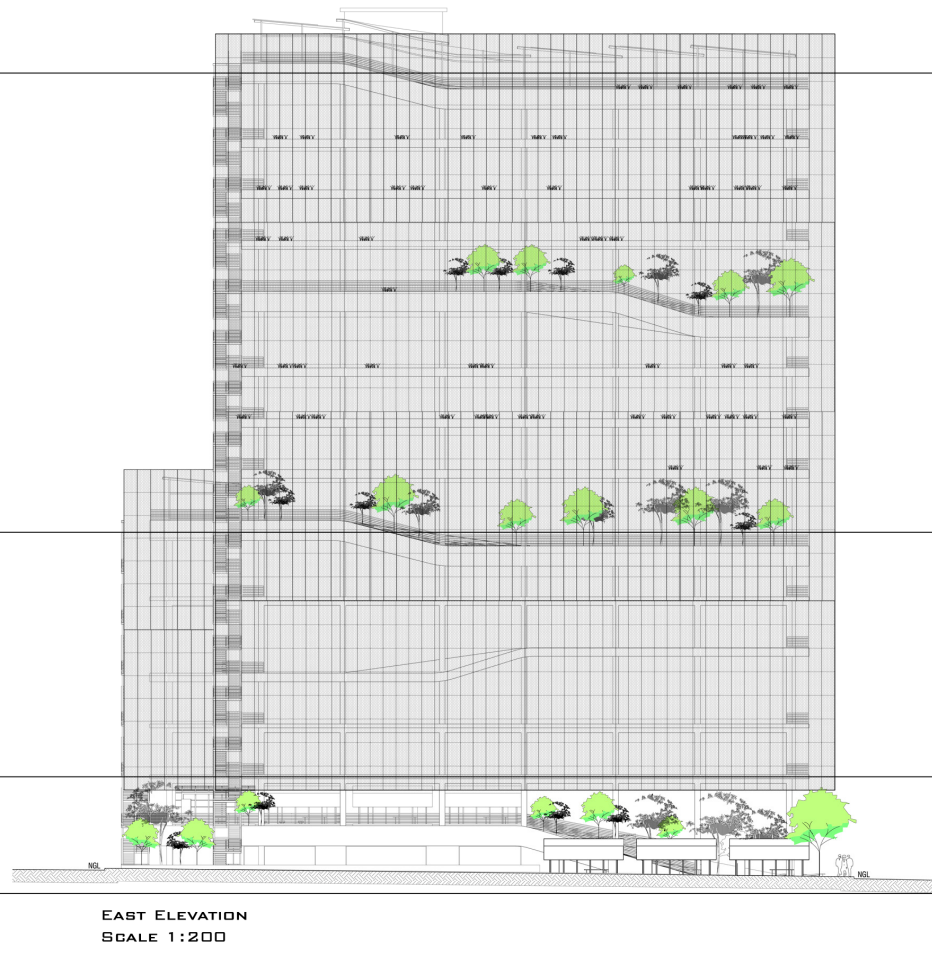
STAFF: 1 BAY PER 25M² OF GROSS FLOOR AREA
VISITORS: 10% OF STAFF PARKING PROVIDED

RESIDENTIAL (27 APARTMENTS)

RESIDENTS: 1 BAY UP TO 2 BEDROOMS
VISITORS: 0.3 PER APARTMENT

TOTAL REQUIRED= 178

TOTAL PROVIDED=181



EAST ELEVATION
SCALE 1:200

SHOPS/MARKET/PUBLIC SQUARE

9 SHOPS (377M²)

14 MARKET STALLS (154M²)

BATHROOMS

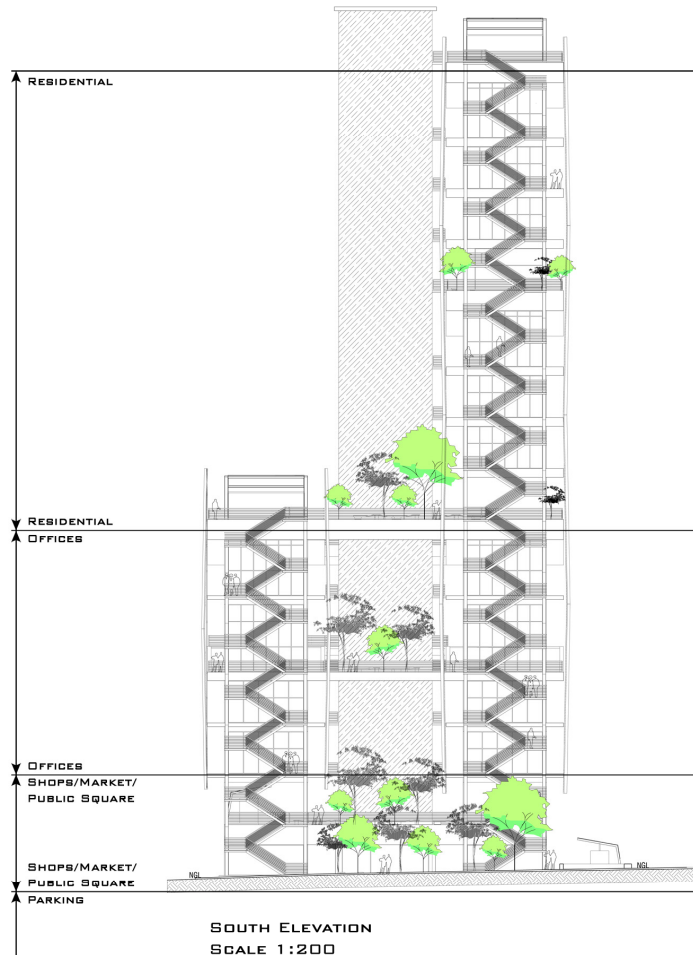
MALE: 5 WC, 8 URINALS, 7 WHB
FEMALE: 12 WC, 7 WHB

OCCUPANCY (1 PERSON / 12M²)

GROUND (200 PEOPLE)

FIRST FLOOR (60 PEOPLE)

- A. FORMAL OPEN SPACE=PARKS+GARDENS= 6M²
- B. INFORMAL OPEN SPACE= 4.8M²
- CIRCULATION, BATHROOM, SUPPORT FACILITIES
- =80% OF FORMAL OPEN SPACE
- C. BUILT AREA=1.08
- (A + B) X 10%



SOUTH ELEVATION
SCALE 1:200

OFFICES (2688M²)

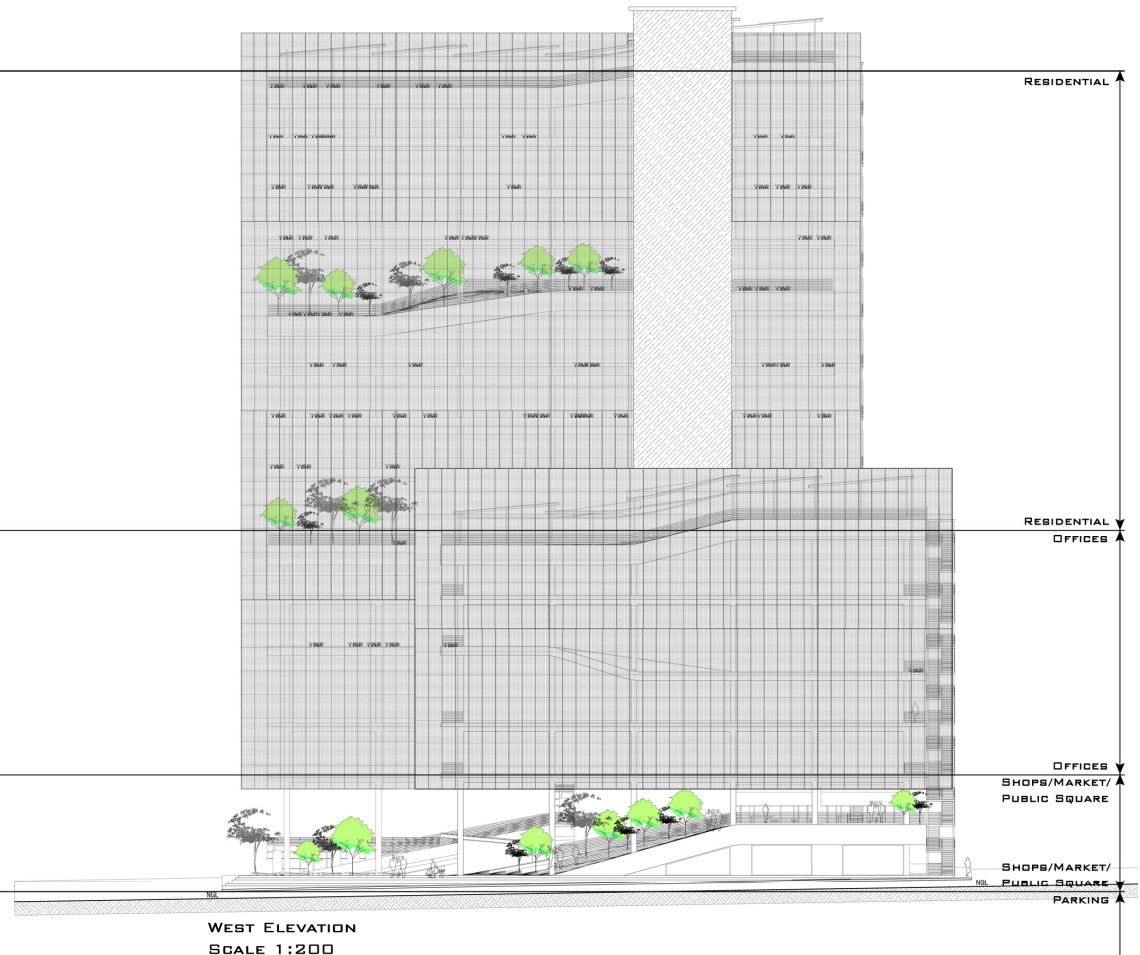
LESS THAN 30 PEOPLE PER FLOOR

BATHROOMS

MALE: 2 WC, 3 URINALS, 2 WHB
FEMALE: 3 WC, 2 WHB

OCCUPANCY (1 PERSON / 25.85M²)

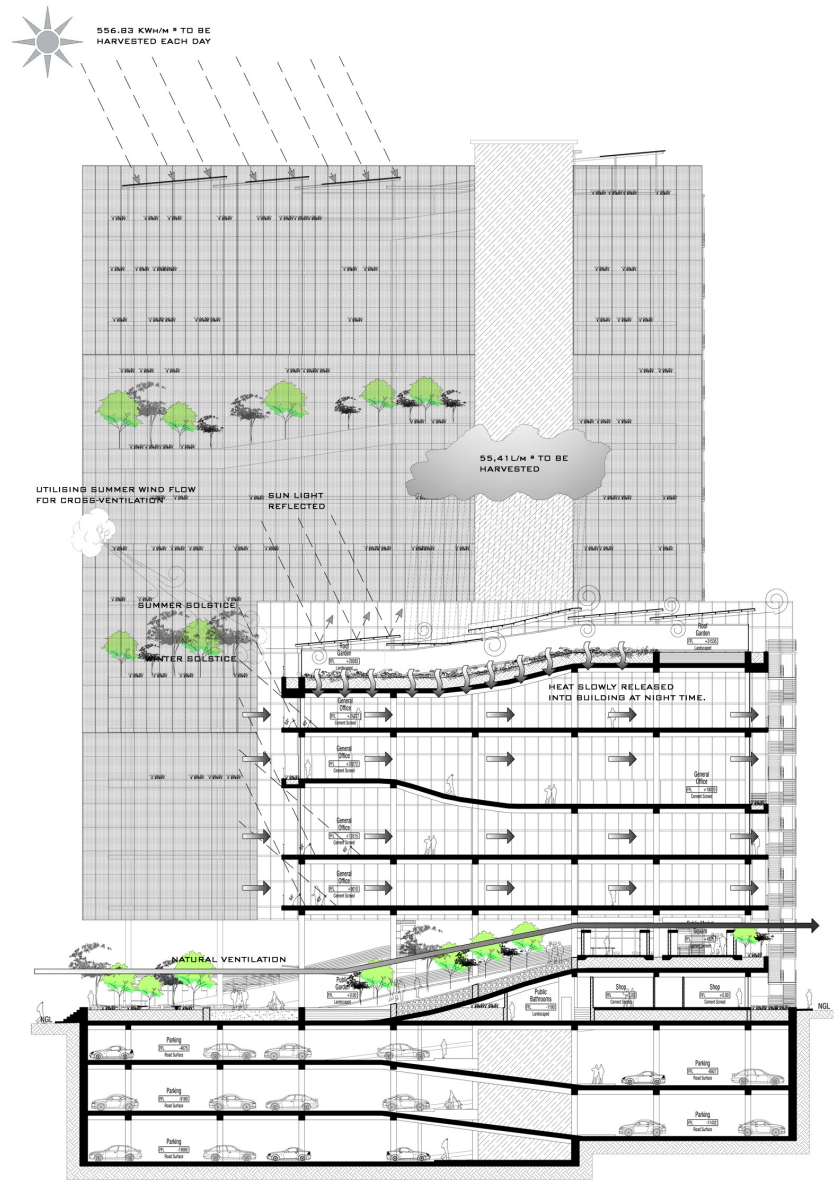
- A. WORKSPACE (ALLOCATED INDIVIDUAL OR OFFICE SPACE $\pm 10M^2$)
- B. WORKSPACE SUPPORT (60% OF WORKSPACE = $6M^2$)
- C. CORE SPACE (75% OF WORKSPACE = $7.5M^2$)
- D. STRUCTURE SPACE (10% OF A + B + C = $2.35M^2$)



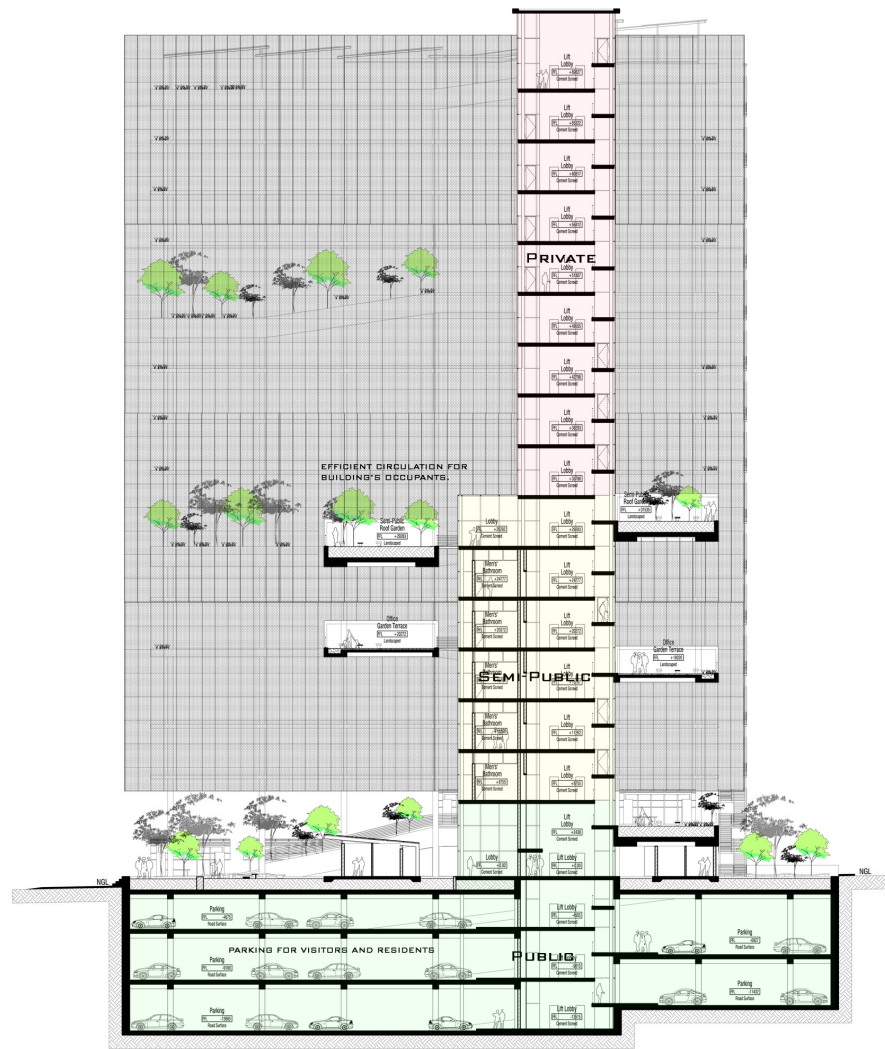
WEST ELEVATION
SCALE 1:200

RESIDENTIAL (27 APARTMENTS)

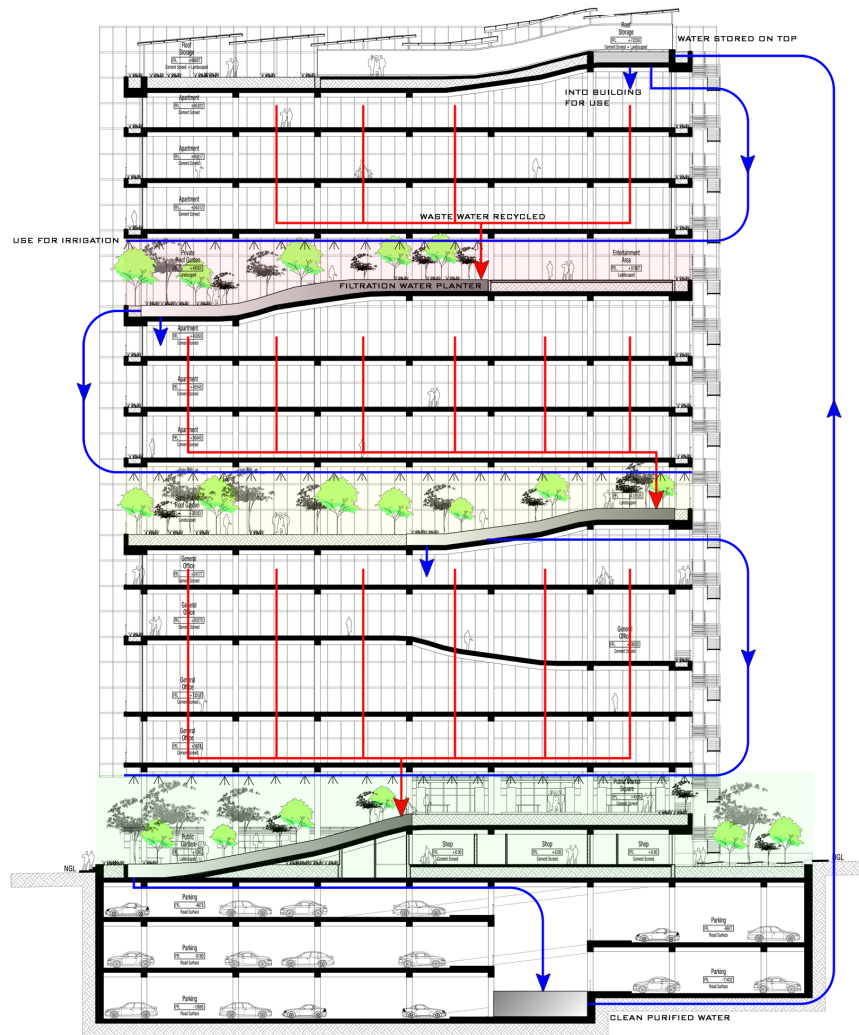
- 6 OF 2 BEDROOM APARTMENTS ($\pm 120M^2$)
- 6 OF 3 BEDROOM APARTMENTS ($\pm 60M^2$)
- 15 OF 1 BEDROOM APARTMENTS ($\pm 60M^2$)



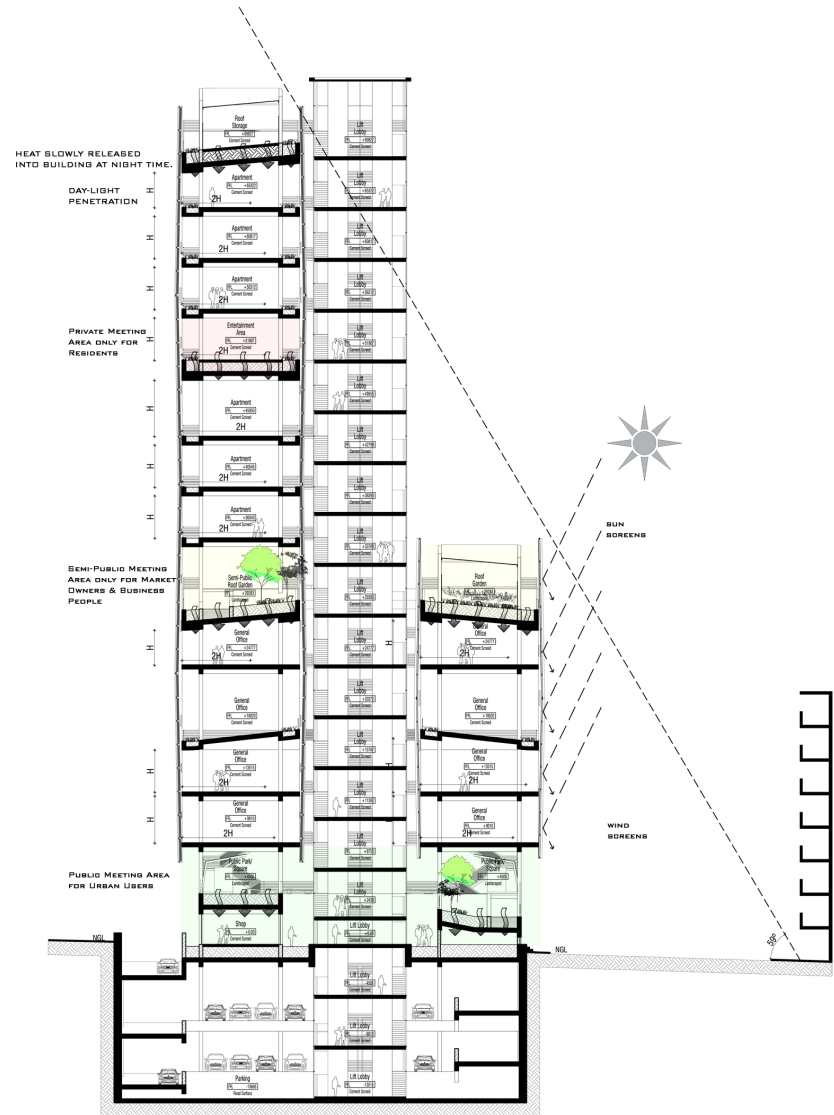
SECTION A
SCALE 1:200



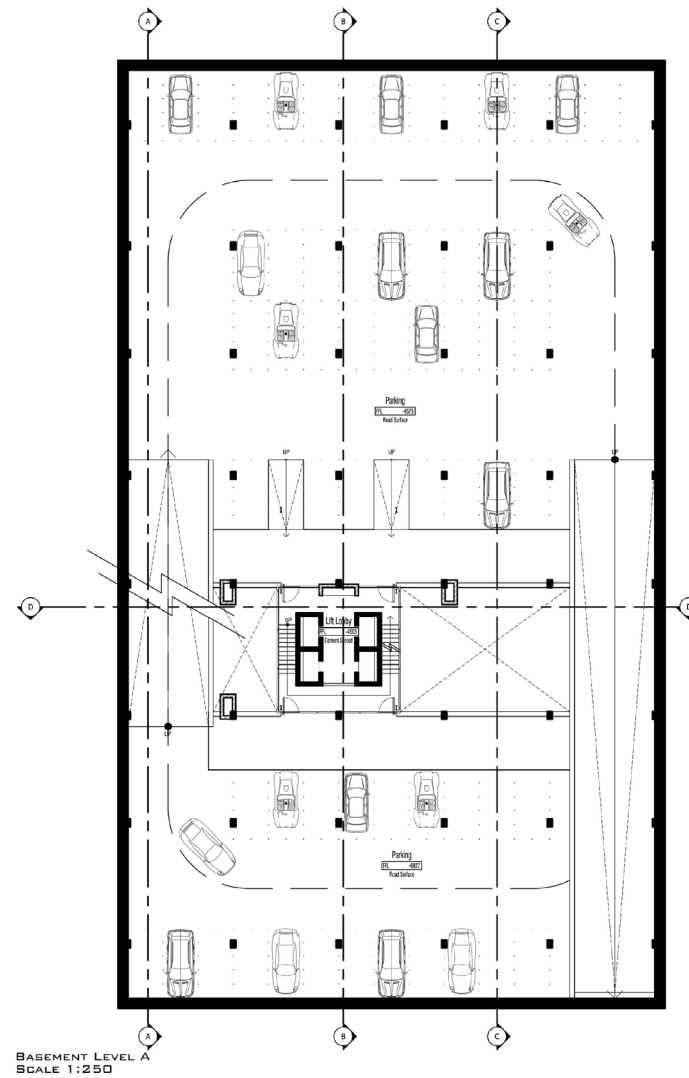
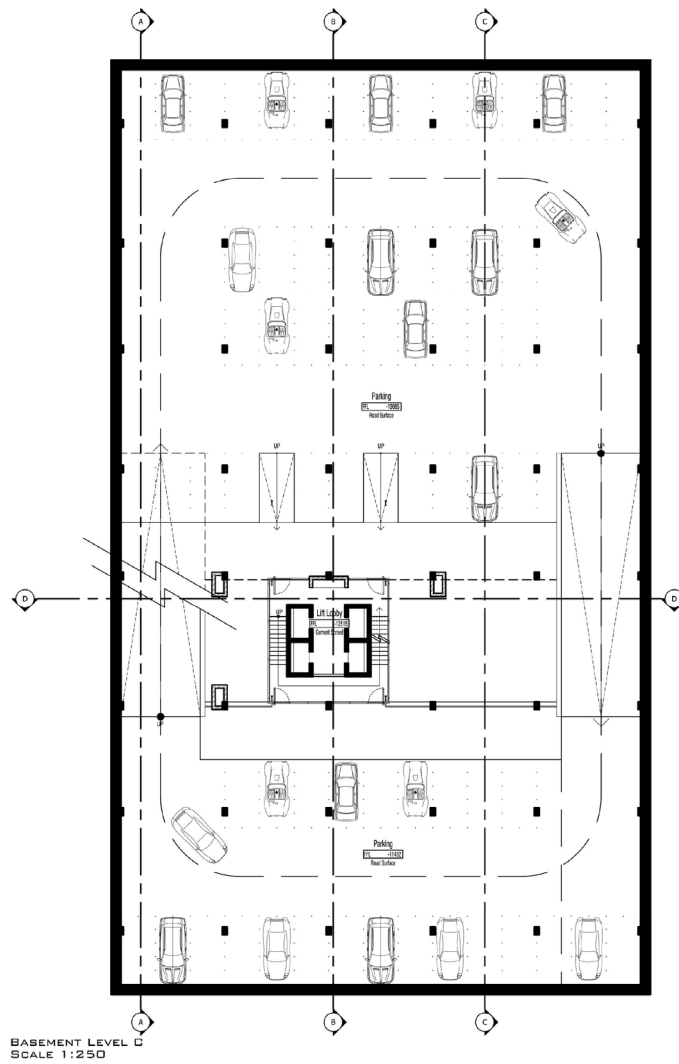
SECTION B
SCALE 1:200

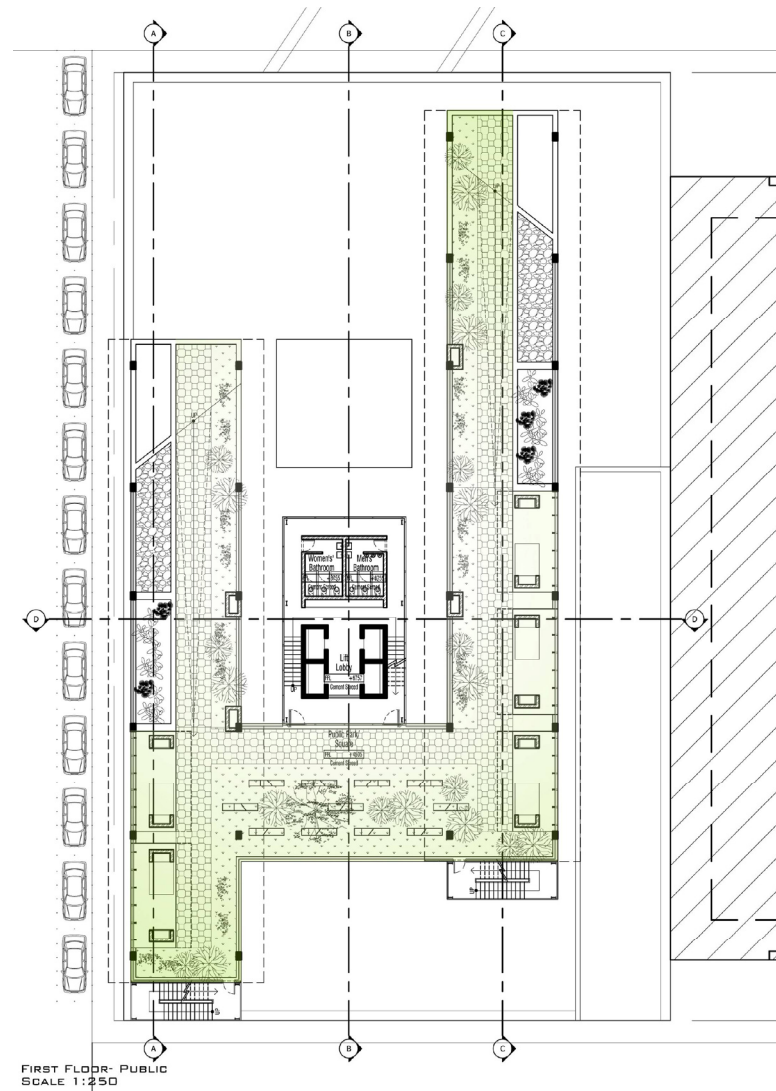
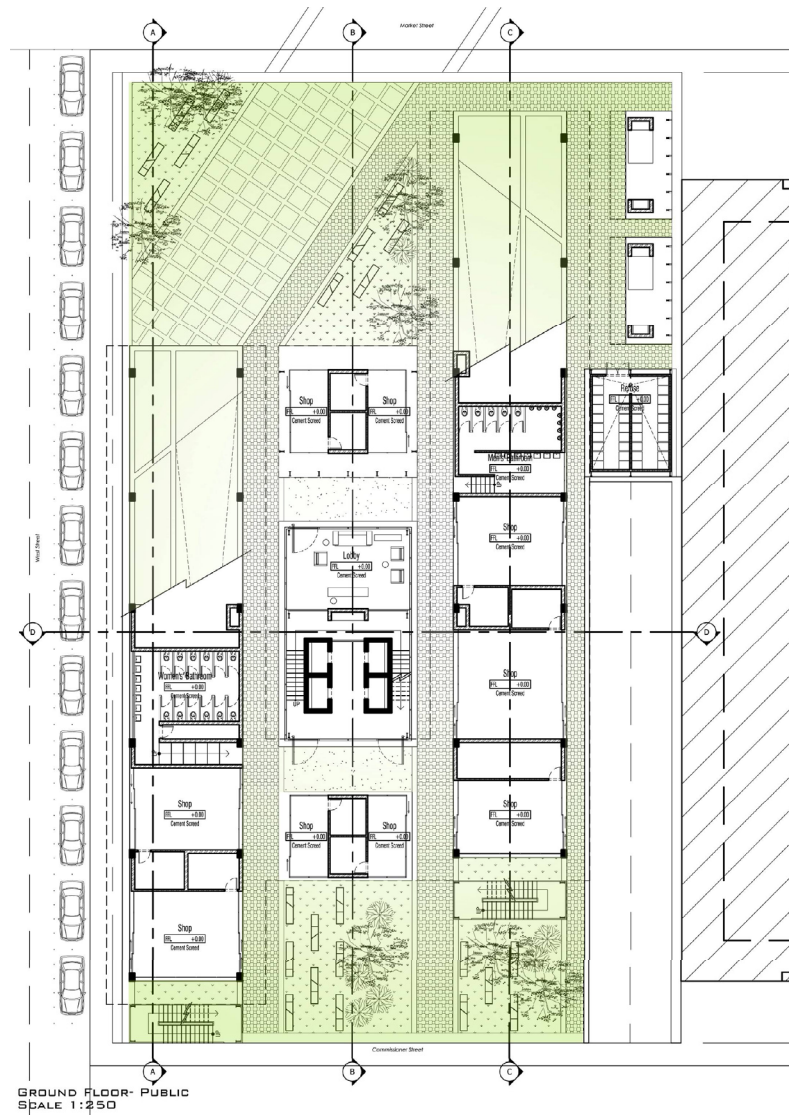


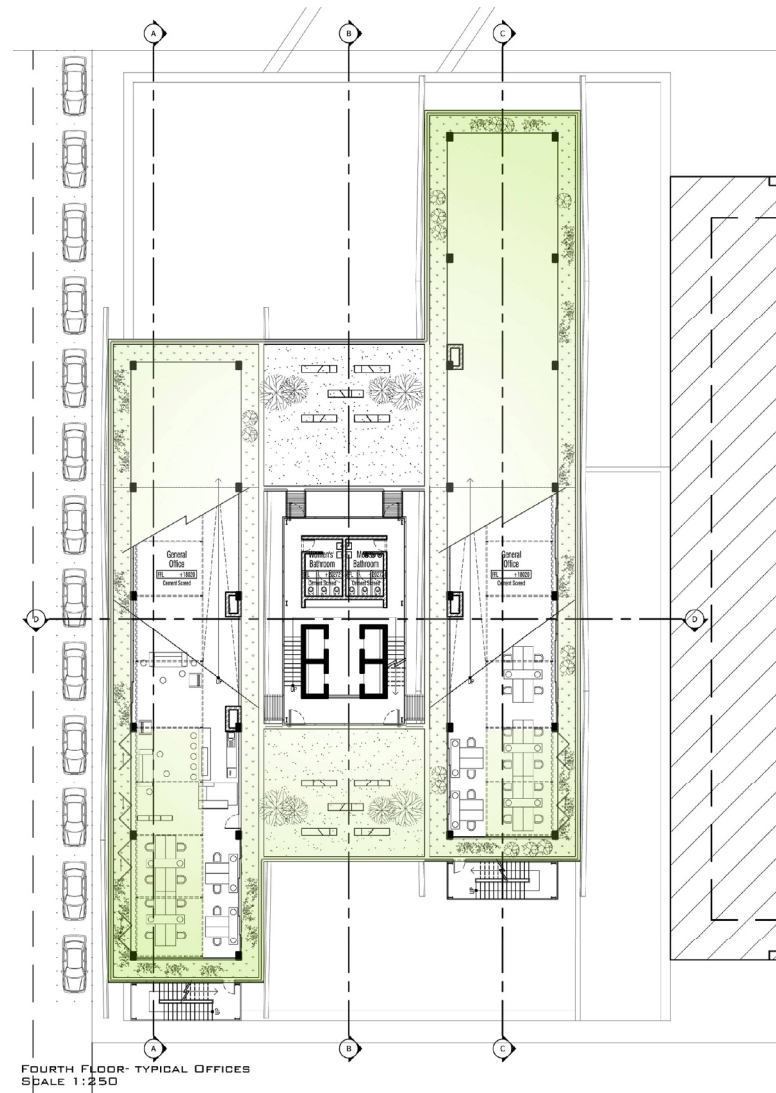
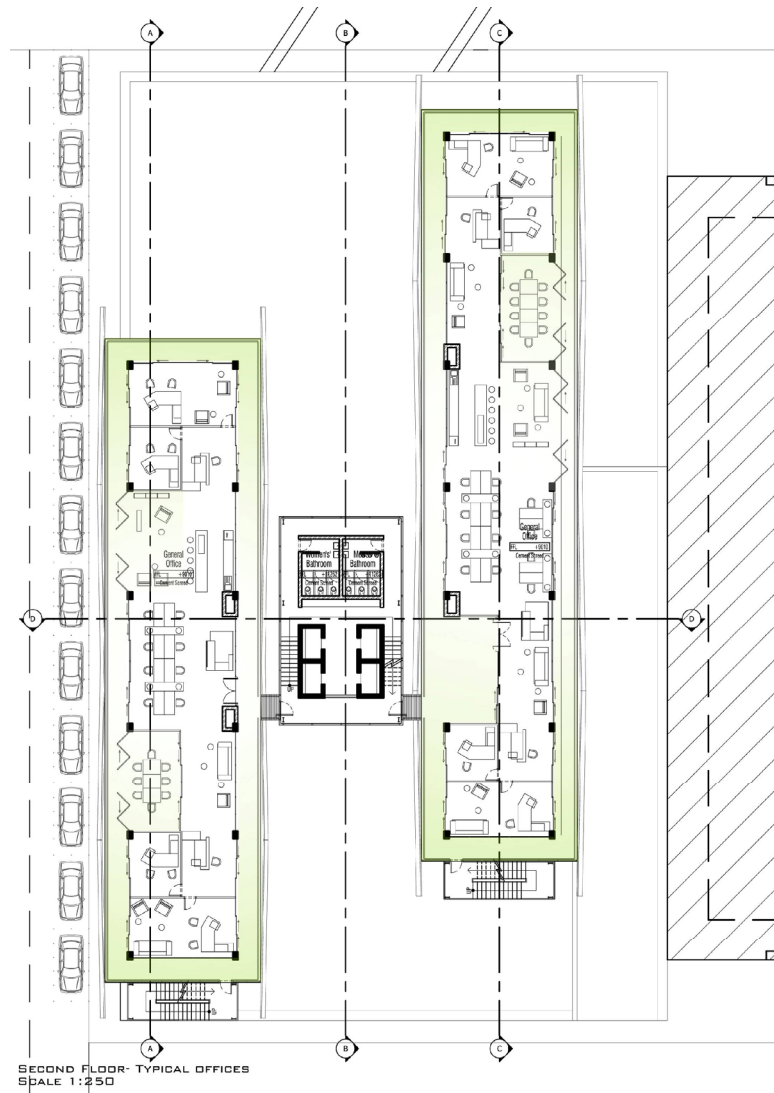
SECTION C
SCALE 1:200

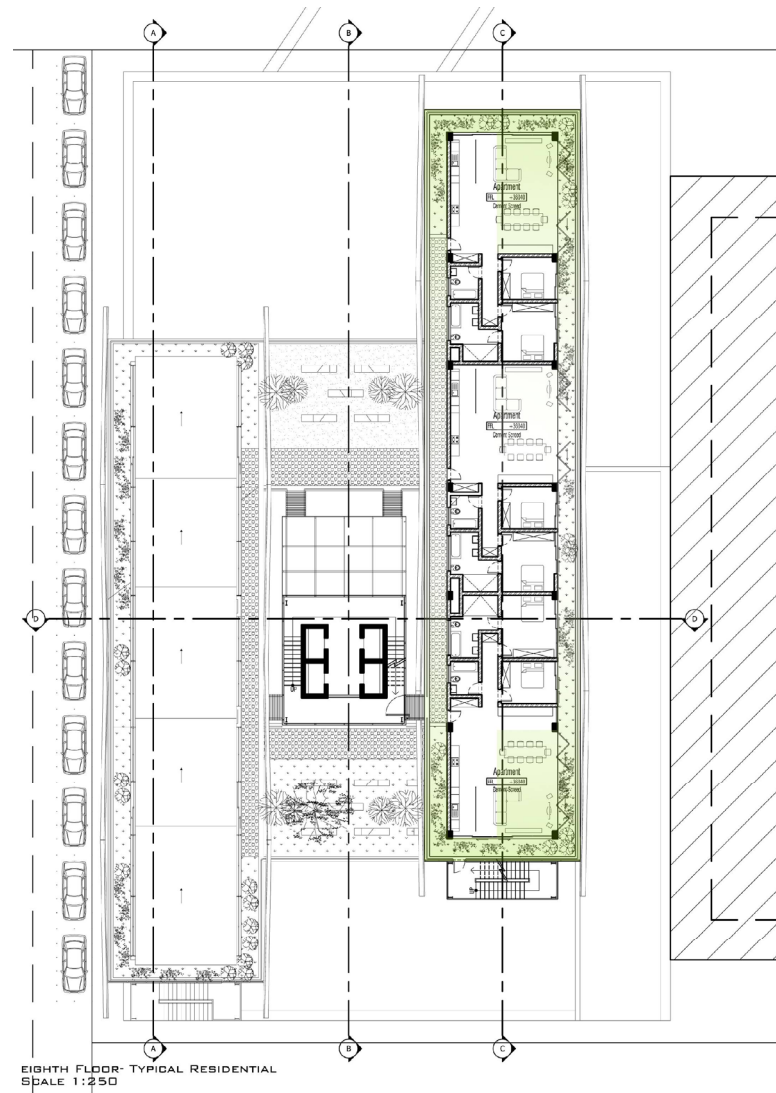
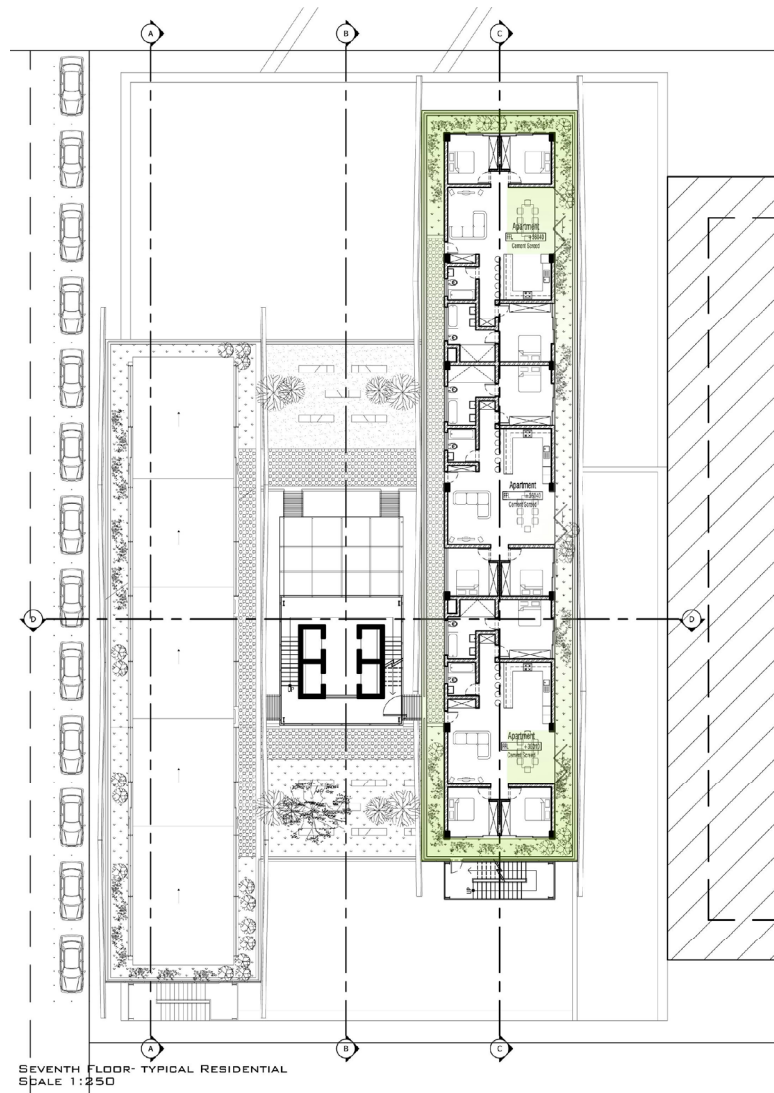


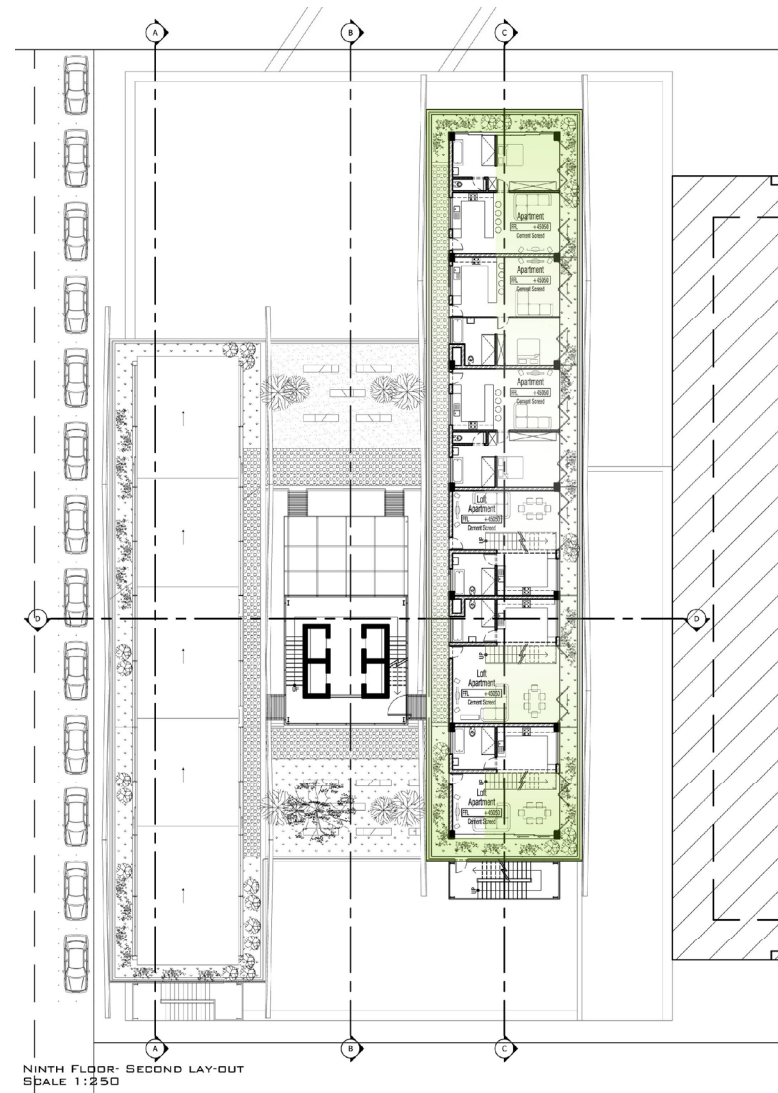
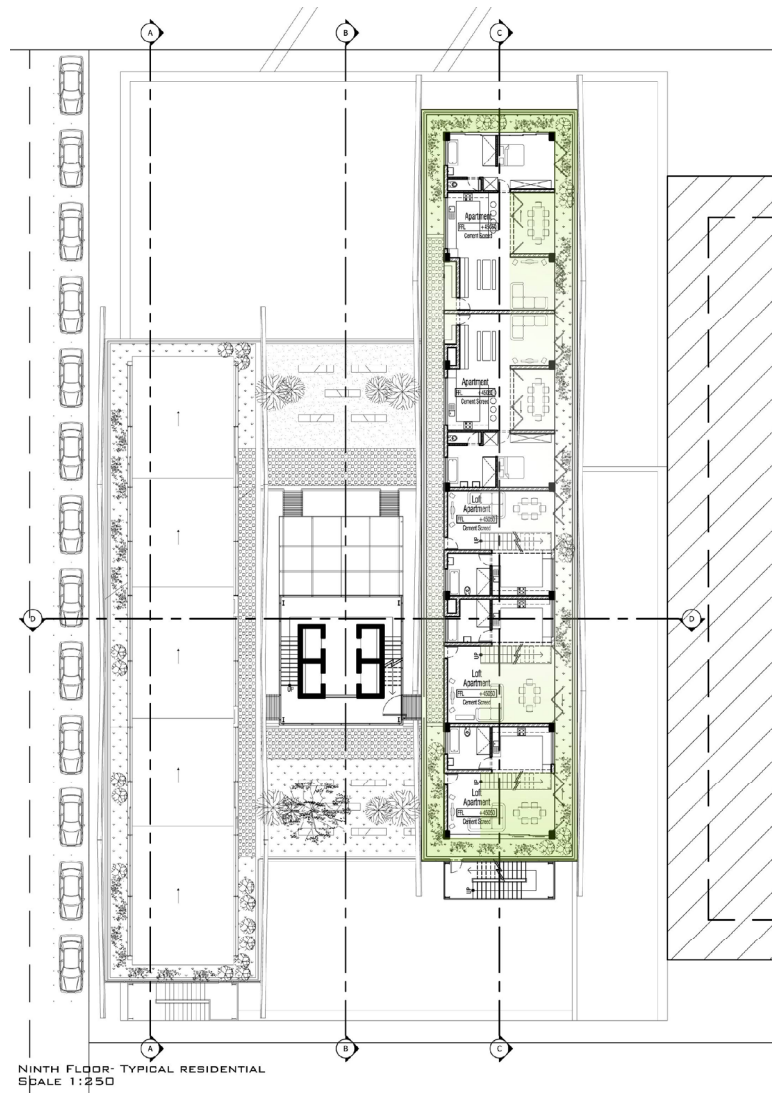
SECTION D
SCALE 1:200

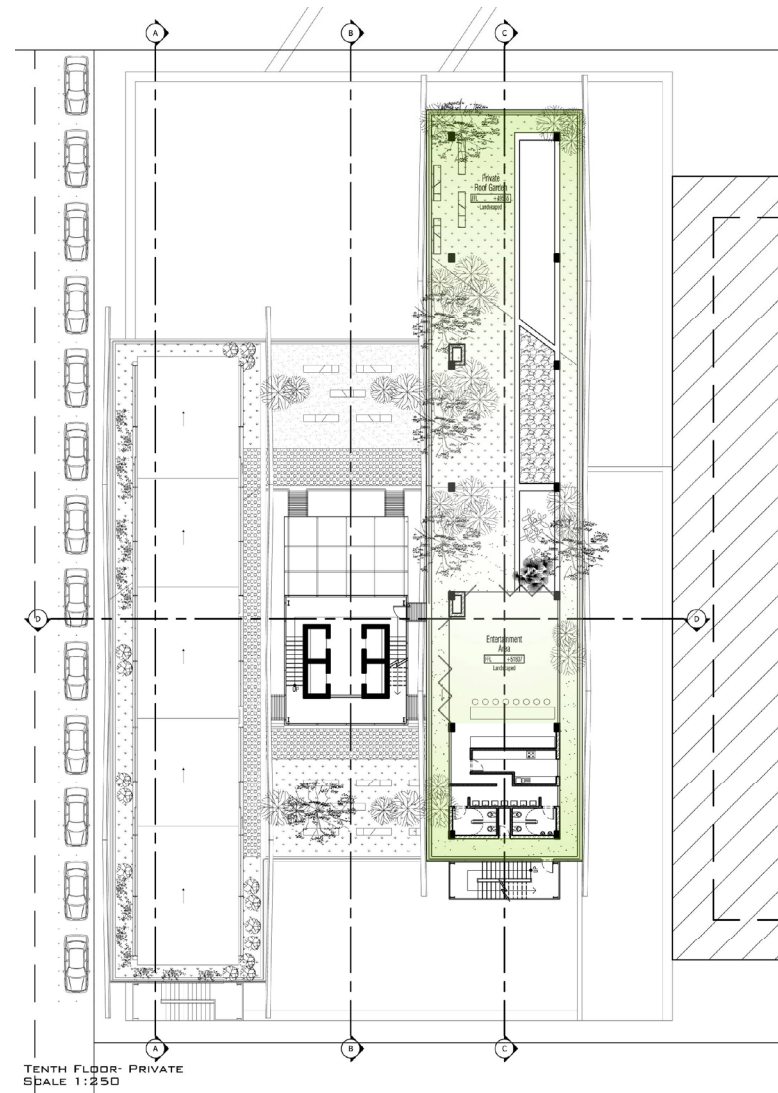
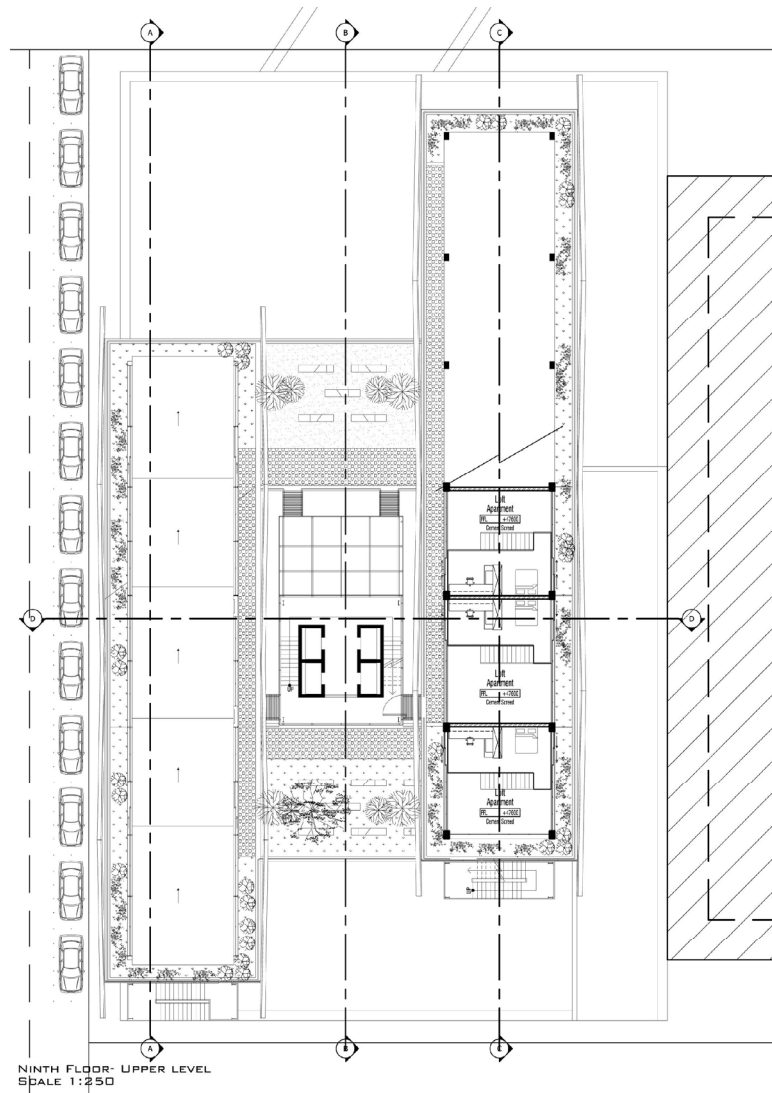


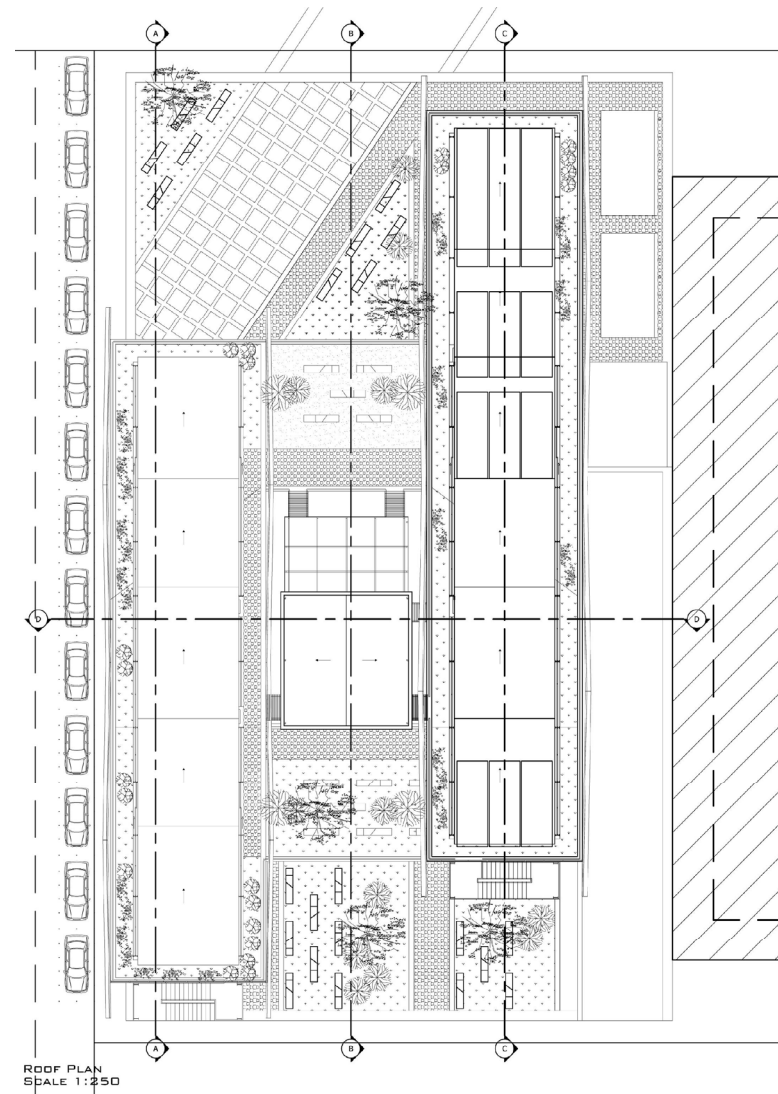
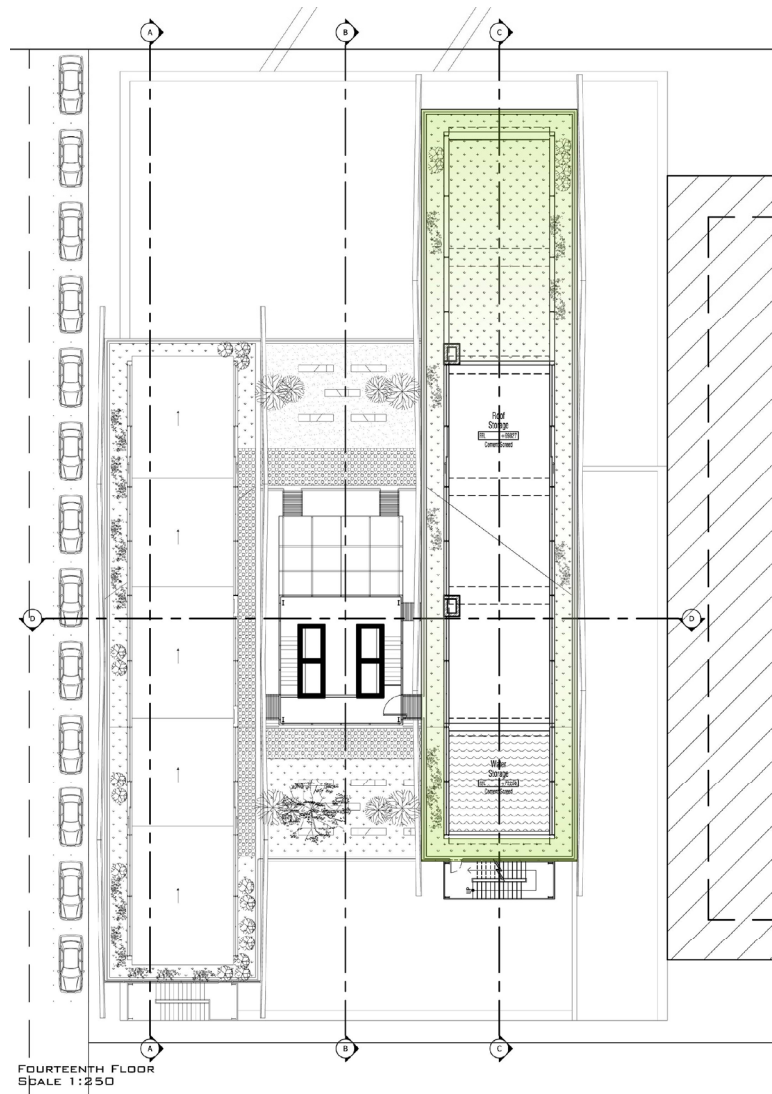












9. BIBLIOGRAPHY

- ABEL, Chris (2000): Architecture and identity: responses to cultural and Technological change. First published in 1997. Second edition 2000 by the Architectural Press.
- ALSAYYAD, Nezar (2004): The End of Tradition? Published 2004 by Routledge, London.
- AREGGER, Hans and GLAUS Otto (1967): High-rise building and Urban Design. Published by Thames and Hudson
- BAUDRILLARD, Jean (2006): Mass. Identity. Architecture. Edited by Francesco Proto. Published in Great Brittan in 2006 by Wiley-Academy.
- CHERMAYEFF S., ALEXANDER C (1963). Toward a new Architecture of Humanism. Published by Anchor Books Doubleday & Company, Inc. Garden City, New York
- CHIPKIN, Clive M. (1993). Johannesburg style: Architecture & Society 1880s-1960s. Published in Cape Town by David Philip.
- DEWAR, D and UYTENBOGAARDT, R.S. (1991). South African Cities: A Manifesto for Change. Published by The University of Cape Town
- ELKIN, Tim (1991): Reviving the city: towards sustainable urban development. Published by Friends of the earth.
- EMMANUEL, Rohinton (2005): An Urban approach to climate-sensitive Design: Strategies for the Tropics. First published in 2005 by Spon Press Taylor & Francis Group.
- HAMZAH, T.R. and YEANG, K. (1994): Bioclimatic Skyscrapers. Second Edition, published by Ellipsis London Limited
- GEHL, Jan (1980): Life between buildings: Using public space. Translated by Jo Koch in 1987. First Published in English by Van Nostrand Reinhold Company Inc.
- HAUSLADEN, G., SALDANHA, M. and LIEDL, P. (2006): Climate Skin: Building-skin Concepts that can do more with less energy. Published by Callwey GMBH ET Co. KG, Munchen.

LABAKI, Lucila and KAWALTOWSKI, Doris C. C. K. (1998): Building and environment: Bioclimatic and vernacular design in Urban settlements of Brazil. Editor: E. H. Mathews vol. 33 no 1-6 (1998) 63-77

MAAS, Winy and RIJS, J.V. with KOEK, Richard (1998): FARMAX: Excursions on Density. Published by 010 Publishers, Watertorenweg 180, 6063 HA Rotterdam, Netherlands.

MOUSSAVI, Farshid & KUBO, Michael (2006): The Function of Ornament. Published by Barcelona: Actar; Cambridge, Mass.: Harvard University, Graduate School of Design.

NEILL, William J.V. (2004): Urban Planning and Cultural Identity. Published 2004 by Routledge, London.

OLGYAY, Victor (1992): Design with climate: Bioclimatic approach to Architectural Regionalism. Published by Van Nostrand Reinhold.

POWELL, Robert (1999): Rethinking the Sky-scraper: The complete Architecture of Ken Yeang. First published in the United States by Whitney Library of Design.

ROAF, Sue (2005): Adapting buildings and cities for climate change: A 21st century survival guide. First published in 2005 by the Architectural Press.

STEELE, F. (1981): The Sense of Place. Published 1981 by CBI Publishing Company, INC

YEANG, Ken (2006): Eco-design: A manual for ecological design. Published in Great Britain by Wiley-Academy, a division of John Wiley & Sons, Ltd.

INTERNET SOURCES

Architecture 2030 (2006-2009). INTERNET. <http://www.architecture2030.org> Sited 07-05-2009

ALMUSAED A., ALMSSAD A., ZAKI A., ABDUSHAIK K., KHALIL A.S, (2006): Biophilic architecture, the concept of healthy sustainable architecture. INTERNET. http://www.unige.ch/cuepe/html/plea2006/Vol1/PLEA2006_PAPER151.pdf. Sited 26-02-2009

BALCOMB, J. D. (1992): Passive Solar Buildings. INTERNET. <http://books.google.co.za>. Sited 20-05-2009

CIAM (2008). Principals of intelligent urbanism. INTERNET.
http://en.wikipedia.org/wiki/Principles_of_Intelligent_Urbanism#References. Sited 11-05-2009

Climate data. INTERNET. <http://www.gaisma.com> Sited 26-02-2009

GOLDREICH, Y. (2005): Urban heat island centred at ground and top of canopy layer determined by an airborne thermal IR image. INTERNET.
http://www.geo.uni.lodz.pl/~icuc5/text/O_27B_2.pdf.
Sited 26-02-2009

HUNN, B. D. (1996): Fundamentals of Buildings' energy Dynamics. INTERNET. <http://books.google.co.za>. Sited 20-05-2009

JHB, Regional Spatial Development Framework Region F: Section 2, 2008/2009. INTERNET.
<http://www.joburg.org.za>. Sited 29-06-2009